INTERNATIONAL ORGANISATION FOR
BIOLOGICAL CONTROL
OF NOXIOUS ANIMALS AND PLANTS

GUIDELINES FOR INTEGRATED PRODUCTION OF STONE FRUITS

IOBC Technical Guideline III

2nd Edition

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INTERNATIONAL ORGANISATION FOR BIOLOGICAL CONTROL
OF NOXIOUS ANIMALS AND PLANTS

GUIDELINES FOR INTEGRATED PRODUCTION OF STONE FRUITS

IOBC TECHNICAL GUIDELINE III

(PEACH, NECTARINE, APRICOT, PLUM AND CHERRY)

2nd Edition 2003
(Original text in English)

The following paper sets out revised general principles, minimum standards and guidelines for Integrated Production of Stone Fruits in the geographic areas covered by the IOBC/WPRS starting from 2002 as agreed by the IOBC sub-group for Integrated Fruit Production Guidelines and Standards in Opatjie, Croatia, in October 2002. It is intended as a framework for formulation of regional or national guidelines and standards according to IOBC standards and to facilitate their harmonisation. The IOBC principles of Integrated Production and Technical Guidelines I and II (2nd edition), published in IOBC/WPRS Bulletin Vol. 22(4) 1999, are an integral part of these crop specific Technical Guidelines III.

1. Definition of Integrated Production of Stone Fruits

In the frame of the IOBC definition for Integrated Production, Integrated Fruit Production (IFP) is defined as the economical production of high quality fruit, giving priority to ecologically safer methods, minimising the undesirable side effects and use of agrochemicals, to enhance the safeguards to the environment and human health.

Based on this short definition, Integrated Production of stone fruits emphasises the following objectives:

- To promote stone fruit production that respects the environment, which is economically viable and sustains the multiple functions of agriculture, namely its social, cultural and recreational aspects.
- To secure a sustainable production of healthy stone fruits of high quality with a minimal occurrence of pesticide residues.
- To protect the farmer's health while handling agrochemicals
- To promote and maintain a high biological diversity in the ecosystem of the orchard and in surrounding areas.

- To give priority to the use of natural regulating mechanisms
- To preserve and promote long-term soil fertility
- To minimise pollution of water, soil and air.

2. Professionally trained, environmentally and safety conscious growers

Successful Integrated Fruit Production requires professional, up-to-date training and a positive and sympathetic attitude to its aims.

Farm managers must be professionally trained in all aspects of Integrated Fruit Production by attending locally organised training courses. They should have a thorough knowledge of the aims and principles of Integrated Fruit Production and of regional guidelines and standards. They should have a positive and sympathetic attitude to environmental conservation and human health and safety.

A requirement for attendance at an introductory training course as well as at regular updating and review meetings is mandatory.

Stone fruit growers must be members of an officially recognised IP association. A contract has to be signed between each member and its IP-association that lists the obligations of the member as defined by Technical Guideline I.

3. Conserving the Orchard Environment

An important aim and requirement of Integrated Fruit Production is conservation of the orchard environment, its habitats and wildlife. They must not be detrimentally altered, grubbed, nor drained, nor polluted.

As far as possible a balanced and natural orchard environment with a diverse ecosystem of plants and animals must be created and conserved. According to IOBC standards, at least 5% of the entire farm surface (excluding forests) must be identified and managed as ecological compensation areas with no input of pesticides or fertilisers in order to enhance botanical and faunistic biodiversity. In areas with predominantly perennial crops and small farms, where a surface area of 5% or more of a common and homogeneous agro-climatic unit (e.g. municipal district) has been set aside as an ecological conservation area by official and well documented programmes, the 5% rule has not necessarily to be applied to the individual farm. Particular attention must be devoted to 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 pathogens, particularly sharka and ESFY, must be avoided; Blackthorn and other Prunus sp. are hosts of *Cacopsylla pruni* which is the vector for ESFY; it is better to avoid them near plum and apricot orchards. IP guidelines must require implementation of at least two ecological options for active enhancement of biological diversity by each member farmer. A list of options for enhancing biological diversity must be provided. Examples are as follows: (i) Nesting boxes and/or perches for birds. (ii) Refugia for predators. (iii) Host plants for beneficials. (iv) Resistant cultivars as pollinators. (v) New wildlife habitats. Hedgerows should provide adequate screening to prevent pollution and contamination of fruit by exhaust fumes from busy roads.

Development of a professionally formulated conservation assessment and plan for the farm and its implementation are recommended.

4. Site, Rootstocks, Cultivar and Planting System for New Orchards

For new orchards and for partial replacement of existing ones, site, rootstocks, cultivars and planting system must be selected and harmonised so that regular yields of quality fruit, and hence economic success, can be expected with the minimum use of agrochemicals and environmentally hazardous practices. Chemical soil sterilisation is not permitted. Sites with a favourable aspect and appropriate soils must be selected; the use of pedological maps is advised. Frost pockets or poor drainage or for peach or nectarines, soils with high active $CaCO_3$ content for instance, should be avoided. The cultivar chosen must offer good prospects for economic success with minimal use of agrochemicals. Cultivars and rootstocks tolerant to fungal diseases and/or pests and resistant to viruses, phytoplasms bacteria and nematodes are preferred. 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. Planting material must be pest and diseases free and, if appropriate, certified virus-free or virus-tested. Where such material is not available, then planting material of the highest health status available must be used. Planting systems must be single-rows. Small trees of uniform size are the aim for the future. This will allow safer, more efficient spraying practices to be adopted.
Planting distances should allow enough space for the tree throughout its expected life span without the use of synthetic plant growth regulators.

5. Soil Management and Tree Nutrition

The structure, depth, fertility, fauna and micro-flora of the soil must be conserved and nutrients and organic matter recycled where possible. The use of organic fertilisers, including high quality compost, should be promoted. The minimum quantities of fertilisers consistent with high yields of quality fruit may only be used when chemical analysis of soil or plant material shows they are justified. Risks and levels of pollution of ground water with fertilisers, especially nitrates, must be minimised.

Soil must be sampled and chemically analysed prior to planting. After planting, plant and/or soil analysis must be done on a regular basis to determine nutrient and fertiliser requirements. Regional or national guidelines must set out a clear method by which requirements are determined, including sampling and analytical procedures and rules for decision making. It is recommended that N-min tests are used. The total maximum nitrogen input (expressed in kg N/ha/year) and period and methods of application must be set to minimise leaching. The total amount of available nitrogen in organic fertilisers should be accounted for a period of 3 years. The same rules apply for other major nutrients with high polluting potential. The amounts of P and/or K applied, indicated by soil or plant analyses, must not exceed the indicated amount by more than 10%, except for organic fertilisers applied every second or third year. Records of soil and/or plant analyses and of all nutrient applications must be kept and made available for inspection by

the controlling officer. Fertilisers, manure or compost contaminated with toxic or environmentally hazardous substances such as heavy metals or pathogenic micro-organisms are not permitted.

6. Alleyways and Weed-free Strip

The aims are to maintain plant species diversity in the orchard so fostering ecological stability, to minimise the use of herbicides (avoiding residual chemicals completely, see Section 10) and to avoid soil erosion and compaction in the alleyways, without detriment to yield with minimum inputs of fertilisers and irrigation water. 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. Alleyways should be of grass and/or herbs and of adequate width to easily accommodate tractor wheelings. Non-competitive grass/herb mixtures are recommended. Mechanical cultivation of alleyways is permitted only during spring and summer and in particularly dry climate.

Where possible, in established cropping orchards with excessively vigorous growth the use of herbicides must not be permitted. In the 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. It is recommended that, where possible, ground cover is allowed to develop in the weed free strip at times of year (e.g. the winter) when soil moisture is adequate. Herbicides permitted in Integrated Fruit Production (see Section 10) may only be used (only on the row) to supplement such cultural weed control methods. They must not be used to achieve overall bare soil. Regional / national guidelines must specify a maximum width for the weed free strip and a maximum percentage of bare soil surface. It is recommended that use of selective broad-leaf weed herbicides in the alleyways is avoided.

7. Irrigation

Trees must be supplied with adequate soil moisture to ensure balanced growth and ensure high internal and external fruit quality. Excessive soil moisture may result in poor fruit quality, leaching of nutrients and increased risk of root rot. Excessive use of irrigation water is wasteful. Irrigation must be applied according to species need.

In orchards where irrigation is required, daily rainfall must be measured and the soil moisture deficit estimated. Irrigation water must be supplied according to the requirements of the tree, the soil moisture balance and water storage capacity. National/regional guidelines must define the maximum water volume that may be supplied.

Particular attention must be focused on water quality with particular reference conductivity, salinity and content of polluting agents.

8. Tree Training and Management

Trees must be trained and pruned to achieve a manageable uniform size, a balance between growth and regular yields, and to allow an optimal distribution of solar radiation and spray in the canopy.

The use of non-naturally occurring, synthetic plant growth regulators is not permitted. Excessive growth should be controlled by preliminary choices (see section 4), cultural measures including reducing fertiliser and irrigation supply, summer pruning and encouraging an optimal fruit set.

9. Fruit Management

Regular yields of quality fruit with minimal use of chemicals are a central aim of Integrated Fruit Production.

Chemical thinning and crop setting agents are not generally permitted except for naturally occurring substances, where weather conditions for pollination and fruit set are not favourable. 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.

On plum trees, where weather for pollination and set is not optimal, a spray of naturally occurring (but chemically synthesised) crop setting or thinning agents (e.g. gibberellins, NAA) or a spray of etherel is permitted. On cherry trees, a spray of a naturally occurring (but chemically synthesised) crop setting agent (e.g. gibberellins NAA) is permitted. The use of non-naturally occurring, synthetic plant growth regulators as fruit finishing or ripening agents is not permitted.

10. Integrated Plant Protection

The modern approach to Integrated Plant Protection in sustainable production systems is described in Technical Guideline II (Appendix 4). All available prophylactic (indirect) plant protection measures must be applied before direct control measures are used. The decision for the application of direct control measures must be based on economic thresholds, risk assessments and forecasts including those provided by official forecasting services. A restrictive list of key pests and diseases that require regular attention must be established.

Priority must be given to natural, cultural, biological, genetic and biotechnical methods of pest, disease and weed control, and the use of agrochemicals must be minimised. Plant protection products may only be used when justified and the most selective, least toxic, least persistent product which is as safe as possible to humans and the environment selected. Products meeting these criteria must be identified in regional guidelines and standards (see below).

Populations of the main natural enemies of stone fruit pests must be preserved. At least two main natural enemies (e.g. parasites of scales or coccinellids and syrphid predators of aphids) in each crop must be identified in national/regional guidelines. This means plant protection products toxic to them may not be used.

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 where they are effective.
Bacillus thuringiensis must be used for control of leaf roller and noctuid caterpillars where effective.
Phytoseiid predatory mites must be conserved and utilised in integrated mite management.
As a basic method, infestations of *Capnodis tenebrionis* should be prevented by irrigation.

The cultural practice of removal of sources of infestation or infection (e.g. scab, 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*. The risk of sharka and ESFY disease must be minimised by timely removal of infection sources from orchards and their surroundings (see section 3). Avoidance of vigorous shoot growth susceptible to pests and diseases is recommended.

Populations of pests, diseases and weeds must be regularly monitored and recorded. Scientifically established assessment methods appropriate to regional or local conditions must be used. For each pest or disease the approximate level of infestation or the risk of damage must be estimated and a decision as to whether or not treatment is required, based on scientifically established threshold levels wherever possible, taken and recorded. Predominant weed species present, their growth stage, distribution and extent should also be recorded.

Wherever an additional control measure is deemed necessary, a biological, genetic or biotechnical control method (e.g. *Bacillus thuringiensis* or pheromone mating disruption for tortricids) should be used if available and effective.

Where the use of plant protection products is necessary, the product selected must be the least hazardous to human beings, livestock and the environment whilst providing effective control of the pest, disease or weed problem.

IP-Organisation guidelines must set out a resistance management for minimising the risk of the development of resistance of pests and diseases to pesticides. The strategy must require the alternation of the use of pesticides with different modes of action (where available). The maximum number of applications of any one fungicide group with a risk of resistance development must be set to three per crop per annum and the maximum number of applications of any acaricide group for control of spider mites must be set to one per crop per annum.

Pesticides available locally or nationally identified as meeting these criteria, as well as being as safe as possible to the main natural enemies, must be identified in a list of permitted products (green list) in regional guidelines and standards, with restrictions where appropriate (yellow list). All other pesticides must not be permitted and examples may be given (red list).

The following criteria should be taken into account in the classification of pesticides into 'permitted', 'permitted with restrictions' and 'not permitted' categories:

Toxicity to man
Toxicity to main natural enemies
Toxicity to other natural organisms
Pollution of ground and surface water
Ability to stimulate pests
Selectivity
Persistence
Incomplete information
Necessity of use

Based on these criteria the following categorisation of certain pesticides and pesticide groups for stone fruit crops is defined:

Not Permitted
Non-naturally occurring plant growth regulators
Organochlorine pesticides
Residual herbicides

Permitted with Restrictions
Benzimidazole fungicides (maximum of 2 application / year)
Dithiocarbamate fungicides (maximum of 3 applications / year)
IBE fungicides (maximum of 3 applications / year)
Dicarboximide fungicides (maximum of 3 applications / year)

Wherever possible, use of synthetic pyrethroids must not be permitted. However, as a short-term measure, whilst research is undertaken to identify more selective control methods, synthetic pyrethroid insecticides may be used only on peaches, nectarines, apricots and plums in the following circumstances:

> Maximum of 1 application / year in emergency situations, shortly before harvest, if no alternatives are available.

Regions / countries which permit the use of pyrethroids must have an active research programme to identify more favourable alternatives.

Statutory maximum residue levels must be observed. The occurrence of pesticide residues on fruits at harvest should be further minimised by maximising safe-to-harvest intervals.

Spray applications should be localised to parts of orchards where damaging infestation is present where possible.

Where available, officially-recognised dose adjustment protocols must be used to adjust dose rates to suit the size and density of the target trees being sprayed.

10.1 Additional requirements for integrated plant protection on peaches, nectarines and apricots

In regions where infestation is low, and especially in young orchards, *Cydia molesta* and *Anarsia lineatella* must be controlled by removal of infested shoots by pruning in summer.

On peaches and nectarines, mating disruption must be used as the basic method for control of *Cydia molesta* and *Anarsia lineatella*, 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 insect growth regulators or other selective compounds.
On apricots, *Anarsia lineatella* populations must be monitored using pheromone traps. Regional / national guidelines must specify threshold trap catches above which insecticide application is permitted.

Parasitoids of scale insects must be conserved and encouraged. Scale insects should be controlled where necessary by application of mineral oil or poly-sulphurs in the dormant period. Control may also be achieved post-harvest in the orchard by application of insecticides. As a last resort, these measures may be supplemented with application of selective insecticides in summer where necessary.

10.2 Additional requirements for integrated plant protection on plums and cherries

On plums, *Cydia funebrana* must be monitored using pheromone traps and control measures only applied where necessary. The use of selective insecticides such as insect growth regulators or *Bacillus thuringiensis* is preferred, but in regions where damage occurs close to harvest use of broader spectrum short persistence insecticides is permitted.

Alcohol-baited traps must be used for mass-trapping to control *Xyleborus dispar* where necessary.

On cherry, *Rhagoletis cerasi* must be monitored using yellow sticky traps. A short persistence insecticide should be applied for control where necessary. An approved feeding attractant may be used to enhance the efficacy of insecticides.

Cherry cultivars and rootstocks resistant or less susceptible to bacterial canker or spot should be selected. Pruning may only be done in summer. Sprays of copper compounds must be applied to cherry orchards at bud-burst and leaf fall.

11. Efficient and Safe Spray Application Methods

Radial flow air assisted sprayers traditionally used for top fruit spraying are often inefficient and generate high levels of spray drift. An important requirement of Integrated Fruit Production is that these sprayers are used as safely and efficiently as possible and that new designs of sprayer which are safer and more efficient are gradually adopted. It is advisable to protect non-cropping areas from contamination by spray drift by planting windbreaks as barriers. Statutory buffer zones specified on pesticide labels must, in any event, be observed.

Sprayers must be regularly serviced and calibrated by the grower and must comply with officially-recognised sprayer testing requirements. They must be serviced by a recognised agent at least every four years. The size and shape of the spray plume generated by the sprayer should be set to match the tree target.

Spraying in windy conditions is not permitted. Statutory buffer zones must be observed to protect watercourses from pollution by spray drift. Wherever possible, tractors must be fitted with a cab.

12. Harvesting, Storage and Fruit Quality

Fruit must be harvested at the correct time according to the cultivar and for the purpose intended. Storage methods must be such as to maintain high internal and external fruit quality. Stores and refrigeration equipment must be maintained to ensure maximum efficiency and must be regularly monitored to ensure correct operating conditions. Accurate records must be required. Fruit in store should be regularly monitored for external and internal condition and firmness: records must be kept and made available for inspection.

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.

13. Post-harvest chemical treatments

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.

14. Mode of Application, Controls, Certification and Labelling

National/regional IP-organisations applying for endorsement by the IOBC commission 'IP-Guidelines and Endorsement' have to organise and operate their inspection and certification systems according to the standards defined by Appendix 2 of the Technical IOBC Guideline 1 (2nd edition 1999). With respect to the establishment of flexible national and regional guidelines, we refer to the recommendations in Appendix 1 in Technical Guideline 1 (2nd edition 1999).

Selected literature

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