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Commission "IP-Guidelines and Endorsement"

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GUIDELINES FOR INTEGRATED PRODUCTION OF SOFT FRUITS

IOBC Technical Guideline III

2nd Edition, 2007

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The content of the contribution is in the responsibility of the authors

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Preface of 2nd edition

The necessity of a revision of the soft fruits guidelines (1st edition, 1999) is mainly due to the necessity to incorporate some components of Good Agricultural Practice contained in important international food safety standards (such as EUREP-GAP). Although we refer often to the full details published in the IOBC basic document of 2004 we repeat many aspects in the soft fruits guideline in order to make our IOBC guidelines and IOBC inspection systems compatible with major international food standards.

The first draft of this revised edition was prepared by Ernst Boller in early 2007, circulated between expert of the IOBC/WPRS Orchards Working Group – Subgroup Soft fruits and discussed in a specific expert panel during the East Malling Meeting held on 25th September 2007.

We would like to extend our thanks to all persons that assisted in the preparation of this document by their direct input and advice.

The final text of the 2nd edition was read and approved by the Commission on November 2007.

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INTERNATIONAL ORGANISATION FOR BIOLOGICAL AND INTEGRATED CONTROL OF NOXIOUS ANIMALS AND PLANTS

GUIDELINES FOR INTEGRATED PRODUCTION OF SOFT FRUITS

IOBC Technical Guideline III

(Strawberry, Raspberry, Blackberry, Currants, Gooseberry, Blueberry, Elder, etc.)*

2007, 2nd Edition
(Original text in English)

The following paper sets out principles, minimum standards and guidelines for in-soil Integrated Production of Soft Fruits. It is intended as a framework for the formulation of specific regional or national guidelines according to IOBC standards and to facilitate their harmonisation.

The requirements for Integrated Production of soft fruits as defined in this document are based on the IOBC Principles of Integrated Production and Technical Guidelines I and II (3rd edition) published in the IOBC/WPRS Bulletin Vol. 27 (2), 2004 and available in full text on internet www.iobc.ch. These documents or up-dated versions thereof, are integral parts of these crop specific Technical Guidelines III.

(*Note: These guidelines are for soft fruit crops grown in the soil in the open or under non-heated protected cropping only. Although only the major soft fruit crops are covered specifically, the same principles can be extended to other closely related minor soft fruit crops).

I. Definition of Integrated Production of Soft 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 soft fruits emphasises the following objectives:

- To promote production systems that respect the environment, are economically viable, and sustain the multiple functions of agriculture, namely its social, cultural and recreational aspects;
- To secure a sustainable production of healthy soft fruits of high quality and with a minimum occurrence of pesticide residues;
- To protect the farmers' health while handling agro-chemicals;

- To promote and maintain a high biological diversity in the production area and its surrounding;
- 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.

II. REQUIREMENTS

1. Formal Requirements for IP Organisations and their Members

1.1. Organisations: Basic requirements, inspection procedures and guideline structure

National or regional IP-organisations applying for endorsement by the IOBC Commission on 'IP-Guidelines and Endorsement' have to fulfil the basic requirement defined by the "Admission Criteria for Organisations seeking IOBC Endorsement" (see www.iobc.ch). They have to organise and operate their inspection and certification systems according to the standards defined in the Technical IOBC Guideline I and its Appendices 2 and 3 (3rd edition 2004 or more recent version). With respect to the establishment of flexible national and regional guidelines, we refer to the recommendations given in Appendix 1 of the Technical Guideline I and in the "IOBC Tool Box" published by the IOBC Commission on internet www.iobc.ch.

1.2 Professionally trained, environmentally and safety conscious growers

Successful Integrated Production requires professional, up-to-date training and a positive and sympathetic attitude to its aims. The requirements for the farmer (member of the regional IP-organisation) are defined by the IOBC Technical Guideline I and are summarised as follows:

The farmer or responsible farm manager must:

- Be professionally qualified to manage the farm according to IP principles;
- Be a member of an officially recognised IP association and has to sign a contract defining clearly the duties as member;
- Have a thorough knowledge of the aims and principles of Integrated Production and of regional IP-guidelines and standards and should have a positive and sympathetic attitude to environmental conservation and human health and safety.
- Undertake basic training and education in IP, and participate actively in the regular updating courses offered by his/her IP organisation;
- Make complete farm records demonstrating essential farm operations such as fertilisation, pesticide applications, soil management, irrigation, according to the rules of the IP association.
- Carry out each year (preferably before harvest) a self-evaluation by completing the check-list (= inspection protocol) of the organisation (Technical Guideline II, point 1.4).

2. Conserving the Fruit Crop Environment: Biodiversity and Ecological Infrastructures

An important aim and requirement of Integrated Fruit Production is the conservation of the fruit crop environment, its habitats and wildlife. They must not be detrimentally altered, grubbed, drained or polluted.

A balanced and natural environment with a diverse agro-ecosystem of plants and animals must be created and conserved. According to IOBC standards at least 5% of the ***entire farm surface*** (excluding forests) have to be identified and managed as ecological infrastructure (= ecological compensation area) with no input of pesticides and fertilisers in order to enhance botanical and faunistic biodiversity. The surface of ecological infrastructures should eventually increase to 10%.

In areas with predominantly perennial crops and small farms, where a surface of 5% or more of a common and homogeneous agroclimatic unit (e.g. municipal district) has been set aside as ecological compensation area by official and well documented regional programs, the 5% rule has not necessarily to be applied to the individual farm.

Existing ecological infrastructures on the farms must be preserved. Headland attractants (flowering field margins) should be established as reservoirs of pest antagonists. A correct management of field margins and surroundings promotes also native pollinators, availability of nesting sites, nectar and pollen sources, clean water. Regional organisations must establish lists of plants to be avoided (e.g. sources of infestations of major diseases, viruses etc). 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 on the farm or planned should be combined in a manner to obtain spatial and temporal continuity as a prerequisite for the enhancement of faunistic diversity and for the maintenance of a diverse landscape. (Practical examples on the evaluation of the ecological quality of the infrastructures, their functions, establishment and maintenance are given in the IOBC Toolbox on internet www.iobc.ch).

Important elements of ecological infrastructures are e.g. border areas and slopes of terraced plots rich in plant species, stone walls and ruderal areas. Particular attention must be devoted to headlands and windbreaks. Windbreaks are essential for the protection of raspberry, blackberry and blueberry plantations and must be planted on sites exposed to strong winds. Hedgerows should provide adequate screening to prevent pollution and contamination of fruit by exhaust fumes from busy roads. High diversity of their composition and structure should be the aim, using or encouraging native species where possible.

3. Site, Cultivar, Planting Material and Planting System for New Soft Fruit Plantations

For new soft fruit plantations, site, cultivars, rootstocks for currants and gooseberries 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. Frost pockets or poor drainage must be avoided. For strawberry and especially for raspberry production, a preference for sites where these crops have not been grown previously must be stated. Sites with significant infestations of soil insects (e.g. *Melolontha* spp.), plant-parasitic or virus-transmitting nematodes should be excluded from production. It is recommended that a crop of *Tagetes* spp. is planted to reduce nematode infestation prior to planting sensitive crops. For blueberries, sites close to the forest with infections of *Armillaria* root rot should be excluded from production.

Sites infected with the soil-borne root rot fungus *Phytophthora fragariae* var. *rubi* must not be used for raspberry production. Ridge cultivation lowers the risk of infection with root rots and should be preferred in strawberries as well as in raspberries, especially on heavy soils. Neither strawberry nor cane fruit should be grown on sites infested with perennial weeds.

The cultivar chosen must offer good prospects for economic success with minimal use of agrochemicals. A preference for cultivars resistant or tolerant to fungal diseases, pests, viruses and/or phytoplasmas must be stated. National/regional guidelines must set out a list of the relative susceptibilities of the commonly grown cultivars of soft fruits to all important pests and diseases. Recommendations for 1) strawberry cultivars resistant to Verticillium wilt and/or powdery mildew, 2) raspberry cultivars less susceptible to *Phytophthora fragariae* var. *rubi* and/or virus-transmitting aphids, 3) black currant cultivars resistant to black currant gall mite and/or reversion disease, 4) black currant and gooseberry cultivars resistant to powdery mildew, must be stated where available.

Soft fruit plantations protected under small and long tunnels in steeply sloping fields could create microclimate problems and related pest infestations (e.g. *T. urticae*). Protections (tunnels) allow to reduce the incidence of *Botrytis cinerea* but, on the other hand, can promote the development of other diseases such as powdery mildew on strawberries and currants.

Planting material must be certified as being of high health status. The requirements of EU regulations must be fulfilled. It must be pointed out that problems with *Phytophthora* spp., *Verticillium*, *Xanthomonas*, *Colletotrichum*, virus diseases, tarsonemid mites or free living nematodes may often be avoided by the use of healthy planting material. Additional testing of the health status of planting material must be recommended. However, no recommendation for growers to propagate their own planting material may be given. The grower may only be permitted to use such material on his own farm with a recommendation for additional testing for the health status of the material. Care should be taken to avoid planting material contaminated with pesticide residues which may disrupt subsequent biological control programmes.

Planting systems must allow safer, more efficient spraying practices to be adopted. Planting distances should allow enough space for the plant throughout its expected life span without the use of growth regulators. A correct planting distance reduces humidity inside the row and therefore prevents cane diseases.

Cane fruit crops must not be grown on the same land twice. In order to avoid the spread of pests and diseases, the spatial and temporal separation between successive soft fruit crops should be maximised.

The maximum life span of strawberry crops must not exceed three years to avoid poor fruit quality and pest or disease problems. Strawberry crops must be integrated into diverse crop rotations, preferably including cereals or peas or beans. Break crops that are host plants for *Verticillium* wilt, e.g. potatoes, tomatoes or linseed, must be avoided. A break of at least five years is generally recommended for the different crops, especially if root pathogens are present in the soil (*Phytophthora*, *Verticillium, Armillaria*, *Rosellinia*, etc). However for strawberry crops with a life span of only one year, continuous cropping is permitted as long as soil-borne diseases do not occur at significant levels.

4. Soil Management and Plant Nutrition

The structure, depth, fertility, fauna and micro-flora of the soil must be conserved and nutrients and organic matter recycled where possible. 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 maximum nitrogen input (expressed in kg N/ha/year) and period and methods of application must be set to minimise leaching. The same rules apply for other major nutrients with high polluting potential. 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 or manures contaminated with toxic or environmentally hazardous substances such as heavy metals or pathogenic micro-organisms are not permitted.

5. Alleyways and Weed-free Strips

The aims are to maintain plant species diversity in cane and bush fruit plantations so fostering ecological stability, to minimise the use of herbicides (avoiding persistent , toxic or water polluting residual herbicides completely, see Section 8) 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 fruit plantations throughout the year is not permitted. In arid areas, 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. Graminaceous species supply pollen to Phytoseiid mites.

To avoid undue competition for moisture and nutrients, a weed free strip should be maintained in the rows of cane and bush fruit crops by mulching or mulching the soil surface or by mechanical cultivation. For elderberry production, 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 8) may only be used 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.

In strawberry crops, mulching the soil with straw and/or plastic reduces fruit pollution, weed competition and infection by fungal diseases. A recommendation for the use of such mulches must be stated.

Where possible, buffer zones immediately adjacent to soft fruit plantations should be mowed partially to avoid migration of phytophagous insects (e.g. leafhoppers and *Lygus)* to crops.

6. Irrigation

Plants 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 rots. Excessive use of irrigation water is wasteful. Irrigation must be applied according to species need. Wherever possible drip irrigation or fertigation should be preferred.

In plantations 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 plants, the soil moisture balance and water storage capacity.

Particular attention must be focused on water quality with particular reference to salt and content of polluting agents.

7. Horticultural and Fruit Management

Plants must be managed to achieve a balance between growth and regular yields, and to allow an optimal distribution of solar radiation and spray in the canopy. The use of plant growth regulators is not permitted. Excessive growth should be controlled by cultural measures, including reducing fertiliser and irrigation supply, pruning and encouraging an optimal fruit set. Pruning could also be a preventive method against pests and diseases.

The flowers of soft fruits are usually self-fertile. However, entomophilous pollination increases fruit set, fruit quality and production. Where native pollinators are insufficient, bees should be introduced to ensure adequate pollination.

The use of chemical agents for fruit management is not permitted.

8. Integrated Plant Protection

8.1 Principles of Integrated Plant Protection

The modern approach to Integrated Plant Protection in the context of sustainable production systems has been described in Technical Guideline II (2004) and can be summarised as follows:

Preventive (indirect) measures and observations in the field on the pest, disease and weed status must have been considered before intervention with direct plant protection measures takes place.

For further details on plant protection strategies we refer to the IOBC Technical Guideline II (2004) and its Appendices 4 and 5, respectively.

Prevention (= indirect plant protection)

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;
- use of adequate cultivation techniques (e.g. ridge cultivation, irrigation system, pruning, plant spacing, protection systems, mulching);
- use of optimum fertilization (especially low nitrogen input) and irrigation practices;
- protection and enhancement of beneficial organisms (e.g. predatory mites, parasitoids);
- utilisation of ecological infrastructures inside and outside production sites to enhance a supportive conservation biological control of key pests by antagonists.

Each IOBC endorsed regional IP-organisation must establish for each geographically defined production zone a list of key pests, key diseases and key weeds that require regular protection measures in the region concerned and a list of the most important known antagonist(s) of the key pests ("Passport", see also chapter 8.3):

Risk assessment and monitoring

Basically, all available prophylactic measures (= indirect plant protection) must be applied before direct control measures are used. The decision for the application of direct control methods is based on economic thresholds (tolerance levels), risk assessment and the services provided by the official forecasting services (prognoses).

Populations of pests and diseases must be regularly monitored and recorded. Scientifically established assessment methods appropriate to the region or locality must be used. For each pest or disease the approximate level of infestation or the risk of damage must be estimated. The decision, if a treatment is necessary, must be based on scientifically established threshold levels and the official forecasts of pest and/or disease occurrence and risks. Validated forecasting models for diseases should be used and the use of adequate monitoring devices by groups of growers recommended.

Direct plant protection measures (= control)

Where indirect plant protection measures are not sufficient to solve the problem and the forecasting operations and threshold values indicate a necessity of intervention with direct plant protection measures, priority must be given to measures with minimum impact on human health, non-target organisms and the environment. Biological, biotechnical[1] and physical methods must be preferred to chemical methods if they provide satisfactory control.

8.2 The Choice of Direct Plant Protection Methods (= control)

All agrochemicals used must fulfil the basic requirements of GAP as detailed in the IOBC Technical Guideline II. All crop protection products applied must be officially registered or permitted by the appropriate governmental organisation in the country of application and final destination of produce. Where no official registration scheme exists reference is made to the FAO Code of Conduct on the Distribution and Use of Pesticides.

The crop protection product applied must be appropriate for the target as recommended on the product label or for officially approved off-label uses.

The choice of pesticides in *sustainable production schemes* and their classification into 'permitted'(green), 'permitted with restrictions' (yellow) and 'not permitted' (red) categories must consider:

- Their toxicity to man
- Toxicity to key natural enemies
- Toxicity to other natural organisms
- Pollution potential for the environment (soil, water, air)

[1] Biotechnical control methods are defined in applied entomology as highly specific procedures that influence the behaviour or development of pests without direct biocidal activity, such as mating disruption, selective attractants and traps, deterrents, sterile insect technique. They are not identical to and should not be confused with genetically modified organisms/ GMOs).

- Ability to stimulate pests and diseases
- Selectivity
- Persistence
- Potential to develop resistance in target
- Incomplete or missing information
- Necessity of use

Wherever an additional control measure is deemed necessary, a biological or biotechnical control method (e.g. *Bacillus thuringiensis* , pheromone mating disruption, entomopathogenic nematodes for vine weevil, *Trichoderma* spp. for root rots) should be used if available and effective. The cultural practice of removal of sources of infestation or infection (see Chapters 8.2.1, 8.2.2 and 8.2.3) as far as practically possible is required.

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.

Regional/national guidelines must set out a strategy of mandatory measures for minimising the risk of development of resistance of pests and diseases to pesticides. The strategy must require the alternation of use of pesticides with different modes of action (where available). The maximum number of applications of any one fungicide group with a risk 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.

Regularly updated data on the side-effects of pesticides are compiled and published by IOBC (see IOBC Toolbox on internet www.iobc.ch) and must be taken into account.

Based on these criteria the IOBC sub-group for Integrated Fruit Guidelines and Standards have identified and agreed the following categorisation of certain pesticides and pesticide groups for soft fruit crops:

Not permitted

- Plant growth regulators
- Organochlorine pesticides
- Persistent (DT50 > 3 months), toxic or ground-water polluting residual herbicides including triazines
- Diquat, Paraquat
- Persistent or phytoseiid mite toxic OP insecticides

Permitted with Restrictions

- Non-persistent (DT50 < 3 months), non-toxic, non-ground water polluting residual herbicides (maximum of 1 dose-equivalent/annum)
- Benzimidazole fungicides (maximum of 1 application/year, except on raspberry a maximum of 2 applications per annum as directed sprays to control cane blight only)
- Other fungicide groups with risk of resistance development (including EBIs, dicarboximides and QOLs) (maximum of 3 applications per group/year alternating different active ingredients)
- Acaricides for control of spider mite (maximum of 1 application per pesticide resistance group / year)
- Pyrethroid insecticides (maximum of 1 application/year for control of *Anthonomus rubi* or aphids and thrips on strawberry)
- OP insecticides of short persistence and low toxicity to phytoseiid predatory mites (maximum of 2 applications/year)

In general, the use of synthetic pyrethroids must not be permitted. However, as a short-term measure, so that more selective control methods can be identified, the use of synthetic pyrethroids may be permitted with the restrictions specified above.
Regions/countries which permit the use of pyrethroids must have an active research programme to identify more favourable alternatives.

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 plantations where damaging infestation is present.

8.2.1 Additional requirements for integrated plant protection on strawberry

Naturally-occurring phytoseiid predatory mites reduce populations of spider mites, tarso-nemid mites and thrips and must be conserved. Use of pesticides harmful to them must be avoided. Where application of a harmful pesticide cannot be avoided, effects may be alleviated by downward-directed spraying to reduce deposits on the undersides of leaves where the predatory mites occur mainly.

The predatory mite *Phytoseiulus persimilis* or another appropriate species must be introduced for biological control of two-spotted spider mite on protected crops (in tunnels etc.).

Orius spp. or suitable predatory mirids should be used to control western flower thrips on protected crops.

Entomopathogenic nematodes, where available, should be used to control vine weevil and other soil-pests in protected crops.

Botrytis cinerea infections on strawberry and other soft fruits can be prevented with an early covering of tunnels.

8.2.2 Additional requirements for integrated plant protection on cane fruits

As for strawberry, predatory mites must be conserved in field crops and *P. persimilis*, or another suitable species, used for biological control in protected crops.

Byturus tomentosus must be monitored regularly by using white sticky traps.

The raspberry clearwing moth, *Synanthedon hylaeiiformis,* must be monitored with pheromone traps. Infested shoots must be pruned and removed from the plantation.

To prevent and control the development of cane diseases the following cultural methods should be applied 1) early removal of infected and superfluous fruiting canes, 2) removal of fruiting canes immediately after harvest, 3) reduction of Nitrogen fertiliser rates, 4) drip irrigation should be preferred to sprinkler and micro-sprinkler systems.

8.2.3 Additional requirements for integrated plant protection of bush fruits

The currant clearwing moth, *Synanthedon tipuliformis,* must be monitored with pheromone traps. Infested shoots must be pruned and removed from the plantation.

Black currant crops must be closely inspected for black currant gall mite galls during the dormant period when they are easily visible and all infested plant material must be removed from the plantation and destroyed. Currant branches infected with *Botrytis cinerea* and *Nectria cinnabarina* should also be removed and the pruning wounds should be protected. Crops must also be inspected for symptoms of reversion disease immediately before flowering and all infected bushes must be grubbed and destroyed. Currant and gooseberry

shoots infected with powdery mildew (*Sphaerotheca mors-uvae* and *Microsphaera grossulariae*) should be removed to reduce inoculum for the next growing season.

In blueberry production, organic mulch with bark, wood chips or sawdust is commonly used but it could be a dangerous inoculum source of root rot pathogens, *Armillaria* spp. in particular. Therefore it's important to pay attention at the presence of *Armillaria* in the bark heaps before their use for mulching.

8.3 Lists to be Compiled by IOBC Endorsed Regional IP Organisations

Each IOBC-endorsed regional IP-organisation must establish for each geographically defined production zone:

- a list of key pests, key diseases and key weeds that require regular protection measures in the region concerned and
- a list of the most important known antagonist(s) of the key pests ("Passport"). At least two key natural enemies (one of them usually a phytoseiid mite, the second one representing important insect parasitoids or predators) must be identified and their protection and augmentation be declared important. Where phytoseiid predators are absent, they must be introduced where the pest situation (e.g. spider mites) requires regular control measures; better results could be obtained by introducing indigenous species;
- a list of field-evaluated, available and recommended indirect plant protection measures (= prevention) as important part of the "Green list of plant protection measures" (see IOBC Toolbox www.iobc.ch).
- a selective list of officially registered pest control measures divided clearly into those that can be used without restrictions in the IP program ("green list") and into those products that can only be used with clearly defined restrictions ("yellow list"). The IP-organisation applying for IOBC endorsement must prove that either no ecologically safer alternatives are available or that the active ingredient is necessary for a planned resistance management. Guidelines must define clearly the restrictions and permitted indications (See 8.2)

8.4 Application of Pesticides and Recording of Pesticide Treatments

For full details see Technical Guidelines II, chapter 8.4

There must be documented evidence on the application according to label instructions and that the application has been accurately calculated and prepared. Label doses are, however, maximum doses approved by the registration authorities. Reduced dosages 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 require the full dosage.

The official pre-harvest intervals must be followed and should, if possible, be extended to minimise pesticide residues. They must be recorded for all crop protection product applications made and evidence provided that they have been observed. In situations with multiple harvest periods, systems must be in place in the field to ensure fail-safe compliance (e.g. warning signs).

Application of pesticides toxic to pollinators must be prohibited during the flowering period to avoid poisoning and death of pollinators.

8.5 Efficient and Safe Storage and Handling of Pesticides

The basic requirements of Good Agricultural Practice (GAP) with respect to storage, safe handling and disposal of pesticides and to the operation and maintenance of spray equipments must be fulfilled. They are listed in IOBC Technical Guideline II (8.5) and must be outlined in detail in IOBC endorsed regional IP guidelines.

The following selected list of mandatory requests includes some of the general aspects as follows:

8.5.1 Safety and handling

There must be adequate facilities for measuring, mixing and filling the products. Adequate emergency facilities must be provided to deal with potential operator contamination, such as running water, eyewash facilities, first aid box and emergency procedures. The emergency plan must include a list of emergency telephone numbers and the location of the nearest telephone. Operators must have appropriate protective clothing and equipment for all operations involving chemicals.

8.5.2 Application and training

The use of best application techniques available to minimize drift and loss is highly recommended. All sprayer operators must have appropriate training and hold, where relevant, the appropriate certificate of competence. Operators on training for the certificate of competence must be supervised during pesticide application by a certificate holder and must be within sight and sound of the supervisor.

8.5.3 Storage

The regulations on storage are numerous and contain in certain GAP standards close to 20 “must” items. Pesticides must be stored in accordance to local 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. Only pesticides that are approved for use on the crops must be stored in the same room; crop protection products used for purposes other than application on crops according to IOBC endorsed IP programs must be clearly identified and stored separated from “green” and “yellow list “products.

8.6 Spray Equipment

Radial flow air assisted sprayers traditionally used for tree and bush fruit spraying are often inefficient and generate high levels of spray drift.

Spraying equipment and spraying conditions minimising the health risk of the operator and drift should be preferred. Wherever possible, tractors must be fitted with a cab.

Spraying in windy conditions is not permitted.

Sprayers must be calibrated at the beginning of each season and their proper functioning should be checked before each treatment.

The spray impact on the environment can be minimised by the proper calculation of the amount of product needed per ha. Sprayers must be calibrated annually by the grower and serviced by a recognised agent at least every four years.

When new sprayers are purchased, transverse flow designs or tunnel sprayers should be selected where possible.

8.7 Disposal of Surplus Mix, Obsolete Pesticides and Empty Containers

Under normal circumstances surplus spray mix should not occur. However, if surplus should occur, disposal must comply with local regulations. Surplus application mix or tank washings must be either disposed of by a registered waste contractor or sprayed onto a designated untreated part of the crop. When surplus mix or tank washings are applied onto designated fallow land, it must be demonstrated that this is legal practice and there is no risk of surface water contamination.

The safe disposal of redundant pesticides must be planned and recorded, and obsolete pesticides must only be disposed of through an approved chemical waste contractor. Empty pesticide containers must be rinsed with water three times and the resultant mixture returned to the spray tank. Empty containers must not be re-used and are crushed or perforated to prevent re-use.

8.8 Pesticide Residues

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

9. Harvesting, Post-harvest Handling, Storage and Fruit Quality

Harvest and post-harvest handling practices of fruits have to fulfil the general requirements for product quality, food safety and traceability established by national or international food safety standards and are outlined in the IOBC Technical Guideline II (chapters 9 and 10). Some selected “must” items are listed below.

Fruit must be harvested at the correct time according to the cultivar and for the purpose intended. For strawberries and cane fruits, picking should be done early in the day while fruit is cool. Fruit should be transferred swiftly to cold stores. 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.

Only fruit of sound internal 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) must be assessed for fruit quality before marketing.

Hygiene

All staff must be aware of the need to harvest, transport and handle the fruits with care having received basic training in personal hygiene requirements for handling of fresh produce.

A documented and up-dated risk assessment covering hygiene aspects of the harvest process and of produce handling operations must be made and hygiene procedures be implemented.

Workers must be provided with clean fixed or mobile toilet facilities at all permanent sites and in vicinity of fieldwork.

Staff must have access to clean hand washing facilities in the vicinity of their work.

10. Post-harvest Chemical Treatments

No post-harvest chemical treatment of fruit is permitted.

11. Workers' Health, Safety and Welfare

The aspects of the workers' health, safety and welfare are detailed in IOBC Technical Guideline I (2004) and in the "Admission Criteria for Organisations seeking IOBC Endorsement", respectively. The criteria are those outlined in the Declaration of the International Labour Organisation (www.ilo.org), an organisation of the United Nations.

III. Selected literature (available in full text on internet www.iobc.ch)

Boller, E.F.; Avilla, J.; Gendrier, J.P.; Jörg, E.; Malavolta, C. 1998. Integrated Production in Europe: 20 years after the declaration of Ovrannaz. – IOBC/WPRS Bulletin 21(1), 41 pp.

Boller, E.F.; Avilla, J.; Jörg, E.; Malavolta, C.; Wijnands, F.; Esbjerg, P. 2004. Integrated Production: Principles and technical Guidelines. 3rd edition. – IOBC/WPRS Bulletin 27(2), 49 pp.

IOBC Toolbox: www.iobc.ch