IOBC-WPRS IP Guidelines

Crop specific technical guidelines for integrated production of

Stone Fruits

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Edited by: Carlo Malavolta, Tim Beliem, Petros Damos & Aude Alaphilippe

With the support of the IOBC Working Groups, specifically the Working Group on "Integrated protection of Fruit Crops", Sub-Group "Stone Fruits".

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These guidelines are meant as inspiration for advanced Integrated Production (IP). Any organization that wants to design and operate an Integrated Production scheme can follow these guidelines. Guidelines drafted by national or regional organisations are referred to in the text as National or Regional IP guidelines.

This guideline consists of parts from the **IP General Technical Guidelines on Annual and Perennial Crops** and the **Crop Specific Technical Guidelines for Integrated Production** (text marked in green).

Two levels are distinguished:

- **Strict rules** are the minimum requirements that, according to the IOBC-WPRS, have to be met to ensure that the potential of the IP approach can be realized.
- **Recommendations** are preferred options for a higher level of IP application constituting extra care for the IP objectives. These approaches may increase the cost of production or the effort required.

–	Strict Rules	Recommendations
1. General Aspects	*In Integrated production good agricultural practices must be applied, products must be traceable to the producer and self-evaluation practice*	
1.1 Good Agricultural Practice (GAP), food safety management procedures and Integrated Production Standard	The IOBC General and crop specific Guidelines do not and cannot mention all published "must" rules of Good Agricultural Practice, but will present selected requirements that seem to be of special relevance to the IP concept. Any organisation that produces according to a certified IP standard will also have to comply with any national or international GAP/food safety standard as pertinent for their situation and markets.	
1.2 Traceability aspects out of general aspects	All participants of the food production chain are responsible for the quality of the final product and, if appropriate, for the quantification of (pollutant) residue levels. All farm products that are IP certified must be traceable to the registered farm and field where it has been grown.	
1.3 Self evaluation	Each farm participating in a certified IP production scheme has to complete once per year the inspection protocol (= check-list) of the specific IP scheme (as made available by the organisation that implements the IP guidelines).	IP guidelines should specify self-evaluation protocols and encourage their use. The result of this self-evaluation should be available at the farm inspection by the control-certifying organisation, and an appropriate correction plan implemented. IP guidelines should include annual training of farmers on specific IP aspects.

–	Strict Rules	Recommendations
2. Biodiversity and landscape	*Biodiversity is one of the major natural resources of the farm to minimise pesticide input. IP guidelines therefore must specify a strategy to actively optimise the biological diversity at all 3 levels (genetic, species, ecosystem).*	
2.1 Ecological infrastructure (ecological compensation areas)	The (non-cropped) ecological farm infrastructures must cover at least 5 % of the total farm surface (excluding forest). Existing ecological infrastructure on the farm must be	The surface of ecological infrastructure with low production intensity and without pesticide/fertilizer input should increase to 10%.

	preserved. Flowering field margins must be established as reservoirs of pest antagonists. Areas of linear elements (e.g. flowering border strips, hedges, ditches, stone walls), and non-linear elements (e.g. groups of trees, ponds etc.), being present or to be planned on the farm should be connected and combined in such a manner that spatial and temporal continuity is obtained. This continuity is a prerequisite for the enhancement of fauna diversity and for the maintenance of a diverse landscape. *Note: The 5% rule does not apply to individual farm in areas with predominantly small farms, with highly scattered properties In such cases the alternative way to comply with the requirement is to designate a surface of 5% or more of a comparable and homogeneous agro-climatic unit (e.g. same municipal district), set aside as ecological infrastructure by official and well documented regional programs. In this case, it has to be shown that the ecological infrastructure areas are well distributed in time and space in the municipal area, thus providing a guaranteed continuity.*	Development of a professionally formulated conservation assessment and plan for the farm and its implementation are recommended. Special attention should be given to enhance the functional biodiversity in and around fields: • Avoiding risks of increasing host pests. • Enhancing the functional biodiversity is possible after conducting specific studies focusing on the target organisms whose populations we wish to increase. IP guidelines should recommend appropriate species. • It is recommended to increase biodiversity within orchards providing ecosystem services such as pest regulation or improved nutrient uptake efficiency or weed seed predation. o e.g. by practicing an alternating mowing regime with a permanent supply of flowering plants as food sources for the orchard fauna). • Plants species that form the vegetation cover in the alleyways should be naturally occurring or be selected/planted due to its favourable characteristics. • Contamination by spray drift from neighbouring crops can be detrimental to beneficial and other fauna. It is advisable to protect the orchard by planting windbreaks as barriers. It is recommended to increase functional biodiversity within the orchard (e.g. by practicing an alternating mowing regime with a permanent supply of flowering plants as food sources for beneficials notably in early spring). Plants species that form the vegetation cover should be native or be selected/planted due to its favourable characteristics. IP guidelines should provide a list with appropriate species. This list should consider and possibly avoid known host plants of destructive new pests (e.g. *Halyomorpha halys, Drosophila suzukii, sharka*) should be limited.
2.2 List of options	IP guidelines must provide a list of at least 5 ecological options for the active enhancement of biological diversity. At least 2 appropriate options have to be selected as "must" by the individual farmer. Examples of lists of options are given in the IOBC-WPRS Tool Box. Specific examples for stone fruits are: (i) Nesting boxes for smaller caterpillar feeding birds such as insectivorous passerines and/or perches for birds of prey (against voles), (ii) Refuges for predators (including artificial ones), (iii) Host plants for beneficial's (such as dedicated flower stripes or purpose planted hedgerow species), (iv) Resistant cultivars as pollinizer trees, (v) New wildlife habitats etc.	Headlands and windbreaks: • Diversity of composition and structure should be the aim, using or encouraging native species where possible. • Species which are host plants of important fruit pest and pathogens, particularly sharka and ESFY, must be avoided. • Avoid blackthorn and other *Prunus* spp. (hosts of *Cacopsylla pruni* which is the vector for ESFY) near plum and apricot orchards. • Hedgerows should provide adequate screening to prevent pollution and contamination of fruit by exhaust fumes from busy roads.
2.3 Field size		The lateral dimension of an individual field should be considered as an important element in functional biodiversity, to provide ecological reservoirs and to secure connectivity with adjacent ecological infrastructures (see IOBC-WPRS Tool Box).
2.4 Buffer zones	Buffer zones between crop areas and sensitive off-crop areas, (such as surface waters, springs, important ecological infrastructures, heavily travelled roads, infested crops, hibernation areas of pests and diseases), must respect legal regulations. If no official regulation exists, buffer zones must be at least 3 m wide.	Buffer zones should preferably be wider than 3 meters.

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3. Site selection	*Suitability of the site has to be assessed and taken into account.*	
3.1 Site selection	Only fields suitable for sustainable production of a particular crop can be used for IP production. If new sites are being brought into cultivation a proper assessment must be done on the suitability of the site for IP production considering prior use of land, type of soil, erosion potential, soil health status, and prior use of persistent	For new agricultural sites a plan needs to be developed, describing and scheduling the measures to minimise all identified (and controllable) risks for environment and crops. Soil with an average content of clay and lime or slightly sandy should be preferred; the same for soil with pH ranging between 6.8 and 7.5

	herbicides, quality and level of ground water, availability of sustainable water sources, and impact on and of the adjacent area. Non suitable sites must not be used for production. For new orchards or for partial replacement of existing ones, site, cultivar, planting systems must be selected and harmonised so that regular yields of quality fruit, and hence economic success, can be expected with a minimum use of agrochemicals and environmentally hazardous practices. Sites with a favourable aspect and appropriate soils must be selected, avoiding the situations in which a continuous supply of inputs will be necessary. Frost pockets or poor drainage for peach or nectarines, or soils with high active CaCO3 content for instance, should be avoided unless appropriate tolerant rootstock is chosen as well as high salinity soils.	Care must be taken to ensure adequate spatial separation of cultivars with successive ripening times to reduce the potential for fruit fly to complete its development. Isolation from other sources of infestation is also desirable. Poor draining soil with water lodging problems should be managed to avoid insufficient respiration and nutritional problems, as well as to avoid Phytopthora and other root rot infections. Care must be taken where there are wild or abandoned untreated cherry trees in the surroundings of the orchard: they can act as inoculum source of several pests and diseases.

—	Strict Rules	Recommendations
4. Crop rotation / Sequence	*Crop rotation/sequence is a major method to improve soil quality and to prevent pests, diseases and weeds.*	
4.1 Annual crops: Frequency and sequence	Not applicable.	Not applicable.
4.2 Perennial crops: Crop sequence and inter/cover crops	When re-planting a perennial crop: • To avoid pathogen transmission and a less vital crop development in the first years after plantation replanting of same crop is only to be admitted in IP guidelines on a case by case analysis. Also agronomic characteristics and period of plantation should be chosen to reduce these risks. • Cover and catch crops have to be considered integrally in the design of the orchards.	The use of leguminous crops (Leguminosae/Fabaceae) as cover crops to improve soil structure, weed control and soil fertility is recommended; Leguminous crops fix N from the air and can contribute thus to the N supply. Elimination of sources of disease inoculum (i.e. roots of old plants) is recommended before replanting. Intercropping with host plants of serious pests and diseases (e.g. solanaceous plants and cotton) should be strictly avoided, especially during the first years of tree development.
4.3 (Inter) cover crops	Cover crops contribute to maintenance of soil physical property (erosion and compaction) (5.1) and soil fertility (7), enhancement of biodiversity (see 2), control of pest and diseases (see 9.1) and prevention of leaching of N. In perennial crops, cover crops must be used in the alleyways. Specific attention to possible host for *Halyomorpha halys*.	
4.4 Any further sub-chapter, e.g. for protected crops		

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5. Sustainable soil management	*Sustainable soil management aims at preserving and optimising soil quality (chemical, physical and biological) in order to sustain quality production on the long term.* *Sustainable soil management is an interplay between key farming methods such as crop rotation, fertilisation and soil tillage:* • *For crop rotation see 4.1 and 4.2 for respectively annual and perennial crops, see also 4.3/5.2 for cover crops* • *For soil fertility/nutrient management: see 7.* • *For soil tillage see 5.1 and for organic matter management 5.3*	
5.1 Soil tillage and compaction	Soil tillage methods and farm machinery use (type, intensity and traffic control: here called field traffic) are key factors to reduce erosion risk and sustain and improve soil fertility, Controlled traffic helps to improve aeration and water infiltration) appropriate soil tillage improves bio-physical soil properties, (e.g. aggregate size and stability) arranging for the least possible soil disturbance (to avoid compaction and erosion). Sound crop residue management helps to improve soil properties and fertility as well as increase water holding capacity Soil tillage methods and farm machinery for the management of soil must be used that are appropriate for soil type, cropping, topography, erosion risk and climate in order to sustain and improve soil fertility.	Minimum soil tillage or non- inversion tillage is recommended. However, if soil borne damaging organisms (weeds, pests, diseases) increase to a level that endangers crop production at all, occasional ploughing is appropriate. Timing of tillage can be used to optimise nitrogen management. Farm machinery and soil management should be chosen in order to minimise disturbance of soil stratification, to reduce soil compaction, to preserve organic matter, to improve the efficiency and effectiveness of mechanical weed control and agrochemical applications, and to reduce fuel consumption. GPS guided traffic (controlled traffic) is recommended where appropriate. It contributes to minimising the area that machinery drives on, thus reducing overall soil degradation.
5.2 Soil protectiona	Soils need to be protected for degradation and erosion by appropriate soil tillage and soil cover strategies maintaining the	Measures to avoid or to control soil erosion should be defined for each crop based on the erosion potential specific to the

	longest possible soil protection by crop or non-crop cover, without detriment to yield with minimum inputs of fertilisers and irrigation water. Soil protection should be sustainable under the local conditions and optimised locally. In regions with leaching and erosion risks, an appropriate soil cover, (with adequate N-uptake capacity), must be maintained. Where erosion damages are visible, a plan needs to be developed and implemented, describing and scheduling the measures to minimise erosion risks. For perennial crops: use of cover crops is required, see 4.2. Specific requirements for stone fruit orchards are: Overall bare soil management of orchards throughout the years is not permitted. In arid areas (without irrigation), bare soil management by soil tillage is permitted in spring and summer. Regional or national guidelines must specify a maximum width for the weed free strip and/or percentage of the soil surface which may be weed-free. The procedures for practical implementation must be defined in the regional guidelines according to climate, soil type, cultivars and precipitation. Herbicides may only be used to supplement mechanical and physical weed control methods. Herbicides must not be used to achieve overall bare soil. They can only be used locally during spring and summer when physical or mechanical control (preferred option) is not appropriate.	region and farm. In very sloping areas, soil protection can also be achieved with contour cultivation and/or terraces. Low intensity cultivation is preferred. Non inversion tillage can contribute to reduction of erosion. In areas with sufficient precipitation (e.g. >500 mm during the growth season) and suitable soil type the maintenance of a permanent or temporary green cover during the growth season is highly recommended to avoid soil compaction, promote water infiltration and increase biodiversity. The use of leguminous crops (Leguminosae/Fabaceae) as cover crops to improve soil structure, weed control and soil fertility is recommended. Take into consideration that some of these plants can be host plant of pest such as *Halyomorpha halys*. Alleyways should be sown with grass and/or herbs and have adequate width to easily accommodate the tractor wheels. Non-competitive grass/herb mixtures are recommended. However, in case of excessive vigorous growth in existing orchards, the use of herbicides should be avoided. A green cover during winter is strongly advised at least in the alleyways, with an exception for arid areas where this green cover could create water deficiencies. It is recommended that in case of necessary control of weeds in the tree row, to avoid undue competition for moisture and nutrients, a weed free strip should be maintained by mulching or covering the soil surface or by mechanical cultivation. Mulch type and sanitary quality should be carefully selected since it could favour certain pest (voles). It is recommended that, where possible, ground cover is allowed to develop in the weed free strip when soil moisture is adequate (e.g. the winter). It is recommended that use of selective broad-leaf weed herbicides in the alleyways is avoided. The use of Leguminosae as cover crops to improve soil structure, weed control and soil fertility is recommended.
5.3 Organic matter	IP guidelines must specify a target range for optimal organic matter content. An organic matter balance must be calculated to determine the surplus or shortage of supply in reference to the defined optimal range Management must be targeted towards maintaining or reaching the targeted level of organic matter content for the specific soil type and location by appropriate measures (fertiliser choice, crop choice, cover crops and green manure etc.).	The use of bio-indicators, (earthworms, cellulose decomposing organisms, predatory mites etc.), for monitoring the diversity of fauna and flora is to be encouraged. The healthy pruning material can be mechanically destroyed to be used as fertilizer. In this case, simultaneous distribution of other organic fertilizers, like compost or green mulching, is suggested to improve humification processes. However, pruning material should be removed from the orchard if heavily infested by pests (i.e. fungi and bacterial diseases).
5.4 Soil disinfection	Chemical fumigation/disinfection is not allowed.	Solarisation is strongly recommended where effective. See 4.2

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6. Cultivars, rootstocks / cultivation systems	*Healthy and vital seeds, rootstock and/or plant material is important for a healthy and resilient crop. Using resistant and tolerant cultivars and varieties for the major pests and diseases is an essential element of the IP approach.*	
6.1 Choice of cultivars	Cultivars and rootstock must be adapted to local conditions. IP guidelines must supply the growers with a list of suitable cultivars. The list should be based also on existing official national lists of varieties. IP guidelines must specify the relevant traits of the cultivar that have to be taken into account when choosing a cultivar, such as disease and pest tolerance and resistance. The cultivar/rootstock chosen must offer good prospects for economic success with minimal use of agrochemicals. IP guidelines must provide a list of the relative susceptibilities of the commonly grown cultivars/rootstock of stone fruits to all important pests and diseases. IP guidelines must provide a list of varieties with different maturation times.	Disease resistant or tolerant varieties should be chosen if they are available and commercially acceptable. Appropriate cultivars can support IP approaches by reducing off farm agro chemical inputs such as fertilizers and pesticides. For instance through adequate resistance or tolerance to major diseases and pests. Alternation of cultivars (e.g. ripening period for flies) capable to disrupt pest cycle are recommended, where appropriate. Cultivars and rootstocks tolerant to fungal diseases and/or pests and resistant to viruses, phytoplasms, bacteria and nematodes and also tolerant to adverse climatic conditions (i.e. frost) are preferred. The planting of well adapted cultivars/rootstock to local conditions is preferred.
6.2 Seed and plant quality	**Annual crops:**	**Annual crops:**

and health status	All seed and planting material for annual and herbaceous perennial crops that is purchased must be certified and accompanied by a plant health certificate. **Perennial crops:** If available, planting material for perennial crops must be sound and certified as virus tested, vector and disease free. Where this is not available, planting material of the highest health status available must be used.	Alternation and mixtures of cultivars are recommended, where appropriate. Seed and Planting material should be of the highest possible level of health status (virus/disease free). **Perennial crops:** All propagation material should be inspected by the grower to be free of pests and diseases. Infested material must not be used. It is strongly recommended that plant health quality control systems are implemented for private or inhouse (on farm) nursery propagation.
6.3 Cultivation/fruit management, planting and training system	The cultivation system, including planting pattern, training and pruning, has to respect the optimum physiological status of the crop plant. New plantations should adopt locally adapted cultivation systems that allow integrated plant protection principles and measures to enhance biodiversity to be integrated optimally. Also agronomic characteristics and period of plantation should be chosen to reduce the risk of weakness in the first years after plantation. For the choice of training and pruning systems, IP guidelines have to recommend those options facilitating the following objectives: • Manageable uniform size, • Balance between growth and regular yields, • Optimal distribution of solar radiation, • Production of high quality fruits, • Reduction of conditions favourable for the development of insect pests and diseases, • More efficient application of pesticides in the canopy and fertilisers, • Planting systems must allow safer, more efficient spraying practices to be adopted, • Reduction of the amount of pesticides applied. Planting distances should allow enough space for the tree throughout its expected life span without the use of synthetic plant growth regulators. The use of growth regulators is not permitted. The use of non-naturally occurring, synthetic plant growth regulators, as fruit finishing or ripening agents, chemical thinning and crop setting agents is also not permitted. The use of antibiotics is not permitted. Where excessive numbers of flowers have pollinated and set during blossom and an excessive crop is likely to result, the young fruitlets must be thinned to the optimum number to ensure adequate fruit size and quality. To get these results, a multi-step approach is strongly recommended, based on: early and late summer pruning, pre-bloom pruning, mechanical and hand thinning. IP guidelines must set out which chemicals are permitted, clearly specifying the aim and the restrictions of their use.	Heavy pruning should be made during dry weather, since bacterial and fungal diseases are often spread by rain, or wounds must be protected. The frequent disinfecting of pruning equipment is recommended to avoid the spread of disease infections (e.g. *Pseudomonas* spp.). Mechanical destruction of healthy pruning materials is recommended as alternative to burning to increase organic matter in the soil. The use of an integrated strategy for growth control based on drip irrigation, weed competition and balanced fertilization is the base for growth regulation. The use of nets (especially single row nets), for example in the case of fruit fly control or even rain or hail protection should be considered at the plantation. Excessive growth should be controlled by preliminary choices (see Section 3), cultural measures including reducing fertiliser and irrigation supply, summer pruning and encouraging an optimal fruit set. On plum trees, where weather for pollination and set is not optimal, a spray of naturally occurring (but chemically synthesized) crop setting or thinning agents (e.g. gibberellins, NAA) or a spray of ethephon is permitted. On cherry trees, a spray of a naturally occurring (but chemically synthesized) crop setting agent (e.g. gibberellins, NAA) is permitted. Cherry cultivars and rootstocks resistant or less susceptible to bacterial canker or spot should be selected. Pruning may only be done in summer. The use of symbiotic microbiological additives when planting trees is encouraged. The placement of bee hives ensures the pollination.

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7. Plant nutrition	*Fertilisation should consider all aspect linked to soil management (see §5) and should be adapted to plant needs (types, dosages and timing) considering the farm context.*	
7.1 Nutrient management strategy macro nutrients P, K	IP guidelines must specify agronomically desirable and environmentally acceptable target ranges for soil fertility for at least P and K. A nutrient allocation plan for P and K for each crop on a plot/field level must be established, taking into consideration: • The actual field status of soil fertility in relation to agronomically desirable and environmentally acceptable levels (P, K evt Mg). • The balance approach: Off-farm fertilizer input must only compensate the real exportation and unavoidable technical losses resulting:	

	• for annual crops in an balance of inputs and exports at a rotational level (including the technical unavoidable losses), • for perennial crops in an annual balance of inputs and exports. • Additional inputs can be justified to maintain the desired soil fertility level, Inputs exceeding this plan are unacceptable: for instance small quantities of phosphate are sufficient to cause over-enrichment of surface waters. Phosphate from agricultural land is mostly translocated by erosion of small soil particles. • The distribution of macro nutrients over the years might be different to the export with crops, as long as the rotational balances are maintained.	
7.2 Assessing P, K and other nutrient requirements	Organic matter and nutrient analysis (minimal for P and K) of the soil is the basis for assessing nutrient requirement (except N): see 6.1. Soil analyses for the major elements, P, K, Mg, must be carried out at defined intervals (i.e. 3-10 years, depending on the crop). IP guidelines must specify the analysis techniques and desired ranges of soil fertility. See also 6.1. Uptake and demand criteria for major nutrients are an additional source for fertilization plans, however the soil balance approach on a rotational level must be maintained.	Foliar analysis can be applied as complementary test method.
7.3 Nitrogen supply and timing	N supply and timing must be matched with the crop demand. The use of nitrogen needs particular care because nitrogen leaching and evaporation have significant environmental consequences. A N fertilization plan must be established that specifies for every crop and plot the N sources and available amounts and shows how the crop demand is met. Taking into account: Hidden nutrient sources such as importation through polluted air (N). The soil mineral N status before cropping season. Mineral N and N mineralisation from organic sources. IP guidelines have to define for each crop the maximum nitrogen input, (expressed in kg N/ha/year or crop rotation component), and specify eventually the time-window of adequate N application. The chemical content of at least NPK in all inorganic and organic fertilizers must be known and documented. Where possible and appropriate N fertilization systems must be used that enable split applications based on N status of soils and or plants.	N - requirements should be covered by Leguminosae, (biological N-fixation), to the largest possible extent while preventing any danger of leaching and taking into account possible effect on augmenting soil borne damaging organisms. The total amount of available nitrogen in organic fertilisers should be accounted for a period of 3 years. The use of slow release fertilizers can contribute to minimize nutrient losses and increasing nutrient availability during the period that they are most needed. The use of leguminous cover crops during winter may reduce the total N requirements when properly managed. The application of nutrients in variable-dosages based on vigour maps or soil or plant samples is recommended. IP growers should be encouraged to reduce the amount of nitrogen whenever possible to minimize leaching (e.g. by observation of the green coloration of the leaves. A dark green colour of the leaves suggests in most cases that the nitrogen fertilization can be reduced).
7.4 Supply of other major or micro nutrients	Inputs have to be justified on the basis of a fertilization plan. See 6.1 nutrient allocation plan. The chemical content of at least NPK in all inorganic and organic fertilizers must be known and documented. Where foliar symptoms or plant analysis indicate a deficiency of micronutrients the application of these elements is justified. These elements should be in general administered via the root system. Foliar fertilization is only permitted when soil application is not possible or when the soil characteristics limit the efficiency of soil application.	The replacement of mineral P-input through enhancement of the activity of soil organisms (e.g. mycorrhiza) should be encouraged.
7.5 Organic manures	Organic manures or compost can help to improve soil fertility by increasing organic matter content, improving nutrient and water retention, and reducing erosion. Organic manures must contain only the lowest possible load of heavy metals and other toxicants and meet the legal regulations. Any use of treated human sewage sludge on land destined for agricultural use must be in accordance with updated versions and internationally applied "Codes of Practice for the agricultural use of Sewage Sludge". Existing "Codes of Practice for the Control of Microbial Hazards" give further guidance. Untreated human sewage sludge must not be applied to farmland.	The use of organic fertilisers, including high quality compost, should be promoted. More severe limitations for heavy metal and other toxicants exceeding minimum legal requirements are to be encouraged.
7.6 Safe and efficient application of fertilisers and	Application machinery must be kept in good condition. Regular servicing and annually verifying calibration, (quantity per time	Slurry should not be applied within 10 m of a watercourse or 50 m from a well, spring or borehole that supplies water for human

manures	and per area), must be carried out by the qualified farmer or a specialised company. IP guidelines must contain lists of measures to reduce technically unavoidable nutrient losses by leaching, erosion and evaporation, (e.g. ground cover or timing of soil cultivation). Manures and fertilizers must not be applied to logged water, frozen soil, or steep ground where there is a risk of run-off.	consumption or for use in farm dairies. Injection or low emission methods of application of manures and slurry should be applied to reduce ammonia and GHG emissions. Fertigation and foliar application should be used to reduce the amount of fertilizers and to control plant growth.
7.7 Storage of fertilisers	Storage conditions and safety precautions for fertilizers must fulfil the basic requirements of Good Agricultural Practice (GAP). Solid fertilisers, manures and plant nutrients must be stored in a clean, dry location where there is no risk of water contamination. Inorganic and organic fertilisers must not be stored with fresh produce and plant propagation material.	

—	Strict Rules	Recommendations
8. Irrigation	*Irrigation has to be based on crop requirement and the irrigation method has to be adapted to the crop and farming context.* *Irrigation must be applied according to need and with the best methods to avoid losses (e.g. micro-irrigation). Excessive soil moisture may result in leaching of nutrients, competition with weeds, and risks of pest and disease (outbreaks). Excessive use of irrigation water is wasteful.*	
8.1 Water requirement of the crops	All measures must be taken to minimise water loss and to optimise product quality.Irrigation is only justified if the available water does not satisfy the crop's requirements taking into account also soil types, climatic conditions and the relation between the amount applied and quality/quantity of the crop. The calculated water amount must not exceed field capacity (water holding capacity) also to avoid nitrate leaching.	Irrigation scheduling systems should be used where available. Advanced systems like deficit irrigation should be used. Systems used should: • Utilise, whenever possible, local data on reference evaporation rates calculated by means of local meteorological stations. • The amount of applied water should be recorded in the farm records.
8.2 Irrigation methods	A water management plan must be available at the farm that specifies water sources, the decision support tools, the irrigation methods, etc. The irrigation plan needs to be established individually for each plot. This will help to optimise water usage and reduce waste, e.g. irrigating at night, maintenance to reduce leakage, collection of rainwater from roofs, etc.	The most efficient and commercially practical water delivery system should always be used to ensure best utilisation of water resources. Whenever possible, a combination of irrigation with fertilisation (fertigation) should be considered. Take into account that irrigation might influence the nutrient dynamics. Water drips should be preferred compared to nozzles, to avoid bark moisting and related *Phytophthora* and other soil-borne fungal diseases (e.g. *Monilia* spp.). Flood irrigations should be avoided to preserve soil structure and leaching. Drip irrigation should be preferred to overhead irrigation, to reduce infections from fruit, foliar and trunk diseases.
8.3 Water quality and supply	Irrigation water has to be shown to be of adequate quality (conductivity, Cl-content, salinity and content of polluting agents), not exceeding the official tolerance levels, and pathogens relevant to the crop. The use of untreated sewage water for irrigation/fertigation is prohibited. Where treated sewage water is used, water quality must comply with the WHO-Guidelines on "Safe Use of Wastewater and Excreta in Agriculture and Aquaculture".	Irrigation water should be obtained from sustainable sources, (i.e. sources that supply enough water under normal conditions). The regular analysis of the water quality with respect to heavy metals, N, and Na/Cl content etc., is recommended. The installation of measuring devices in every plot for registering the amount of water applied is to be encouraged.

—	Strict Rules	Recommendations
9. Integrated plant protection (IPM)	*The Principles of Integrated Plant Protection have to be applied. Preventive (indirect) measures and observations in the field on pest, disease and weed status must have been considered before intervention with direct plant protection measures takes place*	
9.1 Prevention (= indirect plant protection)	The prevention and/or suppression of key pests, diseases and weeds can be achieved or supported among other options especially by the: • Choice of appropriate resistant/tolerant cultivars. • Use of an optimal replanting interval or similar strategy to prevent diseases and weakness.	The prevention and/or suppression of key pests and diseases should be supported among other options especially by: • Hygiene, proper disinfection or cleaning of buildings, clothes, hands, tools, booms, tanks, sprayers and machines is recommended. • Preventing the carryover of organisms which transmit a

	• Use of adequate cultivation techniques, (e.g. green cover, pruning, removal of infected prunings, alternate mowing); pruning not only removes dead tissues but also allows proper ventilation and more effective spray coverage. • Use of balanced fertilisation (especially low nitrogen input) and irrigation practices. • Protection and enhancement of important natural enemies by adequate plant protection measures. • Utilisation of ecological infrastructures inside and outside production sites to enhance a supportive conservation biological control of key pests by antagonists. IP guidelines must (see 8.1.3.c) describe a basic selection of preventive measures that have to be implemented. Use of adequate cultivation techniques (e.g. green cover, pruning, removal of infected prunings, alternate mowing); pruning not only removes dead tissues but also allows proper ventilation and more effective spray coverage. Use of optimum fertilisation (especially low nitrogen input) and irrigation practices. **Diseases** Balanced nutrition and irrigation by using reasonable amounts of N and water for a moderate tree vegetation to prevent a humid environment that favours pathogens and scales. Remove mummified fruits after harvesting and during winter pruning to prevent Monilia infections. The risk of sharka and ESFY disease must be minimised by timely removal of infection sources from orchards and their surroundings (see Section 3). **Pests** **Lepidoptera** **Diptera** ***Ceratitis capitata* (Mediterranean Fruit Fly, Medfly)** • In new plantations an adequate spatial separation of cultivars with successive ripening times can reduce infestation risks. ***Drosophila suzukii* (Spotted-wing drosophila)** • Remove all the fruits after harvest. **Scale insects** ***Comstockaspis (= Quadraspidiotus) perniciosa* (S. José Scale)** ***Pseudaulacaspis (= Diaspis) pentagona* (White Peach Scale)** ***Pseudococcus comstocki* (Comstock mealybug)** • Parasitoids of scale insects must be preserved and encouraged. The level of parasitisation should be assessed.	phytohygenic damage potential, when spread. Examples: Weeds like *Cyperus esculentus* or *Rorippa palustris*, nematodes like *Globodera rostochiensis*, fungi like *Plasmodiophora brassicae* with machines. The prevention and/or suppression of key pests and diseases should be supported among other options especially by the: • Choice of appropriate resistant/tolerant cultivars; • Avoidance of vigorous shoot growth susceptible to pests and disease (e.g. reducing fertilisation and irrigation). **Diseases** Prevent damage by insect pests in reproductive organs and fruits, as they can favour fungal infection. The use of copper formulations as a preventive measure is advised, but not during blooming and not on susceptible cultivars. The cultural practice of removal of sources of infestation or infection (e.g. *Monilia* spp., canker, brown rot) as far as practically possible is required. In particular: • Winter and summer pruning is required to remove sources of infections of *Monilia* and bark/trunk diseases, • Remove and/or destroy fallen leaves affected by *Taphrina deformans*. *Phytophtora* and related soil borne diseases such as *Armillaria* etc: cover the trunk base with copper solutions and/ or calcium carbonate, by using a brush provides additional protection. Cherry cultivars and rootstocks resistant or less susceptible to bacterial canker or spot should be selected. Pruning may only be done in summer. **Pests** **Lepidoptera** ***Cydia (=Grapholita) molesta* (Oriental Fruit Moth),** ***Anarsia lineatella* (Peach Twig Borer),** **Leafrollers *Adoxophyes orana*** Damages are expected to be higher on late ripening varieties. Applications with winter oils may reduce the populations of Lepidoptera overwintering in bark as well as scale populations. **Diptera** ***Drosophila suzukii* (Spotted-wing drosophila)** Sustainable early harvest can be important in reducing exposure of fruits to the pest. Use of netting in highly favourable areas is recommended **Scale Insects and bark pests** Cover the trunk base and branches with calcium carbonate, by using a brush may remove overwintering scale infections. Additionally, it prevents to some extend attacks caused by Lepidoptera larvae as goat moth *Cossus cossus* (Cossidae) or *Synanthedon* (Sesidae). Branches attacked by *Scolytidae* beetles, especially in cherry, should be removed by pruning. **Others** **Marmorated stink Bug**: Use of nets to avoid the entry of the pest and damages on fruits.
9.2 Risk assessment and monitoring	Interventions to control pests, diseases and weeds must be based on adequate monitoring methods and tools to determine whether and when to apply direct control measures. Robust and scientifically sound warning, forecasting and early detection/diagnosis systems (decision support systems) as well as sound threshold values are essential components for decision making. The official forecasts of pest and/or disease risks, or officially established threshold levels defined for the region must be taken into account before treatments.	Empirical threshold values should be replaced by more scientifically sound approaches, like DSS, and expert systems. When information from large-scale decision support tools (e.g., official warning systems, DSSs) is used, it is strongly recommended to adapt this information to local conditions, by accounting for weather variability, cultivar susceptibility, sanitary status of the vineyard, previous pesticide sprays, etc. **Insects** **Scale insects**

Diseases

Based on weather recordings, especially during spring, an early risk assessment is made in relation to regional damage records and orchards case history. Wherever possible, use forecasting models.

Insects

Degree-days and phenology models for the need of reinforcement in key phenology times or the timing of other treatments; combined with other methods suitable for important pests (e.g. visual assessment, pheromone traps, traps baited with food based attractants, beating, coloured sticky traps.

Visual assessment (e.g. aphid and mite in spring and summer; overwintering pests on branches, egg and mobile form counting of tetranychids).

Lepidoptera

Cydia (=Grapholita) molesta **(Oriental Fruit Moth),**
Anarsia lineatella **(Peach Twig Borer),**
Leafrollers (e.g. ***Adoxophyes orana*****)**

Regular monitoring by pheromone traps when mating disruption is not applied or traps with food attractants Combo traps when available (pheromone + attractant) in mating disruption system, sampling of damaged shoots and fruits, especially on early season, to determine the infestation level.

Captures on pheromone or food attractant traps can be used in a combined manner with degree-days and phenology models if they are available and officially validated.

On plums, ***Cydia funebrana***

Must be monitored using pheromone traps and control measures only applied where necessary.

Diptera

Ceratitis capitata **(Mediterranean Fruit Fly, Medfly)**

Monitoring by traps baited with food based attractants starting early in the year (at the end of winter) or, if possible, all year round.

Sampling of fruit to determine the infestation level.

Rhagoletis cerasi **(Cherry Fruit Fly),** ***R. cingulata***

On cherry and sour cherry, must be monitored using yellow sticky traps.

Drosophila suzukii **(Spotted-wing drosophila)**

Monitoring by traps baited with food based attractants all year round. It is very important to observe fruit regularly as they begin to ripen. Special care must be taken close to harvest, for assessing the infestation level.

Thrips

Taeniothrips meridionalis **(Flower thrips)**
Frankliniella occidentalis**, Thrips major (Summer thrips)**

These insects injure mostly nectarines. Damages can be serious on flowers but mainly on young fruits. Attacks close to harvest are difficult to predict (such as beating).

Tetranychidae

Panonychus ulmi **(European red mite)**
Tetranychus urticae **(Two-spotted spider mite)**

Visual monitoring on mobile forms and eggs.

Others

Myzus persicae

Monitoring shoots attacked by active aphid colonies and honeydew production to determine timing of control. Check for the presence of mummies and other natural enemies.

Halyomorpha halys **(Brown marmorated stink bug (BMSB))**

Early detection by using traps such as dark green pyramid traps or transparent sticky panel traps. Some lures are also available, but because the lure available is an aggregative pheromone, it is useful to place the pheromone traps outside the orchard.

Predators and parasitoids

Diaspidiotus (=Quadraspidiotus = Comstockaspis) perniciosus **(S. José Scale)**
Pseudaulacaspis (=Diaspis) pentagona **(White Peach Scale)**
Pseudococcus comstocki **(=Comstock mealybug)**

Use of sticky or pheromone traps to detect movements of crawlers or emergence of adults can be used starting on early spring.

Others

Sampling secondary pests with pheromone/kairomone or blue coloured sticky traps if available is recommended (e.g. mealybugs, scales, thrips).

	Monitoring by suitable methods (e.g. visual assessment, beating) to assess beneficial-pest ratio.	
9.3 Direct plant protection method	Where indirect plant protection measures are not sufficient to prevent a problem and forecasts and threshold values indicate a need to intervene with direct plant protection measures, priority must be given to: • Those measures which have the minimum impact on human health, non-target organisms and the environment. • Biological, biotechnical* and physical methods must be preferred above chemical methods if they provide satisfactory control. **: Biotechnical control methods are defined in applied entomology as highly specific procedures that influence the behavior or development of pests without direct biocidal activity, such as mating disruption, deterrents, sterile insect technique.* Control method to be used if available and effective: • *Bacillus thuringiensis* must be used for control of leaf roller and noctuid caterpillars where effective. • Phytoseiid predatory mites must be preserved and utilised in integrated mite management. This is feasible by avoiding the use of non-selective pesticides (especially pyrethroids) and limit exposure of non-target organisms. To prevent resistance, in case more than one spray per season is applied, rotation of plant protection products with different mode of action should be adopted **Diseases** There are specific restrictions concerning the number of fungicide applications (refer to 9.3.1). Rotation of fungicides is encouraged to prevent resistance development. **Insects** **Lepidoptera** ***Cydia (=Grapholita) molesta* (Oriental Fruit Moth) and *Anarsia lineatella* (Peach Twig Borer),** ***Adoxophyes orana* (Leaf roller)** On peaches, nectarines and apricot mating disruption must be used as the basic control method wherever possible. Circumstances where mating disruption is not possible must be specified in regional/national guidelines. Where an additional or alternative control measure is required, priority should be given to use of selective compounds. In regions where infestation is low, and especially in young orchards, removal of infested shoots by pruning in summer should be the first option. Regional / national guidelines must specify threshold trap catches above which insecticide application is permitted. **On plums, *Cydia funebrana*** Mating disruption or more selective insecticides such as insect growth regulators or *Bacillus thuringiensis* are preferred, but in regions where damage occurs close to harvest use of broader spectrum short persistence insecticides is permitted **Diptera** ***Drosophila suzukii* (Spotted-wing drosophila)** wherever approved, mass trapping is advised. Selective insecticides must be used where necessary. At the time of the completion of the present guideline, *D. suzukii* is a new pest in Europe and integrated control strategies are still not well defined. Due to this reasons a specific exception is admitted for non-selective insecticide use (see 9.3). **Scale insects** ***Comstockaspis (=Quadraspidiotus) perniciosa* (S. José Scale) *Pseudaulacaspis (=Diaspis) pentagona* (White Peach Scale), *Pseudococcus comstocki* (=Comstock mealybug)** Parasitoids of scale insects must be preserved and encouraged. The level of parasitisation should be assessed. Scale insects should be controlled where necessary by application of mineral oil or poly-sulphurs in the dormant period. As last resort, these measures may be supplemented with application of selective	Weed management should be achieved, as far as possible, by non-chemical methods. **Diseases** Plastic cover decrease humidity of the fruit and leave surface during rainy weather. ***Pseudomonas syringae*** Stone fruit bacterial canker or spot: Sprays of copper compounds must be applied to apricot and cherry orchards at bud-burst and leaf fall. As a basic method, mechanical removal of weeds near the trunk could prevent infestations of *Capnodis tenebrionis* especially when irrigation is not applicable. **Insects** Nets and/or plastic covers avoid contact of pests with fruits and trees. **Diptera** ***Ceratitis capitata* (Mediterranean Fruit Fly, Medfly)** On peaches and nectarines, mass trapping or attract & kill should be used wherever possible Where an additional or alternative control measure is required, priority should be given to use of selective compounds. ***Rhagoletis cerasi* (Cherry Fruit Fly)** On cherry, a short persistence insecticide should be applied for control where necessary. An approved feeding attractant may be used to enhance the efficacy of insecticides. ***Drosophila suzukii* (Spotted-wing drosophila)** Exclusion netting should be considered the basic control method. **Scale insects** **Mites** **Tetranychidae** ***Panonychus ulmi* (European red mite)** ***Tetranychus urticae* (Two-spotted spider mite)** Products with mechanical mode of action should be used to control it. **Thrips** ***Taeniothrips meridionalis* (Flower thrips)** ***Frankliniella occidentalis*, Thrips major (Summer thrips)** Removal of leaves touching the fruit can greatly reduce the damage after fruit colouring. **Others** ***Halyomorpha halys* Brown marmorated stink bug (BMSB)** In areas with a high population density, exclusion netting should be considered.

	measures may be supplemented with application of selective insecticides in summer where necessary. Where applicable, mechanical removal is advisable as an additional measure. **Thrips** ***Taeniothrips meridionalis* (Flower thrips) *Frankliniella occidentalis*, Thrips major (Summer thrips)** These insects injure mostly nectarines. Damages can be serious on flowers but mainly on young fruits. Attacks close to harvest are difficult to predict; attention must be given to harvest interval. Based on the poor efficacy of the monitoring tools available, the history of the orchard can be an acceptable reason for the application of control measures; for flower thrips is preferable a post blossom spray (for an alternative pre blossom spray only products known to be selective to honey bees are accepted). For a single pre harvest treatment attention must be given to harvest interval. **Others** ***Scolytus rugulosus, S. amygdali, Xyleborus dispar* (on plum)** Alcohol-baited mass-trapping can be used to control it. **Aphids** ***Myzus persicae* (Green Peach Aphid) and *Myzus cerasi* (Black cherry aphid)** For stone fruit crops, where aphids readily develop resistance to insecticides, special care must be taken to preserve the natural enemies of aphids. Selective aphicides must be used if their efficacy is still demonstrated.	
9.3.1 Restrictive use of pesticides	IP guidelines must (see 8.1.3.d) classify pesticides (to be used for the key pests, diseases and weeds) in three categories: 'permitted' (green list), 'permitted with restrictions' (yellow list) and 'not permitted' (red list) based upon± • Their toxicity to man • Their toxicity to key natural enemies • Their toxicity to other non-target organisms • Their pollution potential for the environment (soil, water, air) • Their ability to stimulate pests and diseases • Their selectivity • Their persistence • Their potential to develop resistance in target • Incomplete or missing information • The necessity of use. Regularly updated data on the eco-toxicological profiles of pesticides are compiled by IOBC cf. toolbox). All agrochemicals used must fulfil the basic requirements of GAP. • The plant protection product applied must be officially approved for the target, as indicated on the product label, or for officially approved off-label uses. • In countries that have no official registration schemes yet, reference is made to the FAO Code of Conduct on the Distribution and Use of Pesticides. • All pesticide applications must comply with the statutory conditions regarding the specific crop, maximum permitted total dose, maximum number of treatments, spray intervals and pre-harvest interval, as indicated on the product label or authorised off-label uses. • Since label doses are maximum doses approved by the registration authorities, reduced dosages are possible, (especially in herbicides). Chemical soil disinfection is not allowed. Based on the general criteria, the following categorization of certain pesticides and pesticide groups is established. It may require up-dating with the development of new products. **Not Permitted*** • Non-naturally occurring plant growth regulators,	The use of reduced dosages is recommended wherever possible in accordance with national documentation, experience and legislation. In Europe EPPO standards are also used as references.

	• Organochlorine pesticides, • Persistent herbicides, • All acaricides toxic to Phytoseiid mites, • Antibiotics. **Permitted with Restrictions*** The following categories compounds don't fit in IPM schemes, however sometimes their use might be unavoidable, Guidelines must define clearly the restrictions and permitted indications (yellow list principle): • Copper-based products: (maximum of 4 kg/ha of copper ion /year. • Benzimidazole fungicides (maximum of 2 applications/year. • Dithiocarbamate fungicides (maximum of 3 applications/year). • IBE fungicides (maximum of 3 applications/year). • Dicarboximide fungicides (not permitted anymore in Europe; maximum of 3 applications/year). • Broad-spectrum insecticides, their use should be limited to the secondary pests or to the mandatory control of quarantine organisms (if not possible by others methods). Their eventual use must be justified by monitoring and use of a tolerance threshold. • Synthetic pyrethroids must not be permitted wherever possible. However, as a short-term measure, whilst research is undertaken to identify more selective control methods, synthetic pyrethroid insecticides may be used on stone fruits in the following circumstances: **Maximum of 1 application/year** in emergency situations, shortly before harvest, if no alternatives are available. In case of demonstrated damages provoked by ***Drosophila suzukii*** or ***Haliomorpha halys*****, and under same conditions as above, a maximum of 2 applications/year**is permitted as a specific short term measure. IP Guidelines which permit the use of pyrethroids must have an active research program to identify more favourable alternatives. • Post-emergence applications of herbicides are permitted in any case only after harvest. • Persistent herbicides with DT90<1 vegetation period (spring-autumn): the situations of their exceptional use must be clearly specified (e.g. in the first three years after planting, maximum of one dose-equivalent per annum). and the risk of residues in olive oil be monitored. *The list of "non-permitted" and "Permitted with restrictions" still contains group of active ingredients no longer allowed in Europe; if these groups are still allowed outside Europe than these rules must be followed:	
9.3.2 Resistance management	Where the risk of resistance against a plant protection measure is known and where the level of pests, diseases or weeds requires repeated application of plant protection products in the crops, IP guidelines and IRAC / HRAC/ FRAC** have to provide clear recommendations or mandatory requests for an anti-resistance strategy to maintain the effectiveness of the products. ***:* • *IRAC = Insecticide resistance action committee* • *HRAC = Herbicide resistance action committee* • *FRAC = fungicide resistance action committee*	
9.4 Lists to be compiled as part of IP guidelines	IP guidelines must establish for each crop: 1. A restrictive list of key pests, diseases and weeds that are economically important and require regular control measures in the region / crop concerned. 2. A list of the most important known site-specific natural antagonist(s), with information on their importance in each crop. The protection and augmentation of at least 2 antagonists must be mentioned in advanced as a desirable objective sustainable production systems. 3. A list of preventive and highly selective direct control measures to be used in the IP program ("green list"). See explanations and examples in the IOBC-WPRS Tool Box.	

	4. A list of pesticides to be used with restrictions ("yellow list"): A selected group of plant protection products that do not qualify for the "green list" but should be available to the grower despite certain negative aspects, (especially for reasons of resistance management or earmarked for exceptionally difficult cases). These listed products are permitted only for precisely identified uses with clearly defined restrictions.	
9.5 Application and recording of pesticides	All pesticide applications must be registered with name, date, crop-pest / crop- disease combination, dosage and field identification where applied. Buffer zones of adequate size between treated crop areas and sensitive off-crop areas, (surface water, springs, ecological infrastructures), must be observed, (see point 2.6). The official pre-harvest intervals to minimise pesticide residues must be followed and should, if possible, be extended. They must be recorded for all applications of crop protection product and evidence should be provided that they have been observed. In situations with continuous harvesting, systems must be in place in the field to ensure that safety rules are sufficiently followed (e.g. warning signals). Spraying during windy weather conditions when wind velocity is exceeding 5m/sec, is not allowed.	It is strongly recommended that the application of pesticides is limited to the smallest possible area (e.g. band spraying, spot treatments, field and site specific localized treatment). The use of best application techniques available to minimize drift and loss is highly recommended. Small untreated areas, (zero treatment or "spray windows"), should be maintained in each crop and in each major plot/field except for arthropod pests, diseases and weeds declared as "highly dangerous/ contagious" by national authorities or in cases with high infectious pests or diseases. Perennial crops: The use of methods to calculate the right dose of pesticides and spray volume to be applied as a function of the plant growth stage and canopy architecture - such as for instance the TRV (Tree Row Volume) or the LWA (Leaf Wall Area) methods – is highly recommended. Always explore this keeping in mind the specific properties of each pesticide-active ingredient. Reduced dosages (rates) are possible (especially in herbicides) if applied on the user's own risk (declined liability of companies) and if resistance management criteria (especially fungicides) do not impose the full dosage. The applied dose rate and water volume should be adapted to the area where the treatment is needed and its structure. In case of vertical crops such as stone fruit, the crop canopy area has to be considered, since it is recognized that the concentration dose expression - e.g. dose per hL or % - is no longer sufficient. To allow the three-dimensional nature of the crop to be considered, the dose rate (on the label) should to expressed in e.g. kg or L per ha of Leaf Wall Area (LWA) or in kg or L per m3 of Tree Row Volume (TRV). The grower should have sufficient technical knowledge or external technical support to calculate/determine the LWA or TRV of the orchard(s) he/she wants to spray. The used water volume should also be adapted to the canopy area (for a full cover spray a runoff water volume is recommended). The exact concentration of the product (l or kg per l water used for spraying) is of secondary importance, as long as the required product per unit leaf wall area is deposited by the water over the full canopy. In exceptional cases the concentration (product dose rate/water volume) can be of primary importance, e.g. for treatment of a product with physical action (which depends on the concentration) or a spot application in an "Attract & Kill" strategy.
9.6 Efficient and safe storage and handling of pesticides	The basic requirements of Good Agricultural Practice (GAP) with respect to storage (9.6.1), safe handling application and training (9.6.2) and disposal of surplus mix, obsolete pesticides and empty containers (9.6.3), must be fulfilled and outlined in IP guidelines.	
9.6.1 Storage	Pesticides must be stored in accordance to legal regulations, in a locked room and separated from other materials. Keys and access to the pesticide store must be limited to workers with formal training in the handling of pesticides. Pesticides must only be stored in their original package.	
9.6.2 Safe handling, application and training	There must be adequate facilities for measuring, mixing and filling the products. Adequate emergency facilities, such as running water, eyewash facilities, first aid box and emergency procedures, must be provided to deal with potential operator contamination. Operators must have appropriate protective clothing and equipment for all operations involving chemicals. All sprayer operators must have appropriate training and hold, where relevant, the appropriate certificate of competence.	
9.6.3 Disposal of surplus mix,	Surplus mix or tank washings must either be sprayed onto a	Under normal circumstances surplus spray mix should not

obsolete pesticides and empty containers	designated untreated part of the crop or disposed of by a registered waste contractor or applied in a biodegradation unit. The safe disposal of spare pesticides must be planned and recorded. They must only be disposed of through an approved chemical waste contractor. Empty pesticide containers must be rinsed with water three times and the rinse water returned to the spray tank. Empty containers must not be re-used but should be crushed or perforated to prevent re-use	occur. However, if surplus should occur, disposal must comply with local regulations. Applications onto designated fallow land should demonstrate that this is legal practice and that there is no risk of surface water contamin
9.7 Spraying equipment (pesticides) and technique	The basic requirements of Good Agricultural Practice (GAP) with respect to the operation and maintenance of spray equipment must be fulfilled and outlined in IP guidelines. The equipment must be kept in a good state of repair. Adequate functioning of the equipment must be verified before each treatment. A thorough technical service of the equipment, (especially manometers and nozzles), should follow the national rules and obligations. Equipment must be verified every 4 year (3 years from 2021) or according to the national guidelines by a competent organisation for correct operation and calibration. The use of aircraft and helicopters is forbidden, except for situations where access to the plot is impossible because of exceptional weather conditions, or if plot topography allows no other way of spraying. Radial flow air assisted sprayers traditionally used for tree and bush fruit spraying are often inefficient and generate high levels of spray drift. Wherever possible spraying equipment and spraying conditions minimising the health risk of the operator and drift must be preferred and tractors must be fitted with a cab. The spray impact on the environment can be minimised by the proper calculation of the amount of product needed per ha.	The use of drift reduction techniques with the least drift and pesticide loss should be encouraged whilst maintaining efficacy. When new sprayers are purchased it is recommended to select models with automatic flow to reduce residues and discharges Localised treatments with protein and/or pheromones are strongly advised against fruit fly. Spraying equipment and spraying conditions minimising the health risk of the operator and drift should be preferred.
9.8 Pesticide residues	Legal requirements of pesticide residues must be fulfilled. The occurrence of pesticide residues on fruits at harvest must be further minimised by maximising safe-to-harvest intervals, taking also into account the risks of concentration.	

–	Strict Rules	Recommendations
10. Harvest	*Harvest practices must fulfil the general requirements for product quality, food safety and traceability established by national or international standards. Selected must items see below.*	
10.1 Product quality	Fruit must be harvested at the correct time according to the cultivar and for the purpose intended. Only fruit of sound internal and external quality may be certified and labelled as meeting Integrated Fruit Production standards. Standards for internal quality based on sound scientific evidence must be defined in regional or national guidelines wherever possible. Where such quality standards are established, regional guidelines and standards must set out measures for checking the quality of fruit (including taste, firmness and internal condition if possible). A representative sample of fruit of each major variety (or cultivar group), from each orchard and from each store must be assessed for fruit quality before marketing.	The necessary measures to obtain optimum product quality at harvest should be defined for each crop taking into account actual national and international standards for external and internal quality.
10.2 Hygiene	All staff must be aware of the need to harvest, transport, store and pack produce with the utmost care having received basic training in personal hygiene requirements for handling of fresh produce. A documented and up-dated risk assessment e.g. HCCP covering hygiene aspects of the harvest process and of produce handling operations must be made and hygiene procedures implemented. With regard to other labour conditions ILO (international labour organisation) charts give guidance.	

–	Strict Rules	Recommendations
11. Post harvest management and storage	*Post-harvest handling and storage practices should fulfil the general requirements for product quality, food safety and traceability established by national or international standards.*	

11.1 Hygiene	See 10.2.	
11.2 Post-harvest washing	The water used for washing final produce must have potable quality and recycled water must be filtered. At adequate intervals a water analysis must been carried out by an accredited laboratory at the point of entry into the washing machinery. The levels of the parameters analysed must be within accepted WHO thresholds or must be accepted as safe for the food industry by the competent authorities.	
11.3 Post-harvest treatments	Treatments with pesticides and other chemical substances must, in general, not be applied to fresh produce for immediate consumption. If there is no alternative to ensure maintenance of good quality of produce destined for longer storage, a selected list of permitted treatments must be established and those eliminated that are in contradiction to the requirements of human health, sustainable production practices and consumers' expectations on natural and healthy food. The record of each treatment must include the justification for the application. Where effective non-chemical post-harvest treatments (e.g. physical treatments or approved biological control agents) are available, they can be used for the control of storage rots and/or disorders. No post-harvest chemical treatments are permitted. IP guidelines must set out which post-harvest treatments chemicals are permitted, clearly specifying the aim and the restrictions of their use.	
11.4 Storage and/or further processing	Storage methods must be such as to maintain high internal and external fruit quality. Stores, controlled atmosphere and refrigeration equipment must be maintained to ensure maximum efficiency and must be regularly monitored to ensure correct operating conditions. Accurate records must be kept and made available for inspection. Product in store should be regularly monitored for external and internal condition and firmness.	

—	Strict Rules	Recommendations
12. Energy use, GHG emissions and waste management	*GHG emissions from agriculture need to be reduced, specifically Methane (CH4), Nitrous oxide (N2O). Emissions from agriculture constitute more than 50% of the EU emission of these gasses. Also the Carbon dioxide (CO2) emission needs to be lowered. Agriculture has also a unique opportunity to sequester Carbon in soils. All amounting to a lower carbon footprint of the farm and the produce. Methods to reduce the carbon footprint and to sequester carbon in soils (see chapter on soil cultivation etc.) and long term biomass like woods (> 50 years) should be included in IP methods.* *The evaluation of such emission should be based on LCA methods to calculate emissions from cradle to farmgate in terms of CO2 equivalent (farm or produce).*	
12.1 Energy use and renewable energy	IP guidelines have to specify efforts to reduce energy use.	Apply the techniques that reduce the direct energy consumption and indirect consumption through purchase of inputs and use wherever possible renewable energy (biodigestion, solar and wind energy, etc.) to substitute non-renewable sources of energy.
12.2 GHG emission reduction	IP guidelines have to specify efforts.	Effective and efficient mitigation methods to reduce GHG emission should be applied that do not reduce productivity (both in terms of quality and quantity). Specifically the following strategies should be evaluated and eventually adapted (see also the other chapters of these guidelines): • Agrochemical input reduction (pesticides and notably mineral fertilizers). • Soil management (directed on improving soil structure) minimal tillage. • Organic matter management, (crop residues, green manures, soil cultivation techniques, crop choice and rotation). • Best practice of organic manure processing (e.g. biodigestion) and management/distribution (e.g. very fast incorporation or injection in soil)

		incorporation or injection in soil). • Mechanisation, reduce number of operations, fuel use, low energy consuming irrigation, etc. • Energy use in storage and processing.
12.3 Carbon sequestration	IP guidelines have to specify efforts.	Optimize organic matter input (including crop residue) and soil management in order to result in a positive organic matter balance and thus in sequestration of CO2. Possibilities are dependent on the actual organic matter status of the soil. Healthy Crop residue (such as residue from pruning and foliage has to be left within the orchard) or taken up in the farm nutrient cycle. Same applies for mill by-products.
12.4 Waste management	IP guidelines have to specify efforts.	Each farm should keep a waste register and develop and implement its sorting and recycling (farm recycling) find alternatives for non degradable materials.

–	Strict Rules	Recommendations
13. Plant production on mixed farms	*Animal and crop production are interrelated components of mixed farms.*	
13.1 Agronomic aspects	For the production of annual and perennial fodder crops: see specifically the general rules of chapters on fertilization and crop protection. Animal density: A maximum livestock density of 2.0 Livestock Units (LU) /ha must be observed in order to avoid excessive amounts of manure that would offset balanced nutrient cycles (especially of P). Mandatory laws on stock density have to be followed.	
13.2 Animal welfare	Holding conditions for farm animals must satisfy at least national legal regulation. However, farms operating at higher quality levels need to consider ethical aspects, especially the welfare of the farm animals. All veterinary treatments should be recorded.	

–	Strict Rules	Recommendations
14. Worker's health, safety and welfare	Any organization that seeks endorsement of IOBC for their guidelines should be able to demonstrate that they follow basic international standards on workers safety, health and welfare. Appropriate standards are those outlined in the Declaration of the International Labour Organisation (www.ilo.org), an organisation of the United Nations.	