Scanning report
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NUTS 3 region(s)[1]:	DK011 (Copenhagen), DK012 (Copenhagen and its environs), DK013 (North Zealand), DK014 (Bornholm), DK021 (East Zealand), DK022 (West- and South Zealand), DK031 (Funen), DK032 (South Jutland), DK041 (West Jutland), DK042 (East Jutland), DK050 (North Jutland).
WP no. and title:	**3 – Reduction in pesticides residues**
Date:	23-05-2016 Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

Pesticide residues in fruit is a topic of concern to the public, media and hence politicians in Denmark. The Department of Food has since 2008 developed research projects that aimed at understanding and reducing pesticide residues in Danish fruit. In the beginning research focused on understanding when and which compounds were more likely to leave residues. From 2010 and onwards experiments aimed at eliminating residues have been conducted in the research orchard of the Department of Food. The research has been financed by the Danish Ministry of food and agriculture.

Inspiration and experience has been sourced from international collaboration with the EUFRIN workgroup on 'Sustainable fruit production to minimize residues', Obstbauzentrum Jork (D) and from work conducted in East Malling (UK).

Best practice findings

The aim is to report about the best European practices to reduce pesticides residues on fruits.

Scientists at the Department of Food Science have demonstrated (on research scale), that with optimal spraying of fruit in the period before fruiting, it is possible to avoid spraying (except for organic compounds) in the period when the fruits develop without this leading to large yield losses and pesticide residues in the fruit.

In the ongoing project DAFRUS, these research results are subjected to a reality check in three commercial fruit orchards. Here the strategy will involve different disease pressures, variety fruit combinations, microclimates and spraying agents. This will result in a better basis for evaluating the extent and the costs of the implementation of the pesticide-free strategy in the industry. The scientist believe that the biggest challenge to the pesticide-free strategy will be fruit rots as these infect the fruit during the last part of fruit development and therefore cannot be controlled before fruitset. Alternative tools like hot-water treatment are therefore believed to be a necessary prerequisite that need to be implemented for growers who choose to follow the residue-free strategy.

In the project 'Less waste and better storability' scientist at the Department of Food Science the scientists have shown that hot water treatment of fruits after harvest can reduce rot diseases to practically the same extent as fungicide sprays given in the orchard. Pesticides used against fruit rots are sure to leave a residue on the fruit because they are given just prior to harvest. In

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

collaboration with engineers a new machine for hot water dipping has been developed that enables the dipping process to take place during fruit grading and lowers the dipping time to 30 seconds without loss of efficacy. F

The growers participating in the project as well as a growing number of growers in general use ferromone disruption technique. This involves hanging plastic straps containing ferromones specific to codling moth and several late season tortrix moths in the orchard at a number of 800/ha. Ferromones diffuse from the straps and disrupts the ability of males to find the female moths. A total of 1-3 sprays against the moths can be avoided with this method and as most of these sprays are late season sprays (july/august) the risk of residues is high and can thus be avoided.

Scanning report apple
Wendy Van Hemelrijck, Dany Bylemans, pcfruit

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NUTS 3 region(s)[1]: BE211 Arr. Antwerpen - BE212 Arr. Mechelen - BE213 Arr. Turnhout- BE221 Arr. Hasselt - BE222 Arr. Maaseik - BE223 Arr. Tongeren - BE231 Arr. Aalst - BE232 Arr. Dendermonde - BE233 Arr. Eeklo - BE234 Arr. Gent - BE235 Arr. Oudenaarde - BE236 Arr. Sint-Niklaas - BE241 Arr. Halle-Vilvoorde - BE242 Arr. Leuven - BE251 Arr. Brugge - BE252 Arr. Diksmuide - BE253 Arr. Ieper - BE254 Arr. Kortrijk - BE255 Arr. Oostende - BE256 Arr. Roeselare - BE257 Arr. Tielt - BE258 Arr. Veurne - BE310 Arr. Nivelles - BE331 Arr. Huy - BE332 Arr. Liège - BE334 Arr. Waremme - BE335 Verviers

WP no. and title: **3 – Reduction in pesticides residues**

Date: 10-05-2016

Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

In Belgium, we have a national action plan to reduce the risk linked to pesticide residues which is called NAPAN (2013-2017). The NAPAN is composed of 184 actions that are complying with the pesticide risk management aspects as pointed out in the directive 2009/128/EC. It has been composed of the action plans of all involved competent authorities and hence comprehends a federal part and three regional parts, namely the Flemish Region, the Walloon Region or the Brussels Region.
One of the topics in this action plan is the introduction of the Phytolicence. This licence includes a certificate for professional users, distributors and advisers of plant protection products. The following phytolicences are provided: "Distribution/Advice Products for Non-professional Use", "Assistant Professional Use", "Professional Use" or "Distribution/Advice". Depending on the type of phytolicence you have, you have to follow several training sessions concerning the use of pesticides to obtain or to keep the licence troughout the years. Another important topic in this plan is to raise the 'awareness' of the general public. Developing a targeted and appropriate communication and information campaign is a major focus in this plan. Awareness and information campaigns are mounted in accordance with a graduated system with the highest priority on top, namely:
(1) to prevent the use of pesticides as much as possible;
(2) to use alternatives;
(3) and, in the last instance, to correctly use chemical agents.
To raise awareness, existing initiatives are first of all built on, namely:
- The 'zonder is gezonder' campaign: the website www.zonderisgezonder.be provides information to both public authorities and citizens.
- Awareness-raising and information via environmental health experts and the LOGOs, i.e. the local health consultation.
- Publication of information through the Flemish Centre of Expertise on Environment and Health
- Awareness-raising and information about pesticides as small hazardous waste through intermunicipal authorities, municipalities and the relevant sector.
Other important topics of this NAPAN are: Protection of the aquatic environment and drinking water; Application of professional plant protection products and the correct disposal of resulting waste streams; Integrated pest management (IPM). IPM must guarantee a sustainable and responsible use of plant protection products. IPM is introduced several years ago for the cultivation of apple and pear and recently also for strawberries and small fruits..

http://c-ipm.org/fileadmin/c-ipm.org/Belgian_NAP__in_EN_.pdf

http://www.pan-europe.info/campaigns/pesticides

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Best practice findings

The aim is to report about the best European practices to reduce pesticides residues on fruits.

1) **Use of decision support systems:**
   Pcfruit sends out specific warnings to fruit growers and advisory organisations to inform them about the infection risk of several diseases (scab, powdery mildew, based on prediction models) or pests. They also send out a 'IPM message' at a regular base to the fruit growers and advisory organisations to inform about the specific stages in phenological development for different pests or to inform about development of diseases.
2) **Spray application:**
   Pcfruit developed a spray test with a movable wall to check the accuracy of your spray installation. Fruit growers can test their spray application with the 'measuring wall' test to see if the nozzles are adjusted well to spray their orchards. As such they are informed about spray deposit, spray losses, …
   Pcfruit developed the 'EVA' app for professional fruit growers. Once you have put in the details of your orchards the app can calculate the correct dose of a specific product and the correct water volume if you want to spray that orchard to control a specific disease or pest. The app is at each time up to date with the latest changes concerning pesticide legislation. When using these techniques no mistakes can be made regarding selection of product, dose rate and water volume calculations and number of registered possible applications per product. The app is used in practice in Belgium since March 2016.
3) **Biocontrol products:**
   Several research projects are/were running at the pcfruit research station to look for alternatives in order to reduce the use of pesticides in fruit growing and to obtain a durable management strategy: control of wooly apple aphid, control of storage diseases by nebulization of biological control organisms in storage rooms, use of arbuscular mycorrhizal fungi. The earwig management tool is introduced to fruit growers in 2012.
4) **Genetics:** different new varieties are tested at the pcfruit research station

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Scanning report strawberries
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WP no. and title: **3 – Reduction in pesticides residues**

Date: 10-05-2016

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Source materials and methodology

In Belgium, we have a national action plan to reduce the risk linked to pesticide residues which is called NAPAN (2013-2017). The NAPAN is composed of 184 actions that are complying with the pesticide risk management aspects as pointed out in the directive 2009/128/EC. It has been composed of the action plans of all involved competent authorities and hence comprehends a federal part and three regional parts, namely the Flemish Region, the Walloon Region or the Brussels Region.
One of the topics in this action plan is the introduction of the Phytolicence. This licence includes a certificate for professional users, distributors and advisers of plant protection products. The following phytolicences are provided: "Distribution/Advice Products for Non-professional Use", "Assistant Professional Use", "Professional Use" or "Distribution/Advice". Depending on the type of phytolicence you have, you have to follow several training sessions concerning the use of pesticides to obtain or to keep the licence troughout the years. Another important topic in this plan is to raise the 'awareness' of the general public. Developing a targeted and appropriate communication and information campaign is a major focus in this plan. Awareness and information campaigns are mounted in accordance with a graduated system with the highest priority on top, namely:
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- Awareness-raising and information via environmental health experts and the LOGOs, i.e. the local health consultation.
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Other important topics of this NAPAN are: Protection of the aquatic environment and drinking water; Application of professional plant protection products and the correct disposal of resulting waste streams; Integrated pest management (IPM). IPM must guarantee a sustainable and responsible use of plant protection products. IPM is introduced several years ago for the cultivation of apple and pear and recently also for strawberries and small fruits..

http://c-ipm.org/fileadmin/c-ipm.org/Belgian_NAP__in_EN_.pdf

http://www.pan-europe.info/campaigns/pesticides

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Best practice findings

The aim is to report about the best European practices to reduce pesticides residues on fruits.

1) **Use of decision support systems**
   Pcfruit sends out specific warnings to fruit growers and advisory organizations to inform them about the infection risk of several diseases (botrytis or colletotrichum fruit rot, powdery mildew,..) or pests (trips, mites, drosophila Suzuki,…). They also send out a 'IPM message' at a regular base to the fruit growers and advisory organizations to inform about the specific stages in phenological development for different pests or to inform about development of diseases.

2) **Spray application**
   Pcfruit developed the 'EVA' app for professional fruit growers. Once you have put in the details of your orchards the app can calculate the correct dose of a specific product and the correct water volume if you want to spray that orchard to control a specific disease or pest. The app is at each time up to date with the latest changes concerning pesticide legislation. When using this techniques no mistakes can be made regarding selection of product, dose rate and water volume calculations and number of registered possible applications per product. The app is used in practice in Belgium since march 2016.

3) **Chemical strategies**
   At the pcfruit research station different prediction models for powdery mildew and/or fruit rot in strawberries are tested in order to reduce the number of chemical spray applications. (research/demonstration phase)

4) **Biocontrol products**
   Several research projects are running at the pcfruit research station and the proeftuin in Hoogstraten to look for alternatives in order to reduce the use of pesticides in fruit growing and to obtain a durable management strategy: control of trips by beneficials, control of drosophila suzukii,…

5) **Genetics:** new varieties are tested at the pcfruit location and the proeftuin in Hoogstraten

Sources:

http://www.pcfruit.be/nl/onderzoek/aardbei; http://www.pcfruit.be/en/research/strawberry

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Scanning report : apples
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Country: France

NUTS 3 region(s)[1]: FR211 Ardennes, FR241 Cher, FR244 Indre-et-Loire, FR246 Loiret, FR301 Nord, FR302 Pas-de-Calais, FR411 Meurthe-et-Moselle, FR412 Meuse, FR413 Moselle, FR414 Vosges, FR421 Bas-Rhin, FR422 Haut-Rhin, FR432 Jura, FR433 Haute-Saône, FR511 Loire-Atlantique, FR512 Maine-et-Loire, FR514 Sarthe, FR515 Vendée, FR532 Charente-Maritime, FR533 Deux-Sèvres, FR534 Vienne, FR611 Dordogne, FR614 Lot-et-Garonne, FR615 Pyrénées-Atlantiques, FR623 Haute-Garonne, FR628 Tarn-et-Garonne, FR631 Corrèze, FR632 Creuse, FR633 Haute-Vienne, FR712 Ardèche, FR713 Drôme, FR714 Isère, FR716 Rhône, FR717 Savoie, FR718 Haute-Savoie, FR721 Allier, FR722 Cantal, FR723 Haute-Loire, FR811 Aude, FR812 Gard, FR813 Hérault, FR815 Pyrénées-Orientales, FR821 Alpes-de-Haute-Provence, FR822 Hautes-Alpes, FR823 Alpes-Maritimes, FR824 Bouches-du-Rhône, FR825 Var, FR826 Vaucluse, FR831 Corse-du-Sud, FR832 Haute-Corse

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Source materials and methodology

To reduce the use of pesticides, the Ministry of Agriculture decided in 2008 to have a national program named “Plan ECOPHYTO 2018”. The idea was to reduce 50 % of the pesticides in ten years, if possible. The main actions are :

- **Provide tools to change practices and reduce the use of plant protection products :** with an epidemiological survey network for pests and diseases and a farm network to demonstrate and disseminate more alternatives techniques to chemicals.
- **Develop training for the safe use of plant protection products :** a certification is provided to distributors, advisers and users.
- **Support research :** coordination for speedier innovation and a specific Ecophyto funding for projects.
- **Elaborate indicators for monitoring progress on Ecophyto 2018 targets :** on national base it’s the indicator called “NODU”, number of doses units.

In this context, a six years project (2012 – 2018), funded by ONEMA, is coordinated by Ctifl and composed by five other French experimental station in fruits, located in the different areas of French apple production : Loire Valley (La Morinière), South West (Invenio, Cefel), South East (Cehm, La Pugère). For the **national Ecophyto apple network**, the aim is to evaluate different production systems where several combinations of alternatives to chemical control are tested regarding to the main pests and diseases. The annual evaluation is based on different indicators : the frequency of chemical and bio-control treatments, the turnover (yield x price/kg) and quality of the fruits, the number of hours for manual and mechanised work, the fuel consumption, the plant protection costs (chemicals, bio-control, physical techniques like nets, …), the mechanisation costs, the incidence on environment, the sustainability of the production system and the number and concentration level of residues.

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In total, 28 systems are studied with varieties having different level of apple scab sensibility, like Gala, Fuji, Golden, Granny (sensible), or Crimson Crisp, Opal, Ariane (resistant), or Akane (less sensible). 9 systems are the regional references and they are compared to the Ecophyto systems. Different topics are studied and described in **figure 1**.

Figure 1 : Alternatives to chemical control of pests, diseases, weeds and thinning combined in the system approach of the national Ecophyto apple network in France (ongoing project 2012 – 2018).

Sources :

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Best practice findings

I. Apple scab management

The first step is to **reduce as good as possible in autumn/winter the inoculum** by destroying the leaf litter or applying urea by leaf fall.
Different **models have been developed to predict the potential risk to have a scab infection**, they may be a help to reduce the use of fungicides, but the results from the national Ecophyto apple network are :

- No risk can be taken at the beginning of the primary infections.
- The strategy has to be preventive taking into account the potential risk of an infection with the coming rain, and also renew when the potential risk is high or if the treatment was washed up (more than 20 mm rain).
- The protection of the primary infection should be maintained up to 100 % ascospores discharged.
- During the intermediary stage between primary and secondary infections (mid-May to mid-June), the risk has to be evaluated on leaves and fruits and the treatments may be applied in a stop or curative position (after the infection).
- The bio-control products like potassium bicarbonate should be reserved for the secondary infections.
- On the secondary infection period, the percentage of leave shoots with apple scab lesions may be higher : 5% end of June - 10% end of July - 15% end of august. Under these thresholds, treatments can be avoided.

With these considerations, between the years 2012 and 2015, the reduction of fungicides used against apple scab in the national apple ECOPHYTO network was between **0 to 41 %** depending of the year, the apple scab inoculum (history) in the orchard and the sensibility level of the apple variety.

II. Apple scab resistance varieties

To prevent bypassing the resistance of the apple varieties to apple scab, the strategy is to treat them only on the main primary projections. In that case, the reduction of the use of fungicides compared to a sensible variety can be **up to 70 %, but**

- powdery mildew protection (ex. Sulphur which is on the “green” list) is needed
- remaining problems with storage diseases (some resistant varities are very susceptible)
- some orchards have already lost their resistance (overcoming) and the treatment program has to be quite like a susceptible variety
- the world market is actually not open to resistance varieties.

III. Rain protection against apple scab

It’s a physical technique based on plastic rain cover on the roof of the trees to prevent the apple scab infections. The trials started in 2010 at Ctifl and coming up from 2014 were developed in other experimental orchards in different regions in France. Even some producers are trying this type of protection, but it’s still at “experimentation stage”. From 2010 to 2015, the reduction of fungicides treatments was between **85 to 91 %.** For five years, the results were very good on Braeburn and Gala without any treatment, **but** in a new planted orchard with a more sensitive variety (Rosy Glow), apple scab came out from the first year (2015) and damaged 3 % of the fruits. In 2016 the situation on leaves in June is the same. The specific microclimate condition under the rain cover are studied, to understand what are the main factors to provide the apple scab development without direct rainfall. Furthermore, the protection against *Neofabraea spp.* (“*Gloeosporium”* or Bull’s Eye Rot) *,* fruit rot diseases, gave some interesting results, but they have to confirmed.
The negative incidences of the rain cover are : powdery mildew and flyspeck & sooty blotch may develop, so some specific treatments should be applied (sulphur and potassium bi-carbonate). Fruit color is less intensive and in some cases even yield can be lower because irrigation has to be adapted.

IV. Codling moth protection

- **Granulosis virus** applications are practiced for almost twenty years. They may be used when the codling moth pressure is low or in combination with nets (Alt'Carpo), **but** some case of pest resistance have been observed. Even with Bio-control products, we have to be aware of the risk to have resistance situation. Granulosis virus treatment should be integrated in a whole strategy.

- **Mating disruption with pheromones** is also an older technique and in the national Ecophyto apple network the reduction of insecticides was **between 37 and 56 %** during the years from 2012 to 2015. **But**, this alternative to chemical products should be reserved to low and medium codling moth pressure, otherwise the efficiency will not be good. Labour time needs to be spend to place the dispensers (2-3 hours/ha) and control every 10-15 days the efficiency of the protection (4-6 h/ha per year).

- **"Alt'Carpo"** is a technique where the row of trees or the whole orchard as a bloc is covered with nets to avoid codling moth to reach the fruits. In the national Ecophyto apples network, nets are around the orchard trials combined with hail-nets on the top of the trees. The reduction of insecticides may achieve **75 % compared to a chemical reference strategy.** Alt'Carpo seems promising **but** is not adapted to high codling moth pressure, and may have a negative incidence on beneficial insects by enclosing them so that wooly aphids increase. The costs has also to be taken in consideration (between 9000 and 12000 €/ha). In practice, nets should be closed before the beginning of the codling moth fly, but after pollination and needs sometimes to be completed with insecticides at the beginning, or when fruit damages detected.

V. Introduction of beneficial insects under nets conditions against rosy aphids

Beneficial insects may have a predatory rule, **but** is not sufficient**.** After 3 seasons, the biological control of rosy aphids with *Chrysoperla carnea* and *Episyrphus balteatus* alone seems not enough and the technic is complex and costs a lot. The results depend of various factors : the climate conditions, the adequate timing between release and annual dynamic of the rosy aphids populations, the balance between prey/predator, the stage of the culture, the use of some active substances with a negative effect on beneficial insects.

VI. Use of clay or talc in autumn against rosy aphids

This practice has been experienced in organic orchards, but also in conventional one. Alone it's not sufficient, but it makes a barrier to the eggs deposit when females come back in autumn. In some cases, the "combined" strategy may reduce the number of applications against aphids, but only at the post-blossom stage.

VII. Mechanisation

Mechanical thinning is complementary to chemical thinning, by eliminating max. 30 % of the potential production volume. The reduction is not on pesticides use but on labour time.

Mechanical weed control is an alternative to the use of herbicides. It can be complementary and give an economy of 2 to 3 treatments or even be a total substitution. Depending of the orchards and the type of weeds, the number of passes can be much higher than with herbicides. Labour time is more important and also fuel consumption.

VIII. Hot water treatments

This alternative to pre-harvest fungicides treatments against storage diseases like "*Gloeosporium"* gives good results when applied by dipping or showering with water at a temperature between 48 and 52 °C during 2 and 3 minutes. Actually the technique remains limited to a small apple volume because of the processing time (20 box pallets in one hour). It's a solution for organic production.

IX. Remove pesticides residues after harvest

Ctifl had trials in 2011, combining hot or cold water with and without detergent, by using or not brushes. The reduction of the concentration of different fungicides find on fruits was interesting, from **42 to 96 %** for the best combination, **but** they were not eliminated. The results had a high variability, but the concentrations were beyond 20 % of MLR.

X. Innovative spray application

Fixed spraying system with micro-sprinklers on the top of the trees : the aim is to optimize the positioning of the treatment according to the contamination (ex. treat against apple scab directly or even during the infection period), use plant strengtheners to enhance the resistance of plants to pests and diseases. Reduction objectives of pesticides is between 15 - 30 %. The advantages are : possibility to have a very quick intervention, no compaction of the soil, economy in fuel and labour time, avoid the noise problems, secure the applicators, less drift problems. A national project called "PulVéFix" coordinated by Ctifl runs for 4 years (2016-2019). Some technical and administrative brakes have to be resolved like the way to rinse the canalisation after treatments, the risk to have frost at the beginning of the treatment period, the spraying quality and agronomic efficiency, the regulation of this type of application.

Doses and volume adaptation : the idea is to adapt them based on the volume of a tree hedge. It has been worked out at the experimental station La Pugère in an orchard planted in 2010 with Golden and Crimson Crisp. With low pest and diseases pressure, the reduction of pesticide from 2013 to 2015 was around 50 % compared to a reference orchard. A national project called "PulvArbo" coordinated by Ctifl has three working packages : find solution against drift, develop methods to evaluate the performance of sprayers, compare different tools to characterize tree hedges (like LIDAR technic) to adapt spraying doses in apple orchards.

XI. Conclusion for 2015

When combining the different techniques, following reductions of the use of chemical pesticides were obtained in the national Ecophyto apple network :

Total % reduction of the chemical frequency treatment indicator compared to the reference system with a sensible variety to apple scab	**Max. 10 %**	**between 40 and 50 %**	**Superior to 70 %**
resistant variety	Situation with bypassed resistance. No mating disruption and Alt'Carpo nets.	Genetics (resistance against apple scab) and possible management of apple scab on primary and secondary infections. Mating disruption or Alt'Carpo nets with some complementary insecticides.	-Genetics and organic production with mating disruption or Alt'Carpo nets and some complementary insecticides. -Genetics and adapted doses, combined with Alt'Carpo nets and some complementary insecticides. -Genetics, Bio-control fungicides, without codling moth pressure, mating disruption or Alt'Carpo nets.

Total % reduction of the chemical frequency treatment indicator compared to the reference system with a sensible variety to apple scab	**Max. 17 %**	**Entre 30 et 45 %**	**65 %**
sensible variety	No or very low possibility to reduce the number of fungicides. Alt'Carpo nets with only one complementary treatment.	-No reduced number of fungicides, but Alt'Carpo nets without insecticides. -No fungicides on secondary infection and mating disruption with only one insecticide. -Adapted doses. Alt'Carpo nets with complementary insecticides.	Rain cover and Alt'Carpo nets without any insecticide.

Scanning report
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Country: France

NUTS 3 region(s)[1]: FR211 Ardennes, FR241 Cher, FR244 Indre-et-Loire, FR246 Loiret, FR301 Nord, FR302 Pas-de-Calais, FR411 Meurthe-et-Moselle, FR412 Meuse, FR413 Moselle, FR414 Vosges, FR421 Bas-Rhin, FR422 Haut-Rhin, FR432 Jura, FR433 Haute-Saône, FR511 Loire-Atlantique, FR512 Maine-et-Loire, FR514 Sarthe, FR515 Vendée, FR532 Charente-Maritime, FR533 Deux-Sèvres, FR534 Vienne, FR611 Dordogne, FR614 Lot-et-Garonne, FR615 Pyrénées-Atlantiques, FR623 Haute-Garonne, FR628 Tarn-et-Garonne, FR631 Corrèze, FR632 Creuse, FR633 Haute-Vienne, FR712 Ardèche, FR713 Drôme, FR714 Isère, FR716 Rhône, FR717 Savoie, FR718 Haute-Savoie, FR721 Allier, FR722 Cantal, FR723 Haute-Loire, FR811 Aude, FR812 Gard, FR813 Hérault, FR815 Pyrénées-Orientales, FR821 Alpes-de-Haute-Provence, FR822 Hautes-Alpes, FR823 Alpes-Maritimes, FR824 Bouches-du-Rhône, FR825 Var, FR826 Vaucluse, FR831 Corse-du-Sud, FR832 Haute-Corse

WP no. and title: **3 – Reduction in pesticides residues**

Date: 26-07-2016

Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

To reduce the use of pesticides, the Ministry of Agriculture decided in 2008 to have a national program named “Plan ECOPHYTO 2018”. The idea was to reduce 50 % of the pesticides in ten years, if possible. *See scanning report for apples from Ctifl to know the main actions of this national plan.*

In this context, two “6 years” projects (2013-2018), funded by ONEMA and coordinated by Ctifl and INRA, aim to evaluate different production systems with several combinations of alternatives to chemical control. The first project, called “Ecopêche” only concerns peaches, the second, called “CAP ReD”, concerns apricots, plums and cherries.

The annual evaluation is based on different indicators: the frequency of chemical and bio-control treatments, the turnover (yield x price/kg) and quality of the fruits, the number of hours for manual and mechanised work, the fuel consumption, the plant protection costs (chemicals, bio-control, physical techniques like nets, …), the mechanisation costs, the incidence on environment, the sustainability of the production system and the number and concentration level of residues.

Some alternatives solutions against stone fruit pest and diseases were also studied in other national projects. Among the most recent projects we can quote the national CASDAR project on *Drosophila suzukii* and the national project “D2Biofruit” which aims to find solution against storage diseases for organic fruits.

Ctifl has also an agreement for good experimental practices and uses to carry out trials on alternatives solutions on fruit’s pests and diseases.

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[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Best practice findings

Physical methods

Alternatives to chemical weeding

Chemical weeding can be partially or totally replaced by an alternative method of weed management. Three methods are validated:

- Mechanical weed control

It can be complementary and give an economy of 2 to 3 treatments or even be a total substitution. This technic is very efficient, but depending of the orchards and the type of weeds, the number of passes can be much higher than with herbicides. Labour time is more important and also fuel consumption. This technic must be implemented on young orchards. The practice can be risky on old trees if the roots are superficial.

- Mulching

Plastic or organic mulch can be spread on the row. Organic mulch can be bought or produced on farm. The spread of mulch can be easier before or just after the trees plantation. Organic mulch must be regularly renewed.

- Permanent grass cover

A permanent grass cover can be sown on the row. It must be non-competitive with the crop. The implementation of the grass cover must be done 4 years after the tree plantation to avoid a strong competition with the young trees.

Hot water treatment against brown-rot on peach

This alternative to pre-harvest fungicides treatments against storage diseases like *Monilia* gives good results when applied by dipping or showering with water at a temperature between 52 and 60 °C during 15 to 60 seconds. The process gives at least 50% of efficacy. Actually the technique remains limited to a small peach or apricot volume because of the processing time. It's a solution for organic production and it can replace some chemical treatments in integrated agriculture.

Glue against earwigs (*Forficularia auricularia)*

Earwigs are considered as beneficial insects in pear and apple orchards but they can cause damages in stone fruits crops by eating fruits. Application of chemicals has a poor efficacy and causes side effects on beneficial insects. The laying of glue on the trees' trunk gives very good results and can totally replace chemicals application. Actually this method is used in only 30-40% of apricot orchards and is very little used in peach crops.

Anti-rain plastic covers against fungal diseases on apricot and plum

Covering trees with plastic covers is being tested against fungal diseases (*Monilia is the most important)* on apricots and plums. It could achieve a reduction of antifungal application before harvest. This technic needs to be validated.

Insect-proof nets against cherry fruit fly and *Drosophila suzukii*

Protect cherry trees with insect-proof nets has been tested since 2010 with two different types of structures: row-by row protection or protection of the whole orchard. This structure is very expensive and can only be used on trees in axis systems but it gives very good results with almost 100% of efficacy. Studies on side-effects on climate, beneficial insects etc. are still ongoing.

Insect-proof nets against codling moth on plums - "Alt'Carpo"

It is a technique where the row of trees or the whole orchard as a bloc is covered with nets to avoid codling moth (*Cydia funebrana*) to reach the fruits.

Chemical mediators

Mating disruption with pheromones (peach, apricot, plum) against codling moth and *Cydia molesta*.

This technic could replace a part or all the chemical treatments against codling moth (*Cydia funebrana*) and *Cydia molesta*, depending on the pest pressure. The average economy is around 2-3 treatments. In France it's already used in 67% of peach crops and only in 7% of apricot crops (only on late varieties which are susceptible to *C. molesta*) and 9% on plum. The surface of the crop must be at least 1ha for peach and apricot crops and 1 to 2ha for plums.

Mass trapping against *Ceratitis capitata*

This technic consist in setting traps (between 50 to 80 traps/ha) in the crops at least one month before the harvest to protect the fruits against damage caused by *Ceratitis capitata*. It can be used on fields of at least 1ha. It cost around 300-400€/ha (plus labour-time) and it can achieve a reduction of 1-2 insecticides.

Bio control agents

Bio control under insect-proof nets against aphids on cherry trees.

The introduction of beneficial insects under insect-proof nets on a cherry crop was tested during 3 years against the brown cherry aphid. Various species were tested: ladybirds, lacewings (*chrysoperla*), hover flies (*syrphid*)… These insects had a predatory action but they were not sufficient to control the pest and chemical application was always necessary.

Nematodes against *Capnodis tenebrionis*

Applications of nematodes (*Stenernema carpocapseae*) have been tested against the development of *Capnodis tenebrionis.* 2 trials were carried out on apricot and peach orchards and a trial is on-going on cherries since 4 years. Due to the peculiar biology of the pest (development in 2-3 years in the roots of the trees), it's very difficult to prove the efficacy of nematodes.

Scanning report on pome fruits
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NUTS 3 region(s)[1]: DE600 Hamburg; DE932 Cuxhaven; DE933 Harburg; DE939 Stade; DEF09 Pinneberg

WP no. and title: 3 – Reduction in pesticides residues

Date: 20-06-2016

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Source materials and methodology

Chemical strategies: increase the pre-harvest interval, use restriction, specific list, depending of the stage

Importance of reduction of pesticide residues on fruits increased during the last ten years. First approaches focused on scanning spray schedules and pesticide residues analyses to develop residue degrading protocols resulting in specific spray schedules "traffic lights table"(ESTEBURG project, ongoing). [*Spray schedules do also exist for stone and soft fruits*.]

Different pesticide treatments were compared in terms of pesticide residues as well as biological efficacy in a five years experiment (Holthusen, 2014).

Insecticide treatments before blossom to prevent dateable pesticide residues at the time of harvest (Holthusen et al., 2015; Lindstaedt et al., 2014).

Bio-control products

Organic PPP (Myco-Sin) was investigated in terms of pesticide residues as well as biological efficacy (storage scab and storage rots) in a five years experiment in comparison to a chemical standard (Holthusen, 2014).

Five years field experiment on long term effects of chemical vs. non chemical insecticide treatments on the sustainability of the apple production in Northern Germany (ESTEBURG experiment).

Testing of organic compounds against *Venturia inaequalis* (Apple scab), *Podosphaera leucotricha* (Powdery mildew of apples), storage rots (e.g. *Neofabraea* spp.), *Cydia pomonella* (Codling moth), *Adoxophyes orana* (Summer fruit tortrix), and *Lygocoris pabulinus* (Common green capsid) (ESTEBURG experiments, ongoing)

Mechanisation

Mowing the ditch vegetation to interrupt the generation cycle of *Lygocoris pabulinus* (Lindstaedt et al., 2014, ESTEBURG experiments, ongoing)

Survey of possible *Psylla pyri* antagonists in pear orchards (Appel et al., 2015) and impacted of modified alleyway treatment on development of antagonists (ESTEBURG project).

Alternatives to postharvest treatments, remove pesticides on fruits

Different post-harvest treatments were tested to remove pesticide residues after harvest (Holthusen, 2014).

Thermonebulisation of the pesticide pyrimethanil in the storage room to control storage rots (Holthusen, 2014).

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Development of a method and understanding the process of hot-water treatment to prevent storage rots in apple without the use of pesticides (Maxin et al., 2014; Maxin et al., 2012a; Maxin et al., 2012b).

Process integration of a hot-water treatment machine into the general post-harvest process. Main focus on general grower's acceptance of hot-water treatment (ESTEBURG project, ongoing).

Best practice findings

Chemical strategies: increase the pre-harvest interval, use restriction, specific list, depending of the stage

Spray schedules ("traffic lights table") with information on degradation time of various pesticides in various fruit crops are widely used within the fruit industry in Northern Germany. Information is confidential and therefore cannot be disseminated. Spray schedules allow fruit growers to use various pesticides while at the same time preventing detectable residues at the time of harvest. Using those spray schedules in apple production made it more or less possible to keep integrated fruit production as well as fulfilling retailers demands in terms of pesticide residues. No exact data one the percentage of growers using "traffic lights tables" is available, but it can be estimated that at least 90% of the apple growers in Northern Germany work with this method. A five years experiment also revealed that a strategy using all available PPP against storage rots (anti-resistant strategy) was only slightly more efficient than the standard strategy recommended in Northern Germany (Fig. 2). However, the number of the detectable residues was doubled (from 3.4 to 6.8) in the anti-resistant compared to the standard strategy.

Insecticide treatments during the summer often result in detectable pesticide residues at the time of harvest. In terms of the woolly apple aphid (*Eriosoma lanigerum*) treatments with Pirimor Granulat before blossom can prevent detectable residues but also effectively control the pest. It could be demonstrated that the pest is not completely controlled by the insecticide but population increase is retarded to a level which allows a further control by natural enemies, especially the parasitoid wasp *Aphelinus mali* (Fig. 1). An additional treatment with Movento 100 SC directly after blossom can increase the efficacy of this concept without producing dateable residues at the time of harvest, too. This new concept of wooly apple aphid control became widely accepted in Northern Germany's apple fruit industry and is now followed in almost every orchard which had problems with wooly apple aphid in the previous year.

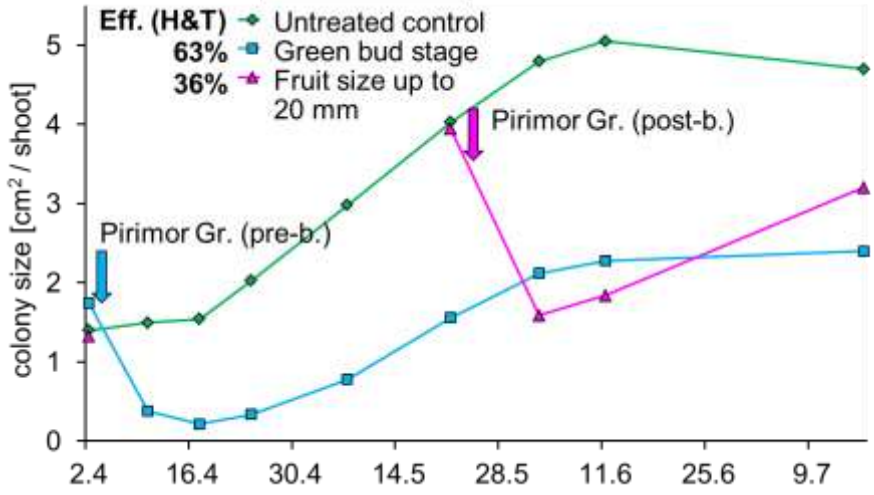

Fig. 1 Wooly apple aphid control with Pirimor Granulat – pre-blossom vs. post-blossom treatment

Bio-control products

Testing different pesticide treatments in a five years' field trial revealed that comparable fruit quality can be produced in terms of storage rots and storage scab when the ecological pesticide Myco-Sin was used instead of using chemical fungicides starting in July until harvest. Stopping any fungicide treatments at BBCH stage 74 resulted in storage rot losses up to 50% (Fig. 2). In terms of pesticide residues fruits treated with the Myco-Sin had less detectable pesticide residues at the time of harvest. However, Myco-Sin cannot be recommended for commercial fruit production since the use resulted in tremendous lenticel burns which reduce the marketability of the fruits.

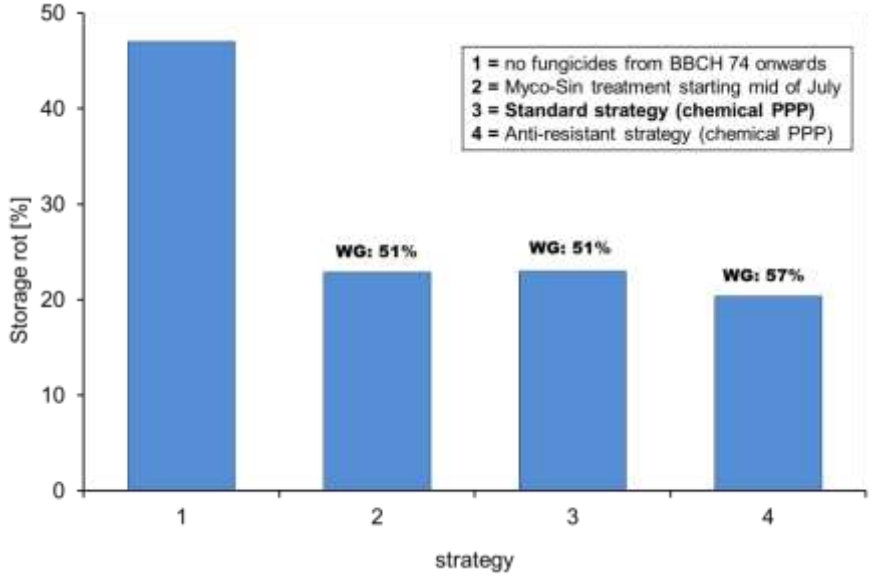

Fig. 2 Incidence of storage rots in cv. Elstar after storing for five month at 2°C [mean of 5 experimental years]

An experiment investigating the long-term effects of using organic vs. chemical insecticides was started two years ago and will proceed for another three years. First results indicate that *Cydia pomonella* and *Adoxophyes orana* control can be achieved to a comparable extent when 10-15 granulose virus application against codling moth as well as 6 organic applications against summer fruit totrix were done in the organic plots while only one application of Coragen was conducted in the chemical plots. None of the products used resulted in detectable residues. Furthermore rosy apple aphid (*Dysaphis plantaginea*) control was achieved to the same degree by using the organic insecticide NeemAzal T/S before blossom or the chemical insecticide Teppeki after blossom.

Mechanisation

Experiments on mowing the ditch vegetation were conducted for two years now and first results indicate that it is most likely to interrupt the lifecycle of *Lygocoris pabulinus* by mowing the ditch vegetation. However, only a reduction in the number of attacked fruits adjacent to mowed ditches was measured. Maybe an insecticide free control of *Lygocoris pabulinus* can be achieved in the future. However, this will be on the cost of reduced biological diversity within the ditches (plants and possible also insects).

Currently different projects with *Psylla pyri* in pears are on-going to find solutions for a better integration between chemical/ alternative treatments and natural enemies.

Alternatives to postharvest treatments, remove pesticides on fruits

Reducing pesticide residues post-harvest by washing and brushing was effective only in the case of the fungicide captan. Concentration on fruits was reduced by 50% when fruits were dumped in water for 3 minutes. Additional or alternative brushing of fruits for 2 minutes could further reduce the concentration down to 20% of the initial concentration. However, it was not possible to reduce the concentration below the detection limit. The method is not specifically incorporated into commercial fruit production but since up to 90% of all apples in Northern Germany are at least treated with water once during the packing process, a significant reduction of captan between harvest and consumption can be estimated.

Thermonebulisation of pyrimethanil (0.04 l Xedathane A/ ton of fruit) was used to treat 100 tons of unsprayed fruits cv. Elstar postharvest in a storage room. The treatment was effective in reducing *Neofabrea perennans* losses by more than 60% after five month of storage at temperatures below 4°C. However, storage scab was only slightly reduced. Samples for pesticide residue analyses were taken at fifteen locations within the storage room. Residual levels ranged between 0.84 and 1.90 mg kg^{-1} with one exception (3.00 mg kg^{-1}). The MRL of pyrimethanil was never exceeded. Currently there is no practical use for this technology in Germany, since there is no registration in place.

Effect of hot water treatment was originally expected to be based on a direct and lethal effect of heat on fungal inoculum. However, Maxin et al. (2012b) were able to show that also an indirect effect may be present, which mediates a stress-induced

physiological response in the fruit. This new understanding of the mode of action was the trigger for alternative treatment set ups. It is no longer necessary to treat fruits with 50 °C for 180 seconds to reduce storage rots by more than 70%. By treating fruits for much shorter periods, e.g. between 20 to 25 seconds at elevated temperatures, it is possible to obtain approximately similar results (Maxin et al., 2014). Currently a research project is carried out whit the aim to improve the integration of short hot water treatment into existing grading lines as well as developing specific short hot-water treatment recipes (time and temperature) for different apple varieties. In general, hot water treatments are used at a small extent in ecological fruit industry in Northern Germany. The share of the fruit industry (ecological and integrated production) which uses hot water technology is expected to strongly increase during the next few years since the technology is capable to protect the crop from storage rots as well as reducing the pesticide load of the fruits.

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Scanning report
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NUTS 3 region(s)[1]: NL230 Flevoland; NL310 Utrecht; NL321 Kop van Noord-Holland; NL338 Oost-Zuid-Holland; NL341 Zeeuwsch-Vlaanderen; NL342 Overig Zeeland; NL411 West-Noord-Brabant; NL412 Midden-Noord-Brabant; NL422 Midden-Limburg; NL423 Zuid-Limburg.

WP no. and title: **3 – Reduction in pesticides residues**

Date: 13/07/2016

Source materials and methodology

Applied Plant Research (PPO-Randwijk is part of st DLO; Wageningen UR) is a research station specialized in fruit growing and encompasses an experimental garden (pome fruit, stone fruit, and small fruits), and is located in Randwijk, near Wageningen. PPO-Randwijk with applied scientific research is dealing amongst others with sustainable fruit production themes including spray application technology. The scanning was focused on the reduction of pesticides on fruit and environment. The Netherlands have a history of reducing environmental pollution by pesticides. Minimizing pesticide use and residues is based on legislation, and good & best practices carried out by growers. Currently, a large number of drift reducing measures are approved by the government. The experiments leading to these approved measures were carried out by st DLO (Wageningen UR). A large number of reports, scientific manuscripts, papers, and journals can be provided about this subject.

Regarding the reduction of pesticide residues on fruits a number of projects (trials) were carried out by Wageningen UR. These experiments were focusing on minimizing the number of spray applications (e.g. use of warning models, developing advanced strategies, adjust spray schedules to lower residues, use of beneficial organisms) or direct removal of pesticides from fruits. It is important to note that most of the fruit growers have to comply with the residues limits as demanded by retailers. These residue limits are often far below the official MRL's.

The source materials for this scanning report are amongst others:

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[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Best practice findings

Which practices were developed the last years to reduce the use of pesticides and limit the risk to find pesticides residues on fruits?

- Development and optimization of warning models.
    - Brown spot of pears (*Stemphylium vesicarium*).
      Brown spot of pears is an important disease in the Netherlands. Most pear growers spray very frequently against this disease. Recently, warning models have been developed (RIM; Bodata) in order to reduce the number of sprat applications.
    - Codling moth (*Cydia pomonella*).
      Codling moth is one of the most important pests of pome fruit in the Netherlands. Timing of spraying is very important for adequate control. In the Netherlands the RIMpro-Cydia model is developed.
    - European fruit tree canker (*Neonectria ditissima*).
      Recently, the most effective fungicides against fruit tree canker have been banned in the Netherlands. To control this disease with less effective products timing becomes very important. Therefor a model is developed (cooperation of Bodata and Wageningen UR) for adequate timing of application, and to avoid unnecessary sprayings.
- Adjust spray schedules to lower residues in soft fruits.
  Several strategies have been developed to reduce the number of spray applications in red currant growing. With these strategies it is possible to reduce the number of applications from appr. 15 to 6, and the number of a.i. from 12 to 6.
- Puffer technology for mating disruption Codling moth.
  With this new technique, codling moth can be controlled over a large number of hectares, and chemical spay applications can be avoided.
- Combination of integrated and organic measures; e.g. bicarbonates.
  Organic measures are often not 100% effective and growers are often reluctant to use these non-chemical alternatives. However, a combination of integrated and organic measures mostly result in a good biological efficacy. That case the number of chemical applications can be reduced significantly.
- Use of beneficial insects or natural enemies; e.g. against pear psylla.
  The control of pear psylla causes great difficulties for pear growers in the Netherlands. Partly because effective chemicals are banned. Recently, research is started to increase the possibilities to use beneficial insects (e.g. earwigs) to control pear psylla.
- Remove of pesticides residues after harvest; e.g. by brushing.
  In cooperation with SME's equipped has been developed to reduce pesticide residues on pome fruit by washing and brushing. Currently these machineries are tested a commercial level.

Which one is already used by the producers ? Warning models.

Which one could be disseminate ?

- Adjust spray schedules to lower residues in soft fruits.
- Combination of integrated and organic measures; e.g. bicarbonates.

Which practices were developed the last years to reduce the use of pesticides and limit the risk to the environment?

- Multiple row (tunnel-) sprayers.
- Crop adapted spray application
- Certified drift reducing measures; e.g. spray nozzle classification.

Which one is already used by the producers ?

- Multiple row (tunnel-)sprayers.
- Certified drift reducing measures; e.g. spray nozzle classification.

Scanning report
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NUTS 3 region(s)[1]: ES 512 Girona, ES513 Lleida

Date: 10-05-2016

Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

Introduction

Fruit residues are one of the most consumer concerns in case of fresh consumption. Fruit.Net program launched by agreement between Department of Agriculture of the Catalonia Autonomous Region and Research on Technology, Food and Agriculture Institute (IRTA), which begun in 2009, has as a principal aim a chemical spraying reduction and minimization of pesticide residues on pomefruits, stonefruits and citrusfruits.

The source materials for this scanning report are amongst others:

Alins, G.; Alegre, S.; Batllori,L.; Carbó,J.; Escudero-Colomar, L.A.; Iglesias, I.; Lordan,J.; Vilajeliu,M.; Vilardell,P. 2013. Manzanos en agricultura ecológica, una opción para diferenciarse. Vida Rural nº 371, pág. 32-35.

Vilardell, P., Vilajeliu, M., Batllori, L., Llorente, I. 2012. Dynamic release of ascospores of *Venturia inaequlis* and apple scab disease control strategy based on the Mills and RIMpro models in Girona (Catalonia-Spain). IOBC-WPRS Bulletin Vol. 84, 2012 pp. 247-253.

Batllori, J. Ll., Vilajeliu, M., Escudero, L.A., Vilardell, P., Usall, J. 2012. Guia técnica Fruit.Net per a la producció de poma. Dossier Tècnic nº 57 Departament d'Agricultura, Ramaderia, Pesca, Alimentació i Medi Natural.

Escudero-Colomar, L.; Vilajeliu, M.; Bosch, D., Vilardell, P.; Batllori, L. 2012. Seguimiento y control de grafolita en manzano. Vida Rural nº 350, pág. 30-34.

Vilajeliu, M.; Vilardell, P.; Escudero-Colomar, L.A.; Llorente, I.; Batllori, L. 2011. POM.net: Un proyecto para minimizar el uso y los residuos de los fitosanitarios en la producción de manzana. Revista Fruticultura, nº 11, pág. 4-17.

Alins, G.; Alegre, S.; Avilla, J.; Batllori, L.; Blázquez, M.D.; Carbó, J.; Dapena, E.; Escudero-Colomar, L.A.; Iglesias, I.; Lordan, J.; Miñarro, M.; Vilajeliu, M.; Vilardell, P. 2010. Producción de manzana en agricultura ecológica: control de plagas y enfermedades. Fruticultura, 7:4-17.

Sisquella, M.; Picouet, P.; Teixidó, N.; Lamarca, N.; Usall, J.; Viñas, I. (2015). Tratamiento con microondas para el control de Monilia spp. en melocotones y nectarinas. Revista PHYTOMA España, nº 270.

Vilajeliu, M.; Vilardell, P.; Escudero-Colomar, L.A.; Batllori, L. 2010. El proyecto POM.net en Girona: producción integrada, trazabilidad y minimización de residuos en manzanas. Vida Rural 315: 46-56.

Vilajeliu, M.; Vilardell, P.; Carbó, J.; Àvila, G.; Escudero-Colomar; A., Batllori, L.; Alins, G.; Iglesias, I.; Alegre, S.; (2010). Defensa sanitària en el cultiu de poma ecològica. Agrocultura 42: 20-23.

Vilardell, P.; Llorente, I.; Vilajeliu, M.; Batllori, Montesinos, E. 2011. Estrategias de control del moteado y la estemfiliosis en frutales de pepita. Revista Vida RURAL, (15/sep), pág. 48-54.

Usall, J.; Casals, C.; Cambray, J.; Batllori, L.; Torà, R.; Vilardell, P.; Giné, J.; (2012) Fruit.Net: El programa de Sanidad Vegetal de frutales en Cataluña. Revista PHYTOMA España, nº 243

Usall, J.; Casals, C.; Sisquella,M.; Palou, L.; De Cal, A. (2015). Alternative technologies to control postharvest diseases of stone fruits. Stewart Postharvest Review 2015, 4:2

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Field trials are annually done to support the Fruit.Net project. Three of them are directly linked with minimizing residues on apples:

1.- How long from harvest must growers do chemical sprayings to avoid residues on apple fruit ?

This trial, which has been carried out annually since 2009, pretends to check how long pesticides remain on fruits in order to be able to select the most suitable active ingredients throughout season, to achieve not residue occurrence at harvest.

Field trials consisted on spraying apple trees at different day distance from harvest and do fruit pesticide analysis just before harvest. According to the obtained results of the first year, new field trials were done in the following year and the next one to fit better the needed number of days that fruit growers had to preserve between the last pesticide treatment and harvest.

The active ingredients were chosen according to the common needs in the Girona fruit area from beginning of summer onwards, so the trials have included insecticides against pests (codling moth, obscure mealy bug, Mediterranean fruit fly) and also preventive fungicides for *Alternaria sp* and *Gloeodes* complex and cold storage room diseases.

According to the residue analysis an advised delay period has been built that shows how much, depending on the active ingredients, the official delay period should be increased to achieve not detectable pesticide residues at harvest. In general terms it has been seen that pyretroid treatments accomplish perfectly with the official delay period but most of the other products require an increase from 2 to 6 times the official delay period.

2.- Alternatives to postharvest treatments on apple

The principal aim of the Fruit.Net project is minimize as much as possible the chemical residues on fruits. Research is done on alternative strategies to the postharvest fungicides.

Total looses of apple and pear production after cold storage are estimated on 8-10 %, due to the weight reduction and physiologic or pathogenic problems. Half of these losses come from rots and from non pathogenic factors. Fruit rots on apples are caused by *Penicillium expansum*, *Rhizopus stolonifer*, *Alternaria alternata*, *Botrytis cinerea*, *Neofabraea* spp. and *Monilinia fructigena*. In the Girona area *P. expansum* causes 70-80 % of the fruit damages.

Some strategies based on chemical or biological fungicide spraying on orchards that produce minimum amount of residues has been developed to control apple cold storage diseases, and a specific strategic dealing plan has been created for each cultivar (or group of cultivars)

Not significant differences were found in postharvest treated *versus* non treated Red Delicious and Golden apple cultivars. On the contrary, higher level of rot damages in Fuji and Pink Lady thesis was found, which shows their higher sensitivity to the cold storage pathogens.

Focus was devoted in 2014 on Golden and on Red Delicious, which had shown low rot incidence in the previous year, by treating only in preharvest with 'Bellis'. Similar percentages of rot fruits appeared after room storage.

The good results might possible an increasing percentage of non treated apple production in Girona fruit area which reached 81 % of the total production in 2014.

3.- Activities for Monilia control on stone fruit

One of the major diseases affecting stone fruit in the area of Lleida is *Monilinia* spp. The potential damages of this disease, the period of greatest susceptibility of fruits (from fruit colouring to harvest) and the lack of alternatives to chemical strategy makes difficult avoid chemical residues at harvest. Fruit.Net Project has proved that in case of early varieties (harvest until mid season), is feasible do not have residues if only non persistent pesticides are used, but for late varieties that are harvested between August and end of September, fruit have some chemical residues at harvest due to weather conditions that force to increase the frequency of treatments.

The Fruit.Net Project is useful to validate a prediction model of this disease to reduce chemical treatments. Results show reductions from 50 to 100% of fungicide applications against *Monilinia* compared with conventional strategy, though no significant differences in the incidence of the post-harvest disease has been observed. Furthermore, trials with new active

ingredients are carried out to evaluate their efficacy and persistence in the *Monilinia* control. The main goal is to rationalize the use and spraying applications of these pesticides to minimize the residues occurrence.

In recent years there is the possibility of post-harvest treatments in stone fruit due to the new registration of Fludioxonil. It causes that fruit contains residues of this active ingredient. Within the context of the Fruit.Net Project this product is only used according to the risk periods and for further consumption markets.

Best practice findings

1.- Present fruit growing companies require to be supported by technologies of plant protection. For pathogens and pests that there are not other control methods than chemicals, it is likely sure that residue may be present at harvest or before consumption.

This is the reason why to use the proper active ingredients from summer onwards is so important. In the Fruit.Net project three periods were distinguished in the season: from winter to postbloom, from postbloom to mid summer and from mid summer to harvest. Attention must be especially paid on the second, and even more, on the third period, in which fruit growers must use, where ever possible, only not persistent pesticides to avoid residues on fruits at harvest. Some active ingredients are not at all persistent on fruits so they are not detectable at harvest but for other ones de delay period must be widely increased.

2.- Chemical residues of postharvest treatments to prevent room storage diseases are often found on fruits. Last decades all production of the Girona fruit area was treated in postharvest to prevent pathogenic and non pathogenic (like Bitter pit) losses.

Nowadays, in the context of the fruit production methodology and the Fruit.Net project, recent trials (with new field fungicides, hygienic measures, etc), have shown that only some cultivars (like Fuji and Pink lady) are very sensitive to fruit rot. As a result of an strategic fruit cold storage plan for each cultivar (or group of cultivars), most of the varieties do not need to be treated after harvest. Since 2011, an increasing percentage of the Girona apple production (that reached 81 % in 2014) has not been treated after harvest.

3.- *Monilinia* spp. is widely recognized as an important disease on stone fruit and there are no other alternative control methods than spraying fungicides. In the Fruit.Net Project there are three different working ways to improve the control of this pathogen and minimize residues: Have checked that only late varieties need to be sprayed, have validated a predictive model that allows a big reduction of fungicide applications and post-harvest treatments with Fludioxonil and other active ingredients.

The aim is to report about the best European practices to reduce pesticides residues on fruits.

Which practices were developed the last years to reduce the use of pesticides and limit the risk to find pesticides residues on fruits ?

1.- To split the season in three parts and to avoid, as much as possible, chemical sprayings in the second and third part. And also enlarge the delay period of some products when possible.

2.- Treat apples in preharvest only, and avoid doing it after harvest in non problematic varieties.

3.- Spray stone fruits with preventive fungicides only in case of late varieties, according to a predictive model and do post-harvest treatments in special conditions

Which one is already used by the producers ?

All of them because of the technical advisers assessment and also because it takes part of the rules of the fruit companies

Which one could be disseminate ?

All of them: Enlarge the delay period of some products when possible and do no treat after harvest common varieties which are not sensitive to room store rots. Spray stone fruit only when necessary is feasible.

Scanning report
Andreas Naef, WBF

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Country: Switzerland

NUTS 3 region(s)[1]: [code(s) and name(s)]

WP no. and title: **3 – Reduction in pesticides residues - pomefruits**

Date: [24-06-2016]

Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

Quality guidelines for farmers

After the publication of the first Greenpeace pesticide report in 2005, the SwissGAP organization established a guideline defining the number of accepted pesticide residues (>0.01 mg/kg) for fruits and vegetables produced in Switzerland.

Produkt	Anzahl Rückstände, Wirkstoffe ≥ 0.01 mg/kg		
	Bis hier i.O.	Sensibilisierungs -bereich	Produkt nicht mehr i.O.
Kernobst	4	5	≥ 6
Steinobst	4	5	≥ 6
Kirschen	4	5 – 6	≥ 7
Erdbeeren, Himbeeren, Brombeeren und andere Strauchbeeren	5	6	≥ 7
Trauben	5	6	≥ 7

This agreement between producers, traders and retailers is still valid but some retailers aim to tighten the limits.

Source: http://www.swissgap.ch/pdf/Mehrfachrueckstaende_de.pdf

Decision support systems

Every second year, Agroscope, the Swiss centre for agricultural research, publishes recommendations for plant protection in commercial fruit production. Yearly, this booklet is supplemented by an updated list of plant protection products. These documents contain information about damage tresholds and effect of chemicals on beneficials and are widely used in practice and education. In addition, Agroscope and regional advisory services distribute up-to-date recommendations for plant protection by e-Mail, fax and mailing.

Agroscope provides several webpages with disease and pest modelling and monitoring information. Pest and disease monitoring is mainly done by research farms and advisory services but rarely by producers.

www.agrometeo.ch (apple scab infection forcasting, wheater data, pest monitoring data, crop stage data)
www.sopra.ch (pest forecasting)
www.feuerbrand.ch (fireblight forcasting)

Sources:

Kuske S., Naef A., Holliger E., Kuster T., Perren S., Werthmüller J., Linder C., Dubuis P.-H., Kehrli P., Bohren C. 2016: Flugschrift Nr. 122 - Pflanzenschutzempfehlungen für den Erwerbsobstbau 2016/2017. Ed. Agroscope,. 68 p.

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Kuske S., Naef A., Holliger E., Kuster T., Perren S., Werthmüller J., Linder C., Dubuis P.-H., Kehrli P., Bohren C. 2016: Flugschrift Nr. 122 (Aktualisierte Beilage): Empfohlene Pflanzenschutzmittel für den Erwerbsobstbau 2016. Ed. Agroscope, 23 p.

Werthmüller J., Kuske S., Holliger E., Häseli A. 2016: Pflanzenschutzmitteilungen für den Obst- und Rebbau, weekly bulletin, eds. Agroscope and FibL.

Chemical low-residue strategies

In 2008, Agroscope started a low-input trial with scab sensitive and scab resistant apple varieties. Main pests and diseases could be controlled with a combination of integrated and organic measures. The use of chemical-synthetic pesticides only until end of bloom allowed a complete elimination of residues. An unsolved problem remained the increased incidence of storage rots, resulting in lower profitability of the production. Agroscope and partners tested different pre harvest fungicide strategies with non-synthetic fungicides such as bicarbonate, acid clay or laminarin to improve control of storage rots, but the success of storage rot control mainly depended on the regional climate. In regions with more than 1000mm precipitation per year, the low-residue strategy resulted in increased losses during storage rot compared to standard IP strategies. Thus, low-residue strategies are not implemented by fruit farmers yet due to economic reasons.

Source:

Gölles M., Bravin E., Kuske S., Naef A. 2015: Herausforderungen der rückstandsfreien Apfelproduktion. Agrarforschung Schweiz. 6, (1), 2015, 12-19

Physical Barriers

In 2005, Agroscope started trials with exclusion netting first on apples to control moths. The exclusion netting is used only by pioneers farmers and orchards next to meadow trees to prevent bees contaminated with fireblight bacteria to enter the orchards.

Sources:

Samietz J. , Höhn H., Kuske S., Gölles M. 2013: Experiences with exclusion netting in fruit production in Switzerland. In: LVZ Haidegg, Graz.

Bio-control

Mating disruption against codling moth is used by about 50% of the apple growers of the Lake of Constance area. The use is lower in regions where fruit production is of minor importance and orchards are smaller and more spread. The combination of mating disruption and granulosis virus is mainly used by organic producers (about 10%).

Since streptomycin has been banned in Switzerland, many farmers are using a combination of biocontrol with yeasts (Blossom Protect), acid clay (Myco-Sin) and potassium aluminium sulphate (LMA) to control fireblight.

Sources:

Endure 2007: Deliverable DR1.8 and DR1.9 - Survey and analysis of the state of art of control strategies in orchardsCrop adapted dosage

Personal communications with fruit advisors.

Best practice findings

Codling moth: Mating disruption is widely used in practice.

Fire blight: increasing use of Blossom Protect.

DSS: webtools on www.agrometeo, www.sopra.ch and www.feuerbrand.ch are widely used

Various pests: forecasting on www.sopra

In general: The recent invasion of new pests such as the spotted wing drosophila, the withdrawal of pesticides like dimethoate and streptomycin and the first Swiss national action plan to reduce risk of pesticide use, becoming operative this year, have changed the mind of many producers and cooperatives. Cooperatives and regional advisory services and intend to establish a net of demonstration farms with low-residue crop protection strategies and are involving Agroscope as expert in these initiatives.

Scanning report
Andreas Naef, WBF

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Country:

NUTS 3 region(s)[1]: [code(s) and name(s)]

WP no. and title: **3 – Reduction in pesticides residues - stonefruits**

Date: 24-06-2016

Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

Quality guidelines for farmers

See scan report for pomefruits.

Decision support systems

Every second year, Agroscope, the Swiss center for agricultural research, publishes recommendations for plant protection in commercial fruit production. Yearly, this booklet is supplemented by an updated list of plant protection products. These documents contain information about damage thresholds and effect of chemicals on beneficials and are widely used in practice and education. In addition, Agroscope and regional advisory services distribute up-to-date recommendations for plant protection by e-Mail, fax and mailing. Agroscope published factsheets with recommendations for control of *Drosophila suzukii* in stonefruits.

Agroscope provides several webpages with disease and pest modelling and monitoring information. Monitoring is mainly done by research farms and advisory services but rarely by producers.

www.agrometeo.ch (apple scab forecasting, weather data, pest monitoring data, crop stage data)
www.sopra.ch (pest forecasting)
www.feuerbrand.ch (fire blight forecasting)
www.drosophilasuzukii.agroscope.ch (D. suzukii monitoring, factsheets)

Sources:

Kuske S., Naef A., Holliger E., Kuster T., Perren S., Werthmüller J., Linder C., Dubuis P.-H., Kehrli P., Bohren C. 2016: Flugschrift Nr. 122 - Pflanzenschutzempfehlungen für den Erwerbsobstbau 2016/2017. Ed. Agroscope,. 68 p.

Kuske S., Naef A., Holliger E., Kuster T., Perren S., Werthmüller J., Linder C., Dubuis P.-H., Kehrli P., Bohren C. 2016: Flugschrift Nr. 122 (Aktualisierte Beilage): Empfohlene Pflanzenschutzmittel für den Erwerbsobstbau 2016. Ed. Agroscope, 23 p.

Bio-control:

Agroscope tested an ‘attract and kill’ approach with protein bait Combi-protec to control spotted wing drosophila on large cherry trees for industrial fruits and on plum trees. The control was not satisfying yet.

Source: Personal communication S. Kuske

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Physical Barriers:

Agroscope started trials with exclusion netting on cherries mainly to replace the withdrawn insecticide dimethoate used to control the cherry fruit fly. Despite of promising results, this method was rarely implemented by producers because of higher costs. But, the recent invasion of spotted wing drosophila and the limited possibilities of chemical control, has changed the mind of producers. Exclusion netting in combination with monitoring by traps and spinosad treatments is used by many table cherry producers now. However, a reduction of residues is questionable, because additional treatments against the new pest may result into additional residues.

Sources:

Kuske S., Kaiser L., Razavi E., Fataar S., Schwizer T., Mühlenz I., Mazzi D. 2015: Netze gegen die Kirschessigfliege. Obstbau. 4, 238-242.

Best practice findings

D. suzukii: exclusion netting is widely used in table cherry production.

See also scan report for pomefruits.

Scanning report
Markus Kelderer, LAI

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NUTS 3 region(s)[1]: ITH10 Bozen-Bolzano, ITD20 Trentino-Alto Adige

WP no. and title: **3 – Reduction in pesticides residues**

Date : 13-05-2016

Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

I got the information from:

a) Checking up the issues from the last 5 years of the technical magazines:

Obstbau-Weinbau, Südtiroler Landwirt, Terra Trentina, Rivista di frutticoltura, Informatore Agrario, Apfel aktuell, the guidelines of the Workgroup for Integrated Fruit Production in South Tyrol

b) Speaking with the quality managers of the South Tyrolean Associations of Fruit Growers Co-operatives, the South Tyrolean Advisory Service and the plant protection experts from the Research Centre Laimburg

c) Quoted publications

Best practice findings – State of Art

Residues on fruits from IP orchards

- **Retailers have different requirements:**
    - Number of residues: e.g. of residues max. 4-5 residues
    - Quantity of residues: e.g. restriction to 30% of some active ingredients MRL
    - Restriction on sum of residues: e.g. 15 % MRL of captan + 29 % MRL of Delan
    - From some active ingredients.: no residues

    Babyfood : 0 residues, organic apples

    e.g. (Wolfgang Graiss: VIP Quality Management, oral statement, 25.05.2016)

→ The IP farmers complain about the continuous changes for the residues; the risk of losses in the time of storage is raising

Plant protection in IP production & residues

- Active ingredients (a.i), number of treatments, application rate and pre-harvest interval are defined at national and regional level
- IP in South Tyrol is defined from the WG Agrios (SBR, VOG, V.IP etc., including foliar fertilizers (amino alcohols, morpholines ecc.)
- Residues on fruit lower than 50 % of MRL

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

→ Very important in this context was the introduction of mating disruption against Coddling Moth (~ 100%); since more than 25 years in South Tyrol and neighbouring Trentino

e.g. (AGRIOS: http://www.agrios.it/doc/agrios_richtlinien_2016.pdf, 30.05.2016)

- Important are independent field trials with new active.ingredients, new formulations, biotechnologies against pests, application techniques and disease on different varieties checking efficacy, side effects and residues

e.g. (Rizzolli W., Acler A. (2012). Movento 48 SC, ein neues Insektizid gegen Läuse im Apfelanbau.

Obstbau-Weinbau, 49 (4), 125-131.)

e.g. (Rizzolli W., Acler A. (2011). Geoxe, ein neues Mittel gegen pilzliche Krankheitserreger im Apfelanbau.

Obstbau-Weinbau, 48 (12), 384-389.)

e.g. (Rizzolli W., Acler A. (2010). Affirm – Versuche gegen Fruchtschalenwickler.

Obstbau Weinbau 47 (5), 185-189)

- Aim is not the scientific publication but the background for the decisions of the WG Agrios

e.g. (AGRIOS: http://www.agrios.it/doc/agrios_richtlinien_2016.pdf, 30.05.2016)

- Residue monitoring in IP-production 1 sample at harvest for 2000 t
- The reports are owned by the Growers Association, they are not public
- Checking the technical magazines (Obstbau/Weinbau; Südtiroler Landwirt, Apfel aktuell, rivista di frutticoltura from the last 5 Year) common consensus everything is under control

e.g. (Waldner W., Zelger R. (2008): Pflanzenschutzmittel-Rückstände im Südtiroler Obstbau, http://www.obstbauweinbau.info/obstbauweinbau/archiv.php?/s,1639/, 30.05.2016)

e.g. Zelger R. (2013). PSM-Rückstände ohne Gefahr. Apfel aktuell, Nr.1, 03/2013, S.12-13)

e.g. (Zelger R. (2014). PSM-Rückstände: Vorgabe bei weitem erfüllt. Apfel aktuell, Nr.1, 04/2014, S.26-27)

e.g. (Zelger R. (2016). PSM-Rückstände unbedenklich. Apfel aktuell, Nr.1, 03/2016, S.34-35):

→ Monitoring harvest 2015: n samples: 490
Samples positive: 487 (99,4%)
N individual residues: 1914
N fungicidal residues: 1824 (95,3% of all residue; Apple scab, Alternaria)
Fungicidal PPP residues: 61,2 % Captan, Dodine + Phosphonates
N residues insecticide, acaricide: 90 (4,9%; codling moth, Chlorantraniloprole)

Plant protection in organic production & residues

- Organically grown apples from South Tyrol are normally free of relevant residues
- From the organic PPP you find: copper and sulphur

e.g. (Kelderer M., Matteazzi A. und Casera C. (2004). Residues of copper and sulphur on fruits from organic orchard. 11th International Conference on Cultivation Technique and Phytopathological Problems in Organic Fruit-Growing. Förderungsgemeinschaft Ökologischer Obstbau e. V. Weinsberg, (11), 213-216)

- Spinosad (§), PBO (§²) are not allowed, and Neem (§²'³) used only early in the spring

e.g. (§ Cavanna S., Kelderer M. and Topp A. (2012). Residue decline behaviour of the natural insecticide spinosad on apples. Proceedings of the 15th International Conference on Organic Fruit-Growing, 91-97)

e.g. (§² Südtiroler Beratungsring: BioLeitfaden 2016, p. 209-212)

e.g. (§³BiolandGermany:30.05.2015
http://www.bioland.de/fileadmin/dateien/HP_Dokumente/Richtlinien/Bioland_Standards_2016-03-14.pdf)

- Monitoring with samples in every organic farm (1-3 samples/ year)

Organic farming and drift from IP production

- The farms in South Tyrol are small and divided in parcels (min. 3.000 m^2)
- There are problems with contamination from IP production (phosphites !!)
- The GA proposed an agreement for a peaceful neighbourhood between organic & IP

  e.g. (Südtiroler Beratungsring: Leitfaden Apfel 2016, S.156-198)
- Some organic growers complain
- The cooperatives BioSüdtirol and Bio VI.P made a risk evaluation from the borders to conventional land
- Monitoring plan includes samples from these risk evaluation (paid by the organic growers and by the cooperatives)
- Once a season every organic farmer is controlled by at least one examination

  e.g. http://www.biosudtirol.com/

  e.g. http://biography.vip.coop/de/home/1-0.html

Pesticide-drift to private and public areas

- New law in our province which regulate these topic

  e.g. (Südtiroler Beratungsring: Leitfaden Apfel 2016, S.192-208)

Activities RC Laimburg with an impact on residues on fruits

- **Field trails with new and alternative Plant Protection Products**

  e.g. (Rizzolli W., Acler A. (2013). Kanemite, ein neues Akarizid für den Apfelanbau. Obstbau-Weinbau, 50 (4), 120-125.)
- **Biology of pre harvest and post harvest disease and monitoring of infection conditions**

  e.g Marschall K., Gölles M., Gallmetzer A., Naef A., Kelderer M. (2014). Marssonia Blattfleckenkrankheit, Beobachtungen und erste Versuchsergebnisse. Obstbau Weinbau 51 (7/8), 236-239.
- **Single row netting (codling moth and others)**

  e.g. (Kelderer M., Lardschneider E., Rainer A. (2014). Crop regulation with single row netting structures and their influence on crop quality. Proceedings of the 16th International Conference on Organic Fruit - Growing from February 17th to February 19th, 2014 University of Hohenheim, Germany, 127-131)

  → In South Tyrol experimental stage, rest of Italy some applications (see rating table at the end)
- **Coverage (Keep in Touch®) to protect the trees from the rain avoiding pathological infections**

  e.g. (Kelderer M., Casera C., Lardschneider E., Telfser J., Topp A., Mescalchin E. (2015). Neues aus dem ökologischen Obstbau. Auswahl von Versuchen zum ökologischen Obstbau in der Region Trentino-Südtirol. Obstbau Weinbau (52/11), 338-340.)

  → see rating table at the end
- **Field trials with alternative products against disease (Co-free, AltRameBio)**
  - Carbonates:

  e.g. Kelderer M., Casera C., Tamm L., Schmitt A., Parveaud C.-E., (2016). Open-field trials for the control of apple scab conducted within the FP 7 Project CO-FREE in Italy and France. Proceedings of the 17th International Conference on Organic Fruit - Growing from February 15th to February 17th, 2016 University of Hohenheim, Germany, 32-44.

  e.g. (Kelderer M., Casera C., Lardschneider E. und La Torre A. (2010). Preventative and curative applications of carbonates against apple scab (Venturia inequalis) in organic apple orchards. 14th International Conference in Organic Fruit-Growing – Eco-fruit, Fördergemeinschaft Ökologischer Obstbau e. V. Weinsberg, Stuttgart, Deutschland, 52-60)

  e.g. (Kelderer M., Casera C. und Lardschneider E. (2006). First results of the use of potassium bicarbonate against scab in South Tyrol. 12th International Conference on Cultivation Technique and Phytopathological Problems in Organic Fruit-Growing, Fördergemeinschaft Ökologischer Obstbau e. V. Weinsberg, (12), 93-97)

- Lime sulphur:

e.g. (Kelderer M., Lardschneider E., Telfser J. (2014). Interactions between varieties, lime sulphur and hailnet on the thinning effect and on side effects using paraffin oils as a June drop thinner. Proceedings of the 16th International Conference on Organic Fruit - Growing from February 17th to February 19th, 2014 University of Hohenheim, Germany, 132-141)

e.g. (Kelderer M., Casera C. und Lardschneider E. (2006). Phytotoxicity of different sulphur products applied with the sprayer or with the overheat irrigation system on Braeburn apples. 12th International Conference on Cultivation Technique and Phytopathological Problems in Organic Fruit-Growing, Fördergemeinschaft Ökologischer Obstbau e. V. Weinsberg, (12), 228-233)

→ see rating table at the end

- **Post harvest techniques**

e.g. (Zanella, A. (2014). Fruchtqualität während der Lagerung erhalten: Die Wichtigkeit des optimalen Erntetermins. Obstbau Weinbau 51 (7/8), 232–235)

e.g. (Zanella A. (2009) DPA-Alternativen für die Lagerung von Red Delicious im Vergleich: ILOS+, SmartFresh (1-MCP) und dynamische CA (DCA). VI.P Blick (1), 14.)

→ see EUFRUIT WP 4 (post harvest)

- **Hot water dipping**

e.g. (Kelderer M., Casera C., Lardschneider E. und Rainer, A. (2010). Controlling Gloeosporium rot on Pinova apple fruits. Part 1: preharvest acid clay sprays versus postharvest hot water dipping treatments. 14th International Conference in Organic Fruit-Growing – Eco-fruit, Fördergemeinschaft Ökologischer Obstbau e. V. Weinsberg, Stuttgart, Deutschland, 78-85)

→ At the moment not applied in practice except in South Italy for citrus; but there is a high interest mainly in organic for apples, pears, peaches etc.; see rating table and photo at the end

- **Physical Barriers between organic & IP**

e.g. (Telfser J., Kelderer M. (2015). Einsatzmöglichkeiten für Mehrzwecknetze im Obstbau. Besseres Obst (Nr.3 /2015), 32-34.)

→ see rating table and photo at the end

- **Alternatives to herbicides (low impact on residues)**

e.g. (Kelderer M., Lardschneider E., Giacomuzzi V. (2014). Die Pflege des Baumstreifens – Alternativen zum Herbizid. Obstbau Weinbau 51 (1), 10-13.)

e.g. (Kelderer M., Casera C. und Lardschneider E. (2006). What can we expect from the commercially available bio-herbicides. 12th International Conference on Cultivation Technique and Phytopathological Problems in Organic Fruit-Growing, Fördergemeinschaft Ökologischer Obstbau e. V. Weinsberg, (12), 172-177)

→ see rating table at the end

- **Mechanical thinning & other (low impact on residues)**

e.g. (Kelderer M., Lardschneider E. und Casera C. (2009). Das Ausdünnungsgerät, eine Alternative für die Ertragsregulierung. Obstbau Weinbau, Ausdünnung spezial, 46 (2), 74-76)

→ see rating table at the end

- **Functional biodiversity (EcoOrchard)**

*e.g. (*Sigsgaard L.*, Warlop F., Herz A., Tchamitchian M., Porcel-Vilches M., Pfiffner L., Kelderer M., Jamar L., Kruzynska D., Korsgaard M., Ozolina-Pole L., Ralle B., Penvern S. (2016). Innovative design and management to boost functional biodiversity of organic orchards. Proceedings of the 17th International Conference on Organic Fruit - Growing from February 15th to February 17th, 2016 University of Hohenheim, Germany, 275-276.)*

e.g. (Fernique S., Penvern S., Cardona A., Ahrenfeld E., Grébeau D., Jamar L., Kruczy´nska D., Matray S., Ozolina-Pole L., Ralle B., Sigsgaard L., Steinemann B., Swiergel W., Telfser J., Warlop F., Herz A. (2016). Organic farmers' reality to manage functional agrobiodiversity in European organic apple orchards. Proceedings of the 17th International Conference on Organic Fruit - Growing from February 15th to February 17th, 2016 University of Hohenheim, Germany, 268-269.)

→ see rating table at the end

- **Resistant & Robust varieties**

e.g. (Guerra W. (2012). Projekt Resistente Sorten Südtirol. ViP Blick Nr.1, S. 16-17) → see rating table at the end

Rating table: techniques with more or less relevant residues in South Tyrol

Techniques	IP	Organic
Mating Disruption	*Cydia pomonella*	*Cydia pomonella, Cydia molesta* *Adoxophyes orana* *Zeuzera pyrina*
Alternative PPP	Low Copper Sulphur *Beauveria brongniartii*	Low Copper (3 kg met Cu/ kg) Lime sulphur *Beauveria brongniartii* Carbonates Acid clays CpGV AoGV *Bacillus thuringiensis* *Steinernema feltiae, Steinernema carpocapsae*
Net	*Melolontha melolontha* (apples) *Drosophila suzukii* (cherries) *Rhagoletis cerasi* (cherries)	*Melolontha melolontha* (apples) *Drosophila suzukii* (cherries) *Rhagoletis cerasi* (cherries) *Cydia pomonella* (experimental)
Coverage	Only cherries	Only cherries; apples experimental
Hot water	No	Yes (experimental)
Physical Barrier	No	Yes (nets, hedges)
Alternative Herbicides	Experimental stage	Yes
Mechanical Thinning	Yes (experimental stage)	Yes
Functional Biodiversity	No (toxic to bees!!!)	Yes
Alternative Mulch	Yes (toxic to bees!!!)	Yes
Resistant & robust varieties	Yes 2%	Yes 5%

Scanning report
Beatrice Michaela IACOMI, USAMV

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Country: Romania

NUTS 3 region(s)[1]: RO111 Bihor, RO112 Bistrița-Năsăud, RO113 Cluj, RO114 Maramureș, RO115 Satu Mare, RO116 Sălaj, RO121 Alba, RO122 Brașov, RO123 Covasna, RO124 Harghita, RO125 Mureș, RO126 Sibiu, RO211 Bacău, RO212 Botoșani, RO213 Iași, RO214 Neamț, RO215 Suceava, RO216 Vaslui, RO221 Brăila, RO222 Buzău, RO223 Constanța, RO224 Galați, RO225 Tulcea, RO226 Vrancea, RO311 Argeș, RO312 Călărași, RO313 Dâmbovița, RO314 Giurgiu, RO315 Ialomița, RO316 Prahova, RO317 Teleorman, RO321 București, RO322 Ilfov, RO411 Dolj, RO412 Gorj, RO413 Mehedinți, RO414 Olt, RO415 Vâlcea, RO421 Arad, RO422 Caraș-Severin, RO423 Hunedoara, RO424 Timiș

WP no. and title: WP3 Reduction in pesticide residues

Date: 10-05-2016

Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

The data are collected from reports of the research institutions and public institutions as Ministry of Agriculture and Rural Development (National Program of Rural Development) http://www.madr.ro/ro/agricultura-ecologica.html; http://www.adcon.at/Products/AgroExpert.html; http://www.pomosat.ro

Soceanu A., Dobrinas S., Stanciu G., Popescu V., Epure D.T. 2012.Evaluation of Pesticides Residues in Fresh Fruits. Rev. Chim.63, 5: 455-458 (http://www.revistadechimie.ro)

Popescu St., Petre Gh., Braniste N. Research regarding integrated diseases and pests control in apple tree cultivation in the Cârcinov-Arges fruit growing basin (*Research and Development Station for Fruit Growing Voinesti, Romania*)

Badiu D.E., Mitre V., Tripon F.A., Zbanca A., Lazar M. 2015. The importance of financial support from european community in romanian fruit production. Scientific papers. Series B, Horticulture. vol. LIX, print issn 2285-5653, cd-rom issn 2285-5661, online issn 2286-1580, issn-l 2285-5653

Mitre, I., Mitre V., Sestras R., Pop A., Sestras A. 2009. Potassium Bicarbonate in Preventing and Control of Apple Scab. Bulletin UASVM Horticulture, 66 (1): 186-190 Print ISSN 1843-5254; Electronic ISSN 1843-5394

Mitre V., Mitre I., Sestras A., Sestras R. 2010. New Products against Apple Scab and Powdery Mildew Attack in Organic Apple Production. Not. Bot. Hort. Agrobot. Cluj 38 (3) 2010, 234-238

Mitre V., Mitre I., Sestras A., Sestras R. Reducing Primary Inoculum of Apple Scab Using Foliar Application of Urea in Autumn 2012. Bulletin UASVM Horticulture, 69(1): 415-416/2012 Print ISSN 1843-5254; Electronic ISSN 1843-5394

Best practice findings

Apples are the most important tree fruit grown commercially in Romania at the present time in terms of area, volume and value. Today's consumer has high expectations for fruits free of pesticide residues. Romania has a relatively new history of the organic products market, but the growth of operators registered in the system is one spectacular - from 2000 in 2008 to nearly 14.470 operators in 2014. However, only 2% of agricultural land from Romania is cultivated in certified organic system. The area cultivated organically increased from 211 ha in 2006 to 6,083 ha in 2012. Orchards and vineyard represent 3,25% from the total surface in organic crop (http://www.madr.ro/ro/agricultura-ecologica.html). For orchards, of the 6,083 hectares approximately 86% are under conversion and only 14% are certified (FAO Statistics; PNDR 2014).

A major factor that led to the decline of the orchards sector is excessive fragmentation of land, especially in hilly favourable fruit crops; average surface area owned tree farm was 0,38 ha in 2010, much less than the minimum area required for a holding fruit

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

to become viable (minimum 0,3 - 5 ha). In terms of ownership structure, 88% of holdings are individual properties and only 10% are held by associations or societies (Badiu et al., 2015).

To minimise the risks from pesticides residues on fruit, part of conventional apple production is based on IPM practices.

The "AgroExpert" Disease Forecasting System (http://www.adcon.at/Products/AgroExpert.html) it is generally used by growers to determine the optimum time for chemical treatment and to reduce the amount of pesticides and the number of treatments (*USAMV Survey*). Five on-site weather stations were established in growers orchards (POMOSAT Project). Growers used models to assess scab infection periods and timing for fungicide application. The only limitations encountered were occasional weather station/computer software interface issues, and lack of time during a busy period for orchard activities to fully analyse all the information available for decision-making. Weather and apple scab infection period information from these orchards were posted on the POMOSAT web site (http://www.pomosat.ro) for neighbouring growers access, helping them make fungicide application decisions.

Almost all apple growers used pheromone traps for monitoring and risk assessment of pests (ex. (atraPOM) for *Cydia pomonella*, codling moth). So, the threshold is established and the decision to apply treatments is made, with more effective pesticide application.

Cultural practices are also used for apple scab management. These include scab-resistant cultivars and sanitation by means of tree pruning and removal of leaf litter to physically reduce fungal inoculum in the orchard. Researches made in orchards with vulnerable varieties (Ionathan, Golden delicious) showed that the average number of treatments was 15, while for the resistant varieties was 7. Savings made in the orchard with resistant varieties by removing up to 90% of fungicides, and a reduction of 81% of insecticides and acaricides, represents 66% compared to those with vulnerable varieties (Popescu, communication - Research and Development Station for Fruit Growing Voinesti, Romania).

Reduced risk alternatives, such as “green products” were identified as potential tools in apple diseases management, with the goal to obtain fruits with less pesticides residues. For example, researches regarding the use of potassium bicarbonate or potassium bicarbonate mixed with potassium silicate as an alternative to classical fungicides (based on copper and sulphur) to control scab and powdery mildew in apple were made. The results obtained highlight the effectiveness of potassium bicarbonate in apple scab control in conditions of Cluj-Napoca, Romania (Mitre, 2009; Mitre 2010).

Some data on the effectiveness of urea as foliar applications (5%), after harvest (but before leaf-fall), to reduce apple scab inoculum are available (Mitre, 2012) but this practice it is still not used by growers.

Unfortunately, there is little or no readily available information’s with regard to the variables that influence grower’s decisions to adopt strategies that minimize residues in fruits. Once growers had discovered a combination of management options that was successful, they would not change that combination unless forced to do so by circumstances (the repeated failure to control pests and diseases - increasing resistance, the emergence of a new pest/disease). When interviewed, growers indicated that their orchard climate, varieties, and history were the determinants of the pest and disease management practices they used. Their choice of pest and diseases management practices is influenced by the availability of chemical and biological options and the cost and effectiveness of those options (*USAMV Survey*)

The following projects were identified in the National Rural Development Programme 2014-2020: ADER 2015-2018 (Ministry of Agriculture and Rural development – Romania: **ADER 3.1.1.** *Evaluation, conservation and management of genetic resources and horticultural ecosystems biodiversity fruit by developing and promoting innovative eco-friendly environment practices*; **ADER 3.2.2.** *Breeding of fruit trees to increase safety and food security*; **ADER 3.3.2.** *Development of new products, practices, processes and integrates technologies for horticultural production*; **ADER 3.3.1**. *Maintaining the authenticity and health of fruit trees propagating material through biotechnological and phytosanitary methods*; **ADER 4.1.1**. *New IPM solutions for pests and diseases in* orchards; **ADER 4.1.4.** *Integrated technologies for pests management in agricultural and horticultural crops with minimum resource consumption*; **SusOrganic** - *Development of quality standards and optimised processing methods for organic produce* (USAMV Bucharest)

Pesticide residues

Romania has a Monitoring Plan of Pesticide Residues in vegetables, fruits and grains as a part of the National Plan of Integrated Control, developed in accordance with Regulation EC no. 882/2004. The Ministry of Agriculture and Rural Development, National Sanitary Veterinary and Food Safety Authority (NSVFSA) and Ministry of Health have the responsibility for National Monitoring Plan of Pesticides Residues in fruits. Implementation of monitoring plans is performed by Agriculture and Rural Development Ministry through Central Laboratory for Pesticides Residues Control in Plants and Vegetable Products. Data on pesticide residues in fruits could be found at http://www.madr.ro/ro/reziduuri-de-pesticide-in-plante-si-produse-vegetale.html. Generaly, 400 fruits samples are analyzed each year

Research studies were conducted to reveal and draw attention to the great problem of environmental pollution, in particular by pesticide residues in 13 types of fruits from Romania, to ensure safety and quality (Soceanu et al., 2012). The obtained results showed the predominance of aldrin in most of the analyzed samples but levels of studied pesticides did not exceed the maximum permissible levels established by European Communities regulations.

Romania has a National Action Plan regarding the reduction of pesticide use or risks in specific areas:
http://ec.europa.eu/food/plant/pesticides/sustainable_use_ pesticides/docs/nap_romania_en.pdf
http://www.madr.ro/ro/utilizarea-durabila-a- pesticidelor/plan-national-de-actiune.html

Also, training sessions are organised by the Plant Protection Association Industry in Romania (AIPROM) regarding "Best Management Practices (BMPs) for foliar applications (AIPROM provide guidance for critical factors that influence coverage and reduce potential for off-target movement).
http://www.aiprom.ro/SUI/materiale.html
http://www.aiprom.ro/SCAPA/colectare.html

Required activities

- The Best Practice Guide for Romanian Fruit Production
- workshops/factsheets on the: a) biological control of pests and diseases; natural enemies orchards ; b) improved pesticide application techniques
- Interactive seminars involving both researcher and consultants/agronomists to improve rapid dissemination of information

Scanning report

dr. Alma Valiuškaitė LRCAF

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NUTS 3 region(s)[1]: LT001 Alytaus apskritis, LT002 Kauno apskritis, LT003 Klaipėdos apskritis, LT004 Marijampolės apskritis, LT005 Panevėžio apskritis, LT006 Šiaulių apskritis, LT007 Tauragės apskritis, LT008 Telšių apskritis, LT009 Utenos apskritis, LT00A Vilniaus apskritis

WP no. and title: **3 – Reduction in pesticides residues**

Date: 10-05-2016

Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

According to EU directive „Sustainable use of pesticides“ definition of IPM principles and national guidelines is a topical issue at the moment, since growers are required to implement IPM in their production from year 2014. All EU members must have implemented IPM with the aim to reduce the impact and use of pesticide. Ministry of Agriculture is responsible for planning, governance and coordination of IPM and approval of National Action Plan (in Lithuania it is named – Plant Protection Plan). Main objectives and facilities of IPM implementation are described in Lithuanian Plant Protection Plan. Some IPM elements are described in Good plant protection practice rules approved by Minister of Agriculture in 2004 (revised in 2011). Scientific research work on IPM according specific programmes will be carried out by qualified experts from Lithuanian Research Centre for Agriculture and Forestry (LRCAF) in 2013-2015.
Projects on Sustainable Use of PPP sand high quality horticulture produce was implemented. During field days and seminars the high attention was paid to IPM principles.
„Technological innovation in organic apple orchards“ No. 1PM-KK-07-1-001591. 2008–2011.
„Value of Plant Protection on competitive and exceptional quality production in sustainable agriculture” 2011.
„Implementation of pest and diseases forecasting models in horticulture“ No. P1_75. 2011–2012.
“Exceptional quality dessert apple growing and processing” No.1PM-PV-10-1-003060. 2011–2013.
„iMETOS®sm forecasting system innovation in sustainable horticulture farms” No.1PM-PV-13-2-007622. 2014–2015.
„Innovative technologies for raspberry and strawberry microbiological safety and quality“ according to the Lithuanian Research Council supporting activity the National research program “Healthy and Safe Food“2012– 2015.

1. Tamošiūnas R., Valiuškaitė A. 2013. The study on temperature sum model for predicting apple sawfly spring emergence and flight intensity in Lithuania. Sodininkystė ir Daržininkystė, 32(1-2): 23-37.
2. Rasiukevičiūtė N., Valiuškaitė A., Uselis N., Buskienė L. Viškelis J., Lukšienė Ž. 2015. New non-chemical postharvest techologies reducing berry contamination. Žemdirbystė-Agriculture, 104(4): 411-416.
3. Valiuškaitė A.; Rasiukevičiūtė N.; Kviklys D., Uselis N. 2015. Environmentally friendly apple fruits management system. Abstracts of the XVIII International Plant Protection Congress (IPPC). O IPM III-1, 146 p.

Minimal use of pesticides in horticulture is important condition in the integrated fruit growing.

Best practice findings

Growers participating in the “Agri-environment payments” program shall follow requirements of Regulation 1782/32003 as well as minimum requirements for fertilizer and plant protection product use and other relevant, mandatory requirements established by national legislation. According these requirements the same active ingredients of plant protection products must be used not more than two times per vegetation season and preharvest interval should be 1.5 times longer than indicated on the label. Plant protection products labelled as "Very toxic" and (or) "Toxic" are forbidden. At the same time, forecasting models should be incorporated in plant protection system. Diseases control program was based on internet supported forecasting system iMETOS®sm (Pessl Instruments, Austria). This system recorded meteorological conditions and calculated apple scab infections at three levels: light, medium and high. Susceptible to apple scab cultivars were sprayed when the risk of ascospores release or conidia light infection reached more than 70-80 %. Reduced pesticide program does not guarantee total scab control;

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

therefore damaged fruits should be thinned manually. Applying environmentally friendly fruit cultivation system high quality fruit yield reached on average 39 t/ha.
Rural development programme 2014-2020 „Environmentally friendly fruits and vegetables cultivation system"(started from 2012). The aim of the system is to encourage farmers growing fruit and vegetables to introduce environmentally friendly production technologies and reduce environmental pollution. The growing of fruits, vegetables and berries under this system is an important tool for improvement of environmental protection while allowing farming. Environment-friendly technologies help to retain and improve quality of soil, reduce water pollution, secure the stability of the eco-system and biodiversity. About 30 percent fruit growers are participating in this support system.

Research on the efficiency of forecasting models for pests and diseases in horticultural plants under Lithuanian climate conditions using internet forecasting system "iMETOS®sm" (Pessl Instrumental, Austria) was started at the Institute of Horticulture in 2007. The forecasting system developed according to PHARE program by Twinning in Plant Protection 'Strengthening of the capacities for administration and control of the plant origin production in Lithuania' by LIH and State Plant Protection Service implemented together with UK Central Science Laboratory. According to this project, 10 meteorological stations were set up on large horticultural farms in different agriculture regions of Lithuania. In the meteorological stations there are introduced forecasting models for apple scab (*Venturia inaequalis*), codling moth (*Cydia pomonella*), fire blight (*Erwinia amylovora*), monilia blight and rot (*Monilinia* spp.) infection risk detection and control during vegetation. In 2015 and later on Lithuanian Agricultural Advisory Service and LRCAF plan to introduce more tools for horticulture, develop a system of integrated plant protection information, consulting and training (www.ikmis.lt.). This system included presentation of personalized results or plant disease, pest and weed spreading analysis. Interactive consultations regard application of integrated plant protection and catalogue of plant protection products, diseases, pests and weeds. There are plan to introduce more early diagnosis systems, using internet forecasting system "iMETOS®sm" for horticulture.

LRCAF are closely related to universities and colleges and to Lithuanian Agricultural Advisory Service, farmers as well with regard to transfer practical and research knowledge in providing scientific and professional education in agricultural area. Collaboration between researches and advisers and farmers is important tool for identification plant protection problems at regional and national level.

Scanning report
Deborah Rees, Richard Hopkins, David Hall, UoG

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Country:	United Kingdom
NUTS 3 region(s)[1]:	UKG11 Herefordshire, UKG12, Worcestershire, UKH12 Cambridgeshire, UKH16 North and West Norfolk, UKH17 Breckland and South Norfolk, UKJ22 East Sussex, UKJ35 South Hampshire, UKJ36 Central Hampshire, UKJ37 North Hamphshire, UKJ41 Medway, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent,
WP no. and title:	WP3 Reduction in pesticide residues
Date:	16-05-2016
	Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

The main sources for research outputs in the UK used for this summary are:

- project outputs funded through the UK Agriculture Horticulture Development Board
- project outputs funded through Innovate UK
- discussions with researchers from key UK fruit research institutes; NIAB EMR (formerly East Malling Research), James Hutton Institute (JHI), Natural Resources Institute (NRI) (University of Greenwich)

For future reports we will expand the scanning process to include:

- Commercial research
- A wider range of researchers
- Consultancy organisations

UK Agriculture Horticulture Development Board (AHDB)

AHDB Horticulture, formerly Horticultural Development Company (HDC), was established in the UK in 1986 with a remit to fund research and development, and to communicate results to growers. In 2003, it was also given responsibility for near-market R&D for the apple and pear industry. AHDB is funded through levy raised annually from the growers depending on yield. AHDB Horticulture looks after the different crop interests across all sectors, or which soft fruit and tree fruit sectors are relevant to the remit of EUFRUIT.

AHDB publishes reports on funded research on its website. www.horticulture.ahdb.org.uk which are freely available across the EU. Some factsheets, wall charts and publications may need to be paid for. Research outputs for apple and pear are published in the Apple Best practice guide and the Pear Best practice guide, which provide particularly useful information for EUFRUIT.

Innovate UK

Innovate UK is a UK government funding body that focuses on projects that support commercial innovation. These projects may or may not include inputs from academic research partners, but are always led by commercial priorities, and a proportion

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

of the funding comes from commercial partners. The Agritech sector is supported by specific funding calls including "Agritech Catalyst". As a result of the commercial/practical focus outputs from funded projects tend to be of immediate commercial value to the agricultural sector. However, for some projects the outputs are initially confidential, in which case it is necessary to consult project leaders for a summary of results that can be publicly disseminated. Innovate manage a Gateway to Research that can be searched for this project.

Commercial research

Scanning for outputs in the UK will be expanded to commercially funded projects, by sending questionnaires to any organization that we identify as conducting research relevant to the fruit industry.

Best practice findings

POME FRUIT

1) Use of decision support systems (monitoring, pheromones, models).

Pheromones and other semio-chemicals for insect monitoring and control

The use of natural products such as pheromones and other semio-chemicals is seen as a means to reduce the use of conventional, chemical insecticides either by allowing accurate monitoring of populations or as part of a direct control system. Examples are given below.

Improvement of codling moth control

Codling moth is the most important pest of apples in the UK, and is also an important pest for pear. Spraying is effective, but further improvements are possible if timing of spraying is better informed. Trials have been carried out to produce a recommendation on how to optimise use/interpretation of information from pheromone traps. A strategy has been developed using pheromone traps together with the RIMpro-Cydia model (developed in the Netherlands, and recalibrated for the UK) with adaptations depending on the level of damage the previous season (AHDB TF204)

Ongoing work on diseases

TF 223 - Improving integrated pest and disease management in Tree Fruit is studying methods for detection of canker. **www.horticulture.ahdb.org.uk**

2) Chemical strategies : increase the pre-harvest interval, use restriction, specific list, depending of the stage

Reduced Residue management systems

There is a strong push in the UK from supermarkets for fruit with reduced residues. Practical strategies to achieve this for apples, developed by NIAB EMR are set out in the AHDB funded Apple Best Practice Guide. http://horticulture.ahdb.org.uk/sector/tree-fruit

The incidence of detectable residues has declined inevitably as post-harvest treatments are used less. However, the main UK apple varieties Cox, Gala, Braeburn and Bramley are susceptible to all the major pests and diseases and the UK climate ensures that one or other of these problems is significant in most seasons. The challenge is therefore to develop crop protection systems that satisfy the consumer, but that are also profitable and sustainable for the grower e.g. through preventative measures and treatment by need, preferentially selecting non-chemical alternatives rather than calender sprays of chemical based pesticides. .

There are two approaches to producing apples with reduced residues:

1. Extending the harvest interval of crop protection products used in the post-blossom period.

2. Not using conventional products after petal fall i.e. zero residue management system (ZRMS).

In some high pest and disease risk seasons a combination of the two approaches may be necessary.

The Apple Best Practice Guide provides information on the harvest interval needed to ensure reduced residues for a range of chemical products currently used post-blossom. In addition, consideration has to be given to alternative ways of controlling the pest and disease problems that the late season product sprays were targeted against. The main strategy is to reduce the populations of pest and disease during the dormant season to ensure negligible inoculum carry over from one season to the next. The Apple Best Practice Guide provides advice on strategies for the key pests and diseases.

3) Bio-control products (micro-organisms, pheromones, natural products, macro organisms)

Predatory insects

One major way to reduce pesticide use is to encourage/enhance a range of predators in the orchard. There has been a lot of work trying to enhance populations of insects such as hoverflies using semiochemical attractants. Vegetation management is another strategy for increasing predators and parasitoids in orchards. Understanding side effects of pesticides is also key. As an example tests of the effects of pesticide treatments in orchards on populations of earwigs have been carried out in order to provide growers with recommendations on how to carry out the necessary controls while minimising the detrimental effect on populations of these important predatory insects. Results indicate that an occasional application of Gazelle or possibly Calipso to control early season pests does not have long-term detrimental effects on earwig populations if the insect is well established (AHDB TF 220).

Ongoing work

TF 220 - Further development of earwig-safe spray programmes for apple and pear orchards **www.horticulture.ahdb.org.uk**

Earwigs are important generalist predators in both apple and pear orchards. They play a key part in regulating populations of several highly damaging pests including woolly aphid and other aphid pests, mussel scale, codling moth and pear sucker. Recent laboratory tests and field experiments at EMR and on UK growers' orchards and experiments by other European scientists have indicated that several very commonly used insecticides including thiacloprid (Calypso), indoxacarb (Steward), chlorpyrifos and spinosad (Tracer) have harmful effects on earwigs and could be responsible for the low populations of these important predators in some orchards. However, growers need to be able to use products containing acetamaprid (Gazelle), thiacloprid (Calypso), abamectin (Agrimec) and spirodiclofen (Envidor) for control of aphids, mussel scale, weevils, capsids, pear sucker and sawfly.

This project will build on research carried out by EMR in HDC project TF 196 which showed that earwigs can be disrupted by unsafe crop protection programmes. It will test how to integrate these key pesticides into pest management programmes without causing harm to earwig populations in the orchard. It will further investigate the sub-lethal effects (growth and reproduction) that these pesticides have on nymph and adult earwigs in highly replicated laboratory trials.

4) Pesticide resistance

An important area of work is that of developing pesticide resistance. Apple scab caused by *Venturia inaequalis* is an important apple disease worldwide. Work has been undertaken by NIAB EMR looking at potential for development of resistance. There is a weak, but significant correlation between the sensitivity to dithianon and the DMIs myclobutanil and fenbuconazole, indicating a common resistance mechanism. As a result it is important not to use these products continuously over several seasons (AHDB TF202), further work is being carried out in a PhD studentship.

8) Cultural methods, plant nutrition

Ongoing work

TF 223 - Improving integrated pest and disease management in Tree Fruit is considering methods for canker control including the effect of rootstock and interstock, the use of soil amendments at various stages of tree production

Research gaps and challenges

Insect pathogens as biological control agents: The use of insect pathogens is seen as a potential way forward for specific pests in the UK, specifically granulovirus for codling and tortrix moths.

STONE FRUIT

Spotted Wing Drosophila (SWD),

SWD was first recorded in small numbers in the UK in August 2012. A cross industry group has been working together since 2012 and a great deal of knowledge has already been learned from other countries' experiences of managing SWD. In addition, an industry funded project was set up in 2013 to investigate the behaviour and control of SWD in the UK. Best practices have been established primarily from information coming from other European countries that saw the pest first, although there are some new developments in the UK; anaerobic treatment methods leading to death of larvae in 48 hours, development of methods for sampling fruit to rapidly quantify infestation, development of dry bait for monitoring.

Testing resistance inducers or elicitors against canker

TF 217 - Improving the management of bacterial canker in stone fruits **www.horticulture.ahdb.org.uk**

Bacterial canker is a destructive disease of plums and cherries, that has been causing on-going problems for growers for many years. It can be caused by two distinct pathovars of *Pseudomonas syringae: pv. morsprunorum* (Psm) and *pv. syringae* (Pss). Psm is host specific to Prunus spp., whereas Pss has a much wider host range, with the potential for cross infection between a number of different species and genera. Although the stem canker phase is the most economically important, these pathogens may also cause leaf spots/shot-holes, shoot die-back and flower blights. This project aimed to determine if there are any potential new or alternative products that have potential for use in disease control. There was no evidence of a benefit for any of the resistance inducers or elicitors or disinfectants applied as foliar sprays.

Research gaps and challenges

- Bacterial canker is a destructive disease of plums and cherries, that has been causing on-going problems for growers for many years. It can be caused by two distinct pathovars of Pseudomonas syringae: pv. morsprunorum (Psm) and pv. syringae (Pss). With the withdrawal of copper from the list of approved plant protection products then this disease is likely to become an increasing problem. A current project is looking at novel biocontrol methods to control this disease.

On-going work

TF 219 - Control of spider mite (Tetranychus urticae) on protected cherry using the predatory mite Amblyseius andersoni

This project will investigate the use of *A. andersoni* to prevent the build-up of *Tetranychus urticae* (two-spot spider mite, TSSM) in protected cherry orchards. Due to warmer, dryer conditions in protected cherry there has, in recent years, been a build-up in TSSM close to harvest. TSSM reduce the photosynthetic ability of the leaves and in severe cases cause webbing, making harvest difficult or impractical. This was particularly problematic in 2013 when warmer dryer weather conditions promoted the population growth of TSSM on cherry trees in tunnels and there is concern by agronomists that this may affect the subsequent years' bud growth. The infestation builds up close to harvest when there are no reliable options of plant protection products. Clofentezine (Apollo 50) has a harvest interval of 56 days and only one application can be made in a season. Pyrethrums are damaging to natural enemies in the crop and of short persistence.

Hence, building up levels of predatory mites on cherry trees early in the season will help to keep spider mites in check.

We will test *A. andersoni* at two densities and two timings in orchards with a history of spider mite infestation in replicated randomised block designs. We will also test *A. andersoni* as a preventative or curative treatment on TSSM inoculated trees. This will enable us to provide recommendations for use of predatory mites by growers in protected cherry orchards.

East Malling Research and Syngenta Bioline have worked closely together on other predatory mite projects and the mites used in the studies will be supplied by the biocontrol company.

SOFT FRUIT

1) Use of decision support systems (monitoring, pheromones, models).

Pheromones and other semiochemicals for insect monitoring and control

The use of natural products such as pheromones and other semio-chemicals.is seen as a means to reduce the use of conventional, chemical insecticides either by allowing accurate monitoring of populations or as part of a direct control system. Examples are given below.

Control of Gall midges

The use of pheromones and host plant attractants to control gall midges has been demonstrated experimentally, with potential for commercial development. Female pheromones for 17 species of Gall midges (Cecidomyiidae) have been identified, and 6 of these for important UK crops have been characterised by a team involving scientists from NRI and NIAB EMR. Several of these are already used commercially for monitoring these pests. Raspberry cane midge and blackberry leaf midge pheromones have been identified and the use of the former to control the pest using mating disruption and Attract and Kill insecticidal traps has been demonstrated. The use of host plant attractants for the females is being investigated. www.horticulture.ahdb.org.uk Semiochemical control of raspberry cane midge

2) Bio-control products (micro-organisms, pheromones, natural products, macro organisms)

On-going research

Ongoing research is looking for predatory mites for soft fruit that are resistant to insecticides. The translation of this work is expected for tree fruit pests in the future.

CP 140 - Optimising the use of biocontrol agents to improve the control of *Botrytis cinerea* in key vegetable and fruit crops (Studentship, NIAB EMR)

Summary: With the reducing number of fungicides available to manage diseases, there is even more pressure to identify effective alternatives for integrated disease management. Only a few products based on microbial biocontrol agents (BCA) have been registered in the UK to control fungal diseases, primarily *Botrytis cinerea*. These BCAs have been usually applied as if they were fungicides and their efficacy is often variable. Recent theoretical modelling suggested that understanding BCA population dynamics in relation to climatic conditions is critical for their deployment to control foliar pathogens. However, this aspect of biocontrol research has so far been neglected.

This project aims to obtain ecological knowledge on BCAs that are currently registered and being registered in the UK and then use the knowledge to develop and evaluate strategies of applying BCAs to improve efficacy against *Botrytis* development on strawberry and lettuce. Specifically, we shall (1) develop molecular methods to quantify the viable population of two commercial BCAs (one fungus and one bacterium), and two new candidate BCAs (identified at EMR and are being formulated by a commercial company); (2) use the method to study BCA population dynamics under different conditions; (3) investigate BCA dispersal under different rainfall intensities in both glasshouse and field conditions; (4) use the new knowledge to optimise BCA applications and evaluate the strategies on strawberry and lettuce; (5) conduct field studies to assess whether combined use of BCAs as well as with reduced fungicide input would lead to synergy and reduced variability in biocontrol efficacy.

Research gaps and challenges.

- Successful control of western flower thrips, tarsonemid mite, strawberry blossom weevil, vine weevil, nematodes, aphids, European tarnished plant bug, capsids and two spotted spider mite;
- •Successful integrated control for strawberry of powdery mildew, crown rot, red core, verticillium wilt and the soft rots botrytis, rhizopus and mucor;
- •Successful control of raspberry cane midge, nematodes, vine weevil, mites, midges, capsids and aphids;
- •Successful control for cane fruit of *Phytophthora* root rot and the soft rots *Botrytis*, *Rhizopus* and *Mucor*;

SPRAY TECHNOLOGIES

Pesticide dose adjustment (Pesticide adjustment to the crop environment = PACE)

Pesticide manufacturers often increase the normal margin-for-error on the label recommended dose-rate to ensure that reliable efficacy is achieved with orchard spraying products across a broad range of target structures, however practical experience has demonstrated that label recommended dose-rates can be reduced in some circumstances without a significant reduction of efficacy. For the range of tree fruit structures cultivated in the UK, PACE research established a method for optimising the adjustment of dose-rate based on data from a tractor mounted scanning LiDAR system.The method was later simplified to make use of grower assessment of canopy density and height initially using a published leaflet, and then a web-based software package to allow growers to calculate the pesticide application rate appropriate for their orchard. Further information is given on www.pjwrc.co.uk.

Project reports considered (all available on www.horticulture.ahdb.org.uk)

CP 140 - Optimising the use of biocontrol agents to improve the control of Botrytis cinerea in key vegetable and fruit crops

TF 223 - Improving integrated pest and disease management in Tree Fruit

TF 219 - Control of spider mite (Tetranychus urticae) on protected cherry using the predatory mite Amblyseius andersoni

TF 220 - Further development of earwig-safe spray programmes for apple and pear orchards

TF 216 - Evaluation of products for control of Nectria galligena on apples

TF 217 - Improving the management of bacterial canker in stone fruits

TF 204 - Improving codling moth spray timing on apple and pear

TF 202 - Monitoring scab populations on apple for fungicide insensitivities and races

TF 203 - Fusarium species causing core and storage rots of apple project

TF 196 - Investigation of the effects of commonly used insecticides on earwigs, important predators in apple and pear

TF 195 - Sensitivity of apple powdery mildew (Podosphaera leucotricha) populations to triazole, strobilurin and other fungicides

CP 077 - SCEPTRE: Sustainable Crop & Environment Protection - Targeted Research for Edibles

TF 194 - Developing biocontrol methods and their integration in sustainable pest and disease management in plum and cherry production

TF 190 - Are (in)sensitivities of scab isolates to different fungicides correlated?

TF 189 - Optimum treatment timing to reduce overwintering codling moth populations

Scanning report
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NUTS 3 region(s)[1]: [code(s) and name(s)]

WP no. and title: **3 – Reduction in pesticides residues**

Date: 18-07-2016

Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

- Conduct official plant protection product efficacy and crop safety studies; e.g. active substances for organic production (e.g. lime-sulphur)
- Undertake comprehensive spray residue reduction studies (alternative methods compared to chemical products)
    - E.g. Codling moth: Test mating disruption (cage method); Test granulosis virus product (brand name – „Stämme“), Test nematodes
    - E.g. Apple scab: Test organic products (lime-sulphur calcium bicarbonate) in comparison to synthetic chemical active substances
    - E.g. Apple scab: Test antagonistic fungi compared to synthetic chemical and organic chemical active substances
    - E.g. Aphid control with alternative active substances e.g. soaps
    - E.g. Tortrix moth control with *Bt* products
- Project management for Interreg Projects (Interreg V):
    - Development of practical control measures to minimise the economic damage from cherry fruit flies. (01.04.2015 to 31.12.2018)
        - Laboratory studies (artifical rearing of fruit flies)
        - Studies in semi-open field (artifical reared fruit flies)
        - Studies in open field (natural population dynamics)
        - Open field pest monitoring
        - Biological studies (life cycle, population dynamics)
    - Low (minimal) residue production: Model orchards to develop integrated plant production systems (1.12.2015 bis 31.12.2019)
        - Establish model orchards (Switzerland, Germany); e.g. at the KOB (2 ha with full net covers and partly covered tree rows with plastic film) to conduct residue reduction studies.
    - Cooperative work with the BLE-Projekt: Model and demonstration orchards (3 commercial apple orchards in the Lake Constance region), Data based development of application and evaluation methods to reduce the application of pesticides
- Phytotoxicity studies to evaluate the side-effects of alternative methods and alternative low residue active substances (E.g. azadirachtin, soaps, chrysanthemum preparations)
- Conduct studies to control fireblight (alternatives to antibiotics streptomycin – running since 2003), Evaluation of phytotoxicity (in particular fruit russet)

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Best practice findings

The aim is to report about the best European practices to reduce pesticides residues on fruit.

- Evaluation of pesticide residues regarding the production method and development of a strategy (application timing) for use by fruit growers
- Work with fruit grower groups, application recommendations over the official pest and disease warning service, grower presentations
- Control of pests and diseases with alternative methods compared to the normally used synthetic chemical active substances e.g. Codling moth granulosis virus and mating disruption (reduction in the number of synthetic chemical active substances from 4 to 1)
    - ¼ of fruit growers in the Lake Constance region using mating disruption
    - 95% of growers in the Lake Constance region using Codling moth granulosis virus
- Increased use of beneficial organisms e.g. though sowing flower meadows to increase biodiversity
    - 10% of growers promote biodiversity with sowing of flower meadows
- Control of apple scab supported by:
    - Leaf removal measures, measures to reduce infection carry over in autumn leaves
        - Calcium nitrate applications before bud-break in spring (reduction in the number of perrithecia)
        - Reduction of leaves from the orchard in early spring before bud-break
        - ~35% of growers applying these measures
    - Application of lime-sulphur and calcium bicarbonate to reduce the number of synthetic chemical active substances to benefit organic chemical active substances
        - ~20% of growers using these products
- Use of sulphur to reduce the applications against rust mites
    - ~95% of growers using sulphur
- Encouragement of predatory mites for the control of spider mites
    - Through the use of active substance, that are safe to predatory mites
    - Active introduction of predatory mites for spider mite control in new orchard plantings
        - 100% of growers using these measurements
- Alternative methods to control cherry fruit flies in stone and berryfruit
    - Full net covering, partial net covering
        - ~60% of growers using these methods
- Monitoring of cherry fruit flies with apple vinegar / red wine traps
    - ~95% of growers using these monitoring methods

Scanning report

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NUTS 3 region(s)[1]: ITH54 Modena, ITH55 Ferrara, ITH57 Ravenna, ITH58 Forlì-Cesena, ITH59 Rimini

WP no. and title: **3 – Reduction in pesticides residues**

Date: 13-05-2016

Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

Within Italy, the Emilia e Romagna region, since 1980, has supported farmers who adopted integrated pest management to protect crops. Every year a panel of experts provided a guide to advise the farmers about non chemical means to control disease and pests and to a more rational and safe use of agrochemicals, to minimize risk for humans and environment. Since then the awareness of farmers, consumers and health authority has greatly increased. Some supermarket chains, to reassure the costumers about the safety and healthiness of their foodstuff have fixed limits lower than 50-70% of MRL. Farmers and suppliers need new cost-effective defense strategies to meet the changing supermarkets and consumers demand of lower residues.

Although in Italy a reduction of the agrochemicals sold, by 15%, was achieved from 2005 to 2015, however detectable residues are still found on fruit crops. Therefore one of the aim of our research was to remove agrochemical residues by alcaline and sonication washings before marketing. Another goal was to use non chemicals means to protect fruit during storage. These objectives were obtained by hot water treatments (on organic and IPM fruit) to control brown rot in peaches and lenticel rot (*Neofabrea* sp.) in apples. We evaluated also biological control agents applied in postharvest.

Best practice findings

The aim is to report about the best European practices to reduce pesticides residues on fruits.

PH washings with Na silicate and sonication, applied at the end of storage, reduced preharvest residues up to 65%. Hot water treatments (HWT) applied by a pilot plant to organic peaches, reduced brown rot, with an efficacy index ranging from 75 to 100%. Although HWTs were also very effective to control lenticel rot in apples, the long dipping treatment required, prevents, in our opinion, the application at commercial level. Various experiments in packing houses to prevent PH losses in peaches and pears, by various biological control agents, failed to provide reliable and replicable results in different operating conditions.

Sources :

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[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

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Scanning report
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NUTS 3 region(s)[1]: ITD20, Trentino-Alto Adige

WP no. and title: **3 – Reduction in pesticides residues**

Date: 03-05-2016

Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

Trentino is one of the most important apple production area in Europe. Apple is grown on about 10,800 ha and the accounts for about 25% of the Italian apple production (Dalpiaz, 2014). Most of the growers (6300 growers and 8,950 ha) produce within a cooperative systems organized in 26 cooperatives, grouped in 3 Producer Organisations (PO) and 1 third tier association (APOT). Growers take advantage of a public advisory service that was free of charge till 2015. Since early Nighties IFP-guidelines are adopted by the apple production system (Agnolin et al., 2000). High attention is addressed to the issue of pesticide residues on apple in order to meet the international supermarket chains requirements (Waldner, 2009). The 500,000 ton of apple annually produced within the APOT system, are checked on the pesticide residue level by analyzing about 600 samples (Baldessari et al., 2013).

Agnolin, C.; Ioriatti, C.; Pontalti, M.; Venturelli, M.B. IFP experiences in Trentino, Italy. Acta Holticulturae 2000, 525, 45–49.

Baldessari, M.; Giuliani, G.; Chiesa, S.; Larcher, R.; Ioriatti, C.; Angeli, G. 2013. Pesticide residue free fruits: The aim of Trentino apple production system. Commun. Agric. Appl. Biol. Sci., 78, 133–137

Dalpiaz A (2014) Innovazione e organizzazione, le uniche risposte per uscire dalla crisi. Frutticoltura, 11:2-6

Waldner, W. Le catene alimentari e la riduzione numerica di residui di agro farmaci. Frutta e Vite, 2009, 4: 182-186.

Best practice findings

The aim is to report about the best European practices to reduce pesticides residues on fruits.

Reduction of the insecticide and acaricide residues on apple has been constant in the last decade, included the last three years. That was the consequence of the area-wide implementation of mating disruption to control the main tortricid pests, covering at present 7200 ha. This strategy allowed a significant and generalized reduction of the summer acaricide/insecticide treatments (in average 1 acaricide and 1-3 insecticides) on the entire apple growing area. Consequently, the conservative biological control of secondary pests was improved and the acaricide and insecticide residues on apple at harvest was significantly reduced, especially for organophosphates (OPs) (only 1,5% of samples in 2015). The current objective of the apple production system is to avoid any OPs residues.

Pilot experiences (about 600 ha) are also in progress in the areas traditionally treated with MD in order to further reduce the metoxyfenozide and clorantranilibrole treatments, the two insecticides more frequently found as residues on fruit at harvest.

More complicated appeared pursuing the current objectives of applied research to reduce fungicide applications and their residues on fruits. The most frequent fungicide residues are related to the pre-harvest treatments (captan, 80%; boscalid, 25.7%; pyraclostrobin 18.7%; fludioxonil, 9.1%) and to the most widespread fungicides used for scab control (dithianon, 94.7%; dodine 39.6; and diotiocarbammates, 27.7%). Different approaches are tested both at experimental level and in pilot farms to reduce fungicide residues:

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

- Replacement of synthetic fungicide with inorganic products for apple scab control
- Widespread of forecasting model for apple scab infections
- Improvement of spay technology and development of fixed spray system
- Use of exclusion netting and water-proof tarpaulin.

The entire apple production in Trentino apply voluntary level of guidelines for integrated fruit production approved by the IPM commission of the agricultural ministry.

1) Use of decision support systems (monitoring, Pheromone, models):
    a. IPM Base. Pheromone monitoring traps are area wide deployed and periodically serviced by the advisory service. RIMpro model are available online for all the apple growers that have subscribed the advisory service (85%). The consultants carry out field scouting in order to better fit the technical advice with the real field situation.
2) Spray application (quality, dose and volume, fix spraying system, injection.
    a. IPM Base. Calibration of the air blast sprayers is compulsory since late Nighties and about 700 machines are controlled every year in order to check them all every 5 years. Replacement of the fine or very fine hollow cone hydraulic nozzles are implemented on part of the air blast sprayers to reduce pesticide drift toward the sensible areas. TRV has been evaluated and it is a best practices to disseminate.
    b. Experimental stage: different fixed spray systems are under evaluation on experimental farms in combination with fruit-wall training system and exclusion netting
3) Chemical strategies: increase the pre-harvest interval, use restriction, specific list, depending on the stage
    a. IPM Base: Chemical strategies are implemented to fit the quality standard required by the most important supermarket chains (<30% LMR, max 4 a.i. etc) The apple production is regularly checked on the pesticide residue level by analyzing about 600 samples.
    b. Experimental stage: alternative to organic fungicides are investigated; experimental field trials and postharvest observations are carried out by FEM
4) Bio-control products (micro-organisms, pheromone, natural products, marco-organisms).
    a. Commercial orchard stage: mating disruption is applied on 7500 ha to control codling moth and oriental fruit moth in apple orchard. Codling moth granuloses virus is applied in organic farms when MD is not applicable due to small size of the orchard.
    b. IPM Base. European spider mite is naturally controlled by predatory mites. Specific acaricides are not generally applied.
    c. Experimental stage: nematodes to control overwintering CM larvae. *Areobasidium pullulans*, laminarina carbonates, are under investigation at experimental stage
5) Physical barrier (nets, plastic cover)
    a. Experimental stage: contrary to soft fruits and cherry where exclusion netting is largely applied as control tool against SWD, only few apple orchard are using Alt–carpo for combined control of CM and hail. Stll at experimental stage are also rain cover for reducing scab infection; first results are very encouraging even though they promote woody apple aphid infestations on vigorous varieties (ex. Fuji).
    b. Commercial orchards stage: physical barrier are also used to reduce the pesticide drift out of the orchard.
6) Mechanisation (thinning, alternative to herbicides)
    a. Commercial orchard stage: mechanical thinning, mechanical pruning and mechanical weed control are more and more implemented. The new fruit-wall based on multi-leader tree architecture makes it much easier than in the past.
7) Genetics (resistant varieties)
    a. Commercials orchards stage. Some interesting new scab resistant varieties are available and promoted by the apple-growers association.
8) Alternative to postharvest treatments, remove pesticide on fruits.
    a. Experimental orchards stage: pesticides are not allowed in post harvest. Removal of pesticide residues on fruits are under investigation.

Scanning report
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NUTS 3 region(s)[1]:	SE224 Skåne län, SE123 Östergötlands län, SE221 Blekinge län, SE213 Kalmar, SE231 Halland, SE232 Västra Götaland
WP no. and title:	**3 – Reduction in pesticides residues**
Date:	10-08-2016
	Y1 report due May 2016 for the period 03-16 to 05-16

Source materials and methodology

The concept of Integrated Pest Management (IPM) was established in Sweden in the late 1950s. Growing problems in terms of pesticide resistance initialized the interest for finding other solutions besides chemicals.

Swedish Board of Agriculture (SJV), particularly Plant Protection Center in Alnarp (PPCA) is responsible for supporting advisors in horticultural sector across the country. Our main goals are to stimulate development and use of plant protection methods with minimum use of chemicals and to increase collaboration between researchers, advisors and growers.

The PPCA take active part in a large number of courses, field excursions, telephone meetings, and national and international conferences. The center also provide advisory and study material, and take part in projects on environmental and plant protection issues.

Other relevant organizations

- The Swedish University of Agricultural Sciences (SLU) - responsible for research in the field of plant protection.
- LRF Horticulture represents the Swedish horticultural industry and is a part of LRF, the Federation of Swedish farmers.
- The Rural Economy and Agricultural Societies (HS) - a national body that has advisory services as a main task but also perform field trials and is involved in research projects.
- Äppelriket - a producer organization owned by 94 fruit growers around southern Sweden.

Best practice findings

1) Use of decision support systems:

Early warning service is one of our most important working pratices. SJV provides annual service of weather stations in orchards (34 stations in total) and manages forecasting system. All stations are connected to RIMpro cloud service from where models for apple scab, codling moth, apple canker and apple sawfly are provided. Information on other pests is collected through weekly field inspections. During the growing season, plant protection data is gathered from approximately 20 fields per week, from April to October (mainly pests and diseases April to July, beneficials and Drosophila suzukii July – October). After processing and analysis of this data, appropriate measures are discussed in regular telephone conferences led by the PPCA.

[1] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

PPCA also perform diagnosis of various pests and receive samples during growing season.

Current information is presented to fruit growers and advisers regularly.

http://www.jordbruksverket.se/etjanster/etjanster/odling/skorvochskadedjursprognos

http://www.jordbruksverket.se/etjanster/etjanster/odling/prognosforskadegorarepabar

2) Spray application:

SJV is a key actor in "Focus on Pesticide Use", an information campaign which started in 1997. The campaign is a cooperation between different authorities, interest organizations and companies. The aim is to reduce pesticides in ground and surface waters and to improve the use of personal equipment when handling pesticides. The campaign distributes information through brochures, courses, leaflets, advertisements and the campaign website.

http://sakertvaxtskydd.se/sv/In-English/

http://sakertvaxtskydd.se/sv/Bibliotek/

In Sweden, anyone who use class 1L and 2L pesticides must complete a course in order to receive a usage licence. The specific course concerning pesticide use in horticultural crops consists of five days basic training. The licence must be renewed every fifth year by attending one day advanced course. The county administrative boards arrange and administrate these training courses.

Applying biological plant protection agents puts great demands on spreading technique. Many biological pesticides have contact mode of action and the effect is dependent on good coverage especially on the underside of leaves where many pests are located. SJV tests potential improvements of current methods by utilizing the available technologies used in agriculture wherein better coverage and more even distribution can be achieved.

3) Biocontrol

PPCA takes active part in participatory action research driven by SLU in Swedish apple production. The projects main goal is to evaluate and develop methods for monitoring of beneficial organisms and to integrate collected information in control strategies.

The earwig management tool is introduced to fruit growers in 2012.

4) Genetics

Department of Plant Breeding at SLU has active public breeding programs on apple, black currant and sea buckthorn targeting Northern Europe. Unique to the Department is the strong link between basic research and applied plant breeding.

Recent released cultivars: apple - Agnes, Trulsa, Lovisa and Folke (2014); black currant - Petter (2013); sea buckthorn - Svenne and Lotta (2011), Sun, Idun, Fenja, Eir (2012) and Torun (2013).

Other ongoing projects

- Control of apple scab with low-risk chemicals - efficiency evaluation of potassium and sodium bicarbonate.
- Resistance to plant protection products in strawberries - the aim is to exclude products with poor effect and prevent unjustified treatments.
- Control of Drosophila suzukii with a new version of catch and kill technique.
- Campaign to raise knowledge level about storage diseases

Selected sources

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