

# **GLOSSARY**

**Definitions of selected words and phrases in the subject index of**

**Sterile Insect Technique  
Principles and Practice in  
Area-Wide Integrated Pest Management**

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Term	Definition
<b>A</b>	
aberration	Any body, form (shape) or structure that deviates from the normal or typical condition (Gordh and Headrick 2001). A form that departs in some striking way from the normal type, occurring either singly, or rarely, at irregular intervals (Torre-Bueno 1978). See 'chromosomal aberration'.
absolute density	Density of a population expressed as an absolute number per ground-surface area or per unit of volume (Pedigo 2002). Density of a population expressed as every individual of a population within a volume of habitat [paraphrased] (Daly et al. 1998). Contrasts with the relative density of a population expressed as a relative number based on the kind of sampling technique used, e.g. number caught in a trap (Pedigo 2002). See 'apparent density', 'Lincoln Index'.
absorbed dose	Quantity of radiating energy (in gray) absorbed per unit of mass of a specified target (FAO 2006). Quantity of ionizing radiation energy imparted per unit mass of a specified material. The SI [International System of Units] unit of absorbed dose is the gray (Gy), where 1 gray is equivalent to the absorption of 1 joule per kilogram of the specified material (1 Gy = 1 J / kg). The mathematical relationship is the quotient ( $D$ ) of $d\bar{E}$ by $dm$ , where $d\bar{E}$ is the mean incremental energy imparted by ionizing radiation to matter of incremental mass $dm$ . The discontinued unit for absorbed dose is the rad (1 rad = 100 erg / g = 0.01 Gy). Absorbed dose is sometimes referred to as 'dose' or 'radiation dose' (International Commission on Radiation Units and Measurements (ICRU)) <a href="http://www.icru.org/">http://www.icru.org/</a> (ISO/ASTM 2004a). The absorbed dose ( $D$ ) is the quotient of the average energy transferred to the matter in a volume element by ionizing radiation and the mass of the matter in this volume element: $D = d\bar{E} / dm$ . The unit of the absorbed dose is joule divided by kilogram, and its special unit name is gray (Gy). The former unit name was rad. 1 Gy = 100 rads (Koelzer 2008). A measure of the energy deposition produced by ionizing radiation in any (specified) medium as a result of ion-pair formation (Oxford 2006). The mean radiation energy imparted by ionizing radiation to a unit mass of the irradiated material. Expressed in rads, grays or joules per kilogram (IAEA 1992). The 'rad' (radiation absorbed dose) is the amount of radiation which will deposit 100 ergs per gram in any material (O'Brien and Wolfe 1964, IAEA 1992, FAO/IAEA 2009). See 'dose'.
absorbed-dose distribution	A representation of the variation of absorbed dose with position in any region of an irradiated object, e.g. within an insect canister exposed to ionizing radiation (Borders 1991).
absorbed-dose mapping	Measurement of absorbed dose within process load [an irradiated material/sample, e.g. insect canister] using dosimeters placed at specified locations to produce a one-, two- or three-dimensional distribution of absorbed dose, thus rendering a map of absorbed-dose values (ISO/ASTM 2004a). See 'dose mapping'.
absorbed-dose rate	Quotient of absorbed dose per unit of time, unit: Gy/h (Koelzer 2008, Borders 1991). The absorbed-dose rate is often specified in terms of its average value over longer time intervals, e.g. in units of Gy/min or Gy/h (ICRU). The absorbed dose in a material per incremental time interval, i.e. the absorbed-dose rate is the quotient of $dD$ by $dt$ . SI Unit = $Gy \cdot s^{-1}$ (ICRU) (ISO/ASTM 2004a).
accelerator	See 'electron accelerator'.
accessory gland	Any secondary gland of a glandular system (Resh and Cardé 2003, Gordh and Headrick 2001). A secretory organ associated with the reproductive system (Borror et al. 1989, Leak 1999, Wall and Shearer 1997). Glandular structure associated with the spermatheca that produces a material that accompanies the sperm during ejaculation (FAO/IAEA/USDA 2003). Male accessory gland = Secretory gland associated with the male reproductive tract that produces seminal fluid and the structural components of the spermatophore (Resh and Cardé 2003, Gordh and Headrick 2001). See 'spermatheca', 'spermatophore', 'refractory'.
acclimatization	Habituation/adjustment of an organism to different environmental conditions (Gordh and Headrick 2001, Resh and Cardé 2003). A process that gradually shifts the optimal performance of insects from the extreme limits to the preferred range of colonization. Acclimatization occurs within variable time limits, which are very much shorter than the evolutionary time scale (C. Calkins, personal communication). See 'colonization'.
acentric	Designating a chromatid or a chromosome that lacks a centromere (King et al. 2006). This condition may arise in an inversion heterozygote as a result of crossing over between a normal and an inverted segment that does not include the centromere (Schlindwein 2006). A chromosome, or chromosome fragment, that lacks a centromere (Hoy 2003). See 'centromere', 'dicentric', 'monocentric', 'holokinetic', 'monokinetic'.
achiasmate	Referring to meiosis without chiasmata. In those species in which crossing over is limited to one sex, the achiasmate meiosis generally occurs in the heterogametic sex (King et al. 2006). No cross-shaped union of chromosomes during nuclear division (Leak 1999).
acoustical signal	An insect communicating with another using sound (Sivinski et al. 1989). See 'chemical communication'.
acrylamide gel	Acrylamide or acrylamide monomer is the trivial name for propenamide, a water-soluble solid that is highly toxic and irritant, and readily polymerizes under the action of UV light or chemical catalysts into polyacrylamide (Oxford 2006). Polyacrylamide gel is prepared by mixing a monomer (acrylamide) with a cross-linking agent (N,N'-methylenebisacrylamide) in the presence of a polymerizing agent. An insoluble three-dimensional network of monomer chains is formed. In water, the network becomes hydrated. Depending upon the relative proportions of the ingredients, it is possible to prepare gels with different pore sizes. The gels can then be used to separate biological molecules like proteins of a given range of sizes (King et al. 2006). See 'gel electrophoresis'.
adenotrophic viviparity	A method of viviparous reproduction restricted to pupiparous Diptera. The egg hatches inside the mother and the larva feeds on uterine secretions produced by the mother. Pupation occurs shortly after larviposition (Gordh and Headrick 2001, Leak 1999). Reproduction in which the female gives birth to a larva which developed and has been nourished within the mother's

	uterus (Leak 1999). The production of live offspring, where eggs are retained within the female oviduct until the larvae are mature at which stage they are laid and immediately pupate (Wall and Shearer 1997). A phenomenon in certain insects whereby the larvae are retained in the parent's body after hatching, develop by feeding on 'uterine' secretions, moult twice and are finally deposited in a mature state ready for pupation (Leftwich 1976). See 'gestation', 'larviposition', 'larviparous', 'viviparous'.
adjuvant	Any ingredient that improves the properties of a pesticide formulation (Pedigo 2002). Any ingredient that improves the solubility or handling properties of a pesticide formulation. Adjuvants are sometimes called "stickers" or "spreaders" (Gordh and Headrick 2001). An additive used in conjunction with an active substance, e.g. a biopesticide, to enhance its performance (Coombs and Hall 1998). Chemical combined with insecticide to improve its storage, safety, or effectiveness (Daly et al. 1998). A spray additive to improve either physical or chemical properties (Hill 1997). See 'chemical control'.
adulticide	A substance, e.g. pesticide, that kills the adult stage of a pest or parasite (NAL 2008). See 'larvicide', 'parasiticide', 'trypanocide'.
advanced very-high-resolution radiometer (AVHRR)	A radiometer is an instrument for detecting or measuring radiation (Oxford 2008). The AVHRR is located on a satellite circling the earth (Cox and Vreysen, this volume).
aerial release	Release of insects, e.g. sterile insects, from the air using aircraft. Refer to Dowell et al. (section 5.3.) (this volume). See 'release', 'ground release', 'static release'.
aerial spray	Pesticide spray treatment of land from the air using aircraft. Refer to Mangan (this volume). See 'ground spray', 'sequential aerosol technique (SAT)', 'chemical control'.
African animal trypanosomiasis (AAT)	African animal trypanosomiasis [trypanosomiasis] (AAT) is a disease complex caused by tsetse-fly-transmitted <i>Trypanosoma congolense</i> Broden, <i>T. vivax</i> Ziemann, or <i>T. brucei brucei</i> Plimmer and Bradford, or simultaneous infection with one or more of these trypanosomes. African animal trypanosomiasis is most important in cattle, but can cause serious losses in pigs, camels, goats, and sheep. Infection of cattle by one or more of the three African animal trypanosomes results in subacute, acute, or chronic disease characterized by intermittent fever, anemia, occasional diarrhea, and rapid loss of condition, and often terminates in death. In southern Africa the disease is widely known as nagana (USAHA 1998). Tsetse-transmitted [ <i>Glossina</i> ] trypanosomiasis is an infectious disease unique to Africa and caused by various species of blood parasites. The disease affects both people [Human African Trypanosomiasis (HAT) or sleeping sickness] (Pentreath and Kennedy 2004) and animals [Animal African Trypanosomiasis (AAT) or nagana], and occurs in 37 sub-Saharan countries covering more than 9 million km <sup>2</sup> , an area which corresponds approximately to one-third of the Africa's total land area. The infection threatens an estimated about 50 million head of cattle. Every year, AAT causes about 3 million deaths in cattle while approximately 35 million doses of trypanocidal drugs are administered. Nagana has a severe impact on agriculture in sub-Saharan Africa (PAAT 2008a; Shaw 2004; Taylor and Authié 2004; Feldmann et al., this volume). There now exists a reasonable collection of methods and reagents from which scientists in well-equipped laboratories may choose the one most appropriate for diagnosis of trypanosomiasis in an given situation (Eisler et al. 2004). See 'trypanosomiasis'.
age structure	Characteristic of a population relating to the age of the individuals in the population. Synonym for age distribution — the distribution of age classes within a population at a particular time; the proportion of individuals of an age class present in a population at any given time (Gordh and Headrick 2001). The proportion of individuals in different age classes of a population at any given time (Pedigo 2002). See 'population ecology', 'population dynamics', 'population process'.
aggregation	A group of individuals of one species gathered in one place or small area (Gordh and Headrick 2001). See 'clumped distribution'.
aggregation pheromone	Chemical compounds synthesized and released by members of a species and which attract members of the same sex or same species to the source of the pheromone (Gordh and Headrick 2001).
air-filtration	Filtration is the process of removing particles from a moving fluid by passage through small openings. In most filtering operations of environmental significance the mechanism is less that of physical straining than of compaction and adsorption onto surfaces of the filter medium (Pfafflin et al. 2008). Filtration of air in an insect rearing facility to remove microbial contaminants and insect diseases, e.g. bacteria, fungi and viruses, and particles, e.g. moth body scales, and hazardous or irritating chemicals that are health hazards to workers. Filters may be coarse, fine (see HEPA) or designed to remove particular chemicals or materials from the air (Dyck 2010, Oborny 1998). See 'sanitation'.
alkylating agent	A compound causing the substitution of an alkyl group (usually methyl or ethyl) for an active hydrogen atom in an organic compound. Many chemical mutagens are alkylating agents (King et al. 2006). Any of a group of chemical compounds that react with another compound so as to introduce an alkyl group into the second compound (Oxford 2006). See 'mutagen'.
allele	A shorthand form of allelomorph, one of a series of possible alternative forms of a given gene, differing in DNA sequence, and affecting the functioning of a single product (RNA and/or protein) (King et al. 2006). Any of the forms of the same gene that occur at the same locus on a homologous chromosome but differ in base sequence (Oxford 2006). One of several alternate forms of a gene occupying a given locus on a chromosome or plasmid (Viljoen et al. 2005). One of two or more alternative forms of a gene at a particular locus. If more than two alleles exist, the locus is said to exhibit multiple allelism (Hoy 2003). Form of a gene. Genes are considered allelic when they occur in the same position on members of a chromosome pair (Resh and Cardé 2003). Mutually exclusive form of the same gene, occupying the same locus on homologous chromosomes, and governing the same biochemical and developmental process (NAL 2008). See 'gene'.
allergy	An immune hypersensitivity response to an agent that is non-antigenic to most of the individuals in a population (King et al. 2006). A state of altered (usually increased) reactivity of the body to foreign material (Oxford 2006). See 'rearing facility', 'occupational health'.
allochthonous	Pertaining to a species with origin in one area but which occurs in other areas (Gordh and Headrick 2001).
allomone	A substance transmitted in chemical communication between individuals of different species that benefits the sender or both

	<p>the sender and receiver (Daly et al. 1998, Jolivet 1998). A chemical substance, produced or acquired by an organism, which, when it contacts an individual of another species in the natural context, evokes in the receiver a behavioural or physiological reaction adaptively favourable to the emitter (Coppel and Mertins 1977). An allelochemic that induces a response in an individual of another species, e.g. an insect, that is beneficial to the emitting organism. Many allomones are essentially defensive, i.e. toxic or repugnant to potential attackers. However, a scent that attracts bees and therefore facilitates pollination is also an allomone (Maxwell and Jennings 1980).</p> <p>See 'kairomone', 'parapheromone', 'pheromone', 'synomone', 'semiochemical'.</p>
allozyme	<p>Allelic form of an enzyme (Krafsur, this volume). Allelic form of an enzyme that can be distinguished by electrophoresis, as opposed to the more general term isozyme (King et al. 2006). Any enzyme variant produced by a particular allele (Oxford 2006). Allozymes are a subset of isozymes. Allozymes are variants of enzymes representing different allelic alternatives of the same locus (Hoy 2003, King et al. 2006). A particular variant of an enzyme (Resh and Cardé 2003). Alternative enzyme forms encoded by different alleles at the same gene locus (Gordh and Headrick 2001). An allozyme differs in amino acid sequence from other forms of the same enzyme and is encoded by one allele at a single locus (NAL 2008).</p> <p>See 'genetic marker', 'restriction fragment length polymorphism (RFLP)', 'randomly amplified polymorphic DNA (RAPD)', 'microsatellite', 'mitochondrial DNA (mtDNA)'.</p>
all-terrain vehicle (ATV)	A four-wheel vehicle designed for off-road use and travel over rough terrain. Similar to a motorcycle, but the extra wheels make it more stable at slow speeds.
alpha( $\alpha$ )-copaene	<p>A potent attractant for male Mediterranean fruit flies, is found as a minor component in the essential oils of various plant species, including orange, guava and mango. The compound potentially serves as a chemical cue to facilitate orientation of flies to the rendezvous site (Nishida et al. 2000).</p> <p>See 'parapheromone'.</p>
amplified fragment length polymorphism (AFLP)	<p>The amplified fragment length polymorphism (AFLP) technique demonstrates the presence or absence of restriction sites or fragments in genomic DNA (Krafsur, this volume). The use of the polymerase chain reaction (PCR) to amplify DNA in the study of restriction fragment length polymorphism (Oxford 2006).</p> <p>The variation in the length of DNA fragments produced by the PCR using either one or several specific or arbitrary oligodeoxynucleotide primers and genomic DNA from two or more individuals of a species. AFLPs arise from restriction site polymorphisms, sequence length polymorphisms, and DNA base pair changes not associated with restriction sites. AFLPs are used for example to discriminate between closely related individuals, to localize specific genes in complex genomes (linkage analysis), and to establish genome maps (Kahl 1995).</p>
anaphase	<p>The third phase of mitosis. During anaphase, the block that prevented DNA replication in the centromere region is removed and the centromere becomes functionally double. The chromatids are converted to independent chromosomes that separate and move to opposite poles (King et al. 2006). A stage in mitosis or meiosis during which the two sister chromatids (or homologous chromosomes or daughter chromosomes) of each chromosome separate and move towards opposite poles of the spindle (Oxford 2006, Schlindwein 2006, Lackie and Dow 1995).</p> <p>See 'mitosis', 'meiosis', 'prophase', 'metaphase', 'telophase', 'interphase'.</p>
anautozenous	Pertaining to adult insects that require a meal or ingested food before eggs can mature or oviposition can occur (Gordh and Headrick 2001). Antonym = autozenous (Resh and Cardé 2003).
animal traction	Work or draft animals, e.g. oxen, pulling farming implements and equipment for field-preparation, transport, etc. (NAL 2008).
anoxia	<p>A deficiency of oxygen in tissues, blood, or in a body of water (Allaby 1994).</p> <p>Anoxic = Devoid of molecular oxygen; describes the oxygen status of an environment (Resh and Cardé 2003). Severe hypoxia (Webster 2008).</p> <p>See 'hypoxia', 'radiation environment'.</p>
antigen	A chemical compound or substance introduced into the body of an organism and which is recognized as 'foreign' of not naturally of that body. Recognition of the foreign substance by the immune system results in the production (release) of antibodies to chemically or physically attack the foreign substance (Gordh and Headrick 2001). A foreign substance that, upon introduction into a vertebrate animal, stimulates the production of homologous antibodies (King et al. 2006). Any molecule that can stimulate an immune response, inducing the production of a specific antibody (MCC 1996).
antimicrobial	<p>Characteristic of a substance or treatment that kills or inhibits micro-organisms (Bijlmakers 2008).</p> <p>Antimicrobial agent = A chemical that kills any or all microbial contaminants (Cohen 2004). Antimicrobial agent = A chemical compound that either destroys or inhibits the growth of microscopic and submicroscopic organisms (MH 1997).</p>
aphrodisiac	Chemical compounds secreted by members of one sex and intended to facilitate copulation after attraction of the opposite sex (Gordh and Headrick 2001).
apparent density	<p>The density of a population that appears to be true according to the sampling method used. Population density is determined by using methods that show proportional changes in population density (Daly et al. 1998). Similar to 'relative density'. Contrast with 'absolute density'. Refer to Vreysen (this volume).</p> <p>See 'absolute density', 'Lincoln Index'.</p>
apyrene	<p>Pertaining to spermatozoa that lack a nucleus, and are smaller than normal spermatozoa. Apyrene sperm are a type of spermatozoa produced by Lepidoptera during spermatogenesis, and are the product of meiosis in which chromatin is not normally developed. Apyrene sperm migrate to the spermatheca, but they do not fertilize the eggs. Apyrene spermatozoa bundles disassociate before they reach the duplex region of the male reproductive system. The function of apyrene sperm is not completely understood, but they may facilitate transfer of eupyrene sperm to a female's copulatory bursa (Gordh and Headrick 2001, King et al. 2006).</p> <p>See 'eupyrene', 'dichotomous spermiogenesis'.</p>
area-freedom	A defined area of land described as free from something, e.g. an insect pest. Area-freedom is a special term implying that an insect pest may have been removed from a given area, but the pest has not necessarily yet been eradicated in the area (Barclay et al., this volume; Hancock et al. 2000).
area-wide	<p>The concept of "area-wide" refers primarily to a total population in a delimited area, the influence of migration/dispersal on its dynamics, and its ecological relationships within its ecosystem (Hendrichs et al. 2007). Area-wide eradication or control refers to eradication or control of a total, discrete, circumscribed population (Leak et al. 2008).</p> <p>See 'deme'.</p>
area-wide control	<p>A synonym for area-wide integrated pest management.</p> <p>Control measures applied against a given plant pest over a geographically defined area that includes all known or potential</p>

	hosts with the objective of preventing pest build-up while minimizing damage to commercial host. Control actions are conducted whenever and wherever the target pest exists regardless of host seasonality (Enkerlin 2007). See 'area-wide', 'area-wide integrated pest management'.
area-wide integrated pest management (AW-IPM)	Management of the total pest population within a delimited area (Hendrichs et al. 2007). Integrated pest management against an entire pest population within a delimited geographic area, with a minimum size large enough or protected by a buffer zone so that natural dispersal of the population occurs only within this area (Klassen, this volume). Area-wide pest management is a concept of preventive suppression of a mobile insect pest species throughout its geographic range, rather than reactive field-by-field control (USDA 2006). See 'area-wide', 'integrated pest management'.
area-wide sampling	Sampling the total pest population. See 'area-wide', 'sampling'.
aromatherapy	Treatment with aromatic oil, e.g. ginger root oil and citrus peel oil, to affect mating behaviour of flies (Shelly et al. 2004a, b).
artificial diet	Food that has been synthesized from one or more ingredients that may be completely defined chemically or that may be partially defined or not defined. An artificial diet and a synthetic diet are essentially synonymous (Cohen 2004). An unfamiliar food which has been formulated, synthesized, processed, and/or concocted by man, on which an insect in captivity can develop through all or part of its life cycle (Singh 1977).
aspermic	Inability of males to produce sperm (Klassen, this volume).
assessment	Evaluation or estimation of the value, importance or quality of something (Oxford 2001), e.g. quality of reared insects, achievement of pest management goals, economic benefits.
assortative mating	A tendency for male/female of a given population to preferably mate with male/female of the same population (FAO/IAEA/USDA 2003). Sexual reproduction in which the pairing of male and female is not random, but involves a tendency for males of a particular kind to breed with females of a particular kind. If the two parents of each pair tend to be more (less) alike than is to be expected by chance, then positive (negative) assortative mating is occurring (King et al. 2006). Preference for mating between similar individuals (Schlindwein 2006). A mating system in which conspecific sexes of a reproducing population tend to mate based on similarity of some measurable parameter such as overall body size, e.g. small males tend to mate with small females and large males mate with large females (Gordh and Headrick 2001). Non-random selection of mates with respect to one or more traits (Ayala and Kiger 1984). See 'isolation index (ISI)', 'relative isolation index (RII)', 'female relative performance index (FRPI)', 'male relative performance index (MRPI)'.
attract and kill	Method of pest control – selectively attracting a pest insect to a source using a chemical attractant, e.g. sex pheromone, and then killing the insect with an insecticide (APTIV 2007). See 'live-bait technology', 'stationary-bait technology', 'lure and kill'.
attraction	Act or power of attracting (Collin 2001). Response of an insect in noticing, responding to or orienting/moving towards an object or chemical that is attractive to the insect. An attractant is a chemical or visual stimulus that results in movement of a pest towards the source (IAEA 2003).
attractive device	Device that is attractive to an insect, or contains an attractant, e.g. sex pheromone trap, object with a particular colour and/or shape, chemical-impregnated lure, light trap, etc. that attracts an insect. See 'delta trap', 'Jackson trap', 'pheromone trap', 'sticky trap', 'trap', 'wing trap'.
attribute	A characteristic quality (Oxford 2001). A quality, trait, characteristic or feature of an organism. Attributes may be biochemical, behavioural, ultrastructural or anatomical (Gordh and Headrick 2001).
augmentative biological control	A strategy for pest management involving the mass propagation and organized release of beneficial natural enemies for the regulation of a pest population (Gordh and Headrick 2001). Biological control designed to increase the number or effectiveness of existing natural enemies (Pedigo 2002).
autocidal	Causing death to itself or to its own species. Autocidal control is the use of an insect species against itself, usually through some means of genetic modification, to suppress or eradicate its natural population (Coppel and Mertins 1977), or the use of insects to control wild-type populations of the same species (Resh and Cardé 2003).
autoconfusion	A type of mating disruption particularly suited for moth pests, in which released sterile males would carry on their bodies pheromone particles that attract wild males. This would transfer particles to them, and subsequently these males would contaminate other males, resulting in increased mating disruption (Robinson and Hendrichs, this volume).
autodissemination	Sterile insects are inoculated with electrostatically charged powder formulated with entomopathogens or slow-acting insecticides, which would be spread throughout the pest population through intraspecific interactions (Robinson and Hendrichs, this volume).
automation	The use of automatic equipment instead of manual labour (Oxford 2001).
autosome	Any chromosome other than a sex chromosome (King et al. 2006).
autosterilization	After being attracted into a trap, wild insects sterilize themselves by contacting a chemosterilant and then escape the trap. Another method is to transfer a chemosterilant from one (treated) insect to another during mating (Klassen, and Nagel and Peveling, and Robinson and Hendrichs, this volume).
<b>B</b>	
backcross	A cross between an offspring and one of its parents or an individual genetically identical to one of its parents (King et al. 2006).
backcross sterility	Sterility in insects resulting from backcrossing (example tobacco budworm, Bloem et al., this volume).
bait	A pesticide formulation that combines an edible and/or attractive substance with a pesticide, e.g. grasshopper bait (Pedigo 2002, Gordh and Headrick 2001). For tsetse fly baits, refer to Van den Bossche and De Deken (2004); for fruit fly baits, refer to Nigg et al. (2004). A lure intended to attract specific organisms (Gordh and Headrick 2001).
bait spray	Bait sprayed as a liquid, e.g. bait spray for fruit flies. Refer to Mangan (this volume), Nagel and Peveling (this volume), Nigg et al. (2004). See 'bait', 'feeding stimulant'.
baseline data	Data about the beginning or original condition, e.g. insect population density, and are used to compare with data obtained subsequently. Refer to Vreysen (this volume), Everitt (2006) and Leak et al. (2008).

bednet	Fine-mesh netting (may be impregnated with an insecticide) hung over a bed to protect a sleeping person from being bitten by an insect such as a mosquito. Refer to WHO (2004).
beef losses	Economic loss from death of beef cattle [due to insect pests] (Barclay, this volume).
behavioural ecology	The study of movements and activities of animals as they relate to interrelations with other organisms and the environment (Resh and Cardé 2003).
behavioural resistance	The ability of an insect population to change its behaviour to avoid insecticides or other detrimental circumstances (Gordh and Headrick 2001). The ability of an insect population to change its behaviour in order to avoid insecticides or other injurious factors (Pedigo 2002).
beneficial species	Any organism directly or indirectly advantageous to plants or plant products, including biological control agents (FAO2006). An organism (pathogen, predator, parasite) that helps reduce a pest population (Gordh and Headrick 2001). An organism that is used in the biological control of pests, weeds or diseases, usually as part of an integrated pest management strategy (Coombs and Hall 1998).
beneficiary	A person who benefits from something (Oxford 2001, 1993). The person who receives or is to receive the benefits resulting from certain acts (Friedman 2007).
benefit/cost analysis (BCA)	<p>Calculation and analysis of the benefits and costs of a project by an appropriate comparison, such as the benefit/cost ratio. The benefit/cost ratio seeks to compare the benefits of a particular action with its cost. For example, a benefit/cost ratio of 2:1 implies that the economic benefit is twice that of the cost. Sometimes it is difficult to quantify the benefits (Porteous 1996).</p> <p>Benefit/cost (or cost/benefit) analysis is a method of measuring the benefits expected from a decision, calculating the cost of the decision, then determining whether the benefits outweigh the costs. This analysis determines whether programmes are achieving their goals or proposed programmes are worthwhile (Friedman 2007, Oxford 1993). It considers all gains (benefits) and losses (costs) regardless of to whom they accrue (Pearce 1992). In terms of human health, Everitt (2006) defines cost/benefit analysis as a technique where health benefits are valued in monetary units to facilitate comparison between different programmes of health care. The main practical problem with this approach is getting agreement in estimating money values for health outcomes. Similar problems occur with environmental and other social benefits, which can be difficult to consistently translate into monetary values. Statt (1991) defines cost/benefit analysis as a technique for comparing all the costs (both tangible and intangible) of a particular course of action with resulting benefits expected. It normally therefore includes social or environmental costs as well as financial ones.</p> <p>Major issues in benefit/cost analysis include: identifying all benefits and costs applicable to the project, establishing consistent units of comparison (usually monetary), identifying opportunity costs of practical alternative investments for comparisons, determining a reasonable time horizon for the analysis (uncertainty increases as the horizon lengthens), choosing an appropriate discount rate, accounting for risk or uncertainty in estimates over time, and choosing the objectives against which project performance is to be measured. Refer to Mumford (this volume).</p>
bent wing	A disabling wing mutation in females of a laboratory-reared strain of the Queensland fruit fly (Franz, this volume). Deformed wings are the wings of flies that are not fully expanded or are bent or crumpled (FAO/IAEA/USDA 2003).
bifurcation	Division into two branches or forks (Barclay, this volume; Oxford 2001, Leak et al. 2008).
binomial distribution	<p>A theoretical distribution of the number of successes in a finite set of independent trials with a constant probability of success.</p> <p>In probability theory and statistics, the binomial distribution is the discrete probability distribution of the number of successes in a sequence of <math>n</math> independent yes/no experiments, each of which yields success with probability <math>p</math> (Wikipedia 2008).</p> <p>A discrete frequency distribution which, when a chance event has only two possible outcomes, often termed "success" and "failure", each with fixed probabilities of occurring, gives the probabilities of the number of successes in a given number of independent trials of the event (Webster 2008, Everitt 2006, Clapham 1996, FAO/IAEA 1973).</p> <p>See 'Poisson distribution', 'Poisson binomial distribution', 'negative binomial distribution', 'hypergeometric probability distribution', 'probability model'.</p>
bioassay	Test of a substance by examining the effect it has on living organisms (Collin 2001). A method of measuring the effects of a biologically active substance using a living organism <i>in vivo</i> or <i>in vitro</i> tissue or cell model under controlled conditions (NAL 2008). The quantitative measurement, under standardized conditions, of the effects of a substance on an organism or part of an organism (Allaby 1994). Measurement of the effect on an organism of a given stress, such as a toxic substance, heat, cold, or drought (Maxwell and Jennings 1980). Bioassay (biological assay) is the measurement of a biological response, e.g. mortality, to different concentrations of a biologically active compound, using standardized conditions in the laboratory or field (Resh and Cardé 2003). A method for determining the concentration of a substance by measuring its effect on a living system under controlled conditions. Bioassays can be used to measure the relative potency of a substance by comparing the effect it causes with that caused by a substance of known potency (Coombs and Hall 1998).
biodiversity	<p>Biodiversity (biological diversity) is the variation in all living organisms from gene to ecosystems (Resh and Cardé 2003). The condition of being different (diverse) biologically. The variety of the world's organisms, including their genetic diversity and the assemblages they form. A 'blanket' term for the natural biological wealth on the earth. The variety of living organisms considered at all levels, from genetics through species, to higher taxonomic levels, and including the variety of habitats and ecosystems. The variety and variability among living organisms and the ecological complexes in which they occur (Gordh and Headrick 2001). Richness of the number of species (Collin 2001). Diversity of plant and animal species in an environment (MCC 1996). All aspects of biological diversity, but especially species richness, the complexity of ecosystems, and genetic variation (Allaby 1994).</p> <p>See 'diversity'.</p>
biological control	<p>Pest control strategy making use of living natural enemies, antagonists, competitors or other biological control agents. A biological control agent is a natural enemy, antagonist or competitor, or other organism, used for pest control (FAO 2006).</p> <p>The use of living organisms, parasitoids, predators, pathogens, and competitors to suppress pest populations below levels that would occur naturally. Biological control programmes are intended to suppress invasive species through importation of specialized natural enemies that have evolved with a pest in its native range (Resh and Cardé 2003). The employment of any biological agent for control of a pest (Pedigo 2002). The control of pests by employing natural enemies including predators, parasites and pathogens. The use of natural enemies such as parasitoids, predators, pathogens, antagonist, or competitor populations to suppress a pest population making it less abundant and thus less damaging (Gordh and Headrick 2001). The use of predatory and parasitic insect species (termed natural enemies or beneficials), or natural products consisting of or derived from micro-organisms, against pests and diseases of crops (Coombs and Hall 1998). Also, biological insect pest suppression is defined as the use or encouragement, by man, of living organisms or their products for the population reduction of pest insects (Coppel and Mertins 1977).</p>

	<p>Classical biological control is the intentional introduction and permanent establishment of an exotic biological agent for long-term pest control (FAO 2006, FAO/IAEA/USDA 2003). Classical biological control is the importation of foreign natural enemies to control previously introduced, or native, pests (Weeden et al. 2000). Biological pest suppression in its narrow, classical sense, usually restricted to the introduction, by man, of parasitoids, predators, and/or pathogenic micro-organisms to suppress populations of plant or animal pests (Coppel and Mertins 1977).</p> <p>See 'natural enemies', 'integrated pest management (IPM)'.</p>
biological radiation effects	<p>The effects of radiation on biological processes, structures and functions; some effects are positive and many are negative. Refer to Bakri et al. (this volume).</p> <p>See 'radiation biology'.</p>
biomass	<p>The total dry weight or volume of all living organisms in a given area (Pedigo 2002). The collective organic matter that results from the photosynthetic conversion of solar energy (Gordh and Headrick 2001). Total weight of living organisms at any one time per unit area (Jolivet 1998). Weight of plant or animal material produced in an area, both as standing biomass and harvested biomass (Hill 1997). The mass of living organisms forming a prescribed population in a given area of the earth's surface. It is usually expressed in grams per square metre (<math>\text{g/m}^2</math>) (Porteous 1996).</p>
biosafety	<p>Prevention of large-scale loss of biological integrity, focusing on both ecology and human health (Webster 2008). Human safety in dealing with biological materials, e.g. eating certain foods that may be regarded as unsafe to eat.</p> <p>See 'genetically modified organism (GMO)', 'food safety'.</p>
biosecurity	<p>Assurance that ecologies sustaining either people or animals are maintained. This may include natural habitats as well as shelter and productive enterprises (especially agriculture), and deals with threats such as biological warfare or epidemics. This is related to the more passive concept of 'biosafety' (Webster 2008). A component of biosecurity is to protect biodiversity and manage risks to plant and animal health and animal welfare (Webster 2008).</p> <p>See 'food security'.</p>
biota	<p>The fauna and flora of a given habitat, area or zoogeographical region (Gordh and Headrick 2001).</p>
bio-terrorism	<p>Bio-terrorism is terrorism using germ warfare, an intentional human release of a naturally occurring or human-modified toxin or biological agent (Webster 2008). The use of biological agents, such as agricultural pathogens or pests, for terrorist purposes (NAL 2008).</p>
birth control	<p>In human biology, birth control refers to the use of contraception to prevent unwanted pregnancies (Oxford 2001). Birth control is also achieved through reproductive sterilization. By releasing sterile males into a fertile insect population, the sterile insect technique (SIT) acts as a form of birth control imposed on an insect pest population to reduce its numbers (Klassen, this volume).</p>
birth rate	<p>The ratio between the number of live births and a specified number of individuals in a population over a given period of time (MH 1997). Natality is the rate of birth, often measured as the total number of eggs or eggs per female per unit of time (Pedigo 2002).</p> <p>See 'mortality'.</p>
bisexual SIT	<p>Bisexual (both males and females) release of sterile insects is probably less effective than male-only release in introducing sterility into the target wild population. In bisexual release, the sterile males tend to mate with sterile females instead of fertile wild females; the number of sterile females is much larger than that of fertile females. Also, for some insect species, releasing sterile females causes damage; for example, sexually sterile fruit fly females sting fruit with their ovipositor (Klassen and Curtis, Calkins and Parker, Franz; this volume).</p>
bivalents	<p>Homologous, synapsed chromosomes (King et al. 2006, Lackie and Dow 1995). During the prophase of meiosis I, homologous chromosomes pair and form synapses. The paired chromosomes are called bivalents. The bivalent has two chromosomes and four chromatids, with one chromosome coming from each parent (Schlindwein 2006). The figure produced by pairing of homologous chromosomes at the beginning of meiosis (Burt and Trivers 2006). The structure containing all four chromatids (two representing each homologue) at the start of meiosis (Lewin 1985). Two homologous chromosomes that pair during the first meiotic division (Ayala and Kiger 1984).</p>
border	<p>Boundary line or area separating countries, states, regions, places, etc.</p> <p>Line demarcating the edge of a thing or an area of activity, e.g. treatment for pest control.</p>
bottleneck	<p>In the context of genetics and insect rearing: the bottleneck effect is the occurrence of fluctuations in gene frequencies when a large population passes through a contracted stage and then expands again with an altered gene pool (usually one with reduced variability) as a consequence of genetic drift (King et al. 2006). A period when a population becomes reduced to only a few individuals (Ayala and Kiger 1984). Change in gene frequencies and decline in total genetic variation where there is a sharp decrease in population numbers (Collin 2001).</p> <p>In general terms, a bottleneck in a technical process is a restriction or blockage that prevents achieving fully the goal of the process.</p>
Bremsstrahlung	<p>Electromagnetic radiation generated when electrically charged particles are accelerated or decelerated. The spectrum of emitted radiation reaches from a maximum energy given by the kinetic energy of the generating particle down to zero energy. Bremsstrahlung only becomes easily noticeable when the energy of the particle is very high compared to its self-energy. This is mostly only valid for electrons (self-energy of the electron: 511 keV) (Koelzer 2008). Broad-spectrum electromagnetic radiation emitted when an energetic electron is influenced by strong electric field, such as that in the vicinity of an atomic nucleus. Particularly, Bremsstrahlung is produced when an electron beam strikes any material (converter). The Bremsstrahlung spectrum depends on the electron energy, the converter material and its thickness, and contains energies up to the maximum kinetic energy of the incident electrons (ISO/ASTM 2002). Electromagnetic radiation emitted (as photons) when a fast-moving charged particle (usually an electron) loses energy upon being accelerated and deflected by an electric field surrounding a positively charged nucleus. X-rays produced in ordinary X-ray machines are Bremsstrahlung. 'Bremsstrahlung' is a German word meaning 'braking radiation' (Borders 1991, Isaacs 2000). The photon radiation emitted by fast-moving charged particles that are sharply decelerated or deflected by an electric or magnetic field (IAEA 1992).</p>
bridge formation	<p>The primary lesion leading to a dominant lethal mutation is a break in the chromosome. When a break is induced in a chromosome in mature sperm, it remains in this condition until after the sperm has entered an egg. Following fusion, nuclear divisions begin, and a break in a chromosome can have drastic effects on the viability of the embryo as development proceeds. During early prophase the broken chromosome undergoes normal replication, but during metaphase the broken ends can fuse leading to the formation of a dicentric chromosome and an acentric fragment. The acentric fragment is frequently lost, while the dicentric fragment forms a bridge at anaphase leading to another chromosomal break. This whole process then repeats itself, leading to the accumulation of serious imbalances in the genetic information of the daughter cells. The accumulation of this genetic damage finally leads to the death of the zygote. If two different chromosomes are broken</p>

	they can also rejoin. These chromosomes produce the same problems for the dividing cells as those formed by a break in a single chromosome, by undergoing incorrect fusion and leading to the breakage-fusion-bridge cycle. In this way dominant lethal mutations can cause cell death, and the accumulation of genetic imbalance in the developing zygote leads to lethality (Robinson, this volume).
broad-spectrum insecticide	Insecticide that affects pests and beneficial organisms (Gordh and Headrick 2001). Insecticide that is active against a wide range of pests, killing insects indiscriminately, including beneficial organisms; thus it may cause outbreaks of other pests such as mites (Coombs and Hall 1998).
Brownian random motion	'Brownian movement' refers to the peculiar random movements shown by microscopic particles in a disperse phase, i.e. when suspended in a liquid or gas. It is caused by the continuous irregular bombardment by the molecules of the surrounding medium (Oxford 2006). The rate of Brownian random motion is invariant in time and space (Itô and Yamamura, this volume). See 'stochastic model'.
<i>Bt</i>	Short form of the bacterium <i>Bacillus thuringiensis</i> Berliner. A bacterium used as a biopesticide in the control of numerous chewing-insect pests, particularly Lepidoptera larvae with alkaline pH in gut. It must be ingested to be effective, and acts as a stomach poison. It is probably the most popular naturally derived product used for insect pest control (Gordh and Headrick 2001).
<i>Bt</i> -cotton	A transgenic variety of the cotton plant developed to have resistance to lepidopterous pests. <i>Bt</i> genes responsible for endotoxin have been incorporated into the cotton genome (Gordh and Headrick 2001). See 'transgenic cotton', 'transgenesis'.
<i>Btk</i>	Short form of the bacterium <i>Bacillus thuringiensis</i> Berliner variety <i>kurstaki</i> .
<i>Bt kurstaki</i>	Bacterium <i>Bacillus thuringiensis</i> Berliner variety <i>kurstaki</i> .
buffer zone [barrier]	An area in which a specific pest does not occur or occurs at a low level and is officially controlled, that either encloses or is adjacent to an infested area, an infested place of production, an area of low pest prevalence, a pest free area, a pest free place of production, or a pest free production site, and in which phytosanitary measures are taken to prevent spread of the pest (FAO 2006). An area separating two or more types of land use (Webster 2008). Land between a protected area, e.g. a nature reserve, and the surrounding countryside or town (Collin 2001). See 'temporary buffer zone', 'permanent buffer zone'.
business plan	A business plan is a summary of how a business owner, manager, or entrepreneur intends to organize a commercial endeavour and implement activities necessary and sufficient for the venture to succeed. It is a written explanation of the company's business model. Business plans are used internally for management and planning, and are also used to convince outsiders, such as banks or venture capitalists, to invest money into a venture. A business plan can be seen as a collection of sub-plans including a marketing plan, financial plan, production plan, and human resource plan. (Webster 2008). A business plan is needed to organize and conduct an operational AW-IPM programme that includes the rearing of insects and an SIT component (IAEA 2008a).
<b>C</b>	
canister	A durable, reusable container, usually an aluminium or steel cylinder, used to hold a product, e.g. factory-reared insects in packaging containers, during the radiation process (ISO/ASTM 2004a). Canisters are not used in some applications in which the packaging container is sufficiently rigid and the design of the irradiator is appropriate.
cannibalism	A behavioural phenomenon in which an insect feeds upon members of the same species. Some insects feed cannibalistically when under conditions of starvation, and some insects are cannibalistic as a part of their lifestyle (Gordh and Headrick 2001).
carcinogenic	Capable of causing or producing cancer (Oxford 2001, Borders 1991). A carcinogen is a physical or chemical agent that induces cancer. A carcinogen is usually mutagenic, and it either damages nucleic acids directly or indirectly, or it causes a genetic imbalance by inducing a chromosomal aberration (King et al. 2006).
carrying capacity	The maximum population density a given environment will support for a sustained period (Pedigo 2002, Gordh and Headrick 2001). The maximum population size or density of a species that can be sustained indefinitely in a given environment (Resh and Cardé 2003). The maximum population that may be sustained in an ecosystem or management unit without adverse effects to the environment (NAL 2008).
cash flow	The total amount of money passing into and out of a business, especially as affecting liquidity (Oxford 2008, Statt 1991). The excess of cash revenues over cash outlays in a given period of time (Webster 2008). Analysis of all the changes that affect the cash account during an accounting period (Friedman 2007). The amount of cash being received and expended by a business, which is often analysed into its various components (Oxford 1993).
census	A count or survey of a population (Oxford 2001).
centralized facility	A single centralized insect rearing facility where all of the major activities related to sterile insect production are conducted — mass-rearing and sterilization of insects, and preparation of the sterilized insects for release. Compare this with the use of satellite facilities (Dowell et al., this volume). See 'satellite facility', 'rearing facility', 'mass-rearing facility', 'modular rearing facility'.
centromere	A region of a chromosome to which spindle traction fibres attach during mitosis and meiosis (King et al. 2006, Oxford 2006, Schindwein 2006, Hoy 2003). In some insects, the spindle fibres attach throughout the length of the chromosome, and such chromosomes are called holocentric (Schindwein 2006, Hoy 2003). See 'acentric', 'dicentric', 'monocentric', 'holokinetic', 'monokinetic'.
ceralure	A synthetic lure to attract male Mediterranean fruit flies (Warthen et al. 1998, IAEA 2003, NAL 2008). See 'cuelure', 'disparlure', 'gossyplure', 'hexalure', 'propylure', 'swormlure', 'trimedlure'.
certified organic	Description or label of agricultural products produced by organic methods and certified as organic by a designated organization. A common feature of organic agriculture is that crops are produced without using synthetic pesticides (Gordh and Headrick 2001).
Chagas' disease	A disease of vertebrates, including humans, in Latin America caused by a parasite <i>Trypanosoma cruzi</i> Chagas. The disease is transmitted among mammals via the excrement of biting bugs ( <i>Triatoma</i> spp., Reduviidae) (Gordh and Headrick 2001, TDR 2008, Lopes and Chapadeiro 2004).
chemical communication	Communication among insects using chemicals (smell, taste). Refer to Wyatt (2003). Communication is the production of a signal by an individual that influences the behaviour of another individual and that is mutually beneficial (Auburn 2008).

	See 'contact pheromone', 'pheromone'.
chemical control	A principal approach or pest management strategy that involves the use of pesticides or toxic chemicals to suppress pest populations (Gordh and Headrick 2001, Schmutterer 1969). Pest management practices which rely upon the application of synthetic or naturally-derived pesticides (Weeden et al. 2000). The control of pests with synthetic pesticides (Bijlmakers 2008).
chemical mutagen	See 'mutagen'.
chemosterilization	Reproductive sterilization of an animal using chemosterilants — chemicals that induce reproductive sterility (Pedigo 2002; Jolivet 1998; Hill 1997, 1975).
chiasmata	Chiasma ( <i>plural</i> chiasmata) is the cytological manifestation of crossing-over; the cross-shaped points of junction between non-sister chromatids (King et al. 2006). A connection formed between chromatids, visible during meiosis, thought to be the point of the interchange involved in crossing-over (Oxford 2006, Schlindwein 2006). Chiasmata occur during prophase I of meiosis and represent points where crossing-over, or exchange of genetic information, between non-sister chromatids occurred. When the synapsed chromosomes begin to separate in late prophase I, they are held together by these connections between the chromatids of homologous chromosomes (Hoy 2003). See 'crossing-over', 'pachytene', 'meiosis'.
chilling	Reducing the temperature of insects, usually to just above 0°C, to immobilize them during handling, transport or storage. An extended period of chilling may be harmful to insects. To immobilize insects, chilling is often more convenient than CO <sub>2</sub> anaesthetization. See 'cold storage'.
chitin	A nitrogenous polysaccharide occurring in the cuticle of arthropods and certain other invertebrates (Resh and Cardé 2003, Gordh and Headrick 2001, Borror et al. 1989, Pfadt 1962). The major component of arthropod cuticle, a polysaccharide composed of acetyl-glucosamine and glucosamine sub-units (Pedigo 2002, Wall and Shearer 1997). The main biopolymer in insect cuticle, consisting of a $\beta$ -pleated polysaccharide sheet (Grimaldi and Engel 2005).
chitin synthesis inhibitor	An insect growth regulator that inhibits production of chitin in the integument of insects and other arthropods (Gordh and Headrick 2001). An insecticide that prevents chitin formation (Wall and Shearer 1997). Insecticide that interferes with cuticle development and moulting (Daly et al. 1998). See 'insect growth regulator (IGR)', 'juvenile hormone (JH)'.
chromatids	The two daughter strands of a duplicated chromosome that are joined by a single centromere. Upon the division of the centromere, the sister chromatids become separate chromosomes (King et al. 2006, Oxford 2006, Schlindwein 2006, Burt and Trivers 2006, Hoy 2003). See 'meiosis', 'crossing-over', 'pachytene'.
chromatin	The complex of nucleic acids (DNA and RNA) and proteins (histones and non-histones) comprising eukaryotic chromosomes (King et al. 2006, Schlindwein 2006). It stains strongly with basic dyes (Oxford 2006).
chromosomal aberration	An abnormal chromosomal complement resulting from the loss, duplication, or rearrangement of genetic material (King et al. 2006). See 'aberration'.
chromosomal inversion	Chromosome segments that have been turned through 180° with the result that the gene sequence for the segment is reversed with respect to that of the rest of the chromosome. Inversions may include or exclude the centromere. An inversion that includes the centromere is called pericentric, whereas an inversion that excludes the centromere is called paracentric (King et al. 2006, Burt and Trivers 2006). Alteration of the sequence of a DNA molecule by removal of a segment followed by its reinsertion in the opposite orientation. Inversions create changes in gene order, and sometimes cause disordered meiosis, genetic abnormalities, and reduced fertility (Hoy 2003, Oxford 2006). In an inversion heterozygote one of the chromosomes contributed by one parent has an inverted segment while the homologous chromosome contributed by the other parent has the normal gene sequence (Schlindwein 2006, Burt and Trivers 2006). Refer to Franz (this volume). See 'pericentric inversion', 'paracentric inversion'.
chromosomal polymorphism	The presence in the same interbreeding population of one or more chromosomes in two or more alternative structural forms (King et al. 2006). The existence within a population of two or more different structural arrangements of chromosomal material (King et al. 2006, Ayala and Kiger 1984).
chromosomal rearrangement	A chromosomal aberration involving new juxtapositions of chromosomal segments (King et al. 2006). Any change in the normal order of genes on a chromosome, caused by inversions or translocations (Kahl 1995).
chromosomal translocation	The exchange of segments of non-homologous chromosomes. Translocations are apparent when the chromosome number is correct, but two chromosomes have abnormal sizes and banding patterns. Some are associated with malignancy (Oxford 2006). Transfer of a segment of a chromosome to a non-homologous chromosome. Translocations are usually reciprocal (Schlindwein 2006, Kahl 1995). Change in location of a chromosome segment by becoming attached to another chromosome (Burt and Trivers 2006). A type of mutation in which a section of a chromosome breaks off and moves to a new position in that or a different chromosome (Hoy 2003). The fusion of part of one chromosome on to part of another (Lackie and Dow 1995, NAL 2008).
chromosome	In the eukaryotic nucleus, one of the threadlike structures consisting of chromatin and carrying genetic information arranged in a linear sequence; in prokaryotes, the circular DNA molecule containing the entire set of genetic instructions essential for life of the cell (King et al. 2006, Schlindwein 2006, Kahl 1995). A structure composed of a very long molecule of DNA and associated proteins, e.g. histones, that carries hereditary information. The number of chromosomes is characteristic for the species concerned (Oxford 2006). Units of the genome with many genes (Hoy 2003, Burt and Trivers 2006, Pedigo 2002).
citrus canker	Disease of citrus trees caused by a bacterium, usually having lesions on the leaves, stems and fruit, with localized patches of dead tissue surrounded by swollen margins (Wikipedia 2008, Gordh and Headrick 2001, IDIDAS 2008).
citrus peel oil	Oil from citrus peel has been found to affect the mating behaviour of fruit flies. See 'aromatherapy'.
civil unrest	Civil unrest, or civil disorder, is a condition in the society where people, due to discontent over some issue, are engaged in several forms of disturbance such as parades, sit-ins, riots, sabotage and other forms of crime. It is intended to be a demonstration to the public and the politics but can be easily evolved to chaos (Webster 2008).
clumped distribution	The distribution of individuals (manner in which they are spread out over an area) may be described as uniform, random or clumped. In a clumped distribution, individuals are found in groups which are separated and distinct from other groups, i.e. a patchy distribution (Wikipedia 2008). Refer to Vreysen (this volume). See 'distribution', 'homogeneous distribution', 'continuous distribution', 'fragmented distribution', 'island distribution'.

Code of Conduct	In general, a 'code of conduct' is a description of acceptable behaviour in relation to a specific activity or procedure. Sometimes governments agree on a code of conduct regarding trade practices and procedures. Regarding the import and release of biological control agents, a regulatory framework has been provided by the International Plant Protection Convention (IPPC) in the form of International Standard for Phytosanitary Measures (ISPM) Number 3 "Code of Conduct for the Import and Release of Exotic Biological Control Agents" (FAO 1996a; Robinson and Hendrichs, this volume). There is also an International Code of Conduct on the distribution and use of pesticides (FAO 2003).
Code of Practice	The rules and documented procedures established by regulatory bodies or trade associations which serve as a guide to acceptable practices. They do not have the force of law (NAL 2008).
cold storage	Storage of materials at a cold temperature using refrigeration, usually close to 0°C. See 'chilling' and 'cryopreservation'.
cold tolerance	Ability to withstand for a period of time the effects of exposure to cold temperatures and suffer no or little biological damage. Some animals and plants are more cold tolerant than others (Kimura 2004; Parker, this volume).
colonization	The act of colonizing or state of being colonized (Gordh and Headrick 2001); to start a new colony of insects in a laboratory using wild insects collected in the field. In biological control, the release of natural enemies into an area for the control of pests (Gordh and Headrick 2001). In ecology/evolutionary biology, often refers to the infiltration of a parasite onto new host species; in biogeography, to infiltrate new territory and establish breeding populations (Grimaldi and Engel 2005). See 'domestication', 'strain domestication', 'selection'.
colony	Individuals of one species living in close association in space and time (Gordh and Headrick 2001). For insect mass-rearing, a colony of a species consists of all stages of the insect kept in a rearing facility. For social insects, a colony is a group of individuals that cooperatively construct nests or rear offspring (Gordh and Headrick 2001).
colony contamination	Presence in an insect colony of individuals that are undesirable for genetic or other reasons.
commercialization	In the context of rearing insects or operating area-wide pest management programmes, producing and managing insects for a profit, usually by a private company (IAEA 2008a; Dyck, Flores et al., this volume).
commission	In the context of the SIT and AW-IPM, an organization established to manage, finance, and operate a pest management programme. Even though somewhat similar to a government, a commission has the advantage of being independent of normal government bureaucratic procedures and therefore is able to respond quickly and efficiently in dealing with programme requirements (Dyck, Flores et al., this volume). See 'operational independence'.
compatibility	Ability to exist or be used together without conflict, well suited to each other (Oxford 2001). Ability of two organisms to live together in a balanced relationship, e.g. host and parasite; also applies to a mixture of chemicals in a pesticide spray (Hill 1997, Bijlmakers 2008). In the context of sexual compatibility, the level of anatomical and especially behavioural similarity that permits mating between individuals of different origins, e.g. different insect strains of different geographical origins. Mating tests in a field cage or laboratory can measure sexual compatibility. Mating compatibility means that females of a given strain are able and willing to accept, for mating, the males of another strain; this also includes synchrony and other factors that cause reproductive disconformancy (FAO/IAEA/USDA 2003). Refer to Lance and McInnis (this volume). See 'mating compatibility', 'mating barrier'.
competitiveness	Ability of an organism to compete with conspecific organisms for a limited environmental resource (FAO/IAEA/USDA 2003). The level of ability to compete with others (physical struggle or indirect interaction) for the same object, place or goal. The interaction among individuals for a common resource. Competition can be intraspecific or interspecific (Gordh and Headrick 2001). Competition occurs when two or more organisms, or populations, interfere with or inhibit one another as they strive to secure a resource that is in limited supply (Bijlmakers 2008, FAO/IAEA/USDA 2003). Interaction between two or more organisms or species that utilize the same resources, in which the presence of one reduces the birth rate or increases the death rate of the other (Resh and Cardé 2003). In the SIT, reared sterile males compete against wild males to mate with wild females. See 'mating competitiveness', 'Haisch Index'.
conditional lethal mutation	A mutation that may be lethal only under certain environmental conditions (Hoy 2003). Any mutation that produces a mutant whose viability depends on the conditions of growth. It grows normally in permissive conditions but in restrictive conditions it does not grow, thereby expressing its lethal mutation, e.g. temperature-sensitive mutation (Oxford 2006, Watson 1976). A mutation that exhibits wild phenotype under permissive environmental conditions, but exhibits a mutant phenotype under restrictive conditions. For example, some bacterial mutants are conditional lethals that cannot grow above 45°C, but grow well at 37°C (King et al. 2006, Fenner et al. 1987, Lewin 1985, Ayala and Kiger 1984). See 'temperature-sensitive lethal ( <i>tsl</i> )'.
conditional probability	The probability that an event occurs given the outcome of some other event; usually written, Pr(A B) (Everitt 2006). For two events A and B, the probability that A occurs, given that B has occurred, is denoted by Pr(A B), read as 'the probability of A given B' (Clapham 1996).
confidence limits	The endpoints of the interval about the sample statistic that is believed, with a specified confidence coefficient, to include the population parameter (ASQC 1996). A confidence interval is an interval, calculated from a sample, which contains the value of a certain population parameter with a specified probability. The end-points of the interval are the <b>confidence limits</b> . The specified probability is called the confidence level. An arbitrary but commonly used confidence level is 95%, which means that there is a one-in-twenty chance that the interval does not contain the true value of the parameter (Clapham 1996). A confidence interval is a range of values, calculated from the sample observations, that is believed, with a particular probability, to contain the true parameter value (Everitt 2006).
conservation	Avoiding waste of, and renewing when possible, human and natural resources; the protection, improvement, and use of natural resources according to principles that will assure their highest economic or social benefits (USDA 1993). Preservation of natural habitats, and protection of natural resources with a view to sustained yield (Hill 1997). In biological control, any practice designed to protect and maintain populations of existing natural enemies (Pedigo 2002, Weeden et al. 2000, Daly et al. 1998).
conspecific	Belonging to the same species (Jolivet 1998, Earthlife 2008). Individuals, populations or subspecies that are assigned to one

	nominal species or belong to the same species (Gordh and Headrick 2001).
constraint	A limitation or restriction (Oxford 2001). Refer to Whitten and Mahon (this volume).
contact pheromone	A pheromone communicated by contact with antennae (contact chemoreception), involves cuticular hydrocarbons, and may be a component of mate recognition and other behaviour such as aggregation (Schulz and Ando 2004, Wyatt 2003, Cardé and Minks 1997, Siljander et al. 2007, Ginzel and Hanks 2003, Ginzel et al. 2003, Hammack 1992). See 'pheromone', 'cuticular hydrocarbon'.
containerized rearing system	To avoid cannibalism, rearing individual insects in containers, e.g. cups, cells, etc. that isolate insects from each other. Rearing insects in relocatable containers (each container being a small laboratory) which can be moved to a new site if desired.
containment	Application of phytosanitary measures in and around an infested area to prevent spread of a pest (FAO 2006; IAEA 2003; Hendrichs et al., this volume). The prevention of the spread of an organism or substance beyond a defined boundary (Coombs and Hall 1998). A type of regulatory-control programme in which a target pest is confined within a geographical region. The concept of containment is applied in a legal sense against pests established in the area of concern and for which eradication is not practical or applicable. Typically, containment does not attempt to reduce or eliminate the pest population in the area of infestation (Gordh and Headrick 2001). Refer to Hendrichs et al.(section 2.3.) (this volume). See 'prevention', 'exclusion', 'pest free area', 'invasive species', 'strategic option'.
contamination	Presence in a commodity, storage place, conveyance or container, of pests or other regulated articles, not constituting an infestation (FAO 2006). A contaminant is an undesired physical, chemical, biological, or radiological substance that can have an adverse effect on air, water, soil, etc. (USDA 1993). The deposition of unwanted radioactive material on the surfaces of structures, areas, objects, or personnel. It may also be airborne or internal (inside components or personnel) (FAO/IAEA 2009). Presence of an undesirable substance, the contaminant. For artificial diets, contaminants are often fungi or bacteria.
contingent valuation	Attempts to elicit consumer valuations of goods and services which are not usually traded in markets. Individuals are confronted with hypothetical choices and are asked either 'willingness to pay' or 'willingness to accept compensation' questions. This approach has been most widely used in the area of environmental economics (Pearce 1992). Survey-based economic method that is used to determine the monetary value of the benefits or costs of an environmental policy (Collin 2001). A method of estimating the value people put on, usually, non-market goods or costs by surveying their willingness to pay to receive or avoid them (NAL 2008). Refer to Enkerlin (this volume). See 'willingness to pay (WTP)'.
continuous distribution	Individuals of a species are distributed continuously over their habitat, i.e. no large separations between individuals from one part of the habitat to another. Similar to a uniform distribution, and contrasts with a clumped distribution. Refer to Hendrichs et al. (this volume). See 'distribution', 'clumped distribution', 'homogeneous distribution', 'fragmented distribution', 'island distribution'.
control chart	A graphical method for evaluating whether a process is or is not in a state of statistical control. The concept was developed by W.A. Shewhart. If a standard value is known for the parameter under consideration, the control limits on the chart are based on adopted standard values applicable to the statistical measures plotted on the chart. Limits on a control chart are used as criteria for signalling the need for action (ASQC 1996). A chronological graphical comparison of measured product characteristics with limits reflecting the ability to produce, derived from past experience (Chambers and Ashley 1984). Chronological graphical comparison of the specifications of all quality assessment and control parameters (Moore et al. 1985). To plot a parameter with predetermined limits on a time scale and to present this information in an easy to interpret graphical form such as on mean- or range-charts that have control limit lines (FAO/IAEA/USDA 2003). A chronological graphical comparison of actual product-quality characteristics with limits reflecting the ability to produce as shown by past experience on the product characteristics. Used to analyse data generated over a period of time. It fulfils three functions: 1) define a goal of an operation, 2) aid in attaining the goal, and 3) judge whether the goal has been reached (Feigenbaum 1961). A graphical chart with upper and lower control limits and plotted values of some statistical measure for a series of samples. Control limits are numerical calculations of the usual variation limits. Limits on a control chart are used as criteria for action (Charbonneau and Webster 1978). Refer to Calkins and Parker (section 8 and Box 2) (this volume) for a description and examples of control charts.
control strategy	Suppression, containment or eradication of a pest population (FAO 2006; IAEA 2003; FAO/IAEA/USDA 2003; Hendrichs et al., this volume). A strategy for controlling a pest population, e.g. suppression, eradication, containment, prevention (Hendrichs et al., this volume). A strategy for reducing or regulating a population in an area (Gordh and Headrick 2001). Refer to Hendrichs et al. (this volume). See 'pest control', 'integrated pest management (IPM)', 'suppression', 'eradication', 'containment', 'prevention'.
conventional pest management	Pest management according to conventional strategies and methods, usually implying that single control methods, especially chemical pesticides, are applied to reduce or suppress a pest population. See 'integrated pest management (IPM)'.
copulation	The act of coupling or bonding during sexual intercourse; the state of being joined during sexual intercourse (Gordh and Headrick 2001, FAO/IAEA/USDA 2003). The period or process during which an intromittent organ (almost always of the male) introduces gametes into a reproductive tract of the opposite sex (Resh and Cardé 2003, Aluja and Norrbom 2001). The joining of male and female genital structures; mating (Pedigo 2002). See 'insemination', 'fertilization', 'locking', 'mating duration'.
cordelitos	Baited (with a synthetic lure) and insecticide-treated wicks which attract and kill fruit flies; from Spanish. These may be released in large numbers from aircraft. Refer to Nagel and Peveling (this volume).
cost-effective	An activity that generates sufficient value to offset its cost (Friedman 2007). To achieve a goal with the minimum of expenditure; to achieve a goal with an expenditure that makes the achievement viable in commercial terms (Oxford 1993). A measure of the extent to which money has been effectively spent on something. It is found by seeing whether the benefits that have resulted could have been obtained with a lower expenditure (Statt 1991). Achieving an objective in the least-cost way (Pearce 1992).
cost recovery	Obtaining back or recovering money spent directly or indirectly on something, a project or service.

	See 'payback'.
courtship	Traditionally viewed as communication between the sexes that brings about successful copulation. However, given that communication during copulation may influence fertilization success, courtship can in theory occur anytime during mating (Resh and Cardé 2003). An elaborate pattern of instinctive behaviour performed by some animals prior to mating (Leftwich 1973). A series of behavioural events between two conspecific individuals of opposite sex that may result in the mounting of the female by the male (Aluja and Norrbom 2001). The courting behaviour of male animals with the expectation of mating (FAO/IAEA/USDA 2003). See 'lek', 'mating behaviour', 'mate-choice'.
critical ratio	The minimum overflooding ratio of sterile to wild males in the field needed for the SIT to reduce fertility in the wild population and suppress its density. Kean et al. (2007) provided a mathematical description of the critical overflooding ratio ( $\Phi_c$ ), the number of irradiated males that needs to be released per wild male to prevent the population from increasing. Refer to Hendrichs et al. (this volume) and Barclay (this volume).
critical release rate	The number of sterile males that must be released in a specified time period to achieve a critical ratio. (This rate is influenced by many biological variables, e.g. wild population density, survival and competitiveness of released males). Refer to Barclay (this volume). See 'release', 'release rate'.
crop damage	A measurable loss of crop (plant) utility, most often including yield quantity, quality, or aesthetic appeal (Pedigo 2002). The adverse effect on plants or crops due to biotic or abiotic agents, resulting in economic loss (reduction of yield and/or quality) (Bijlmakers 2008). In agricultural entomology, damage to crop plants caused by the actions of insect pests, e.g. feeding damage to fruits, seeds, leaves.
crop residue	Any organic matter left in the field after the harvest of a crop plant, e.g. leaves, stalks, stubble, roots, hulls (NAL 2008). A crop is the plants grown by humans for particular purposes, usually edible plants grown for their fruits or foliage, etc. (Hill 1997). See 'sanitation', 'cultural control'.
cross-bred	An animal resulting from crossbreeding (outbreeding) two distinctive varieties of a species (MH 1997), or from the fertilization of an organism from another organism with a different genetic constitution (Schlindwein 2006).
crossing-over	The reciprocal exchange of segments at corresponding positions along pairs of homologous chromosomes by symmetrical breakage and crosswise rejoining (NAL 2008). The reciprocal exchange of segments at corresponding positions along pairs of homologous chromosomes by symmetrical breakage and crosswise rejoining of the chromatids. It results in the recombination of alleles (Oxford 2006). The exchange of genetic material between paired homologous chromosomes during meiosis (MH 1997). The reciprocal exchange of polynucleotides between homologous chromosomes during meiosis (Hoy 2003). The exchange of genetic material between homologous chromosomes. Meiotic crossing over occurs during pachynema, and involves the non-sister strands in each meiotic tetrad. Each exchange results in a microscopically visible chiasma. Crossing over can also occur in somatic cells during mitosis. Exchange between sister chromatids can also occur, and is a sensitive indicator of DNA damage caused by ionizing radiations and chemical mutagens. Sister chromatid exchanges normally do not result in genetic recombination (King et al. 2006). The breaking during meiosis of one maternal and one paternal chromosome, the exchange of corresponding sections of DNA, and the rejoining of the chromosomes. This process can result in an exchange of alleles between chromosomes and gives rise to new character combinations (Schlindwein 2006, Burt and Trivers 2006). This is one of the essential biological mechanisms for creating genetic variation during sexual reproduction of eukaryotic organisms (Kahl 1995). See 'chiasmata', 'pachytene'.
cryopreservation	The maintenance of cells under extremely cold conditions, such as liquid nitrogen (Gordh and Headrick 2001). Refer to Leopold (2007).
cryptic species	Reproductively distinct species that show little or no outward morphological differences, and thus are difficult to distinguish (Gordh and Headrick 2001). [Cryptic = hidden or concealed] See 'sibling species'.
cucurbitacin	A chemical attractant for adult corn rootworms (Klassen, this volume).
cuelure	A synthetic lure (cuelure is a parapheromone) to attract fruit flies (IAEA 2003). A synthetic kairomone eliciting attraction of tephritid fruit flies (NAL 2008). See 'parapheromone', 'ceralure', 'disparlure', 'gossypylure', 'hexalure', 'propylure', 'swormlure', 'trimedlure'.
cultural control	A pest management strategy that involves the use of production practices, such as crop spacing, crop rotation, planting and harvest dates, clean culture, irrigation, pruning and tillage operations, individually or in combination, to disrupt a pest's life cycle (Gordh and Headrick 2001, USDA 1993). Purposeful manipulation of a cropping environment to reduce rates of pest increase and damage (Pedigo 2002). See 'integrated pest management (IPM)', 'sanitation', 'crop residue', 'trap crop'.
cumulative recaptures	Accumulating or adding up the number of marked insects recaptured in a trap over time. Refer to Itô and Yamamura (this volume).
cuticular hydrocarbon	Chemicals (hydrocarbons) from the insect cuticle can serve as chemical messengers between insects (Howard and Blomquist 1982) and as identifiers of the geographical source of adults (Brown et al. 1998). See 'contact pheromone'.
cytochrome oxidase	Terminal enzyme of the electron transport chain that accepts electrons from (i.e. oxidizes) cytochrome <i>c</i> and transfers electrons to molecular oxygen (Lackie and Dow 1995). Any of a family of respiratory pigments that react directly with oxygen in the reduced state. Also known as 'cytochrome <i>a<sub>3</sub></i> ' (MH 1997). Cytochrome refers to the complex protein respiratory enzymes occurring within plant and animal cells in the mitochondria, where they function as electron carriers in biological oxidation (Hoy 2003).
cytology	Branch of biology dealing with the structure, behaviour, growth, and reproduction of cells, and the function and chemistry of cell components (MH 1997, King et al. 2006).
cytoplasm	The protoplasm of an animal or plant cell external to the nucleus (MH 1997, King et al. 2006). Substance contained within the plasma membrane excluding, in eukaryotes, the nucleus (Lackie and Dow 1995).
cytoplasmic incompatibility	Reproductive incompatibility between two populations caused by factors that are present in the cytoplasm. Often associated with micro-organisms (Hoy 2003). Occurs when factors in the egg cytoplasm prevent fusion of the sperm and egg nuclei (Pedigo 2002). Reproductive incompatibility between allopatric populations of the same species in which eggs fertilized by

	sperm from males infected with a rickettsial endosymbiont fail to hatch. This effect occurs chiefly in insects as well as some other arthropods, and the most studied and apparently most common of these reproductive parasites are <i>Wolbachia</i> spp. (NAL 2008).
<b>D</b>	
data analysis	Data analysis is the process of looking at and summarizing data with the intent to extract useful information and develop conclusions (Wikipedia 2008). Organizational, mathematical or structural manipulation of data (database) to distil [extract the most important aspects of] higher levels of order or patterns (Gordh and Headrick 2001).
data layer	A data layer is a set of data on a particular subject, e.g. insect density in the field, insect population distribution, meteorological data, host animals, vegetation classification, crop, land use, soil type, geographical boundaries, satellite imagery, digitized topographical maps, demographic data. In using geographic information systems (GIS), many data layers may be used and are then related to each other. Refer to Cox and Vreysen (this volume) and Leak et al. (2008). See 'geographic information systems (GIS)'.
data management	The systematic management of a large structured collection of information, that can be used for storage, modification and retrieval of data (Everitt 2006). Methodology of storing, manipulating, and retrieving data in a database. Aspects include entering, classifying, modifying and updating data and presenting output reports. Also, sorting, recording, and classifying data for making calculations or decisions (Friedman 2007). Raw information is collected, recorded, organized and analysed, and converted into a form where it may conveniently be used or stored (Statt 1991).
database	A structured collection of data that is organized in such a way that it may be accessed easily by a wide variety of application programmes (Everitt 2006). A collection of data stored on a computer storage medium in a common pool for access on an as-needed basis. The same pool of information can serve many applications, even those not anticipated at the time the database was created (Friedman 2007). A store of information, usually held in a computer, which is logically arranged for a certain use (Statt 1991). A large collection of data organized such that elements of information can be expanded, updated and retrieved rapidly for various tasks (Gordh and Headrick 2001). A large collection of information that has been coded and stored in a computer in such a way that it can be extracted under a number of different category headings (Isaacs 2000).
decision support	Use of various tools such as computer software to provide supporting information that enables an informed decision about an activity to be made. Refer to Cox and Vreysen (this volume).
declaration of eradication	A formal statement by an authority that a certain insect pest has been eradicated in a defined region. However, a particular procedure must be followed before a declaration can be made, i.e. two phases of monitoring must be conducted. The first phase involves the continual operation of traps to attempt to catch the insect while also continuing control actions. The second phase involves stopping control actions but continuing detection trapping and waiting for an appropriate period of time. Refer to Barclay et al. (this volume) for a detailed description of the required procedures to follow before eradication can be declared. Refer also to Barclay and Hargrove (2005).
defined diet	Diet in which all components are chemically pure and of known composition (Cohen 2004). Diet in which the constituents can be described (ideally consisting of only chemically pure constituents) (Vanderzant 1966). See 'artificial diet'.
delayed sterility	Synonym for inherited sterility (IS) or F <sub>1</sub> sterility (Carpenter et al., this volume). See 'inherited sterility (IS)', 'partial sterility', 'full sterility', 'sterility', 'induced sterility'.
deleterious	Causing harm or damage (Oxford 2001). 'Deleterious' may be used in the context of harmful effects on chromosomes caused by radiation.
delta trap	Triangular insect trap [delta-shaped from the fourth letter of the Greek alphabet 'Δ'] containing a lure, e.g. a sex pheromone, and coated with a sticky substance on the inside to hold the insect after it enters the trap (Cooper Mill 2008). See 'attractive device', 'Jackson trap', 'pheromone trap', 'sticky trap', 'trap', 'wing trap'.
deme	A local population of a species consisting of potentially interbreeding individuals at a given locality (Gordh and Headrick 2001, Leak et al. 2008). A subpopulation of interbreeding individuals (Pedigo 2002, Schindwein 2006). Assemblage of taxonomically closely related individuals (Hill 1997, Minks and Harrewijn 1987). A randomly mating population (Doncaster 2008). See 'population', 'gene flow', 'area-wide'.
demographic	Pertaining to demography or parameters of populations. Demography is the statistical analysis of populations, including natality, mortality, migration, and sex; the rate of growth and age structure of populations, and the study of the factors which influence them (Gordh and Headrick 2001, MH 1997).
density	The number of individuals of a species per unit of habitat (Resh and Cardé 2003, Pedigo 2002).
density-dependence	The change of influence of environmental or physiological factors upon population size as population density increases (Gordh and Headrick 2001). A population-regulating factor changes proportionally in intensity with changes in population density (Pedigo 2002, MH 1997). Population of a species is regulated by its density (Collin 2001). The tendency for the birth rates or death rates to change as density of a population increases or decreases (Resh and Cardé 2003). Population growth can be density-dependent where either or both of birth rate and mortality depend on population size, usually in such a way as to eventually stabilize the population around some long-term mean value (Barclay, this volume). Contrast with density-independence. See 'inversely density-dependent', 'density-independence'.
density-independence	The lack of change in population size as population density changes (Gordh and Headrick 2001). A population-regulating factor that causes mortality and is unrelated to a population's density (Pedigo 2002, MH 1997). Factors operating in population regulation that are not related to population density, e.g. climate (Resh and Cardé 2003). Population growth can be density-independent where birth rate and mortality are independent of population size (Barclay, this volume). Contrast with density-dependence. See 'density-dependence'.
derelict orchard	An orchard in very poor condition resulting from disuse and neglect (Oxford 2001).
deterministic model	A simulation model that offers an outcome with no allowance or consideration for variation. Deterministic models are well suited to predict results when the input is predictable (Friedman 2007). A model that contains no random or probabilistic elements (Everitt 2006). A model is a mathematical explanation applied to biological phenomena (Gordh and Headrick 2001). Each independent variable in the model may be assigned a predetermined value to observe its effect on other variables (FAO/IAEA 1973). See 'stochastic model', 'model', 'modelling'.

developmental stage	A morphologically recognizable stage in the development of an insect during its life cycle, e.g. egg, larva or nymph, pupa, adult. Development is an orderly sequence of progressive changes resulting in an increased complexity of a biological system (King et al. 2006).
diapause	A dynamic state of low metabolic activity, with reduced morphogenesis, increased resistance to environmental extremes, and altered or reduced behavioural activity (Brown 1991). A syndrome of developmental, physiological, biochemical, and behavioural attributes that together serve to enhance survival during seasons of environmental adversity (Denlinger 2003). A programmed state of dormancy or arrest of development mediated by the neuroendocrine system, usually occurring in a species-specific stage of the life cycle. It may be induced obligatorily or facultatively in response to seasonal cues (daylength, temperature, food quality, etc.) (Resh and Cardé 2003, Pedigo 2002, Coombs and Hall 1998). A physiological condition or state of restrained development and reduced metabolic activity which cannot be directly attributed to unfavourable environmental conditions; an anticipated, typically long-term, cyclical interruption in growth or development of an organism due to one or more environmental factors that occur well before adverse environmental conditions are manifest (Gordh and Headrick 2001, Pedigo 2002, Coombs and Hall 1998). See 'dormancy'.
dicentric	A chromosome or chromatid having two centromeres (King et al. 2006, Hoy 2003). Applied to a chromatid or chromosome with two centromeres, such as arises in an inversion heterozygote as a result of crossing-over between a normal and an inverted segment that does not include the centromere (Schlindwein 2006). See 'centromere', 'acentric', 'monocentric', 'holokinetic', 'monokinetic'.
dichotomous spermiogenesis	Spermiogenesis is the series of morphological and chemical changes that transform the haploid spermatids resulting from the meiotic divisions of a spermatocyte into functional spermatozoa (King et al. 2006, Oxford 2006, MH 1997, Scott 1996). Dichotomous refers to the formation of two types of spermatozoa, i.e. apyrene and eupyrene, found in some insects, e.g. Lepidoptera. Refer to Carpenter et al. (this volume). See 'apyrene', 'eupyrene'.
diet	The foods on which an animal feeds (Cohen 2004). If the diet is artificial, a synonym is 'medium', but usually 'medium' is used in the context of culturing micro-organisms (Singh 1977). See 'artificial diet', 'defined diet', 'extruder', 'food processing'.
diet disposal	Disposing (getting rid of, throwing away) of insect diets after being used. Environmental concerns must be addressed when disposing of artificial diet (Parker, this volume; Dyck 2010). See 'spent diet', 'artificial diet'.
dietary supplement	A product that is intended to supplement the diet. In insect rearing, supplements or additives may be included to improve competitive behaviour, e.g. sexual performance, dispersal. Some supplements are proteins, semiochemicals and micro-organisms. Refer to Parker (this volume), Robinson and Hendrichs (this volume), Niyazi et al. (2004). See 'probiotic'.
diffusion	The process of movement or insect dispersal used in differential equations; it is measured by the coefficient, <i>D</i> , as used in diffusion equations. Refer to Itô and Yamamura (this volume) and Barclay (this volume). See 'dispersal'.
dilution	Act of diluting (weakening or thinning) by modifying or adding other elements (Oxford 2001). In the context of insect dispersal, dilution refers to the recruitment of insects in a specified area from immigration or emergence, resulting in the dilution of a marked population in that area. Refer to Itô and Yamamura (this volume).
dimer	A dimer is a molecule or molecular complex consisting of two identical molecules linked together (Oxford 2008, 1990). A dimer is a chemical entity consisting of an association of two monomeric subunits (King et al. 2006). See 'monomer', 'polymer', 'primer'.
dimeric locus	A locus that codes for an enzyme of two subunits. Heterozygotes for dimeric enzymes display three bands. Refer to Krafsur (this volume). See 'dimer', 'locus', 'monomeric locus'.
dip	Special pool with water and insecticide through which cattle are forced to swim and thus become 'dipped' to control tsetse flies (Vale and Torr 2004). See 'pour-on', 'chemical control', 'live-bait technology'.
diploid	Having two complete sets of chromosomes (Burt and Trivers 2006, Hoy 2003, Resh and Cardé 2003). Chromosomes are in homologous pairs, thus with two copies of each autosomal genetic locus (Lacker and Dow 1995). Possessing the full complement of maternal and paternal chromosomes (Pedigo 2002). A full set of genetic material, consisting of paired chromosomes, one chromosome from each parental set. Most animal cells except the gamete have a diploid set of chromosomes (Schlindwein 2006). Diploidy results from the fusion of the haploid egg nucleus and a haploid sperm nucleus (King et al. 2006, Oxford 2006). See 'haploid', 'polyploid'.
direct benefits	Economic benefits from pest management activities received directly by agricultural producers, e.g. increased yield and quality of products, and reduced production costs (Enkerlin, this volume). See 'benefit/cost analysis (BCA)', 'indirect benefits'.
direct sampling	Taking a direct sample of insects from the habitat, i.e. actual insects are collected, using traps or by dissecting host organisms (Vreysen, this volume). See 'sampling', 'indirect sampling'.
disability-adjusted life year index (DALY)	An index that measures the burden of a disease — life years lost due to the disease (Murray 1994).
discount rate	A rate used in determining the present value of future cash flows (Friedman 2007). The rate at which future benefits and costs are discounted because of time preference or because of the existence of a positive interest rate (Pearce 1992). The discount rate is the real cost of deferring benefits, for example the interest rate minus the inflation rate would give a commercial discount rate. The actual discount rate applied may be more than this, if the opportunity costs for an investment were higher than the commercial interest rate. The discount rate could also be lower if a social rate of interest was applied, for example one could argue that a social discount rate of zero be applied if there was no difference between present and future values, for example for conservation or disease prevention.

	See 'present value', 'net present value (NPV)', 'future value', 'economic return', 'rate of return', 'internal rate of return'.
discrete generations	Generations of an insect population where each generation is individually distinct, separate in time and clearly identifiable.
disease transmission	In medical and veterinary entomology, transmitting or passing on a disease, e.g. malaria, nagana, sleeping sickness. Transmission may be biological or mechanical. The passage of an infective parasite from an intermediate host (insect vector) to a definitive host (e.g. human), or vice versa (Gordh and Headrick 2001, Torre-Bueno 1978). See 'vector', 'transmission', 'parasitism', 'African animal trypanosomosis (AAT)', 'human African trypanosomosis (HAT)'.
disinfestation	A process or treatment which gets rid of an infestation of pests by destroying the pests infesting a commodity, e.g. fumigation or heat treatment of fruit destined for export. Refer to Bakri et al. (this volume).
disparlure	Synthetic sex pheromone of the gypsy moth <i>Lymantria dispar</i> (L.) (Gordh and Headrick 2001). A chemical substance that is a synthetic analogue of the sex pheromone produced by females, and it attracts male moths (Coombs and Hall 1998, NAL 2008). See 'sex pheromone', 'ceralure', 'cuelure', 'gossyplure', 'hexalure', 'propylure', 'swormlure', 'trimedlure'.
dispersal	A non-directional movement of insects within or between habitats (Gordh and Headrick 2001). The process of scattering, spreading out, in various directions; an active or passive extension of territory (Pedigo 2002, Scott 1996). Movement of individuals out of a population (emigration) or into a population (immigration) (Hill 1997). See 'migration'.
dispersion	The spatial arrangement of individuals in their habitat (Pedigo 2002). The distribution of the individuals of a species in space or on a surface (Scott 1996). See 'distribution'.
distribution	The distribution of individuals (manner in which they are spread out over an area) may be described as uniform, random or clumped (Wikipedia 2008). Pattern in which a species is found in various areas, depending on climate, altitude, etc. (Collin 2001). Range of an organism or group in biogeographical divisions of the world; spatial arrangement or pattern of the members of a group (Hill 1997). The geographical area inhabited by a species (Bijlmakers 2008). The pattern of location of individuals in their habitat — how they are located in relation to one another. For examples of tsetse fly <i>Glossina</i> spp. distribution, refer to Rogers and Robinson (2004). See 'clumped distribution', 'homogeneous distribution', 'continuous distribution', 'fragmented distribution', 'island distribution', 'dispersion'.
diurnal rhythm	Regular periodicity in the pattern of biological activity or behaviour of animals in which the pattern recurs daily during daylight (Scott 1996). Contrast with nocturnal.
diversity	Differences in appearance, habits, etc. in a group of animals or plants; also species variety and richness (Hill 1997, Collin 2001). The distribution and abundance of different plant and animal communities and species within an area; the number of species in a community or region (USDA 1993). See 'biodiversity'.
DNA	Deoxyribonucleic acid — a compound of deoxyribose, phosphoric acid, and nitrogen bases. A DNA molecule consists of two strands in the shape of a double helix (Pedigo 2002). The molecule that encodes genetic information. DNA is a double-stranded molecule held together by weak bonds between base pairs of nucleotides. The four nucleotides in DNA contain the bases adenine, guanine, cytosine and thymine (Schlindwein 2006). See 'RNA'.
DNA repair	The reconstruction of a continuous two-stranded DNA molecule without mismatch from a molecule which contained damaged regions (NAL 2008). Following DNA damage from ionizing radiation, a molecular process in which the DNA is repaired. This is mentioned in the context of the high radioresistance in Lepidoptera. Refer to Carpenter et al. (this volume).
domestication	The process of breeding for one or more desirable characteristics in plants and animals (NAL 2008). The adaptation of an animal or plant through breeding in captivity to a life intimately associated with, and advantageous to, humans (MH 1997). The conversion of wild animals into domestic animals. Domesticated species show a much wider variation of form than the corresponding wild species (Scott 1996). See 'strain domestication', 'selection', 'colonization'.
dominant conditional lethal (DCL)	Dominant lethal mutation which is expressed only under a certain set of permissive conditions, e.g. temperature, or only in females as described for Lepidoptera in Marec et al. (2005). See 'dominant gene', 'lethal gene'.
dominant gene	An allele of a character which is fully expressed in a heterozygote. A dominant gene is the stronger gene of a pair of alleles, expressed as fully when in single dose (i.e. heterozygous) as it is when present in double dose (i.e. homozygous). The opposite is recessive (Resh and Cardé 2003, NAL 2008). See 'gene'.
dominant lethal induction	Use of any mechanism to induce a dominant lethal mutation in germ cells. See 'dominant gene', 'lethal gene', 'dominant lethal mutation (DLM)'.
dominant lethal mutation (DLM)	Any mutation which kills an individual which is heterozygous for it. See 'dominant gene', 'lethal gene'.
dormancy	A seasonally recurring period in the life cycle when growth, development, and reproduction are suppressed (Pedigo 2002, Weeden et al. 2000). A condition of resting or quiescence, hibernation or aestivation, alive but not growing (Hill 1997, MH 1997). State of an animal or plant, where metabolism is slowed during a certain period of the year (Collin 2001, Scott 1996). An imperfectly understood physiological phenomenon that is generally regarded as a state of suspended development or reduced metabolic activity (Gordh and Headrick 2001). See 'diapause'.
dose	A general term denoting the quantity of radiation or energy absorbed in a specific mass (FAO/IAEA 2009). See 'absorbed dose'.
dose distribution	See 'absorbed-dose distribution'.
dose fractionation	Process where the required dose is delivered over time in a series of smaller irradiations (K. Mehta, personal communication). A method of administering radiation in which relatively small doses are given daily or at longer intervals (Borders 1991).

dose mapping	Measurement of the absorbed dose distribution within a process load through the use of dosimeters placed at specific locations within the process load (FAO 2006). See 'absorbed-dose mapping'.
dose rate	See 'absorbed-dose rate'.
dose-response curve	The functional relationship between dose and effect (Borders 1991).
dosimeter	A device that, when irradiated, exhibits a quantifiable change in some property of the device which can be related to absorbed dose in a given material using appropriate analytical instrumentation and techniques (FAO 2006, ISO/ASTM 2004a).
dosimetry	A system used for determining absorbed dose, consisting of dosimeters, measurement instruments and their associated reference standards, and procedures for the system's use (FAO 2006, ISO/ASTM 2004a).
double-stranded RNA (dsRNA)	A structure that occurs when complementary base sequences in single-stranded RNA form a duplex (Oxford 2006). An RNA duplex in which a messenger RNA is bound to an antisense RNA containing a complementary sequence of bases. Endogenous or exogenous dsRNAs provide a powerful means of silencing gene expression (King et al. 2006).
droopy wing syndrome	Wings of reared fruit flies drooped due to mechanical damage from sifting pupae while they were developing. Evidently indirect flight muscles did not insert properly into the cuticle of the exoskeleton, resulting in non-flying flies (Little and Cunningham 1978). Refer to Calkins and Parker (this volume).
drug resistance	A decreased reactivity of living organisms to the injurious actions of certain drugs and chemicals (MH 1997). The relatively enhanced resistance of an organism to the action of a drug. It may be caused by induction of an enzyme acting on the drug, by mutation, or by the acquisition of a plasmid coding for drug resistance (Oxford 2006). Resistance in an organism to a drug administered for the control of a disease, e.g. trypanosome parasites are becoming resistant to drugs administered to control trypanosomiasis. Refer to Feldmann et al. (this volume). See 'African animal trypanosomiasis (AAT)'.
dry storage of radiation source	When a radiation source is not in use, dry storage involves shielding the source by lead or other appropriate high-atomic-number material (Bakri et al., this volume). See 'wet storage of radiation source', 'panoramic irradiator', 'gamma irradiator'.
Dyar's Rule	Insects double their weight at each moult, and thus their cells need to divide only once per moulting cycle (Hutchinson et al. 1997, Behera et al. 1999). Refer to Bakri et al. (this volume). Dyar's Law -- An empirical observation that indicates a geometric progression in head width in successive instars of most holometabolous larvae, as proposed by H. G. Dyar in 1890 (Resh and Cardé 2003, Gordh and Headrick 2001, Torre-Bueno 1978).
dye	A chemical used to colour insects internally or externally, and thereby mark them for future identification purposes. Internal dyes are usually added to an artificial diet, and may be fat-soluble, while external dyes are usually fluorescent powders to permit later identification under ultraviolet light. Refer to Parker (this volume), and Dyck (2010). See 'fluorescent dye', 'marking', 'mark-release-recapture'.
dynamics	The forces which stimulate development or change within a system or process (Oxford 2008). Active, as opposed to static (Gordh and Headrick 2001). See 'population dynamics'.
<b>E</b>	
economic damage	The amount of pest-induced injury that justifies the cost of applying pest control measures (Gordh and Headrick 2001, Hill 1997).
economic injury level	The level of injury to a crop by a pest at which the implementation of control measures becomes cost effective (Gordh and Headrick 2001). The lowest pest population density that will cause economic damage (Hill 1997). The degree of crop damage at which economic losses become significant (Maxwell and Jennings 1980). The amount of pest damage equal to the cost of preventing damage (Daly et al. 1998). See 'economic threshold', 'cost-effective', 'economic damage', 'economic loss'.
economic loss	For an agricultural crop, the fraction of the realizable yield that is lost to the combined effect of all pests and the physical forces of the environment (Resh and Cardé 2003). Situation in which a producer does not earn the level of profit that would justify remaining in business in the long run (Friedman 2007).
economic return	Financial profit or economic benefit obtained from an investment. See 'rate of return', 'internal rate of return', 'discount rate', 'net present value', 'present value'.
economic threshold	The pest density at which management action should be taken to prevent an increasing pest population from reaching the economic injury level (Gordh and Headrick 2001, Daly et al. 1998, Hill 1997). A pest population level at which economic damage begins to occur; this level may vary depending upon crop and locality (USDA 1993). See 'economic injury level', 'economic damage'.
economies of scale	Reductions in the average cost of a product in the long run, resulting from an expanded level of output (Pearce 1992). Reduction of the costs of production of goods due to increasing the size of the producing entity and the share of the total market for the good (Friedman 2007). The advantages resulting from a large, as opposed to a small, scale of operation in an organization. They include lower unit costs, greater purchasing power by buying in bulk, opportunities for training, etc. (Statt 1991).
ecosystem	A dynamic complex of plant, animal and micro-organism communities and their abiotic environment interacting as a functional unit (FAO 2006). A community of organisms and their interaction with the physical environment (Resh and Cardé 2003). An ecological system formed of component members (a community) and the abiotic environment surrounding the system (Gordh and Headrick 2001, Hill 1997, Walker and Cox 1995).
ectoparasitic	An ectoparasite is a parasite that lives on the surface or within the skin of its host (Resh and Cardé 2003). Ectoparasites include fleas and lice (Gordh and Headrick 2001). See 'parasitism', 'endoparasitic'.
ectopic	Meaning 'out of place', occurring in an unusual place or an unusual form or manner. In developmental genetics, the word 'ectopic' is sometimes used to describe the expression of a regulatory gene in the wrong place (King et al. 2006, Oxford 2006). Ectopic expression is the expression of a gene in all tissues (Robinson, this volume).
effective population size	Approximately the number of successfully reproducing individuals in a population (Krafsur, this volume; Ayala and Kiger 1984). The average number of individuals in a population that contributes genes to succeeding generations. If the population

	size shows a cyclical variation as a function of season of the year, predation, parasitism, and other factors, the effective population size is closer to the number of individuals observed during the period of maximal contraction (King et al. 2006). The size of a real population, adjusted mathematically to account for varying sex ratios, degrees of inbreeding, etc., so that different populations may be compared (Scott 1996).
egg mass	The group of eggs laid by a female in a single egg-laying event (NAL 2008).
egg raft	A mass of eggs that floats on water, produced for example by <i>Culex fatigans</i> mosquitoes (MH 1997). Refer to Robinson (this volume).
eggshell	The typically hard, external covering of an egg; collectively, the chorion and vitelline membrane of an insect egg (Gordh and Headrick 2001).
ejaculate	Seminal fluid emitted from the body of the male (Gordh and Headrick 2001). The semen released in a given copulatory interaction (King et al. 2006).
electromagnetic radiation	Kind of radiation including visible light, radio waves, gamma rays, and X-rays, in which electric and magnetic fields vary simultaneously (Oxford 2008). Radiation consisting of associated and interacting electric and magnetic waves that travel at the speed of light (Borders 1991). Radiation from synchro systems and magnetic waves travelling at the speed of light. (Koelzer 2008).
electron accelerator	Device that accelerates a beam of electrons to high energy, and emits it towards some material (with the intention of modifying its properties) (K. Mehta, personal communication). Device to accelerate electrically charged particles to high energies (Koelzer 2008).
electron beam	A stream of electrons, generally emitted from an electron accelerator (K. Mehta, personal communication). See 'electron accelerator'.
electroretinogram	Device to measure the quality of vision (Agee and Park 1975). Refer to Calkins and Parker (this volume) and Scott (1996).
elemental marker	Using chemical elements, e.g. stable isotopes, instead of dyes to mark insects (Hood-Nowotny and Knols 2007, FAO/IAEA 2009). Refer to Parker (this volume). See 'isotope', 'dye'.
embryogenesis	The formation of an embryo from an egg and the processes of its development (Oxford 2006, MH 1997). The development of the embryo within an egg (Gillett 1971).
embryonic arrest	Cessation of embryonic development, and death of the embryo (Vreysen, this volume).
emergence	The escape of the adult insect from the cuticle of the pupa (FAO/IAEA/USDA 2003). The escape of an adult winged insect from its cocoon, pupal case or nymphal integument (Gordh and Headrick 2001, Bijlmakers 2008, Torre-Bueno 1978). See 'Tanaka box', 'plastic adult rearing container (PARC)', 'tower system'.
emigration	Movement of organisms out of a particular area (Hill 1997, Pedigo 2002). The movement of individuals out of a population (Bijlmakers 2008). The movement of individuals, groups or populations from one place to another place (Gordh and Headrick 2001). See 'migration', 'immigration'.
endoparasitic	An endoparasite lives within the body of its host (Resh and Cardé 2003); any organism that develops as a parasite within the body of another organism at the expense and to the detriment of the 'host' (Gordh and Headrick 2001, Coombs and Hall 1998). See 'parasitism', 'ectoparasitic'.
endosymbiont	An organism that lives within another organism in a symbiotic relationship, e.g. ants, termites and other wood-feeding insects contain endosymbiotic bacteria that digest cellulose and make it available as food (Resh and Cardé 2003, Burt and Trivers 2006). Internal symbionts are generally on the gut wall or inside the Malpighian tubules of an insect (Jolivet 1998). Symbiotic organisms (bacteroids/rickettsia-like organisms) living in the digestive tract (Leak 1999). Symbionts that live intracellularly or within hemocoel (Daly et al. 1998). An example of an endosymbiont is the genus <i>Wolbachia</i> (Robinson and Hendrichs, this volume). See 'symbiont'.
enforcement	The cooperation of whole communities is required for area-wide integrated pest management programmes to succeed, and if cooperation is not voluntary then sometimes it has to be enforced by appropriate authorities. Quarantine practices, bylaws, agreements and pest control actions may require enforcement (Dyck, Regidor Fernández et al., this volume).
entomopathogen	An organism that causes an insect disease (Coombs and Hall 1998, Resh and Cardé 2003, Coppel and Mertins 1977).
entry	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO 2006, FAO/IAEA/USDA 2003). See 'established pest', 'exotic species', 'native species', 'invasive species'.
environment	The complex of physical and biotic factors within which an organism exists (King et al. 2006, Collin 2001, Allaby 1994). The total of the natural conditions under which animals live, including climatic, geographic, physiographic and faunal conditions (Gordh and Headrick 2001, Porteous 1996). The sum total of external influences acting upon an organism including physical, chemical and biotic factors (Hill 1997).
environmental compatibility	The extent to which a technology, e.g. the SIT, is compatible with the environment. See 'environment-friendly'.
environmental control	Control of the environment, e.g. temperature, relative humidity, in an insect mass-rearing facility, using engineered systems and appropriate equipment to achieve the level of control required. Often referred to as 'controlled environment'. Refer to Parker (this volume).
environmental impact assessment	Environmental analysis that evaluates the positive and negative changes to the environment conditions at and around a particular site of a proposed project. Evaluation of the effect upon the environment of, for example, a large construction programme (Collin 2001). The identification and evaluation of the environmental consequences of a proposed development, and of measures intended to minimize adverse effects (Allaby 1994). The assessment is embodied in an environmental impact statement. This statement is a tool for decision making; it describes the positive and negative effects of the undertaking and cites alternative actions (NAL 2008, USDA 1993).
environmental impact quotient (EIQ)	A relative value that estimates the environmental impact of a pesticide, by taking into account toxicity to natural enemies, wildlife, and humans, degree of exposure, aquatic and terrestrial effects, soil chemistry, etc. (Weeden et al. 2000). An economic value for the environmental damage of pesticides (Kovach et al. 1992; Mumford, this volume).
environmental risk	The risk that methods of pest management (e.g. insecticides, the SIT, operating an insect mass-rearing facility), or even increasing agricultural production, might harm the environment must be assessed and prevented or at least managed. Risk

	mitigation is important for protecting the environment. Refer to Nagel and Peveling (this volume). The Precautionary Principle is the belief that even if there is scientific uncertainty regarding a risk and its consequences, preventive measures may be justified (Webster 2008).
environment-friendly	Not harmful to the environment (Collin 2001). See 'environmental compatibility'.
epidemiology	The study of development and spread of a disease throughout a host population (Hill 1997). Science of the study of disease in populations (Fenner et al. 1987).
equilibrium	State of balance. Fluctuation around an apparent average state, where the average state is also changing through time. A stable population stays at the same level (same number of individuals in an area) since numbers entering and leaving the population are approximately in balance (Collin 2001, Allaby 1994, Pedigo 2002, Gordh and Headrick 2001). In a population, the condition in which the frequencies of allelic genes are maintained at the same values from generation to generation (MH 1997). Equilibrium in the number of individuals in a population, in the genotypes present in a population, and among groups within the population. Refer to Barclay (this volume), Klassen and Curtis (this volume), Krafzur (this volume), Franz (this volume).
eradication	Application of phytosanitary measures to eliminate a pest from an area (FAO 2006; IAEA 2003; FAO/IAEA/USDA 2003; Resh and Cardé 2003; Hendrichs et al., this volume). A type of regulatory-control programme in which a target pest is eliminated from a geographical region (Gordh and Headrick 2001). Complete and total elimination of a group of organisms from an area (Pedigo 2002). The elimination of a (tsetse) species from a given area – it does not mean global elimination (extinction) (Leak et al. 2008). The complete elimination of a pest species; for some agricultural pests, this may mean the reduction of the pest populations to non-detectable levels (USDA 1993). Refer to Hendrichs et al. (section 2.2.) (this volume). Pest free area = An area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained (FAO 2006, IAEA 2003). See 'extinction', 'freedom from pests', 'insect-free', 'fly-free', 'pest free area', 'pest free field', 'pest free status', 'pest free zone', 'tsetse-free zone', 'strategic option'.
established pest	A pest species that is expected, for the foreseeable future, to be present in an area. This species may have been in the area for a very long time, e.g. native pest, invaded or 'entered' the area long ago, or become established recently. It is expected that the pest is, or has become, a part of the local community of organisms and the ecosystem, fits into a suitable habitat, and its population dynamics is adjusted to local natural enemies. See 'establishment', 'entry', 'exotic species', 'native species', 'invasive species', 'pest establishment'.
establishment	See 'pest establishment', 'established pest'.
eupyrene	A type of spermatozoa produced by Lepidoptera during spermatogenesis, having correctly formed chromatin, that fertilizes eggs (Gordh and Headrick 2001, King et al. 2006). Contrasts with apyrene spermatozoa. See 'apyrene', 'dichotomous spermiogenesis'.
evolutionary genetics	Evolution from a genetic and molecular perspective; the genetic mechanisms of evolution. The study of evolution at the molecular level to understand the mechanisms of evolution and to clarify the evolutionary history of genes or species at the molecular level. For a population to evolve, the gene frequencies of that population must undergo change. The major tenets of the evolutionary synthesis, then, is that populations contain genetic variation that arises by random mutation and recombination; that populations evolve by changes in gene frequency brought about by random genetic drift, gene flow, and especially natural selection. This field of study attempts to account for evolution in terms of changes in gene and genotype frequencies within populations, and the processes that convert the variation with populations into more or less permanent variation between species. The central challenge of evolutionary genetics is to describe how the evolutionary forces shape the patterns of biodiversity observed in nature (SEP 2008, Wikipedia 2008). Refer to Krafzur (this volume), Avise (2004), Li (1997), Smith (1998), Doncaster (2008), UG (2006), McClean (1997), Fitch (1997). See 'biodiversity', 'Hardy-Weinberg theorem'.
exclusion	Synonym for 'prevention'. Prevention is defined as the application of phytosanitary measures in and/or around a pest free area to avoid the introduction of a pest (Hendrichs et al., this volume). The application of regulatory and phytosanitary measures to prevent the introduction or re-introduction of a pest into a pest free area (IAEA 2003). Control of a pest organism by excluding it from an area or country, often by use of phytosanitary legislation (Hill 1997). See 'prevention', 'containment', 'pest free area', 'invasive species'.
exotic species	Organisms that are not native to a particular country, ecosystem or ecoarea (applied to organisms intentionally or accidentally introduced as a result of human activities) (FAO 2006, FAO/IAEA/USDA 2003). Not native, introduced from abroad (Coppel and Mertins 1977). Species that is introduced, foreign, non-endemic; a foreign animal or plant species that is not acclimatized (Hill 1997). An organism that evolved in one part of the world and that now occurs either accidentally or intentionally in a new region (Bijlmakers 2008). See 'entry', 'established pest', 'native species', 'invasive species'.
externalities	External costs (externalities) are the harmful effects arising from pest control operations, which affect parties other than the pest control decision-maker, but for which no compensation is paid to the persons harmed (Reichelderfer et al. 1984). Externalities are the environmental and social impacts on society from actions such as pest management operations. Refer to Klassen, Mumford, Whitten and Mahon, and Enkerlin (this volume). In economics, a cost or benefit attributable to an economic activity which is not reflected in the price of the goods or services being produced. Thus damage to the environment may not be counted as a cost (or environmental protection as a benefit) in production (Allaby 1994).
extinction	The eradication of a species from an area, or possibly even from the earth in a range-wide species extinction. The act or process of destroying life or eliminating it (Gordh and Headrick 2001). Annihilation; the death or extinguishing of a species or a population (Hill 1997). Dying out of a species (Collin 2001). The worldwide death and disappearance of a specific organism or group of organisms (MH 1997). In evolutionary history, many species have become extinct, but this has not occurred as a consequence of human efforts directed specifically at that result. See 'eradication', 'freedom from pests', 'insect-free', 'fly-free', 'pest free area', 'pest free field', 'pest free status', 'pest free zone', 'tsetse-free zone'.
extruder	Machine that, after processing and sterilizing insect artificial diet, forces out (extrudes) the diet on to trays or into containers. Extruders are extensively used in the food processing industry, providing versatility and high output (Cohen 2004). Refer to

	Parker (this volume). See 'diet', 'food processing'.
<b>F</b>	
F <sub>1</sub> generation	The first filial generation; the first generation following the parental (P) generation (King et al. 2006). The first generation formed by crossing two parental lines (Burt and Trivers 2006).
F <sub>2</sub> generation	The second filial generation; the progeny produced by intercrossing or self-fertilization of F <sub>1</sub> individuals (King et al. 2006).
facility design	The engineering design, layout and plans for an insect rearing facility (Dowell et al., this volume; Dyck 2010; IAEA 2008a; Fisher 2002; Phillimore 2002; Wyss 2002; Leppla and Eden 1999; Nordlund 1999; Wood and Wendel 1999; Oborny 1998; Fisher 1984; Fisher and Leppla 1985; Griffin 1984a, b; Harrell and Gantt 1984; Kakinohana 1982; Marroquin 1985; Owens 1984; Schwarz et al. 1985).
fauna	The collective animal life of any region, place or area (Gordh and Headrick 2001, Torre-Bueno 1978). The animal life characteristic of a particular region or environment (MH 1997). See 'flora'.
feasibility assessment	An assessment of the feasibility of conducting a programme, e.g. an AW-IPM programme. It involves many aspects, e.g. financial budgets and a benefit/cost analysis, economic development, organization and administrative/political matters, work plan, pest impact, biological procedures, and environmental issues. Refer to Dyck, Reyes Flores et al. (this volume), Mumford (this volume), and Cox and Vreysen (this volume). See 'decision support'.
fecundity	The number of eggs produced by a female during her lifetime (Gordh and Headrick 2001). The rate at which females produce eggs (Pedigo 2002). The innate potential reproductive capacity of the individual organism (MH 1997). See 'infecundity'.
feedback loop	Feedback refers to the influence of the result of a process upon the functioning of the process (King et al. 2006); information about the output of a system is used to influence the input to that system, and such feedback may increase the input to the system. A cyclic system of components participating in feedback forms a feedback loop (Oxford 2006). Returning output information to the beginning of a process for correcting discrepancies between intended and actual performance or for the maintenance of current process standards and procedures (Chambers and Ashley 1984, Moore et al. 1985). In the context of insect mass-rearing and quality control, quality assessments provide an ongoing check on the quality of insects being produced, providing an opportunity to correct any quality problems; this acts as a feedback loop to the production process. Refer to Calkins and Parker (this volume), Dowell et al. (this volume), and Dyck (2010). See 'quality control (QC)'.
feeding stimulant	Substance that increases the appetite of an organism, usually an insect pest. Feeding stimulants are often used in combination with biopesticides to ensure that insects ingest lethal doses of toxin (Coombs and Hall 1998). Chemical compounds can be added to attract insects to, and stimulate feeding on, baits. Refer to Nagel and Peveling (this volume), Mangan (this volume), Nigg et al. (2004). Also feeding stimulants may be added to artificial diets to encourage neonate insects to feed on the diet. Refer to Dyck (2010). See 'bait', 'bait spray'. Also see 'artificial diet', 'diet'.
female relative performance index (FRPI)	Relative measure of the mating propensity of females, and indicates the degree of sexual compatibility (or isolation) between two strains/populations of insects. The mathematical formula for this quality control test is given in Calkins and Parker (Box 1) (this volume) and FAO/IAEA/USDA (2003). See 'isolation index (ISI)', 'relative isolation index (RII)', 'male relative performance index (MRPI)', 'assortative mating'.
female-specific trap	A trap designed to attract and catch only female insects. Refer to Franz (this volume), Vreysen (this volume), IAEA (2003). See 'trap'.
fertility	Ability to reproduce (Torre-Bueno 1978). The ability to reproduce or produce viable offspring (Gordh and Headrick 2001, King et al. 2006). The rate at which fertilized eggs (zygotes) are produced (Pedigo 2002). See 'zygote'.
fertilization	Union or fusion of male and female gametes to form a diploid zygote. In insects, fertilization is characterized by mature sperm moving through the micropyle of an egg to unite with the female pronucleus (Gordh and Headrick 2001, King et al. 2006, Leftwich 1973, Torre-Bueno 1978, Watson 1976). See 'gamete', 'diploid', 'zygote', 'fusion'.
filariasis	A disease transmitted by mosquitoes or other nematoceros Diptera, caused by the presence of microscopic nematodes (filaria) (Gordh and Headrick 2001). See 'vector', 'transmission', 'parasitism', 'pathogen'.
filter rearing system (FRS)	This system for insect rearing is described by Parker (this volume). The concept involves maintaining a small colony at a low density, or even under semi-natural conditions, and therefore assumedly a low-selection pressure. Surplus insects from this low-density mother stock or clean stream are fed into a high-density amplification chain, leading up to the final insects to be released. The important feature is that no individuals are ever fed from the amplification stages back to the mother stock. The low-density rearing conditions of the filter can be supplemented with any further conditions deemed desirable, e.g. host plant, mating competition or pheromone response, and each generation the non-performing individuals are eliminated. A filter rearing system can provide a means to control the selection pressure on the mother stock used for the colony while avoiding many of the worst traits from the pressure of mass-rearing. Any undesirable traits selected for in the high-density amplification stages have only three or four generations to accumulate before release, and do not affect the mother stock. A further advantage is that, if it is desired to replace the strain with a new one, a new mother stock can be set up in parallel with the old one, and amplification easily switched from one to the other. Refer to Calkins and Parker (this volume), Franz (this volume), Robinson and Hendrichs (this volume). See 'colony'.
fitness	The survival value and the reproductive capability of a given genotype as compared with the average of the population or of other genotypes in the population (Oxford 2006, King et al. 2006). The environment, and competition for survival within it, determine which individuals are fittest to survive and propagate their genes in the next generation (Doncaster 2008). Genetic fitness. See 'survival', 'fertility'.

fixed cost	Cost that remains constant regardless of output. Fixed costs of a business include salaries of executives, interest expense, rent, depreciation, and insurance expenses. They contrast with variable costs (direct labour, materials costs) and semivariable costs, which vary, but not necessarily in direct relation to sales (Friedman 2007). See 'variable cost'.
fixed-wing aircraft	Conventional aircraft with wings fixed or permanently attached to the fuselage or body of the aircraft. Contrast with helicopter. See 'helicopter'.
flight ability	Flight is the movement and active locomotion in the air of adult insects with the aid of wings that are powered by muscles (Gordh and Headrick 2001; Scott 1996; Leftwich 1973, 1976). Adult capability to achieve a defined flight performance; a routine quality control test (FAO/IAEA/USDA 2003). Refer to Calkins and Parker (this volume), Dyck (2010). See 'quality control', 'product control'.
flight tube	A plastic tube used in a flight ability test (FAO/IAEA/USDA 2003; Calkins and Parker, this volume; Dyck 2010). Observations are made on the ability of adults to fly out of the tube. See 'flight ability'.
flora	The plant life characterizing a specific geographic region or environment (MH 1997, Allaby 1994). Wild plants which grow naturally in a certain area (Collin 2001). See 'fauna'.
fluorescent dye	A dye which fluoresces under ultraviolet light. A powdered dye (various colour are available) is dusted onto adult insects to mark them. Refer to Parker (this volume), Dowell et al. (this volume), Dyck (2010). See 'dye', 'marking', 'mark-release-recapture'.
fly-free	The FAO defines 'free from' as follows: Without pests (or a specific pest) in numbers or quantities that can be detected by the application of phytosanitary procedures (FAO 2006). An area where flies of a particular pest species are not present, i.e. free of flies, either due to natural causes, e.g. unsuitable habitat or climate, or to eradication resulting from an area-wide integrated pest management programme. Refer to Barclay et al. (this volume), Enkerlin (this volume), Feldmann et al. (this volume), Hendrichs et al. (this volume). See 'eradication', 'extinction', 'freedom from pests', 'insect-free', 'pest free area', 'pest free field', 'pest free status', 'pest free zone', 'tsetse-free zone'.
follicle	The ovarian follicle is a sac or tube of cells in the ovary enclosing a developing ovum (Leftwich 1973, Torre-Bueno 1978). Follicle cells, not derived from germ cells, cover oocytes and contribute to their development (Resh and Cardé 2003, Gordh and Headrick 2001). Refer to Vreysen (this volume). See 'ovary', 'ovariole'.
food chain	A trophic path or succession of populations through which energy flows as a result of feeding; each provides food for the next (Gordh and Headrick 2001, Collin 2001, Allaby 1994, Porteous 1996). The scheme of feeding relationships by trophic levels which unites the member species of a biological community (MH 1997). See 'food web', 'ecosystem'.
food irradiation	Processing of food products by ionizing radiation [specifically gamma rays, X-rays or accelerated electrons as specified in the Codex General Standard for Irradiated Foods] to, among other things, control foodborne pathogens, reduce microbial load and insect infestation, inhibit the germination of root crops, and extend the durable life of perishable produce (ISO/ASTM 2003). See 'irradiation', 'ionizing radiation', 'gamma radiation', 'X-ray', 'electron accelerator'.
food processing	Manufacturing foods, usually on a large scale, using any of a wide variety of processing techniques, most often with the goal of preserving food for the market (NAL 2008). Food processing is the set of methods and techniques used to transform raw ingredients into food for consumption by humans and animals. Food processing often takes clean, harvested or slaughtered and butchered components, and uses these to produce attractive and marketable food products (Wikipedia 2008). See 'diet', 'extruder'.
food residue	Regarding insect diets, food remaining after insects have completed their development. See 'diet disposal'.
food safety	The fitness of a food for human consumption (NAL 2008). Food safety is a scientific discipline describing the handling, preparation, and storage of food in ways that prevent foodborne illness (Wikipedia 2008). See 'biosafety', 'genetically modified organism (GMO)'.
food security	Food security exists when all people, at all times, have access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO). Access by all people, at all times to sufficient food for an active and healthy life. Food security includes at a minimum: the ready availability of nutritionally adequate and safe foods, and an assured ability to acquire acceptable foods in socially acceptable ways (NAL 2008). See 'biosecurity'.
food web	A complex of food chains that connect populations in an ecosystem (Gordh and Headrick 2001, Collin 2001, Allaby 1994, Porteous 1996). A modified food chain that expresses feeding relationships at various, changing trophic levels (MH 1997). See 'food chain', 'ecosystem'.
founder effect	When a new population is derived from a few immigrants, these founders represent a very small sample of the genetic pool to which they formally belonged; natural selection operating on this restricted variety soon yields gene combinations quite different from those found in the ancestral population, or those of a second small sample of founders (Doncaster 2008, Gordh and Headrick 2001). The principle that when a small sample of a larger population establishes itself as a newly isolated entity, its gene pool carries only a fraction of the genetic diversity represented in the parental population. The evolutionary fates of the parental and derived populations are thus likely to be set along different pathways because the different evolutionary pressures in the different areas occupied by the two populations will operate on different gene pools (NAL 2008, King et al. 2006). A high frequency of a particular allele in a population resulting from the presence of the allele in one or more of a small number of individuals from whom the population is descended (Oxford 2006). Refer to Parker (this volume) and Dyck (2010). Genetic drift observed in a population founded by a small non-representative sample of a larger population (Schlindwein 2006, Ayala and Kiger 1984). Speciation resulting from the establishment of a small population in an entirely new area and the subsequent divergence of the resulting population from the parent stock (Auburn 2008).

	See 'colony', 'bottleneck', 'genetic drift', 'founding population'.
founding population	The insects that are collected from a wild population and used to initiate and found (lay the base for) an insect colony in a laboratory (Dyck 2010). Refer to Parker (this volume). See 'founder effect', 'colony'.
fractionated dose	See 'dose fractionation'.
fragmented distribution	Distribution of a species in a fragmented pattern, i.e. occupied habitats are not contiguous due to, for example, patches of unsuitable habitat in between the occupied habitats. Some tsetse fly species have a fragmented distribution (Feldmann et al., this volume). Refer to Hendrichs et al. (this volume). See 'distribution', 'clumped distribution', 'homogeneous distribution', 'continuous distribution', 'island distribution'.
freedom from pests	Without pests (or a specific pest) in numbers or quantities that can be detected by the application of phytosanitary procedures (FAO 2006). Refer to Barclay et al. (this volume). See 'eradication', 'extinction', 'insect-free', 'fly-free', 'pest free area', 'pest free field', 'pest free status', 'pest free zone', 'tsetse-free zone'.
free radical	A molecular fragment or an ion that has one or more unpaired electrons, rendering it highly reactive (Porteous 1996). An unstable and highly reactive molecule, bearing an atom with an unpaired electron, that non-specifically attacks a variety of organic structures, including DNA. The interaction of ionizing radiation with water can generate hydroxyl and hydroperoxyl groups (free radicals that are potent oxidizing agents) (King et al. 2006). An atom or group of atoms with an unpaired valence electron (K. Mehta, personal communication). See 'hydrogen radical', 'peroxy-radical'.
free-rider	Those farms, which do not use the SIT but are located adjacent or near to farms that do apply the SIT, are called 'free-riders' [they get a free ride] since they benefit somewhat from the SIT (some sterile insects move into their fields from the fields in which they were released) but do not pay directly for this benefit. Refer to Whitten and Mahon (this volume). Refer also to Pearce (1992).
frugivorous	Feeding on fruit (Aluja and Norrbom 2001, White and Elson-Harris 1992, Gordh and Headrick 2001). See 'insectivorous', 'nectarivorous'.
fruit stripping	Removing (stripping) all or infested fruit from fruit trees to also remove insect pests, e.g. codling moth larvae, feeding inside the fruit. This is a method of reducing a pest population during the population reduction phase. Refer to Hendrichs et al. (this volume).
full sterility	Fully sterile insects are unable to reproduce. Refer to Robinson (this volume) and Carpenter et al. (this volume). See 'inherited sterility (IS)', 'partial sterility', 'delayed sterility', 'sterility', 'induced sterility'.
fumigation	Treatment with a chemical agent that reaches the commodity wholly or primarily in a gaseous state (FAO 2006). Treating a confined area with a volatile chemical that acts as a poisonous gas (Resh and Cardé 2003, USDA 1993). The application of a fumigant to disinfest an area from pests (Bijlmakers 2008).
fusion	Synonym of 'fertilization'. A union or combining of gametes into one cell, the zygote. See 'fertilization', 'zygote', 'gamete'.
future value	The value that a sum of money (the present value) invested at compound interest will have in the future (Oxford 1993). See 'present value', 'net present value (NPV)', 'discount rate'.
<b>G</b>	
gamete	A germ or reproductive cell, i.e. the sperm and ovum or egg (Hoy 2003, Borders 1991). A haploid germ cell (King et al. 2006). A mature reproductive cell capable of fusing with a similar cell of opposite sex to give a zygote (Ayala and Kiger 1984). See 'zygote', 'fusion', 'haploid', 'germ cell'.
gametogenesis	The formation of gametes (King et al. 2006). See 'gamete'.
gamma irradiator	The basic components of an irradiation unit are the radiation source (pencils of either cobalt or caesium) and the associated control systems, system for transporting the product (e.g. insects) to and from the position at which irradiation occurs, and shielding to protect workers and the surrounding environment from radiation (Bakri et al., this volume). Refer to Bakri et al. (this volume), IAEA (2008b). See 'panoramic irradiator', 'dry storage of radiation source', 'wet storage of radiation source'.
gamma radiation	The electromagnetic radiation emitted in the process of nuclear transition or particle annihilation (IAEA 1992, Borders 1991). High energy, short wavelength radiation emitted from the nuclei of atoms. Less damaging than the same dose of alpha radiation, but much more penetrating. Can be stopped by thick slabs of lead or concrete (FAO/IAEA 2009). Highly-energetic, short-wave electromagnetic radiation emitted from the nucleus of an atom. Gamma radiation energies usually range between 0.01 and 10 MeV. X-rays also occur within this energy range; they originate, however, not from the nucleus, but are generated by electron transfers in the electron sheath or by electron deceleration in matter (Bremsstrahlung). In general, alpha and beta decays and always the fission process are accompanied by gamma radiation. Gamma rays are extremely penetrative, and may best be weakened by material of high density (lead) and high atomic number (Koelzer 2008). See 'X-ray', 'gamma ray', 'Bremsstrahlung', 'ionizing radiation', 'radiation'.
gamma ray	A highly penetrating type of nuclear radiation, similar to X-rays, except that it comes from within the nucleus of an atom, and, in general, has a shorter wavelength (FAO/IAEA 2009). Short-wavelength electromagnetic radiation of nuclear origin (Borders 1991). Electromagnetic radiation of short wavelength emitted from an atomic nucleus undergoing radioactive decay (King et al. 2006). Gamma rays have shorter wavelengths than X-rays and higher photon energies (Oxford 2006). See 'gamma radiation', 'X-ray'.
gamodemes	Isolated breeding communities (MH 1997). Sympatric, and generally non-interbreeding, populations (Whitten and Mahon, this volume).
gel electrophoresis	Separation of molecules on the basis of their net electrical charge and size (Hoy 2003). The movement of the charged molecules in solution in an electrical field. The solution is generally held in a porous support medium, such as a gel made of starch, agar, or polyacrylamide. Electrophoresis is generally used to separate molecules from a mixture, based upon differences in net electrical charge and also by size or geometry of the molecules, dependent upon the characteristics of the gel matrix (King et al. 2006, Walker and Cox 1995, Kahl 1995). The negatively charged DNA molecules move at a rate that is inversely proportional to their size (Viljoen et al. 2005).

	See 'acrylamide gel', 'polymerase chain reaction (PCR)'.
gene	The fundamental physical and functional unit of heredity. A gene is an ordered sequence of nucleotides. It encodes a specific functional product, i.e. a protein or RNA molecule. It includes regions involved in regulation of expression and regions that code for a specific functional product (Schlindwein 2006). A hereditary unit that occupies a specific position (locus) within the genome or chromosome; a unit that has one or more specific effects upon the phenotype of the organism; a unit that can mutate to various allelic forms; and a unit that recombines with other such units (King et al. 2006). A segment of DNA that codes for an RNA and/or a polypeptide molecule (Hoy 2003, Doncaster 2008).
gene flow	The exchange of genes between different populations of the same species produced by migrants, resulting in simultaneous changes in gene frequencies at many loci in the recipient gene pool (King et al. 2006). The exchange of genes between different but (usually) related populations (Schlindwein 2006, NAL 2008). The exchange of genes (in one or both directions) at a low rate between two populations, due to the dispersal of gametes or of individuals from one population to another (Ayala and Kiger 1984). The injection of new genes by migration. When the rate of immigration is high, gene flow can serve both as a source of new genetic variability and as a prime mover of evolution (Doncaster 2008). See 'deme', 'gene pool'.
gene frequency	The percentage of all alleles at a given locus in a population represented by a specific allele (King et al. 2006). A measure of the proportion of an allele in a given population, equal to the number of loci at which a given allele occurs, divided by the total number of loci at which it could occur (Oxford 2006). The proportion of one particular in the total of all alleles for one genetic locus in a breeding population (NAL 2008). See 'locus', 'allele'.
gene pool	All the hereditary material (genes) in a population (Doncaster 2008, Burt and Trivers 2006). The total genetic information possessed by the reproductive members of a population of sexually reproducing organisms (King et al. 2006). All of the alleles available among the reproductive members of a population from which gametes can be drawn (Schlindwein 2006). See 'allele', 'gamete'.
gene-silencing	A phenomenon in which genes near certain chromosomal regions, such as centromeres or telomeres, are rendered transcriptionally inactive (King et al. 2006). Interruption or suppression of the expression of a gene at transcriptional or translational levels (NAL 2008). See 'centromere', 'telomere'.
genetic control	Altering the genetic makeup of organisms to inhibit their reproduction and survival (Pedigo 2002). A method of pest control that employs genetically altered individuals which are released into the wild population, successfully copulate with members of that population, and produce sterile or inviable progeny (Gordh and Headrick 2001). A method of pest control which makes use of selected strains of the target species that possess genetic abnormalities (Bijlmakers 2008). See 'sterile insect technique', 'genetically impaired female technique (GIFT)', 'genetic engineering', 'release of insects carrying a dominant lethal (RIDL)', 'transgenesis'.
genetic damage	Deleterious effects on genetic material. Refer to Robinson (this volume). See 'somatic damage'.
genetic differentiation	The accumulation of differences in allelic frequencies between isolated or semi-isolated populations due to various evolutionary forces such as selection, genetic drift, gene flow, assortative mating, etc. (King et al. 2006, MH 1997). See 'selection', 'genetic drift', 'gene flow', 'assortative mating'.
genetic distance	A measure of the numbers of allelic substitutions per locus that have occurred during the separate evolution of two populations or species. The distance between linked genes in terms of recombination units or map units (King et al. 2006, MH 1997). A way of measuring the amount of evolutionary divergence in two separated populations of a species by counting the number of allelic substitutions per locus that have cropped up in each population (Schlindwein 2006).
genetic diversity	A property of a community of organisms of a certain species, in which members of the community have variations in their chromosomes due to a large number of slightly dissimilar ancestors; this property makes the community in general more resistant to diseases or to changing ecological conditions (Schlindwein 2006).
genetic drift	The fluctuation of the allele frequency from one generation to the next (NAL 2008). Random change in gene frequency in a small and isolated population (MCC 1996, MH 1997). The random change in the occurrence of a particular gene in a population; genetic drift is thought to be one cause of speciation when a group of organisms is separated from its parent population (Schlindwein 2006). The alteration of gene frequencies (evolution) through chance processes alone. Genetic drift is most likely to be effective in very small populations (<100 individuals), where reduction of genetic variability lowers the capacity of a population to adapt to changes in the environment, and also tends to reduce the overall fitness of the population (Doncaster 2008). The random fluctuations of gene frequencies due to sampling errors. While drift occurs in all populations, its effects are most evident in very small populations (King et al. 2006). See 'founder effect', 'fitness', 'colony'.
genetic engineering	The formation of new combinations of heritable material by the isolation of nucleic acid molecules, produced by whatever means outside the cell, into any virus, bacterial plasmid, or other vector system so as to allow their incorporation into a host organism in which they do not naturally occur, but in which they are capable of continued propagation (Walker and Cox 1995, Kahl 1995). The technique of removing, modifying, or adding genes to a DNA molecule (Pedigo 2002, MH 1997). Technology used to isolate genes from an organism, manipulate the genes in the laboratory, and insert them into another organism (Gordh and Headrick 2001). Directed modification of the gene complement of a living organism by such techniques as altering the DNA, substituting genetic material by means of a virus, transplanting whole nuclei, transplanting cell hybrids, etc. (NAL 2008). Gene splicing, gene manipulation, gene technology, recombinant DNA technology (Hoy 2003). The manipulation of a cell's or an organism's genetic endowment by introducing or eliminating specific genes through modern molecular biology techniques. Should result in a new capability such as production of different substances or new functions. A broad definition of genetic engineering also includes selective breeding and other means of artificial selection (Schlindwein 2006). See 'genetic control', 'genetically impaired female technique (GIFT)', 'release of insects carrying a dominant lethal (RIDL)', 'transgenesis', 'sterile insect technique', 'recombination', 'vector'.
genetic fingerprinting	A technique (more properly termed DNA typing) that relies on the presence of simple tandem-repetitive sequences that are scattered throughout the genome. DNAs from different individuals are enzymatically cleaved and separated by size on a gel. A hybridization probe containing the core sequence is then used to label those DNA fragments that contain complementary sequences. The pattern displayed on each gel is specific for a given individual (King et al. 2006). Genetic profiling (Oxford 2006).

	<p>The establishment of a DNA fingerprint (the highly specific hybridization pattern [fingerprint] generated by restriction fragment length polymorphisms (RFLP) of genomic DNA). Genomic DNA is restricted with a four- or six-base cutter restriction endonuclease. The resulting fragments are separated by gel electrophoresis, transferred to membranes and hybridized with a fingerprint probe. Since the appropriate probes detect individual-specific polymorphisms, this method can be used for the genetic identification of different individuals of one species with high certainty (Kahl 1995). Identification of chemical entities in animal tissues as indicative of the presence of specific genes (MH 1997). See 'restriction fragment length polymorphism (RFLP)', 'gel electrophoresis', 'probe', 'polymerase chain reaction (PCR)'.</p>
genetic isolation	<p>The absence of genetic exchange between populations or species as a result of geographic separation or of mechanisms that prevent reproduction (MH 1997).</p>
genetic load	<p>The accumulation of unfavourable or deleterious mutations in the gene pool of a specific population (Kahl 1995). Genetic burden. The decrease in fitness of a population due to deleterious mutations in the population gene pool. Specifically the average number of recessive lethal mutations, in the heterozygous state, estimated to be present in the genome of an individual in a population (Lackie and Dow 1995). See 'gene pool', 'mutation', 'genome', 'fitness'.</p>
genetic marker	<p>A gene that enables one to detect a transgenic individual. The marker gene is located within the gene vector, usually a transposable element, and its expression indicates that the vector has inserted it into the target DNA (Resh and Cardé 2003). A phenotypically recognizable genetic trait which can be used to identify a genetic locus, a linkage group, or a recombination event (NAL 2008, Oxford 2006). An allele whose phenotype is recognized and which can be used to monitor the inheritance of its gene during genetic crosses between organisms with different alleles (Hoy 2003). A gene, whose phenotypic expression is usually easily discerned, used to identify an individual or a cell that carries it, or as a probe to mark a nucleus, chromosome, or locus (King et al. 2006, MH 1997). Molecular methods for making inferences about descent. These include 'allozymes', 'restriction fragment length polymorphisms (RFLPs)', 'multilocus minisatellite' or 'DNA fingerprints', 'single locus minisatellites' or 'variable number of tandem repeats (VNTRs)', 'randomly amplified polymorphic DNA (RAPDs)', 'microsatellites', and 'mitochondrial DNA (mtDNA)'. Amongst the newer methods, minisatellites can provide a similarity index for populations, microsatellites reveal information about kinship, and mitochondrial DNA determines the maternal contribution to descent (Doncaster 2008). See 'marker', 'selectable marker', 'transgenesis', 'transgenic strain', 'transposable element', 'vector', 'allozyme', 'restriction fragment length polymorphism (RFLP)', 'randomly amplified polymorphic DNA (RAPD)', 'microsatellite', 'mitochondrial DNA (mtDNA)'.</p>
genetic recombination	<p>Formation of new combinations of alleles in offspring as a result of exchange of DNA sequences between molecules (Lackie and Dow 1995, Hoy 2003). The processes by which a new genotype is formed by reassortment of genes resulting in gene combinations different from those that were present in the parents. In eukaryotes genetic recombination can occur by chromosome assortment, intrachromosomal recombination, or non-reciprocal interchromosomal recombination. Intrachromosomal recombination occurs by crossing over (Oxford 2006, King et al. 2006, Kahl 1995, Schindwein 2006). The formation of new combinations of alleles, typically during meiosis. This may include the process by which DNA molecules are broken and the fragments rejoined into new combinations (Burt and Trivers 2006). The genetic exchange between two homologous chromosomes leading to the occurrence of recombinants. In case of genetic sexing, it refers primarily to recombination in males resulting, in the next generation, in a reversal of the sexing system, i.e. recombinants are either wild-type females or mutant males (FAO/IAEA/USDA 2003). Refer to Franz (this volume). See 'recombination', 'male recombination', 'crossing-over', 'genetic engineering', 'meiosis', 'genetic sexing'.</p>
genetic sexing	<p>Also 'genetic sexing system (GSS)'. Genetic method to produce unisexual progeny. See 'sex separation'.</p>
genetic sterility	<p>Sterility caused through alteration in the genetic material. See 'cytoplasmic incompatibility', 'refractory', 'genetic engineering', 'genetically impaired female technique (GIFT)', 'release of insects carrying a dominant lethal (RIDL)'.</p>
genetic transformation	<p>A stable, heritable change in genotype caused by the incorporation of foreign DNA into the genome (Resh and Cardé 2003). A change in the genetic structure of an organism via genetic engineering (Pedigo 2002). Change brought about to an organism's genetic composition by unidirectional transfer and incorporation of foreign DNA into prokaryotic or eukaryotic cells by recombination of part or all of that DNA into the cell's genome (NAL 2008). See 'genotype', 'genome', 'genetic engineering'.</p>
genetic variation	<p>Genetic variation of a population is the presence of genotypically different individuals.</p>
genetically impaired female technique (GIFT)	<p>System combines chromosome rearrangements with eye colour and other mutations, such that mass-reared females are killed or debilitated. The mutations and rearrangements are inherited in the offspring of field females mated by released males, causing genetic death, leading to population collapse (Foster et al. 1993). Refer to Klassen (this volume). See 'genetic control', 'sterile insect technique'.</p>
genetically modified organism (GMO)	<p>Food or plants with a genetic composition that has been altered through genetic engineering (Collin 2001). An organism whose genes have been deliberately manipulated (Bijlmakers 2008). Living modified organism (LMO) = Any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology (FAO 2006). See 'biosafety', 'biodiversity', 'genetic engineering', 'organism'.</p>
genetics revolution	<p>The recent rapid scientific developments in genetics, gene technology and biotechnology – genetically modified organisms (GMOs), genetic engineering, description of the genomes of humans and other organisms, treatment of diseases, cloning of animals, etc. Refer to Whitten and Mahon (this volume), Morgan (2005), TIME (1999). See 'genome', 'genetically modified organism (GMO)', 'genetic engineering'.</p>
genitalia	<p>Genitalia are external components of the reproductive system (Gordh and Headrick 2001). Copulatory organs of an animal (Hutchinson 1998). See 'copulation'.</p>
genome	<p>The entire nucleotide sequence of an organism, including the entire set of genes (Resh and Cardé 2003). The total complement of DNA in an organism (Hoy 2003). The full genome of an individual is borne by a single representative of each of all the chromosome pairs in a nucleus (Doncaster 2008). All the genetic material in the chromosomes of a particular organism; its size is generally given as its total number of base pairs (Schindwein 2006). See 'gene', 'chromosome'.</p>

genotype	All or part of the genetic composition of an individual or population (Resh and Cardé 2003, Hoy 2003). The genetic constitution of an organism, cell, individual or taxon, as distinct from its physical appearance, i.e. phenotype (NAL 2008). The hereditary constitution of an individual, or of particular nuclei within its cells (Schlindwein 2006). See 'phenotype'.
geographic information systems (GIS)	Computer-based systems capable of capturing, cleaning (checking for errors and gaps), integrating, storing, retrieving, analysing, and displaying spatial data. GIS incorporate spatial data (geographical features) in the form of geographical coverages (maps), and descriptive data (attributes) in the form of relational databases linked to the mapped features. GIS have the ability to analyse data based on their location and spatial characteristics (Cox and Vreysen, this volume). Computer-based information systems for gathering, storing, integrating, analysing, and displaying geospatial information, e.g. insect densities across a field (Pedigo 2002, Gordh and Headrick 2001, NAL 2008). See 'database', 'spatial analysis', 'kriging'.
geographic range	The geographic area or region over which a species is distributed (MH 1997). See 'home range', 'range fragmentation'.
geo-reference	Geo-referencing – The practice of establishing the relationship between coordinates on a map or image with the specific real-world coordinates (a geographic location) (NAL 2008). Examples: attaching geographic location information to insect traps in the field, or to data on pest population density or pest infestation. Refer to Leak et al. (2008). See 'Global Positioning System (GPS)', 'geographic information systems (GIS)'.
geostatistics	A body of analytical techniques for the study of spatial pattern. There are two interrelated components to geostatistics: variography and spatial interpolation (kriging) (Glossary 2008). See 'kriging'.
germ cells	Cells that are ancestors of oocytes (Resh and Cardé 2003). Early-stage undifferentiated reproductive cells in the ovariole which are destined to become ova or spermatozoa (Gordh and Headrick 2001). The male and female reproductive cells (Walker and Cox 1995). See 'ovariole', 'oocyte', 'spermatogenesis'.
gestation	The period from egg fertilization to oviposition during which the embryo matures in the body of the female parent (Gordh and Headrick 2001), or in the case of insects that reproduce by adenotrophic viviparity, e.g. tsetse flies <i>Glossina</i> spp., the period from egg fertilization to larviposition. See 'adenotrophic viviparity', 'fertilization', 'larviposition', 'larviparous', 'viviparous'.
ginger root oil	See 'aromatherapy', 'citrus peel oil'.
Global Positioning System (GPS)	The GPS is useful for mapping spatial features. The basis of the GPS is a constellation of 24 satellites which act as reference points, with each satellite transmitting a radio signal in the form of pseudo-random code. On the ground, GPS receivers use this code to determine distances to each satellite ('ranging'), and calculate their position and altitude by 'trilaterating' signals from a number of satellites (Cox and Vreysen, this volume). A technology that uses the position of satellites to provide precise location coordinates on the earth's surface (NAL 2008). In applying the SIT, the GPS is used to geo-reference insect traps, and to guide the flight path of aircraft releasing sterile insects. Refer to Vreysen (this volume), Dowell et al. (this volume). See 'geo-reference', 'aerial release', 'geographic information systems (GIS)'.
globalization	The worldwide integration of markets for goods, services and capital (NAL 2008).
gonadotrophic cycle	Also 'gonadotropic cycle', referring to cyclical gonadal functions, e.g. periodic production of an egg in the ovary of tsetse flies <i>Glossina</i> spp. A 'gonad' is an animal organ, e.g. ovary, that produces gametes. Refer to Vreysen (this volume), Saunders (1972).
gonial cells	Primordial sex cells (gonia), e.g. oogonia and spermatogonia (MH 1997).
gossypure	The sex pheromone of the female pink bollworm <i>Pectinophora gossypiella</i> (Saunders) as well as the synthetic sex attractant used to elicit attraction of male bollworms (NAL 2008). Refer to Mangan (this volume), Bloem et al. (this volume). See 'sex pheromone', 'attraction', 'ceralure', 'cuelure', 'disparlure', 'hexalure', 'propylure', 'swormlure', 'trimedlure'.
gravid	Pertaining to female animals when carrying young or eggs (MH 1997).
green fluorescent protein (GFP)	Sterile insects for release are usually marked with a fluorescent powder; transgenic techniques could enable them to be marked with a fluorescent protein. Using a genetic marker for released insects requires that the marker be dominant, and that it can be monitored even in dead adults, as insects are usually dead when removed from traps. There are currently two fluorescent protein markers available to accomplish this, i.e. green fluorescent protein (GFP) and red fluorescent protein (DsRed) (Robinson and Hendrichs, this volume). A protein produced by the jellyfish <i>Aequorea victoria</i> . It produces a green emission when it is excited by blue light. GFP provides an excellent means for cytologically localizing the product from any foreign gene that can be spliced to the GFP open reading frame. The fused protein is often fully functional, and can be localized to its normal site in the cell by its green fluorescence (King et al. 2006, Oxford 2006). See 'marking', 'red fluorescent protein (DsRed)', 'genetic marker'.
gross domestic product (GDP)	The value of the total final output of goods and services produced inside a country during a given year (NAL 2008).
ground release	Release of sterile insects from the ground. Refer to Dowell et al. (section 5.2.) (this volume). See 'release', 'aerial release', 'static release'.
ground spray	Application of a pesticide spray from the ground. Refer to Nagel and Peveling (this volume), Mangan (this volume). See 'aerial spray', 'chemical control'.
growth model	Mathematical model or equation that describes the growth in number of individuals in a population over time. Refer to Barclay (this volume), Barclay et al. (this volume). A 'growth curve' is a graphed version of a growth model, showing changes over time in the population size (Gordh and Headrick 2001).
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Haisch Index	An index to measure the sexual competitiveness of sterile insects in the field. Refer to Itô and Yamamura (this volume), Haisch (1970). See 'competitiveness', 'mating competitiveness'.

Haldane's Rule	There is preferential sterility or inviability in the hybrids of the heterogametic sex. This means that, in Lepidoptera where the female is heterogametic, the major hybrid effects would be seen in the resulting female hybrids, whereas in Diptera where the male is heterogametic, the F <sub>1</sub> males will be more affected (Robinson, this volume). When one sex is absent, rare, or sterile, in the offspring of two different animal races or species, that sex is the heterogametic sex. The rule may be explained by the non-harmonious interaction of X- and Y-linked fertility genes in the hybrid (King et al. 2006). See 'heterogametic'.
Hale-Malthusian	The basic mathematical model to describe the exponential increase of populations (Itô and Yamamura, this volume). See 'logistic model', 'population model'.
Hamada method	One of the mark-recapture methods to estimate the population density in the field. The 'Hamada method' is a modification of the 'Jackson positive method'; the bias is reduced in this method. It is assumed that the number of wild individuals, excluding marked individuals, is kept constant during the capture period (Itô and Yamamura, this volume). See 'Itô method', 'Jackson positive method', 'Jackson negative method', 'Jolly-Seber method', 'Petersen method', 'Yamamura method'.
haplodiploidy	A genetic system found in some animals, e.g. honey bee, in which males develop from unfertilized eggs and are haploid, whereas the females develop from fertilized eggs and are diploid (King et al. 2006, Burt and Trivers 2006) See 'haploid', 'diploid'.
haploid	Condition in which a cell or organism has a single genome or a single set of homologous chromosomes (King et al. 2006, Oxford 2006, Hoy 2003). See 'diploid', 'polyploid', 'gamete'.
haplotype	The symbolic representation of a specific combination of linked alleles in a cluster of related genes. This term is a contraction of <i>haploid genotype</i> (King et al. 2006). A set of genes located on a single chromosome; the term is used also to denote the characteristics dependent on those genes (Oxford 2006). A set of closely linked genetic markers present on one chromosome which tend to be inherited together (Schlindwein 2006). See 'haploid', 'genotype'.
Hardy-Weinberg theorem	The Hardy-Weinberg law: The allelic (gene) and genotype frequencies in an infinitely large interbreeding population remain constant from generation to generation if mating is at random and there is no selection, migration or mutation (Doncaster 2008, King et al. 2006). A principle by which genotypic frequencies can be predicted on the basis of gene frequencies, under the assumption of random mating (Ayala and Kiger 1984). Hardy-Weinberg equilibrium: An equilibrium of genotypes achieved in populations of infinite size in which there is no migration, selection, or mutation after at least one generation of panmictic mating (Hoy 2003). See 'evolutionary genetics', 'population genetics'.
Heavily Indebted Poor Countries (HIPC)	Countries in the world listed as Heavily Indebted Poor Countries by the World Bank and the International Monetary Fund (WB 2008).
helicopter	Aircraft with horizontally rotating blades. See 'fixed-wing aircraft'.
hemimetabolous	Refers to those insects in which metamorphosis is simple and gradual; incomplete metamorphosis. Each insect gradually acquires wings during a period of growth interrupted by several moults. Immature forms are called nymphs, if terrestrial, naiads if aquatic, and resemble the adult form (King et al. 2001, Resh and Cardé 2003). See 'holometabolous'.
heterochromatin	Regions of the genome that are highly condensed and (mostly) transcriptionally inactive throughout the cell cycle (Burt and Trivers 2006, Lewin 1985). Chromosomal material that, unlike euchromatin, shows maximal condensation in nuclei during interphase (King et al. 2006, Oxford 2006). Composed of non-coding repetitive DNA (Schlindwein 2006, Hoy 2003).
heterogametic	A sex that produces gametes containing unlike sex chromosomes. Many males are XY and thus heterogametic. Lepidopteran females are the heterogametic sex (Hoy 2003). See 'homogametic'.
heterogeneity	Differing in kind, character or content, as in a heterogeneous population (Oxford 2008). Contrast with 'homogeneity' – being uniform in kind.
heterosis	The greater vigour in terms of growth, survival, and fertility of hybrids, usually from crosses between highly inbred lines. Heterosis is always associated with increased heterozygosity (King et al. 2006). Hybrid vigour (Hoy 2003). Superiority of the heterozygote over the homozygotes (Ayala and Kiger 1984). See 'hybrid vigour', 'hybrid', 'hybridization', 'underdominance'.
heterozygous	Having genetically different alleles at a particular locus on homologous chromosomes (Walker and Cox 1995, Lewin 1985, Ayala and Kiger 1984, Schlindwein 2006). A measure of genetic variation in a population estimated by a single locus or an average over several loci (Hoy 2003). See 'homozygous'.
hexalure	A synthetic sex attractant that is used to control the pink bollworm <i>Pectinophora gossypiella</i> (Saunders) (Coombs and Hall 1998; Mangan, this volume). See 'sex pheromone', 'attraction', 'ceralure', 'cuelure', 'disparlure', 'gossyplure', 'propylure', 'swormlure', 'trimedlure'.
High Efficiency Particulate Air (HEPA)	Type of air filter that can remove very small particles from the air, and thus used to provide very clean air for a rearing facility. HEPA filters can remove at least 99.97% of airborne particles 0.3 microns in diameter (Wikipedia 2008). Refer to Dowell et al. (this volume), Parker (this volume), Dyck (2010).
holokinetic	Chromosome with diffuse kinetic activity due to the presence of non-localized (diffuse) instead of localized centromere (Robinson, this volume). See 'centromere', 'acentric', 'dicentric', 'monocentric', 'monokinetic'.
holometabolous	Refers to those insects in which larval and pupal stages are interposed between the embryo and the adult. Metamorphosis is complete, with four very different life stages — egg, larva, pupa, adult (King et al. 2006, Resh and Cardé 2003). See 'hemimetabolous'.
home range	The total area occupied over the years by a group of animals or an individual animal (Allaby 1994). The physical area of an organism's normal activity (MH 1997, Scott 1996). Native range = The ecosystem that a species inhabits (Wikipedia 2008). See 'geographic range', 'range fragmentation'.

homogametic	A sex that produces gametes with only one kind of sex chromosome. The females of many insects are XX and thus homogametic (Hoy 2003). See 'heterogametic'.
homogeneous distribution	The even or uniform distribution (arrangement, pattern) of individuals of a species in its habitat (Allaby 1994). Contrasts with clumped distribution. See 'distribution', 'clumped distribution', 'continuous distribution', 'fragmented distribution', 'island distribution'.
homolog	Also spelled 'homologue'. One of a pair, or larger set, of chromosomes having the same overall genetic composition and sequence (Doncaster 2008). Homologs are chromosomes carrying the same genetic loci (Lewin 1985). See 'homologous chromosomes'.
homologous chromosomes	Two or more identical chromosomes (Hoy 2003). A pair of chromosomes containing the same linear gene sequences, each derived from one parent (Schlindwein 2006). See 'homolog'.
homoplasy	Phenomena that lead to similarities in character states for reasons other than inheritance from a common ancestor, including convergence, parallelism, and reversal (Hoy 2003). Appearance of similar structures in organisms not inherited from a common ancestor or developed from a common anlage. Indication for the universal mechanisms of evolution (Schlindwein 2006).
homozygous	Having genetically identical alleles at a particular locus on homologous chromosomes (Walker and Cox 1995). The presence of the same alleles at one or more loci (Schlindwein 2006). Having two identical alleles of a particular gene on both homologous chromosomes (Hoy 2003, Doncaster 2008). See 'heterozygous', 'homologous chromosomes', 'allele'.
host	An organism which harbours a parasite (Allaby 1994). An organism on or in which a parasite lives; a plant on which an insect feeds (MH 1997, Pedigo 2002, Coombs and Hall 1998, Cohen 2004). A parasite lives permanently, or for part of its life cycle, on or in the host, where it feeds and reproduces (Scott 1996). Any plant or animal attacked by a pest or a parasite (USDA 1993, Hill 1997). See 'host-parasitoid model', 'parasitism', 'parasitoid'.
host-parasitoid model	See 'Nicholson-Bailey model', 'model', 'host', 'parasitoid', 'parasitism'.
host-plant resistance	In the context of integrated pest management (IPM), host-plant resistance to pests refers to the relative amount of heritable qualities possessed by a plant that reduces the degree of damage done to the plant by a pest (Pedigo 2002, Gordh and Headrick 2001). See 'host', 'resistance management'.
host range	The variety of different host species that provide nourishment, shelter or are otherwise associated with a specific parasite or symbionts (NAL 2008). The group of species that can be attacked by a given parasite (King et al. 2006). The spectrum of host organisms that can be infected by a specified infectious agent or parasite (Oxford 2006). Species capable, under natural conditions, of sustaining a specific pest or other organism (FAO 2006). See 'host'.
host specificity	The degree to which parasites of plants or animals show specificity for a host varies – strictly one host, or having an alternate host, or having a secondary host (Scott 1996). See 'host'.
host-vector	Relationship between an animal (or plant) host and an insect vector of a disease. See 'host', 'vector'.
hot spot	A location or area with an unusually high insect density (Vreysen, this volume). Untreated or inadequately treated refugium or microhabitat unusually favourable for the pest, i.e. 'hot spot', from which recruits could come to reinfest cleared areas (Klassen, this volume).
human African trypanosomiasis (HAT)	The human disease trypanosomiasis (trypanosomiasis) (sleeping sickness) found in sub-Saharan Africa caused by trypanosomes and transmitted by tsetse flies. Refer to Pentreath and Kennedy (2004), Feldmann et al. (this volume). See 'African animal trypanosomiasis (AAT)', 'trypanosomiasis'.
hybrid	An offspring from genetically dissimilar parents, even different species. A heterozygote (King et al. 2006). A cross-bred, heterozygote organism or cell, an individual from any cross involving parents of differing genotypes. Offspring of unlike parents (Schlindwein 2006).
hybridization	The mating of individuals belonging to genetically disparate populations or to different species. The mating of any two unlike genotypes or phenotypes (King et al. 2006). The process of joining two complementary strands of DNA, or one each of DNA and RNA, to form a double-stranded molecule (Schlindwein 2006). See 'hybrid'.
hybrid sterility	The failure of hybrids between different species to produce viable offspring (King et al. 2006). Reduction or suppression of the reproductive capacity in hybrid organisms (Ayala and Kiger 1984). See 'hybrid'.
hybrid vigour	The increase in size or rate of growth or fertility or survival associated with increased heterozygosity (Doncaster 2008). See 'heterosis', 'hybrid', 'hybridization', 'heterozygous'.
hydrogen radical	Hydrogen atom which has lost one valence electron (K. Mehta, personal communication). See 'free radical', 'peroxy-radical'.
hydroponics	The growing of plants in aqueous chemical solutions (Bijlmakers 2008).
hypergeometric probability distribution	Similar to a binomial distribution, but while the binomial distribution assumes sampling with replacement, the hypergeometric probability distribution assumes sampling without replacement. For large populations, the two give very similar probabilities, and for infinite populations, there is no difference between the two. However, for small populations and samples that are a significant proportion of the total population, they differ noticeably (H. Barclay, personal communication; Everitt 2006). See 'binomial distribution', 'Poisson distribution', 'Poisson binomial distribution', 'negative binomial distribution', 'probability model'.
hyperparasitoid	A parasitoid that lives within or off of another parasitoid (Grimaldi and Engel 2005, Hill 1997).

	See 'parasitoid'.
hypoxia	An oxygen-reduced environment. A deficiency of oxygen reaching the tissues of the body (Bakri et al., this volume; Oxford 2008). Clinical manifestation of respiratory distress consisting of a relatively complete absence of oxygen (NAL 2008). See 'anoxia', 'radiation environment'.
<b>I</b>	
immigration	Movement of individuals into a population or area (Collin 2001, Hill 1997). See 'migration', 'emigration'.
immunization	Rendering an organism immune to a specific communicable disease (MH 1997). Deliberate stimulation of the host's immune response (NAL 2008).
impact	Having a marked, forceful or strong effect, influence or consequence on somebody or something (Oxford 2008, Webster 2008).
<i>in utero</i>	Within the uterus (MH 1997). Biological process, growth or development of organisms in a uterus. In insects, the uterus is the enlarged portion of the median oviduct in viviparous insects; sometimes the enlarged portion of the bursa copulatrix at the junction of the oviducts (Gordh and Headrick 2001).
inbreeding	Breeding of closely related individuals (MH 1997). The crossing of closely related plants or animals (King et al. 2006). The mating of genetically related individuals (Schlindwein 2006, NAL 2008). Pairing and reproduction between individuals that are more closely related than average pairs selected at random from the population (Scott 1996). See 'inbreeding coefficient'.
inbreeding coefficient	Probability of identity by descent (Krafsur, this volume). A measure of the rate of inbreeding or the degree to which an individual is inbred (MH 1997). The probability that two allelic genes united in a zygote are both descended from a gene found in an ancestor common to both parents. Also, the proportion of loci at which an individual is homozygous (King et al. 2006). The probability of homozygosity by descent (having common ancestors). The probability that a zygote obtains copies of the same ancestral gene from both its parents because they are related (Schlindwein 2006, NAL 2008). The probability that two alleles at the same locus in an individual are copies of the same gene, i.e. identical by descent (Scott 1996). See 'inbreeding'.
indirect benefits	Various social and economic benefits from pest management activities received indirectly by agricultural producers and the local community, e.g. increase in agricultural exports; increase in yield through reduced secondary pest outbreaks; better human nutrition; savings in medical costs and even deaths, and in public health and environmental costs, through reduced use of pesticides; greater protection of beehives; and new jobs created in agriculture and related industries (Enkerlin, this volume). See 'benefit/cost analysis (BCA)', 'direct benefits'.
indirect sampling	Sampling insects indirectly by monitoring host organisms, e.g. surveillance of myiasis cases in animals, disease transmission, and crop damage (Vreysen, this volume). See 'sampling', 'direct sampling'.
induced sterility	Sterility caused by physical, chemical or biological intervention (A.S. Robinson, personal communication). Refer to Robinson (this volume), Carpenter et al. (this volume), Vreysen (this volume). See 'sterility', 'inherited sterility (IS)', 'full sterility'.
infecundity	Inability to produce eggs. Refer to Klassen (this volume). See 'fecundity'.
infrared	Electromagnetic radiation with wavelengths longer than that of red light but shorter than radio waves, i.e. radiation in the wavelength range 0.7 micrometre to 1 millimetre (Isaacs 2000).
inherited sterility (IS)	Sterility caused by inheritable chromosome changes (A.S. Robinson, personal communication). Refer to Carpenter et al. (this volume). See 'partial sterility', 'delayed sterility', 'full sterility', 'induced sterility', 'sterility'.
inoculative release	The release of relatively small numbers of natural enemies that are expected to colonize, reproduce, and spread naturally throughout an area (Weeden et al. 2000). Contrast with 'inundative release'. See 'inundative release'.
insect growth regulator (IGR)	A category of insecticidal compounds which function as juvenile hormone analogues that interrupt growth and development or act as chitin synthesis inhibitors. IGRs display low mammalian toxicity and are effective only on immature insects (Gordh and Headrick 2001). Substance effective in upsetting or modifying normal insect growth processes (Pedigo 2002). See 'juvenile hormone (JH)', 'chitin synthesis inhibitor'.
insect-free	Referring to an area or product in which a specific insect pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained. See 'eradication', 'extinction', 'freedom from pests', 'fly-free', 'pest free area', 'pest free field', 'pest free status', 'pest free zone', 'tsetse-free zone'.
insecticide residue	The insecticide that remains on or in food after it has been applied to a food crop. See 'pesticide residue', 'residue'.
insecticide resistance	Genetically inherited ability to withstand doses of insecticide which would kill individuals from strains whose ancestors had not been exposed to the insecticide (Weeden et al. 2000). The ability of an organism to survive doses of a toxin that would normally be expected to be fatal (Coombs and Hall 1998). The ability of an insect population to withstand and survive the poisonous and toxic effects of an insecticide (Bijlmakers 2008, Hill 1997). The ability of strains of insects to survive normally lethal doses of insecticide, the ability having resulted from selection of tolerant individuals in populations exposed to the toxicant for several generations (Pfadt 1962). See 'resistance management', 'pesticide resistance'.
insectivorous	Insect-eating; pertaining to organisms subsisting on insects (Gordh and Headrick 2001). Feeding on a diet of insects (MH 1997). See 'nectarivorous', 'frugivorous'.
insemination	Fertilizing with semen (Gordh and Headrick 2001). See 'fertilization', 'copulation'.
inspection	Official visual examination of plants, plant products or other regulated articles to determine if pests are present and/or to

	determine compliance with phytosanitary regulations (FAO 2006).
integrated control	Control of pests that emphasizes selective use of insecticides so as to conserve natural enemies in the agroecosystem (Pedigo 2002). An approach to pest control which embraces techniques including biological control, chemical control, cultural control (Gordh and Headrick 2001).
integrated pest management (IPM)	The careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption in agroecosystems and encourages natural pest control mechanisms (FAO 2003, Hendrichs et al. 2007). A programmatic approach to pest control that has as its foundation the use of biological control methods, plant breeding, and the judicious application of pesticides, especially selective pesticides (Gordh and Headrick 2001). A system for controlling pests that is based on the combined use of a range of different methods (e.g. biopesticides, biocontrol agents, mating disruption, trapping, crop rotation, etc.) in order to minimize the use of chemical pesticides (Coombs and Hall 1998). For a compendium of IPM definitions, see: <a href="http://ipmnet.org/IPMdefinitions/home.html">http://ipmnet.org/IPMdefinitions/home.html</a>
intellectual property rights (IPR)	The rights granted by a government authority for certain products of intellectual effort and ingenuity (Webster 2008). Refers to creations of the mind. Under intellectual property law, the holder of an abstract 'property' has certain exclusive rights to the creative work (Wikipedia 2008).
interbreed	To breed by crossing different stocks, varieties, or species of animals or plants (IDIDAS 2008). To breed with an animal of a different race or species (Oxford 2008). Breed animals or plants using parents of different races and varieties (Webster 2008). See 'hybridization', 'hybrid'.
internal rate of return (IRR)	This concept explicitly takes into account the timing of the cash flows from a project. It is the discount rate which makes the net present value of a project equal to zero (Pearce 1992). If the internal rate of return exceeds the market rate of interest, then the project is profitable. The internal rate of return is usually considered less reliable than the actual net present value as a means of appraising a project (Oxford 1993). Another way of thinking of the internal rate of return is that it represents the average rate of return for a project over its life, taking into account negative returns in early years of investment and positive rates in later years. See 'rate of return', 'economic return', 'net return', 'discount rate', 'net present value', 'present value', 'payback', 'cost recovery'.
interphase	The period between succeeding mitoses (King et al. 2006). The state of a eukaryotic cell when not undergoing mitosis or meiosis (Oxford 2006). The stage of the cell or nucleus when it is not in mitosis, hence comprising most of the cell cycle (Lackie and Dow 1995). The period in the cell cycle when DNA is replicated in the nucleus (Schlindwein 2006, Hoy 2003). See 'mitosis', 'meiosis', 'prophase', 'metaphase', 'anaphase', 'telophase'.
intervention	Taking action (intervening) in some situation, e.g. a pest infestation, to change the course of events, e.g. to manage the pest.
intervention block	An area (block) of land or habitat demarcated as the area for intervention action (treatment) in area-wide integrated pest management. A block contains a core area, where the commodity to be protected, e.g. crop, is located, and an edge area next to or around the core area. Refer to Hendrichs et al. (this volume).
intrinsic rate of increase	The rate at which a population is increasing in number, measured by deducting the instantaneous death rate from the instantaneous birth rate (Allaby 1994). The fraction by which a population is growing at any instant in time (Gordh and Headrick 2001). Inherent rate at which a population increases in number, i.e. based on the basic biological characteristics of the species.
introduction	In the context of classical biological control, introduction refers to the importation of a natural enemy from a foreign country or continent, usually to control a pest also of foreign origin (Weeden et al. 2000). However, in the context of pest introduction, see 'pest introduction', 'invasive species', 'entry'.
inundative release	The release of large numbers of mass-produced biological control agents or beneficial organisms with the expectation of achieving a rapid effect (FAO 2006). A method of periodic introduction [augmentation] of biotic agents which is analogous to insecticide treatment in that a greater amount of the liberated material is used than is actually effective, repetition may be necessary, and the effect is more or less immediate (Coppel and Mertins 1977, Daly et al. 1998, Weeden et al. 2000, Coombs and Hall 1998). Contrast with 'inoculative release'. See 'sterile insect technique', 'inoculative release'.
invasion	The expansion of a species into an area not previously occupied by it (Wikipedia 2008). Arrival of large numbers of pests in an area (Collein 2001). See 'entry', 'pest introduction', 'invasive species', 'exotic species', 'immigration', 'reinvansion'.
invasive species	Species that tend to spread beyond their native range to new areas. Invasive species are those plants, animals, and microbes not native to a region which, when introduced either accidentally or intentionally, cause economic or environmental harm or harm to human health (NAL 2008). A subset of plants or animals that are introduced to an area, survive, and reproduce, and cause harm economically or environmentally within the new area of introduction (Wikipedia 2008). See 'entry', 'pest introduction', 'exotic species', 'prevention', 'home range', 'pest establishment'.
inversely density-dependent	Refers to mortality factors or processes in the environment which destroy a decreasing percentage of the subject population as its numerical density increases (Coppel and Mertins 1977). See 'density-dependence'.
inversion	See 'chromosomal inversion', 'paracentric inversion', 'pericentric inversion'. See 'temperature inversion'.
ionizing radiation	Charged [or uncharged] particles and electromagnetic waves that as a result of physical interaction create ions by either primary or secondary processes (FAO 2006). Certain radiations, in their passage through matter, are capable of causing ionization, i.e. they can knock electrons out of atoms or molecules or create ions either directly or indirectly (Porteous 1996, IAEA 1992, Borders 1991). Any radiation capable of displacing electrons from atoms or molecules, thereby producing ions. Some examples are alpha, beta, gamma, X-rays, neutrons (FAO/IAEA 2009). Any radiation which directly or indirectly ionizes, e.g. alpha, beta, gamma, neutron radiation (Koelzer 2008). See 'gamma radiation', 'radiation'.
irradiation	Treatment with any type of ionizing radiation (FAO 2006). Exposure to some form of radiation (FAO/IAEA 2009, Borders 1991). See 'ionizing radiation', 'gamma radiation', 'radiation exposure'.

irradiation protocol	Documented procedure for irradiating a sample, e.g. an insect canister, that is based on experimental results and consideration of all factors that could affect the irradiation process (K. Mehta, personal communication). See 'irradiation'.
irradiator	See 'gamma irradiator', 'panoramic irradiator', 'wet storage of radiation source', 'dry storage of radiation source'.
irritability	The capacity of an organism to receive external stimulus and respond to that stimulus (Gordh and Headrick 2001). A condition or quality of being excitable; the power of responding to a stimulus (MH 1997). A behavioural parameter of importance in insect rearing. A loss of irritability can mean a loss of predator-evasion behaviour when reared insects are released in the field, hence the development of a quality control test (startle test). Refer to Calkins and Parker (this volume). See 'startle test'.
island distribution	The distribution of an insect population confined to an island surrounded by water. Refer to Hendrichs et al. (this volume). See 'distribution', 'clumped distribution', 'homogeneous distribution', 'continuous distribution', 'fragmented distribution'.
ISO/ASTM standard	An international reference standard created by the International Organization for Standardization (ISO) and the American Society for Testing and Materials International (ASTM). These two organizations serve as an open forum for the development of international standards. Note the standard entitled "Guide for dosimetry for sterile insects release programs" ISO/ASTM 51940:2004.
isocline	A line representing all points satisfying a derivative equated to zero in a differential equation, or all points representing no change in a difference equation. If there are two or more isoclines, then the points where they intersect represent equilibria of the system (H. Barclay, personal communication).
isodose curves	Lines or surfaces of constant absorbed dose through a specified medium (Borders 1991, ISO/ASTM). Geometric place for all points where the dose variable has the same value (Koelzer 2008). Refer to Bakri et al. (this volume).
isofemale strain	A strain of insects based on the progeny of a single mated pair (Krafsur, this volume). A genetic lineage that began with a single inseminated female (King et al. 2006).
isolated infestation	A pest infestation that is localized and separated from other sites of infestation by the same species.
isolation index (ISI)	A measure of mating compatibility between two strains/populations, and is a quality control parameter. Refer to Calkins and Parker (Box 1) (this volume), (FAO/IAEA/USDA 2003). See 'relative isolation index (RII)', 'female relative performance index (FRPI)', 'male relative performance index (MRPI)', 'assortative mating'.
isotope	One of two or more forms of an element differing from each other in atomic weight, and in nuclear but not chemical properties. Each of two or more forms of the same element that contain equal numbers of protons [same atomic number] but different numbers of neutrons [different mass number or atomic weight] in their nuclei (FAO/IAEA 2009, Oxford 2008, Borders 1991). Atoms of the same atomic number, i.e. the same chemical element, however with a different nucleon number (Koelzer 2008).
isotropic	Having the same properties in all directions. Regarding radiation emission, this indicates equal emission in all directions from a point source (Borders 1991).
isozyme	Synonym for 'isoenzyme' (Oxford 2006). Enzymes that act on a common substrate (Krafsur, this volume). Multiple forms of an enzyme. These are not isomers, as a rule, but distinct protein molecules with unique metabolic functions (Gordh and Headrick 2001). Isozymes are complex proteins made up of paired polypeptide subunits. Isozymes often have different isoelectric points, and therefore can be separated by electrophoresis (King et al. 2006). Isozymes differ from each other in their substrate affinity, in their activity, or in their regulatory properties (Hoy 2003). Multiple forms of an enzyme whose synthesis is controlled by more than one gene (Schlindwein 2006).
Itô method	One of the mark-recapture methods to estimate the population density in the field. The 'Itô method' is a modification of the 'Jackson positive method'; the bias is reduced in this method. It is assumed that the total number of individuals, including wild and marked individuals, is kept constant during the capture period (Itô and Yamamura, this volume). See 'Hamada method', 'Jackson positive method', 'Jackson negative method', 'Jolly-Seber method', 'Petersen method', 'Yamamura method'.
<b>J</b>	
Jackson negative method	One of the mark-recapture methods to estimate the population density in the field. The 'Jackson negative method' is based on multiple-release single-recapture data. Marked individuals are released on several occasions with different markings, and thereafter a single random catch is made on day 0 (Itô and Yamamura, this volume). See 'Hamada method', 'Itô method', 'Jackson positive method', 'Jolly-Seber method', 'Petersen method', 'Yamamura method'.
Jackson positive method	One of the mark-recapture methods to estimate the population density in the field. The density and survival rate are estimated for the population by a single release and multiple recapture censuses. It is assumed that the total number of individuals, including wild and marked individuals, is kept constant during the capture period. Recaptured individuals should be returned to the original population (Itô and Yamamura, this volume). See 'Hamada method', 'Itô method', 'Jackson negative method', 'Jolly-Seber method', 'Petersen method', 'Yamamura method'.
Jackson trap	A delta-shaped (triangular) insect trap with a sticky cardboard insert, usually used with a parapheromone lure to attract and capture male fruit flies (IAEA 2003). See 'attractive device', 'delta trap', 'pheromone trap', 'sticky trap', 'trap', 'wing trap', 'parapheromone', 'attraction'.
Jolly-Seber method	One of the mark-recapture methods to estimate the population density in the field. The 'Jolly-Seber method' is applicable where the population density is changing because of mortality, emigration, birth, and immigration. Two or more releases are required, and recapture censuses are also required two or more times (Itô and Yamamura, this volume). See 'Hamada method', 'Itô method', 'Jackson positive method', 'Jackson negative method', 'Petersen method', 'Yamamura method'.
juvenile hormone (JH)	A sesquiterpene hormone produced by the corpora allata. Juvenile hormone is best known for its inhibition of development to the adult stage. It is also involved in the regulation of many physiological functions including diapause, heartbeat, migration, moulting and oogenesis (Gordh and Headrick 2001). One of the two major insect developmental hormones (the other is ecdysteroid or moulting hormone). During larval stages juvenile hormone maintains larval characters (Resh and Cardé 2003, Leak 1999). Juvenile hormone prevents moulting (Grimaldi and Engel 2005, Auburn 2008).

	See 'insect growth regulator (IGR)', 'chitin synthesis inhibitor'.
<b>K</b>	
kairomone	A chemical that is produced by one organism conveying information to another organism of a different species; it is advantageous to the recipient but detrimental to the producer of the chemical (Resh and Cardé 2003, Auburn 2008). An interspecific messenger substance that benefits the receiver but not the releaser, e.g. attractants, excitants (Pedigo 2002, Gordh and Headrick 2001, Coombs and Hall 1998, Coppel and Mertins 1977). A chemical or mixture of chemicals emitted by an organism, e.g. a plant, that induces a response in an individual of another species, e.g. an insect, that is beneficial to the receiving organism. Example: plant scent that makes the plant more easily identifiable to an insect pest (Maxwell and Jennings 1980, Bijlmakers 2008). See 'allomone', 'pheromone', 'parapheromone', 'pheromone', 'synomone', 'semiochemical'.
karyotype	The visual appearance of the set of chromosomes of a typical somatic eukaryotic cell of a given species, individual, or cell strain. It is expressed in terms of chromosomal sizes, shapes, and number (Oxford 2006, Doncaster 2008, Burt and Trivers 2006, Lackie and Dow 1995, Ayala and Kiger 1984). The morphology of chromosomes is described in terms of their relative lengths, centromere positions, and secondary constrictions (King et al. 2006). A photomicrograph of an individual's chromosomes arranged in a standard format (Schlindwein 2006). See 'chromosome'.
key pest	A perennial, severe and persistent pest of crop production; a pest that dominates the development and implementation of pest control activities. In the absence of human intervention, the pest commonly attains population densities that exceed economic injury levels (Gordh and Headrick 2001, Pedigo 2002, Maxwell and Jennings 1980). Pest species whose control is crucial for profitable crop production (Daly et al. 1998). See 'secondary pest', 'intervention', 'economic injury level'.
kinetochore	Body which attaches laterally to the chromosomal centromere, and is the site of chromosomal tubule attachment (Schlindwein 2006, Watson 1976). Late in prophase, kinetochores develop on the two faces of the centromere that point toward the spindle poles, binding to centromeric DNA. The microtubules of the traction fibre attach to the kinetochores (King et al. 2006, Lewin 1985). See 'prophase', 'centromere'.
kriging	An analytical technique. An interpolation procedure that relies on an autocorrelation function (the variogram) to provide weighting of nearby points used in the estimates. Kriging is ideally suited to the analysis of trap data, with interpolated output taking the form of contour maps or density surfaces of insect densities (Cox and Vreysen, this volume). A method of spatial interpolation based upon geostatistics. 'Spatial interpolation' is estimating the value of a variable at an unsampled location based upon measured values of the same value at known locations. The most common application of kriging is mapping (Glossary 2008). A complex function that looks at the existing spatial distribution of an element in several locations to derive a prediction of the spatial distribution of that same element in new or unobserved spaces (NAL 2008). See 'geographic information systems (GIS)', 'geostatistics'.
<b>L</b>	
land use	The way in which land is used, and for what purpose it is used, e.g. crop production, livestock production, nature reserve, human settlement, watershed, forest, etc. (Collin 2001). The deployment of land for any use. Competition for limited areas of land requires the establishment of priorities among claims, which is the object of land-use planning (Allaby 1994).
larvicide	Any substance that is used to kill or control the larvae of insects (Coombs and Hall 1998). A poison effective against larval insects (Hill 1997). Chemical agent that kills the larval stage of a pest or parasite (NAL 2008, Bijlmakers 2008). See 'adulticide', 'trypanocide', 'parasiticide'.
larviparous	Reproduction in which the egg hatches within the female and the larva is deposited (Wall and Shearer 1997, Gordh and Headrick 2001). Giving birth to larvae instead of eggs (Hill 1997, King et al. 2006, Grimaldi and Engel 2005). Tsetse flies <i>Glossina</i> spp. are unique among pest insects in being larviparous, i.e. females do not lay eggs but gestate a larva in a uterus (one larva at a time) (Klassen and Curtis, this volume). See 'adenotrophic viviparity', 'gestation', 'larviposition', 'viviparous'.
larviposition	The deposition of living larvae that have already hatched inside the female (Resh and Cardé 2003). See 'adenotrophic viviparity', 'gestation', 'larviparous', 'viviparous'.
late embryonic lethality (LEL)	Death of an embryo, caused by genetic factors, at a late stage in its development.
lattice pattern	Consists of lines crossing each other with square or diamond-shaped spaces left between (Oxford 2008).
Law of Bergonie and Tribondeau	The following generalizations, with some exceptions, have become known as the Law of Bergonie and Tribondeau: The most radiosensitive cells are those (1) with a high mitotic rate, (2) with a long mitotic future (i.e. under normal circumstances, they will undergo many divisions), and (3) which are of a primitive type (Bakri et al., this volume).
leading edge	When a pest infestation is spreading in a certain direction, the front portion of the infestation, or leading edge, can through pest monitoring be observed over time to move in that direction.
Least Developed Countries (LDC)	Least Developed Countries are countries which, according to the United Nations, exhibit the lowest indicators of socioeconomic development, with the lowest Human Development Index ratings of all countries in the world. A country is classified as a Least Developed Country if it meets three criteria based on: low income, human resource weakness, and economic vulnerability. The classification currently applies to 49 countries (Wikipedia 2008). A list of Least Developed Countries is available from the United Nations (UN 2008).
lek	A communal display site where males aggregate for the sole purpose of attracting and courting females and to which females come for mating (FAO/IAEA/USDA 2003). Specific site where males gather to display and compete for the attention of females (Jolivet 1998, Daly et al. 1998, Gordh and Headrick 2001). A group of males defending territories for mating purposes; also a type of mating system or strategy (Aluja and Norrbom 2001). Refer to Horng and Plant (1993). See 'mating arena', 'courtship', 'mating behaviour'.
lesion	A zone of tissue with impaired function resulting from damage by disease or wounding (Oxford 2006). A break in a chromosome is a lesion.
lethal gene	Any gene carrying a lethal mutation. Such mutations may only be fatal in the homozygous state (Oxford 2006). Mutated gene

	that is capable of causing death (Schlindwein 2006, Hoy 2003). A lethal mutation in a gene results in the premature death of the organism carrying it. Dominant lethals kill heterozygotes, whereas recessive lethals kill only homozygotes (King et al. 2006, Oxford 2006, NAL 2008, Lackie and Dow 1995, Ayala and Kiger 1984). See 'gene', 'dominant lethal induction', 'dominant lethal mutation (DLM)', 'release of insects carrying a dominant lethal (RIDL)', 'lethality'.
lethality	The quality of being deadly (Webster 2008). See 'lethal gene', 'dominant lethal induction', 'dominant lethal mutation (DLM)', 'release of insects carrying a dominant lethal (RIDL)'.
levy	The imposition of a tax, fee, fine, or subscription (Oxford 2008).
life cycle	The sequence of stages in the growth and development of an organism, eventually resulting in the reappearance of the first stage (Whiteside et al. 1988, Hill 1997). The sequence of events in the development of an insect that occur from birth (egg hatch) to reproduction (mating and egg laying) (Bijlmakers 2008, Weeden et al. 2000, Pedigo 2002). Progressive series of changes undergone by an insect from an egg to an adult (Collett 2001, Resh and Cardé 2003). The period of time between fertilization of an insect egg and the death of the individual which proceeds from that egg (Torre-Bueno 1978, Gordh and Headrick 2001).
life history	The taxonomic, biological and ecological studies of a species. Habits and changes undergone by an organism from the egg stage to its death as an adult (Pfadt 1962, Earthlife 2008). Made up of a series of instars and a series of moults or ecdyses between each instar and the next (Leftwich 1976). See 'phenology'.
lifespan	The length of time that an animal lives (Scott 1996, Oxford 2008). See 'longevity'.
Lincoln Index	A simple mathematical model to assess absolute insect population density (Southwood 1978). Recapture method, capture-recapture method. A number of live individuals is trapped, marked, then released. After a certain period, trapping is repeated, and the ratio of marked to unmarked individuals in the trapped sample is determined. It is assumed that the marked animals after release become randomly distributed in the population, and that all animals, marked or unmarked, have an equal probability of being trapped (Scott 1996). Refer to Vreysen (this volume), Itô and Yamamura (this volume). See 'absolute density', 'apparent density', 'marking'.
linear energy transfer (LET)	The energy imparted to a medium by a charged particle of a specified energy, per unit distance. High-LET radiation (e.g. alpha particles, neutrons); low-LET radiation (X-rays, gamma rays) (Bakri et al., this volume; IAEA 1992; FAO/IAEA 2009; Koelzer 2008). The linear rate of loss of energy (locally absorbed) by an ionizing particle traversing a material medium (Borders 1991).
live-bait technology	In this technique, residual insecticides are applied to host animals that attract pest insects, e.g. tsetse flies, which are killed on contact with the insecticide (Mangan, this volume; Cox and Vreysen, section 3.2., this volume). The use of live animals to attract insect pests (Vale and Torr 2004). See 'attract and kill', 'lure and kill', 'stationary-bait technology'.
locking	Failure of mating pairs to disengage upon completion of copulation (Bloem et al., this volume). See 'copulation'.
locus	A locus is the specific position, in all homologous chromosomes, of a particular gene or one of its alleles (Oxford 2006, King et al. 2006, Schlindwein 2006, Hoy 2003, Doncaster 2008, Burt and Trivers 2006). The site in a linkage map or on a chromosome where the gene for a particular trait is located (Lackie and Dow 1995, Kahl 1995, Lewin 1985, Ayala and Kiger 1984). May refer to the gene itself (Resh and Cardé 2003). See 'gene', 'allele', 'chromosome'.
logistic model	A classical continuous-time model to describe a sigmoidal increase in population density over time (Itô and Yamamura, this volume; Hill 1997). Logistic growth = Population growth that is influenced by the carrying capacity of the environment (Resh and Cardé 2003). See 'population model', 'Hale-Malthusian'.
longevity	The length of life of an individual or a population (Hill 1997). See 'lifespan'.
Lotka-Volterra model	A mathematical (differential equation) predator-prey model. Refer to Barclay (Box 2) (this volume). See 'model', 'predation', 'prey'.
low pest prevalence area	An area, whether all of a country, part of a country, or all or parts of several countries, as identified by the competent authorities, in which a specific pest occurs at low levels and which is subject to effective surveillance, control or eradication measures (FAO 2006, IAEA 2003). Areas that are established by means of a systems approach through the application of a series of pre-and post-harvest suppression and mitigating measures (Klassen, this volume). Refer to Hendrichs et al. (this volume), Enkerlin (this volume).
Low-Income Food-Deficit Countries (LIFDC)	There are 82 countries on this list (as of November 2006). Criteria for a country to be on this list include: per capita income below the 'historical' ceiling, and net food trade position averaged over the preceding 3 years (FAO 2008).
lure	A chemical, food or colour that attracts insects; for the purpose of monitoring or control (Coombs and Hall 1998). Refer to IAEA (2003). In general, 'lure' is defined as a thing that attracts or lures an animal to do something (Oxford 2008), or anything that serves as an enticement (Webster 2008). See 'attraction', 'bait'.
lure and kill	A technique to control insects by attracting them to a lure or bait (usually in a trap) which is associated with something, e.g. insecticide, that kills the attracted insects. See 'attract and kill', 'lure', 'live-bait technology', 'stationary-bait technology'.
<b>M</b>	
malaria	An acute or chronic (sometimes fatal) pan-tropical disease of humans caused by sporozoan parasites ( <i>Plasmodium</i> spp.) and transmitted by various insects, e.g. anopheline mosquitoes (Gordh and Headrick 2001). See 'vector', 'transmission', 'parasitism', 'pathogen'.

male annihilation technique (MAT)	The male annihilation technique involves the use of a high density of bait stations consisting of a male lure combined with an insecticide. An insect pest control method that reduces pest populations by employing mass trapping to lure and kill male insects before they have a chance to mate. Often used to control fruit flies (USDA 1993). Refer to Horng and Plant (1993), SPC (2002). See 'attraction', 'bait', 'lure', 'attract and kill', 'lure and kill', 'stationary-bait technology'.
male recombination	See 'genetic recombination'.
male relative performance index (MRPI)	Relative measure of the mating propensity of males, and indicates the degree of sexual compatibility (or isolation) between two strains/populations of insects. The mathematical formula for this quality control test is given in Calkins and Parker (Box 1) (this volume) and FAO/IAEA/USDA (2003). See 'isolation index (ISI)', 'relative isolation index (RII)', 'female relative performance index (FRPI)', 'assortative mating'.
<i>Maleness</i> factor	Dominant genetic factor, usually found on the Y chromosome, which switches the sex determination cascade to the male mode. This type of sex determination system is found in many non-drosophilid Diptera like the Mediterranean fruit fly (and other fruit flies), the house fly, the sheep blow fly, and <i>Megaselia scalaris</i> (G. Franz, personal communication). Refer to Franz (this volume). See 'sex chromosome', 'sex determining'.
male-only release	In the sterile insect technique (SIT), the release of sterile males only and no sterile females. This is achieved by sorting the sexes before release, or by releasing males produced in a genetic sexing strain. Male-only releases may introduce more sterility into a wild population than bisexual releases. Refer to Calkins and Parker (this volume), Franz (this volume). See 'sex ratio', 'optimal sex ratio', 'overflowing ratio', 'sterile:wild ratio', 'sterile insect technique (SIT)'.
marker	A gene with a known location on a chromosome and a clear-cut phenotype, used as a point of reference when mapping a new mutant (King et al. 2006). Any gene of known function and known location on a chromosome (Oxford 2006). Gene that confers some readily detectable phenotype on cells carrying the gene, either in culture or in transgenic or chimeric organisms. Gene could be an enzymic reporter gene, a selectable marker conferring antibiotic resistance, or a cell membrane protein with a characteristic epitope (Lackie and Dow 1995). An identifiable physical location on a chromosome (e.g. restriction enzyme cutting site, gene, minisatellite, microsatellite) whose inheritance can be monitored (Schlindwein 2006). Marker genes include genes conferring resistance to antibiotics, expression of green fluorescent protein, eye colour, etc. (Hoy 2003). DNA size marker = A DNA fragment of known size used to calibrate an electrophoretic gel (Hoy 2003, Lewin 1985). See 'genetic marker', 'selectable marker', 'gel electrophoresis', 'green fluorescent protein (GFP)', 'microsatellite', 'phenotype'.
market access	The extent to which a good or a service can compete with locally made products in another market (NAL 2008). Market access for goods in the World Trade Organization means the conditions, tariff and non-tariff measures, agreed by members for the entry of specific goods into their markets (Wikipedia 2008).
marking	Marking reared or captured insects in such a way that the mark is identifiable when a marked insect is captured or collected in the field. Refer to Parker (section 10) (this volume), Robinson and Hendrichs (this volume), Itô and Yamamura (this volume). See 'dye', 'fluorescent dye', 'elemental marker', 'mark-release-recapture'.
mark-release-recapture	A technique of estimating insect population size by marking and releasing captured individuals and counting their proportional abundance in later samples (Daly et al. 1998). Refer to Itô and Yamamura (this volume), Vreysen (this volume), FAO/IAEA/USDA (2003), Southwood (1978). See 'Hamada method', 'Itô method', 'Jackson positive method', 'Jackson negative method', 'Jolly-Seber method', 'Petersen method', 'Yamamura method', 'marking', 'dye', 'fluorescent dye', 'elemental marker', 'Lincoln Index', 'release', 'recapture'.
mass-rearing	The key concept that identifies mass-rearing is that insects are handled in groups and not as individuals (Dyck 2010). Rearing of insects as in a factory, often on a large scale, using procedures that handle insects in groups and not as individuals (IDIDAS 2008). Insect production in large numbers, as in production for release programmes (Weeden et al. 2000, Coombs and Hall 1998). Mass-rearing is a systematic enterprise accomplished with machinery in integrated facilities for the purpose of producing a relatively large surplus of insects for distribution (Leppla et al. 1982). In mass-rearing the objective is to produce large numbers of 'acceptable' insects at the lowest possible cost (Singh 1977). The production of insects competent to achieve programme goals with an acceptable cost/benefit ratio and in numbers per generation exceeding ten thousand to one million times the mean productivity of the native population female (Chambers 1977). Refer to Parker (this volume), Dowell et al. (this volume). See 'mass-rearing facility', 'rearing'.
mass-rearing facility	A facility, e.g. building and equipment, in which insects are mass-reared. Refer to Dowell et al. (this volume), Parker (this volume), Dyck (2010). See 'mass-rearing', 'modular rearing facility', 'rearing facility', 'centralized facility', 'satellite facility'.
mass-trapping	The use of traps, baited with pheromones or other attractants, to control insect pests. Chemical pesticides or biopesticides can be used in conjunction with the pheromones to kill target insects (Coombs and Hall 1998). Refer to Mangan (this volume), IAEA (2003). See 'trap', 'attractive device', 'pheromone', 'sex pheromone'.
mate	An individual who has formed a bond with a member of the opposite sex for breeding; an individual actually engaging in a sexual union (King et al. 2006). To form an alliance for future breeding; to engage in a sexual union which may result in the fertilization of eggs (King et al. 2006). Male and female coming together in sexual reproduction. To pair for breeding, to copulate (MH 1997). See 'mating', 'sexual behaviour', 'copulate', 'sperm transfer'.
mate-choice	The situation where an animal (usually a female) chooses as a mate a specific individual from a small group within the species (King et al. 2006). One member of a mating pair expresses a choice of mating, or not mating, with the other member. For example, a female can accept or reject a male for mating (Doncaster 2008). See 'mating system', 'lek', 'courtship', 'sexual behaviour'.
mate-finding	Searching by one sex in a population to find the other sex to mate with it.
maternal effect	Any specific effect of the maternal genotype or maternal environment (phenotype) on the immediate offspring (Rieger et al. 1991). The influence of the mother's phenotype or genotype on the phenotype of its offspring (NAL 2008). Determination of characters of the progeny by the maternal parent; mediated by the genetic constitution of the mother (MH 1997). Phenotypic

	trait that can be traced to the maternal genome (Malacinski 1988). See 'genotype', 'phenotype'.
mating	The act of pairing a male and female organism for reproductive purposes (Schlindwein 2006). The meeting of individuals for sexual reproduction (MH 1997). The union of the sexes for reproduction; copulation (Torre-Bueno 1978, Leftwich 1976). See 'courtship', 'sexual behaviour', 'copulation', 'sperm transfer', 'mate', 'mating behaviour'.
mating arena	See 'lek'.
mating barrier	Factor that causes two individuals not to mate with each other, resulting in reproductive incompatibility and isolation; the factor could be genetic, ecological, temporal or behavioural. Tests of mating compatibility can determine if a mating barrier exists. Refer to Whitten and Mahon (this volume), Krafur (this volume), Calkins and Parker (this volume), FAO/IAEA/USDA (2003). See 'gamodeme', 'mating compatibility'.
mating behaviour	All behaviours performed by males and females to acquire mates for the purpose of reproduction (Aluja and Norrbom 2001). Refer to Lance and McInnis (this volume). See 'lek', 'courtship', 'sexual behaviour', 'mating'.
mating compatibility	Relative measure of how readily two populations of insects are reproductively compatible (Lance and McInnis, this volume). Level of mutual attraction and tolerance in mating, and of functionality in sperm transfer, between male and female adults (IDIDAS 2008). Sexual compatibility is the degree to which two sympatric groups of animals tend to mate randomly without regard to their group of origin rather than mating selectively with members of their own group (FAO/IAEA/USDA 2003). Mating compatibility means that females of a given strain are able and willing to accept, for mating, the males of another strain; this also includes synchrony and other factors that cause reproductive disconformancy (FAO/IAEA/USDA 2003). Refer to Calkins and Parker (this volume), Lance and McInnis (this volume), FAO/IAEA/USDA (2003). See 'mating barrier', 'relative isolation index', 'isolation index', 'male relative performance index', 'female relative performance index', 'compatibility'.
mating competitiveness	Level of rivalry between an adult male insect and another male in relation to mating opportunities with a female (IDIDAS 2008). The mating competitiveness of sterile males is a function of their mating propensity and mating compatibility (Lance and McInnis, this volume). Refer to Calkins and Parker (this volume), FAO/IAEA/USDA (2003). See 'competitiveness', 'Haisch Index', 'relative sterile index', 'mating propensity', 'mating compatibility'.
mating disruption	The controlled release of large amounts of pheromones to confuse the females or males of an insect pest population, thus limiting their potential to mate (Coombs and Hall 1998). Use of pheromones to interfere with mating for pest control (Daly et al. 1998). The application of a formulated pheromone to a crop in order to interfere with mate finding by a pest insect (Resh and Cardé 2003). See 'sex pheromone', 'area-wide integrated pest management'.
mating duration	Length of time spent <i>in copula</i> (FAO/IAEA/USDA 2003). See 'copulation', 'mating', 'mating behaviour'.
mating efficiency	In the context of the formula in Box 8 of Barclay (this volume), mating efficiency is the number of females that get mated, as limited by the number of males, some of which have been trapped and killed. If no males are trapped, then all the females get mated, and alpha will be 1.0 (H. Barclay, personal communication).
mating frequency	The number of pairs of individuals which mated in a given time period (Schlindwein 2006). The number of times an individual mated successfully in a given time period.
mating index	See 'mating propensity'.
mating inhibitor	See 'mating disruption'.
mating propensity	The tendency to locate a mate, copulate and inseminate (Lance and McInnis, this volume). A measure of the level of eagerness or willingness of an insect to mate (Calkins and Parker, this volume). Measured by the percentage of individuals that mate (FAO/IAEA/USDA 2003). [Propensity = An inclination or tendency; the tendency for an individual insect to carry out an act, or for an individual event to occur (FAO/IAEA/USDA 2003, Boller and Chambers 1977)] See 'male relative performance index', 'female relative performance index'.
mating speed	Time males take to copulate with virgin females when they are introduced into a container, reflecting overall male mating success [includes both speed of courtship and speed of copulation (mating duration)] (Hoffmann 1999). See 'copulation', 'mating duration', 'courtship'.
mating system	The process of assuring that males and females of a given species interact sexually for reproduction. In the case of pest tephritid fruit flies, it is a female-choice system (FAO/IAEA/USDA 2003). The pattern of matings between individuals of a population, including such factors as extent of inbreeding, pair-bonding, and number of simultaneous mates (Schlindwein 2006). The pattern of mating in sexually reproducing organisms; two types of mating systems are random mating and assortative mating (Ayala and Kiger 1984). There are simple and complex mating systems; some mating systems are female-choice, and others male-choice (Lance and McInnis, this volume). Modes of gene transmission from one generation to the next by sexual reproduction (NAL 2008). Refer to Lance and McInnis (this volume). See 'mate-choice', 'sexual behaviour', 'mating', 'mating behaviour', 'remating', 'monogamy', 'polyandry', 'polygamy', 'multiple mating'.
mating table	A portable platform (mating table) containing a tethered or wing-clipped virgin female moth (or one prevented from leaving the table) that permits a field-released or wild male moth to find the female and mate with her (Judd et al. 2006, Dyck 2010).
maximum likelihood estimate	An estimation procedure involving maximization of the likelihood or the log-likelihood with respect to the parameters. Such estimators are particularly important because of their many desirable statistical properties such as consistency, and asymptotic relative efficiency (Everitt 2006). The estimator for an unknown parameter given by the method of maximum likelihood (Clapham 1996). A term descriptive of a general econometric estimation technique which involves the maximization of the likelihood function of the sample observations with respect to the values of the parameters of the equation(s) being estimated. It chooses these values of the parameters which are 'most likely' to have generated the sample observations (Pearce 1992).
mechanical control	The control of pests by mechanical methods (Schmutterer 1969). The control of pests by the use of physical barriers, e.g. tree banding, screens, row covers, etc. rather than chemical or biological methods (Coombs and Hall 1998, Weeden et al. 2000, Pfadt 1962). Physical control = Physical actions (e.g. fruit stripping, host destruction, hand-picking, heat, cold, light, electricity, sound waves, radiation) taken to control a pest (USDA 1993, Pfadt 1962, Coombs and Hall 1998). Refer to Mangan (this volume). See 'integrated pest management (IPM)'.

meiosis	A specialized form of nuclear division in which there are two successive nuclear divisions (meiosis I and II) without any chromosome replication between them. Each division can be divided into four phases similar to those of mitosis. Meiosis reduces the starting number of $4n$ chromosomes in the parent cell to $n$ in each of the four daughter cells. Each cell receives only one of each homologous chromosome pair, with the maternal and paternal chromosomes being distributed randomly between the cells; this is vital for the segregation of genes. During the prophase of meiosis I (classically divided into stages: leptotene, zygotene, pachytene, diplotene and diakinesis), homologous chromosomes pair to form bivalents, thus allowing crossing-over, the physical exchange of chromatid segments. This results in the recombination of genes. In animals, meiosis occurs during the formation of gametes (gametogenesis), which are thus haploid (Lackie and Dow 1995, King et al. 2006, Oxford 2006, Schlindwein 2006, Hoy 2003, Doncaster 2008). See 'gamete', 'gametogenesis', 'pachytene', 'haploid', 'mitosis', 'chromosome', 'homologous chromosomes', 'bivalents', 'crossing-over', 'chromatids', 'genetic recombination'.
meiotic drive	Any alteration in meiosis or the subsequent production of gametes that results in preferential transmission of a particular genetic variant (King et al. 2006). Any meiotic mechanism that results in the unequal recovery of the two types of gametes produced by a heterozygote (Hoy 2003, Doncaster 2008). The unequal recovery of homologous chromosomes during meiosis (Pedigo 2002).
meridic diet	Artificial diet some of whose ingredients are defined chemically and some not defined (Cohen 2004). Artificial diet of known chemical structure which contains at least one substance or preparation which is of unknown structure or uncertain purity, e.g. protein, yeast (Dyck 2010). See 'artificial diet'.
messenger RNA (mRNA)	An RNA molecule that functions during translation to specify the sequence of amino acids in a nascent polypeptide (King et al. 2006). See 'translation', 'RNA'.
metabolic heat	See 'metabolic rate'.
metabolic rate	The rate at which an organism converts chemical energy into heat. Increased metabolic rate is correlated with greater oxygen consumption and with greater production of carbon dioxide, water, and heat (Resh and Cardé 2003). The rate of conversion of the physiologically utilizable chemical energy of food material into heat and work, and its utilization for the synthesis of body material. Any decrease in the stored energy of an organism is equal to the sum of the energy lost as heat and work (Scott 1996).
metaphase	The second phase of mitosis. During metaphase, the chromosomes move about within the spindle and eventually arrange themselves in the equatorial region of the spindle. The two chromatids are now ready to be separated and to move under the action of the traction fibres to the poles of the spindle (King et al. 2006, Schlindwein 2006). See 'mitosis', 'meiosis', 'prophase', 'anaphase', 'telophase', 'interphase'.
metapopulation	Set of local populations linked together by dispersal (Resh and Cardé 2003). Set of populations that exchange individuals through migration (Collin 2001). A theoretical concept describing an assemblage of spatially divided subpopulations whose units are interconnected by migration. One of its characteristic features is that not all its subpopulations are extant at the same time, reflecting a stochastic process of local extinctions and recolonizations which is dynamic over time. This results from the interplay of the local dynamics of births and deaths in individual subpopulations, with dispersal flow between patches of habitat (Doncaster 2008). Refer to Barclay (this volume). See 'migration', 'dispersal', 'stochastic'.
microbial contamination	Harbouring of, or having contact with, micro-organisms (microbes) without symbiotic or pathogenic relationships (Sikorowski and Lawrence 1994). See 'micro-organism'.
microbial control	Use of pathogenic microbes or their products, e.g. toxins, to suppress pest populations (Bijlmakers 2008, Weeden et al. 2000). See 'micro-organism', 'integrated pest management (IPM)'.
micro-organism	Also spelled 'microorganism'. A protozoan, fungus, bacterium, virus or other microscopic self-replicating biotic entity (FAO 2006, USDA 1993, Singleton and Sainsbury 1978). A microbe (Hill 1997). See 'organism'.
microsatellite	Chromosomal sites that contain repeats of a small number of nucleotides arranged one after the other. The tandemly repeated motif usually contains between one and six nucleotides. Microsatellites are also called 'short tandem repeats' (King et al. 2006). A repeating DNA segment; the base core repeat unit involves a two or four nucleotide pair repeat motif. Their highly polymorphic nature has made them invaluable for analysis of pedigrees and in linkage analysis (Oxford 2006, Lackie and Dow 1995, Kahl 1995). Highly polymorphic DNA marker comprised of mononucleotides, dinucleotides, trinucleotides or tetra-nucleotides that are repeated in tandem arrays and distributed throughout the genome. The best studied are the CA (alternatively GT) dinucleotide repeats. They are used for genetic mapping (Schlindwein 2006). Pieces of the same small segment which are repeated many times (Hoy 2003). Segments of DNA with tandem repeats of short-sequence motifs. They are numerous, highly variable and easy to score using the polymerase chain reaction (PCR), making them excellent genetic markers for kinship studies (Doncaster 2008). [Motif = A recurring pattern of short sequence of DNA, RNA, or protein, that usually serves as a recognition site or active site (Viljoen et al. 2005); distinctive sequences, on protein or DNA molecules, that have three-dimensional structures that allow binding interactions to occur (King et al. 2006)] Refer to Krafur (this volume). See 'genetic marker', 'allozyme', 'restriction fragment length polymorphism (RFLP)', 'randomly amplified polymorphic DNA (RAPD)', 'mitochondrial DNA (mtDNA)', 'polymerase chain reaction (PCR)', 'polymorphic locus'.
migration	Long-range dispersal, either away from a declining resource or as part of a seasonal cycle (Gordh and Headrick 2001, Auburn 2008). Change of habitat according to season, climate, food supply, etc. by certain animals (Hill 1997). Movement of individuals between otherwise reproductively isolated populations (Schlindwein 2006). An adaptation to periodically transport insects beyond the boundaries of their old reproductive sites and into new ones (Pedigo 2002). See 'dispersal', 'immigration', 'emigration'.
migration rate	The number of individuals of a population migrating in a specified time period.
Millennium Development Goal (MDG)	The eight Millennium Development Goals (MDGs) – which range from halving extreme poverty to halting the spread of HIV/AIDS and providing universal primary education, all by the target date of 2015 – form a blueprint agreed to by all the world's countries and all the world's leading development institutions. They have galvanized unprecedented efforts to meet the needs of the world's poorest. One of the goals is to 'eradicate extreme poverty and hunger' (MDG 2008).

misconception	A false or mistaken idea or belief (Oxford 2008). An incorrect conception (Webster 2008).
mitochondrial DNA (mtDNA)	Circular or linear DNA of the mitochondria. It codes for only a small but essential part of the mitochondrial proteins and for genes for tRNAs and rRNAs. In animals and yeast every species has a uniform type; in plants it varies even within one cell (Schlindwein 2006). Mitochondrial DNA is maternally inherited. Mitochondrial genomes experience higher mutation rates than those in nuclear genomes, and thus have more power to reveal evolutionary differences between closely related species than nuclear genes have. mtDNAs do not undergo genetic recombination, so their sequences stay the same from one generation to the next, except when altered by mutations (King et al. 2006). See 'genetic marker', 'allozyme', 'restriction fragment length polymorphism (RFLP)', 'randomly amplified polymorphic DNA (RAPD)', 'microsatellite', 'mutation'.
mitosis	The usual process of nuclear division in the somatic cells of eukaryotes. The chromosomes are actually replicated prior to mitosis. Mitosis is classically divided into four stages – prophase, metaphase, anaphase and telophase. New nuclear envelopes form around the two sets of chromosomes, and cell division (cytokinesis) follows. Mitosis ensures that each daughter cell has a diploid set of chromosomes which is identical to that of the parent cell (Lackie and Dow 1995, King et al. 2006, Oxford 2006, Hoy 2003, Doncaster 2008). The most frequent process of nuclear division (karyokinesis) in cells that produces daughter cells that are genetically identical to each other and to the parent cell. Mitosis and interphase make the cell cycle (Schlindwein 2006). See 'meiosis', 'prophase', 'metaphase', 'anaphase', 'telophase', 'interphase', 'diploid'.
mixed farming	Growing crops and feed and livestock all on the same farm (Webster 2008). Farming involving arable and dairy farming (Collin 2001).
mobility	Moveable, having the power of motion (Torre-Bueno 1978, Gordh and Headrick 2001). The ability of insects to move is important for the SIT. Refer to Vreysen (this volume), Calkins and Parker (this volume), Lance and McInnis (this volume), Dyck (2010). See 'dispersal', 'migration', 'product quality control'.
model	A model is a mathematical explanation applied to biological phenomena (Gordh and Headrick 2001). A mathematical model is the characterization of a process, object or concept in mathematical terms as a series of equations. The variables may then repeatedly be assigned values and adjusted to see how the model behaves in different situations (FAO/IAEA 1973). Description of the assumed structure of a set of observations that can range from a fairly imprecise verbal account to, more usually, a formalized mathematical expression of the process assumed to have generated the observed data. The purpose of such a description is to aid in understanding the data (Everitt 2006, Maxwell and Jennings 1980, Allaby 1994). Mathematical models involve equations, graphs or algorithms behind computer code (Barclay, this volume). See 'deterministic model', 'stochastic model', 'modelling', 'Nicholson-Bailey model', 'Lotka-Volterra model'.
modelling	Investigative technique using a mathematical or physical representation of a system or theory that accounts for all or some of its known properties; models are often used to test the effect of changes of system components on the overall performance of the system (USDA 1993). Means of describing a real or proposed situation by use of computer programming to form a model. Qualitative factors in the real case must be resolved to quantitative factors in the model (FAO/IAEA 1973). The abstraction of processes or states of being (Barclay, this volume). See 'model'.
modular rearing facility	Rearing insects in self-contained modules offers flexibility, and increased safety from catastrophic occurrences, compared with using a single building which houses all facets of the rearing process (Dowell et al., this volume; Tween 1987). The modular approach has the advantage of simplifying design and expansion, and of allowing the facility to be easily scaled to the required size, so as to maintain the utilization efficiency; if demand falls, complete modules can be closed without affecting production in the remaining modules, or converted to rearing another insect (Parker, this volume). Contamination, disease, or equipment maintenance or repair in one module does not affect production in other modules (Dowell et al., this volume). The entire insectary could be moved with the expanding eradication or low pest prevalence front (Hendrichs et al., this volume). Refer to Parker (this volume), Dowell et al. (this volume), Hendrichs et al. (this volume). See 'mass-rearing facility', 'rearing facility', 'centralized facility', 'satellite facility'.
molecular biology	Biology devoted to the molecular nature of the gene and its biochemical reactions such as transcription and translation (Hoy 2003).
molecular genetics	Genetic studies that focus on the molecular nature of genes and gene expression (Hoy 2003).
molecular sterility	Conditional lethality induced through the use of a transgenic construct (A.S. Robinson, personal communication). See 'sterility', 'genetic sterility', 'transgenesis', 'transgenic strain', 'transformation'.
monitoring	Ongoing observations and measurements of characteristics of a pest population. An official ongoing process to verify phytosanitary situations (FAO 2006). The act of measuring components or results to verify the efficacy of treatments (USDA 1993). Regular checking or examining and recording of the progress of something (Collin 2001). The systematic measuring, quantitatively or qualitatively, of a phenomenon or the presence of a substance over a period of time (Allaby 1994). Monitoring survey = Ongoing survey to verify the characteristics of a pest population (FAO 2006). Refer to Vreysen (this volume), IAEA (2003). In radiobiology, monitoring refers to periodic or continuous determination of the amount of ionizing radiation or radioactive contamination present in an occupied region, as a safety measure, for the purpose of health protection (FAO/IAEA 2009). See 'sampling', 'reference monitoring site (RMS)'.
monocentric	Designating a chromosome having a single centromere (King et al. 2006). See 'centromere', 'acentric', 'dicentric', 'holokinetic', 'monokinetic'.
monoculture	The planting of a single crop species over a large area of land (Coombs and Hall 1998). The cultivation of a crop of the same type year after year on the same land to the exclusion of all other crop types (Allaby 1994, Collin 2001, Coppel and Mertins 1977).
monogamy	A mating system in which an individual has one mating partner (Doncaster 2008). An animal reproductive strategy in which a specific male and female form an exclusive mating pair during a reproductive cycle, a season, or a lifetime (King et al., 2006). See 'mating system', 'remating', 'polyandry', 'polygamy', 'multiple mating'.
monokinetic	Chromosome with one localized centromere (Robinson, this volume). See 'centromere', 'acentric', 'dicentric', 'monocentric', 'holokinetic'.

monomer	A monomer is any protein that is made up of non-identical structural units (Oxford 2006). A chemical compound which consists of single molecules (Allaby 1994). See 'dimer', 'polymer', 'primer'.
monomeric locus	A locus that codes for a monomeric enzyme, i.e. an enzyme of one unit. Heterozygotes for monomeric enzymes typically display two bands. Refer to Krafzur (this volume). See 'monomer', 'locus', 'dimeric locus'.
monophagous	Pertaining typically to an herbivorous organism that feeds on one species of food plant, a predator that feeds on one species of prey, or a parasite that feeds on one species of host (Gordh and Headrick 2001, Coppel and Mertins 1977). Specialized to feed and develop on one host plant (Resh and Cardé 2003). See 'oligophagous', 'polyphagous'.
Monte-Carlo simulation	Method for finding solutions to mathematical and statistical problems by simulation. Used when the analytic solution of the problem is either intractable or time consuming (Everitt 2006). The use of sampling involving the generation of random numbers, normally by computer, to solve mathematical problems such as the approximation of certain integrals (Clapham 1996). In statistics, the construction of an artificial, stochastic model of the process being studied to provide a basis for sampling experiments (Allaby 1994). Refer to Barclay (this volume), Barclay et al. (this volume), Horng and Plant (1993). See 'model', 'modelling', 'stochastic', 'simulation'.
mortality	Death rate of organisms in a population, or numbers dying per unit of time (Hill 1997, Pedigo 2002). The properties or factors which cause death of individuals and a subsequent decrease in population size (Gordh and Headrick 2001). All deaths reported in a given population (NAL 2008). See 'birth rate'.
mother colony	A colony of insects that is the original colony established from field-collected insects. The progeny of a mother colony are used to create other colonies called daughter colonies. The mother colony is usually kept smaller in size, and reared differently, than daughter colonies, i.e. the mother colony is kept under conditions that are as similar as possible to field conditions. Refer to Parker (this volume), Franz (this volume). See 'filter rearing system (FRS)'.
multiple mating	Mating more than once in an individual's lifetime. Both females and males, especially males, may mate more than once. See 'remating', 'mating system', 'polyandry', 'polygamy'.
multivoltine	Having two or more complete generations annually (Coppel and Mertins 1977, Hill 1997, Aluja and Norrbom 2001, Resh and Cardé 2003, White and Elson-Harris 1992, Pedigo 2002, Allaby 1994, Gordh and Headrick 2001). See 'univoltine', 'voltinism'.
mutagen	A substance that tends to increase the frequency or extent of genetic mutations; any substance that can cause a change in genetic material (USDA 1993). A chemical agent able to induce a mutation in a DNA molecule (Hoy 2003, Allaby 1994). A chemical agent that raises the frequency of mutation above the spontaneous rate (King et al. 2006, Oxford 2006, Lewin 1985). Physical or chemical agents, such as radiation, heat, or alkylating or deaminating agents, which raise the frequency of mutation greatly above the spontaneous background level (Watson 1976). See 'mutation', 'mutagenesis'.
mutagenesis	The process of generating genetic mutations. It may occur spontaneously or be induced by mutagens (NAL 2008). See 'mutagen', 'mutation'.
mutation	Change in the genetic material of a cell (USDA 1993). Abrupt appearance of a new, heritable characteristic as the result of a change in the genetic material of one individual (UC 1984, Hill 1997, Allaby 1994). An abrupt change of genotype which is inherited. Any permanent and heritable change in DNA sequence. Mutations can involve duplications, deletions, inversions, translocations, and substitutions (Schlindwein 2006, Hoy 2003,). Any detectable and heritable change in the genetic material not caused by genetic segregation or recombination, which is transmitted to daughter cells and to succeeding generations, providing it is not a dominant lethal factor (NAL 2008). Heritable change in the nucleotide sequence of the genome of an organism (Fenner et al. 1987, Ayala and Kiger 1984, Watson 1976). See 'dominant lethal mutation (DLM)', 'genome', 'mutation rate'.
mutation rate	The number of mutation events per gene per unit time (King et al. 2006, Kahl 1995). The frequency with which a particular mutation appears in a population, or the frequency with which any mutation appears in the whole genome of a population (Oxford 2006, Lackie and Dow 1995). See 'mutation'.
myiasis	The infestation of living vertebrates, including humans, with dipteran larvae which feed on the vertebrate's tissue, fluids or ingested food (Gordh and Headrick 2001, Wall and Shearer 1997). The invasion of living tissues by fly larvae (maggots) (Resh and Cardé 2003, NAL 2008, Coombs and Hall 1998, Goddard 1996, Hill 1997, Borror et al. 1989).
<b>N</b>	
nagana	See 'African animal trypanosomosis (AAT)', 'trypanosomosis'.
native species	A species that currently lives, or its ancestors originated or evolved, in a specified area; an indigenous species (Gordh and Headrick 2001, Coombs and Hall 1998). A species which exists naturally in a certain place, i.e. not introduced by humans either intentionally or accidentally (Collin 2001, Wikipedia 2008, Weeden et al. 2000). See 'established pest', 'exotic species', 'invasive species'.
natural enemies	A natural enemy is an organism which lives at the expense of another organism in its area of origin and which may help to limit the population of that organism. This includes parasitoids, parasites, predators, phytophagous organisms and pathogens (FAO 2006). They are the active agents of biological control (Coombs and Hall 1998). Living organisms (e.g. parasitoids, predators, pathogens) found in nature that kill insects outright, weaken them, or reduce their reproductive potential (Pedigo 2002, Gordh and Headrick 2001, Coppel and Mertins 1977, NAL 2008, Bijlmakers 2008, Weeden et al. 2000). See 'biological control', 'integrated pest management (IPM)'.
natural selection	Mechanism of evolution -- any organism not able to endure surrounding conditions is eliminated; only 'fit' individuals survive and reproduce (Gordh and Headrick 2001). In the struggle for existence, only those organisms with favourable genetic variations survive. The favourable variations accumulate through subsequent generations, and descendants diverge from their ancestors (MH 1997, Scott 1996). The process whereby one genotype leaves more progenies than another genotype because of superior life history attributes (fitness) such as survival or fecundity (Schlindwein 2006, Ayala and Kiger 1984). The differential contribution of offspring to the next generation by individuals of different genetic types but

	belonging to the same species (Doncaster 2008).
near-infrared spectroscopy (NIRS)	A spectrometer is an instrument that measures the distribution of photon intensity over a range of wavelengths – in this case the electromagnetic radiation is near-infrared (wavelength range 950–1650 nm). An object, e.g. an insect, is illuminated with white light, and the reflected energy is transmitted to a spectrometer that measures the intensity in the near-infrared range (A. Parker, personal communication; Dowell et al. 2005; Mendoza et al. 2002; Isaacs 2000; Wikipedia 2008). Refer to Parker (this volume), Vreysen (this volume). See 'white light'.
nectarivorous	Nectarivorous animals eat the sugar-rich nectar produced by flowering plants. Most nectarivores are birds or insects (Hill 1997, Jolivet 1998, Wikipedia 2008). See 'insectivorous', 'frugivorous'.
negative binomial distribution	In probability and statistics, the negative binomial distribution is a discrete probability distribution. It can be used to describe the distribution arising from an experiment consisting of a sequence of independent trials, subject to several constraints. Firstly each trial results in success or failure, the probability of success for each trial, $p$ , is constant across the experiment, and finally the experiment continues until a fixed number of successes have been achieved (Wikipedia 2008). In probability theory, the negative binomial distribution is the probability distribution of the number of trials needed to get a fixed (i.e. non-random) number of successes in a Bernoulli process. If the random variable $X$ is the number of trials needed to get $r$ successes in a series of trials where each trial has success probability $p$ , then $X$ follows the negative binomial distribution with parameters $r$ and $p$ (Webster 2008, Everitt 2006). Negative binomial model = A mathematical model used to describe a clumped, or contagious, dispersion of organisms (Pedigo 2002). See 'binomial distribution', 'Poisson distribution', 'Poisson binomial distribution', 'hypergeometric probability distribution', 'probability model'.
net benefit	The amount of money remaining after all payments made are subtracted from all payments received. See 'benefit/cost analysis (BCA)', 'net return'.
net present value (NPV)	The sum that results when the discounted value of the expected costs of an investment are deducted from the discounted value of the expected returns (Pearce 1992). Method of determining whether the expected financial performance of a proposed investment promises to be adequate (Friedman 2007). The economic value of a project calculated by summing its costs and revenues over its full life, and deducting the former from the latter. If the calculation yields a positive NPV, then the project should be profitable. Future costs and revenues should be adjusted by the relevant discount rate (Oxford 1993). See 'benefit/cost analysis (BCA)', 'present value', 'future value', 'discount rate', 'economic return', 'internal rate of return', 'rate of return'.
net return	The profit made on an investment after the deduction of all expenses (Oxford 1993). See 'benefit/cost analysis (BCA)', 'net benefit'.
Nicholson-Bailey model	A mathematical (difference equation) host-parasitoid model. Refer to Barclay (Box 2) (this volume). See 'model', 'host', 'parasitoid', 'parasitism'.
non-target species	Animal or plant species that are not the intended target, i.e. the object or focus, of a pest management programme, but which nevertheless may be affected by pest management activities (USDA 1993, Bijlmakers 2008). Refer to Nagel and Peveling (this volume). Non-target impact = Mortality or injury that may occur to neutral or beneficial species as a consequence of the use of natural enemies in biological control programmes or insecticide applications (Resh and Cardé 2003). See 'target population', 'natural enemies', 'biological control', 'integrated pest management (IPM)'.
nucleotide	Nucleotides are the constitutional units into which nucleic acids are broken down by partial hydrolysis, and from which they are considered to be built up (Oxford 2006). A subunit of DNA or RNA consisting of a nitrogenous base (purine in adenine and guanine, pyrimidine in thymine, or cytosine for DNA and uracil cytosine for RNA), a phosphate molecule, and a sugar molecule (deoxyribose in DNA and ribose in RNA). Depending on the sugar the nucleotides are called deoxyribonucleotides or ribonucleotides. Thousands of nucleotides are linked to form a DNA or RNA molecule (Schlindwein 2006). One of the monomeric units from which DNA or RNA polymers are constructed, consisting of a purine or pyrimidine base, a pentose, and a phosphoric acid group. The nucleotides of DNA are deoxyadenylic acid, thymidylic acid, deoxyguanilic acid, and deoxycytidylic acid. The corresponding nucleotides of RNA are adenylic acid, uridylic acid, guanylic acid, and cytidylic acid (King et al. 2006). See 'monomer', 'DNA'.
null trapping	Insect trap-catch results where zero or null insects were captured. Refer to Barclay et al. (this volume), Vreysen (this volume), IAEA 2003. See 'zero catch', 'trap'.
nulliparous	Descriptive of a female that has not yet given birth or oviposited (Leak 1999, Wall and Shearer 1997, Gillett 1971, Gordh and Headrick 2001). See 'viviparous', 'larviparous', 'oviposition'.
nurse cell	Cell whose function is to assist the ovum (egg) in some way (Leak 1999). Nutritive cell associated with the developing oocyte (Borror et al. 1989, Pfadt 1962, Leftwich 1976, MH 1997, Earthlife 2008). Synonym = trophocyte. See 'trophocyte'.
<b>O</b>	
occupational health	The promotion of a safe and healthy environment to support the physical and mental well-being among humans in the workplace (NAL 2008).
odour	A volatile emanation [something emitted] that is perceived by the sense of smell (Webster 2008). A distinctive smell (Oxford 2008). See 'olfactometer'.
offshore	Made, situated, or registered abroad; relating to a foreign country; situated at sea some distance from the shore (Oxford 2008).
olfactometer	A device for testing the behavioural response of insects to odours (Gordh and Headrick 2001). An instrument for measuring the sensitivity of the sense of smell (Maxwell and Jennings 1980). See 'odour'.

oligophagous	Dietary items are closely related. Pertaining to an herbivorous organism which feeds on a few species of food plants, a predator which feeds on a few species of prey, or a parasite which feeds on a few species of host (Gordh and Headrick 2001). Feeding on a few, often related plant taxa, such as different species in one genus or a few genera in one family (Resh and Cardé 2003). See 'polyphagous', 'monophagous'.
onchocerciasis	Disease occurring primarily in tropical Africa; typically associated with life along swift-flowing streams. Disease caused by the filarial worm <i>Onchocera volvulus</i> (Leuckart) and transmitted only by simuliid flies. Synonym = river blindness (Gordh and Headrick 2001, Pfadt 1962).
oocyte	A female gamete before formation of the first polar body. The egg cell differentiated from the oogonium before maturation (Gordh and Headrick 2001). Cell produced by the ovaries that eventually becomes an ovum (egg cell) after meiosis (Hoy 2003). See 'gamete', 'oogonia', 'polar body'.
oogenesis	Egg maturation; the formation of polar bodies in the egg. First phase of insect development; it begins with incorporation of proteins and nutrients within the oocyte that resides in the germarium of the ovariole. Subsequently, an eggshell is fabricated (Gordh and Headrick 2001). The process of differentiation of a mature egg cell from an undifferentiated germ-line cell, including the process of meiosis (Ayala and Kiger 1984). See 'oocyte', 'ovariole', 'polar body', 'germ cell', 'parthenogenesis'.
oogonia	Oogonium (plural oogonia) is the first stage in the differentiation of an egg cell from a primary female germ cell (Gordh and Headrick 2001). A primordial germ cell that gives rise, by mitosis, to oocytes, from which the ovum and polar bodies develop by meiosis (Ayala and Kiger 1984). See 'germ cell', 'oocyte', 'polar body', 'mitosis', 'meiosis'.
operational independence	Operation of a programme with political and financial autonomy, and the ability to make decisions that are in the best interest of the programme. Such independence includes the authority and freedom not to follow bureaucratic regulations that reduce efficiency and flexibility (Dyck, Reyes Flores et al., this volume). See 'commission'.
optimal sex ratio	The male:female sex ratio regarded as being optimal for sterile insect releases. See 'male-only release', 'sex ratio'.
optimization	Making the best or most effective use of a resource or situation (Oxford 2008).
organism	Any biotic entity capable of reproduction or replication in its naturally occurring state (FAO 2006). See 'micro-organism', 'genetically modified organism (GMO)'.
outbreak	A recently detected pest population, including an incursion, or a sudden significant increase of an established pest population in an area (FAO 2006). See 'pest outbreak'.
outcrossing	The crossing of genetically unrelated plants or animals; outbreeding, crossbreeding (King et al. 2006, Burt and Trivers 2006). A mating system in which matings between close relatives do not usually occur (Ayala and Kiger 1984). Mating individuals that belong to different strains or families within the same breed or variety (NAL 2008). See 'mating system', 'mating'.
output	Final product, the things produced; the amount of something produced; what is produced in a given time period (Oxford 2008, Webster 2008).
ovariole	Tapering, elongate, apically closed tubules that collectively comprise the ovary. Oocytes are produced and develop into eggs within the ovariole. Each ovariole is composed of a terminal filament, germarium, vitellarium and pedicel (Gordh and Headrick 2001). See 'follicle', 'ovary', 'oocyte'.
ovary	The enlarged basal portion of the female reproductive system. Ovaries are compact, composite bodies within the female abdomen. Ovaries are paired in most insects, but some have only one ovary. Each ovary is composed of several ovarioles (Gordh and Headrick 2001). See 'ovariole', 'follicle'.
overcrowding	Overcrowding occurs when an organism's numbers exceed the carrying capacity of its habitat (Wikipedia 2008). Excessively high density of organisms, e.g. many insects in a small cage. See 'carrying capacity'.
overflowing ratio	The ratio of sterile insects to wild insects in the population in an SIT programme (FAO/IAEA/USDA 2003). See 'male-only release', 'sterile-wild ratio', 'sterile insect technique (SIT)'.
overlap	To extend over, so as to cover partly; to partly coincide; to concur partially or wholly; to have something in common (Oxford 2008, Webster 2008). Lie together, one partly over another (Davies 1967).
oviposition	The act or process of laying eggs, ovipositing, depositing; the passage of an egg from the median oviduct to outside the insect's body (Resh and Cardé 2003, Gordh and Headrick 2001).
oviposition cage	A cage designed to collect eggs as females in the cage oviposit. See 'oviposition'.
ovulation	The passage of an egg from the ovariole into the oviduct (Resh and Cardé 2003). The release of eggs from an ovary (Leftwich 1973, MH 1997).
oxygen tension	Oxygen concentration in tissues being irradiated (A. S. Robinson, personal communication).
<b>P</b>	
pachytene	During the pachytene stage (third phase of prophase I) of meiosis, each paired chromosome separates into its two component sister chromatids (except at the region of the centromere). As a result of the longitudinal division of each homologous chromosome into two chromatids, there exist in the nucleus N groups of four chromatids lying parallel to each other called tetrads. A type of localized breakage followed by exchange between non-sister chromatids occurs. This process is called crossing-over. The exchange between homologous chromosomes results in the production of crossover chromosomes containing genetic material of both maternal and paternal origin (King et al. 2006, Oxford 2006, Lackie and Dow 1995, Schlindwein 2006). See 'meiosis', 'chromatids', 'crossing-over', 'chiasmata', 'centromere'.

packing house	A facility in which fruit or other produce is stored, sorted and packed for the market.
panoramic irradiator	Large-scale irradiator for large-volume irradiation. The radiation source can be raised out of or lowered into a shielded storage chamber (water for wet storage, or lead or other appropriate high-atomic-number material for dry storage) (Bakri et al., this volume). Refer to IAEA (2008b). See 'gamma irradiator', 'wet storage of radiation source', 'dry storage of radiation source'.
paracentric inversion	A chromosomal inversion that does not include the centromere (King et al. 2006, Oxford 2006, Ayala and Kiger 1984). See 'chromosomal inversion', 'pericentric inversion'.
parapheromone	Specific chemical compounds produced by plants and which mimic the effect of insect pheromones. Parapheromones may be synthesized and used to detect, monitor, mass-trap or disrupt the mating of target insect species (Gordh and Headrick 2001, IAEA 2003). See 'pheromone', 'ceralure', 'cuelure', 'trimedlure', 'alpha-copaene', 'Jackson trap', 'allomone', 'kairomone', 'synomone'.
parasitism	A qualitative term referring to a kind of symbiosis in which one party (the parasite) lives at the expense of the other (the host), contributing nothing to the relationship, and frequently destroying the host in the process (Coppel and Mertins 1977, Bijlmakers 2008, Gordh and Headrick 2001). The relationship between a parasite and its host (Wall and Shearer 1997). A parasite is an organism which lives on or in a larger organism, feeding upon it (FAO 2006, USDA 1993). A parasite is an organism living off of another, unrelated species, which harms the host but generally does not kill it (Grimaldi and Engel 2005). Organism living on or within another, to its own advantage in food or shelter (Hill 1997). See 'ectoparasitic', 'endoparasitic', 'host', 'parasitoid', 'biological control'.
parasiticide	A substance, usually a chemical, that kills a parasite. See 'adulticide', 'larvicide', 'trypanocide', 'parasitism'.
parasitoid	An insect (internal or external) parasite of an arthropod (Coppel and Mertins 1977, Jolivet 1998). An insect parasitic only in its immature stages, killing its host in the process of its development, and free living as an adult (FAO 2006, USDA 1993, Enkerlin and Quinlan 2004). An insect living off of another, unrelated insect, which eventually and generally kills the host (Grimaldi and Engel 2005, Cohen 2004). Larval parasitoids require one host to complete development. Adult female parasitoids can kill hosts through host feeding (Resh and Cardé 2003, Gordh and Headrick 2001). See 'parasitism', 'host', 'host-parasitoid model', 'biological control'.
paratransgenesis	Technique that attempts to eliminate a pathogen from vector populations through transgenesis of a symbiont of the vector. The goal of this technique is to control vector-borne diseases. The first step is to identify proteins that prevent the vector species from transmitting the pathogen. The genes coding for these proteins are then introduced into the symbiont, so that they can be expressed in the vector. The final step in the strategy is to introduce these transgenic symbionts into vector populations in the wild (Wikipedia 2008). See 'transgenesis', 'genetic engineering', 'genetic control', 'symbiont', 'vector', 'pathogen'.
parous	A female that has laid at least one egg (Wall and Shearer 1997).
parthenogenesis	Formation of an embryo from an unfertilized egg (Burt and Trivers 2006, King et al. 2006, Goddard 1996, Gordh and Headrick 2001). Reproduction by development of an unfertilized usually female gamete that occurs especially among lower plants and invertebrate animals (Schlindwein 2006, Oxford 2006). Reproduction without sex, from unfertilized eggs (Grimaldi and Engel 2005). Virgin birth; reproduction without fertilization, usually through eggs but sometimes through viviparity (Hill 1997). See 'oogenesis', 'thelytoky'.
partial sterility	See 'inherited sterility (IS)', 'induced sterility', 'sterility'.
pathogen	Micro-organism causing disease (FAO 2006, USDA 1993, Cohen 2004, Gordh and Headrick 2001). A virus, bacterium, parasitic protozoan, or other micro-organism that causes disease by invading the body of a host (Hoy 2003). Micro-organism that is capable of producing disease under normal conditions of host resistance, and rarely lives in close association with the host without producing disease (Sikorowski and Lawrence 1994). See 'micro-organism', 'biological control'.
payback	Profit from an investment equal to the initial outlay (Oxford 2008). See 'pay-back period', 'cost recovery'.
pay-back period	Time required for an investment to generate sufficient increments of cash to recover the initial capital expenditure. It thus takes into account the capital expenditure on a new project, and relates that to the net cash flow of that project. Projects are ranked according to the length of the payback period with preference being given to those which have the shortest paybacks (Pearce 1992, Oxford 1993, Friedman 2007). The pay-back period should be calculated using discounted values for costs and returns. See 'payback'.
percent flight	Percentage of reared insects that are able to fly in a flight ability test, based on the number of pupae placed in the test (C. Calkins, personal communication). Percent effective flight = Percentage of emerged insects that can fly in a flight test (C. Calkins, personal communication).
pericentric inversion	A chromosomal inversion that includes the centromere (King et al. 2006). See 'chromosomal inversion', 'paracentric inversion'.
permanent buffer zone	A buffer zone that is established permanently. Refer to Hendrichs et al. (section 9.2.) (this volume). See 'buffer zone', 'temporary buffer zone'.
peroxy-radical	The absorption of energy from ionizing radiation by target atoms produces damage to molecules by direct and indirect actions. Indirect action involves the production of reactive free radicals whose toxic damage on the key molecule results in a biologic effect. When free radicals react with oxygen, they form peroxides which contain oxygen in the form O <sub>2</sub> <sup>2-</sup> . Organic peroxy-radicals are formed in the oxidation of hydrocarbons and other organic molecules. The transfer of the free radical to a biologic molecule can be sufficiently damaging to cause bond breakage or inactivation of key functions. The organic peroxy free radical can transfer the radical form molecule to molecule causing damage at each encounter. Thus a cumulative effect can occur, greater than a single ionization or broken bond. Increased radiation damage in a high-oxygen environment is a general phenomenon in radiobiology. Ionizing radiation initiates a chain of oxidative reactions along the radiation path in the tissues and the formation of free radicals. In the presence of oxygen, damaging peroxy-radicals may be formed, and the organic molecules, including the germ cell chromosomes, are irreversibly altered (Bakri et al. this volume).

	See 'free radical', 'hydrogen radical'.
pest	An insect, rodent, nematode, fungus, weed, or other form of terrestrial or aquatic plant or animal life, or virus, bacterial, or micro-organism that is injurious to health or the environment (USDA 1993, Bijlmakers 2008). An organism causing damage to humans, livestock, crops and possessions (Hill 1997, Resh and Cardé 2003). A species or organism that interferes with human health, activities or property, or is objectionable (Gordh and Headrick 2001). Plant pest = Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products (FAO 2006). See 'pest control'.
pest control	Suppression, containment or eradication of a pest population (FAO 2006; IAEA 2003; FAO/IAEA/USDA 2003; Hendrichs et al., this volume). To reduce damage or pest density to a level at which damage is insignificant, by physical, chemical or biological means (Hill 1997). The application of technology, in the context of biological knowledge, to achieve satisfactory reduction of pest numbers or effects (Pedigo 2002). See 'integrated pest management (IPM)', 'area-wide integrated pest management (AW-IPM)', 'pest'.
pest establishment	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2006, FAO/IAEA/USDA 2003). See 'established pest', 'entry', 'exotic species', 'invasive species'.
pest free area	An area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained (FAO 2006, IAEA 2003). Barclay et al. (this volume) list the three stages in the establishment of a pest free area: (1) systems to establish freedom from pests, (2) measures to maintain freedom, and (3) checks to verify that freedom has been maintained (FAO 1996b). There are two kinds of pest free areas — pest free zones, and pest free production fields or areas (Klassen, this volume). Refer to Hendrichs et al. (this volume), Barclay et al. (this volume). See 'eradication', 'extinction', 'freedom from pests', 'insect-free', 'fly-free', 'pest free field', 'pest free status', 'pest free zone', 'tsetse-free zone'.
pest free field	Pest free place of production = Place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period (FAO 2006). [Place of production = Any premises or collection of fields operated as a single production or farming unit. This may include production sites which are separately managed for phytosanitary purposes (FAO 2006)]. Production field or area that requires demonstration of non-host-status or the demonstrated suppression of quarantine pests to non-detectable levels (Klassen, this volume). Pest free production site = A defined portion of a place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period and that is managed as a separate unit in the same way as a pest free place of production (FAO 2006). See 'eradication', 'extinction', 'freedom from pests', 'insect-free', 'fly-free', 'pest free area', 'pest free status', 'pest free zone', 'tsetse-free zone'.
pest free status	The pest population has been eradicated from the target area (Barclay et al., this volume). Refer to Barclay et al. (this volume), FAO (1999). See 'eradication', 'extinction', 'freedom from pests', 'insect-free', 'fly-free', 'pest free area', 'pest free field', 'pest free zone', 'tsetse-free zone', 'pest status'.
pest free zone	Large geographic area, including entire countries, that are certified free of a particular pest species (Klassen, this volume). See 'eradication', 'extinction', 'freedom from pests', 'insect-free', 'fly-free', 'pest free area', 'pest free field', 'pest free status', 'tsetse-free zone'.
pest introduction	The entry of a pest resulting in its establishment (FAO 2006). This can occur by natural processes or through human action (Coombs and Hall 1998). Introduced species are species that were intentionally or unintentionally brought by humans into a new geographic area or environment which is outside of their native range (NAL 2008). See 'entry', 'invasive species', 'pest establishment', 'immigration'.
pest management	Synonym for 'integrated pest management (IPM)'. See 'integrated pest management (IPM)', 'area-wide integrated pest management (AW-IPM)', 'pest control', 'population management', 'total population management'.
pest outbreak	A recently detected pest population, including an incursion, or a sudden significant increase of an established pest population in an area (FAO 2006). See 'outbreak'.
pest status	Pest status (in an area) = Presence or absence, at the present time, of a pest in an area, including where appropriate its distribution, as officially determined using expert judgement on the basis of current and historical pest records and other information (FAO 2006). The ranking of a pest relative to the economics of dealing with the species (Pedigo 2002, Gordh and Headrick 2001). Refer to FAO (1999). See 'pest free status'.
pesticide residue	Amount of pesticide that remains in the environment after treatment (Collin 2001). Quantity of pesticide and its metabolites remaining on and in a crop, soil, or water (USDA 1993). Amount of pesticide remaining on or in the target tissues after a given time (Hill 1997). Substance which remains in or on a feed or food commodity, soil, air, or water following use of a pesticide. For regulatory purposes, it includes the parent compound and any specified derivatives such as degradation and conversion products, metabolites, and impurities considered to be of toxicological significance (IDIDAS 2008). See 'insecticide residue', 'residue'.
pesticide resistance	The ability of an organism to survive doses of a toxin that would normally be expected to be fatal (Coombs and Hall 1998, Bijlmakers 2008, Schmutterer 1969). Ability of a pest to be unaffected by a pesticide (Collin 2001). Pesticide resistance is the adaptation of pest species targeted by a pesticide resulting in decreased susceptibility to that chemical. In other words, pests develop a resistance to a chemical through artificial selection; after they are exposed to a pesticide for a prolonged period it no longer kills them as effectively. The most resistant organisms are the ones to survive and pass on their genetic traits to their offspring (Wikipedia 2008). Pesticide = A substance of chemical or biological origin that can be used to kill or control animal and plant pests and pathogens (Coombs and Hall 1998, Gordh and Headrick 2001). Any substance for controlling, preventing, destroying, disabling, or repelling a pest (Pedigo 2002). Resistance = The ability of a strain to tolerate or avoid factors that would prove lethal or reproductively degrading to the majority of strains in a normal population (Pedigo 2002).

	See 'insecticide resistance', 'resistance management', 'pest'.
Petersen method	One of the mark-recapture methods to estimate the population density in the field. The 'Petersen method' is the simplest procedure among the mark-recapture methods; it is based on a single episode of releasing marked animals and a second single episode of recapturing individuals (Itô and Yamamura, this volume). See 'Hamada method', 'Itô method', 'Jackson positive method', 'Jackson negative method', 'Jolly-Seber method', 'Yamamura method'.
pharate	The early period of an instar in which a new cuticle has been formed, and the insect is still enclosed in the cuticle of the former instar (Resh and Cardé 2003). Pharate adult = The unenclosed (unemerged) adult of holometabolous insects within the pupal case, in which the adult cuticle has separated from the pupal cuticle (Grimaldi and Engel 2005). Developing adult within the pupal cuticle (Leak 1999). See 'holometabolous', 'emergence', 'teneral'.
pharmacophagy	The eating of chemicals or drugs for other than nutritional purposes (Gordh and Headrick 2001).
phenology	The periodicity of biological phenomena (Pedigo 2002). Study of periodic or cyclical biological phenomena (reproductive cycles, host availability, life cycles) in relation to edaphic factors, climate and weather changes (Gordh and Headrick 2001). Recording and study of seasonal biotic events in relation to climate, time and other factors (Hill 1997). The seasonal life history of an insect population (Weeden et al. 2000). See 'life history'.
phenotype	The appearance or observable characteristics of an organism that are determined by both genotype and environment (Hoy 2003, Doncaster 2008, Lewin 1985, Oxford 2006). The appearance of an organism with respect to a particular character or group of characters (physical, biochemical, and physiologic), as a result of the interaction of its genotype and its environment. Often used to define the consequences of a particular mutation (Schlindwein 2006). See 'genotype'.
pheromone	Chemical signal or message (or a synthetic analogue of that substance) (an exocrine chemical messenger secretion) released by an individual that induces either a behavioural reaction or a developmental process in other individuals of the same species (Resh and Cardé 2003, FAO/IAEA/USDA 2003, Coombs and Hall 1998, Leak 1999, Coppel and Mertins 1977). An agent of intraspecific chemical communication, e.g. sex pheromone, alarm pheromone, aggregation pheromone, trail pheromone (Gordh and Headrick 2001, Pedigo 2002). A volatile compound dispersed to the air or laid down on substrate that is used for intraspecific communication (Grimaldi and Engel 2005). See 'allomone', 'kairomone', 'synomone', 'semiochemical', 'parapheromone', 'sex pheromone', 'pheromone trap'.
pheromone trap	An insect trap in which dispensers with insect pheromones are used as an attractant. Usually the inside surface of the traps is covered with glue to prevent escape (Bijlmakers 2008). A device to catch insects using a sex pheromone as the lure or bait to attract insects into the trap. Refer to IAEA (2003). See 'attractive device', 'delta trap', 'Jackson trap', 'sticky trap', 'trap', 'wing trap', 'pheromone', 'sex pheromone', 'sex attractant'.
photon	Energy quantum of electromagnetic radiation. The rest mass of the photon is equal to zero. It has no electrical charge (Koelzer 2008, Borders 1991).
photoperiod	Combination of photophase and scotophase in one day (24-hour period). The entire cycle of illumination and darkness to which an organism is exposed. Conventionally expressed as L:D (light:dark) and totalling 24 for one 24-hour period (Gordh and Headrick 2001, Gillett 1971). See 'photophase', 'scotophase'.
photophase	The daylight portion of the photoperiod (Gordh and Headrick 2001). The length of day, the period of illumination during a 24-hour period (Resh and Cardé 2003). See 'scotophase', 'photoperiod'.
phototaxis	The movement of a cell or organism toward or away from light (Hoy 2003). A behavioural reaction, typically in the form of movement or body orientation, by an organism to the stimulus of light (Gordh and Headrick 2001).
physical control	See 'mechanical control'.
phytosanitary	Pertaining to the health of plants. Pertaining to plant quarantine (IDIDAS 2008). Phytosanitary procedure = Any official method for implementing phytosanitary measures including the performance of inspections, tests, surveillance or treatments in connection with regulated pests (FAO 2006). Phytosanitary measure = Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO 2006).
plastic adult rearing container (PARC)	These plastic containers are now used instead of the paperboard Tanaka box. These containers are sanitized after each use, and reduce the number of flies lost through escape. Adults emerge from paper bags holding pupae. Screen panels on the sides of the container provide ventilation, and a screen panel in the lid permits the flies to feed on a gelatinous slab consisting of agar, sucrose and water (Dowell et al., section 4.1., this volume). See 'emergence', 'Tanaka box', 'tower system'.
Poisson distribution	In probability theory and statistics, the Poisson distribution is a discrete probability distribution that expresses the probability of a number of events occurring in a fixed period of time if these events occur with a known average rate and independently of the time since the last event. The Poisson distribution can also be used for the number of events in other specified intervals such as distance, area or volume (Wikipedia 2008, Clapham 1996). A theoretical distribution that is a good approximation to the binomial distribution when the probability is small and the number of trials is large. A specific binomial probability distribution often used when a large number of independent events each have a small probability of occurrence (FAO/IAEA 1973, IAEA 1992, FAO/IAEA 2009). The distribution of number of events in a given time, arising from a Poisson process. This differs from the binomial distribution in that there is no upper limit, corresponding to the parameter 'n' of a binomial process, to the number of events which may occur (Webster 2008, Everitt 2006). A mathematical expression giving the probability of observing various numbers of a particular event in a sample when the mean probability of that event on any one trial is very small. The Poisson distribution is sometimes referred to as the 'law of small numbers' (IDIDAS 2008). See 'binomial distribution', 'Poisson binomial distribution', 'negative binomial distribution', 'hypergeometric probability distribution', 'probability model'.
Poisson binomial distribution	A particular type of combination of the Poisson and the binomial distributions. See 'binomial distribution', 'Poisson distribution', 'negative binomial distribution', 'hypergeometric probability distribution', 'probability model'.

polar body	A small cell produced during meiosis in oogenesis, and that does not develop into a functional ovum (Ayala and Kiger 1984, King et al. 2006). One of the daughter nuclei of the primary oocyte, with very little cytoplasm, expelled from the nuclear material in maturation (Gordh and Headrick 2001). See 'oocyte', 'oogenesis', 'meiosis'.
pollinator	An arthropod which carries pollen between host flowers, and thus is a beneficial species (IDIDAS 2008, Scott 1996). Refer to Nagel and Peveling (this volume).
polyandry	The condition in which one female copulates with several males (Gordh and Headrick 2001). See 'mating system', 'remating', 'monogamy', 'polygamy', 'multiple mating', 'copulation'.
polygamy	The condition of one male copulating with or inseminating many conspecific females (Gordh and Headrick 2001). See 'mating system', 'remating', 'monogamy', 'polyandry', 'multiple mating', 'conspecific', 'copulation', 'insemination'.
polymer	A chemical compound constructed from a long chain of identical or similar units (Hoy 2003). A macromolecule composed of a covalently bonded collection of repeating subunits or monomers linked together during a repetitive series of similar chemical reactions. Each strand of DNA is a linear polymer of nucleotide monomers (King et al. 2006). See 'monomer', 'dimer', 'primer', 'nucleotide'.
polymerase	An enzyme that assembles a number of similar or identical subunits into a larger unit, or polymer, e.g. DNA polymerase and RNA polymerase (Ayala and Kiger 1984). An enzyme that catalyzes the addition of a nucleotide to a nucleic acid molecule. All polymerases require templates upon which to build a new strand of DNA or RNA; however, DNA polymerases also require a primer to initiate the new strand, while RNA polymerases start synthesis at a specific promoter sequence (Viljoen et al. 2005). See 'polymerase chain reaction (PCR)', 'polymer', 'nucleotide', 'primer'.
polymerase chain reaction (PCR)	A method of producing large amounts of DNA with a specific base sequence by repeated cycles of denaturation and synthesis of copies, resulting in an approximate doubling of the amount of DNA each cycle (Coombs and Hall 1998). Technique for amplifying a region or segment of DNA using a pair of flanking primers and a thermostable polymerase. PCR primers are usually designed to amplify a specific locus, e.g. a dinucleotide simple sequence locus (microsatellite), based on a knowledge of the flanking nucleotide sequences (Doncaster 2008, King et al. 2006). A method for amplifying a DNA base sequence using a heat-stable polymerase and two 20-base primers, one complementary to the (+)-strand at one end of the sequence to be amplified and the other complementary to the (-)-strand at the other end. Because the newly synthesized DNA strands can subsequently serve as additional templates for the same primer sequences, successive rounds of primer annealing, strand elongation, and dissociation produce rapid and highly specific amplification of the desired sequence. PCR also can be used to detect the existence of the defined sequence in a DNA sample (Schlindwein 2006, Viljoen et al. 2005). A method of amplifying DNA by means of DNA polymerases. PCR fundamentally involves denaturing double-stranded DNA, adding dNTPs, DNA polymerase, and primers. DNA synthesis occurs, resulting in a doubling of the number of DNA molecules defined by the primers. Additional rounds of denaturation and synthesis occur, resulting in a geometric increase in DNA molecules because each newly synthesized molecule can serve as the template for subsequent DNA amplification. The PCR is used to clone genes, produce probes, produce ss DNA for sequencing, and carry out site-directed mutagenesis. DNA sequence differences are used to identify individuals, populations, and species (Hoy 2003). See 'genetic fingerprinting', 'primer', 'probe', 'mutagenesis', 'microsatellite', 'randomly amplified polymorphic DNA (RAPD)'.
polymorphic locus	A genetic locus, in a population, at which the most common allele has a frequency less than 0.95. Contrast with monomorphic locus = a genetic locus at which the most common allele exceeds a frequency of 0.95 in the gene pool of the population (King et al. 2006). See 'locus', 'allele', 'gene pool'.
polyphagous	Feeding on a wide variety of hosts (Grimaldi and Engel 2005). Adapted to the use of a wide variety of plant or animal species as hosts or prey (Coppel and Mertins 1977). See 'oligophagous', 'monophagous'.
polyploid	Having three or more sets of homologous chromosomes (Schlindwein 2006, King et al. 2006). An increase in the number of copies of the haploid genome. Most individuals are 2n, but species are known that are polyploid (3n, 4n, 5n, 6n), and such species are parthenogenetic because of the difficulty of maintaining normal meiosis. Many insect species have tissues that are polyploid, including the salivary glands, nurse cells of the ovary, and fat body, but the germ-line tissues remain 2n (Hoy 2003). See 'diploid', 'haploid', 'parthenogenesis', 'salivary gland', 'nurse cell', 'germ cell'.
polytene chromosome	Chromosomes in which the chromatid has duplicated up to 1000-fold without separating. Salivary gland chromosomes in <i>Drosophila</i> and other Diptera are polytene. The discrete bands of polytene chromosomes allow a physical map of genes to be constructed using light microscopy (Hoy 2003, Schlindwein 2006, King et al. 2006, Oxford 2006, Lackie and Dow 1995). Chromosomes consisting of parallel, identical, exactly paired chromatids (Leak 1999). See 'chromatids', 'salivary gland'.
pome fruit	A simple fleshy fruit, the outer portion being formed by the expanded floral parts and receptacle. Characteristic of only one subfamily of the rose family (Rosaceae), e.g. apple, pear (Little and Jones 1980). See 'stone fruit'.
population	A potentially interbreeding group of organisms of a single species, occupying a particular space at the same time (USDA 1993, MCC 1996, Wikipedia 2008, Pedigo 2002, Resh and Cardé 2003). A group of organisms of the same species relatively isolated from other groups of the same species (Schlindwein 2006). A group of individuals of the same species living in a limited and defined area (Pfadt 1962). See 'deme'.
population density	The number of individuals of one population per unit area or volume (Bijlmakers 2008).
population dynamics	The study of numerical changes in populations of living organisms in time and space, and of the processes which cause such variation (Coppel and Mertins 1977). The interplay between populations and the environmental forces that influence them (Pedigo 2002). The aggregate of processes that determine the size and composition of any population (MH 1997). The study of the changes in the number of organisms living in a certain area (Collin 2001). The study of changes in population densities over time (Allaby 1994, Bijlmakers 2008). Variations in the size and composition of a population, due to births, deaths, immigration and emigration (Scott 1996). Refer to Hargrove (2004). See 'population ecology'.

population ecology	<p>The field of ecology dealing with the dynamics of populations within species, and the patterns in space and time of the interactions of these populations with environmental factors (NAL 2008). Study of the relationship between populations and their environment. Important characteristics of a population are, for example, population density, the distribution of individuals within the populated space, fertility, natality, and mortality. The growth of a population depends on its specific reproduction rate, and at first it proceeds exponentially. Indefinite unrestricted exponential growth is, however, not possible, because the environmental resources for each species are limited. Therefore, as the population size approaches the capacity limit of the environment, there is a large increase in the negative effects of density-dependent factors. The result is a sigmoid growth curve (Scott 1996). Refer to Itô and Yamamura (this volume), Barclay (this volume).</p> <p>See 'population dynamics', 'population density', 'dispersion', 'distribution', 'fertility', 'birth rate', 'mortality', predator-prey model', 'host-parasitoid', 'outbreak', 'pest outbreak', 'rate of increase', 'carrying capacity', 'density-dependence', 'sigmoidal', 'competitiveness', 'age structure'.</p>
population genetics	<p>The study of the distribution of genes (alleles) in populations, and the factors that change the frequency of genes and genotypes from generation to generation. It is based on the concept of the Hardy-Weinberg law (Oxford 2006, Scott 1996). The study of the genetic composition of populations. Population geneticists estimate gene frequencies, and detect the selective influences that determine them in natural populations. They also build mathematical models to elucidate the interaction of factors such as selection, population size, mutation, and migration upon the fixation and loss of linked and unlinked genes (King et al. 2006). Refer to Krafsur (this volume), Krafsur et al. (2000), Gooding and Krafsur (2004).</p> <p>See 'Hardy-Weinberg theorem', 'evolutionary genetics'.</p>
population management	<p>Synonym for area-wide integrated pest management (AW-IPM).</p> <p>See 'area-wide integrated pest management (AW-IPM)', 'total population management', 'integrated pest management (IPM)'.</p>
population model	<p>A population model keeps track of population numbers, and includes various features that influence population size and trend, such as birth rate, mortality, age structure, immigration and emigration, competition, etc. (Barclay, this volume).</p> <p>See 'model', 'modelling', 'population dynamics', 'population ecology', 'birth rate', 'mortality', 'age structure', 'immigration', 'emigration', 'competitiveness', 'logistic model', 'Hale-Malthusian'.</p>
population movement	<p>Movement of individuals in a population from one area to another, e.g. immigration, emigration, dispersal. Refer to Barclay (this volume).</p> <p>See 'emigration', 'immigration', 'dispersal'.</p>
population process	<p>Process that occurs at the population, i.e. aggregate, level but generally not at the individual level, although there may be some overlap. Examples are population increase or decrease, population stability, immigration or emigration rate, birth and death rates (H. Barclay, personal communication).</p> <p>See 'population dynamics', 'population ecology'.</p>
population suppression	<p>See 'suppression', 'integrated pest management (IPM)'.</p>
post-control	<p>The period of time or situation following a pest control action.</p> <p>See 'pest control'.</p>
post-copulatory	<p>The period of time or situation following copulation. Refer to Lance and McInnis (section 6) (this volume).</p> <p>See 'copulation'.</p>
post-eradication	<p>The period of time or situation following eradication of a pest species.</p> <p>See 'eradication'.</p>
postharvest treatment	<p>The preparation of gathered or harvested commodities, such as food crops, feed crops or wood, for fresh market or processing. This may include postharvest pest or disease control, various types of preservation techniques, packing, grading, curing (crops) or ripening initiation (NAL 2008).</p>
post-meiotic	<p>The time period or situation after meiosis occurs.</p> <p>Sperm are haploid post-meiotic cells, whereas mature eggs are pre-meiotic (Robinson, this volume).</p> <p>See 'meiosis', 'pre-meiotic'.</p>
pour-on	<p>Type of insecticide treatment in which a liquid formulation is poured or sprayed on to an animal, e.g. control of tsetse flies on livestock.</p> <p>See 'live-bait technology', 'dip', 'chemical control'.</p>
precautionary principle	<p>An approach to decision-making in risk management which justifies preventive measures or policies despite scientific uncertainty about detrimental effects (NAL 2008).</p> <p>See 'risk management'.</p>
predation	<p>The killing of animals (prey) by other animals (carnivores) for food (Hill 1997).</p> <p>Predator = A natural enemy that preys and feeds on other animal organisms, more than one of which are killed during its lifetime (FAO 2006, Coppel and Mertins 1977).</p> <p>See 'predator-prey model', 'prey', 'biological control'.</p>
predator-prey model	<p>A mathematical model that describes the numbers of prey and their predators in an area over time, as well as the interactions between the two species (H. Barclay, personal communication).</p> <p>See 'Lotka-Volterra model', 'model', 'predation', 'prey'.</p>
pre-intervention	<p>Refers to phase or activity in an area-wide integrated pest management programme that occurs before an intervention (pest control action) takes place, e.g. insect survey, collection of baseline data, development of infrastructure. Refer to Cox and Vreysen (section 3.1.) (this volume), Hendrichs et al. (section 3) (this volume).</p> <p>See 'intervention'.</p>
pre-mating	<p>The time period or situation before mating occurs. The term is used here in the context of pre-mating isolating mechanisms or reproductive isolation between individuals.</p> <p>See 'mating', 'reproductive isolation', 'mating barrier'.</p>
pre-meiotic	<p>The time period or situation before meiosis occurs.</p> <p>Sperm are haploid post-meiotic cells, whereas mature eggs are pre-meiotic (Robinson, this volume).</p> <p>See 'meiosis', 'post-meiotic'.</p>
preparedness model	<p>Includes the components of a plan of action to be ready if an invasive insect pest species enters or is introduced into an area or country.</p>

	Prevention is far more cost effective and environmentally desirable than measures that have to be taken once the introduction of an exotic invasive species has occurred (Bloem et al., this volume). Refer to Vargas-Terán et al. (this volume), Tweddle 2002.
pre-release	The time period or situation before the release of sterile insects in the field. Before sterile insects are released, various activities may occur, e.g. suppression of the pest population. See 'pre-release suppression', 'suppression'.
pre-release suppression	Pest population suppression before the release of sterile insects. See 'pre-release', 'suppression'.
presence-absence prediction	Model (geographic information systems (GIS)) that predicts the presence or absence of an insect species based on field survey data, e.g. insect trap catches, vegetation, geographic features. Maps produced by GIS show the probability of presence. Refer to Vreysen (Figure 2) (this volume). See 'geographic information systems (GIS)'.
present value	The worth of a future stream of returns or costs in terms of their value now. To obtain a present value a discount rate is used to discount these future returns and costs (Pearce 1992). See 'benefit/cost analysis (BCA)', 'net present value (NPV)', 'future value', 'discount rate', 'internal rate of return', 'rate of return', 'economic return'.
prevention	Application of phytosanitary measures in and/or around a pest free area to avoid the introduction of a pest (Hendrichs et al., this volume). A pest control measure applied in anticipation of a pest attack (Hill 1997). 'Prevention' is the preferred term rather than 'exclusion'. Refer to Hendrichs et al. (section 2.4.) (this volume). Knipling (1979) described 'prevention' as another possible strategic use of the SIT: As more experience is gained in the use of sterile insects for insect suppression and with greater confidence in the value of this technique, releasing sterile insects routinely in certain areas may be more expedient to prevent establishment of major pests than eliminating them after they become established. See 'exclusion', 'containment', 'pest free area', 'invasive species', 'phytosanitary', 'pest introduction', 'strategic option'.
Preventive Release Program (PRP)	Programme of repeated releases of sterile insects in a prevention strategy. If there are frequent entries of a major exotic pest, and the area is endangered (area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss), the most economical strategy to protect the area from any potential introductions will often be preventive releases of sterile insects, a successful example being the Preventive Release Program in California (Hendrichs et al., this volume). The Preventive Release Program (PRP) in California, operational since 1994, and in Florida since 1998, to protect pest free areas by the continuous release of sterile Mediterranean fruit flies that prevents any introduced flies from reproducing and establishing (Enkerlin, section 4.1., this volume). Refer to Enkerlin (this volume), Dowell et al. (2000). See 'prevention', 'strategic option', 'pest free area', 'entry', 'sterile insect technique'.
prey	Animal killed or hunted by predators (Hill 1997). See 'predator-prey model', 'predation', 'biological control'.
primer	An oligonucleotide that is complementary to a specific region within a DNA or RNA molecule, and that is used to prime (initiate) synthesis of a new strand of complementary DNA at that specific site, in a reaction or series of reactions catalyzed by a DNA polymerase (Viljoen et al. 2005). A short oligonucleotide that is attached to a ss DNA molecule to provide a site at which DNA replication can begin (Hoy 2003). Short pre-existing single-stranded polynucleotide chain to which new deoxyribonucleotides can be added by DNA polymerase. It anneals to a nucleic acid template and promotes copying of the template starting from the primer site (Schlindwein 2006). A substrate that is required for a polymerization reaction, e.g. DNA synthesis, and that is structurally similar to the product of the reaction itself (Ayala and Kiger 1984). See 'polymerase chain reaction (PCR)', 'dimer', 'monomer', 'polymer', 'nucleotide'.
probability model	A mathematical expression that defines or describes the generation of probabilities as a result of certain processes. Examples are: binomial probability model, Poisson model, and the normal distribution. Each of these arises as a result of the action of certain processes to generate the probabilities. For example, the binomial distribution results from random sampling from an infinite population containing two kinds of entities. Flipping coins a fixed number of times is an example of this. If one does this experiment many times, then the number of heads (and tails) will follow a binomial distribution (H. Barclay, personal communication). Probability = The expectation of the occurrence of a particular event. Likelihood of the occurrence of any event in the doctrine of chances, or the ratio of the number of favourable chances to the whole number of chances, favourable and unfavourable (Schlindwein 2006). See 'binomial distribution', 'Poisson distribution', 'Poisson binomial distribution', 'negative binomial distribution', 'hypergeometric probability distribution'.
probe	In molecular biology, any biochemical labelled with radioactive isotopes or tagged in other ways for ease in identification. A probe is used to identify or isolate a gene, a gene product, or a protein (King et al. 2006, Hoy 2003). Single-stranded DNA or RNA molecules of specific base sequence, labelled either radioactively, immunologically, or by other means, that are used to detect the complementary base sequence by hybridization (Schlindwein 2006, Viljoen et al. 2005). A nucleic acid molecule that can be used to detect, by complementary base-pairing, another nucleic acid molecule that has a complementary or homologous sequence (Walker and Cox 1995). See 'genetic fingerprinting', 'gene', 'isotope', 'radioactive'.
probiotic	Live, non-pathogenic, non-toxic microbial organisms which, when administered in adequate amounts, confer a health benefit on the host (NAL 2008). An adult insect diet that contains beneficial gut micro-organisms, intended to improve the performance of insects. Refer to Niyazi et al. (2004). See 'dietary supplement'.
probit 9	The proportion (or percentage) of cases being considered in which the value recorded falls outside of nine standard deviations from the mean value. Its value is extremely small, and is often taken as an acceptable value when the consequences of its occurrence are severe. For example, if a heat treatment kills most of the fungi in lumber being exported and the consequences of exporting fungi are severe, then probit 9 is a measure of an acceptable rate of survival of the fungi as a result of the heat treatment, given that the heat treatment cannot guarantee 100.0% kill rate (H. Barclay, personal communication).
process control	See 'process quality control'.
process quality control	Control of the quality of the process of insect rearing, i.e. measuring how things are done, such as diet preparation, infestation of diet, insect holding and collection, and unfinished product quality such as egg hatch and pupal weight, etc. (Bigler 1992;

	Calkins and Parker, this volume). Regulation of the performance of production processes through feedback so that deviations from product tolerances and specifications do not occur. Parameters within the realm of process quality control for fruit fly production include, among others, percent egg hatch, eggs per unit of diet, quantity of diet inoculated, percent pupation, age of pupae irradiated (FAO/IAEA/USDA 2003). Process control tells how the manufacturing processes are performing, and it controls these processes so that deviations from the product specifications will not occur as a result of variation in the processes (Chambers and Ashley 1984, Moore et al. 1985). See 'quality control'.
product control	See 'product quality control'.
product quality control	Control of the quality of the adult insects produced, which are evaluated for quantity, various biological parameters, and the effectiveness in completing the purpose for which they were reared (Bigler 1992; Calkins and Parker, this volume). The composite product characteristics of production and testing to which the product in use will meet the expectations of the customer. Parameters within the realm of product quality control for fruit fly production include, among others, pupal weight, sex ratio, longevity, flight ability, pheromone production and response, mating propensity, and mating compatibility (FAO/IAEA/USDA 2003). Product control tells how well the product is conforming to specifications and standards of quality, and it gives feedback so that a product's departure from established specifications can be corrected, or it eliminates substandard products (Chambers and Ashley 1984, Moore et al. 1985). See 'quality control'.
production control	See 'production quality control'.
production cost	Cost of producing insects for sterile insect release, or cost of producing agricultural commodities, e.g. crops, livestock.
production quality control	Control of the quality of the insect rearing operations and procedures, where the inputs to rearing are addressed, including diet ingredients, equipment, environmental conditions, etc. (Bigler 1992; Calkins and Parker, this volume). Development, installation, and maintenance of methods used to produce a product at the greatest rate, most efficiently (FAO/IAEA/USDA 2003). Production control regulates the consistency and reliability of production output, the numbers of items produced, and the timeliness of their production (Chambers and Ashley 1984, Moore et al. 1985). See 'quality control'.
progeny	The offspring from a given mating; members of the same biological family with the same mother and father; siblings (King et al. 2006). The subsequent generation following a mating or crossing of parents (Schlindwein 2006). The offspring of a particular mate, or of a particular individual in the case of asexual reproduction (Enkerlin and Quinlan 2004). See 'reproduction'.
pro-nucleus	The haploid nucleus of an egg, sperm, or pollen grain (King et al. 2006). The maternal (egg) or paternal (sperm) nucleus following fertilization but prior to nuclear fusion (Malacinski 1988, Oxford 2006, Lackie and Dow 1995). See 'haploid'.
prophase	The first phase of mitosis (nuclear division). During prophase, the centriole divides and the two daughter centrioles move apart. The chromosomes become visible within the nucleus because they coil up to produce a series of compact gyres. Each chromosome is longitudinally double except in the region of the centromere, and each replicate strand of a chromosome is called a chromatid. The nucleolus and the nuclear envelope breakdown (King et al. 2006). The stage of mitosis or of meiosis I or II before breakdown of the nuclear membrane (Schlindwein 2006). See 'mitosis', 'meiosis', 'metaphase', 'anaphase', 'telophase', 'interphase', 'chromatids'.
propylure	Attractant reported as a natural male sex lure secreted by the female pink bollworm (Coombs and Hall 1998). Refer to Mangan (this volume). See 'sex pheromone', 'attraction', 'ceralure', 'cuelure', 'disparlure', 'gossyplure', 'hexalure', 'swormlure', 'trimedlure'.
protein electrophoresis	Method of analysing a mixture of proteins by means of gel electrophoresis (Wikipedia 2008). Technique used to separate the different component proteins (fractions) in a mixture of proteins on the basis of differences in how the components move through a fluid-filled matrix under the influence of an applied electric field. See 'gel electrophoresis'.
protein hydrolysate	Hydrolyzed protein bait to attract fruit flies (IAEA 2003, Gopaul and Price 2008). May be mixed with the insecticide malathion and sprayed aerially or from the ground (USDA 1993). See 'bait', 'aerial spray', 'ground spray'.
protocol	Set of guidelines, rules, procedures to be followed.
ptilinum	A modification of the frons [upper/anterior portion of the head capsule] that forms a soft vesicular membranous sac-like or bladder-like, inflatable, pulsatile, cuticular organ on the head of teneral flies. The ptilinum is used to aid emergence from the puparium and to burrow through the soil to reach the surface. After emergence, the ptilinum is retracted by muscles; it hardens and becomes invisible on the integument's surface (Gordh and Headrick 2001, Grimaldi and Engel 2005, Leak 1999).
public relations	The systematic attempt by an organization to present itself to best advantage, both to an external public and to its employees, by a process of persuasive communication. It concentrates usually on the mass media. The objective is to build up and maintain good relations between the organization, its public and its employees (Statt 1991).
<b>Q</b>	
quality	The degree to which a product meets the requirements of the objective or of the expected function (FAO/IAEA/USDA 2003). Fitness for use (Chambers and Ashley 1984, Moore et al. 1985). The ability of the released insects to perform their function, and to perform relative to some standard (Chambers 1975). See 'quality control (QC)'.
quality assurance (QA)	All systematic actions necessary to provide adequate confidence that a calibration, measurement, or process is performed to a predefined level of quality (ISO/ASTM 2002). All those planned and systematic actions necessary to provide adequate confidence that an item or a facility will perform satisfactorily in service (Borders 1991). See 'quality control (QC)'.
quality control (QC)	A systematic process whereby management critically evaluates the elements of production, establishes standards and tolerances, obtains, analyses and interprets data on production and product performance, and provides feedback so as to predict and regulate product quality and quantity (FAO/IAEA/USDA 2003). A management procedure that develops, maintains, and improves quality. The steps required in this process are setting quality standards, appraising conformance with those standards, acting on appraisal information, and planning how to improve the product (Calkins and Parker, this volume;

	Chambers and Ashley 1984; Moore et al. 1985; Bigler 1994). Operational techniques and procedures that are employed routinely to achieve and sustain a predefined level of quality (ISO/ASTM). The overall system of activities whose purpose is to control the quality of a product or service so that it meets the needs of users. The aim is to provide quality that is satisfactory, adequate, dependable, and economic (Borders 1991). Refer to Boller and Chambers (1977). See 'quality', 'quality standard', 'process quality control', 'product quality control', 'production quality control'.
quality standard	Steps in quality control include setting quality standards, and appraising conformance with these standards (Calkins and Parker, this volume). See 'quality control (QC)', 'standard'.
quarantine	Official confinement of regulated articles for observation and research or for further inspection, testing and/or treatment (FAO 2006). Isolation; operations intended to prevent importation or spread of unwanted noxious organisms (Hill 1997). Plant quarantine = All activities designed to prevent the introduction and/or spread of quarantine pests or to ensure their official control (FAO 2006). Quarantine pest = A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 2006).
<b>R</b>	
radiation	Energy given off by atoms when they are moving or changing state. Can take the form of electromagnetic waves or streams of particles (FAO/IAEA 2009). Energy dispersion through matter or space. In atomic physics the term is also extended to fast-moving particles (alpha and beta radiation, free neutrons, etc.) (Koelzer 2008, Borders 1991). See 'ionizing radiation', 'gamma radiation'.
radiation biology	Branch of biology which deals with the effects of radiation on biological systems (Borders 1991). Branch of radiology dealing with the mechanisms of action and effects of radiation, in particular ionizing radiation, on biological systems, i.e. on subcellular and cellular levels as well as on the levels of cell systems and organisms (Koelzer 2008). See 'biological radiation effects'.
radiation dose	See 'absorbed dose'.
radiation dosimetry	See 'dosimetry'.
radiation environment	The physical environment, e.g. oxygen or nitrogen atmosphere, in which something is irradiated. See 'anoxia', 'hypoxia'.
radiation exposure	Humans exposed to radiation (Koelzer 2008). The act or state of being irradiated by ionizing radiation (Borders 1991).
radiation-induced toxin	A toxin that may be produced through irradiation. However, Whitten and Mahon (this volume) stated that: Given the low levels of irradiation for insects, the small biomass of the released insects and their wide dispersal, there are no plausible grounds for concern about residual radioactivity, or radiation-induced toxins, in released insects.
radiation safety	To protect workers from radiation hazard, handling and operating radiation equipment must be done in a safe manner and according the prescribed safety procedures (Borders 1991). Radiation protection deals with the protection of individual persons, their descendants and the population as a whole against the effects of ionizing radiation (Koelzer 2008). Refer to Bakri et al. (section 3.2.) (this volume), IAEA 2008b.
radiation-sensitive indicator	Materials such as coated or impregnated adhesive-backed substrates, inks, coatings or other materials which may be affixed to or printed on the process loads [e.g. insect container or canister] and which undergo a visual change when exposed to ionizing radiation. Indicators are used as aids in tracking whether or not specific containers have been irradiated (ISO/ASTM 2005; Bakri et al., this volume; K. Mehta, personal communication). Refer to Bakri et al. (section 3.5.3.) (this volume).
radiation source	An apparatus or a material emitting or capable of emitting ionizing radiation (Borders 1991). Source of radiation, e.g. a radioactive isotope such as cobalt-60 or an electron accelerator (K. Mehta, personal communication).
radioactive	Emitting radioactivity (Borders 1991, FAO/IAEA 2009). Radioactivity = Property of certain substances to convert without external effect, emitting a characteristic radiation (Koelzer 2008); the spontaneous decay or disintegration of an unstable atomic nucleus, usually accompanied by the emission of ionizing radiation (Borders 1991); the amount of a radioactive substance expressed as the number of disintegrations taking place per unit time (IAEA 1992).
radioactive decay	Spontaneous nuclear transformation of an unstable nucleus, with emission of charged particles, photons or both. Rate of decay is usually expressed in terms of radionuclide decay constant or half-life (Borders 1991, ISO/ASTM). Nuclear decay in which particles or electromagnetic radiation are emitted or the nucleus undergoes spontaneous fission or electron capture (IDIDAS 2008).
radioactive waste	Unwanted radioactive materials obtained in the processing or handling of radioactive materials (Borders 1991).
radiochromic film	Specially prepared film containing ingredients that undergo change in optical absorbance under ionizing radiation. This change in optical absorbance can be related to absorbed dose, and thus the film can be used as a dosimeter (ISO/ASTM 2004b; K. Mehta, personal communication; Li et al. 2000).
radioisotope	A radioactive isotope, a radioactive nuclide (Borders 1991). An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation (FAO/IAEA 2009). A radioactive isotope of a specified element (IDIDAS 2008). See 'isotope', 'radioactive', 'radionuclide'.
radionuclide	Synonym of radioisotope. A radioactive nuclide; any radioactive form of an element (Borders 1991). Instable nuclide spontaneously decaying without external effect under radiation emission (Koelzer 2008, FAO/IAEA 2009). A nuclide that is radioactive (IDIDAS 2008).
radioresistance	Relative resistance of cells, tissues, organs, or organisms to the injurious action of ionizing radiation (Borders 1991). Ability of an organism, especially pathogenic micro-organisms, to withstand irradiation without death, severe injury or adverse effect (NAL 2008). Contrast with 'radiosensitivity'.
radiosensitivity	Relative susceptibility of cells, tissues, organs, organisms, and any substances to the injurious action of ionizing radiation (Borders 1991). Contrast with 'radioresistance'.
radiosterilization	A process in which sterilization is achieved through ionizing radiation (K. Mehta, personal communication). See 'sterilization', 'sterilizing dose'.
randomly amplified polymorphic DNA (RAPD)	A widely used technique for amplifying anonymous stretches of DNA using PCR with arbitrary primers (Schlindwein 2006). A variation of the PCR in which many short (~10 nucleotide) primers are used. The products of the reaction from different sources can lead to recognition of polymorphisms and physical maps (Oxford 2006, Hoy 2003). Technique based on the polymerase chain reaction (PCR) in which short, intentionally non-specific, primers are used to amplify genomic DNA. The

	<p>range of products generated from a series of such primers is run on a high-resolution gel, and the array of bands considered to be a 'fingerprint' of the particular strain or population, allowing comparison with analogous arrays from different populations (Lackie and Dow 1995). Any DNA segment that has been amplified using short oligodeoxynucleotide primers of arbitrary nucleotide sequence (amplimers) and polymerase chain reaction (PCR) procedures. In short, genomic DNA is isolated and single primers, about 10 nt long and of arbitrary sequence are annealed to it. After a conventional PCR amplification the amplified fragments are electrophoretically separated on agarose gels and visualized by simple staining with ethidium bromide. If such RAPDs from two related organisms are compared, they may exhibit length polymorphism. The detected polymorphisms can be used as genetic markers to construct gene maps (Kahl 1995).</p> <p>See 'polymerase chain reaction (PCR)', 'DNA', 'genetic marker', 'allozyme', 'restriction fragment length polymorphism (RFLP)', 'microsatellite', 'mitochondrial DNA (mtDNA)', 'primer', 'gel electrophoresis', 'genetic fingerprinting', 'genetic marker'.</p>
randomness	<p>Governed by chance, not completely determined by other factors, non-deterministic (Everitt 2006). Governed by or involving equal chances for each item (Oxford 2008). The quality of lacking any predictable order or plan. Synonym = haphazardness (Webster 2008).</p> <p>See 'model'.</p>
range fragmentation	<p>The range of a species is fragmented into discontinuous parts.</p> <p>See 'home range', 'geographic range'.</p>
raster model	<p>In most geographic information systems (GIS) packages, geographic data are represented by vector and raster data models. In the raster model, spatial data comprise a regular grid of cells in which points are represented as single cells, and lines as strings of connected cells. Depending on the size of the cells that constitute the raster grid, this arrangement can be significantly less precise than the vector model. However, raster data are better suited to storing and modelling variables that vary continuously in space. Topographic data, for example, are commonly stored as raster grids (digital elevation models). Climate data, which vary continuously in space and time, are also commonly stored as rasterized climate 'surfaces' (Cox and Vreysen, this volume).</p> <p>Raster data = A type of spatial data that is represented in a two-dimensional matrix where the value stored for each cell corresponds to a specific characteristic of the location (NAL 2008).</p> <p>For a definition of "raster layer", see Leak et al. (2008).</p> <p>See 'vector model', 'data layer'.</p>
rate of increase	<p>The crude birth rate minus the crude death rate of a population (excluding migration) (Collin 2001, Wikipedia 2008). Also 'rate of natural increase'.</p> <p>Rate of population growth = Increase in population in a certain area divided by the initial population (Collin 2001).</p> <p>See 'population', 'birth rate', 'mortality'.</p>
rate of return	<p>A general concept referring to the earnings from the investment of capital, where the earnings are expressed as a proportion of the outlay. It can refer to the earnings from the investment of physical capital, money capital, and also to the return to investment in human capital (Pearce 1992, Oxford 1993).</p> <p>See 'internal rate of return', 'economic return', 'discount rate', 'present value', 'net present value'.</p>
rearing	<p>Bringing up and caring for offspring/progeny. Breeding or raising insects in a laboratory.</p> <p>See 'mass-rearing'.</p>
rearing facility	<p>A facility, e.g. room or building and equipment, in which insects are raised.</p> <p>See 'rearing', 'mass-rearing facility', 'modular rearing facility', 'centralized facility', 'satellite facility'.</p>
recapture	<p>Insects that initially were either reared or collected in the field, then marked in some way and released in the field, are later recaptured in traps. Refer to Itô and Yamamura (this volume), Vreysen (this volume), FAO/IAEA/USDA (2003), Southwood (1978), IAEA (2003).</p> <p>See 'mark-release-recapture', 'marking', 'trap', 'Lincoln Index'.</p>
receptivity	<p>The degree to which a female is receptive or willing to mate with a male. Refer to Lance and McInnis (this volume).</p> <p>See 'mating behaviour', 'refractory'.</p>
recessive lethal mutation	<p>A lethal mutation results in the premature death of the organism carrying it. Dominant lethals kill heterozygotes, but recessive lethals kill only homozygotes. A recessive lethal is an allele that kills the cell or organism that is homozygous or hemizygous for it (King et al. 2006, Lewin 1985).</p> <p>See 'dominant lethal mutation (DLM)', 'lethal gene', 'mutation'.</p>
recidivist	<p>In entomology, a species that has evolved resistance to a wide range of insecticides (Whitten and Mahon, this volume).</p>
reciprocal cross	<p>Each of two strains provides the males in one cross and the females in the other, as in male A x female B, and male B x female A (Ayala and Kiger 1984, Hoy 2003). A pair of crosses where the first cross is the progeny of breeding a male from population A with a female from population B, and the second cross is the progeny of breeding a male from population B with the female from population A (NAL 2008). Cross of the forms female A x male B and female B x male A, where the individuals symbolized by A and B differ in genotype or phenotype or both. Reciprocal crosses are employed to detect sex linkage, maternal inheritance, or cytoplasmic inheritance (King et al. 2006).</p> <p>Reciprocal mating = Two matings between unlike individuals within each mating one sex having the same characteristics as the opposite sex in the other mating (IDIDAS 2008). Using male and female gametes for two different traits, alternating the source of gametes (Schlindwein 2006).</p> <p>Reciprocal recombination = The production of new genotypes with the reverse arrangements of alleles according to maternal and paternal origin (Lewin 1985).</p> <p>See 'sex linkage', 'progeny'.</p>
recombination	<p>See 'genetic recombination'.</p>
recruitment	<p>Adding to an existing population, e.g. through birth or immigration.</p>
recycling	<p>Using something again, for the same or a different purpose. The act of processing used or abandoned materials for use in creating new products. The re-use of materials that would otherwise be considered waste (Webster 2008).</p>
red fluorescent protein (DsRed)	<p>Sterile insects for release are usually marked with a fluorescent powder; transgenic techniques could enable them to be marked with a fluorescent protein. Using a genetic marker for released insects requires that the marker be dominant, and that it can be monitored even in dead adults, as insects are usually dead when removed from traps. There are currently two fluorescent protein markers available to accomplish this, i.e. green fluorescent protein (GFP) and red fluorescent protein (DsRed) (Robinson and Hendrichs, this volume).</p>

	See 'marking', 'green fluorescent protein (GFP)', 'genetic marker'.
reference monitoring site (RMS)	Selecting reference (or fixed) monitoring sites, representative of a certain area, is a useful approach to efficiently monitor or survey large geographical areas (Vreysen, this volume). Refer to Vreysen (Box 4) (this volume). See 'monitoring', 'sampling'.
reference site	See 'reference monitoring site (RMS)'.
refractory	Inhibition of female from mating again, usually induced by a substance from the male (FAO/IAEA/USDA 2003). See 'receptivity', 'mating behaviour', 'accessory gland'.
refuge	Also 'refugium'. Safe place where species can escape environmental change and continue to exist as before (Collin 2001). An area which has escaped great changes undergone by the region as a whole and so often provides conditions in which relict colonies can survive (Allaby 1994). In the context of natural enemies, 'refuge' is a location in or near crop fields in which natural enemies are protected from pesticides, and provided with resources necessary for their survival and reproduction (Resh and Cardé 2003). See 'relict population', 'remnant population', 'natural enemies'.
regulatory	Restricting according to rules or principles (Webster 2008). Regulated pest = A quarantine pest or a regulated non-quarantine pest (FAO 2006). Regulatory control = An approach to pest control which seeks to prevent importation and establishment of exotic pests in areas where the pests do not occur. Examples of regulatory controls are hygiene, local quarantine inspections, and reporting of pest occurrence. Refer to Robinson and Hendrichs (sections 2.6. and 4.5.) (this volume).
reinfestation	Pest infestation occurring again, or the return of pests. Infestation (of a commodity) = Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection (FAO 2006). Infested = Contaminated with a pest or so exposed to a pest that contamination can reasonably be expected to exist (IAEA 2003). Infested area = An area that has been determined to have an established pest population (IAEA 2003).
reinvansion	Reoccurrence of an insect pest invasion. See 'invasion', 'invasive species'.
relative biological effectiveness (RBE)	The RBE of radiation is the ratio of the dose of 200–250 kV X-rays required to produce a specific biological effect to the dose of radiation required to produce the same effect (Bakri et al., this volume; Koelzer 2008; Borders 1991).
relative isolation index (RII)	A measure of mating compatibility between two insect strains, and is a quality control parameter. Refer to Calkins and Parker (Box 1) (this volume), (FAO/IAEA/USDA 2003). See 'isolation index (ISI)', 'female relative performance index (FRPI)', 'male relative performance index (MRPI)', 'assortative mating'.
release	Intentional liberation of an organism into the environment (FAO 2006). See 'critical release rate', 'release rate', 'sterile insect technique (SIT)'.
release of insects carrying a dominant lethal (RIDL)	Insect strains that carry a 'release of insects carrying a dominant lethal' (RIDL) system (Klassen and Curtis, this volume). Transgenic strains that will induce embryonic lethality in eggs fertilized by released fertile transgenic males carrying a dominant lethal gene, the so-called RIDL system (Robinson and Hendrichs, this volume). See 'genetic engineering', 'genetic control', 'sterile insect technique', 'genetically impaired female technique (GIFT)'.
release rate	Number of insects that are released in a given area over a given time period. Refer to Barclay (this volume), Hendrichs et al. (this volume), Dowell et al. (this volume). Regarding the release rate of volatile chemicals, refer to Vreysen (this volume). See 'release', 'critical release rate'.
release-recapture	See 'mark-release-recapture', 'recapture', 'release'.
relict population	The surviving remnants of a population which was formerly more widespread or characteristic of the area (Allaby 1994). A persistent, isolated remnant of a once-abundant species (MH 1997). Species which is still in existence, even though the environment in which it originally developed is no longer present (Collin 2001). A taxon or distribution that is isolated phylogenetically or geographically as a result of extinction (Grimaldi and Engel 2005). See 'remnant population', 'residual population', 'refuge'.
remating	The act of a male or female mating again at some time after previous mating (FAO/IAEA/USDA 2003). Refer to Lance and McInnis (this volume). See 'multiple mating', 'mating', 'mating behaviour', 'mating system', 'polyandry', 'polygamy'.
remnant population	See 'relict population', 'residual population', 'refuge'.
remote sensing (RS)	The practice of obtaining information about the earth's surface land and water features from images acquired at a distant vantage point. Includes aerial photography, satellite imaging and radar sensing methods (NAL 2008). Getting information about the physical aspects of the earth (such as the movement of water or pests, etc.) from satellite observation and aerial photography (Collin 2001). The obtaining of information at a distance from the subject being examined, usually from above. Instruments carried in aircraft or satellites scan the atmosphere and ground surface. Photographic techniques are not confined to the visible light spectrum (e.g. infrared photography) nor to the representation of natural colours (Allaby 1994). Satellite remote sensing (RS) is the process of gathering information about the earth's surface using electromagnetic sensors on board satellites. The potential value of satellite RS for ecological research has long been recognised, particularly in terms of its ability to offer objective, up-to-date assessments of surface conditions over large, sometimes inaccessible, areas. Moreover, the repeatability of satellite measurements makes RS particularly suitable for monitoring environmental conditions over time (Cox and Vreysen, this volume). Refer to Cox and Vreysen (section 2.3.) (this volume).
repellent	Chemical which has the property of inducing avoidance by a particular pest due to unpleasant odour, colour, taste or mechanical effect (Bijlmakers 2008, Hill 1997). Chemical that causes insects to orient their movements away from a source (Pedigo 2002).
replication (of DNA)	A duplication process requiring copying from a template. During DNA replication the two strands of the duplex molecule separate to form a 'replication fork' (King et al. 2006). The means whereby new strands of deoxypolynucleotides are synthesized. In the structure of DNA, two strands of complementary base pairs can unwind, and each strand acts as the template for a new strand, thus forming two helices, each containing one parental strand and one new one (daughter strand)

	(Oxford 2006, Lackie and Dow 1995, Kahl 1995).
reproduction	The process of producing young (offspring, progeny) (Hill 1997). The act or process through which organisms replicate themselves. The dominant form of reproduction in plants and animals is sexual, and involves the union of a sex cell from each parent to produce an embryo (Gordh and Headrick 2001, MH 1997). See 'progeny'.
reproductive capacity	The potential reproduction possible for a particular insect population, sometimes expressed as absolute potential or partial potential (Hill 1997).
reproductive cell	See 'germ cell'.
reproductive isolation	The inability to interbreed due to biological differences (Ayala and Kiger 1984). A condition in which interbreeding between two or more populations is prevented by intrinsic factors, called reproductive isolating mechanisms. Reproductive isolation is a populational phenomenon, and results from the sequential process of individuals determining the correct conspecific sexes for reproduction. Thus, species recognition and mating barriers contribute to reproductive isolation (Aluja and Norrbom 2001). The absence of interbreeding between members of different species (King et al. 2006). See 'conspecific', 'mating barrier', 'pre-mating'.
reproductive period	In the case of a tsetse fly <i>Glossina</i> female, the time period required to mature one larva in her uterus. Refer to Barclay et al. (this volume).
reproductive sterility	See 'sterility'.
residual fertility	Some level of fertility remaining due to incomplete sterilization of insects. Also, proportion of released sterilized insects that remains fertile. Radiation doses that sterilize males typically kill oogonial cells, but the radiation sensitivity of oocytes varies with such factors as maturity and meiotic stage. As a result, females of some species may retain a degree of fertility after irradiation, especially when treated late in development. For example, in <i>Ceratitis capitata</i> , careful monitoring is needed to ensure that pupae are not irradiated too early, resulting in poor quality, or too late, leaving females with residual fertility (Lance and McInnis, this volume). Can occur in females or males or both. Refer to Lance and McInnis (this volume), Robinson (this volume), Barclay (this volume). See 'fertility'.
residual population	As a pest population declines due to pest control actions, ultimately it could form a small and undetectable residual population (Barclay et al., this volume). See 'relict population', 'remnant population', 'refuge'.
residual radiation	Regarding concerns that irradiated insects or foodstuffs retain residual radiation. Given the low levels of irradiation for insects, the small biomass of the released insects and their wide dispersal, there are no plausible grounds for concern about residual radioactivity, or radiation-induced toxins, in released insects (Whitten and Mahon, this volume). A study of the irradiation of foodstuffs, where irradiation levels are much higher, dispels this fear. The conclusion of all the studies on irradiated foods indicates that there are no levels of residual radiation to give cause for concern (Whitten and Mahon, this volume). See 'radioactive'.
residue	Material remaining or left over after a process has taken place or after a material has been used (Collin 2001). See 'insecticide residue', 'pesticide residue', 'crop residue', 'food residue', 'residual radiation'.
resistance management	Use of pesticides and alternate pest control measures so as to minimize or delay the development of resistance in the target pest (IDIDAS 2008). By using chemicals and biopesticides together in integrated pest management systems, the build-up of resistance can be minimized (Coombs and Hall 1998). Pest resistance to a pesticide is commonly managed through pesticide rotation, which involves alternating among pesticide classes with different modes of action to delay the onset of or mitigate existing pest resistance. Only a limited number of consecutive applications of a pesticide class should be made before alternating to a different pesticide class; this extends the useful life of a product. Tank-mixing pesticides is the combination of two or more pesticides with different modes of action to improve individual pesticide application results and delay the onset of or mitigate existing pest resistance. Another strategy is to avoid using pesticides more often than necessary (Wikipedia 2008). See 'insecticide resistance', 'pesticide resistance', 'host-plant resistance'.
resistance to insecticide	See 'insecticide resistance'.
resistance to the SIT	The possibility that wild insects could evolve sexual isolating barriers, which would enable wild females to avoid mating with mass-reared sterile males (mate-choice) (behavioural mechanisms that would preclude sterile-fertile matings), has not been a problem. Nevertheless, in this context, it is important to refresh periodically the genetic variability within a mass-reared strain (Whitten and Mahon, this volume; Barclay, this volume; Itô and Yamamura, this volume). Refer to Whitten and Mahon (section 3.5.) (this volume), Barclay (section 2.19.) (this volume), Lance and McInnis (section 5.2.) (this volume), Robinson and Hendrichs (section 2.7.) (this volume), Itô and Yamamura (sections 5.3., 5.4.) (this volume). See 'sterile insect technique (SIT)'.
restriction endonuclease (RE)	Also 'restriction enzyme'. Enzyme used to 'cut' a gene from a piece of DNA (Pedigo 2002). An enzyme that cuts DNA only at a limited number of specific nucleotide sequences (Hoy 2003, Kahl 1995). Any of a group of enzymes, produced by bacteria, that cleave molecules of DNA internally at specific base sequences. They therefore act to 'restrict' the replication of foreign, usually viral, DNA entering the bacterial cell. Some of them also methylate the host bacterial DNA to protect it from degradation (Oxford 2006). A bacterial enzyme that recognizes a specific palindromic sequence (recognition sequence) within a double-stranded DNA molecule, and then catalyzes the cleavage of both strands at that site (Viljoen et al. 2005, Fenner et al. 1987). An endonuclease that recognizes specific nucleotide sequences in DNA, and then makes a double-stranded cleavage of the DNA molecule (Ayala and Kiger 1984, Schlindwein 2006). Recognizes specific short sequences of (usually) unmethylated DNA and cleaves the duplex (sometimes at target site, sometimes elsewhere, depending on type) (Lewin 1985). Restriction endonucleases are used extensively to map DNA regions of interest (King et al. 2006).
restriction fragment length polymorphism (RFLP)	Variations in the lengths of fragments of DNA generated by digestion of different DNAs with a specific restriction endonuclease, reflecting genetic variation (polymorphism) in the DNAs (Viljoen et al. 2005). Variations occurring within a species in the length of DNA fragments generated by a specific endonuclease (King et al. 2006, Kahl 1995). A polymorphism in an individual, population, or species defined by restriction fragments of a distinctive length. Usually caused by gain or loss

	<p>of a restriction site, but could result from an insertion or deletion of DNA between two conserved restriction sites. Differences in RFLPs are visualized by gel electrophoresis (Hoy 2003). Genetic variation between individuals in DNA fragment sizes resulting from a difference in DNA sequence that affects the recognition sequence for restriction enzymes when cut by specific restriction enzymes. When DNA is digested by a particular enzyme, the fragment sizes will differ depending on the presence or absence of the proper recognition sequence for the enzyme. Polymorphic sequences that result in RFLPs are used as markers on both physical maps and genetic linkage maps. RFLPs are usually caused by mutation at a cutting site (Schlindwein 2006). Any differences observed between genotypes in the fragment lengths produced when DNA is digested by a restriction enzyme (Walker and Cox 1995). Polymorphism within a population of organisms of the size of the fragments of DNA produced by the action of a restriction enzyme. RFLP is exploited in constructing physical maps of the genome, and widely used for localizing specific genes and detecting genetic differences between closely related individuals (Oxford 2006). Technique, also known as 'DNA fingerprinting', that allows familial relationships to be established by comparing the characteristic polymorphic patterns obtained when certain regions of genomic DNA are amplified (typically by PCR) and cut with certain restriction enzymes (Lackie and Dow 1995).</p> <p>See 'restriction endonuclease (RE)', 'genetic marker', 'allozyme', 'randomly amplified polymorphic DNA (RAPD)', 'microsatellite', 'mitochondrial DNA (mtDNA)', 'genetic fingerprinting', 'polymerase chain reaction (PCR)'.</p>
ribosomal RNA	<p>A class of RNA found in the ribosomes of cells (Schlindwein 2006). The RNA molecules that are structural parts of ribosomes (Ayala and Kiger 1984, Hoy 2003, Lackie and Dow 1995, Kahl 1995). Constituent of ribosomes, the cell organelles that are the sites of protein synthesis (MCC 1996). RNA component of the ribosome that may play catalytic roles in translation (Viljoen et al. 2005, King et al. 2006).</p> <p>Ribosomes = Granules composed of RNA and protein found in large numbers in all types of cells, where they synthesize protein (Doncaster 2008).</p> <p>Ribosome = An organelle, consisting of two subunits composed of RNA and proteins, that synthesizes polypeptides, whose amino acid sequences are specified by the nucleotide sequences of messenger RNA molecules (Ayala and Kiger 1984, Hoy 2003). The site of protein biosynthesis resulting from translation of messenger RNA (Oxford 2006).</p> <p>See 'RNA'.</p>
rickettsia	<p>Group of minute, rod-shaped bacterial obligate parasites of arthropods (Leak 1999). A group of parasitic micro-organisms intermediate in size between bacteria and viruses, without cellular structure, many of which are pathogenic and transmitted by arthropods (Wall and Shearer 1997, Pfadt 1962, King et al. 2006). Intracellular, gram-negative bacterial parasites of animals (Daly et al. 1998).</p> <p>Rickettsial diseases = Infections with bacteria of the genus <i>Rickettsia</i> (NAL 2008).</p> <p><i>Wolbachia</i> is a rickettsia-like bacterium that is found in up to 76% of arthropod species (Whitten and Mahon, this volume).</p> <p>See 'parasitism', 'vector', 'transmission'.</p>
rinderpest	<p>A viral disease of cloven-hoofed animals caused by <i>Morbillivirus</i> (rinderpest virus). It may be acute, subacute, or chronic with the major lesions characterized by inflammation and ulceration of the entire digestive tract (NAL 2008).</p>
risk analysis	<p>An analytical process to determine the nature, and often the magnitude, of risk to organisms, including attendant uncertainty; an analytical process based on scientific considerations, but also requiring judgment when the available information is incomplete (USDA 1993).</p> <p>Risk, as a technical term, is defined as the product: risk = magnitude of hazard x probability of occurrence. This is a measure of the probability that damage to life, health, property and/or the environment will occur as a result of a given hazard and the magnitude of the consequences of the effect occurring (IDIDAS 2008).</p> <p>Pest risk analysis = The process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it (FAO 2006).</p> <p>See 'phytosanitary'.</p>
risk assessment	<p>The process of analyzing and identifying potential hazards, injuries, losses or other adverse effects by qualitative or quantitative means (NAL 2008).</p> <p>Component of risk management, which comprises all processes, concerned with identification, estimation and qualitative and quantitative evaluation of risks. Risk assessment consists of hazard identification, hazard assessment, risk estimation and risk reduction (Wikipedia 2008).</p> <p>Pest risk assessment for quarantine pests = Evaluation of the probability of the introduction and spread of a pest and of the associated potential economic consequences (FAO 2006).</p>
risk level	<p>To determine if an insect pest population has been eradicated, a risk level must be established, i.e. the type I error level of a test of hypothesis (the alpha level). It is the risk (probability) of wrongly rejecting a true null hypothesis (that insects are present). The risk level is the probability of inferring the absence of insects when in fact insects are present. Refer to Barclay et al. (section 3.1.1.) (this volume).</p>
risk management	<p>Risk management is a structured approach to managing uncertainty related to a threat, through a sequence of human activities including: risk assessment, strategies development to manage it, and mitigation of risk using managerial resources (Wikipedia 2008). The process an organization undertakes to minimize financial, health or other risks by identifying potential hazards or adverse effects, and by planning for and handling incidents which do occur in such a manner that their effect and cost are minimized (NAL 2008).</p> <p>Pest risk management for quarantine pests = Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2006).</p> <p>See 'systems approach'.</p>
risk mitigation	<p>Reduction (mitigation) of the risk using technological, human and organizational resources. Involves methods that reduce the severity of the loss or the likelihood of the loss from occurring. Outsourcing could be an example of risk reduction if the outsourcer can demonstrate higher capability at managing or reducing risks. The strategies include transferring the risk to another party, avoiding the risk, reducing the negative effect of the risk, and accepting some or all of the consequences of a particular risk (Wikipedia 2008).</p> <p>Pest-risk mitigation = Reducing the risk of pest entry by controlling the pest at the offshore point of origin. An important approach to offshore risk mitigation is the creation of pest free areas.</p> <p>See 'entry', 'offshore', 'pest free area'.</p>
riverine	<p>Living near a river (Davies 1967).</p>
RNA	<p>Ribonucleic acid. Family of single-stranded nucleic acids that are used to synthesize proteins (MCC 1996, King et al. 2006). Nucleic acid characterized by the presence of D-ribose and the pyrimidine base uracil. It occurs in three principal forms, as messenger-RNA, ribosomal-RNA, and transfer-RNA, all of which participate in protein synthesis (Doncaster 2008, Kahl</p>

	1995). A polynucleotide in which the sugar residue is ribose and which has uracil rather than the thymine found in DNA (Ayala and Kiger 1984). A chemical found in the nucleus and cytoplasm of cells; it plays an important role in protein synthesis and other chemical activities of the cell. The structure of RNA is similar to that of DNA. There are several classes of RNA molecules, including messenger-RNA, transfer-RNA, ribosomal-RNA, and other small RNAs, each serving a different purpose (Schlindwein 2006). See 'DNA', 'ribosomal RNA'.
RNAase	Also 'RNase'. Ribonuclease. An enzyme that degrades (hydrolyzes) RNA (Hoy 2003, King et al. 2006). Any of a group of nuclease enzymes that catalyzes the cleavage phosphodiester bonds in RNA; most are proteins (Oxford 2006, Kahl 1995). See 'RNA'.
rolling-carpet principle	The various operational phases of pest management are carried out simultaneously in a phased manner. Intervention entails a unidirectional front. This principle of dynamic (Hendrichs et al., section 7.1., this volume). See 'continuous distribution', 'wave principle', 'area-wide integrated pest management (AW-IPM)'.
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salivary gland	Any of several glands that originate in the head and display different anatomical forms among various insect species (Gordh and Headrick 2001). Glands that open into the mouth or at the beginning of the alimentary canal, secreting a digestive, irritant or anticoagulatory material, the saliva (Torre-Bueno 1978, Pfadt 1962, Earthlife 2008). In blood-feeding dipterans, glands are located in the thorax, and in adult females the glands are associated with blood feeding (Resh and Cardé 2003).
sample size	The number of samples, or the number of units in a sample (ASQC 1996). See 'sampling'.
sampling	The process of selecting some part of a population to observe so as to estimate something of interest about the whole population (Everitt 2006, Daly et al. 1998). Estimating the density of organisms (pests or natural enemies) or damage by examining a defined portion of the crop (Weeden et al. 2000). Sample = A selected subset of a population chosen by some process usually with the objective of investigating particular properties of the parent population (Everitt 2006, Hill 1997). Any set of observations or measurements of a particular variable, which does not include all possible observations (Pearce 1992). A portion of material taken from a larger quantity which serves to provide information to judge the quality of the larger quantity (Charbonneau and Webster 1978). See 'direct sampling', 'indirect sampling', 'sequential sampling', 'monitoring', 'reference monitoring site (RMS)', 'sample size', 'sampling fraction', 'survey'.
sampling fraction	The ratio of sample size to population size (Wikipedia 2008). See 'sample size'.
sanitation	Field sanitation involves removing crop residues and the food/habitat of insect pests as a method of pest control (Daly et al. 1998). Refer to Bloem et al. (this volume), Mangan (this volume). In insect mass-rearing, sanitation refers to the control of microbial contamination. Refer to Dyck (2010), Parker (this volume), Dowell et al. (this volume). See 'cultural control', 'crop residue', 'integrated pest management (IPM)', 'mass-rearing'.
satellite facility	In addition to a single insect rearing facility for the mass-rearing and sterilization of insects, there may be one or more satellite facilities for the preparation of the sterilized insects for release. Compare this with a centralized facility (Dowell et al., this volume). See 'centralized facility', 'mass-rearing facility', 'rearing facility', 'modular rearing facility'.
satellite imagery	Images or photographs of the earth's surface obtained by means of artificial satellites in space (Wikipedia 2008).
satellite remote sensing	See 'remote sensing (RS)'.
scotophase	The length of night (the darkness portion of the photoperiod) usually during a 24-hour period (Resh and Cardé 2003, Gordh and Headrick 2001). See 'photophase', 'photoperiod'.
scramble competition	Competition for a resource that is inadequate for the needs of all, but is partitioned equally among contestants, so no competitor obtains the amount it needs and in extreme cases all die (Allaby 1999). Competition in which many individuals 'scramble' for a limited resource, such as food (Auburn 2008). Competition or adverse interaction resulting in all individuals obtaining a smaller share of the food or shelter that is in short supply. Intraspecific competition can be of scramble (resources divided equally) or contest (resources divided unequally). In the context of mating systems, relatively simple mating systems often involve scramble competition among males for females (Lance and McInnis, this volume). See 'mating system', 'mating competitiveness'.
seasonality	Changes in insect populations or human activities due to changes in the season of the year, i.e. changes in temperature, daylength, crop growth, etc. Refer to Lance and McInnis (section 3.1.3.) (this volume). See 'life cycle', 'life history', 'voltinism', 'diapause'.
secondary pest	Pest species that are usually present at low levels and whose population numbers are controlled by the action of natural enemies. Such species can assume full pest status when the natural enemies are destroyed by a pest management tactic, e.g. insecticide application (Gordh and Headrick 2001, Pedigo 2002, Auburn 2008). Pests that do not normally occur in economically important numbers, but which can exceed the economic injury level as a result of changes in cultural practices or crop varieties, or the injudicious use of insecticides applied for a key pest (Maxwell and Jennings 1980). Species that reach damaging levels only after control has been used against a pest species (Daly et al. 1998). A pest which preferably attacks such host plants which have been weakened before by other (primary) pests (Schmutterer 1969). Pest upset = A condition in which innocuous species become man-made pests as a result of insecticide use which unintentionally destroys their population-regulative natural enemies (Coppel and Mertins 1977). See 'key pest', 'economic injury level', 'natural enemies'.
selectable marker	In the context of a genetic sexing system, the term 'selectable marker' is used in a derived sense. A selectable marker can be any genetic mutation that allows separation or elimination of females in a sexing system (i.e. in combination with a Y-autosome translocation). The term is usually used in a rather applied sense, i.e. it refers only to those mutations where the separation/elimination can be achieved on a large scale using appropriate equipment (G. Franz, personal communication). Refer to Franz (this volume). See 'genetic marker', 'marker', 'genetic sexing'.

selection	Any process resulting in observable changes within a generation in the means, variance, and covariance of phenotypic distributions. The evolutionary response to selection depends on inheritance, i.e. its primary consequence is a change in the frequencies of genes affecting traits upon which selection acts. Thus, different genotypes contribute alleles to the gene pool of each generation, not precisely in proportion to their number but relative to the selective advantage they enjoy. The unit of selection is the individual organism. There are three types of selection: natural, sexual and artificial. In contrast to natural selection, artificial selection is a purposeful process with definite goals set by the breeder. It normally occurs with controlled matings of a few selected genotypes, and its goal is to change specific phenotypic traits of a population (Rieger et al. 1991). See 'phenotype', 'genotype'.
self-contained	Refers to self-contained dry-storage irradiator. 'Self-contained' refers to the design of such an irradiator, i.e. the irradiator houses the radiation source within a protective shield of lead or other suitable material, and has a mechanism to move the sample to be irradiated from the loading position to the irradiation position. Such an irradiator can be placed very conveniently in an existing laboratory or a room without needing extra shielding (IAEA 2008b). See 'dry storage', 'irradiator', 'gamma irradiator'.
seminal duct	Also 'vas deferens'. A portion of the male's internal reproductive system that consists of one of the paired canals (tubes), and acts as a conduit for spermatozoa from the testes. Distal ends of paired ducts unite to form an ejaculatory duct (Gordh and Headrick 2001). See 'sperm', 'spermatogenesis'.
seminal fluid	Also 'semen'. A nutrient fluid containing spermatozoa; the product of the testis and its accessory glands (Leftwich 1973). The fluid secreted within the seminal vesicles of the male and surrounding the spermatozoa (Gordh and Headrick 2001). Fluid discharged at ejaculation by the male, consisting of spermatozoa and secretions of glands associated with the genital tract (Pedigo 2002). See 'accessory gland', 'sperm', 'spermatogenesis'.
semiochemical	A chemical produced by an organism that has a communication effect on another individual of the same or a different species (Resh and Cardé 2003, Gordh and Headrick 2001, Hill 1997, Wall and Shearer 1997, Pedigo 2002). A natural or chemical substance emitted by one organism (a producer organism) that modifies the behaviour of a different organism (a receptor organism). Four major types of semiochemicals exist: allomones, kairomones, pheromones, and synomones. These are used in a variety of ways in IPM systems to control the behaviour of insect pests (Coombs and Hall 1998). See 'allomone', 'kairomone', 'pheromone', 'synomone', 'semiochemical', 'sex pheromone'.
semi-sterility	See 'inherited sterility (IS)', 'sterility'.
sensitivity analysis	Involves changing the parameters of a decision problem and studying how this affects the outcome. It is particularly associated with benefit/cost analysis (BCA), where the most common form is the use of alternative discount rates. The purpose of the analysis is to identify the important assumptions upon which the analysis is based – those to which the outcome is sensitive (Pearce 1992). A sensitivity analysis can identify which input parameters are important in contributing to the prediction imprecision of the outcome variable. Consequently, a sensitivity analysis quantifies how changes in the values of the input parameters alter the value of the outcome variable (Everitt 2006). Consideration of various possible outcomes on the rate of return or other measure of profitability (Friedman 2007). Sensitivity analysis, the process of testing the model with a realistic range of values, is important in BCA to indicate how risks associated with the programme could affect decisions. Sensitivity analysis would demonstrate the range of outcomes using input values with some variation around the most likely expected values. Sensitivity analysis may indicate that some high returns are associated with greater risk (Mumford, this volume). See 'benefit/cost analysis (BCA)'.
sentinel animal	Animals susceptible to an insect pest or disease are kept intentionally in a place where they are vulnerable to the pest or disease, and the monitored health status of these animals is used to indicate the presence or absence of the pest or disease.
sequential aerosol technique (SAT)	The application in sequence of several ultra-low-volume sprays of non-residual insecticides, usually by aircraft. Refer to Mangan (this volume), Cox and Vreysen (section 3.2.) (this volume), Allsopp and Hursey (2004). See 'aerial spray', 'chemical control', 'area-wide control', 'temperature inversion'.
sequential eradication	Repeated eradication over time of an insect pest in an area, each eradication operation following a reinvasion of the pest. Refer to Hendrichs et al. (section 2.2.) (this volume), Barclay et al. (this volume). See 'eradication', 'serial eradication', 'pest free area', 'pest free status'.
sequential release	Repeated inundative release of sterile insects, one release followed by another release after a period of time. See 'release', 'aerial release', 'ground release', 'sterile insect technique (SIT)'.
sequential sampling	A statistical process to decide which of two hypotheses to accept as true. Observations are made one at a time, and a test is carried out to decide whether one of the hypotheses is to be accepted or whether more observations should be made. The sampling stops when it has been decided which hypothesis to accept (Clapham 1996). Sampling inspection in which, after each unit is inspected, the decision is made to accept the lot, not to accept it, or to inspect another unit (ASQC 1996). See 'sampling'.
serial eradication	Repeated eradication operations following each reinvasion of an insect pest. However, in contrast to 'sequential eradication', the eradication operations do not involve large investments to prove the 'status of eradication'. To obtain the trade advantages, the concept of serial eradication would entail a 'systems approach', which includes a combination of low-cost monitoring, postharvest treatments, and occasional intensive area-wide control actions. Refer to Hendrichs et al. (section 2.2.) (this volume), Barclay et al. (this volume). See 'eradication', 'sequential eradication', 'postharvest treatment', 'systems approach', 'pest free area', 'pest free status'.
setae	Socketed hairs in insects (Grimaldi and Engel 2005, Pedigo 2002). Long, thin, cuticular extensions, produced by epidermal cells; flexible at the base (Wall and Shearer 1997).
sewage treatment	Domestic and industrial sewage (waste water and other refuse such as human waste carried away in sewers) that is treated (removal of solids, biological oxidation and bacterial action) in special plants to make it safe to be pumped into a river or the sea, or used in some way such as fertilizer (Collin 2001, Porteous 1996). Waste lagoons = Artificial ponds used for the storage and/or treatment of wastewaters, liquid wastes, sludges, etc. (NAL 2008). See 'waste disposal', 'water treatment', 'spent diet', 'diet disposal'.
sex attractant	Something that attracts the opposite sex, or one of the sexes. See 'sex pheromone', 'attraction'.

sex chromosomes	Chromosomes involved in sex determination. In many species, these are the X and Y chromosomes; they are distinguished from the autosomes (Hoy 2003, Oxford 2006, Lackie and Dow 1995). The homologous chromosomes that are dissimilar in the heterogametic sex (King et al. 2006). Those chromosomes whose content are different in the two sexes; usually labelled X and Y (or W and Z), one sex has XX (or WW), the other sex has XY (or WZ) (Burt and Trivers 2006, Lewin 1985). See 'chromosome', 'heterogametic', 'autosome'.
sex linkage	Sex-linked genes are those carried on sex chromosomes (Doncaster 2008, Ayala and Kiger 1984, Watson 1976). Pattern of inheritance shown by genes carried on a sex chromosome (Lewin 1985). A special case of linkage occurring when a gene that produces a certain phenotypic trait (often unrelated to primary or secondary sexual characters) is located on the X chromosome. The result is that in certain crosses the phenotypic trait in question may be observed only in individuals of the heterogametic sex, differences between reciprocal crosses may also be observed, and the trait will be observed much less frequently among members of the homogametic sex. Genes riding on the Y chromosome will influence only the heterogametic sex (King et al. 2006). The linkage of a gene producing a certain phenotype with a sex chromosome. Such a gene, or the character it determines, is said to be 'sex linked'. Mutation of genes on the X chromosome is often apparent only in the male offspring, which have only one X chromosome. The mutation may be masked in the female unless the mutation also occurs on the other X chromosome (Oxford 2006). Refer to Franz (section 2.2.) (this volume). See 'chromosome', 'gene', 'phenotype', 'heterogametic', 'homogametic', 'reciprocal cross'.
sex pheromone	Chemical compounds released from exocrine glands which are used to attract conspecific members of the opposite sex (Gordh and Headrick 2001). An intraspecific chemical messenger emitted by one sex which attracts the opposite sex (Pedigo 2002). See 'pheromone', 'pheromone trap', 'allomone', 'kairomone', 'semiochemical', 'mating disruption', 'conspicific'.
sex ratio	Within a population, the proportion of males compared with that of females (Pedigo 2002, Hill 1997). See 'male-only release', 'optimal sex ratio'.
sex separation	Physical separation of male and female insects, usually for the purpose of sterilizing and releasing only males. Refer to Parker (section 9) (this volume). See 'male-only release', 'genetic sexing'.
sexing system	See 'genetic sexing', 'sex separation'.
sexual behaviour	Behaviour relating to sexual communication between males and females. Refer to Lance and McInnis (this volume). See 'mating behaviour', 'mating', 'mating system', 'courtship', 'lek', 'mate-choice', 'copulation'.
shelf-life	Length of time that live insects tolerate storage and/or long-distance shipment. Refer to Robinson and Hendrichs (section 3.2.1.) (this volume).
sibling species	Species that are very similar morphologically and in other ways, and thus considered to be closely related (Grimaldi and Engel 2005, Aluja and Norrbom 2001, White and Elson-Harris 1992, Auburn 2008). See 'cryptic species'.
sigmoidal	Description of a curve having an elongated 'S'-shape (Everitt 2006, Borror et al. 1989). Refer to Itô and Yamamura (Figure 1) (this volume).
silver staining	A sensitive method for detecting protein in polyacrylamide gels. At the site of the protein on the gel, silver ions are reduced to metallic silver in the presence of the developing reagent, formaldehyde, in a reaction promoted by the protein. Protein bands stain black. A modification of the protocol can be used for the sensitive detection of DNA in polyacrylamide gels (Oxford 2006, Walker and Cox 1995). A technique for the visualization of proteins and nucleic acids in polyacrylamide gels, in which silver ions react with the macromolecules at pH>10, form complexes, and are subsequently reduced to elementary silver. The silver is deposited at the sites of reduction, and can be visualized easily (Kahl 1995). See 'single-strand conformational polymorphism (SSCP)', 'polymerase chain reaction (PCR)', 'mitochondrial DNA (mtDNA)', 'gel electrophoresis'.
simulation	An attempt to replicate a physical procedure mathematically, where the system being studied is too complicated for explicit analytic methods to be used. Because of the complexity, simulation is often carried out by computer, perhaps using Monte Carlo methods. As simulation is often only an approximation to the physical procedure, the use of sensitivity analysis is crucial (Clapham 1996). A form of forecasting which generates a range of alternative projections based on differing assumptions about future situations (Pearce 1992). The creation of a controlled replication of a real-life situation for purposes of analysis or policy decision-making. It may be abstract and use sophisticated mathematics (Statt 1991). The artificial generation of random processes (usually by means of pseudorandom numbers and/or computers) to imitate the behaviour of particular statistical models (Everitt 2006). See 'modelling', 'Monte-Carlo simulation', 'sensitivity analysis', 'growth model', 'logistic model', 'population model', 'deterministic model', 'stochastic model'.
single-strand conformational polymorphism (SSCP)	A method for distinguishing between similar-sized DNA fragments according to the mobility of the single-stranded DNA (ssDNA) under polyacrylamide gel electrophoresis (Schlindwein 2006). Technique for the detection of mutations in genomic DNA, that is based on subtle differences of electrophoretic mobility between a non-mutated single-stranded sequence and its mutated counterpart. Such differences arise from mutation-induced changes in the three-dimensional structure of the target DNA (Kahl 1995). Technique for detecting point mutations in genes by amplifying a region of genomic DNA (using asymmetrical PCR) and running the resulting product on a high-quality gel. Single base substitutions can alter the secondary structure of the fragment in the gel, producing a visible shift in its mobility (Lackie and Dow 1995). A method for detecting mutations by the rate at which single-stranded DNA (ssDNA) migrates on electrophoresis gels, under conditions in which the conformation adopted by the DNA is critical. The technique involves amplification of a DNA sequence of interest using the PCR; the DNA is denatured to form single strands and then applied to the gel under non-denaturing conditions. The three-dimensional conformation adopted by ssDNA is sequence dependent and sensitive to single base changes, and this in turn affects the rate of migration in the gel. Wild-type DNA produces two bands of characteristic mobilities that act as references with which to compare the rate of migration of DNA containing a mutation or polymorphism (Oxford 2006). See 'gel electrophoresis', 'polymerase chain reaction (PCR)', 'DNA'.
sleeping sickness	See 'human African trypanosomiasis (HAT)', 'trypanosomiasis'.
soil drench	Soil treatment with insecticide. It consists of a drench [soaking] treatment within the drip-line of infested host plants to control pest larvae entering the soil and adults emerging from the soil (Nagel and Peveling, this volume).
somatic damage	Non-hereditary damage to individual cell tissues from radiation (Cutter and Renwick 2003). Irradiation of insects intended to damage germ cells unfortunately also causes unintended damage to somatic cells, resulting in a lower quality insect with reduced competitiveness. However, there are ways to reduce somatic damage. Refer to Bakri et al. (this volume).

	Somatic cells = All cells in the body except gametes and their precursors (Schlindwein 2006). All the eukaryotic body cells except the germ-line cells and the gametes they produce (Hoy 2003, Lewin 1985, NAL 2008). See 'genetic damage'.
spatial analysis	A number of techniques that analyse objects using their topological, geometric, or geographic properties. In the context of ecological studies, these techniques are most commonly used to manipulate or transform data within geographic information systems (GIS) to extract additional meaning from them. Common examples of spatial analysis include buffering map features (e.g. to define areas of exposure (potential infestation) around insect-breeding sites), interpolating between points (e.g. to produce climate "surfaces" from a network of weather stations), and overlaying a number of individual geographical coverages to produce derivative maps (Cox and Vreysen, this volume). See 'geographic information systems (GIS)'.
spatial distribution	Distribution and dispersion patterns of insects in relation to location within the habitat, microhabitat and ecological niches. Most populations tend to have a somewhat aggregated dispersion pattern (Barclay, this volume). Knowledge of spatial distribution is important in placing the control effort and simultaneous monitoring in the most effective positions. The distribution of the pest population within the targeted area, with particular regard to terrain, vegetation, and other features likely to affect distribution and density, should be ascertained (Barclay et al., this volume). The spatial distribution of most insect pests is not uniform but patchy, and there can be localized pockets of high insect density, in spite of a potentially misleading low-overall population density. It is of prime importance, for the development and implementation of an insect control programme, that these pockets or 'hot spots' be located (Cox and Vreysen, this volume). The availability of temporal and spatial distribution models of the target insects on a large spatial scale has implications beyond the design of efficient sampling frames. In particular, such models should facilitate a more efficient deployment of suppression tools, as well as a better-targeted release of sterile insects (Cox and Vreysen, this volume). Refer to Barclay (section 2.13.) (this volume), Vreysen (section 2.2.3.) (this volume), Barclay et al. (section 3.1.2.) (this volume), Cox and Vreysen (section 3.1.) (this volume), Hendrichs et al. (section 6) (this volume). See 'distribution', 'dispersion'.
spatial heterogeneity	Non-uniform and varied distribution and location of insects within the habitat. Spatial heterogeneity is related mostly to host availability and vegetation (Vreysen, this volume). See 'spatial distribution', 'clumped distribution'.
spatial occupation	Location of ecological niches in the microhabitat (e.g. certain vegetation types) occupied by a species. See 'spatial distribution', 'spatial heterogeneity'.
spatial resolution	Pixel size. The spatial resolution (pixel size) of various satellite sensors varies enormously, from 0.61–2.4 m to 250–2400 m (Cox and Vreysen, this volume). Refer to Cox and Vreysen (Box 1) (this volume). See 'remote sensing (RS)'.
species-specific	A characteristic or parameter of a species, a control method, or a mathematical model that is specific to a particular species. The sterile insect technique (SIT) is a technology that is species-specific; released sterile insects target individuals only of the same species.
spectral resolution	The number, width and spacing of the spectral 'bands' used by a satellite sensor. Sensors detect radiation from the sun that has been reflected by the earth's surface. The amount of reflected radiation depends on the nature of the surface and on the wavelength of the radiation concerned. The ability to use these 'spatial signatures' to infer surface properties depends on the spectral resolution of the remote-sensing data being used. Such data are used to distinguish between different land-cover types (Cox and Vreysen, this volume). Refer to Cox and Vreysen (Box 1) (this volume). See 'remote sensing (RS)'.
spent diet	Insect diet that has been used up and is ready for disposal. See 'diet disposal', 'diet'.
sperm	Also 'spermatozoon'. Any male gamete. Principal components of sperm include an acrosome, head, nucleus and tail (Gordh and Headrick 2001, Schlindwein 2006). A mature male germ cell (MH 1997). Plural 'spermatozoa' (Torre-Bueno 1978). See 'spermatogenesis'.
sperm precedence	In multiple matings, the tendency for sperm from the most recent mating to fertilize the eggs (Auburn 2008). The increased likelihood that sperm from a particular mating will be used for fertilizing an egg (Resh and Cardé 2003). Having sperm that fertilize the eggs of a female, regardless of multiple matings (Daly et al. 1998). Refer to Lance and McInnis (this volume).
sperm transfer	The successful transfer [or passing] of sperm from a male to a female's spermathecae during copula. This may be accompanied by accessory gland fluid (FAO/IAEA/USDA 2003). See 'copulation', 'insemination', 'mating', 'accessory gland', 'sperm', 'spermatheca'.
spermatheca	Also 'seminal receptacle'. A sac, duct or reservoir within the female insect that receives spermatozoa during copulation which are stored until fertilization (Gordh and Headrick 2001, MH 1997, Leak 1999). A sperm storage organ in female insects that dispenses sperm as the eggs pass through the oviduct (Resh and Cardé 2003, IDIDAS 2008). See 'sperm', 'copulation'.
spermathecal value	A measure of the quantity of accessory fluid transferred (Calkins and Parker, this volume). After copulation and sperm transfer, the proportion of the spermathecae that is filled. A full spermatheca is given a value of 1.0. For two spermathecae, the maximum spermathecal value is 2.0. See 'spermatheca', 'sperm transfer', 'accessory gland', 'copulation'.
spermatids	The cells that are produced during meiosis in spermatogenesis and that eventually develop into functional spermatozoa (Ayala and Kiger 1984). The final male reproductive cells, arising by division of the second spermatocytes; contain the haploid chromosome number and are converted without further reduction division into spermatozoa (Gordh and Headrick 2001). A spermatid is one of four haploid cells formed during meiosis in the male. Spermatids without further division transform into spermatozoa, a process known as spermatogenesis (King et al. 2006). See 'spermatogenesis', 'haploid', 'sperm', 'meiosis'.
spermatogenesis	The process whereby primordial germ cells form mature spermatozoa (Lackie and Dow 1995, Resh and Cardé 2003). The process of differentiation of a mature sperm cell from an undifferentiated germ-line cell, including the process of meiosis (Ayala and Kiger 1984). The process of sperm development through reduction division of chromosomes and transformation of cell content from a spermatogonium, through primary and secondary spermatocytes, to a spermatozoon (Gordh and Headrick 2001). Spermatogenesis involves a series of events, including mitotic divisions in spermatogonia, meiotic divisions in spermatocytes, and morphological changes in spermatids that lead to the formation of mature spermatozoa (King et al.

	2006).
spermatophore	Some male insects produce an encapsulated package of sperm that is passed during mating and can include proteins that are eaten or absorbed by the female (Resh and Cardé 2003, Pedigo 2002). A covering, capsule or envelope around the spermatozoa (Torre-Bueno 1978, NAL 2008). The package is composed of seminal fluid mixed with excretions of the male accessory glands. The spermatophore is made by the male reproductive system and transmitted to the female during copulation (Gordh and Headrick 2001). See 'sperm', 'seminal fluid', 'accessory gland', 'copulation', 'mating'.
stakeholder	Anyone with an interest, concern or 'stake' in something, in an entity or in what the entity does (Oxford 2008, Webster 2008), e.g. stakeholder in an area-wide integrated pest management programme.
standard operating procedure (SOP)	A procedure, for example an activity in mass-rearing insects, that has been standardized through experimentation, review and agreement, and then described in detail in a standard operating procedure (SOP) document. Subsequently any worker performing this procedure should follow exactly the written instructions as given in the SOP. Refer to Parker (this volume), FAO/IAEA (2006). See 'standard', 'quality standard'.
standard	Document established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context (FAO 2006). Quality or measure serving as a basis or principle by which others conform or should conform, or by the accuracy or quality of others is judged (FAO/IAEA/USDA 2003). An accepted or agreed object, thing or definition to which all others in its category are referred (Gordh and Headrick 2001, Collin 2001). Refer to Boller and Chambers (1977). See 'quality standard', 'standard operating procedure (SOP)'.
startle test	The quality control 'startle test' measures the level of irritability in insects. Refer to Calkins and Parker (this volume), Boller and Chambers (1977), Boller et al. (1981). See 'irritability', 'quality control (QC)', 'product quality control'.
static release	One method of releasing sterile insects is static ground-based receptacles (static release). Sterile pupae or adults are placed into the receptacles from which they emerge or exit (Dowell et al., section 5.1., this volume). See 'release', 'aerial release', 'ground release'.
stationary-bait technology	Use of stationary traps and insecticide-impregnated targets, e.g. attractively coloured material, to suppress insect pest populations. Refer to Mangan (this volume), Cox and Vreysen (section 3.2.) (this volume), Vale and Torr (2004). See 'attract and kill', 'lure and kill', 'pheromone trap', 'live-bait technology'.
status of eradication	The condition or status that eradication has occurred, and the pest is no longer present in the area. See 'eradication'.
steady state	With respect to a specified substance, the characterization of a dynamic system in which the input and output rates of the substance are equal (IAEA 1992). Situation where the input, output and properties of a system remain constant over time (Collin 2001). A condition in which the properties of any part of a system are constant during a process or reaction; i.e. where the rate of formation or increase of a particular quantity is balanced by its rate of removal or decrease (Oxford 2006). The state of a system in which the characteristic parameters remain constant. Dynamic equilibrium (Webster 2008).
stem cell	Stem cells are able to self-renew and generate cell populations that differentiate to maintain adults tissues (Hoy 2003, Watson 1976). Any member of the various groups of reserve cells that replace cells destroyed during the normal life of the animal. Stem cells can divide without limit; after division, the stem cell may remain as a stem cell or proceed to terminal differentiation (Oxford 2006, Walker and Cox 1995). Undifferentiated or partially differentiated animal or plant cells that can proliferate. There are two classes – embryonic stem cells and adult tissue stem cells (King et al. 2006).
stepwise mutation model (SMM)	Each mutation introduces an allele differing from the progenitor allele by one 'step', either in a positive or a negative direction in the allele space. For microsatellites, most of which are three or four base pair (bp) units, each step would be + or - 3 or 4 bp. Refer to Krafur (Box 2) (this volume). See 'microsatellite', 'mutation', 'allele'.
sterile insect	An insect that, as a result of a specific treatment, is unable to reproduce (FAO 2006; Klassen, this volume; Robinson, this volume). An insect incapable of reproduction (Gordh and Headrick 2001). See 'sterility', 'induced sterility', 'sterile insect technique (SIT)'.
sterile insect technique (SIT)	Method of pest control using area-wide inundative release of sterile insects to reduce reproduction in a field population of the same species (FAO 2006; Klassen, this volume; Robinson, this volume). The SIT depends upon inducing a high proportion of sterile matings in a natural population that reduces reproduction to a level below population maintenance (Parker, this volume). A genetic control technique used to control or eradicate pest insects. Large numbers of mass-produced males are given non-lethal but sterilizing doses of radiation and then released. Females in natural populations mate with the sterilized males, and produce inviable progeny. After multiple releases a new generation is not produced (Hoy 2003, King et al. 2006, Coppel and Mertins 1977, Daly et al. 1998, Bijlmakers 2008, NAL 2008). A process in which insects are reared in massive numbers, sterilized, and released to prevent normal mating in target populations (Resh and Cardé 2003). A method of insect control in which laboratory-propagated insects are irradiated to the point of sterility and then released into the environment to compete for males with conspecifics in feral populations (Gordh and Headrick 2001). Sterile male technique = A method of insect control, in which sterile males are introduced to a community of insect pests to control population growth (Coombs and Hall 1998). See 'sterile insect', 'genetic control', 'genetically impaired female technique (GIFT)', 'release of insects carrying a dominant lethal (RIDL)', 'sterility', 'induced sterility', 'inundative release'.
sterile sting	Fruit damage caused by oviposition of an inviable egg by a sterile female fruit fly (Franz, this volume).
sterile:wild ratio	See 'overflooding ratio'.
sterility	Complete or partial failure of an individual to produce functional gametes or viable zygotes (A.S. Robinson, personal communication). A structural or functional inability to reproduce (Gordh and Headrick 2001). Temporary or permanent incapability to produce (Borders 1991). See 'induced sterility', 'inherited sterility (IS)', 'substerile', 'full sterility', 'gamete', 'zygote'.
sterility testing	Testing samples of irradiated insects on a regularly scheduled basis to confirm that specified levels of sterility are being achieved. The test compares the egg hatch from pairings of irradiated and non-irradiated insects with that from crosses of non-irradiated insects (Bakri et al., this volume). Refer to Bakri et al. (section 3.5.3.) (this volume). See 'sterility', 'induced sterility', sterile insect technique (SIT)'.

sterilization	The process of eliminating the ability to reproduce (IDIDAS 2008, King et al. 2006). To render incapable of sexual reproduction (Oxford 2006). Refer to Bakri et al. (this volume). The process of killing or removing all living micro-organisms from a sample (IDIDAS 2008, King et al. 2006, NAL 2008). Refer to Dyck (2010). See 'radiosterilization', 'sterilizing dose', 'sterility', 'induced sterility', 'sanitation'.
sterilizing dose	Radiation dose that will sterilize the sample to the specified level of sterility (K. Mehta, personal communication). Refer to Bakri et al. (section 3.4.1.) (this volume). See 'substerilizing dose', 'radiosterilization', 'sterilization', 'induced sterility', 'inherited sterility (IS)', 'absorbed dose'.
sticky trap	Insect trap where a surface inside the trap is covered with a sticky glue to catch and hold insects attracted or lured to the trap. See 'attractive device', 'delta trap', 'Jackson trap', 'pheromone trap', 'trap', 'wing trap'.
stochastic model	A stochastic or random model is a simulation model based on variables with values determined by chance (a random variable). The model does not perfectly explain all observations (Friedman 2007). A model containing random or probabilistic elements (Everitt 2006). Each independent variable in the model may be assigned a range of values, which will be random, but which will generally correspond to a statistical distribution (FAO/IAEA 1973). See 'deterministic model', 'simulation', 'model', 'modelling', 'Brownian random motion'.
stone fruit	A drupe or pyrene. A fruit having a thin or leathery exocarp, a fleshy mesocarp, and a single seed with a stony endocarp, e.g. cherry, plum, peach, apricot (Little and Jones 1980, MH 1997). See 'pome fruit'.
strain degradation	Degradation [reduction to a lower quality] of insect strains in a mass-rearing environment may be related to adaptation through selection, inbreeding and genetic distance from founding and target populations. A progressive loss of diversity in laboratory colonies, coupled with a progressive decay in physiological quality control indices, could provide evidence of degradation, and possibly predict a decline in field competitiveness (Krafsur, this volume). Refer to Krafsur (this volume), Franz (this volume), Parker (this volume), Calkins and Parker (this volume). Strain = A group of related individuals having certain characters that distinguish the members from other such groups within the same species (Oxford 2006, Kahl 1995, Gillett 1971). A breed or stock of insects that have been held in isolated colonies for a period of time (FAO/IAEA/USDA 2003). Insects descended from a common stock or line, sometimes identified by certain characters or qualities (IDIDAS 2008, Oxford 2006). See 'selection', 'inbreeding', 'founding population', 'diversity', 'quality control', 'competitiveness', 'colonization'.
strain domestication	Adaptation of a colony of insects to laboratory conditions within a few generations through rearing-induced genetic changes (Calkins and Parker, this volume). Refer to Calkins and Parker (section 3) (this volume), Parker (this volume). See 'domestication', 'selection', 'colonization'.
strategic option	The strategic (critically planned) options (choices) [or approaches] in which the sterile insect technique (SIT) can be integrated into area-wide integrated pest management (AW-IPM) programmes. The four strategic options are suppression, eradication, containment and prevention (Hendrichs et al., this volume). Refer to Hendrichs et al. (section 2) (this volume), Enkerlin (section 3.2.) (this volume). See 'area-wide integrated pest management (AW-IPM)', 'integrated pest management (IPM)', 'total population management', 'pest control'.
stress test	The longevity/stress test, often related to pupal size, measures the percentage of adults that survives for a set time period, depending on species, without food or water. This test produces stress, and is indicative of the amount of nutritional reserves present when adults emerge (Calkins and Parker, section 4.9., this volume). Refer to FAO/IAEA/USDA (2003). See 'quality control (QC)', 'product quality control', 'process quality control'.
substerile	Partially sterile. Refer to Carpenter et al. (this volume), Robinson (this volume). See 'inherited sterility (IS)', 'sterile insect', 'sterility', 'induced sterility', 'sterile insect technique (SIT)'.
substerilizing dose	Radiation dose that will incompletely sterilize the sample. Refer to Carpenter et al. (this volume), Bakri et al. (section 3.4.1.) (this volume). See 'inherited sterility (IS)', 'sterilizing dose', 'radiosterilization', 'sterilization', 'induced sterility', 'absorbed dose'.
suitability analysis	Spatial coverages are weighted and combined to identify and display locations that meet specific criteria (Cox and Vreysen, this volume). Refer to Cox and Vreysen (this volume). See 'geographic information systems (GIS)', 'spatial analysis'.
supernumerary chromosome	A chromosome that is present, often in varying numbers, in addition to the characteristic invariable complement of chromosomes (King et al. 2006, Leak 1999). Refer to Krafsur (this volume). See 'chromosome'.
supplementary pest control	See 'supplementary pest suppression', 'pest control', 'pest management'.
supplementary pest suppression	In the context of area-wide integrated pest management (AW-IPM) and the integrated application of the sterile insect technique (SIT), pest suppression using various control methods is usually undertaken as a supplementary approach to reduce the pest population density before and/or during the application of the SIT. Refer to Mangan (this volume). See 'suppression', 'strategic option', 'pest control', 'pest management', 'area-wide integrated pest management (AW-IPM)', 'integrated pest management (IPM)', 'sterile insect technique (SIT)'.
supplementary population control	See 'supplementary pest suppression', 'population suppression', 'population management', 'total population management'.
suppression	The application of phytosanitary measures in an infested area to reduce pest populations (FAO 2006; FAO/IAEA/USDA 2003; IAEA 2003; Hendrichs et al., this volume). A type of regulatory control programme in which a target-pest population is decreased within a geographical region (Gordh and Headrick 2001). Reduction of a pest population to below some predetermined economic threshold (USDA 1993). Reducing the numbers of a tsetse population in a given area so that the density falls below an unspecified level, resulting in reduced disease transmission to humans or livestock. The objective may be to reduce the population to a level at which SIT becomes feasible rather than for disease control (Leak et al. 2008). Refer to Hendrichs et al. (section 2.1.) (this volume), Mangan (this volume). See 'phytosanitary', 'strategic option', 'regulatory', 'pest control', 'pest management', 'economic threshold'.
surveillance	An official process which collects and records data on pest occurrence or absence by survey, monitoring or other procedures (FAO 2006). The watch kept on a pest for detection of the species' presence and determination of population density, dispersion, and dynamics (Pedigo 2002, Gordh and Headrick 2001). Refer to Vreysen (this volume), IAEA (2003).

	See 'survey', 'monitoring', 'trap', 'attractive device', 'sampling'.
survey	An official procedure conducted over a defined period of time to determine the characteristics of a pest population or to determine which species occur in an area (FAO 2006). A detailed inspection or critical examination of an object or area for a specific purpose (Gordh and Headrick 2001). Refer to Vreysen (this volume), IAEA (2003), Leak et al. (2008). See 'surveillance', 'monitoring', 'trap', 'attractive device', 'sampling'.
survival	Continuing to live (Collin 2001). State of surviving; remaining alive; a natural process resulting in the evolution of organisms best adapted to the environment. One measure of fitness (Schlindwein 2006). See 'population dynamics', 'population ecology', 'population processes', 'longevity', 'mortality'.
suspension zone	When an outbreak of an invasive species has been detected, the transport of materials that could contain live insects is suspended in the zone around the area of infestation until the pest has been brought under control. Refer to Barclay et al. (section 3.5.) (this volume). See 'outbreak', 'invasive species'.
swormlure	An attractant or lure placed in traps to catch adult New World screwworms. Refer to Mangan (this volume). See 'trap', 'wing trap', 'attractive device', 'attraction', 'lure', 'ceralure', 'cuelure', 'disparlure', 'gossypure', 'hexalure', 'propylure', 'trimedlure'.
symbiont	A species living in close association with another, unrelated species (Grimaldi and Engel 2005, Hoy 2003). One species living in symbiosis with another (Pedigo 2002, Jolivet 1998, NAL 2008). Symbiosis = A close association between two or more different species that benefits one or both of the species (Pedigo 2002, Coppel and Mertins 1977). The mutually advantageous association between two dissimilar organisms (Collett 2001, Walker and Cox 1995). See 'endosymbiont'.
synaptonemal complexes	An elaborate morphological structure that holds paired chromosomes together during synapsis in prophase I of meiosis and promotes genetic recombination (Oxford 2006, Lewin 1985). An organelle, present during meiosis, that mediates close pairing between homologous regions of chromatids (Ayala and Kiger 1984). The protein structure aggregating the two paired chromosomes at the pachytene stage of meiosis (Schlindwein 2006). Structure lying between chromosomes during synapsis; consists of two lateral plates closely apposed to the chromosomes and connected to a central plate by filaments. It appears to act as a scaffold, and is essential for crossing-over (Lackie and Dow 1995, King et al. 2006, NAL 2008). Synapsis = Describes the association of the two pairs of sister chromatids representing homologous chromosomes that occurs at the start of meiosis; resulting structure is called a bivalent (Lewin 1985). The pairing of homologous chromosomes during the zygotene stage of meiosis (Hoy 2003, Ayala and Kiger 1984). See 'crossing-over', 'pachytene', 'zygotene', 'meiosis', 'chromosome', 'chromatids'.
synchrony	Simultaneous action, development, or occurrence (Oxford 2008).
synergism	The action of two or more factors together achieving a greater effect than the sum of the individual effects of the factors (Pedigo 2002, Walker and Cox 1995). The action of two or more substances to achieve an effect of which each is individually incapable; synergistic effects may be greater or less than the sum of effects of the substances in question (USDA 1993).
synomone	Chemical that benefits both a plant and an insect in a mutualistic relationship (Nagel and Peveling, section 5.5., this volume). A substance (semiochemical) that is transmitted from one organism to another, producing a response that is beneficial to both the sender and the receiver, as in a floral scent which indicates a nectar source to a pollinator and thereby facilitates pollination (Coombs and Hall 1998, Resh and Cardé 2003, Gordh and Headrick 2001, Bijlmakers 2008). See 'pharmacophagy', 'pollinator', 'semiochemical', 'allomone', 'kairomone', 'pheromone', 'parapheromone'.
systems approach	The integration of different risk management measures, at least two of which act independently, and which cumulatively achieve the appropriate level of protection against regulated pests (FAO 2006). The integration of those preharvest and postharvest practices used in production, harvest, packing, and distribution of a commodity which cumulatively meet the requirements for quarantine security (IAEA 2003). See 'integrated pest management (IPM)', 'risk management', 'postharvest treatment', 'quarantine', 'serial eradication'.
<b>T</b>	
Tanaka box	Paperboard box in which adult fruit flies emerge from pupae held in paper bags. The box allows for ventilation, and food and water is provided to the flies (Dowell et al., section 4.1., this volume). See 'emergence', 'plastic adult rearing container (PARC)', 'tower system'.
target (insecticide-impregnated)	A stationary device, e.g. attractively coloured material, impregnated with an insecticide to suppress insect pest populations. Refer to Mangan (this volume), Cox and Vreysen (this volume), Nagel and Peveling (this volume), Leak 1999, Vale and Torr 2004. See 'stationary-bait technology'.
target population	The population of an organism that is the intended target, object or focus of an action or programme. In the context of the SIT, the target population is the wild population that the sterile insects are being released against (FAO/IAEA/USDA 2003). See 'non-target species'.
telomere	A specialized DNA sequence found at the ends of eukaryotic chromosomes (King et al. 2006). The DNA-protein structure seals either end of a chromosome. Telomeric DNA consists of simple tandemly repeated sequences specific for each species (Oxford 2006). The sequences at the ends of the chromosomes are necessary to allow chromosomes to replicate (Walker and Cox 1995), and protect the ends of chromosomes and confer stability (Hoy 2003). See 'chromosome', 'centromere'.
telophase	The fourth phase of mitosis. During telophase, the spindle disappears and reconstruction of nuclear envelopes about the two groups of offspring chromosomes begins. As nuclear envelopes form around each group, the chromosomes return to their extended state, and nucleoli reappear (King et al. 2006). The last stage of mitosis, or of either division of meiosis, during which the chromosomes become progressively thinner and more elongated. Telophase begins with the formation of a nuclear membrane around each group of daughter-chromosomes (Schlindwein 2006, Ayala and Kiger 1984). See 'mitosis', 'meiosis', 'prophase', 'metaphase', 'anaphase', 'interphase'.
temperature inversion	An atmospheric phenomenon where a layer of cold air just above the ground is colder than warm air above it, making the temperature of the air rise as it gets further from the ground (Collin 2001, Allaby 1994, Porteous 1996). Refer to Cox and Vreysen (this volume).

	See 'sequential aerosol technique (SAT)'.
temperature-sensitive lethal ( <i>tsl</i> )	A conditional mutation that causes lethality in a particular temperature range. In the permissive temperature range the mutant gene product is stable and the mutant is viable (G. Franz, personal communication). See 'conditional lethal mutation', 'lethality'.
temporal resolution	The time taken for a satellite to revisit the same point in its orbit (repeat time or revisit time) (Cox and Vreysen, this volume). Refer to Cox and Vreysen (Box 1) (this volume). See 'remote sensing (RS)'.
temporary buffer zone	A buffer zone that is established temporarily. Eradication programmes that proceed in phases or blocks might require buffer zones between the intervention blocks to temporarily protect achievements made in each phase of the advancing programme (Hendrichs et al., this volume). Refer to Hendrichs et al. (section 9.1.) (this volume). See 'buffer zone', 'permanent buffer zone'.
teneral	Pertaining to the adult soon after emergence from the nymphal or pupal stage when the integument is not hardened or its definitive colour has not been completed (Gordh and Headrick 2001, Aluja and Norrbom 2001, Torre-Bueno 1978, Resh and Cardé 2003, Daly et al. 1998, Borror et al. 1989). Condition of a newly emerged, not yet fully mature, adult insect (Wall and Shearer 1997). A tsetse fly is called a teneral fly from the time it emerges until the taking of its first blood meal (Bijlmakers 2008). See 'pharate'.
teratogenic	Characteristic of a substance that produces malformations in embryos (Oxford 2006, King et al. 2006). Causing defects in developing embryos (Daly et al. 1998).
territorial behaviour	A pattern of behaviour in which one or more animals occupy and defend a definite area or territory, mainly against members of the same species (MH 1997, Allaby 1994, Aluja and Norrbom 2001). Animal behaviour that serves to establish, demarcate and defend an area (Scotty 1996). This behaviour leads to individual animals or groups being spaced further apart than would be expected from a random occupation of suitable habitats (Doncaster 2008).
thelytoky	A type of parthenogenesis in which diploid females are produced from unfertilized eggs, and males are absent or rare (King et al. 2006). Unmated females produce female progeny only, or rarely, a few males (Hoy 2003, Hill 1997, Daly et al. 1998, Borror et al. 1989). See 'parthenogenesis', 'progeny'.
topography	Description and mapping of the surface features of an area of land (Hill 1997). Refer to Hendrichs et al. (section 5.5.) (this volume). For a definition of "topographic map", see Leak et al. (2008).
total population management	Synonym for area-wide integrated pest management (AW-IPM). According to Hendrichs et al. (2007), the principle of total population control was described by Knippling as follows: Uniform suppressive pressure applied against the total population of the pest over a period of generations will achieve greater suppression than a higher level of control on most, but not all, of the population each generation. See 'area-wide integrated pest management (AW-IPM)', 'integrated pest management (IPM)'.
total quality control	Adoption of tools and procedures to regulate the processes of production so that product quality will be insured through control of processes (Chambers and Ashley 1984). Encompasses the entire structure and associated mechanisms for developing and improving product quality and productivity (Leppla and Fisher 1989). Total quality control utilizes a systems approach, and emphasizes planning and measuring methods to ensure product quality rather than increased inspection (Boller and Chambers 1977). An effective system for integrating the quality-development, quality-maintenance, and quality-improvement efforts of the various groups in an organization so as to enable production and service at the most economical levels which allow for full consumer satisfaction (Feigenbaum 1961). See 'quality control'.
tower system	A recently developed system of collecting emerging fruit flies. Trays of pupae are stacked in 'towers', and after adults emerge and feed, they are chilled and collected (Dowell et al., section 4.1., this volume). See 'emergence', 'Tanaka box', 'plastic adult rearing container (PARC)'.
transboundary	Insect pests with high dispersal rates are a transboundary problem, i.e. they cross or exist across national boundaries or borders. Therefore, some AW-IPM programmes involve more than one country, e.g. Mediterranean fruit fly (Enkerlin, this volume), New World screwworm (Vargas-Terán et al., this volume). Shipments of sterile insects among countries require regulatory support (Enkerlin and Quinlan 2004, EMPRES 2008).
transcription	The production of a strand of RNA from a DNA template (Burt and Trivers 2006, GT 2008, Lewin 1985, Lackie and Dow 1995, Viljoen et al. 2005, NAL 2008). The process whereby a molecule of RNA is synthesized by the enzyme RNA polymerase using DNA as a template. The process involves complementary base-pairing (Walker and Cox 1995, King et al. 2006). The process of producing an RNA copy of a gene (Hoy 2003). See 'RNA', 'DNA'.
transcriptional activation	Increased rate of gene expression directed by either viral or cellular proteins. These regulatory factors (diffusible gene products) act in trans -- that is, act on homologous or heterologous molecules of DNA. Cis-acting factors act only on homologous molecules (NAL 2008). Refer to Robinson and Hendrichs (this volume). See 'RNA', 'DNA', 'primer'.
transfer RNA (tRNA)	Transfer RNA molecules carry amino acids to a messenger RNA template bound to a ribosome, where the amino acids are linked, in a specific order dictated by the code on the messenger RNA, to produce a protein (Walker and Cox 1995). Any relatively small RNA molecule that mediates the insertion of an amino acid at the correct point in the sequence of a nascent polypeptide during protein synthesis (Oxford 2006, Hoy 2003). An RNA molecule that transfers an amino acid to a growing polypeptide chain during translation (King et al. 2006). The role of tRNAs in protein synthesis is to bond with amino acids and transfer them to the ribosomes, where proteins are assembled according to the genetic code carried by mRNA (Schlindwein 2006). See 'RNA', 'translation', 'messenger RNA', 'ribosomal RNA'.
transformation	A process by which the genetic material carried by an individual cell is altered by incorporation of exogenous DNA into its genome (Schlindwein 2006, King et al. 2006). The process of changing the genetic makeup of an organism by introducing foreign DNA. Transformation may be transient or stable (transferred to succeeding generations) (Hoy 2003). See 'genetic engineering', 'transgenesis'.
transgenesis	The experimental introduction of DNA into organisms so that foreign DNA has been integrated into their germ-line.

	Sequences integrated into the host genome are transmitted through the germ-line to succeeding generations (King et al. 2006, Schlindwein 2006, Oxford 2006, Hoy 2003, Lackie and Dow 1995). Alteration of the genetic composition of an organism to include selected genes from other species by methods other than those used in traditional animal or plant breeding (Walker and Cox 1995, Doncaster 2008). See 'genetic engineering', 'release of insects carrying a dominant lethal (RIDL)', 'genetic control', 'paratransgenesis', 'transformation'.
transgenic cotton	A transgenic variety of the cotton plant developed to have resistance to lepidopterous pests. <i>Bt</i> genes responsible for endotoxin have been incorporated into the cotton genome (Gordh and Headrick 2001). See ' <i>Bt</i> -cotton', 'transgenesis', 'genetic engineering'.
transgenic strain	Transgenic organism = Organism into which genetic material from another organism has been experimentally transferred (Jolivet 1998). Organism that has integrated foreign DNA into its germ-line as a result of the experimental introduction of DNA (Lackie and Dow 1995). Strain = A group of related individuals having certain characters that distinguish the members from other such groups within the same species (Oxford 2006, Kahl 1995, Gillett 1971). A breed or stock of insects that have been held in isolated colonies for a period of time (FAO/IAEA/USDA 2003). Insects descended from a common stock or line, sometimes identified by certain characters or qualities (IDIDAS 2008, Oxford 2006). See 'transgenesis', 'genetic engineering'.
translation (genetic)	The production of a protein from an RNA template (Burt and Trivers 2006). The formation of a protein directed by a specific messenger RNA molecule. Translation occurs in a ribosome (King et al. 2006). The process in which the genetic code carried by mRNA directs the synthesis of proteins from amino acids. The mRNA base sequence is translated into sequence of amino acids in a peptide or protein. Occurs on ribosomes (Schlindwein 2006, Hoy 2003, GT 2008, Oxford 2006). See 'messenger RNA', 'ribosomal RNA'.
translocation	In almost all cases in this volume, 'translocation' refers to 'chromosomal translocation'. See 'chromosomal translocation'. However, in chapter 5.2. (section 5.7.), 'translocation' refers to the relocation of wildlife.
translocation fragment	Chromosomal segment that has been exchanged in a translocation between non-homologous chromosomes (G. Franz, personal communication). See 'translocation', 'chromosomal translocation'.
transmission	Disease transmission = The transfer of a pathogen from organism to organism, or from one generation to another (IDIDAS 2008). The passage of a parasite from an intermediate host (vector) to a definitive host (Gordh and Headrick 2001). Transmission genetics = That part of genetics concerning the mechanisms involved in the transfer of genes from parents to offspring (King et al. 2006). See 'pathogen', 'vector'.
transposable element	Also 'transposon'. Segment of DNA capable of moving to a new chromosomal location (Burt and Trivers 2006, King et al. 2006, Hoy 2003). Discrete segments of DNA which can excise and reintegrate to another site in the genome. Most are inactive, i.e., have not been found to exist outside the integrated state (NAL 2008).
trap	A baited device used for catching animals (IAEA 2003). A mechanical device for capturing and/or killing animal pests as a control measure or as a means of monitoring populations (Coombs and Hall 1998). To capture or kill animals using a structure to hold them captive; often using a bait for attraction (Hill 1997). Refer to Vreysen (this volume), IAEA (2003). See 'attractive device', 'delta trap', 'Jackson trap', 'pheromone trap', 'sticky trap', 'wing trap', 'mass-trapping'.
trap crop	A plant, not of economic use, that is planted adjacent to or within a crop of economic value, to attract pests of the economic crops so they can be monitored or controlled, providing a measure of protection. They may occupy only a small fraction of the cultivated land, e.g. around the edge of the field (Coombs and Hall 1998). A small area of a crop used to divert pests from a larger area of the same or another crop (Pedigo 2002). A small planting of a susceptible and highly attractive host, planted early in the season, or removed in space from the main crop, to divert attack and infestation by pests and allow for their easy destruction (Coppel and Mertins 1977, Weeden et al. 2000, Auburn 2008). See 'cultural control'.
trap efficiency	Refers to detectability. The conditional probability that an insect is caught in a given trap (Barclay et al., this volume). The percentage of insects approaching the trap that are actually caught (PAAT 2008b). Refer to Barclay et al. (this volume), Itô and Yamamura (this volume), PAAT (2008b). See 'mark-release-recapture', 'sampling', 'trap', 'trapping grid', 'mass-trapping'.
trapping grid	The location and spatial pattern of traps placed in a given area, e.g. uniform placement of traps in a lattice pattern (Itô and Yamamura, this volume). Trap array = The spatial pattern of trap placement within an area (IAEA 2003). Trap density = The number of traps per unit of area (IAEA 2003). Refer to Barclay et al. (this volume), Itô and Yamamura (this volume), Vreysen (this volume). See 'trap'.
trichogen cell	An epidermal cell which secretes a cuticular hair or scale on the body or wing of an insect (Leftwich 1976, Auburn 2008). An epidermal cell that generates a seta (Gordh and Headrick 2001). See 'setae'.
trimedlure	A synthetic lure (trimedlure is a paraperomone) to attract fruit flies (IAEA 2003). A chemical compound that can be used as a feeding lure for monitoring or trapping the Mediterranean fruit fly (Coombs and Hall 1998, Gordh and Headrick 2001). A synthetic kairomone eliciting attraction of male Mediterranean fruit flies (NAL 2008). See 'paraperomone', 'ceralure', 'cuelure', 'disparlure', 'gossyplure', 'hexalure', 'propylure', 'swormlure'.
trophic	Descriptive of or pertaining to foods or eating (Jolivet 1998, Gordh and Headrick 2001).
trophocyte	Cell that elaborates nutritive materials (Torre-Bueno 1978). Principal cell type comprising insect fat body (Gordh and Headrick 2001). Trophic cell = Specialized cell containing a reserve of fat or other nutritive substance (Resh and Cardé 2003). See 'nurse cell'.
trypanocide	Something, e.g. drug, that kills the parasite <i>Trypanosoma</i> (Holmes et al. 2004, Black and Seed 2001). An agent destructive or lethal to trypanosomes (Webster 2008). See 'parasiticide', 'adulticide', 'larvicide', 'trypanosome'.
trypanosome	Common name for protozoan parasites of the genus <i>Trypanosoma</i> that occur in the blood of many vertebrates. These

	parasites are transmitted to new hosts by insect vectors, and undergo a complex life cycle which includes several phases (Maudlin et al. 2004, Gordh and Headrick 2001, Black and Seed 2001). A protozoan parasite of the blood and lymph (Pedigo 2002). A type of protozoan that has a leaf-like motile stage (Resh and Cardé 2003). See 'trypanosomosis'.
trypanosomiasis	Synonym for 'trypanosomosis' (Maudlin et al. 2004, PAAT 2008a, WHO 2008, Black and Seed 2001, Ashford 2001, Kassai et al. 1988). See 'trypanosomosis'.
trypanosomosis	An assemblage of diseases of humans and domesticated animals which are induced by parasitic Protozoa of the genus <i>Trypanosoma</i> (Maudlin et al. 2004, Gordh and Headrick 2001, PAAT 2008a, WHO 2008). See 'African animal trypanosomosis (AAT)', 'human African trypanosomosis (HAT)', 'trypanosome', 'vector'.
trypanosomosis-free zone	Areas or regions in which the disease trypanosomosis is not found, either due to natural causes (no vectors or parasites are present) or to human actions that have suppressed or eradicated the disease and/or vectors (Feldmann et al., this volume; Feldmann 2004; Feldmann and Hendrichs 2001; Feldmann and Jannin 2001; PAAT 2008a; PATTEC 2008; WHO 2008). See 'trypanocide', 'tsetse-free zone', 'trypanosomosis'.
trypanosusceptible	Characteristic of cattle breeds that naturally are susceptible and succumb to infection by trypanosomes when an infected vector (tsetse fly) bites them. See 'trypanosome', 'trypanosomosis', 'vector'.
trypanotolerant	Characteristic of cattle breeds that naturally resist infection or symptoms (at least to some extent) by trypanosomes when an infected vector (tsetse fly) bites them (Murray et al. 2004, ITC 2008, Black and Seed 2001). See 'trypanosome', 'trypanosomosis', 'vector'.
tsetse-free zone	Areas or regions in which tsetse flies <i>Glossina</i> spp. are not found, either due to natural causes, e.g. unsuitable habitat, or to human actions that have suppressed or eradicated the fly (Feldmann et al., this volume; Feldmann 2004; Feldmann and Hendrichs 2001; Feldmann and Jannin 2001; PAAT 2008a; PATTEC 2008). See 'eradication', 'extinction', 'freedom from pests', 'insect-free', 'fly-free', 'pest free area', 'pest free field', 'pest free status', 'pest free zone', 'trypanosomosis-free zone', 'vector'.
tuberculosis	An infectious disease of vertebrates including humans and transmitted by a bacterium ( <i>Mycobacterium</i> ), in which tubercles (small swellings) appear in the tissues, especially the lungs (Oxford 2001, WHO 2007, NAL 2008). Infection transmitted by inhalation or ingestion of tubercle bacilli and manifested in fever and small lesions (usually in the lungs but in various other parts of the body in acute stages) (Webster 2008).
type-1 male recombination	This term differentiates two types of genetic recombination in males heterozygous for a Y-autosome translocation. Type-1 recombination occurs at homologous sites between the free and the translocated autosome (G. Franz, personal communication). Refer to Franz (this volume). See 'Y-autosome translocation'.
type-2 male recombination	This term differentiates two types of genetic recombination in males heterozygous for a Y-autosome translocation. Type-2 recombination occurs between non-homologous sites of the two translocated Y fragments (G. Franz, personal communication). Refer to Franz (this volume). See 'Y-autosome translocation'.
<b>U</b>	
unbalanced gamete	Genetically unbalanced gamete in F <sub>1</sub> progeny caused by chromosome translocations whose exchange of chromosome material is unequal resulting in extra or missing genes; this is the main chromosomal mechanism of inherited sterility (IS) (J. Carpenter, personal communication). See 'gamete', 'inherited sterility (IS)', 'chromosomal translocation', 'F <sub>1</sub> generation'.
underdominance	The unusual situation where a heterozygote shows an attribute, such as viability or fertility, that is lower than either homozygote (King et al. 2006). 'Underdominance' is the same as 'negative heterosis'. See 'heterosis'.
unembryonated egg	Insect egg without an embryo, due to a lack of fertilization or to zygotic lethality (J. Carpenter, personal communication). See 'embryonic arrest'.
univoltine	Having only one complete generation annually (Coppel and Mertins 1977, Resh and Cardé 2003, Pedigo 2002, Gordh and Headrick 2001). See 'multivoltine', 'voltinism'.
user-pays principle	'User pays' is a pricing approach based on the capitalist idea that the most economically efficient allocation of resources occurs when consumers pay the full cost of the goods that they consume. In Australian politics the phrase 'user pays' has often been used by governments as a justification for why something will no longer be unconditionally provided out of government revenue. In the case of public goods, there is no definable cost of providing the good to each consumer, and so the transition to a market-based 'user pays' system may actually decrease efficiency (Wikipedia 2008). The 'user-pays principle' is the variation of the 'polluter-pays principle' that calls upon the user of a natural resource to bear the cost of running down natural capital (OECD 2008). Refer to Whitten and Mahon (section 3.2.) (this volume).
uterus	The enlarged portion of the median oviduct in viviparous insects (Gordh and Headrick 2001). See 'viviparous'.
<b>V</b>	
vapour heat	Use of steam to humidify an insect mass-rearing room (Dyck 2010).
variable cost	Cost that changes directly with the amount of production, such as direct material or direct labour needed to complete a product (Friedman 2007). Cost which varies with the level of output (Pearce 1992). See 'fixed cost'.
vector (insect)	An organism capable of transmitting or transporting a micro-organism or pathogen or parasite from one host to another (Pedigo 2002, Resh and Cardé 2003, Gordh and Headrick 2001). See 'transmission', 'pathogen', 'parasitism', 'host', 'host-vector'.

vector model	In most geographic information systems (GIS) packages, geographic data are represented by vector and raster data models. In the vector model, geographical features are represented by points, or as lines and polygons made up of points joined by lines (arcs) (Cox and Vreysen, this volume). Vector data = A type of spatial data that uses a coordinate system to represent a point, line or polygon (area) (NAL 2008). For a definition of “vector layer”, see Leak et al. (2008). See ‘raster model’, ‘data layer’.
verification	Process of authenticating, validating or confirming the status of a condition or situation; proving or ascertaining the correctness of data. In the context of AW-IPM programmes integrating the SIT, the last temporal phase is the verification phase — to confirm and preserve the pest free status (containment and eradication strategies) through permanent implementation of monitoring and quarantine activities (Hendrichs et al., this volume). See ‘area-wide integrated pest management (AW-IPM)’.
vigour	The health or hardiness of an organism exhibited by growth, high fertility, large size and longevity (NAL 2008). See ‘hybrid vigour’.
virgin female	A female that has not copulated (Gordh and Headrick 2001). See ‘copulation’.
viviparous	Reproduction by giving birth to live offspring rather than eggs (Resh and Cardé 2003, Gordh and Headrick 2001, NAL 2008). Giving birth to active young, which undergo growth and development inside the mother (Pedigo 2002). See ‘adenotrophic viviparity’, ‘gestation’, ‘larviparous’, ‘larviposition’, ‘uterus’.
voltinism	Number of generations produced in one year (Pedigo 2002). Polymorphism of diapause (Gordh and Headrick 2001). Refer to Lance and McInnis (section 3.1.3.) (this volume). See ‘multivoltine’, ‘univoltine’.
<b>W</b>	
waste disposal	In the context of mass-rearing insects, getting rid of waste materials arising from insect diets, cleaning and sanitation activities in a rearing facility, used chemicals, and used paper products. See ‘sewage treatment’, ‘diet disposal’, ‘mass-rearing facility’.
wastewater treatment	Processing wastewater to make it reusable or so it may be disposed of safely (Collin 2001). If a mass-rearing facility does not have access to municipal wastewater treatment, the installation of a wastewater treatment plant just for the facility may be required. See ‘sewage treatment’.
W-autosome translocation	Translocation between the female-specific W chromosome and an autosome. As a consequence all genes on the respective translocated autosome are inherited through the female lineage (G. Franz, personal communication). Refer to Franz (this volume). See ‘chromosomal translocation’, ‘W chromosome’, ‘autosome’.
wave principle	The wave principle entails an expanding operational block size with each phase of an AW-IPM programme using the SIT (Hendrichs et al., section 7.2., this volume). See ‘continuous distribution’, ‘rolling-carpet principle’, ‘area-wide integrated pest management (AW-IPM)’.
W chromosome	The sex chromosome of an animal in which the female is the heterogametic sex. In such cases, the W chromosome is female-determining (King et al. 2006). See ‘Z chromosome’, ‘heterogametic’.
wet storage of radiation source	When a radiation source is not in use, wet storage involves shielding the source by water (Bakri et al., this volume). See ‘gamma irradiator’, ‘dry storage of radiation source’, ‘panoramic irradiator’.
white light	White light is the presence of the complete visible spectrum (approximately 400–700 nm) of the electromagnetic spectrum where all the colours are blended to appear white, colourless or even slightly yellow to the eye (NAL 2008). See ‘near-infrared spectroscopy (NIRS)’.
wildlife	All living things (except humans) that are undomesticated (Webster 2008).
wild-type allele	The allele commonly found in nature or arbitrarily designated as ‘normal’, or any gene sequence that serves as original before being modified in genetic engineering experiments (King et al. 2006, Kahl 1995). The non-mutated form of a specific gene in an organism (Walker and Cox 1995). See ‘allele’.
willingness to pay (WTP)	The valuation placed by an individual on a good or service in terms of money (Pearce 1992). A valuation technique, used for environmental valuation, is called ‘contingent valuation’. This method is based on the choices people make when they are presented with a variety of goods and services; a ‘willingness to pay’ (WTP) indicates a positive preference (Enkerlin, this volume). See ‘contingent valuation’.
wing-beat frequency	The rate of wing movement in insects varies greatly, from about 10/sec in a butterfly to several hundred or even one thousand per second in dipterans (Leftwich 1976). A measure of the quality of adult insects.
wing-fray analysis	Analysis of the rate of wear to the wings of insects. A convenient way to give a reasonable, albeit crude, indication of the mean age of tsetse fly populations. Fraying is influenced by the activity pattern of flies, and thus the rate of wing fraying varies between species and the sexes (Vreysen, this volume). See ‘age structure’.
wing trap	An insect trap of a particular design (Trece 2008). See ‘attractive device’, ‘delta trap’, ‘Jackson trap’, ‘pheromone trap’, ‘sticky trap’, ‘trap’.
wing waving	During courtship, Mediterranean fruit fly females wave their wings. See ‘courtship’, ‘lek’, ‘mating behaviour’, ‘mating system’.
<b>X</b>	
X chromosome	A sex chromosome that is usually present in two copies in insect females (XX) and in one copy (unpaired) in males (XO or XY) (Hoy 2003).

	See 'Y chromosome', 'homogametic', 'heterogametic'.
X-ray	X-rays originate, not from the nucleus, but are generated by electron transfers in the electron sheath or by electron deceleration in matter (Bremsstrahlung) (Koelzer 2008). Photons originating in the electron field of the atom are called X-rays; also called roentgen rays (FAO/IAEA 2009, Borders 1991). When a beam of electrons strikes a material (usually with a high atomic number, such as tungsten), X-rays are generated (K. Mehta, personal communication). See 'gamma radiation', 'gamma ray', 'Bremsstrahlung'.
<b>Y</b>	
Y chromosome	A sex chromosome that is characteristic of males in species in which the male typically has two dissimilar sex chromosomes (XY) (Hoy 2003). See 'X chromosome', 'heterogametic'.
Yamamura method	One of the mark-recapture methods to estimate the population density in the field. The 'Yamamura method' is the second simplest procedure among mark-recapture methods; it is based on one release procedure and two capture censuses, and takes mortality into account (Itô and Yamamura, this volume). See 'Hamada method', 'Itô method', 'Jackson positive method', 'Jackson negative method', 'Jolly-Seber method', 'Petersen method'.
Y-autosome translocation	Translocation between the male-specific Y chromosome and an autosome. As a consequence all genes on the respective translocated autosome are inherited through the male lineage (G. Franz, personal communication). Refer to Franz (this volume). See 'chromosomal translocation', 'autosome', 'Y chromosome', 'type-1 male recombination', 'type-2 male recombination'.
yellow fever	An infectious, mosquito-transmitted viral disease (Pedigo 2002). See 'transmission', 'vector', 'pathogen'.
<b>Z</b>	
Z chromosome	The sex chromosome found in both heterogametic females (ZW) and homogametic males (ZZ) (King et al. 2006, Hoy 2003). See 'W chromosome', 'heterogametic', 'homogametic'.
zero catch	Traps having caught no insects in a given time period. See 'null trapping', 'trap'.
zero grazing	Cattle or small livestock are kept indoors and feed is brought to them. See 'crop residue'.
zygote	Diploid cell formed by union of two gametes or reproductive cells. Ovum (female gamete) fertilized by a sperm (male gamete) (Hoy 2003, Pedigo 2002, King et al. 2006, Schlindwein 2006, Burt and Trivers 2006). See 'gamete', 'fusion', 'fertilization', 'haploid', 'diploid'.

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