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Work package 3: Reduction in pesticide residues

March 2016 – August 2018

EUFRUIT

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*** Partner 6 (EMR) has been transferred to NIAB EMR. NIAB EMR is committed to performing all project tasks previously assigned to EMR. The personnel involved by EMR will continue performing the work in the project.**

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Synthesis report
WP3 Sustainable fruit production to minimize residues

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WP: WP3 Reduction in pesticide residues

IEG thematic area: Minimal pesticides input, alternative technologies, prediction tools, spray technologies

Covered NUTS 3 regions:

Country	Regions (NUTS 3 REGIONS)
Denmark	DK011 (Copenhagen), DK012 (Copenhagen and its environs), DK013 (North Zealand), DK014 (Bornholm), DK021 (East Zealand), DK022 (West- and SouthZealand), DK031 (Funen), DK032 (South Jutland), DK041 (West Jutland), DK042 (East Jutland), DK050 (North Jutland).
Belgium	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.
France	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.
Germany	DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, DE9 (Niedersachsen), DE8 (Mecklenburg-Vorpommern), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen).
Netherlands	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.

Spain	ES512 Girona, ES513 Lleida.
Switzerland	CH011 Vaud, CH012 Vallis, CH021 Bern, CH022 Fribourg, CH023 Solothurn, CH024 Neuchâtel, CH025 Jura, CH032 Basel-Landschaft, CH033 Aargau, CH040 Zürich, CH052 Schaffhausen, CH055 St. Gallen, CH056 Graubünden, CH057 Thurgau, CH061 Luzern, CH063 Schwyz, CH066 Zug, CH070 Ticino.
Italy	ITH10 Bozen-Bolzano, ITH54 Modena, ITH55 Ferrara, ITH57 Ravenna, ITH58 Forlì-Cesena, ITH59 Rimini, ITD20 Trentino-Alto Adige
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Lithuania	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.
UK	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.
Sweden	SE224 Skåne län, SE123 Östergötlands län, SE221 Blekinge län, SE213 Kalmar, SE231 Halland, SE232 Västra Götaland.
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[2] Farm holder/grower, advisor/consultant, research institute/RTO, SME, NGO or other

Synthesis findings 2018

In the EUFRUIT project, WP3 is focusing on the reduction of pesticide residues on fruits and in the environment by using alternatives to chemical protection against pest sand diseases, developing strategies to limit the negative incidences of pesticides and adopting new spraying technologies. The following document is the third synthesis report of the IEG composed by members of the EUFRIN WG "Sustainable fruit production to minimize residues" and partners involved in the EUFRUIT project. The state of art has been done in eleven European countries (Belgium, Denmark, Germany, France, Italy, Lithuania, the Netherlands, Rumania, Spain, Switzerland, United Kingdom). The aim is to provide an overview on different alternatives techniques to pesticides, which may already be used by the growers and others, which are at an experimental stage. In 2018, eleven subjects were handled:

1) Biodiversity
2) Biological control (microorganisms, beneficial insects)
3) Cultural practices
4) Decision tools
5) Detection
6) Natural substances
7) Physical methods (mechanical, thermal, barriers, traps)
8) Plant resistance inducers
9) Semio-chemicals
10) Spray applications
11) System approach where different techniques to reduce the use of pesticides are combined

I. Biodiversity

Orchards offer opportunities to foster ecosystem services, but input reduction is challenging. The principle is: apply a much as possible "soft protection practices" (i.e. prefer non-chemical solutions, use pesticides only as "last" resort, avoid non selective pesticides) and develop a supervised plant diversity management to enhance conservation biocontrol and limit pest outbreak. **INRA Gotheron** in a pear project between 1995 and 2005 (South-Eastern France) elaborated a design of a multi-species hedgerow to increase pear psyllid (*Cacopsylla pyri* L). Three main points came out:

1) ban plants hosting quarantine or key pests and diseases of the orchard and surrounding crops.
2) selection of plants hosting a rich and/or abundant natural enemy complex.
3) provide natural enemies with habitat and food resources (pollen, nectar, alternative prey) all year round. Beside these criteria, tree species have of course to be adapted to soil and climate conditions.

Biodiversity is also a central part of the plant health care strategies in organic farming. The EcoOrchard project contributes to the kowledge and experiences on Functional AgroBiodiversity (FAB) management both from practitioners and scientists. **Laimburg Research Centre** (Italy) is working on the performances of different seed mixtures and the impact a sowed flower strip in the middle of the tree rows can have on pests like rosy aphids and codling moths. Natural enemies were significantly more abundant on trees in the flower strip plots than in the control plots, but the reduction of damages in presence of beneficial insects remains low and the difference between the number of treatments in an orchard with flower strips and without is limited to one or two.

The gap to develop more biodiversity is about knowledge on the occurrence and biology of many natural predators. It is also necessary to adapt the practices to avoid negative incidences of the spray application on the beneficial insects. The AHDB project TF220 (UK) has explored the effects of pest control products on earwigs, who are generalist predators of pests in apples and pears. The conclusion is that it is unlikely that occasional spraying will have long term effects, but early summer applications have to be avoided.

II. Biological control

Microorganisms

On fruits, only a few products are registered in Europe. For example: ***Bacillus subtilis, Aureobasidium pullulans*** may be used for the control of some fungal pathogens like powdery mildew or postharvest diseases (Botrytis cinerea, Monilinia fructigena, …) or **granulovirus preparation** against codling moth or fruit tortrix. Further research is needed to identify new "alternative" solutions to chemical pesticides.

In Belgium (pcfruit, KU Leuven, ILVO) **entomopathogenic fungi products** (different Beauveria bassiana strains and Metarhizium anisopliae) were tested on thrips in strawberry. The best results were between 50 and 70 % efficacy, but others were less good. The inconvenient is that these products have to be sprayed multiple times in short interval.

To increase chances to apply biological control products at the right place for example against Fire blight on apple flowers, (bumble) bees may be of some help as **entomovector**. But the Belgian results showed that the visitation was limited because of the climate condition, and may be the low attractiveness of the species. A new approach will be to apply the biological control products with biological models and test Osmia sp. as a vector.

In packing houses, the idea is to apply biological control products **by nebulisation** to control storage diseases on apples. Pcfruit, KU Leuven, ILVO (Belgium) studied the distribution of the products in cold storage rooms and in paloxes. The application of biological control products by cold nebulisation is possible, but the tested products achieved max. 50-60 % efficacy against Neofabraea spp. An important point is that fungicides sprayed in orchards may still have an impact on the biological control product applied on the fruits later.

As treatments close to harvest against storage diseases are a potential risk to have residues on apples, Agroscope (Switzerland) is working on **yeasts**, which have an antagonistic activity. The candidate Metschnikowia pulcherrima can be formulated and sprayed in field. The reduction of storage rot could be achieved with M. pulcherima, but in combination with fungicides applied 21 days before harvest.

Some **bacterial antagonists and lytic bacteriophages** against Fire blight, Xanthomonas, Pseudomonas, like Bacillus spp., are already available, other are identified and tested (Pseudomonas fluorescens, Pantoea agglomerans, Pantoea vagans). Lactic acid bacteria are very promising.

Further experiments are needed to optimize biological control products in practice (i.e. coformulats to enhance persistence, and environmental fitness, shelf-life…)

Beneficial insects

At AU-BIOS (Denmark) a pilot study has been conducted to explore the potential of using **wood ants** to reduce pests in apple orchards against winter moths and other caterpillars. The success was limited due to increased aphid's problems. Therefore, ants were offered a sugar solution to divert them from milking and protecting aphids. An interesting side effect was that ants may also use fungi (scab, Monilia) as a food source. This could be of potential interest.

Predator introduction, like ***Amblyseius andersoni***, against spider mites (Tetranychus urticae), on cherries "under cover", at a rate of one sachet per 5 trees, give good results (UK project).

III. Cultural practices

Apple scab usually survives over winter under the trees, in the dead, infected leaves from the previous season. The fungus continues to live within the leaves during winter, forming small, flask-shaped bodies, in which spores (ascospores) develop. These ascospores mature in spring and are forcibly ejected during spring rains. They are contaminating new shoots, leaves and further on small fruits. **Cultural practices consist in crushing "infected" leaves** fallen on the soil to reduce primary inoculum. At the Copenhagen University (Denmark), work has been conducted over 4 years on a strategic watering of the soil with covered with scabbed leaves to release ascospores in dry periods. 25 to 40 %

ascospores could be released, but a lot of water is needed and in fact, no reduction of scab and number of fungicides could be achieved.

IV. Decision tools

There are different type of tools:

- **Warning systems** for growers and advisory organisations based on observations, and models to predict infection risks of diseases and simulate pest development, but also their predators. The aim is to optimize treatments and apply them at the right moment.
- **Guidelines** to consider side-effects of plant protection products on beneficial insects.
- **Systems for treatment management**, like DOSA3D (Universitat de Lleida - Spain), a tool which calculates the dose taking into account the tree dimensions and the leaf density.

V. Detection

A first step towards the **use of drones** equipped with spectral sensors for fire blight detection was achieved by identification and validation of suitable wavelengths (pcfruit – Belgium). However, the accuracy of 52-54% for correct identification of the tree status (healthy or infected) is not sufficient yet for practical implementation of the technique and warrants further improvement.

VI. Natural substances

In France, there **a two types of alternative products to chemicals: the "biocontrol products" and the natural preparations "without danger"**. The biocontrol products are registered like pesticides and are divided in four groups. One of them contains products with natural substances coming from plants, animals, or minerals, like pelargonic acid, eugenol, thymol, garlic extracts, clove oil, potassium bicarbonate, laminarin, potassium phosphonates, pyrethrins, sulphur. The natural preparations without danger are composed by base substances which are registered at European level, for example: Equisetum arvense, saccharose, Salix cortex, vinegar et al. These preparations should be made by the growers themselves (fermented plant extract, herb infusion, decoction, maceration).

More solutions are needed. They must be identified and tested in laboratory conditions and field. Furthermore, the registration of naturally occurring substances is difficult. Thus, the technical issues of the development of new substances are as important as the support for the registration of the substance.

To reduce the use of cupper against apple scab, potassium bicarbonate and sulphur or potassium bicarbonate and potassium silicate give good results (University of Bucarest – Romania). Obstbauzentrum Jork (Germany) tested a product, an ion salt form of pelargonic acid against apple sab, in greenhouse and open field. The results are similar or even better than the chemical or organic references. In Spain (IRTA), three basic substances (*Equisetum arvense* L, Urtica spp; and sodium hydrogen carbonate) and laminarin are under evauation in the control of apple scab.

The institute of Horticulture LRCAF (Lithuania) is working on plants, which are grown under the conditions of Lithuanian climate. Thymus vulgaris and Coriandrum sativum essential oils were extracted from local material. They inhibit Alternaria and Fusarium gramineraum. A student thesis is carried out on i) the selection of plant extracts and essential oils from different plants (*Asteraceae, Alliaceae*, … ; ii) the evaluation of their antifungal effect on strawberry diseases.

In the European project DROPSA, chitosan, laminarin, essential oils, Bacillus subtilis QST713 and benzothiadiazole were evaluated in the control of quarantine diseases caused by *Xanthomonas arboricola pv. pruni* (peach), *Pseudomonas syringae pv. actinidiae* (kiwi) and *X. fragariae* (strawberry).

VII. Physical methods

Mechanical techniques

Weed control in orchards becomes a major concern, because of the progressive exclusion of the glyphosate herbicide. **Mechanical weeding** is already practised in organic production, but new technologies are emerging. The important points are to be able to work on the tree interspace, to have a good work speed, to be used on massive weed infestation and wet soil conditions. In future, new machines like the "GrassKiller" from Italy, working with high pressure (up to 1.250 bar) water and the "Electroherb" from Brasil, using high-frequency alternating current, may change weed management in orchards.

Hot water treatment

There are **two types of applications**.

One is tested in orchards to **control weeds**. The temperature of the water goes up to 98°C, so the cost of the heating still hinders the general usage. KOB (Germany) showed in field trials several problems relayed to the high water quantity and the important time amount. Furthermore, economically this method was not satisfying. Another method with hot steam gave better results, but is still under investigation.

The second is already applied to **prevent apples form storage rots** (*Gloeosporium*). The treatment is applied quickly after harvest. The fruits are dipped in water by 48-50°C between 2 to 3 minutes and cold stored.

Traps

Beside pheromones traps, other traps may **attract insects with their colour or with food attractant like sugar, vinegar**.

In case of apple sawfly, white seems to be the right colour. Wageningen (Netherland) is working on different type of traps, different type of "white" and different densities. The strategy is to prevent adults to come out of the soil, to catch away the adults and to prevent larvae to enter the soil.

Barriers

- **Rain covers**
  Reduce the incidence of rain on the development of fungus and bacteria is the aim of a rain cover on the top of the trees. In practice, cherries are covered for a short time close to harvest to avoid fruit cracking. On apples and pears trials are going on at the University of Aarhus (Denmark), Ctifl (France), Laimburg (Italy), and with a new project, in Wageningen (Netherland). The main objective is to cover the whole season the orchard for apple scab protection, but also Gloeosporium. In Italy, but also in France, successful experiences have been achieved on kiwi against *Pseudomonas syringae pv. actinidae*.

  After studying the technology on apples, the University of Aarhus (Denmark) had a three years trial on pears. Even if the light level is reduced by 30 %, no detrimental effects on yield, fruit size, colour and fruit quality was noticed. On the Conference variety, the benefit is to have significantly greener fruit. The goal is to get organic production untreated. The main problem is the wind.

  At Ctifl (France), there are two types of rain roofs: one is placed under the hail nets, the other is combined with the hail nets in order to form only one cover. The efficacy against apple scab depends on the type of rain cover, but the symptoms on shoots are reduced (between 2 for the combined solution and 20 % for the rain cover under the hailnets) and almost missing on fruits (less than 2 % in 2017). Because of the "non treatments" under the rain covers, powdery mildew may develop. The strategy is to add a sulphur protection from March to the

end of May. In 2017, Ctifl tested also the effect of two plant resistance inducers based on phosphonates, by spraying them one time a week in the same period as the sulphur. With these treatments, the apple scab on shoots was reduced to 3 %. But the rain covers seems to have a negative incidence on yield (quantity and colour). It was observed on an older orchard (Gala, 2004). After 4 years cover, the cumulated difference between the covered and uncovered parts of the orchards was 70 t/ha. On a younger orchard (Rosy Glow, 2014), the irrigation was adapted with two types of irrigation systems (drip irrigation and micro jet). Under rain cover, the micro jet gives less good results. Compared to micro jet in the not covered part, the differences are between 13 and 23 t/ha.

At Laimburg (Italy), the Keep in Touch® system provides a rainproof net on the upper part and an insect proof net on the lateral part. On Fuji, the maximum scab on shoots was around 8 % (in that case, the rain covers was opened at the beginning of April) and on fruits, it was less than 1 % (end of the primary infection period and at harvest). On Cripps Pink, the rain covers seems to reduce *Alternaria* when opened in August, but against *Marsonina* leaf blotch, no effect could be seen. To study the efficacy against *Gloeosporium*, the system was opened in July or August on Pinova and in August on Rosy Glow, the % of affected fruits were significantly reduced for Pinova when covered in July and for Rosy Glow. The thinning effect of the cover system was important on Fuji when opened before flowering and during flowering (up to 60-65 %).

Further research is needed to understand the mechanism of the protection under plastic tunnels against apple scab and *Gloeosporium*; the effect of plastic on other pathogens; the productivity and fruit quality under plastic; the long-term sustainability on soil. Other plastic tunnel types have to be investigated, as one of the major limitations for this technology are the costs.

The new project in Netherland will be on retractable roofs, with questions like return of investment, fruit tree canker, image for agro tourism.

- **Exclusion netting**
  On apples, nets may be used against codling moth, oriental moth and also Mediterranean fruit fly and Halyomorpha halys. At IRTA (Spain), the use of insecticides could significantly be reduced in a netted and closed orchard, but aphids (grey and woolly) have to be controlled. Work was done in two different ways : i) by releasing three types of *Coccinelidae*, but it was not sufficient ; ii) by having an autumn action by keeping the nets closed to avoid that grey aphids come back to the orchard combined with two kaolin spraying and introducing two parasitoids against woolly aphids. In the second case, a biological control of the aphids could be achieved in one trial. Furthermore, other common pests like San José scale and leafrollers may increase in exclusion netting orchards.

  At Laimburg (Italy), after 8 years trials combining hail nets, single row with downside open or closed, the percentage of affected fruits at harvest is significantly reduced compared to the untreated control, but different from one case to another, with good results (≤ 2 %) and bad results (around 15 % and even 36 %).

  To help the pollinisation, bumblebees and wild bees are placed into the netted orchards.

  On cherries, to protect against *Drosophila suzukii*, the combination of exclusion nets and spinosad treatments reachs a 100 % control (Agroscope – Switzerland).

VIII. Plant resistance inducers

Extracts or chemical compounds inducing resistance are often referred to “plant activators”, “inducers” or, if derived from micro-organisms, “elicitors”. Classical inducers do not have a direct impact on pathogens, which clearly distinguishes them from fungicides. In France (INRA, Ctifl and other partners), a project called PEPS, was organised in three Work packages: 1) screening in lab by molecular analyses the plant resistance inducer potential of different compounds 2) evaluation of their performances in apple orchards when applied weekly on the scab primary contaminations or close to

harvest against Gloeosporium 3) study in controlled condition the factors affecting their efficacy. Two compounds, a K-phoshonate and foliar fertilizers gave interesting results on apple scab, but not on storage diseases. The problem is the number of applications and the amount of phosphonate residues on fruits. The next step will be to use these types of products depending of the pathogen risks.

IX. Semio-chemicals

To increase the efficacy of thrips chemical control, Pcfruit (Belgium) tested attractive additives. There are three types: 1) **gustatory stimulants** (stimulating feeding, making sprayed surface more preferred); 2) **attractants** (volatile compounds making olfactory orientation possible); 3) repellents (volatile compounds to discourage insects to come on the plant). In laboratory condition and field, a gustatory stimulant, increased efficacy of the chemical insecticide by 20 to 30 %.

On *Drosophila suzukii*, insecticides were improved with a feeding enhancer. The best was composed of Baker"s yeast and brown sugar.

In the UK, large field trials are going on, testing the combination of semio-chemicals to attract hoverflies. The name of the commercial predator lure is "Magipal".

X. Spray applications and environment protection

KOB (Germany) is partner of a BLE project, called Corona PRO. The aim of the project is to find a method to optimise the use of pesticides. Therefore, orchards are scanned by **drones** to record gaps in the orchard and the surface structure of individual tees. These data generate individual applications maps. In combination with computer controlled sprayers, these new technology could reduce the output of pesticides.

Because of the high water density in the region "Altes Land", Jork (Germany) is testing different sprayers to reduce drift. In case of a **tunnel sprayer** compared to an axial fan sprayer, the reduction of pesticides is up to 20 % due to the recycling technique. Furthermore, the double-row sprayers increase the performance by 30 %. But there are some negative points: the maximum height and row spacing is 3.7 m; it's not usable with hail nets or roofs; the time to set-up and clean is longer and finally the handling is more difficult, because of the big seize. However, growers must be convinced of the biological efficacy and the investment.

Wageningen (Netherland) is studying several ways to improve the applications of pesticides while reducing the emission of crop protection products and achieving a uniform crop coverage. The methods are: i) regulate wind speed and spray direction ii) blow and spray trees from both sides at the same time iii) adjust spraying liquid by nozzle position iv) the nozzle choice v) adapt spraying to crop vi) reduce spray volume. Despite large variation, there are significant differences between techniques and adjustments, but the performances of the sprayers will come from the adaption of our orchards to the sprayers.

XI. Systems approach where different techniques to reduce the use of pesticides are combined

In France, Ctifl coordinated a long term (6 years), multi-location and multi-factors apple orchards network. During the seasons, several techniques to reduce the use of pesticides were combined (ECOPHYTO modality) and compared to a reference system (called BASE). In terms of treatment frequency index reduction, to most important (> 75 % reduction) were obtained with resistant varieties combined with mating disruption or enclosure netting and the use of biological control insecticides and "alterntive" fungicides, or when treatment doses were adapted to the vegetation volume. On apple scab sensitive varieties, the most important reduction (> 50 %) was achieved with rain covers combined with mating disruption or Alt'Carpo nets. The adaption of treatment doses gave also good results. The "zero" residues were achieved with organic production systems (behalf cupper detection), scab resistance varieties with low codling moth pressure and

no storage diseases treatments, rain cover on Gala and Alt'Carpo (with a low codling moth pressure), and also systems with doses adjustments but without storage diseases treatments.

In 2016, started an **Interreg Project** "Residue – poor fruit production – model orchards for improvement of integrated crop protection. Kob (Germany) is leading the project and Agroscope (Switzerland) is one of the partners. The goal is the construction of demonstration orchards in which combinations of promising measures are studied. The project is running up until 2019.

List of action to reduce the use of pesticides and limit the risk to have residues on fruits and environment contaminations, presented in the scan reports (see Annex).

n°	EUFRUIT Partner	Fruit species	Pest & Diseases & other uses	Technology	Description	Short results
9	Laimburg	apples	pests	biodiversity		Gap : little knowledge about occurrence and biology of many natural predators
18	UoG	pomefruits	general	biodiversity	effects of pest control products on earwigs	Recommendation on insecticides which should be avoided
21	INRA	fruits	pests	biodiversity	multi-species hedgerows	Pear project (1995 - 2005): three main principales. 1) ban plants hosting quarantine or key pests and diseases of the orchard and surrounding crops. 2) selection of plants hosting a rich and/or abundant natural enemy complex. 3) provide natural enemies with habitat and food ressources (pollen, nectar, alternative prey) all year round
1	Aarhus University	apples	winter moths (Operophera brumata) & other caterpilllars	biological control	ants	Despite feeding the ants with sugar, increased aphid damage was seen.
2	Pcfruit	strawberry	thrips	biological control	entomopathogenic fungi	less repercussions on beneficial arthropods and fruit residues
2	Pcfruit	apples & pears	Fire Blight	biological control	bumble bees to transfer the BCO (entomovectoring)	Positive greenhouse results to establish BCO on flower stigma and flower bottom, but limited flower visitation in pears and apples. Attractant (mixture of terpenes) did not increase the visitation rates. Other idea : combine BCO spraying followed by BCO distribution with insects (bumble bees, honeybees, solitary bees)
2	Pcfruit	apples & pears	Fire Blight	biological control	apple & pear flower microbiomes	Aim: find candidate antagonists of Erwinia amylovora

2	Pcfruit	apples	storage diseases	biological control	by nebulization at postharvest	Computational fluid dynamics (CFD) model for the distribution of the biocontrol agent. Good results with this technique.
2	Pcfruit	strawberry	thrips	biological control	guidelines for the use of BCA on different climatic conditions	
2	Pcfruit	apple	aphids	biological control	banker plants & mass reared parasitoïds	inventory of orchards to get an overview on banker plants and the species that could be commercialized
2	Pcfruit	strawberry	thrips	biological control	predatory mites	preventive introduction to reduce the insecticide input
2	Pcfruit	pome & stone fruits	aphids	biological control	mass released parasitoids	Successful control of aphids, but depending on several factors (timing of starting the releases, aphid pressure, climate conditions).
8	Agroscope	pome fruits	scab, storage diseases	biological control	antagonistic yeast	Screening in laboratory condition: strong anatgonstic. Formulated test product. Field-testing: reduction of storage rot in combination with other fungicides.
18	UoG	cherries	spider mites	biological control	predatory mites	Predator introduction at a rate of one sachet per 5 trees seems to be a potential tool for spider mite control.
20	UNIBO	fruits	pests	biological control	Bacillus thuringiensis ; Serratia ; Pseudomonas entomophila ; Burkholderia ; Chromobacterium , Xenorhabdus ; Photorhabdus luminiscens / nemtodes ; Metarhizium anisopliae	Photorhabdus luminiscens has been successfully used to control Drosophila suzukii in cherry.

20	UNIBO	fruits	bacteria	biological control	cyclolipopeptides in Bacillus spp. ; phenolics in Pseudomonas fluorescens ; pseudopeptides in Pantoea agglomerans and vagans ; Trichoderma harzianum	Bacterial antagonists and lytic bacteriophages against Fire blight, Xantomonas, Pseudomonas. Lactic acid bacteria are very promising.
8	Agroscope	pome fruits	Fire Blight	biological control, natural substances	yeasts, acid clay (Mycosin), potassium aluminium sulphate (LMA)	2018 : the weather during bloom was highly favorable
4	Jork	apples	weeds	chemical strategy	soil active herbicides in winter or in spring on the tree strip / repeated in summer and after post-harvest	Aim: reduce the use of glyphosate and other herbicides. Costs evaluation.
1	Aarhus University	apples	scab	cultural practices	prophylaxis : triggering ascospores release from overwintering leaves	Up to 70 % of the spores were released during a dry period, but high water volumes were necessary. Different ways to apply the water (sprinkler, water wagon, …). Big droplets and 1,6 mm rain. 2-4 periods during spring. To small effect. 4-year study.
20	UNIBO	fruits	pests & diseases	cultural practices	irrigation, fertilization, use of bio-regulators, pruning, prophylaxis	Avoid all kind of excess. Example: Drosophila suzukii. Clean harvest strategies, fruit removal, edge rows management, use of consociation with soya bean inside the orchards.
2	Pcfruit	fruits		decision tools	warnings system for fruit growers and advisory organisations	infection risk of diseases like scab, powdery mildew or pests and phenological development
2	Pcfruit	apples & pears	wooly aphids & psylla	decision tools	earwig management tool & guidelines	Aim: to take into account the side effects of pesticides on earwigs population. Results: a reduction of pear sucker related residues on pears.

2	Pcfruit	cherries	Drosophila suzukii	decision tools	monitoring guidelines & phenology model	It reduces the amount of sprays when the pest is not yet present in the plot.
2	Pcfruit	pears	pear psylla	decision tools	phenology of the pest and beneficial arthropods	Used for an improved warning system and advice in the extension service. Transfer to growers.
2	Pcfruit	apples	scab	decision tools	technique to determine the potential ascospore inoculum for an orchard at the beginning of the seazon	better organization of the treatments
2	Pcfruit	apples	scab	decision tools	technique to follow up the ascopore relaese in an orcahrd	This may be helpful to determine the star and the end of the ascospore season and can lead to reduce the treatments at the beginning and at the end of the scab ascopore season.
2	Pcfruit	strawberry	Botrytis, Powdery mildew	decision tools	models	ongoing research
2	Pcfruit	strawberry	pests	decision tools	guidelines for monitoring	Thresholds, identification help, methodology. Knowledge of the population size and phenology, leads to optimized treatments.
2	Pcfruit	strawberry	thrips	decision tools	guidelines for curative sprays	Situation when the crop system is less favorable for predatory mite introductionor when the control by predatory mites is insufficient
7	IRTA	fruits	general	decision tools	DOSA3D	Calculates the dose taking into account the tree dimensions and the leaf density. System for treatment management.

8	Agroscope	pome & stone fruits	general	decision tools	webpages with disease and pest modeling and monitoring information	For example: apple scab, pest monitoring data, crop stage data, insect pest forecasting, fire blight forecasting)
2	Pcfruit	pears	Fire Blight	detection	drones	Only 52-54 % accuracy.
8	Agroscope	apples	???	genetics	varieties	trials done under a standard IP plant protection strategy and a low input strategy with reduced use of synthetic pesticides
9	Laimburg	apples	scab	genetics	varieties & rootstocks	Challenges in research for Organic Farming (OF). Problem with resistant varieties: other diseases become prominent, resistance breakdown.
4	Jork	apples	scab	natural substances	ion salt form of pelargonic acid	greenhouse experiments and open field
9	Laimburg	apples	apple sawfly	natural substances	Quassia amara extracts	
9	Laimburg	fruits	general	natural substances	natural and naturally derived substances	
10	Bucharest	apples	scab & powdery mildew	natural substances	potassium bicarbonate	Aim: reduce the use of copper, complete the Sulphur treatments. Results of a 3 years trial (2014-2016): potassium bicarbonate + sulphur = potassium bicarbonate + potassium silicate. No symptoms of phytotoxicity.

12	Lithuania	fruits	general	natural substances	plants	They are a valuable source of bioactive compounds: terpenes, phenolic compounds, essential oils, alkoloids. Obtained by extraction process. Results from a study in laboratory conditions : Thymus vulgaris, Coriandrum sativum essential oils / Alternaria ssp., F. graminearum.
5	Wageningen	apples	apple sawfly	physical method	plastic white traps	
4	Jork	apples	weeds	physical method	hot water treatment (98°C)	high costs
9	Laimburg	apples	storage diseases	physical method	hot water treatment	
19	KOB	fruits	weeds	physical method	hot water treatment (98°C)	technialy (water quantity and time) and economically not satisfaying. New topic: hot steam.
4	Jork	apples	weeds	physical method	mechanical weeding (roll hoe, Naturagriff, Krümler Ladurner Modell 7)	Important points: work on the tree interspace, speed, massive weed infestation, wet soil conditions.
7	IRTA	fruits	weeds	physical method	mechanical weeding	Alternative methods applicable in conventional and organic orchards.
8	Agroscope	fruits	weeds	physical method	mechanical weeding	Becoming more and more important in integrated production, due to political pressure on herbicides such as glyphosate.
8	Agroscope	apples	thinning	physical method	mechanical thinning	Used by organic farmers.
9	Laimburg	apples	weeds	physical method	tilling & mulching	Tillage in spring (nitrogen mobilization), a light cover of the tree row with the cut vegetation, new machinery that removes weeds by brushing
9	Laimburg	apples	thinning	physical method	mechanical thinning	
1	Aarhus University	pears	scab	physical method	rain roofs (1,6 m large)	Reduced light levels (30 %), but no detrimental effects on yield, fruit size, color and fruit quality. 3 years study.
2	Pcfruit	small fruits & cherries + grapes	Drosophila suzukii	physical method	nets (whole plots or individual rows)	Reduces the amount of sprays to nearly zero

3	Ctifl	apples	scab	physical method	rain roofs (Filpack and Voen)	Efficacy against scab, but incidence on yield. Irrigation must be adopted. Development of powdery mildew.
5	Wageningen	apples	scab	physical method	retractable rain roofs	New project in the Netherland.
7	IRTA	fruits	pests	physical method	exclusion nets	Avoid damages of codling moth, leafrollers, and Mediterranean fly. Promote biological control against aphids. Against also Halyomorpha halys.
8	Agroscope	cherries	Drosophila suzukii	physical method	exclusion nets	Until 2015, rarely implemented because of jugh costs. Now used in combination with spinosad to reach 100 % control.
8	Agroscope	pome fruits	codling moth	physical method	exclusion nets	Only used by pioneer farmers. Bumble bees and wild bees are placed to ensure pollination.
9	Laimburg	apples	scab	physical method	rain roofs	Agronomic + carbon footprint
9	Laimburg	apples	codling moth	physical method	exclusion nets	Agronomic + carbon footprint
20	UNIBO	fruits	pests & diseases	physical method	plastic tunnel & nets	Incidences on microclimate inside orchards (t°, relative humidity, light quality and intensity, leaf wetness), but also on plant development, physiological response of the plant against pests and diseases, and on the pathogen virulence. Successful practical applications: pear / codling moth; stone fruits / Drosophila; apple, pears, stone fruits / Halyommorpha alays; kiwifruit / Pseudomonas syringae pv. actinidae.
3	Ctifl	apples	scab, storage diseases	Plant resistance inducers	elicitors	Large lab screening. 5 elicitors. Phosphonates gave the best results in orchards. High residues level. Interesting under rain roofs to reduce apple scab pressure.
2	Pcfruit	strawberry	thrips	Semio-chemicals	attractive additivies	higher spray efficacy and less applications
2	Pcfruit	cherries	Drosophila suzukii	Semio-chemicals	attractive additivies/baits	Insecticide efficacy can be significantly increased by adding additives.

2	Pcfruit	cherries	Drosophila suzukii	Semio-chemicals	attractive additivies/baits	Is it possible to reduce the insecticide dose?
2	Pcfruit	cherries	Drosophila suzukii	Semio-chemicals	attractive additivies/baits	Is it possible to practice "Attract and kill"?
8	Agroscope	pome fruits	codling moth	Semio-chemicals	mating disruption	50 % of the apple growers of the Lake of Constance area. The combination of mating disruption and granulosis virus is used by 10 % of the organic producers.
18	UoG	pomefruits	general	Semio-chemicals	attractant for beneficial insects	A combination of semiochemicals to attract hoverflies. A commercial predator lure "Magipal".
19	KOB	apples	general	spray application	drone to pilote application	BLE-Project: Corona PRO. Model and demonstration orchards to reduce the application of pesticides. Orchards are scanned by drones. Gaps are recorded and serve to generate individual applications maps; Combination with computer controlled sprayers.
2	Pcfruit	fruits	general	spray application	movable wall to check the accuracy of the sprayer	In 2017, only 1 sprayer of 160 tested was correct.
2	Pcfruit	fruits	general	spray application	EVA app to plan the applications and set up the spraying schedule	155 growers in 2017; 135 in 2018. Pcfruit = technical assistance
4	Jork	apples	general	spray application	tunnel technique	Significant pesticide saving and drift reduction. More investigation is needed for the equipment.
5	Wageningen	fruits	general	spray application	performances	Aim: reduce the emission of crop protection products. Achieve a uniform crop coverage. Method : crop dependent spraying based on crop volume or crop row volume dosage + adjusting spray parameters such as air speed and nozzle type
2	Pcfruit	cherries	Drosophila suzukii	system approach (combination of methods)	mass trapping ; repellents and deterrents ; Push and Pull	Goal : no insecticides

2	Pcfruit	apples, pears, strawberry	general	system approach (combination of methods)	treatment schedule + different findings to achieve the "zero residues" level	Treatment schedule are based on larger preharvest interval to avoid residues.
3	Ctifl	apples	general	system approach (combination of methods)	scab management, models, prophylaxis, biocontrol products, exlusing nets, biodiversity	6 years national project.
4	Jork	apples	root sucker	system approach (combination of methods)	pelargonic acid (8 %) in summer combined to post-harvest glyphosate application or mechanical weed management	Aim : alternatives to glufosinate
8	Agroscope	apples	general	system approach (combination of methods)	residue-poor fruit production (apples, cherries, pears)	Agroscope long-terme trial: adapt fungal diseases strategies, insect exclusion netting, mating disruption, mulching leaves to reduce scab inoculum, modern storage techniques. The low-residue strategy is not profitable without a price premium compared to integrated production.
8	Agroscope	cherries	Pseudomonas	system approach (combination of methods)	acid clay, white stem painting and summer pruning	New trial.
9	Laimburg	apples	codling moth	system approach (combination of methods)	mating disruption ; granolosis virus ; entomophagous nematodes	
9	Laimburg	apples	scab	system approach (combination of methods)	less susceptible varieties, reduction of ascospore concentraton, organic farming products	Copper, sulphur, lime sulphur, carbonates & forecasting models. But copper accumulates in the soils.

18	UoG	cherries	Drosophila suzukii	system approach (combination of methods)	dry bait ; entompathogenic fungi : repellents and oviposition deterrents ; push pull	
19	KOB		general	system approach (combination of methods)	nets, roofs	Project (december 2015 to december 2019) : 2 ha model orchard.
19	KOB	cherries	Drosophila suzukii	system approach (combination of methods)	Alternative methods to insecticides	A three-component strategy seems to be the best: insects, nets, hygiene and insecticides.

Summary for EIP dissemination

Project title: **EUFRUIT: European Fruit Network**

Keywords: Fruits, pesticide residues, alternative products and techniques, environmental friendly crop production

Summary:

The synthesis report 2018 of WP3 provides information from 14 European institutes, partner of the EUFRUIT project and members of the EUFRIN WG "Sustainable fruit production to minimize residues", on on-going research and practices to reduce the use of pesticides and limit the risk to have residues on fruits and in the environment.

The choice has been made to illustrate the state of the art by examples on several topics like:

- Biodiversity – how to preserve beneficial insects and how to provide natural enemies with habitat and food
- Biological control like entomopathogenic fungi, predatory mites, antagonistic yeasts, microorganisms, peptides
- Chemical strategies to reduce the use of pesticides
- Cultural practices
- Decision tools
- Genetics
- Natural substances
- Physical methods to control weeds, but also to protect against fungi and insects with hot water, rain covers and nets, or to regulate yield by mechanical thinning
- Plant resistance inducers (PRI)
- Semio-chemicals
- Innovative spray applications to protect environment
- A system approach where different techniques are combined to reduce pesticides,

The first part of the report is a selection of presentation discussed during the IEG meeting. The annex provides all the scan documents written by the project partners, where more details on a specific technique or strategy can be find.

The goal is to share knowledge coming from research and to analyse what is already used in practice by the growers and technicians, what are the hurdles to develop it on a larger scale, what can be communicate to the whole food chain, what is acceptable by the growers and the society. Furthermore the synthesis reports aims to point out where gaps exist and where more research is needed.

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2. Dissemination catalogue of planned and executed activities 2016-2019

Activity types	Executed 01-03-2016 – 01-06-2018		Additionally planned the 3. year up to 28-02-2019
	No. activities	No. participants	No. activities
A. Participation in…			
A1: Dialogue meeting (Policy)	FRESHFEL:1	*Total:* *Female:* *Male:*	
A2: EIP-AGRI conference or workshop	OVA: 1	*Total:* *Female:* *Male:*	
A3: Scientific conference	AU: 1, PCFRUIT: 11, IRTA: 2, AGROSCOPE: 6, LAIMBURG: 18, LRCAF: 7, UNIBO: 7	*Total: 3.880* *Female:* *Male:*	
A4: Industry event or exhibit	OVA: 7, LAIMBURG: 2, LRCAF: 1	*Total: 58.256* *Female: 25.000* *Male: 25.000*	OVA: 2, USAMV: 1
A5: Other stakeholder meeting	PCFRUIT: 1, OVA: 5, IRTA: 22, LAIMBURG: 3, LRCAF: 2, UNIBO: 2, INRA: 1	*Total: 2.054* *Female: 24* *Male: 21*	OVA: 1, IRTA: 2
A6: Event aimed at general public	LRCAF: 1, UoG:1	*Total:105* *Female:73* *Male:32*	
B. Organising/holding…			
B1: Seminar/lecture-based workshops	AU: 4, PCFRUIT: 3, CTIFL: 2, IRTA: 1, AGROSCOPE: 1, LAIMBURG: 38, USAMV: 1, LRCAF: 5, UoG:1, UNIBO: 3, INRA: 6	*Total: 1.468* *Female: 170* *Male: 241*	AU: 1, IRTA: 1
B2: Field-based workshops	AU: 1, PCFRUIT: 1, OVA: 1, WR: 3, IRTA: 1 UHOH/KOB: 20	*Total: 294* *Female:48* *Male:166*	OVA: 1
B3: Open demonstration day	AU: 1, PCFRUIT: 11, OVA: 5, WR: 2, IRTA: 4, AGROSCOPE: 6 USAMV: 6, UHOH/KOB: 1, UNIBO: 1	*Total: 6.553* *Female: 105* *Male: 258*	AU: 1, PCFRUIT: 3, OVA: 1, WR: 1, AGROSCOPE: 2 USAMV: 3, UHOH/KOB: 3
B4: Field visit	CTIFL: 2, OVA: 5, IRTA: 2, LAIMBURG: 13, UNIBO: 1	*Total:865* *Female: 95* *Male: 1.350*	OVA: 1, LAIMBURG: 1, UHOH/KOB: 1

B5: Industry group meeting/event	PCFRUIT: 2, USAMV: 1, LRCAF: 1, FRESHFEL: 2, UNIBO: 5	*Total: 1.039* *Female: 158* *Male: 570*	UHOH: 1
B6: Other stakeholder meeting/event	PCFRUIT: 2, CTIFL: 1, OVA: 5, IRTA: 3, AGROSCOPE: 2, INRA: 1	*Total: 833* *Female: 177* *Male: 454*	CTIFL: 3, IRTA: 1, UHOH/KOB: 1
B7: event aimed at general public	AGROSCOPE: 2	*Total:50* *Female:15* *Male:35*	AGROSCOPE: 1
C. Publication of…			
C1: EIP-AGRI practitioner abstract / scanning report	AU: 1, OVA: 1, CTIFL: 3, AGROSCOPE: 3, LAIMBURG: 2, USAMV: 2, LRCAF: 1		AGROSCOPE: 1, USAMV: 1
C2: Technical bulletin/guideline	LAIMBURG: 1, LRCAF:1	*Total:100* *Female:* *Male:*	
C3: Flyer/leaflet			WR**:** 1 INRA: 1
C4: Newsletter	FRESHFEL: 9, UHOH/KOB: 1	*Total: 7.000* *Female:* *Male:*	FRESHFEL: 3
C5: Book/booklet/chapter	OVA: 2, LAIMBURG: 1		OVA:1
C6: Audio/video content			
C7: IEG Synthesis report	CTIFL: 3		
D. Publication in…			
D1: Scientific journal (peer review)	LAIMBURG: 2		
D2: Technical journal	AU: 2, CTIFL: 3, OVA: 1, IRTA: 1, AGROSCOPE: 9, LAIMBURG: 9		CTIFL: 1

D3: Industry journal/magazine	OVA: 8	OVA: 1
D4: Other stakeholder journal/magazine	LAIMBURG: 1	
D5: Journal/magazine aimed at general public	LAIMBURG: 1, LRCAF: 2	
E. Final project conference		
E1: Participation with presentation (oral)		
E2: Participation with presentation (poster)		
E3: Other material		

Annex – WP3 Scanning reports 2018

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **EU FRUIT europæisk netværk**

***Project title (English):** **EUFRUIT: European Fruit Network**

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Section A. Summary for EIP dissemination

***Keywords:** [keywords describing project and scanning report]

***Main geographical location:** [[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]

Other geographical locations: [copy other NUTS 3 region from section C, below, 'NUTS 3 region(s)']

***Summary (native language):**

Alternativer til sprøjtning i økologisk produktion af æbler og pærer

Økologisk produktion er for mange forbrugere synonym med usprøjtet produktion. Det er imidlertid ikke tilfældet for økologisk produktion af høj-værdig afgrøder som fx æble og pære. Begge er mangeårige, og det giver skadevoldere gode vilkår for opformering, samtidig er vækstsæsonen lang, og kravene til frugternes kosmetiske udseende høj. Alt dette nødvendiggør sprøjtning imod både svampesygdomme og insekter. For at bringe den økologiske produktion mere i overensstemmelse med forbrugernes forventninger, arbejdes der på at udvikle alternativer, som kan reducere eller helt overflødiggøre sprøjtning. Overdækning med et plastik regntag er en sådan foranstaltning. Ved Institut for Fødevarer, AU har vi tidligere vist at et regntag er effektivt til at forhindre angreb af skurv, der er den alvorligste sygdom på æble, og den der hyppigst sprøjtes imod. I nye forsøg har samme reducerende effekt på skurv i pærer kunne dokumenteres og det åbner mulighed for en økologisk pærer produktion. Trods skyggeeffekt af regntaget, har der ikke kunne påvises negative konsekvenser for hverken udbytte, frugtstørrelse eller frugtkvalitet.

Ved AU-BIOS er det undersøgt om myrer kan bruges til bekæmpelse af frostmålere og andre larver i æbler. Tilstedeværelsen af myre førte til forøget forekomst af bladlus. Det blev observeret at myrerne brugte svampe som fødekilde og det kan have potentiel interesse, hvis myrenes beskyttelse af bladlus kan bringes under kontrol ved at tilbyde supplerende sukker.

Ved KU har man i et 4 årigt projekt arbejdet med at fremprovokere sporeudslyngning af skurvsvampens sporer i tørre perioder, hvor en infektion ikke kan finde sted. På trods af at op imod 70% af sporerne kan bringes til udslyngning har der ikke kunne konstateres reduceret skurvangreb, og metoden er også så vand krævende at den ikke skønnes brugbar i praksis.

Summary (english):

Organic production is for many consumers equal to unsprayed production. When it comes to high-value crops like fruit in particular pome fruits, this is not the case. Pome fruit are a stationary, long-lived culture with high demands for blemish-free fruit which necessitates spraying. In order to reduce spraying and bring organic production more in line with consumer expectancies alternative strategies are investigated. Covered production using a plastic rain roof is one such strategy. At AU-FOOD we have previously documented that rain roofs are highly efficient in reducing scab and rots in apple. A recent three-year study document the same effect in scab susceptible pears. Despite reduced light levels under the roof, no detrimental effects on neither yield, fruit size, fruit colour nor internal quality of fruit could be documented.

At AU-BIOS ants have been tested as biological control agent of winter moths, but despite feeding the ants with sugar, increased aphid damage was seen. The ants, however, used fungus an alternate food source, which could hold potential for further investigation.

Experiments Copenhagen University aimed at triggering ascospore release of the scab fungus during dry spells where infection cannot take place proved unsuccessful. Up to 70% of spores were released, but high water volumes were necessary and the effect was too small to warrant the costs.

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Etablere et europæisk netværk med fokus på frugtsektoren
2. Udvikle og implementere en systematisk fremgangsmetode til at scanne og syntetisere eksisterende videnskabelig og praktisk viden til gavn for frugtsektoren i Europa
3. Løbende dialog med faglige politiske miljøer i EU-kommissionen, nationalt og regionalt
4. Identificere og støtte op om nye forskningsområder ved vedvarende afdækning og analysering af eksisterende og kommende forsknings- og innovationsaktiviteter.

Project Objectives (English):

1. Establish a European network focused on the fruit sector.

2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

1. Aarhus University, Department of Food Science (Denmark) • AU
2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL
4. Obstbauversuchsanstalt Jork (Germany) • OVA
5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA
8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
10. University of Agronomic Sciences and Veterinary Medicine of Bucharest (Romania) • USAMV
11. National Agricultural Research and Innovation Centre Fruitculture Research Institute (Hungary) • NARIC
12. Lithuanian Research Centre for Agriculture and Forestry (Lithuania) • LRCAF
13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
14. Variety Innovation Consortium South Tyrol (Italy) • SKST
15. Freshfel Europe (Belgium) • FRESHFEL
16. Elbe-Obst Erzeugerorganisation r.V. (Germany) • EO
17. Fruitconsult BV (Netherlands) • FC
18. University of Greenwich (United Kingdom) • UoG
19. University of Hohenheim (Germany) • UHOH
20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
Marianne Bertelsen, AU

Author: Marianne Bertelsen, Senior Scientist, Department of Food, Aarhus University (AU)
Tel.: +45 87158328 Email: marianne.bertelsen@food.au.dk

Country: Denmark

NUTS 3 region(s)[2]: [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: WP3 – Reduction in pesticides residues

Date: 10-5-2017

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Source materials and methodology

Consultations with colleagues at Aarhus University, Dept. Food Science to identify staff involved in research on relevant topics. The collection of publications and disseminations from the last approximately one year to provide a start for the state of art. The personal database over publications/disseminations (PURE database) for each scientist was used as basis.

Best practice findings

Alternatives to chemicals

Physical barriers update

The apple production in Denmark constitutes about 1400 ha, of which app. 20% is grown with organically. However, due to low yields in the organic production less than 10% of the apples sold are of organic origin. The main obstacles for the organic production are losses due to fungal disease, particular apple scab and fruit rots, but also insects are detrimental to production. The small acreage combined with restrictive environmental regulations limits the number of compounds available for pest management in the Danish organic apple production. Hence research has focused on alternative strategies. Also from a political point of view the organic movement is encouraging research into alternative solutions in order to bring the organic production in line with what the consumers perceives as organic, namely 'unsprayed'.

Since 2012, experiments have been conducted with protected production of apples and since 2015 with pears. At the end of 2017 the results of the three-year study of pears trees covered by a narrow rain roof (1.6 m) can be evaluated. Pear scab in the experiments was initially slow to develop, but in the third experimental year 75% of unsprayed pears of the scab-susceptible cultivar 'Clara Frijs' had to be discarded due to scab, whereas only 1% of the likewise unsprayed, but covered pears were discarded. The pear varieties 'Alexander Lucas' and 'Concorde' were also tested under cover, but due to their higher tolerance against scab the results were not as striking. In apples, the cover had a profound effect on reducing fruit rots, but in pear no significant effect was found due to a general low rot incidence in all three experimental years. Internal fruit quality was little affected by the cover, but in years of large crop load fruit size was marginally smaller under cover. Light measurements documented that although light was reduced by up to 30% on days with high light intensity, the effect of photosynthesis was not as detrimental as expected. Trees received more diffuse light, and responded by producing more efficient shade leaves. Trees were less stressed during under the hot mid-day sun causing the mid-day depression of the photosynthesis to be less under the covered trees. Microclimate was not significantly affected by the cover due to the construction of the cover, which include flaps that can open during wind, and less than half of the orchard area being covered.

Bio-control using ants

At AU-BIOS a pilot study has been conducted to explore the potential of using ants as an IPM-tool to reduce pest insects and plant diseases in Danish fruit production. Apples was used as model crop and the primary target were winter moths and other caterpillars. Ants were offered a sugar solution to divert them from milking and protecting aphids. The results showed some predation on larvae but also a significant increase in aphid population. An interesting side effect was ant predation on scab, and monilia may also be used as a food source by the ants. This could be of potential interest if the sugar solution offered can be optimized to deter the ants from cultivating aphids.

Triggering ascospore release

At Copenhagen University a four year study of the possibility of triggering ascospore release from scab infections in overwintering leaves have been studied. Several methods involving sprinkler spraying, sound as well as broad scale watering (using a water wagon) was applied to trigger the ascospore release during dry periods in the primary scab season where a subsequent infection could not take place. The study showed that big droplets and 1.6 mm 'rain' were needed for a sufficient spore release. It was possible in all years to identify 2-4 periods during spring with sufficient stable weather to run the risk of triggering spore release without getting an infection. Spore traps documented a spore release of up to 70% of the mature spores in response to broad scale watering, but it was not possible to document a significant reduction in scab occurrence in 7 out of 8 experiments. It was concluded that the method was not practical applicable due to the large amounts of water needed and the insignificant effect.

The study used the RIMPRO scab warning program to estimate the risk of scab infections, and a good correlation between actual and predicted spore release dates were found. The predicted amount of spores released, however, did not show a good correlation with actual spore release.

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **Europees netwerk rond fruit**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** Dr. Wendy Van Hemelrijck , pcfruit, wendy.vanhemelrijck@pcfruit.be; +32(0)11/69.70.20

Dr. Dany Bylemans, pcfruit, dany.bylemans@pcfruit.be

Section A. Summary for EIP dissemination

***Keywords:** nebulization, postharvest, bumble bee vector, BCO

***Main geographical location:** BE221 (Hasselt)

Other geographical locations: BE242 (Leuven), BE334 (Waremme-Borgworm), BE223 (Tongeren), BE236 (Sint-Niklaas), BE256 (Arr. Roeselare), BE253 (Ieper), BE211 (Arrondissement. Antwerpen)

***Summary (native language):**

Onderzoek is lopende omtrent biologische controle van bacterievuur, luizen en bewaarziekten bij appel en peer. Ter bestrijding van bacterievuur is onderzoek lopende om hommels als vector te gebruiken om biologische controle organismen van bacterievuur in de bloemen af te zetten. Voor de bestrijding van de bewaarziekte is onderzoek lopende waarbij biologische controle organismen worden verneveld in koelcellen. Voor beide onderzoeken is nog verder onderzoek nodig om het volledige potentieel hiervan te bepalen.

Summary (english):

[space for optional translation of the native language short summary of scanning report to English]

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant,

NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Oprichten van een Europees netwerk rond fruit
2. Ontwikkelen en implementeren van een methode om lopend onderzoek en praktijkervaring te scannen en te niveleren
3. Houden van een dialoog met relevante gezaghebbers op regional, nationaal en Europees niveau
4. Exploreren van nieuwe topics in onderzoek door het uitvoeren van een survey naar reeds opgedane kennis en lopend onderzoek omtrent nieuwe innovaties.

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

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2. Research Station for Fruit npo (Belgium) • Pcfruit
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4. Obstbauversuchsanstalt Jork (Germany) • OVA
5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA
8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
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17. Fruitconsult BV (Netherlands) • FC
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20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
[Van Hemelrijck, pcfruit]

Author: Dr. Wendy Van Hemelrijck , pcfruit, wendy.vanhemelrijck@pcfruit.be; +32(0)11/69.70.20

Country: Belgium

NUTS 3 region(s)[2]: BE221 (Hasselt)

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

Date: 17-04-2018

Source materials and methodology

Underneath the source materials are listed. Most of the fruit research for integrated farming is done by pcfruit so all the source

Dekeyser, Donald; Vanwalleghem, T; Ambaw, A.; Verboven, P.; Van Hemelrijck, W.; Nuyttens, D. (2016). Evaluation of fogging devices for BCO application in fruit cold storage rooms. Communications in Agricultural and Applied Biological Sciences: 68th International Symposium on Crop Protection. Vol. 81 3. ed. 2016. blz. 470.

Vanwalleghem, Tanja; Dekeyser, Donald; Nuyttens, David; Tsige, Alex; Verboven, Pieter; Van Hemelrijck, Wendy; Bylemans, Danny (2016). Influence of additives on the efficiency of biological control organisms against storage diseases. Ecofruit: Proceedings of the 17th International Conference on Organic Fruit-Growing, Vol. 17, 2016, blz. 180-183.

Vanwalleghem, Tanja; Dekeyser, Donald; Nuyttens, David; Tsige, Alex; Verboven, Pieter; Van Hemelrijck, Wendy; Bylemans, Danny (2016). Vaporization of biological control organisms in cold storage rooms to control postharvest diseases. Acta Hort. 1144, 121-127.

Clymans, R., Trekels, H., Boonen, M., Craeye, S., Hanssens, J., Smagghe, G., Vervoort, M., Melis, P., Bylemans, D., Belien, T. (2016). Matching commercial thrips predating phytoseids with the highly diversified climate conditions of different strawberry production systems. Acta Hortic. In Press.

Jaarverslag pcfruit 2016 en 2017..

Remy S., Smessaert J., Claes M., Pisman M., Cottyn B., Schoofs H., Maes M., Smagghe G., Keulemans W., Honnay O., Deckers T. And Bylemans D. (2017). Biocontrol to protect apple and pear flowers against fire blight using bumblebees. Comm. Appl. Biol. Sci., Ghent University, 82/3: 311-319.

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Alhmedi A, Belien T, Raymaekers S, Bylemans D, Tomanovic Z, (2017). Food web structure of aphids and their parasitoids in Belgian fruit agroecosystems. Entomological Science, accepted. DOI:10.1111/ens.12303

Belien, T., Bangels, E., Brenard, N., Reijniers, J., Leirs, H., Bylemans, D. (2017). Optimized timing of IPM treatments against pear Psylla (*Cacopsylla pyri*) based on a temperature driven population dynamics model. IOBC-WPRS bulletin 123: 96-100.

Clymans, R., Trekels, H., Boonen, M., Craeye, S., Hanssens, J., Smagghe, G., Vervoort, M., Melis, P., Bylemans, D., Belien, T. (2017). Matching commercial thrips predating phytoseids with the highly diversified climate conditions of different strawberry production systems. Acta Hortic. 1156, 863-870. DOI: 10.17660/ActaHortic.2017.1156.127.

Goffin J., Gallace N., Berkvens N., Casteels H., De Ro M., Bylemans D. and Belien T. (2017). Toxicity of erythritol, a sugar alcohol and food additive to *Drosophila suzukii* (Matsumara). Acta Hortic. 1156: 843-848. DOI: 10.17660/ActaHortic.2017.1156.124.

[1] Equivalent to 'final report' in EIP-AGRI format.

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

Vervoort, M., Melis, P., Hanssens, J., Craeye S., Pisman, M., Smagghe, G., Clymans, R., Belien, T. (2017) Thrips control with predatory mites *A. limonicus* and *A. Swirskii* in different strawberry cultivation systems. Acta Hortic. 1156: 833-842. DOI10.17660/ActaHortic.2017.1156.123.

Clymans, R., Bangels, E., Boonen, M., Bylemans, D., Vervoort, M., Melis, P., Craeye, S., Hanssens, J., Pisman, M., Smagghe, G., Belien, T. (2017). Entomopathogenic fungi in the control of thrips in strawberry. Poster at the 3rd International Strawberry Congress, September 6-8, Antwerp.

Best practice findings

Topics ongoing research:

Together with its project partners University of Ghent, University of Leuven and Flanders Research Institute for Agriculture, Fisheries and Food, the Fruit Research Station pcfruit is investigating the potential of bumble bees to transfer biocontrol organisms (BCOs) in apple and pear flowers for protection against fire blight (*Erwinia amylovora*) infection (i.e. entomovectoring). Greenhouse results showed the potential of several existing BCOs including their ability to establish themselves on the flower stigma and hypanthium (flower bottom) and to suppress fire blight symptoms, but the absent and limited flower visitation in pear ('Conference') and apple ('Jonagold'), respectively, require research in alternative approaches. The use of an attractant containing a mixture of several terpenes proved unsuccessfull to increase the bumble bee flower visitation rates, which was confirmed by the low number of colony forming units of BCO per flower following entomovectoring in the orchard. An alternative strategy which consists of a BCO spaying at the beginning of bloom follwed by secondary distribution of the the BCO by flower visiting insects is under investigation. Bumble bees, honeybees as well as solitary bees are introduced to support this secondary BCO dispersal. Within the same project, apple and pear flower microbiomes are also studied to identify, characterise and test new, candidate antagonists of *Erwinia amylovora*. Research is focusing both on existing BCO products (*Aureobasidium pullulans*) as well as new candidates (*Bacillus subtilis* specific strain, *Pantoea agglomerans* experimental strain, *Paenibacillus sp.* experimental strain, *Pseudomonas sp experimental* strain).

Towards the control of storage diseases research was done to apply biological control agents by nebulisation as postharvest treatment in the cold storage rooms. A computational fluid dynamics (CFD) model for the distribution of the biocontrol agent can be developed for this application based on the dimensions of the cold storage room. The research pointed out that biocontrol agents can be applied by this technique. Some further optimalisation is still needed for a more optimal distribution of the biocintrol agent in the storage room and the paloxes.The tested BCO are *Aureobasidium pullulans* and *Metschnikowia fructicola.*

For thrips in strawberries guidelines on suitability of biological control agents (BCA's) (both arthropod predators and entomopathogens) for different climatic conditions are build up.

In pome and stone fruit parasitoid communities and their interactions with aphids are investigated with the aim of reaching an efficient biological control of pest aphids. Field trials with mass released parasitoids have been executed. Succesfull control of aphids was achieved, but was depending on several factors including the timing of starting of the releases (preventive, targeting the aphid stem mothers), the aphid pressure and the climatological conditions (warm spring conditions of Southern Europe turned out to be more suitable for this strategy).

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **Europees netwerk rond fruit**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** Dr. Wendy Van Hemelrijck , pcfruit, wendy.vanhemelrijck@pcfruit.be; +32(0)11/69.70.20

Dr. Dany Bylemans, pcfruit, dany.bylemans@pcfruit.be

Section A. Summary for EIP dissemination

***Keywords:** Drosophila, Attract and Kill, orchard of future

***Main geographical location:** BE221 (Hasselt)

Other geographical locations: BE242 (Leuven), BE334 (Waremme-Borgworm), BE223 (Tongeren), BE236 (Sint-Niklaas), BE256 (Arr. Roeselare), BE253 (Ieper), BE211 (Arrondissement. Antwerpen)

***Summary (native language):**

Om de aanwezige residu's op het fruit te beperken wordt onderzoek uitgevoerd naar de geschikte toepassingsmomenten voor gewasbeschermingsmiddelen in de levenscyclus van plagen en ziekten. Daarnaast worden alle onderzoeksresultaten die leiden tot een verminderd gebruik van gewasbeschermingsmiddelen toegepast in de percelen van de toekomst bij appel, peer en aardbei met als doel het uiteindelijke residu op de vruchten zo laag mogelijk te houden.

Summary (english):

[space for optional translation of the native language short summary of scanning report to English]

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant,

NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Oprichten van een Europees netwerk rond fruit
2. Ontwikkelen en implementeren van een methode om lopend onderzoek en praktijkervaring te scannen en te niveleren
3. Houden van een dialoog met relevante gezaghebbers op regional, nationaal en Europees niveau
4. Exploreren van nieuwe topics in onderzoek door het uitvoeren van een survey naar reeds opgedane kennis en lopend onderzoek omtrent nieuwe innovaties.

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

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2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL
4. Obstbauversuchsanstalt Jork (Germany) • OVA
5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA
8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
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12. Lithuanian Research Centre for Agriculture and Forestry (Lithuania) • LRCAF
13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
14. Variety Innovation Consortium South Tyrol (Italy) • SKST
15. Freshfel Europe (Belgium) • FRESHFEL
16. Elbe-Obst Erzeugerorganisation r.V. (Germany) • EO
17. Fruitconsult BV (Netherlands) • FC
18. University of Greenwich (United Kingdom) • UoG
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20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
[Van Hemelrijck, pcfruit]

Author: Dr. Wendy Van Hemelrijck , pcfruit, wendy.vanhemelrijck@pcfruit.be; +32(0)11/69.70.20

Country: Belgium

NUTS 3 region(s)[2]: BE221 (Hasselt)

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

Date: 18-04-2018

Source materials and methodology

Underneath the source materials are listed. Most of the fruit research for integrated farming is done by pcfruit so all the source material is related to this research institute and their partners in these research topics:

Clymans, R., Bangels, E., Boonen, M., Bylemans, D., Vervoort, M., Melis, P., Craeye, S., Hanssens, J., Pisman, M., Smagghe, G., Belien, T. (2016). Increasing efficacy of thrips chemical control with attractive additives in strawberry. Proceedings of IOBC-WPRS Working Group "Integrated Plant Protection in Fruit Crops", Thessaloniki 04-08/09/2016. In Press.

Clymans, R., Trekels, H., Boonen, M., Craeye, S., Hanssens, J., Smagghe, G., Vervoort, M., Melis, P., Bylemans, D., Belien, T. (2016). Assessing the suitability of commercial thrips predatory mites for different strawberry production systems. Proceedings of IOBC-WPRS Working Group "Integrated Plant Protection in Fruit Crops", Thessaloniki 04-08/09/2016. In Press.

Clymans, R., Trekels, H., Boonen, M., Craeye, S., Hanssens, J., Smagghe, G., Vervoort, M., Melis, P., Bylemans, D., Belien, T. (2016). Matching commercial thrips predating phytoseids with the highly diversified climatic conditions of different strawberry production systems. Poster at 8th international Strawberry symposium, 13-17/08/2016, Québec, Canada.

S. Croes, T. Vanwalleghem, A. Ceustermans, S. Torfs, W. Keulemans, K. Heungens, W. Van Hemelrijck, V. Philion and D. Bylemans (2016). Rational and site specific control of apple scab. Ecofruit: Proceedings of the 17th International Conference on Organic Fruit-Growing, Vol. 17, 2016, blz. 164-166.

Jaarverslag pcfruit 2016

Clymans, R., Bangels, E., Boonen, M., Bylemans, D., Vervoort, M., Melis, P., Craeye, S., Hanssens, J., Pisman, M., Smagghe, G., Belien, T. (2017). Increasing efficacy of thrips chemical control with attractive additives in strawberry. IOBC-WPRS bulletin 123, 86-95.

Van Kerckvoorde, V., Bangels, E., Clymans, R., Smets, S., Thys, T., Berkvens, N., Casteels, H., De Ro, M., Bylemans, D. Belien, T. (2017). Lab and field comparison of feeding enhancers for improved *Drosophila suzukii* control. Poster at the 3rd International Strawberry Congress, September 6-8, Antwerp.

Belien, T., Bangels, E., Brenard, N., Reijniers, J., Leirs, H., Bylemans, D. (2017). Optimized timing of IPM treatments against pear Psylla (*Cacopsylla pyri*) based on a temperature driven population dynamics model. IOBC-WPRS bulletin 123: 96-100.

Best practice findings

Topics ongoing research:

For the control of thrips in strawberries, for cropping systems less favorable for predatory mite introduction or for insufficient control by predatory mites, guidelines on curative sprays are created. The application of PPP's based on entomopathogenic

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

fungi against thrips has less repercussions on both beneficial arthropods and fruit residues. The application of standard insecticides in combination with attractive additives results in a higher spray efficacy and hence takes away the need to repeat an unsatisfying application.

For the control of *Drosophila suzukii*, insight in insecticide efficacy and target life stages is under investigation. Knowledge on which products are effective against which life stages is of high importance, futile sprays can hence be avoided. Research towards attractive additives/baits for thrips and *Drosophila suzukii* is carried out and first results indicate that insecticide efficacy can be significantly increased by adding certain additives. Further investigation will show if attractive additives can also enable the use of lower insecticide doses while keeping the same efficacy level or if attractive additives can enable the practice of "Attract and Kill". With "Attract and Kill", only a small proportion of the field or plant is sprayed (or the crop is not sprayed at all but the alley of grass is for instance). A standard blanket spray with an increased efficacy results in fewer insecticide applications. If baits can enable lower doses or smaller treated plant surfaces, the effects on fruit residues can be substantial. The research on the use of behaviour modifying compounds is not limited to attractive additives/baits (cfr. supra), it also comprises the concepts "mass trapping" , "repellents and deterrents" and their combination: "Push and Pull". These concepts are based on semiochemicals and require no insecticides on the crop.

For the reduction of thrips in strawberries, for several cropping systems/seasonal periods a preventative introduction of predatory mites was advised and adopted by growers, significantly reducing the insecticide input.

To be able to set up a treatment schedule with low or no amount of residue at harvest research is going on in an apple, pear and strawberry orchard. To this end, specific treatments schedules are set up with respect to the preharvest interval of pesticides to have 'zero-residue'. Furthermore also all the findings of the research projects concerning reduction of residues are implemented in those orchards.

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **Europees netwerk rond fruit**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** Dr. Wendy Van Hemelrijck , pcfruit, wendy.vanhemelrijck@pcfruit.be; +32(0)11/69.70.20

Dr. Dany Bylemans, pcfruit, dany.bylemans@pcfruit.be

Section A. Summary for EIP dissemination

***Keywords:** warnings, monitoring/management tools and models

***Main geographical location:** BE221 (Hasselt)

Other geographical locations: BE242 (Leuven), BE334 (Waremme-Borgworm), BE223 (Tongeren), BE236 (Sint-Niklaas), BE256 (Arr. Roeselare), BE253 (Ieper), BE211 (Arrondissement. Antwerpen)

***Summary (native language):**

Er is momenteel veel onderzoek lopende naar beslissingsondersteunende systemen. Zo worden vanuit pcfruit jaarlijks waarschuwingen verstuurd voor alle ziekten en plagen in alle fruitteelten in België. Jaarlijks worden de adviezen aangepast op basis van de bevindingen in lopende onderzoeken. Ook het monitoringssysteem voor nutigen en plagen wordt ge-update als er nieuwe inzichten zijn, wat leidt tot een reductie in het gebruik van gewasbeschermingsmiddelen. Recent zijn ook enkele modellen bv. voor oorwormen, in de praktijk geïntroduceerd welke een doordachter gebruik van gewasbeschermingsmiddelen introduceerden, wat leidt tot een daling van de residu's. Een aantal andere modellen zijn momenteel nog in testfase.

Summary (english):

[space for optional translation of the native language short summary of scanning report to English]

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

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Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Oprichten van een Europees netwerk rond fruit
2. Ontwikkelen en implementeren van een methode om lopend onderzoek en praktijkervaring te scannen en te niveleren
3. Houden van een dialoog met relevante gezaghebbers op regional, nationaal en Europees niveau
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Section C. Annex: Scanning report1

Scanning report
[Van Hemelrijck, pcfruit]

Author: Dr. Wendy Van Hemelrijck , pcfruit, wendy.vanhemelrijck@pcfruit.be; +32(0)11/69.70.20

Country: Belgium

NUTS 3 region(s)[2]: BE221 (Hasselt)

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

Date: 18-04-2018

Source materials and methodology

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Alhmedi A, Belien T (2016). 'Schijnbare competitie' tussen bladluissoorten via gemeenschappelijke sluipwespen. Fruitteeltnieuws (jaargang 29) 13:4-7.

Belien, T., Brenard, N. (2016). Doordachte en gecoördineerde bestrijding van perenbladvlo dankzij nieuwe inzichten en ontwikkeling van een innovatief model. Fruit Revue (jaargang 68), 5 (mei): 13-16.

Vrancken, K. (2016). Nieuwe inzichten voor het bereiken van een evenwicht tussen perenbladvlo en diverse van zijn predatoren (New insights into reaching a balance between pear sucker and predators). European Fruit Magazine 2016 (3). 12-13.

Belien, T., Bangels, E., Goffin, J., Berkvens, N., De Ro, M., Casteels, H., Bylemans, D. (2016). Factors influencing attractant preferences of *Drosophila suzukii*: implications for monitoring population dynamics and IPM measures. IOBC-WPRS bulletin (IOBC Thessaloniki 04-08/09/2016. In Press.

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De Ro, M., Devos, T.; Berkvens, N., Casteels, H., Goffin, J.; Beliën, T., De Clercq, P. (2016). Cold hardiness of *Drosophila suzukii* (Diptera: Drosophilidae) in Belgium. Publication in proceedings of the 68th International Symposium on Crop Protection, 17/05/2016, Ghent. In Press.

Jaarverslag pcfruit 2016.

Van Campenhout J., Torfs S., Croes S., Heungens K., Keulemans K., Van Hemelrijck W. and Bylemans D. (in press). Orchard specific management of scab (Venturia inaequalis) on apple. Proceedings of the 11th International IOBC-WPRS workshop on pome fruit diseases.

Van Kerckvoorde, V., Belien, T. (2018). Drosophila suzukii in 2017. Fruit (jaargang 2) 4:6-8.

[1] Equivalent to 'final report' in EIP-AGRI format.

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

Best practice findings

Topics already introduced in practice:

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. Every time new insights or research results are present, these results are incorporated in the warnings.

Guidelines and tools for the augmentation and safeguarding of earwigs as important predators of wooly apple aphid and pear psylla are developed; e.g. the online application Earwig Management Tool (https://www.pcfruit.be/nl/fruitteler/bedrijfsbegeleiding/earwig-management-tool), a tool for growers to consider side-effects/noxious effects of plant protection products (PPP's) and soil disturbance on the earwig population. This tool and guidelines contribute to the reliability of biological control and therefore reduces the number of insecticide sprays. Guidelines on how to profit from these additional predators, with emphasis on side-effects of common used PPP's. Towards the end of the project the auctions reported a reduction in the amount of pear sucker related residues on pears.

An inventory/description of orchard associated aphids and parasitoids have contributed to an overview of possible "banker plants" and has delivered insights in species that can be commercialized for aphid control in orchards. The release of mass reared parasitoids appeared ready for implementation in certain crops. Biological control with parasitoids, combined with the monitoring of parasitation and aphid colonies, can significantly decrease the insecticide input.

For the control of *Drosophila suzukii* monitoring guidelines are delivered and readily adopted by growers. Monitoring significantly reduces the amount of sprays by taking away the sprays when the pest is not yet present in the plot. The on-farm monitoring is assisted by the advisory services of pcfruit npo. Also a phenology model for D. suzukii was developed to support and improve the warning system.

Topics close to dissemination:

A population dynamics models of pear Psylla as well as the main beneficials was developed.. The model predicts the proportions of pear sucker life stages for a certain moment and certain area, based on climatic data from all over Flanders. The model, together with similar models of key predators is combined in an online application. The application enables a substantiated decision-making by pear growers, allowing them to apply insecticides exactly on their optimal moment (pear sucker life stage) while also considering the effects on the predators. The developed tool results in fewer but well positioned insecticide sprays against pear sucker.

https://www.pcfruit.be/nl/fruitteler/bedrijfsbegeleiding/eindelijk-vereenvoudigde-administratie/perenbladvlo-model.

In 2017 the model was used for an improved warning system and advise in our extension services (with the goal to have an optimized sustainable control with more contribution of natural enemies and less chemical residues). From 2018 on the model can also be consulted and used by fruit growers theirselves.

During a research project a technique was developed to determine the potential ascospore inoculum for an orchard at the beginning of the season. By doing this the fruit grower has a better idea about the potential scab pressure of that orchard and he can better organize his treatments. In the same project also a technique is developed to follow up the actual ascospore release in an orchard. This may be helpfull to determine the start and the end of the ascospore season and can lead to a reduction of treatments in the beginning of the end of the scab ascospore season (no treatment necessary if no ascospores are captured and no scab symptoms are present in the orchard).

Topics ongoing research:

Models for the control of Botrytis cinerea and Powdery mildew on strawberry are under investigation. Guidelines for monitoring key pests in strawberry are under investigation: setting thresholds, identification help, methodology. Main purpose is demonstration for growers, making them aware of the added value of monitoring pests and beneficials. Knowledge of the pest population size and phenology leads to optimized insecticide usage, meaning higher efficacy and less treatments needed. A first step towards the use of drones equipped with spectral sensors for fire blight detection was achieved by identification and validation of suitable wavelengths. However, the accuracy of 52-54% for correct identification of the tree status (healthy or infected) is not sufficient yet for practical implementation of the technique and warrants further improvement.

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **Europees netwerk rond fruit**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** Dr. Wendy Van Hemelrijck , pcfruit, wendy.vanhemelrijck@pcfruit.be; +32(0)11/69.70.20

Dr. Dany Bylemans, pcfruit, dany.bylemans@pcfruit.be

Section A. Summary for EIP dissemination

***Keywords:** nets

***Main geographical location:** BE221 (Hasselt)

Other geographical locations: BE242 (Leuven), BE334 (Waremme-Borgworm), BE223 (Tongeren), BE236 (Sint-Niklaas), BE256 (Arr. Roeselare), BE253 (Ieper), BE211 (Arrondissement. Antwerpen)

***Summary (native language):**

Onderzoek is lopende dat aantoont dat het gebruik van specifieke netten zeer nuttig is in de controle van *Drosophila suzukii* in bepaalde teelten waardoor de behandelingen tegen deze plaag sterk gereduceerd kunnen worden.

Summary (english):

[space for optional translation of the native language short summary of scanning report to English]

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Oprichten van een Europees netwerk rond fruit
2. Ontwikkelen en implementeren van een methode om lopend onderzoek en praktijkervaring te scannen en te niveleren
3. Houden van een dialoog met relevante gezaghebbers op regional, nationaal en Europees niveau
4. Exploreren van nieuwe topics in onderzoek door het uitvoeren van een survey naar reeds opgedane kennis en lopend onderzoek omtrent nieuwe innovaties.

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

1. Aarhus University, Department of Food Science (Denmark) • AU
2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL
4. Obstbauversuchsanstalt Jork (Germany) • OVA
5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA
8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
10. University of Agronomic Sciences and Veterinary Medicine of Bucharest (Romania) • USAMV
11. National Agricultural Research and Innovation Centre Fruitculture Research Institute (Hungary) • NARIC
12. Lithuanian Research Centre for Agriculture and Forestry (Lithuania) • LRCAF
13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
14. Variety Innovation Consortium South Tyrol (Italy) • SKST
15. Freshfel Europe (Belgium) • FRESHFEL
16. Elbe-Obst Erzeugerorganisation r.V. (Germany) • EO
17. Fruitconsult BV (Netherlands) • FC
18. University of Greenwich (United Kingdom) • UoG
19. University of Hohenheim (Germany) • UHOH
20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
[Van Hemelrijck, pcfruit]

Author: Dr. Wendy Van Hemelrijck , pcfruit, wendy.vanhemelrijck@pcfruit.be; +32(0)11/69.70.20

Country: Belgium

NUTS 3 region(s)[2]: BE221 (Hasselt)

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

Date: 17-04-2018

Source materials and methodology

Underneath the source materials are listed. Most of the fruit research for integrated farming is done by pcfruit so all the source material is related to this research institute and their partners in these research topics:

Jaarverslag pcfruit 2016 and 2017

Best practice findings

Topics ongoing research:

Guidelines on the use of specific nets/insect gauze as a physical barrier for whole plots or individual rows are created for the control of *Drosophila suzukii* on small fruits and cherries. It seems that netting is an investment that is proven to reduce the amount of sprays to nearly zero. In 2017 also a trial with nets on grapes was executed. The outcomes confirmed the high control efficacy of the nets.

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **Europees fruit netwerk**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** Dr. Wendy Van Hemelrijck , pcfruit, wendy.vanhemelrijck@pcfruit.be; +32(0)11/69.70.20

Dr. Dany Bylemans, pcfruit, dany.bylemans@pcfruit.be

Section A. Summary for EIP dissemination

***Keywords:** movable wall, EVA-app

***Main geographical location:** BE221 (Hasselt)

Other geographical locations: BE242 (Leuven), BE334 (Waremme-Borgworm), BE223 (Tongeren), BE236 (Sint-Niklaas), BE256 (Arr. Roeselare), BE253 (Ieper), BE211 (Arrondissement. Antwerpen)

***Summary (native language):**

In België maken sinds 2016 een deel van de telers al gebruik van de EVA-app voor het plannen en de registratie van al hun behandelingen. Deze app helpt de telers bij het voorbereiden van de spuitoplossing en voorkomt dat foute producthoeveelheden worden gehanteerd bij de bespuitingen. Daarnaast werd een test ontwikkeld om na te gaan of het spuittoestel goed is afgesteld. In 2016 en 2017 trekt pcfruit doorheen België om bij de telers die dit wensen te controleren of hun spuittoestel goed is afgesteld.

Summary (english):

[space for optional translation of the native language short summary of scanning report to English]

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

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Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Oprichten van een Europees netwerk rond fruit
2. Ontwikkelen en implementeren van een methode om lopend onderzoek en praktijkervaring te scannen en te niveleren
3. Houden van een dialoog met relevante gezaghebbers op regional, nationaal en Europees niveau
4. Exploreren van nieuwe topics in onderzoek door het uitvoeren van een survey naar reeds opgedane kennis en lopend onderzoek omtrent nieuwe innovaties.

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

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9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
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11. National Agricultural Research and Innovation Centre Fruitculture Research Institute (Hungary) • NARIC
12. Lithuanian Research Centre for Agriculture and Forestry (Lithuania) • LRCAF
13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
14. Variety Innovation Consortium South Tyrol (Italy) • SKST
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16. Elbe-Obst Erzeugerorganisation r.V. (Germany) • EO
17. Fruitconsult BV (Netherlands) • FC
18. University of Greenwich (United Kingdom) • UoG
19. University of Hohenheim (Germany) • UHOH
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21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
[Van Hemelrijck, pcfruit]

Author: Dr. Wendy Van Hemelrijck , pcfruit, wendy.vanhemelrijck@pcfruit.be; +32(0)11/69.70.20

Country: Belgium

NUTS 3 region(s)[2]: BE221 (Hasselt)

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

Date: 17-04-2018

Source materials and methodology

Most of the fruit research for integrated farming is done by pcfruit so all the source material is related to this research institute and their partners in these research topics:

Jaarverslag pcfruit 2016 and 2017.

Best practice findings

Topics already introduced in practice:

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 this test to see if the nozzles are adjusted well to spray their orchards. As such they are informed about spray deposit, spray losses, … In 2017 and 2018 pcfruit is organizing specific days across Belgium to test the spray installations of the fruit growers. In 2017 in total 160 sprayers are checked by pcfruit. 159 of those sprayers needed some adjustment, so only 1 sprayer sprayed correctly. For each sprayer a report is given to the fruit grower which indicates the adjustments done to correct the spray application. In the beginning of 2018 28 orchard sprayers were checked by pcfruit.

The 'EVA' app for professional fruit growers, which is developed by pcfruit, is used by fruit growers to plan their applications and set up their spraying schedule. In 2017 155 fruit growers used the EVA-app already. A demonstration of how to use the app was given to each fruit grower which used the app. If there are problems, the fruit growers can contact pcfruit to solve the problem with the app. In 2018 we have already 135 growers using the EVA-app.

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **[EUFRUIT : réseau européen pour les fruits]**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** [Mrs. ZAVAGLI Franziska, Ctifl, 28, route des Nébouts – 24130 Prigonrieux (France), zavagli@ctifl.fr, 00/33/5.53.58.13.10]

Section A. Summary for EIP dissemination

***Keywords:** [apple trees, "system" trials, pest and diseases protection, residues, indicators]

***Main geographical location:** [FR611 Dordogne, FR244 Indre-et-Loire, FR633 Haute-Vienne, FR628 Tarn-et-Garonne, FR813 Hérault, FR826 Vaucluse]

Other geographical locations: [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]

***Summary (native language):**

27 systèmes de culture, répartis sur six sites en France, constituent le réseau national EXPE Ecophyto Pomme. L'étude vise à acquérir des références techniques et économiques sur les moyens permettant de réduire l'emploi des produits phytosanitaires et de limiter les résidus détectables sur les fruits. Les principaux leviers mobilisés sont la génétique (résistance variétale), le contrôle cultural (prophylaxie), le biocontrôle, l'efficience (outils d'aide à la décision et seuils d'intervention, modulation des doses, techniques de pulvérisation), la protection physique (filet Alt'Carpo, bâches anti-pluie), la mécanisation (désherbage mécanique), la lutte biologique (par lâchers et par conservation). Les systèmes économes étudiés sont conduits en protection fruitière intégrée ou en agriculture biologique (AB).

Sur une moyenne de cinq campagnes, 12 systèmes (sur 19) ont atteint un pourcentage de réduction de l'IFT chimique total de plus de 50 % par rapport à une modalité dite de « Base ». Par contre, uniquement 7 systèmes sont considérés comme des systèmes économes et performants (SCEP2). Parmi ceux-là, seuls les 3 systèmes conduits en AB présentent un produit brut égal ou supérieur aux charges engagées.

Summary (english):

27 production systems, located on six places in France, compose the national apple network EXPE Ecophyto. The study aims to acquire technical and economic references to reduce the use of pesticides and limit detectable residues on fruits. The main mobilized technics are genetics (varietal resistance), cultural practices (prophylaxis), biocontrol products, efficiency (models and decision thresholds, doses modulation, spraying techniques), physical protections (Alt'Carpo nets, rain covers), mechanization (mechanical weed control), beneficial insects (released or by preservation). The economic systems are led with an integrated fruit protection program or in an organic way.

On an average of five years, 12 systems (on 19) reached a percentage of reduction of the total chemical treatment frequency indicator (in French : IFT) of more than 50 % with regard to the reference. On the other hand, just 7 systems are considered as economic and efficient systems (in French : SCEP2). Among those, only the 3 organic systems present an equal or upper economic profit than the incurred production costs..

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Etablir un réseau européen orienté vers le secteur des fruits.
2. Développer et mettre en place une approche systématique pour « scanner » et synthétiser les connaissances scientifiques et pratiques existantes.
3. Etablir un dialogue permanent avec les politiques européennes, nationales et régionales pertinentes.
4. Identifier et supporter les nouveaux axes de recherche prioritaires en suivant continuellement et analysant les activités de recherche et d'innovation existantes et à venir.

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.

4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

1. Aarhus University, Department of Food Science (Denmark) • AU
2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL
4. Obstbauversuchsanstalt Jork (Germany) • OVA
5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA
8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
10. University of Agronomic Sciences and Veterinary Medicine of Bucharest (Romania) • USAMV
11. National Agricultural Research and Innovation Centre Fruitculture Research Institute (Hungary) • NARIC
12. Lithuanian Research Centre for Agriculture and Forestry (Lithuania) • LRCAF
13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
14. Variety Innovation Consortium South Tyrol (Italy) • SKST
15. Freshfel Europe (Belgium) • FRESHFEL
16. Elbe-Obst Erzeugerorganisation r.V. (Germany) • EO
17. Fruitconsult BV (Netherlands) • FC
18. University of Greenwich (United Kingdom) • UoG
19. University of Hohenheim (Germany) • UHOH
20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
[ZAVAGLI Franziska, Ctifl]

Author: [Mrs. ZAVAGLI Franziska, Ctifl, zavagli@ctifl.fr, 00/33/5.53.58.13.10]

Country: [France]

NUTS 3 region(s)[2]: [FR611 Dordogne, FR244 Indre-et-Loire, FR633 Haute-Vienne, FR628 Tarn-et-Garonne, FR813 Hérault, FR826 Vaucluse]

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

Date: [07-05-2017]

Source materials and methodology

The present scanning report is a synthesis of the results obtained between 2013 and 2017 by the French national apple network, composed by five experimental stations in fruits (La Morinière, Invenio, Cefel, Cehm, La Pugère) and coordinated by the Ctifl. The network was established in a six years ECOPHYTO project (2012 – 2018), funded by ONEMA. The principle is to combine several alternatives to chemical control in order to reduce the use of pesticides and limit the risk to find pesticides residues on fruits. Agronomic and economic indicators are evaluated for each production system. In total, 27 orchards, from 500 to 5200 m^2, are studied during the whole season. Two different type of varieties have been chosen : one group is sensible to apple scab, the other is resistant. The apple scab management is based on : i) the evaluation of apple scab risks with the "Rimpro" model, the counting of shoots with apple scab lesions to decide whether to continue our not to treat, the use of "alternative" fungicides to "chemical" fungicides and also a plastic cover prototype to protect trees from rain. Codling moth protection is done by granulosis virus applications, mating disruption with pheromones and nets (Alt'Carpo). Thinning and weed control may be done in a mechanical way. Two innovative spray application are tested : a fixed spraying system with micro-sprinklers on the top of the trees and an adapted dose and spray volume based on the volume of the tree hedge.

Sources :

- Réduire l'emploi des produits phytosanitaires en verger de pommier. Les enseignements du réseau national EXPE Ecophyto Pomme Projet DEPHY 2012 - 2017. Zavagli F. & co, publication à venir dans Revue Innovations Agronomiques INRA, 2018.
- Rapport annuel du projet ECOPHYTO DEPHY Expé réseau national Pomme – campagne 2017, mars 2018.

Best practice findings

The use of chemical pesticides is calculated by an indicator, the annual treatment frequency index (TFI). The indicators takes into account : i) the applied doses, ii) the number of fungicides, insecticides, herbicides and other products like for thinning used in one season, iii) the treated surface of the orchard or on the trees. To measure the reduction of chemical pesticides, every ECOPHYTO system is compared to a regional reference led with a sensitive apple scab variety, called "Base". **Tables 1 and 2** describe the level of pesticides reduction achieved on average between 2013 and 2017, depending of the diseases and insects pressure in the year and the way protection strategies were combined.

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

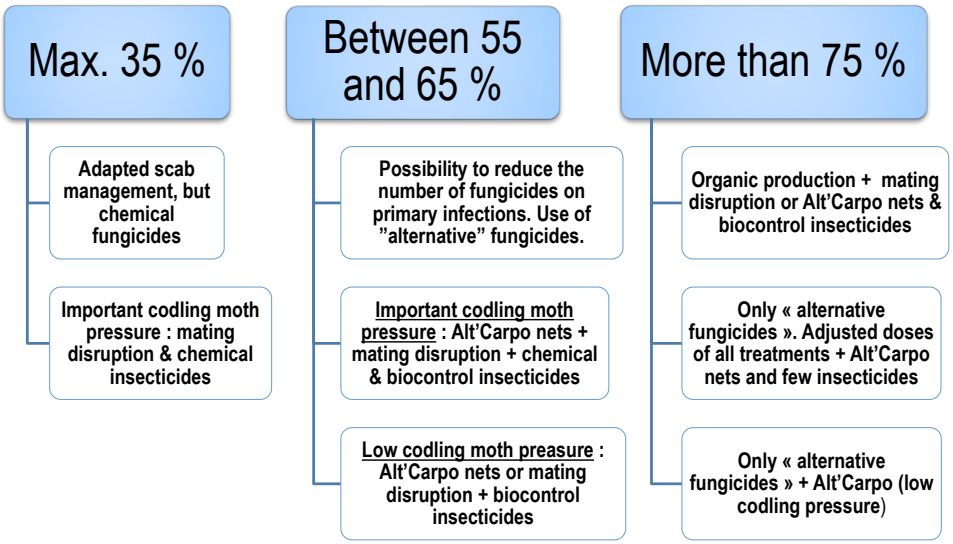

Table 1 : possible reduction level of the TFI (treatment frequency indicator) for resistant varieties systems – French national ECOPHYTO apple network. 2013 – 2017

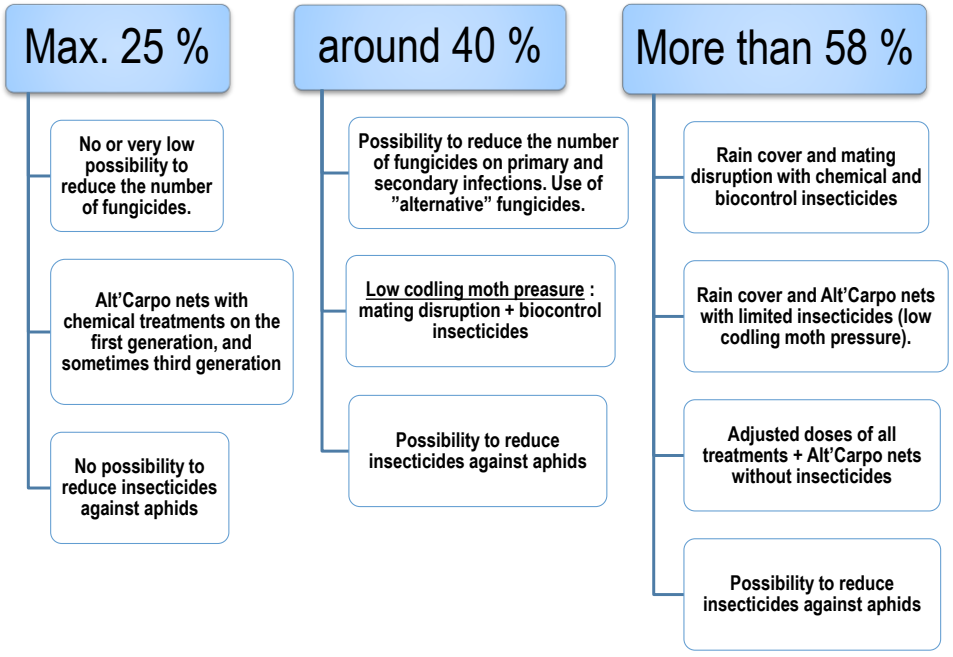

Table 2 : possible reduction level of the TFI (treatment frequency indicator) for sensitive varieties systems – French national ECOPHYTO apple network. 2013 - 2017

Regarding the pesticides residues on fruits, each apple system (ECOPHYTO and reference) is analysed at harvest. Between 2013 and 2017, the results are a maximum of 4 residues detected for the ECOPHYTO strategies while for the references the maximum can reach 8. Altogether, the residues concentration level is low, generally beneath 10 % of the MLR (maximum level of residues). By summing the percentages of each detected MLR, the amount is, excepted for one case, beyond 30 %, corresponding to the requirements of some retailers.
When no residues could be detected, the orchard was : i) organic and cupper was not analysed, ii) resistant to apple scab, not treated against storage diseases and the codling moth could be managed with mating disruption or Alt'Carpo nets, iii) covered with plastic combined and surrounded by Alt'Carpo nets, iv) treated with adapted doses and no storage diseases applications.

On 27 production systems, 8 had a higher turnover than the expenses for protection costs, mechanization and labour costs and 4 other had expenses equivalent to the turnover. These production systems were the regional references of each experimental

station, the 6 BASE systems, or correspond to 6 ECOPHYTO systems and organic systems. For the ECOPHYTO systems, the best economic results were obtained with :

- Organic production + scab resistant variety + Alt'Carpo nets (low codling moth pressure)
- A reduced number of fungicides on a medium sensitive variety to apple scab and with a general lower scab pressure + Alt'Carpo nets
- Scab resistant variety + doses and water volume adjusted to the leave volume
- Fixed spraying system + Alt'Carpo nets (low codling moth pressure).

But the reduction of pesticides compared to their references was different from case to case, sometimes lower (around 25 %) and sometimes higher (up to 92 %). Good economic results are not always in relation with pesticides reduction;

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **[EUFRUIT : réseau européen pour les fruits]**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** [Mrs. ZAVAGLI Franziska, Ctifl, 28, route des Nébouts – 24130 Prigonrieux (France), zavagli@ctifl.fr, 00/33/5.53.58.13.10]

Section A. Summary for EIP dissemination

***Keywords:** [apple scab, storage diseases, plant resistance inducers]

***Main geographical location:** [FR611 Dordogne, FR244 Indre-et-Loire, FR633 Haute-Vienne, FR628 Tarn-et-Garonne, FR813 Hérault, FR826 Vaucluse]

Other geographical locations: [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]

***Summary (native language):**

Dans le cadre de projet PEPS financé par le Ministère de l'Agriculture français, cinq stimulateurs de défense des plantes ont été testés tant au verger que dans des conditions contrôlées. Le premier « Workpackage » du projet portait sur le screening en laboratoire d'environ trente produits commercialisés pour choisir les cinq stimulateurs de défense de la pomme les plus efficaces. Les produits ont ensuite été testés dans le réseau PEPS composé de vergers expérimentaux pour étudier leur capacité de protéger contre la tavelure de la pomme et des maladies de conservation. En parallèle aux essais de verger, plusieurs études ont été réalisées dans des conditions contrôlées pour identifier les facteurs qui peuvent influencer l'efficacité des stimulateurs de défense des plantes et étudier les propriétés supplémentaires des produits.

Summary (english):

In the frame of PEPS project supported by French Ministry of Agriculture, five plant resistance inducers (PRIs) have been tested both in orchard and in controlled conditions. The first workpackage of the project was to screen in laboratory around thirty commercialized products in order to select the five most efficient apple defense activators. The products have then been tested throughout the PEPS network of experimental orchards for their ability to protect against apple scab and storage diseases. In parallel to orchard trials, several studies were performed in controlled conditions in order to identify factors that can influence PRI efficiency and to study additional properties of the products.

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Etablir un réseau européen orienté vers le secteur des fruits.
2. Développer et mettre en place une approche systématique pour « scanner » et synthétiser les connaissances scientifiques et pratiques existantes.
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4. Identifier et supporter les nouveaux axes de recherche prioritaires en suivant continuellement et analysant les activités de recherche et d'innovation existantes et à venir.

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13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
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22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
[ZAVAGLI Franziska, Ctifl]

Author: [Mrs. ZAVAGLI Franziska, Ctifl, zavagli@ctifl.fr, 00/33/5.53.58.13.10]

Country: [France]

NUTS 3 region(s)[2]: [FR611 Dordogne, FR244 Indre-et-Loire, FR633 Haute-Vienne, FR628 Tarn-et-Garonne, FR813 Hérault, FR826 Vaucluse]

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

Date: [07-05-2017]

Source materials and methodology

The scanning report provides some results on the use of plant résistance inducers (PRI) against apple scab and storage diseases. Trials were provided in a project called PEPS (2014 – 2017). 5 products were tested, as a result of screening tests in laboratory done by INRA with a qPFD tool on 28 defense genes. The performance in orchard was studied in a "light IPM" management program, with treatment gaps, in order to take more risks to have a bigger chance to have chance to develop apple scab infections. PRI were applied weekly, with a back pack sprayer on 10 consecutive trees. The final report is yet not published.

Sources :
- Evaluation and optimization of the use of plant resistance inducers in apple orchard (PEPS project). Brisset - MN. & co, not yet published, IOBC abstract June 2017.

Best practice findings

The 5 plant resistance inducers, "candidates" for the tests in orchards, were based on Salicylic acid analog, K-phosphonate, K-bicarbonate and two foliar fertilizers. The trials were organised on 8 experimental units located on different places in France. Three modalities have been decided : i) a classical IPM program covering the whole season, ii) a light IPM program on the primary infection in order to have a gap in the apple scab protection, iii) the same light IPM program, but added with PRI to test their interests.

On apple scab, in 2016 and 2017, interesting results on shoots came up in the "light IPM program" completed with either potassium phosphonate or one of the foliar fertilizers. On fruits, there was no significant difference between all PRI candidates, the efficacy was similar to the reference for all of them. Furthermore, there was no difference between two doses of the potassium phosphonate. This results suggests, that the applied doses may be lower, to avoid to be too close to the phosphoric acid MLR.

Against storage diseases, the results were not homogenous from one year to another, but in general, there was no effect or only once with potassium phosphonate. The comparison was done between a reference program based on 2 or 3 treatments close to harvest and 3 to 5 PRI applications from 40 to 4 days before harvest, applied cadenced.

The challenge is to find more PRI candidates and to elaborate the best strategy to integrate them or even substitute the conventional strategy.

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **[EUFRUIT : réseau européen pour les fruits]**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** [Mrs. ZAVAGLI Franziska, Ctifl, 28, route des Nébouts – 24130 Prigonrieux (France), zavagli@ctifl.fr, 00/33/5.53.58.13.10]

Section A. Summary for EIP dissemination

***Keywords:** [apple trees, apples scab, rain cover, plant resistance inducers]

***Main geographical location:** [FR611 Dordogne, FR244 Indre-et-Loire, FR633 Haute-Vienne, FR628 Tarn-et-Garonne, FR813 Hérault, FR826 Vaucluse]

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***Summary (native language):**

Dans le cadre du Plan français « Ecophyto » qui vise à réduire le nombre de traitements dans l'agriculture, la protection des pommes contre la pluie avec des bâches plastique sur le sommet des arbres a été testé dès 2010 par le Ctifl, sur son site de Lanxade dans le Sud-ouest de la France. Différents types de couverture de pluie ont été étudiés. L'efficacité a été bonne sur Braeburn et Gala, permettant une protection des fruits sans aucun fongicide supplémentaire, même en présence d'un peu de tavelure sur les pousses. Par contre, dans un verger nouvellement planté, avec une variété plus sensible à la tavelure, les symptômes sont apparus sous les bâches dès le début. Différentes causes possibles sont analysées, par la mesure de données climatiques, le piégeage de spores et le modèle RIMpro. En outre, le microclimat sous les couvertures de pluie semble être favorable à l'oïdium, les pucerons lanigères et parfois à la maladie de la suie et des crottes de mouche. La stratégie devrait être améliorée avec des traitements pour éviter l'oïdium et les infections de tavelure les plus graves, voire l'introduction de stimulateurs de défense des plantes.

Summary (english):

The French Ecophyto Plan aims to reduce the number of treatments in agriculture. In this frame, Ctifl started from 2010 to study the protection of apples against rain with plastic covers placed on the top of the trees. Trials are at the Ctifl Center called Lanxade in the South-West of France. Different types of rain cover have been studied. The efficacy has been successful on Braeburn and Gala, protecting the fruits without any additional fungicides, even in presence of little scab on shoots. In a new planted orchard, with a more susceptible variety, an outbreak of scab occurs under the covers from the start. The different possible causes are analyzed, through measuring climatic data, trapping spores and running RIMpro model. Furthermore, the microclimate under the rain covers seems to be favorable to powdery mildew, woolly aphids and sometimes on sooty blotch. The system could be improved with some treatments to avoid powdery mildew and the most severe scab infections, or even by applying plant resistance inducers.

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Etablir un réseau européen orienté vers le secteur des fruits.
2. Développer et mettre en place une approche systématique pour « scanner » et synthétiser les connaissances scientifiques et pratiques existantes.
3. Etablir un dialogue permanent avec les politiques européennes, nationales et régionales pertinentes.
4. Identifier et supporter les nouveaux axes de recherche prioritaires en suivant continuellement et analysant les activités de recherche et d'innovation existantes et à venir.

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

1. Aarhus University, Department of Food Science (Denmark) • AU
2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL

4. Obstbauversuchsanstalt Jork (Germany) • OVA
5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA
8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
10. University of Agronomic Sciences and Veterinary Medicine of Bucharest (Romania) • USAMV
11. National Agricultural Research and Innovation Centre Fruitculture Research Institute (Hungary) • NARIC
12. Lithuanian Research Centre for Agriculture and Forestry (Lithuania) • LRCAF
13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
14. Variety Innovation Consortium South Tyrol (Italy) • SKST
15. Freshfel Europe (Belgium) • FRESHFEL
16. Elbe-Obst Erzeugerorganisation r.V. (Germany) • EO
17. Fruitconsult BV (Netherlands) • FC
18. University of Greenwich (United Kingdom) • UoG
19. University of Hohenheim (Germany) • UHOH
20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
[ZAVAGLI Franziska, Ctifl]

Author: [Mrs. ZAVAGLI Franziska, Ctifl, zavagli@ctifl.fr, 00/33/5.53.58.13.10]

Country: [France]

NUTS 3 region(s)[2]: [FR611 Dordogne, FR244 Indre-et-Loire, FR633 Haute-Vienne, FR628 Tarn-et-Garonne, FR813 Hérault, FR826 Vaucluse]

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

Date: [07-05-2017]

Source materials and methodology

The scanning report presents some new results on the combination of plastic rain covers put on the top of apple trees and plant resistance inducers against apple scab.

Trials with rain covers have started in 2010 at Ctifl, first on Braeburn, than on Gala with two different type of rain cover, one placed under the hail nets and the other combining plastic cover and hail nets together. Actually trials are running on Pink Lady® Rosy Glow planted in 2013/2014. Between 2014 and 2017, two types of plastic "roofs", VOEN and FILPACK, cover 6 and 10 rows. The observations are done for apple scab (shoots and fruits), powdery mildew, storage diseases like *Gloeosporium*, and pests like aphids or codling moths. Yield and fruit quality including the level of residues on fruits are also an important issue in the study. To reduce the negative effect of the plastic covers ono water resources, irrigation is adapted. To improve the efficacy against apple scab, plant resistance inducers were applied under the rain covers. The results obtained under the rain cover are compared to a reference, or Base system.

Sources :

- A mechanical barrier against apple scab, M. Giraud, F. Zavagli, IOBC Latvia abstract, June 2017.

- Réduire l'emploi des produits phytosanitaires en verger de pommier. Les enseignements du réseau national EXPE Ecophyto Pomme Projet DEPHY 2012 - 2017. Zavagli F. & co, publication à venir dans Revue Innovations Agronomiques INRA, 2018.

- Rapport annuel du projet ECOPHYTO DEPHY Expé réseau national Pomme – campagne 2017, mars 2018.

Best practice findings

Studied in another French project called PEPS, two plant resistance inducers gave good results against apple scab. They were chosen to increase the protection under the rain covers. Their composition is based on potassium phosphonate or a complex foliar fertilizer (P, K, Mg, Ca, Si). The strategy was to apply them weekly from the end of March at Mid-May to achieve a "self-defence" situation for the trees. Furthermore, to avoid also powdery mildew under the rain covers, sulphur was sprayed, starting at the beginning of March to the end of May. In total 7 plant resistance inducers and 8 sulphur were applied in 2017. The result was that apple scab was less frequent with Plant resistance inducers, than without. The difference on shoots was around 20 %, but there was no significant difference between the two types of Plant Resistance Inducers. At harvest, the modalities with Plant Resistance Inducers had maximum 3 % symptoms on shoots and less than 0,5 % on fruits.

However, the main problem is to maintain a high yield level and good fruit quality. In case of Pink Lady®Rosy Glow, the cumulative yield in the "Base" achieved around 125 t/ha (in three years). Under the rain covers, the production level seems to depend on the irrigation system. The best results were achieved with drip irrigation compared to micro jet, but in both cases the fruit production is lower than the reference and even too low (around 91 t/ ha in three years for the micro jet systems).

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Furthermore, when covered, the trees have less luminosity, which may influence the “behaviour” of the trees and delays the colour of the fruits.

This rain cover technology is promising to reduce the number of chemical treatments, but still different technical and economically points have to be studied. A positive point is that residues are less detected on fruits when covered, but on the other hand when phosphonates are applied to complete the efficacy against apple scab, the risk is important to overlap the MLR of phosphoric acid.

In conclusion, to limit the incidence of rain covers on fruit production, the goal would be to automatize the opening and closing of the roofs depending of the climate condition and apple scab risks.

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **EUFRUIT: Europäisches Obstnetzwerk**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** Hinrich H. F. Holthusen, ESTEBURG – Obstbauzentrum Jork, Dep. Plant Protection and Diagnostics, Email: Hinrich.Holthusen@lwk-niedersachsen.de, Tel.: +49-4162-6016-131

Section A. Summary for EIP dissemination

***Keywords:** Electroherb, flazasulfuron, flumioxazin, glyphosate, GrassKiller, mechanical weed management, pelargonic acid, pome fruit, root suckers, soil-active herbicide, total herbicide

***Main geographical location:** DE6 (Hamburg); DE9 (Niedersachsen)

Other geographical locations: DE8 (Mecklenburg-Vorpommern), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen)

***Summary (native language):**

Der Report befasst sich mit Ergebnissen zur Unkrautbekämpfung im Kernobstanbau. Der Fokus liegt dabei insbesondere auf der Vermeidung bzw. Reduzierung von glyphosathaltigen Produkten durch die verstärkte Anwendung bodenwirksamer Herbizide und der Einbeziehung mechanischer Unkrautbekämpfung in die Herbizidstrategie auch im Integrierten Obstanbau.

Summary (english):

The report deals with results for weed control in pome fruit growing. In particular, the focus is on the avoidance or reduction of glyphosate-containing products through the increased use of soil-active herbicides and the inclusion of mechanical weed control in the herbicide strategy in integrated fruit production.

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226

Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Etablierung eines europäischen Netzwerks, das sich auf den Obstsektor konzentriert.
2. Entwicklung und Umsetzung eines systemischen Ansatzes zur Sichtung und Zusammenstellung bestehenden wissenschaftlichen und praxisnahen Wissens.
3. Etablierung eines laufenden Dialogs mit relevanten politischen Gremien auf regionaler, nationaler und EU Ebene.
4. Ermittlung und Unterstützung neuer Forschungsschwerpunkte durch kontinuierliches Monitoring und Auswertung bestehender und neu entstehender Forschungs- und Innovationsaktivitäten.

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

1. Aarhus University, Department of Food Science (Denmark) • AU
2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL
4. Obstbauversuchsanstalt Jork (Germany) • OVA
5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA
8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
10. University of Agronomic Sciences and Veterinary Medicine of Bucharest (Romania) • USAMV
11. National Agricultural Research and Innovation Centre Fruitculture Research Institute (Hungary) • NARIC
12. Lithuanian Research Centre for Agriculture and Forestry (Lithuania) • LRCAF
13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
14. Variety Innovation Consortium South Tyrol (Italy) • SKST
15. Freshfel Europe (Belgium) • FRESHFEL
16. Elbe-Obst Erzeugerorganisation r.V. (Germany) • EO
17. Fruitconsult BV (Netherlands) • FC
18. University of Greenwich (United Kingdom) • UoG
19. University of Hohenheim (Germany) • UHOH

20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
Hinrich H. F. Holthusen, Obstbauversuchsanstalt Jork

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Country: Germany

NUTS 3 region(s)[2]: DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen)

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

Date: 23-04-2018

Source materials and methodology

Reports on weed managements in orchards published in "Obstbau" 2017/2018 were scanned. Three articles were used for this report: "Alternatives in tree strip treatment" (Zimmer, 2017), "Solutions for weed control in pome and stone fruit orchards" (Scheuer, 2018), and "Herbicides in apple production – a status report" (Scheer & Hagl, 2018). The report was rounded off by data from a two years field experiment with soil-active herbicides in Northern Germany (Wiebusch et al., 2017) published in "Mitteilungen des Obstbauversuchsringes des Alten Landes". Both fruit grower magazines are published in German and were approached using ESTEBURG library.

Best practice findings

Due to favorable condition for weed growth in Northern Germany, especially on the loamy soils in the Elbe valley, repeated herbicide treatments are necessary to keep the tree strips in pome fruit orchards free of weeds. Standard weed control in Northern Germany depends on repeated treatments (2-4 times) of glyphosate herbicides (per treatment: max. 1,800 g glyphosate / ha tree strip) combined with a broadleaf herbicide (up to two times: 1,000 g MCPA / ha tree strip). In general, first application take place in spring around flowering, followed by at least one more application in summer, and a last application during autumn after harvest (without MCPA). In some cases, also a second summer application is needed. In all cases only the tree strip is treated which accounts roughly for one third of the whole orchard in Germany.

To reduce the use especially of glyphosate as well as the total number of herbicide applications (to save time and money), herbicide strategies with soil-active herbicides applied in winter and / or spring were tested. By applying 0.6 kg Vorox F / ha tree strip (300 g flumioxazin / ha tree strip) combined with 900 g glyphosate / ha tree strip short before flowering or 3 kg Chikara Duo / ha tree strip (20 g flazasulfuron plus 864 g glyphosate / ha tree strip) short after flowering an additional application of a glyphosate products during summer became unnecessary. Up to 2,700 g glyphosate / ha tree strip could be saved annually. Replacing the autumn application of glyphosate by a winter application of 6.25 l Kerb Flo / ha tree strip (2,500 g propyzamid / ha tree strip) followed by a solo application of 0.6 kg Vorox F / ha tree strip short before flowering showed the best long-lasting efficacy in 2017 and reduce the usage of glyphosate to zero. However, looking at the cost for chemical weed control the application of Kerb Flo in winter followed by Vorox F before blossom is the most expensive option, generating total costs of almost € 220 / ha orchard Compared to that the costs are only € 115 / ha orchard if glyphosate plus MCPA is applied once in spring or if the application is repeated in summer, € 175 / ha orchard. Both strategies also require a final after harvest application of glyphosate. In most cases the application of Chikara Duo in spring after blossom followed by glyphosate after harvest will be the cheapest option, costing € 130 / ha orchard. Vorox F plus glyphosate before blossom followed by glyphosate after harvest produces costs of € 195 / ha orchard (Wiebusch et al., 2017).

A field trial in western Germany also revealed the very good efficacy of glyphosate in combination with flumioxazin (Vorox F). Since *Echinochloa* spp. were present only to a low degree in the experimental field there was almost no effect of an additional dimethenamid-P (Spectrum) treatment. Long time efficacy of Chikara Duo (flazasulfuron plus glyphosate) was almost similar to Vorox F plus glyphosate, but showed some weaknesses against *Echinochloa* spp. (Scheuer, 2018).

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Root sucker removal from apple trees was originally done by summer or autumn application of glufosinate (Basta). Since glufosinate is banned in Germany since summer 2017 alternatives are needed. Pelargonic acid (8%) kills weeds as well as root suckers within hours, however, the effect will last for a maximum of three weeks only. The application of pelargonic acid in the summer to kill the root sucker, followed by a post-harvest glyphosate application, can prevent the possible uptake of glyphosate by the fruit trees and the resulting phytotoxic damage to the trees.In combination with soil-active herbicides like Vorox F (flumioxazin) or Katana (flazasulfuron) pelargonic acid showed a very good and long lasting herbicidal effect of at least three months Pelargonic acid can also be combined with mechanical weed management, treating only the selective weed growth around the trees while the rest of the tree strip is hoed five times a year. Another combination tested with good results was the application of glyphosate in spring followed by hoeing with the ”Krümler Ladurner Modell 7”. The use of hot water (98 °C) for weed control was also tested, however, the costs to heat the water still hinder the general usage (Scheer & Hagl, 2018).

Mechanical weed management gains increasing importance also in integrated orchard management. Different systems were demonstrated in 2017. A mechanical roll hoe can weed the tree strip excepted the tree interspace and thereby save much time compared to conventional mechanical weeding. Another machine NaturaGriff, developed in France, worked with rotating brushes also in the tree interspace and can be managed with a tractor speed of 8 km h^{-1}. The ”Krümler Ladurner Modell 7” is a commonly used machine for weed control in organic orchards in Germany. It is very flexible and works with two scanning arms to adjusted the working width to the row distance. The machine is also capable to handle massive weed infestation as well as wet conditions. For the similar purpose machines with nylon fibers were developed, which can chop off strong weeds as well as handle wet soil conditions. All machines are made to save treatment time as well as number of treatments per year. In future new machines like the ”GrassKiller” from Italy, working with high pressure (up to 1,250 bar) water, and the ”Electroherb” from Brasil, working with high-frequency alternating current, may change weed management in orchards a lot (Zimmer, 2017). However, first results with the “GrassKiller” revealed some weaknesses in terms of treatment speed and efficacy in the tree interspace. In comparison the ”Krümler Ladurner Modell 7” as well as a machine with nylon fibers showed better results (Scheer & Hagl, 2018).

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Zimmer, J. (2017). Alternativen in der Baumstreifenbehandlung. *Obstbau* 42(9): 532–535.

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **EUFRUIT: Europees Fruit Kennis Netwerk**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** Ir. Marcel Wenneker, Wageningen University & Research, Stichting Wageningen Research, Business Unit Field Crops, marcel.wenneker@wur.nl; +31 488 473745

Section A. Summary for EIP dissemination

***Keywords:** pesticides, environment, residues, fruit, spray application, fungicides

***Main geographical location:** NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg

***Summary (native language):**

Met nieuwe, innovatieve toedieningstechnieken, kan emissie van gewasbeschermingsmiddelen sterk worden teruggedrongen. Ook kan mogelijk minder gewasbeschermingsmiddel gebruikt worden, doordat met deze nieuwe toedieningstechnieken een betere en meer uniforme bedekking van het gewas mogelijk is. Nieuwe toedieningstechnieken worden voor fruitteeltgewassen ontwikkeld via gewasafhankelijk spuiten op basis van gewasvolume of gewasrijvolume-dosering. Dit moet leiden tot toedieningstechnieken in de hoogste driftreductieklasse met een emissiereductie van minimaal 95%. Dankzij deze nieuwe technieken kan de emissie naar het milieu en de blootstelling van omstanders en bewoners sterk worden teruggedrongen, met behoud van een goede biologische effectiviteit. Daarnaast worden nieuwe trajecten onderzocht, zoals beschermde teelt, waarbij het gewas wordt droog gehouden waardoor infecties door schimmels van het gewas niet vinden en er minder chemische gewasbescherming hoeft worden uitgevoerd.

Summary (english):

New innovative application techniques can be used to significantly reduce the emission of crop protection products. New application techniques are developed for fruit crops via crop-dependent spraying based on crop volume or crop row volume dosage, and adjusting spray parameters (such as air speed and nozzle type). It is estimated that this will result in application techniques in the highest drift reduction class that produce an emission reduction of at least 95%. These new techniques can significantly reduce emissions into the environment and the exposure of bystanders and local residents, while retaining a high level of biological effectiveness, and avoid overdosing on leaves and fruits.

Fungal diseases need free water to cause infections. Preventing the fruit to become wet, would prevent infections. Covering fruit crops with plastic or anti-rain nets showed in different regions within Europe a good control for several fungal diseases. In the Netherlands a project is started to work with retractable roofs that opens and closes automatically. In this way fungal diseases can be prevented and the microclimate can be regulated to prevent other diseases and pests. A significant reduction of sprays is expected.

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Oprichting van een Europees kennisnetwerk gericht op de fruitsector.
2. Ontwikkelen en implementeren van een systematische aanpak voor het scannen en het ontsluiten van bestaande wetenschappelijke en praktische kennis.
3. Ontwikkelen van een permanente dialoog met de relevante EU-, nationaal en regionale beleidslichamen.
4. Identificeren en te ondersteunen van nieuwe onderzoeksgebieden door voortdurend bestaande en toekomstige onderzoeks- en innovatieactiviteiten te monitoren.

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analyzing existing and upcoming research and innovation activities.

***Project partners:**

1. Aarhus University, Department of Food Science (Denmark) • AU
2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL
4. Obstbauversuchsanstalt Jork (Germany) • OVA
5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA

8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
10. University of Agronomic Sciences and Veterinary Medicine of Bucharest (Romania) • USAMV
11. National Agricultural Research and Innovation Centre Fruitculture Research Institute (Hungary) • NARIC
12. Lithuanian Research Centre for Agriculture and Forestry (Lithuania) • LRCAF
13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
14. Variety Innovation Consortium South Tyrol (Italy) • SKST
15. Freshfel Europe (Belgium) • FRESHFEL
16. Elbe-Obst Erzeugerorganisation r.V. (Germany) • EO
17. Fruitconsult BV (Netherlands) • FC
18. University of Greenwich (United Kingdom) • UoG
19. University of Hohenheim (Germany) • UHOH
20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
Marcel Wenneker, WR

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Country: The Netherlands

NUTS 3 region(s)[2]: NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg

WP no. and title: WP3 – Reduction in pesticides residues

Date: 23-04-2018

Source materials and methodology

Wageningen Plant Research (WPR) Randwijk (part of 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. WPR-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 experiments leading to approved measures to reduce drift were carried out by WR. 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, and improving spray applications. 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.

Results have been communicated via grower magazines, field days, demonstrations, workshops and symposia.

The source materials for this scanning report are amongst others:

Wenneker, M., Zande van de, J.C, 2017. Spuittechnieken in de fruitteelt. Fruitteelt 107 (11): 8-9.

Wenneker, M., Michielsen, J.M.P.G., Stallinga, H., Velde, van P., Dalfsen, van P., Zande, van de J.C., 2017. Improving spray deposition in orchard spraying by a Munckhof multiple row sprayer. Book of Abstracts of the 14th Workshop on Spray Application in Fruit Growing, 10-12 May, Hasselt, Belgium: 25-26.

Michielsen, J.M.P.G., Stallinga, H., Velde, van P., Dalfsen, van P., Wenneker, M., Zande, van de J.C., 2017. Spray deposition and distribution of a cross-flow fan orchard sprayer in spindle apple trees. Book of Abstracts of the 14th Workshop on Spray Application in Fruit Growing, 10-12 May, Hasselt, Belgium: 21-22.

Wenneker, M., Pham, K.T.K., Leeuwen, van P.J., 2017. Emerging and threatening postharvest diseases in pome fruit in the Netherlands. Book of Abstracts of the 11th IOBC-WPRS Workshop on Pome Fruit Diseases, 27-30 June 2017, Jurmala, Latvia.

Wenneker, M., 2017. Effective spray drift reduction in fruit growing by the use of coarse droplet spray applications. Book of Abstracts of the 11th IOBC-WPRS Workshop on Pome Fruit Diseases, 27-30 June 2017, Jurmala, Latvia.

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Best practice findings

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

Retractable roofs to prevent fungal diseases in development

Fungal diseases need free water to cause infections. Preventing the fruit to become wet, would prevent infections. Covering fruit crops with plastic or anti-rain nets showed in different regions within Europe a good control for several fungal diseases. On the other hand the microclimate changes creates other problems like powdery mildew and woolly apple aphid. In the Netherlands a project is started to work with retractable roofs that opens and closes automatically. In this way fungal diseases can still be prevented and the microclimate can be regulated to prevent other diseases and pests. A substantial reduction of sprays is expected. Pests are prevented with mating disruption, trapping and stimulation the use of natural enemies like the common earwig.

Efficient innovative spray application techniques

New innovative application techniques can be used to significantly reduce the emission of crop protection products. It may also be possible to reduce the amount of crop protection agents used as these new application techniques ensure a better and more uniform crop coverage. In cooperation with spray machine manufacturers and the agrochemical industries we develop new application techniques for fruit crops via crop-dependent spraying based on crop volume or crop row volume dosage, and adjusting spray parameters (such as air speed and nozzle type). It is estimated that this will result in application techniques in the highest drift reduction class that produce an emission reduction of at least 95%. These new techniques can significantly reduce emissions into the environment and the exposure of bystanders and local residents, while retaining a high level of biological effectiveness, and avoid overdosing on leaves and fruits. To develop application methods and calculation rules to ensure a uniform coverage of the crop to be sprayed depending on application technique and crop stage. The goal of reducing emissions by at least 95% will be achieved through a combination of technology and a decrease in the amount of applied product.

Approaches to achieve these goals:

- Quantifying adjustable spraying technique parameters such as air assistance and variable spray volume on spray liquid distribution.
- Quantifying spray liquid distribution in the crop and over the ground surface in and around the plot.
- Developing algorithms for use in practice.

Communication is achieved via manuscripts in journals and via open days and field days, such as:

Zande, van de J., Wenneker, M., 2017. Innovatieve Efficiënte Toedieningstechnieken. Kennisdag voor de Fruitteelt, 16 november 2017, Wageningen, Nederland.

Wenneker, M., Dalfsen, van P., 2017. Demonstraties spuitechniek en driftreductie Kleinfruit. Landelijke Klein- en Steenfruitdag, 14 juni 2017, zachtfruitbedrijf Berrybrothers, Roggel, Nederland.

Zande, van de J., Dalfsen, van P., Wenneker, M., 2017. Demonstraties Innovatieve Efficiënte Toedieningstechnieken. Open Dag Fruitteelt Proef Station Randwijk, 17 & 18 Augustus 2017, Randwijk, Nederland.

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **[EUFRUIT: Xarxa europea per a la fruita**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** Mr. Mariano Vilajeliu, IRTA-MAS BADIA, 17134 La Tallada d'Empordà,

E-mail: mariano.vilajeliu@irta.cat, Phone: 0034 972 78 02 75

Section A. Summary for EIP dissemination

***Keywords:** mechanical methods, weed control, volume rates, dosages, exclusion netting

***Main geographical location:** ES 512 Girona, ES 513 Lleida (Lérida)

Other geographical locations: FR 8 Mediterranée

***Summary (native language):**

Es fa menció de tècniques innovadores en la producció de fruita orientades a prioritzar l'ús de mètodes alternatius als químics i millorar els tractaments fitosanitaris, que permetin reduir la dependència dels tractaments fitosanitaris i minimitzar el contingut de residus en la fruita tant en plantacions convencionals com ecològiques.

Summary (english):

Several alternative methods to chemical treatments and how improve plant protection sprayings on fruit production actions are described in order to achieve a reduction of the pesticide dependence and a residues minimization on fruit on conventional and organic orchards.

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid

Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Constituir una xarxa europea del sector de la fruita
2. Desenvolupar i implementar un procediment sistemàtic per a conèixer i sintetitzar l'existent coneixement científic i pràctic
3. Establir un diàleg constant amb els interlocutors responsables de la EU, de les polítiques nacionals i regionals
4. Identificar, promoure i donar prioritat a les noves àrees de recerca mitjançant la monitorització i anàlisi de les activitats d'innovació actuals i a curt termini

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

1. Aarhus University, Department of Food Science (Denmark) • AU
2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL
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5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA
8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
10. University of Agronomic Sciences and Veterinary Medicine of Bucharest (Romania) • USAMV
11. National Agricultural Research and Innovation Centre Fruitculture Research Institute (Hungary) • NARIC
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13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
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19. University of Hohenheim (Germany) • UHOH
20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
[Mariano Vilajeliu, IRTA-MAS BADIA]

Author: [Mr. Mariano Vilajeliu, IRTA-MAS BADIA; mariano.vilajeliu@irta.cat, 34 972 78 02 75

Country: Spain (Catalonia)

NUTS 3 region(s)[2]: [ES 512 Girona)]

WP no. and title: [WP 3 Reduction in pesticide residues]

Date: [23-04-2018]

Source materials and methodology

The findings described are linked with present research activities on fruit plant protection carried out in the IRTA – Mas Badia Experimental Station located in Girona province, and also, from other Catalonian fruit areas and important European fruit regions.

Most suitable devices for **weed control** should be identified in each of the fruit regions according to its characteristics. There are several soft programs and mobile application for **adjustment of the liquid volume rates** (DOSA3D). Exists separated information about the use of **exclusion nets** for different purposes.

Best practice findings

1. MECHANICAL METHODS FOR WEED CONTROL OF THE ROWS UNDER FRUIT TREES

The usual system of weed management in conventional orchards of the rows under fruit trees consists on herbicide sprayings. This method involves the use of various active ingredients all round year, which are residual and persistent in the environment, select the resistant plants and reduces the breathing and microorganisms activity of the soil. One of these herbicide active ingredients commonly used is glyphosate, a systemic product that will probably disappear in the following years, due to its negative secondary effects. In addition to this, chemical control of the spontaneous vegetation implies the non-tillage and this practice promotes the activity of the rodent micromammals pest (arvicola sp., microtus sp.).

The mechanical system of control of the spontaneous vegetation on the rows under fruit trees is a real alternative to chemical herbicides to reduce the use of plant protection products and activity of the micromammals rodents. At present, there are a wide availability of tractor machines that work superficially the soil, which are usable, even, in newly planted trees. Moreover, these methods are applicable in conventional and organic orchards.

2. ADJUSTMENT OF THE LIQUID VOLUME RATES AND PLANT PROTECTION PRODUCTS DOSAGES TO ORCHARD NEEDS

The orchards features are very variable and liquid volume rates and plant protection products dosages needs too. A method called DOSA3D (*GR Agricultura de Precisió, Universitat de Lleida, Agrotecnio*) allows to calculate the dose taking into account the trees dimension and the leaf density according to the efficiency of the sprayer. DOSA3D is also a system of treatments management.

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Plant protection product concentration will be the same as a conventional spraying, but it will be inferior in case that the dose recommendation of pesticide companies is in amount of product per Ha. The DOSA3D is a method to minimize costs, risks and residues on fruits. Moreover, it is applicable in conventional and organic orchards.

3. EXCLUSION NETTING USE FOR ALL POSSIBLE PURPOSES

Exclusion nets are more and more used in conventional orchards for preventing hailstorm damages and improve quality of fruit. Exclusion nets, including side orchards, may be used as well to avoid damages caused by key fruit pests (codling moth, leafrollers and Mediterranean fruit fly) and are a good infrastructure to promote biological control of some other common pests (aphids) too. This physical method may be useful for *Halyomorpha halys* control, a new pest in some European countries to which common insecticides, that should be sprayed close to harvest, do not work properly and risks of residues on fruit. In addition to this, if roof nets prevents from rain, they may be used as well to reduce fungicides for apple scab control.

As nets are increasingly used in conventional orchards for several reasons, this proposal consists on using them for all possible purposes: to prevent damages of hailstorm, increase quality of fruit, preserve and increase biodiversity, and, where necessary, prevent damages of common and new pest (*H. halys*), in order to reduce pesticide treatments and residues on fruit. Moreover, these methods are applicable in conventional and organic orchards.

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **EUFRUIT: European Fruit Network, WP3 Reduktion von Pestizidrückständen**

***Project title (English):** **EUFRUIT: European Fruit Network, WP3 Reduction in pesticides residues**

***Author/native language editor:** Dr. Andreas Naef, Agroscope, Schloss 1, 8820 Wädenswil, Switzerland andreas.naef@agroscope.admin.ch,+41 58 460 62 57

Section A. Summary for EIP dissemination

***Keywords:** disease and pest modelling, monitoring, low-input trial, mating disruption, exclusion nets

***Main geographical location:** CH0 Schweiz/Suisse/Svizzera

Other geographical locations: CH011 Vaud, CH012 Valais, CH021 Bern, CH022 Fribourg, CH023 Solothurn, CH024 Neuchâtel, CH025 Jura, CH032 Basel-Landschaft, CH033 Aargau, CH040 Zürich, CH052 Schaffhausen, CH055 St. Gallen, CH056 Graubünden, CH057 Thurgau, CH061 Luzern, CH063 Schwyz, CH066 Zug, CH070 Ticino

***Summary (native language):**

In integrierten Obstproduktionssystemen werden nach Ausschöpfung der präventiven Massnahmen selektive und nützlingsschonende Pflanzenschutzmittel zur Bekämpfung von Schädlingen, Krankheiten und Unkräutern eingesetzt. Dies bedingt den Einsatz einer grösseren Anzahl verschiedener Wirkstoffe, die als Rückstände auf den Früchten nachweisbar sein können. Konsumenten erwarten aber eine Reduktion des Pflanzenschutzmitteleinsatzes in der Landwirtschaft und idealerweise die Eliminierung von Rückständen der Pflanzenschutzmittel, um Auswirkungen auf die Umwelt und die Gesundheit zu minimieren. Grossverteiler haben Qualitätsmanagement-Systeme lanciert, um die Gesamtmenge an Rückständen und die Anzahl der verwendeten Pflanzenschutzmittel zu reduzieren. Agroscope hat bei Äpfeln in einem mehrjährigen Versuch die Möglichkeiten einer rückstandsfreien Produktion aus agronomischer und ökonomischer Sicht geprüft. Die Ergebnisse zeigen, dass die Produktion von rückstandsfreien Tafeläpfeln unter Schweizer Bedingungen möglich ist, wenn die Pflanzenschutzstrategie gegen Pilzkrankheiten angepasst wird und alternative Methoden wie Totaleinnetzung gegen Schädlinge, Verwirrungstechnik gegen den Apfelwickler (Cydia pomonella), Mulchen des Falllaubs zur Reduktion des Schorfinokulums (Venturia inaequalis) und moderne Lagerungstechniken eingesetzt werden. Mit der Umsetzung einer solchen Strategie in der Anbaupraxis liesse sich ein wichtiger Konsumentenwunsch erfüllen. Bisher rentiert diese Strategie ohne Preisdifferenzierung gegenüber der integrierten Produktion ökonomisch bisher nicht. Im Rahmen eines grenzübergreifenden Projekts im Bodenseeraum sollen die innovativen Pflanzenschutzstrategien nun in Modellanlagen weiter optimiert werden.

Summary (english):

Integrated fruit production systems rely on pest, disease and weed control with specific pesticides, which spare beneficial organisms. This leads to crop protection strategies with a larger number of different pesticides. However, consumers demand a reduction of pesticide use in agriculture and ideally the elimination of pesticide residues in order to minimize the impact on the environment and the risk for human health. Wholesalers introduced quality management systems in to reduce residues and the use of plant protection products. For several years, Agroscope tested a low residue strategy from a technical and economic point of view. The production of residue-free apples is possible under Swiss conditions if the crop protection strategy against fungal diseases is adapted and alternative measures such as insect exclusion netting, mating disruption against codling moth (Cydia pomonella), mulching with leaves to reduce scab (Venturia inaequalis) inoculum, and modern storage techniques are applied. The production of such low-residue apples meets consumer demand, but the economic calculation showed that the low-residue strategy is not profitable without a price premium compared to integrated production. In the frame of a transnational project in the lake of constance region these innovative crop protection strategies will be further developed.

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Gründung eines europäischen Netzwerks im Bereich des Fruchtsektors.
2. Entwicklung und Implementierung eines systematischen Ansatzes um bestehendes wissenschaftliches und praktisches Wissen abzufragen und zusammenzufassen.
3. Aufbau eines fortlaufenden Dialogs mit relevanten EU, nationalen und regionalen Interessensvertretern
4. Identifizierung und Unterstützung neuer Prioritätsbereiche durch kontinuierliches Monitoring und Analysieren bestehender und künftiger Forschungs- und Innovationsaktivitäten.

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.

4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

1. Aarhus University, Department of Food Science (Denmark) • AU
2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL
4. Obstbauversuchsanstalt Jork (Germany) • OVA
5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA
8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
10. University of Agronomic Sciences and Veterinary Medicine of Bucharest (Romania) • USAMV
11. National Agricultural Research and Innovation Centre Fruitculture Research Institute (Hungary) • NARIC
12. Lithuanian Research Centre for Agriculture and Forestry (Lithuania) • LRCAF
13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
14. Variety Innovation Consortium South Tyrol (Italy) • SKST
15. Freshfel Europe (Belgium) • FRESHFEL
16. Elbe-Obst Erzeugerorganisation r.V. (Germany) • EO
17. Fruitconsult BV (Netherlands) • FC
18. University of Greenwich (United Kingdom) • UoG
19. University of Hohenheim (Germany) • UHOH
20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
Andreas Naef, Agroscope

Dr. Andreas Naef, Agroscope, Andreas.naef@agroscope.admin.ch,+41 58 460 62 57

Country: Switzerland

NUTS 3 region(s)[2]: CH0 Schweiz/Suisse/Svizzera

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

Date: 26042018

Source materials and methodology

1) Decision support systems

Pome and stone fruits

Agroscope, the Swiss center for agricultural research, frequently publishes advisory documents on plant protection for fruit production. In 2018, the recommendations for plant protection, including the updated list of plant protection products, had been revised and published in German and French (Naef et al. 2018: Agrosocpe Transfer: Pflanzenschutzempfehlungen für den Erwerbsobstbau, Ch. Linder et al. 2018: Guide phytosanitaire pour l'arboriculture fruitière). Furthermore, technical leaflets on new pests such as a mining moth have been published. Leaflets on apple varieties tolerant to fire blight and on control of Drosophila suzukii had been updated. All of these documents are widely used by advisors and farmers and for the education of farmers.

Due to limited resources, Agroscope had to stop the weekly plant protection bulletin for fruit production in 2017. This bulletin Agroscope was replaced with a joint bulletin of several regional advisory services, which are supported with three information meetings during the season organized by Agroscope. These meetings are used for knowledge transfer and are highly appreciated by advisors and therefore continued in 2018.

Agroscope provides several webpages with disease and pest modelling and monitoring information:
www.agrometeo.ch (apple scab infection forcasting, wheater data, pest monitoring data, crop stage data)
www.sopra.ch (insect pest forecasting)
www.feuerbrand.ch (fireblight forcasting)

For apple scab, pilot users have successfully tested a new model for prediction of infections in 2017. In the season of 2018, the model replaces the older WELTE model on the Agrometeo forecasting platform. The online monitoring tool for pests was improved suit the needs of farmers. Monitoring data input mainly comes from research farms and advisory services but rarely from producers.

3) Chemical strategies

Pome fruits

Agroscope started a low-input trial with scab sensitive and scab resistant apple varieties several years ago. Results are described in the general summary. In 2017, two new projects were started. An international project in the Lake of Constance region aiming to build up demonstration orchards with innovative plant protection strategies and a collaboration with the fruit trading company aiming to build up a network of farmers producing low-residue apples. In 2018, an additional international project on weed control has been started. In all projects, field trials will deliver results on efficacy and costs of innovative plant protection strategies.

Stone fruits

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Agroscope started a new trial to control Pseudomonas in cherries with a combination of chemical treatments with acid clay and Bion and non-chemical preventive measures such as white stem painting and summer pruning.

4) Bio-control

Pome fruits

Mating disruption against codling moth is used by about 50% of the apple growers of the Lake of Constance area. In 2017 and 2018 Agroscope performs test with pheromone buffers. The combination of mating disruption and granulosis virus is mainly used by organic producers (about 10%).

Streptomycin has been banned in Switzerland since 2016. Farmers are using now a combination of biocontrol with yeasts (Blossom Protect), acid clay (Myco-Sin) and potassium aluminium sulphate (LMA) to control fireblight. The weather during flowering was highly favorable in spring 2018. It is expected, that the coming weeks will show the efficacy of this strategy under severe infection conditions.

5 Physical Barriers

Pome fruits

In 2005, Agroscope started trials with exclusion netting on apples to control moths. Until now, exclusion netting is used only by pioneer farmers and for orchards next to extensively managed high stem trees to prevent contaminated bees to enter the orchards. Bumble bees and wild bees are placed in these orchards to ensure pollination.

Stone fruits

Since 2010, trials with exclusion netting on cherries were done to find an alternative on 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. Since 2015, the situation has completely changed. In table cherry production, exclusion netting is used in combination with spinosad treatments to reach a 100% control of spotted wing drosophila. However, a reduction of residues is questionable, because additional treatments against the new pest may result into additional residues.

6) Mechanisation

Pome and stone fruits

Mechanical thinning is used only by organic farmers but mechanical weeding is becoming more and more important in integrated production – mainly due to political pressure on herbicides such as glyphosate. In 2016 a demonstration day was used to show different machines available. In addition, a project has been started to test mechanical weeding in integrated cherry production.

7) Genetics

Pome fruits

The Agroscope apple-breeding program focusses on robust varieties. The most promising candidates from this program and from other breeders are tested under a standard IP plant protection strategy and a low input strategy with reduced use of synthetic pesticides.

Best practice findings

As described in previous years, the invasion of new pests and diseases such as the spotted wing drosophila and the withdrawal of pesticides like dimethoate and streptomycin and the first Swiss national action plan to reduce risk of pesticide use have changed the mind of many producers and cooperatives. Cooperatives and regional advisory services intend to establish a net of demonstration farms with low-residue crop protection strategies. Researchers of Agroscope are involved as experts in these initiatives.

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **EUFRUIT: Europäisches Obst-Netzwerk**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** Dr. Markus Kelderer, Laimburg Research Centre, Laimburg 6, 39040 Post Auer, BZ-Italia, Markus.Kelderer@laimburg.it, +390471969662

Section A. Summary for EIP dissemination

***Keywords:** Thematic Network, Fruit Sector, EUFRUIT,
Organic Farming, Plant Protection, Fertilization, Biocontrol, Crop Regulation

***Main geographical location:** ITH10 Bolzano-Bozen

Other geographical locations: ITH10 Bolzano-Bozen

***Summary (native language):**

Fokus und einige der größten Herausforderungen in den Versuchen in der Biologischen Obstbau (BO):

- **Entwicklung von Sorten und Unterlagen für den BO**: Sorten sollen niedrige Anfälligkeit gegen die wichtigsten Krankheiten, Schädlinge und abiotischen Schäden aufweisen. Die Früchte sollen schmackhaft, bekömmlich, niedrig an Allergenen, mit gutem Shelf-life und Lagerfähigkeit sein. Genetisch modifizierende Züchtungsmethoden werden im BO nicht akzeptiert. Sie sind allerdings unverzichtbar um die genetische Basis für tolerante Pathogene zu erhöhen und ein resilientes, nachhaltiges System zu errichten. Probleme mit resistenten Sorten: andere Krankheiten nehmen zu, die Resistenz wird überwunden.
- **Verbesserung der Bodenfruchtbarkeit**: im BO sollen natürliche Ressourcen des eigenen Systems angewandt werden, während externe Inputs minimiert werden sollen. Neben der Erntemenge sollte der Effekt eines Düngemittels auch nach Fruchtqualität und Shelf-life bestimmt werden. Biologische Düngemittel deren Zusammensetzung ähnlich den Bedürfnissen der Bäume sind werden benötigt.
- **Pflanzenschutzstrategien**: Biodiversität wird mit direkten Applikationen von Pflanzenschutzmitteln kombiniert (natürliche oder von der Natur stammende Substanzen).
  Unkrautbekämpfung: Angewandte Strategie: Kombination von Bodenbearbeitung im Frühjahr gefolgt von leichter Bedeckung der Baumreihe mit geschnittener Vegetation, zusammen mit einer neuen Technologie, welche Unkraut durch Bürsten entfernt. Eine Gründünger-Periode vor der Neupflanzung wird empfohlen.
  Krankheitsbekämpfung: indirekte Methoden: weniger anfällige Sorten; für Schorf: Reduktion der Sporenkonzentration. Direkte Methoden: Kupfer, Schwefel, Schwefelkalk, Karbonate. 4 Säulen zur Kupferreduktion: weniger anfällige Sorten, Reduktion des Befallsrisikos, Vorhersagemodelle um die Anwendungen genau zu timen, neue Produkte, Regenabdeckungen. Gegen Lagerkrankheiten: Heißwasserbehandlungen.
  Schädlingsbekämpfung: funktionelle Biodiversität. Lücke: wenig Wissen über das Auftreten und die Biologie vieler Prädatoren. Die Apfelblattlaus bedarf direkte Kontrollmaßnahmen. Die Blattwespe wird mit Quassia amara-Extrakten bekämpft. Verwirrungsmethoden sowie Netze werden gegen den Apfelwickler eingesetzt. Neue exotische Schädlinge können jedoch jederzeit auftreten.
  Ausdünnung: u.a. werden Transpirationshemmer angewendet.
- **Ökosystemservice:** Life-cycle-assesment systeme werden benötigt (Energiekonum, ökologischer Fußabdruck verschiedener Produktionssysteme)!

Summary (english):

Focus and some key challenges in research on Organic Farming (OF):

- **Development of varieties and rootstocks suited to OF:** varieties should hold low susceptibility towards the most important diseases, pests and abiotic damages (frost, sunburn…). Fruits should be tasty, salubrious, low in allergens, with a good shelf-life and storage stability. Breeding techniques based on genetic modification are not accepted in OF. However, for a truly resilient sustainable system, it will be indispensable to broaden the genetic basis of the tolerance to pathogens. Problem with resistant varieties: other diseases become prominent, resistance breakdown.
- **Improving soil fertility management:** in OF natural resources internal to the system are applied and off-farm inputs are minimized. Next to the yield, evaluation of the effect of fertilization should consider the fruit quality and the shelf-life. Also, organic fertilizers are needed in OF that have a nutrient composition close to the needs of the fruit trees.
- **Strategies for plant health care:** Biodiversity is combined with the direct input of plant protection products (natural or naturally derived substances).
  Weed control: A spread practice: Combination strategies of tillage in spring followed by a light cover of the tree row with the cut vegetation, combined with a new machinery that removes weed by brushing. A green manure period before planting is advised.
  Disease control: indirect methods: less susceptible varieties; for apple scab: reduction of ascospore concentration. Direct methods: copper, sulphur, lime sulphur, carbonates. 4 pillars to reduce copper: less susceptible varieties, reduce infestation potential, forecasting models for precise timing of applications, new products, rain covers. For storage diseases: hot water treatments.
  Pest control: functional biodiversity. Gap: little knowledge about occurrence and biology of many natural predators. The rosy apple aphid requires direct control measures. Direct control of apple sawfly is managed with Quassia amara extracts. Codling moth is controlled through mating disruption and several measures (mainly C. pomonella granulosis virus). The population of diapausing larvae can be reduced with entomophagous nematodes in autumn. The codling moth population is also reduced with netting. New exotic pests can appear any time.
  Thinning: rope thinners are tested and the application of transpiration inhibitors.
- **Ecosystem services:** Calculation systems that allow a fast check of the effect of intended changes in the production system on carbon footprint and energy consumption would be important!

Section B. Project information

***Project coordinator:**	Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049
***Project period:**	2016 - 2019
***Project status:**	Ongoing
***Funded by:**	Horizon 2020
***Total budget:**	€1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, UKG11 Herefordshire, UKG12, Worcestershire, UKH12 Cambridgeshire, UKH16 North and West

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Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Errichtung eines europäischen Netzwerkes, welches sich auf den Obstsektor konzentriert
2. Entwicklung und Umsetzung einer systematischen Vorgehensweise zum Festhalten und Synthetisieren des bestehenden wissenschaftlichen und praktischen Wissens
3. Schaffen eines kontinuierlichen/anhaltenden Dialogs mit relevanten EU, nationalen, sowie regionalen politischen Körperschaften
4. Identifikation und Unterstützung von neuen prioritären Forschungsgebieten durch das kontinuierliche Monitoring und Analysieren von bestehender und aufkommender Forschung und Innovationsaktivitäten.

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

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2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL
4. Obstbauversuchsanstalt Jork (Germany) • OVA
5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA
8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
10. University of Agronomic Sciences and Veterinary Medicine of Bucharest (Romania) • USAMV
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20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
Markus Kelderer, Laimburg

Author: Dr. Markus Kelderer, Laimburg Research Centre, Markus.Kelderer@laimburg.it, +390471969662

Country: Italy

NUTS 3 region(s)[2]: ITH10 Bolzano-Bozen

WP no. and title: WP3, Reduction in pesticide residues

Date: 20/04/2017

Source materials and methodology

J. Kienzle, Independent Researcer, M. Kelderer, Laimburg Research Centre, "Growing organic apples in Europe", in K. Evans (edt)., Washington State University, "Achieving sustainable cultivation of apples" (2017). ISBN-13: 9781786760326

Best practice findings

Def. Organic farming (OF): sustainable holistic farming system, including the whole food processing chain from farmer to consumer. Regarding research in OF, it is often characterized by a participatory and holistic approach.

The Council Regulation (EC) NO 834/2007 defines that natural resources internal to the system should be applied. External resources can be applied too, but they should derive from organic production or from products present in nature. The OF sector is constantly increasing and includes currently at least 10% of the fruit-growing area in important EU-fruit-growing regions. This was mainly possible due to the innovations in the plant health care strategy, the equipment for tree row tillage and the introduction of new robust varieties. However, there are still some key challenges for OF research to be faced:

- **Development of varieties and rootstocks suited to OF:** varieties should present a durable level of low susceptibility towards the most important diseases, pests and abiotic damages (frost, sunburn…). Fruits should be tasty, salubrious, low in allergens, with a good shelf-life and storage stability. Breeding techniques based on genetic modification are not accepted in OF. However, for a truly resilient sustainable system, it will be indispensable to broaden the genetic basis of the tolerance to pathogens.
  Recently, some EU research stations collaborated with organic farmers to establish special test systems under organic conditions.
  Once scab resistant varieties were introduced and organic farmers reduced the application of fungicides, other diseases became prominent, and a resistance breakdown is already observed frequently. Yet, the scab-resistant varieties still produce an interesting output (no fruit damaged by scab) with a lower input.
  New breeding approaches: Pyramiding of several scab resistances with powdery mildew resistance and fire blight tolerance; and quantitative tolerance on a genetical basis as broad as possible.
- **Improving soil fertility management:** in OF natural resources internal to the system are applied and off-farm inputs are minimized (i.e. through the on-farm production of fertilizers, cover crops in the alley can provide nitrogen fixation, biomass for mulch…). Next to the yield, evaluation of the effect of fertilization should consider the fruit quality and the shelf-life, using i.e. formulations based on rhizosphere microorganisms. Also, some researchers expressed the need to use organic fertilizers in OF that have a nutrient composition close to the needs of the fruit trees.
- **Strategies for plant health care:** Biodiversity is a central part of the plant health care strategies in OF and is combined with the direct input of plant protection products: these are natural or naturally derived substances. In future, quantitative and qualitative aspects of how these substances occur in nature will be more important. The registration of naturally occurring substances is difficult. Thus, the technical issues of the development of new substances are as important as the support for the registration of the substance.

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Weed control: different tillage and mulching types for OF are studied. Combination strategies of tillage in spring for nitrogen mobilization followed by a light cover of the tree row with the cut vegetation, combined with a new machinery that removes weed by brushing is practised. A green manure period before planting is advised.
Disease control: indirect methods: less susceptible varieties; for apple scab: reduction of ascospore concentration (mechanical removal of leaves, accelerate decomposition, irrigation before rain to elicit the release of ascospores). Direct methods: copper (low amounts of copper with frequent applications), sulphur, lime sulphur, carbonates. BUT copper accumulates in the soil; 4 pillars to reduce copper: less susceptible varieties, reduce infestation potential, forecasting models for precise timing of applications (i.e. scab 'Stop applications'), new products (alternatives such as carbonate-formulations, Limonene, electrolyzed water, liquorice extract, thymol extract, cladosporium formulations, algae extracts and others are tested). Rain roofs seem attractive to prevent many diseases. For storage diseases: hot water treatments are tested.
Pest control: functional biodiversity (for enhancement of beneficials: flowering plant strips). Gap: little knowledge about occurrence and biology of many natural predators. The rosy apple aphid requires direct control measures. Direct control of apple sawfly is managed with Quassia amara extracts, and some tests are conducted to reduce the population by application of entomophagous nematodes in spring. Codling moth is controlled through mating disruption and several measures (mainly C. pomonella gronulosis virus). The population of diapausing larvae can be reduced with entomophagous nematodes in autumn. The codling moth population is also reduced with netting. New exotic pests can appear any time.
Thinning: rope thinners are tested and the application of transpiration inhibitors.

- **Ecosystem services:** Calculation systems that allow a fast check of the effect of intended changes in the production system on carbon footprint and energy consumption would be important!

Scanning report (EIP format for practice abstracts)

***Project title (native language): EUFRUIT: Rețeaua Europeană de Pomicultură**

***Project title (English): EUFRUIT: European Fruit Network**

***Author/native language editor:** Conf.dr. Iacomi Beatrice, Bd. Marasti, 59, 011464 București, Romania;
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Section A. Summary for EIP dissemination

***Keywords:** organic apple, apple scab, powdery mildew, potasium bicarbonate

***Main geographical location:** RO321 București

Other geographical locations: 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 Telorman, RO321 București, RO322 Ilfov, RO411 Dolj, RO412 Gorj, RO413 Mehedinți, RO414 Olt, RO415 Vâlcea, RO421 Arad, RO422 Caraș-Severin, RO423 Hunedoara, RO424 Timiș

***Summary (native language):**

In ultimii ani, plantațiile de măr în sistem organic se extind continuu, odată cu creșterea cererii pentru mere sănătoase, fără rezidii chimice. Pentru pomicultori, managementul rapănului și făinării rămâne în continuare o provocare, știut fiind faptul că în plantațiile organice doar câteva produse (cu molecula activă sulf și cupru) sunt omologate și acceptate pentru controlul acestor două boli. Chiar dacă cuprul a rămas o moleculă eficace, persistentă și ieftină, în timp, utilizarea sa în mari cantități, duce la acumularea în solul plantației, peste limita europeană (36 mg/kg de sol). Sulful și compușii pe bază de sulf au, adesea, proprietăți mai puțin curative decât compușii pe bază de cupru, mai ales în condiții de vreme rece. In acest context, au fost identificate alternative organice, precum bicarbonații, potențiale fungicide în managementul bolilor în plantațiile de măr.

Bicarbonatul de potasiu este considerat un produs fără risc din punct de vedere ecotoxicologic și face parte dintre substanțele active care pot fi folosite în agricultura organică pentru managementul bolilor (Anexa II EEC 2091/92).

Pntru managementul răpănului și făinării au fost testate următoarele produse acceptate în pomicultura organică: bicarbonat de potasiu (85%, 5 kg/ha), polisulfură de calciu (5 kg/ha), sulf (Thiovit Jet - 4 kg/ha), silicat de potasiu (30%, 2.6 kg/ha) și amestecurile bicarbonat de potasiu + silicat de potasiu (20%, 2.5kg/ha + 30%, 0.5 kg/ha), bicarbonat de potasiu + sulf (20%, 5 kg/ha + 2 kg/ha). Tratamentele au fost aplicate într-o livadă comercială din Cluj-Napoca (Steluța LTD).

Toate tratamentele au controlat eficace rapănul și făinarea comparativ cu martorul netratat (Mitre et al., 2018). Bicarbonatul de potasiu a redus atacul de rapăn și făinare, fiind la fel de eficace precum sulful dar mult mai eficae în combinație cu acesta, aplicat după fiecare ploaie. Amestecul bicarbonat de potasiu + silicat de potasiu a înregistrat aceeași eficacitate în reducerea atacului de rapăn și făinare precum cea a amestecului bicarbonat de potasiu + sulf. Nu au fost înregistrate simptome de fitotoxicitate pe frunze sau fructe, cu excepția polisulfurii de calciu și sulfului.

Lipsa toxicității pentru om și a rezidiilor chimice din fructe face ca aceste produse să devină de perspectivă pentru plantațiile organice de măr, pentru managementul făinării și rapănului.

Summary (english):

In the last decades, organic apple crop is constantly expanding, and the demand for healthy apples, with no chemical residues, is increasing. For organic apple growers, the biggest challenge is scab and powdery mildew management. In organic apple, sulphur and copper products are available. Even if the copper is effective, persistent and, highly active, over the years, repeated applications of copper-based compounds is leading to an accumulation of copper in the orchard soil (official limit in Europe: 36 mg kg^{-1} soil). Elementary sulphur and sulphur based compounds often have less curative properties against scab

and powdery mildew than copper-based compounds, especially in cold weather (unless lime sulphur). In this terms, bicarbonates salts were identified as potential tools in apple diseases management.

Among the bicarbonates salts, potassium bicarbonate is considered harmless from an ecotoxicological and toxicological point of view and this product has already been introduced in Annex II of European Regulation EEC 2091/92 (list of active substances which may be used as plant protection products in organic farming).

Potassium bicarbonate ((85%, 5 kg/ha), lime sulphur (5kg/ha), wettable sulphur (Thiovit jet, 4 kg/ha), potassium silicate (30%, 2.6 kg/ha), cooper ammonium-phosphate (300 g/ha) as well as the mixtures potassium bicarbonate + potassium silicate (20%, 2.6 kg/ha + 30%, 0.5 kg/ha), potassium bicarbonate + wettable sulphur (20%, 5 kg/ha + 2 kg/ha) were tested to control apple scab and powdery mildew. The experiment was carried out in a commercial apple orchard (Steluța LTD) in Cluj-Napoca (Mitre et al., 2018).

All products gave better results than the untreated control. Potassium bicarbonate used alone had reduced apple scab and powdery mildew, being as effective as wettable sulphur, but was more effective in combination with wettable sulphur applied immediately after each rain. The mixture potassium bicarbonate + potassium silicate was as effective as the mixture potassium bicarbonate + wettable sulphur in reducing apple scab and powdery mildew attack. No symptoms of phytotoxicity on leaves or fruits, except lime sulphur and wettable sulphur and cooper ammonium phosphates was recorded.

Given that this products are not toxic to human health, they becomes a perspective fungicides, especially for organic fruit tree growing in order to control apple scab and powdery mildew attack.

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Realizarea unei rețele europene în sectorul pomicol
2. Dezvoltarea și implementarea unei abordări sistematice pentru scanarea și sintetizarea cunoștințelor practice și științifice existente
3. Stabilirea unui dialog continuu cu organisme recunoscute de politici europene, naționale și regionale
4. Identificarea și sprijinirea unor noi domenii prioritare de cercetare prin monitorizarea continuă și analiza activităților existente și viitoare de cercetare-inovare

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

1. Aarhus University, Department of Food Science (Denmark) • AU
2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL
4. Obstbauversuchsanstalt Jork (Germany) • OVA
5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA
8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
10. University of Agronomic Sciences and Veterinary Medicine of Bucharest (Romania) • USAMV
11. National Agricultural Research and Innovation Centre Fruitculture Research Institute (Hungary) • NARIC
12. Lithuanian Research Centre for Agriculture and Forestry (Lithuania) • LRCAF
13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
14. Variety Innovation Consortium South Tyrol (Italy) • SKST
15. Freshfel Europe (Belgium) • FRESHFEL
16. Elbe-Obst Erzeugerorganisation r.V. (Germany) • EO
17. Fruitconsult BV (Netherlands) • FC
18. University of Greenwich (United Kingdom) • UoG
19. University of Hohenheim (Germany) • UHOH
20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
[Iacomi Beatrice, Ana Cornelia Butcaru, USAMV]

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Country: Romania

NUTS 3 region(s)[2]: 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 Telorman, 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: WP 3 – Reduction in pesticides residues

Date: 05.04.2018

Source materials and methodology

One of the three priorities of the National Strategy for the Development of the Food sector (2020-2030) consist in growing the organic production, from 3% in the present to 10% in 2020 respectively 15% in 2030 (http://www.madr.ro/strategia-pentru-dezvoltarea-sectorului-agroalimentar-pe-termen-mediu-si-lung-orizont-2020-2030.html).

In the last decades, organic apple crop is constantly expanding, and the demand for healthy apples, with no chemical residues, is increasing. For organic apple growers, the biggest challenge is scab (*Venturia inaequalis*) and powdery mildew (*Podosphaera leucotricha*) management. In organic apple growing, just a few approved products are available for disease control, mainly based on sulphur and copper.

The use of copper in organic apple is often disputed even if the copper is effective, persistent, highly active, and covers a well-known number of fungal diseases. Over the years, the application of copper-based compounds especially in high quantities is leading to an accumulation of copper in the orchard soil over of the official limit in Europe (36 mg kg-1 soil). Elementary sulphur and sulphur based compounds often have less curative proprieties against scab and powdery mildew than copper-based compounds, especially in cold weather (unless lime sulphur). In this terms, reduced risk alternatives, such as bicarbonates salts were identified as potential tools in apple diseases management.

Sources:

http://www.madr.ro/strategia-pentru-dezvoltarea-sectorului-agroalimentar-pe-termen-mediu-si-lung-orizont-2020-2030.html

Mitre I., Mitre V., Sestras R., Pop A., Sestras A. 2009. Potassium bicarbonate in preventing and control apple scab. Bulletin UASMV Horticulture 66(1-2):186-190.

Mitre V., Mitre I., Sestras A., Sestras R. 2010. New products against apple scab and powdery mildew attack in organic apple production. *Notulae Botanicae Horti Agrobotanici* Cluj-Napoca 38(3):234-238.

Mitre V., Buta E., Lukács L., Mitre I., Teodorescu R., Hoza D., Sestraș A., Stănică F. 2018. Management of Apple Scab and Powdery Mildew Using Bicarbonate Salts and Other Alternative Organic Products with Fungicide Effect in Apple Cultivars. *Notulae Botanicae Horti Agrobotanici* Cluj-Napoca, 46(1):115-121. DOI: 10.15835/nbha46110783

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Best practice findings

Bicarbonates as alternative fungicides in apple scab and powdery mildew management

The fungicidal properties of bicarbonates have long been known but have never been significantly exploited and used in agriculture. However, bicarbonate salts have experienced a revival of attention in recent years as alternatives for plant disease control.

Among the bicarbonates salts, potassium bicarbonate is considered harmless from an ecotoxicological and toxicological point of view (Environmental Protection Agency – EPA, 1999) and this product has already been introduced in Annex II of European Regulation EEC 2091/92, list of active substances which may be used as plant protection products in organic farming.

Potassium bicarbonate and some other products accepted in organic apple production were tested to control apple scab (*Venturia inaequalis*) and powdery mildew (*Podosphaera leucotricha*). The experiment was carried out in a commercial apple orchard (3,175 trees/ha) established in 2011 belonging to Steluța LTD, Cluj-Napoca, Transylvania (NW Romania). The biological material was represented by three scab resistant cultivars (Luna, Topaz and Sirius) and three scab susceptible cultivars (Elstar, Pinova and Golden Delicious).

The tested products were: potasium bicarbonate (85%, 5 kg/ha), lime sulphur (5 kg/ha), wettable sulphur (Thiovit Jet, 4 kg/ha), potassium silicate (30%, 2.6 kg/ha), cooper ammonium-phosphate (300 g/ha) and the mixtures potassium bicarbonate + potassium silicate (20%, 2.5 kg/ha + 30%, 0.5 kg/ha), potassium bicarbonate + wettable sulphur (20%, 5 kg/ha + 2 kg/ha). First treatments were applied just before or at the beginning of the infection risk periods. A number of 18-22 treatments were made annually (2014-2016), after each rain. All treatments were applied at a low spray rate of 500 l/ha (Mitre et al., 2018).

Visual observations in the field were made on the intensity and frequency attack of apple scab and apple powdery mildew on leaves, the intensity and frequency attack of scab on fruits and phytotoxicity on leaves and fruit. Fruit scab intensity and frequency was calculated (as the proportion of total harvested fruit with at least one scab lesion).

All products gave better results than the untreated control. Potassium bicarbonate used alone reduced apple scab and powdery mildew, being as effective as wettable sulphur, but was more effective in combination with wettable sulphur applied immediately after each rain.

The mixture potassium bicarbonate + potassium silicate was as effective as the mixture potassium bicarbonate + wettable sulphur in reducing apple scab and powdery mildew attack.

Wettable sulphur proved to be less effective in scab and powdery mildew control than lime sulphur. The advantage displayed by cooper ammonium phosphate is the efficiency, similar or better, to the potassium silicate, wettable sulphur and potassium bicarbonate, with a cooper doses of ten times lower per hectare, meaning lower price for disease control and longer lasting effect.

No symptoms of phytotoxicity on leaves or fruits, except lime sulphur and wettable sulphur and cooper ammonium phosphates was recorded.

Apple scab and apple powdery mildew control require a large number of treatments and substances, causing a large quantity of chemical residues on fruit. So, it is necessary to use a new generation of non-toxic substances for human health in apple disease management, such as potassium bicarbonate and potassium bicarbonate mixed with potassium silicate. Given that this products are not toxic to human health, they becomes a perspective fungicides, especially for organic fruit tree growing.

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **[**Europos sąjungos vaisių tinklas EUFRUIT**]**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** [dr. Alma Valiuškaitė, senior researcher, Head of Plant Protection Laboratory, Institute of Horticulture LRCAF. email: a.valiuskaite@lsdi.lt; phone: + 370 37 55 52 17]

Section A. Summary for EIP dissemination

***Keywords:** [aromatic plants, essential oils, inhibition, pathogens]

***Main geographical location:** [LT002 Kauno apskritis]

Other geographical locations: [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]

***Summary (native language):**

Augalai yra vertingas bioaktyvių junginių, tokių kaip terpenai, fenoliniai, eteriniai aliejai, alkaloidai ir t.t., šaltinis. Taikant įvairius ekstrakcijos metodus, iš augalų galima išgauti norimus junginius ekstraktų pavidalu. Tyrimais nustatytas augalinių ekstraktų toksiškas poveikis augalų ir žmonių patogenams.Augalų fenoliniai junginiai yra reikšmingi apsaugoje nuo patogeninių grybų. Žemės ūkio sektoriuje auga naujų augalų apsaugos produktų paklausa dėl esamų ir atsirandančių naujų žaladarių, kurie sparčiai įgyja arba jau turi atsparumą plačiai naudojamiems pesticidams. Nustatytas antimikrobinis ir antigrybinis aktyvumas turi potencialo augalinių ekstraktų pritaikymui maisto pramonėje ir augalų apsaugoje nuo žaladarių, kaip alternatyva cheminėms medžiagoms. Be to, augaliniai ekstraktai yra mažai toksiški ir suyrantys gamtoje. Naudojama ekstraktų koncentracija neturi daryti įtakos skoninėms ir aromatinėms produktų savybėms ir priimtinumui vartotojams. Tuo tikslu gali būti naudojami ekstraktų mišiniai, sudaryti iš mažesnių skirtingų ekstraktų koncentracijų. Dar vienas ekstraktų mišinių privalumas yra tai, kad patogenams sunkiau įgyti atsparumą kelioms sudedamosioms dalims. Šio straipsnio tikslas – apžvelgti augalinių ekstraktų sudėtį ir tyrimus, susijusius su ekstraktų antimikrobinėmis ir antigrybinėmis savybėmis.

Summary (english):

Plants are a valuable source of bioactive compounds: terpenes, phenolic compounds, essential oils, alkaloids etc. Applying different methods of extraction, desired components from plants could be obtained as extracts. Various studies determined plant extracts effect on plant pathogens and human pathogens. Phenolic compounds of the plants play an important role in protection against fungal pathogens. There is a growing demand for plant protection measures in the agronomy sector because of the new and existing plant diseases; plant pathogens are getting or already have resistance to widely used plant protection products. The findings of plant extract antimicrobial ant antifungal activities; low toxicity and biodegradability make it potential for use in the food industry and plant protection against pathogens instead of chemicals. The concentration of the extracts used should not change the sensory properties of the product in order not to become unacceptable to the consumers. The use of the extract mixtures could help to get better sensory properties of the products. The other advantage would be the difficulties for pathogens to get resistance to complex components.The aim of this publication is to review the composition of various plant extracts and the studies related to antimicrobial and antifungal properties of the extracts.

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement.Antwerpen),BE212 (Mechelen), BE213 (Turnhout),BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde),BE233(Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242(Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende),BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel),BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8Méditerranée;FR81 Languedoc-Roussillon,FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0(Schleswig-Holstein), DEE0 (Sachsen-Anhalt),DEA(Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119,E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE128, DE129, DE12A, DE12B,DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137,DE138, DE139, DE13A, DE141,DE142, DE143,DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 +NLZ Holland; NL224zuidwestGelderland, NL 226Arnhem/Nijmegen, NL230 Flevoland,NL310 Utrecht,NL321 Kopvan Noord-Holland, Nl322 Alkmaar enomgeving, NL338oost Zuid-Holland,NL33Azuidoost Zuid-Holland,NL341Zeeuws-Vlaanderen, NL342overig Zeeland,Nl411west Noord-Brabant, NL413 noordoostNoord-Brabant, NL414 zuidoostNoord-Brabant, NL421 noordLimburg, NL422 Midden-Limburg, NL423zuidLimburg, ES620Murcia,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,UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona,CH0 Schweiz/Suisse/Svizzera, ITH51-59 EmiliaRomagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, LT001 Alytausapskritis, LT002 Kaunoapskritis, LT003 Klaipėdosapskritis, LT004 Marijampolėsapskritis, LT005 Panevėžioapskritis, LT006 Šiauliųapskritis, LT007 Tauragėsapskritis, LT008 Telšiųapskritis, LT009 Utenos apskritis, LT00A Vilniausapskritis.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Sukurti Europos vaisių sektoriaus tinklą.
2. Parengti ir įgyvendinti mokslinių tyrimų ir praktinių žinių vieningą sklaidą.
3. Sukurti nuolatinį ryšį tarp atitinkamų ES, nacionalinių ir regioninių institucijų.
4. Nustatyti ir remti naujas prioritetines tyrimų sritis, nuolat stebėti ir analizuoti esamas bei būsimas mokslinių tyrimų ir inovacijų veiklas.

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

1. Aarhus University, Department of Food Science (Denmark) • AU
2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL
4. ObstbauversuchsanstaltJork (Germany) • OVA
5. StichtingWageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~(terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA

8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
10. University of Agronomic Sciences and Veterinary Medicine of Bucharest (Romania) • USAMV
11. National Agricultural Research and Innovation Centre Fruitculture Research Institute (Hungary) • NARIC
12. Lithuanian Research Centre for Agriculture and Forestry (Lithuania) • LRCAF
13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
14. Variety Innovation Consortium South Tyrol (Italy) • SKST
15. Freshfel Europe (Belgium) • FRESHFEL
16. Elbe-Obst Erzeugerorganisation r.V. (Germany) • EO
17. Fruitconsult BV (Netherlands) • FC
18. University of Greenwich (United Kingdom) • UoG
19. University of Hohenheim (Germany) • UHOH
20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report

[dr. Alma Valiuškaitė LRCAF]

Author: [dr. Alma Valiuškaitė, senior researcher, Head of Plant Protection Laboratory, Institute of Horticulture LRCAF. email: a.valiuskaite@lsdi.lt; phone: + 370 37 55 52 17]

Country: [LITHUANIA]

NUTS 3 region(s)[2]: [LT002 - Kaunas apskritis

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

Date: [17-04-2018]

Source materials and methodology

The present studies were carried out to investigate the antifungal effects of essential oils from different aromatic plants against pathogens. The research was carried out at the LAMMC Institute of Horticulture. The pathogens mycelial growth inhibition was evaluated at concentrations 200µl/l, 400µl/l, 600µl/l, 800µl/l and 1000µl/l. Single-spore of pathogens fragment was placed in the centre of PDA with different essential oil concentrations. Plates were incubated 22°C in darkness and evaluated after 2, 5, 7, 10 days.

Valiuškaitė A., Dambrauskienė E., Šernaitė L., Karklelienė R., Rasiukevičiūtė N. Antifungal activity of essential oil from *Coriandrum sativum* essential oil on seed pathogens. Biological and integrated control of plant pathogens IOBC-WPRS Bulletin Vol. 133, 2018 p. 44

Rasiukevičiūtė N., Supronienė S., Valiuškaitė A., Morkeliūnė A., Dambrauskienė E. Essential oils from *Thymus vulgaris* and *Coriandrum sativum* for the control of *Fusarium graminearum.* Biological and integrated control of plant pathogens IOBC-WPRS Bulletin Vol. 133, 2018 p. 48

Valiuškaitė A., Dambrauskienė E., Rasiukevičiūtė N. Aromatic plants activity on *Alternaria* spp. pathogen. Biological and integrated control of plant pathogens IOBC-WPRS Bulletin Vol. 133, 2018 p. 49

Rasiukevičiūtė N., Valiuškaitė A., Uselis N., Lukšienė Ž. Environment-friendly postharvest technologies reducing strawberry fruit contamination. Biological and integrated control of plant pathogens IOBC-WPRS Bulletin Vol. 133, 2018 pp. 98-99

Šernaitė L. 2017. Plant extracts: antimicrobial and antifungal activity and appliance in plant protection.Review. Sodininkystė ir daržininkystė, 36 (3-4):58-68.

Best practice findings

The use of biological plant protection products is also an integral part of integrated harmful organism management. In the Plan of Plant Protection (National Action Plan), confirmed by the 2012 June 29th law of the Minister of Agriculture of the Republic of Lithuania, is emphasized that integrated control of harmful organisms is inseparable from the use of biological plant protection products. At the moment the assortment of these products is quite scarce and is necessary to promote biological plant protection products efficiency and appliance research. Therefore the challenge is to create innovative biological products – bio pesticides – from the plants, which are grown under the conditions of Lithuanian climate that have a composition of valuable organic components, have high herbs yields and pesticide properties. The *Thymus vulgaris* and *Coriandrum sativum* essential oils were extracted from local material. The antifungal activity was assessed based on radial growth inhibitions. The essential oils are promising for control of *Alternaria* spp. pathogens. The results showed that essential oils from *T. vulgaris* completely inhibited Alternaria spp. growth at concentration > 400 µl/l and essential oils from *C. ativum* inhibited mycelial growth of tested pathogen at a concentration of > 600 µl/l. *T. vulgaris* and *C. sativum* essential oils showed inhibitory effect on *F.graminearum* mycelial development. There was no growth in *T. vulgaris* concentration of > 400 µl/l. The highest inhibitory effect was registered for treatment with *C. sativum* essential oil at concentrations > 800 µl/l. There is describes the antifungal activity of two

[1]Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

essential oils on *F.graminearum,* which could be useful in designing new biocontrol product. Essential oils are a promising tool for their antifungal properties as biodegradable and eco-friendly botanical products. Essential oils have the ability to influence the growth of pathogens because of the natural compounds in oils. The demand for natural bioproducts significantly increased, due to the adverse effects of pesticides. Investigation of the composition of grown in Lithuania plants CO2 extracts and their effect on horticulture, field and orchard plants harmful organisms could let to discover perspective material for the creation of alternative products with pesticide properties. Application of these products in horticulture, gardening and crop production is undoubted. One of the ways of application would be in strawberries gardens, where picking up of the berries is continuous and the danger of the harmful organisms is high.

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

Author:	Dr Daniel Bray, Dr Deborah Rees, Dr Richard Hopkins, Professor David Hall, University of Greenwich, d.bray@gre.ac.uk, +44 1634 883729
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:	31-05-2018
	[Y1 report due May 2016 for the period 03-16 to 05-16
	Y2 report due May 2017 for the period 06-16 to 05-17
	Y3 report due May 2018 for the period 06-17 to 05-18]

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)

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 of the funding comes from commercial partners. 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

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

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 projects.

Best practice findings

POME FRUIT

Monitoring

The pear weevil *Anthonomus spilotus* is a new pest to the UK, believed to have arrived in 2015 (AHDB Factsheet 10/18). Growers are advised to monitor pear orchards weekly from February-May by tap sampling branches, and checking for the presence of adult weevils. As there is currently no economic threshold for this pest, careful consideration should be made prior to application of chemical control measures.

Project TF 223 continues to monitor for a number of important apple diseases. In 2016, apple scab was more severe on *vf* - expressing cultivars than in previous years, suggesting that the pathogen may have broken the resistance normally conferred by this gene.

Biocontrol products

AHDB project TF 220 has explored the effects of pest control products commonly applied in orchards on earwigs. These insects are recognized as important generalist predators of pests in apples and pears. Recommendations for growers based on the project findings were that occasional sprays of Agrimec, Calpyso or Gazelle were unlikely to have long term effects on large earwig populations if application are made in response to pest thresholds. However, applications of Agrimec and Envidor in pear orchards should be avoided in early summer, when numbers of young earwigs appear to decline.

Work in project TF 218 focussed on formulation of a combination of semiochemicals into a release device to attract hoverflies to orchards. Hoverfly larvae are important predators of aphids, and attracting adult hoverflies into orchards early in the season may assist in control aphid numbers. The developed lures were consistently attractive to hoverflies, and will be tested in large plot trials in project TF 223.

Ongoing research

Project CP 161 - Endophytes of Apple. This PhD project will determine whether *Neonectria ditissima*, the causative agent of European apple canker, resides in apples prior to the onset of visible disease. Serological tools and next generation sequencing will be applied to increase our knowledge of asymptomatic infection of apples by endophytes, and to determine whether abiotic stressors (including planting) can trigger the onset of disease.

Project TF 223 - Improving integrated pest and disease management in Tree Fruit aims to develop IPM approaches to replace the loss of active pesticide substances which are being withdrawn for use in the UK. The project is investigating new tools to reduce losses from European apple canker, scab, powdery mildew, Monilinia species and bacterial canker affecting stone fruit, codling and tortrix moths, pear sucker, apple fruit rhynchites weevil, apple sawfly and phytophagous mites.

STONE FRUIT

Monitoring

Monitoring for *Xylella fastidiosa* continues in project TF 223. The main recommendations for growers are to keep plant passports up to date and not to bring in plant material from demarcated areas.

Biocontrol

Spider mites (*Tetranychus urticae*) on cherry trees maintained under cover can produce enough webbing to reduce photosynthesis and interfere with harvesting. The problem is exacerbated by withdrawal of the active substance Clofentezine for control on cherries. Project TF 219 explored whether these pests can be controlled by the predatory mite *Amblyseius andersoni*. Predator introduction at a rate of one sachet per 5 trees was found to be a potential toll for spider mite control.

SOFT FRUIT

Monitoring, physical barriers and cultural methods

Numbers of *Drosophila suzukii* detected through surveillance in project 223 continue to increase year on year. Growers are advised by AHDB (Factsheet 06/17) to monitor adults from March using Drosotraps at a density of two traps per hectare. As fruit begins to ripen, growers should use weekly flotation tests to check for presence of larvae in developing fruits. Strict crop hygiene measures should be applied during harvest, with all waste fruit disposed of within 48 hours. More cost-effective lures, which require less labour to deploy and replace than current liquid-based attractants, were developed in Innovate project 132169.

Ongoing research

AHDB project CP 165 – SCEPTREplus will identify sustainable plant protection products for use in horticulture. New active ingredients and biopesticides which are better targeted and have lower environmental impact than existing pesticides are being produced. However, few products are register for use because the UK horticultural market is relatively small compared to costs of development. This project, which will run until 2021, will assess currently available and pre-commercial pesticides and biopesticides for use in the UK horticultural market, in order both to meet growers' need for crop protection productions, and to reduce pesticide use.

Reports cited (all available on www.horticulture.ahdb.org.uk)

CP 165 - SCEPTREplus - Research for sustainable plant protection products for use in horticulture

CP 161 - Endophytes of Apple: Understanding Endophytes to improve tree health

TF 218 - Increasing hoverfly populations in apple orchards for control of apple aphids

TF 219 – Control of two-spotted 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 223 - Improving integrated pest and disease management in Tree Fruit

Factsheet 06/17 - Management and control of spotted wing drosophila

Factsheet 10/18 - *Anthonomus spilotus* – a new pest of pears in spring.

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **EUFRUIT: Europäisches Obstnetzwerk**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** [Dr. Christian Scheer, Kompetenzzentrum Obstbau, Schuhmacherhof 6, 88213 Ravensburg, Deutschland; scheer@kob-bavendorf.de; 0049 751 7903 306].

Section A. Summary for EIP dissemination

***Keywords:** [**Reduction of herbicide, Optimising plant protection, Low residue production, Strategy against spotted wing drosophila**]

***Main geographical location:** [main location in at NUTS 3 level; see below, 'NUTS 3 region(s)']

Other geographical locations: [copy other NUTS 3 region from section C, below, 'NUTS 3 region(s)']

***Summary (native language):**

Am Kompetenzzentrum Obstbau Bodensee werden vier Projekte durchgeführt, die unter anderem einen reduzierten Aufwand von Pflanzenschutzmitteln zum Ziel haben.

In einem ersten Projekt werden Methoden zur Unkrautbekämpfung untersucht. Im speziellen wurde hier eine Methode mit 98°C heißem Wasser getestet. Diese stellte sich jedoch aufgrund eines hohen Wasser- und Zeitaufwandes als wenig effizient raus. Eine weitere Methode mit heißem Dampf könnte vielversprechender sein.

Per Dronenbefliegung soll eine individualisierte Applikationskarte entstehen. Mit den Information der Oberflächenstruktur individueller Bäume sowie dem Ort und der Größe von Baumlücken kann dann in Kombination mit computergesteuerten Spritzen eine Reduktion von Pflanzenschutzmitteln erfolgen.

In einem dritten Projekt sollen per Vergleich vier verschiedener Anbauflächen, welche sich im Aufwand der Pflanzenschutzmittel sowie ihrer Ausstattung unterscheiden, verschiedenen Lösungsansätze und deren Probleme zur Reduktion von PSM aufgezeigt werden.

Ein Projekt zur Bekämpfung der Kirschessigfliege zeigt, dass der alleinige Einsatz von PSM nicht effizient ist. Nur die Kombination von insektensicherem Netz, Hygiene und Pflanzenschutz stellt hier einen effizienten Schutz dar.

Summary (english):

[space for optional translation of the native language short summary of scanning report to English]

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-

Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Etablierung eines europäischen Netzwerks, das sich auf den Obstsektor konzentriert.
2. Entwicklung und Umsetzung eines systemischen Ansatzes zur Sichtung und Zusammenstellung bestehenden wissenschaftlichen und praxisnahen Wissens.
3. Etablierung eines laufenden Dialogs mit relevanten politischen Gremien auf regionaler, nationaler und EU Ebene.
4. Ermittlung und Unterstützung neuer Forschungsschwerpunkte durch kontinuierliches Monitoring und Auswertung bestehender und neu entstehender Forschungs- und Innovationsaktivitäten.

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

1. Aarhus University, Department of Food Science (Denmark) • AU
2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL
4. Obstbauversuchsanstalt Jork (Germany) • OVA
5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA
8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
10. University of Agronomic Sciences and Veterinary Medicine of Bucharest (Romania) • USAMV
11. National Agricultural Research and Innovation Centre Fruitculture Research Institute (Hungary) • NARIC
12. Lithuanian Research Centre for Agriculture and Forestry (Lithuania) • LRCAF

13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
14. Variety Innovation Consortium South Tyrol (Italy) • SKST
15. Freshfel Europe (Belgium) • FRESHFEL
16. Elbe-Obst Erzeugerorganisation r.V. (Germany) • EO
17. Fruitconsult BV (Netherlands) • FC
18. University of Greenwich (United Kingdom) • UoG
19. University of Hohenheim (Germany) • UHOH
20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016

Section C. Annex: Scanning report[1]

Scanning report
[Dr. Christian Scheer, Foundation KOB]

Author: [Dr. Christian Scheer, Kompetenzzentrum Obstbau, Schuhmacherhof 6, 88213 Ravensburg, Deutschland; scheer@kob-bavendorf.de; 0049 751 7903 306].

Country: Germany

NUTS 3 region(s)[2]: [code(s) and name(s)]

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

Date: [18.04.2018]

Source materials and methodology

Reduction of herbicide:

The intention of this investigation was to test if a common hot water method, which normally is used on non agricultural areas, is also useful for the herbicide control in fruit production. Therefor the KOB tested a common system that removes herbicides with hot water with a temperature of 98°C.

Furthermore the KOB testes a method that works alternatively with hot steam instead of hot water.

Optimising plant protection:

This BLE project is called Corona PRO. The aim of the project is to find a method to optimise the use of pesticides. Therefor orchards should be scanned by drone technology to record gaps in the orchard and the surface structure of individual trees. These data serve to generate individual applications maps. In combination with computer controlled sprayers these new technology could reduce the output of pesticides.

Low residue production:

Limitations of application rules, increasing residue conditions and reduced applications rates in contrast to healthy, sustainable, cheap and high quality fruits demands new methods. The aim of this project is to compare different production scenarios. Therefor at the KOB a model orchard with 2 ha was established. This orchard is divided in four equal areas (each 0.5 ha) with different treatment protection components (roof and insect nets).

1. roof with insect nets at all sites and reduced plant protection
2. roof with reduced fungicides
3. hail net with plant protection (IP standard)
4. hail net with reduced plant protection

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Strategy against spotted wing drosophila:

After emerging in 2011 in the Lake Constance region spotted wing drosophila (SWD) has established. In cooperation with several partners around the Lake Constance the KOB searches for efficient methods against SWD. These investigations include to test the effectivity of different insecticides in the lab, in semi field trails and in field trails. We also test alternative methods like mass trapping, netting or methods with reduced amount of insecticides. A long term monitoring gives us information about the annual appearance and the annual damages.

Best practice findings

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

Reduction of herbicide:

In the field the hot water method shows several problems. For an efficient use in the field the water uptake as well as the time amount was too high. Economically this method was not satisfying.

In first trails the method with hot steam shows better results. However this investigation is not completed.

Optimising plant protection:

The project is still in the initial phase.

Low residue production:

After installing the model orchards, now the phase of investigations has just begun.

Strategy against spotted wing drosophila:

Our investigations show, the control of SWD only with pesticides is not efficient. The best method against SWD is a combination of insect nets, hygiene and insecticides. This three component strategy helps to reduce the amount of insecticides compared to orchards without nets.

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **[EUFRUIT: Network Europeo di Frutticoltura]**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** [Dr Francesco Spinelli, Department of Agricultural Sciences, Alma Mater Studiorum - University of Bologna, viale Fanin 46, 40127 Bologna – Italy, Phone: +39 051 2096436; Email: Francesco.spinelli3@unibo.it]

Section A. Summary for EIP dissemination

***Keywords:** [minimal pesticides input, alternative control strategies, IPM, DSS and pest control]

***Main geographical location:** [ITH55]

Other geographical locations: [ITH51, ITH52, ITH53, ITH54, ITH56, ITH57, ITH58, ITH59]

***Summary (native language):**

Questo documento riporta una sintesi delle più moderne e sostenibili strategie per minimizzare l'uso di pesticidi in frutticoltura.

Summary (english):

[space for optional translation of the native language short summary of scanning report to English]

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124, DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent,

UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

[Please translate project objectives, below, to native language]

1. Sviluppare una Rete Europea del settore frutticolo
2. Sviluppare e rafforzare un approccio di sistema per la sintesi e disseminazione dei risultati scientifici ai principali attori della filiera frutticola
3. Creare una rete per la discussione tra il mondo scientifico, la filiera produttiva e gli organi legislativi nazionali e regionali
4. Identificazione e promozione delle aree di ricerca prioritarie tramite il costante e capillare monitoraggio dell'offerta di ricerca e innovazione a livello Europeo

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

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21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
[Francesco Spinelli, UNIBO]

Author: [Dr Francesco Spinelli, Department of Agricultural Sciences, Alma Mater Studiorum -University of Bologna, viale Fanin 46, 40127 Bologna – Italy, Phone: +39 051 2096436; Email: Francesco.spinelli3@unibo.it]]

Country: [Italy]

NUTS 3 region(s)[2]: [ITH51, ITH52, ITH53, ITH54, ITH55, ITH56, ITH57, ITH58, ITH59]

WP no. and title: [WP3 -Physical Barrier]

Date: [14-07-2017]

Source materials and methodology

[I am leading the working package on "Practical Solution for Control" inside the FP7 project DROPSA "Strategies to develop effective, innovative and practical approaches to protect major European fruit crops from pests and pathogens" (Grant Agreement: 613678). I was also UNIBO principal investigator for the FP6 project QDETECT: "Developing quarantine pest detection methods for use by National Plant Protection Organizations (NPPO) and inspection services" (Grant Agreement: 245047). The participation to these projects allowed a constant update of the most effective and innovative control strategies. Moreover, in cooperation with the Technical University of Munich, we created and coordinate the "HortAlliance", a group of stakeholders and academic bodies. The group have constant information exchanges with the major fruit growers' association. Other updates have been obtained by the participation to scientific meeting and symposia and extension workshops both at national and international level. Extensive bibliographic researches have been performed on the major online databases. The following databases were consulted (alphabetically listed):CABI: https://www.cabdirect.org/?target=%2fcabdirect%2fsearch ;- Google Scholar: https://scholar.google.com/; ISI-WOS: www.webofknowledge.com; JSTOR: https://www.jstor.org/; ORCID: https://orcid.org/, PUBMED: https://www.ncbi.nlm.nih.gov/pubmed?otool=iitamsublib; SCOPUS: https://www.scopus.com/Best practice findings

Best practice findings

RATIONALE. Physical barriers such as plastic tunnel or nets have been widely used in horticultural crops and are, nowadays, an increasing practice also in fruticulture. The cultivation under plastic tunnels and nets can greatly reduce the use of pesticide in fruit crops since this methods allow the physical exclusion of pest and disease from the orchard. Moreover, these practices are especially important for those pest and diseases causing damages during fruit development, when any chemical application may result in residues in fruits. Finally, the use of plastic tunnel reduces the wash off of pesticides allowing a reduction in their dosages and number of application. The mechanisms underlying the efficacy of these physical methods are very complex and encompass the simple exclusion of pests and diseases. Plastic tunnel, in fact also influence the micro-climatic conditions inside orchards and the tree or vine canopy are critical factors in determining the local severity and extent of the diseases. A number of studies carried on cherry, yellow fleshed kiwifruit, apple and pear and grapes demonstrates that protected cultivation modifies temperature, relative humidity and light quality and intensity. Both plastic films and nets also reduces the leaf wetness which is a key parameter influencing pathogen ability to grow on the plant and cause infection. Among these conditions, the effect of light quality and intensity has received, so far, little attention. Light intensity and quality are crucial factor influencing plant development and physiological response against pest and pathogen, but they may also affect movement, survival and virulence of the pathogenic agents. Indeed, light quality, which is modified under coloured plastic film and nets is perceived by pathogens influencing their virulence, by pest modifying the visual clues by mean they choose fruits or plants and by the host plant modifying callose formation, expression of defense related genes and phenolic compound accumulation. The methods also reduce the number of possible entry point of the pathogen by minimizing the damages and bruised caused on the plants by climatic factors such wind, heavy rain or hail. Example of successful practical applications of nets and tunnel are registered on

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

pear for the control of *Carpocapsa*; grapes, cherry and stone fruit for the control of *Drososphila suzukii*; apple, pears and stone fruits for the control of *Halyomorpha alys* and on kiwifruit for the control of *Pseudomonas syringae* pv. *actnidiae*

LIMITATIONS. Currently the deploy of plastic tunnel in fruit tree cultivation is limited to those crop with a very high orchard gate turnover. In fact, according to the fruit species, the cost of the tunnel may exceed 50,000€ per hectare. Additional costs, further limiting the economic viability of plastic tunnel are linked to the labor needed to open and close tunnel during the year, which may exceed in Northern Italy 5000€ per hectare per year. Finally, plastic film need to be replaced every 6 years.

RESEARCH NEEDS TO PROGRESS BEYOND THE STATE OF THE ART. The precise mechanisms responsible for the protective mechanisms of plastic tunnel are largely unknown and need to be fully investigated.

The effect of plastic colour on disease emergence and development needs to be studied for the different pathogen.

Moreover, the effect of tunnel on plant development, productivity and fruit quality need further investigation. Similarly, the long-term sustainability of these methods, having possible implication on soil and rhizosphere bioma and nutrient cycle, still need to be assessed.

Finally, novel low-cost methods to build orchard tunnel easier to be managed need to be developed

Section C. Annex: Scanning report[3]

Scanning report
[Francesco Spinelli, UNIBO]

Author: [Dr Francesco Spinelli, Department of Agricultural Sciences, Alma Mater Studiorum -University of Bologna, viale Fanin 46, 40127 Bologna – Italy, Phone: +39 051 2096436; Email: Francesco.spinelli3@unibo.it]]

Country: [Italy]

NUTS 3 region(s)[4]: [ITH51, ITH52, ITH53, ITH54, ITH55, ITH56, ITH57, ITH58, ITH59]

WP no. and title: [WP3 - Cultural Methods and DSS]

Date: [14-07-2017]

Source materials and methodology

[I am leading the working package on "Practical Solution for Control" inside the FP7 project DROPSA "Strategies to develop effective, innovative and practical approaches to protect major European fruit crops from pests and pathogens" (Grant Agreement: 613678). I was also UNIBO principal investigator for the FP6 project QDETECT: "Developing quarantine pest detection methods for use by National Plant Protection Organizations (NPPO) and inspection services" (Grant Agreement: 245047). The participation to these projects allowed a constant update of the most effective and innovative control strategies. Moreover, in cooperation with the Technical University of Munich, we created and coordinate the "HortAlliance", a group of stakeholders and academic bodies. The group have constant information exchanges with the major fruit growers' association. Other updates have been obtained by the participation to scientific meeting and symposia and extension workshops both at national and international level. Extensive bibliographic researches have been performed on the major online databases. The following databases were consulted (alphabetically listed):CABI: https://www.cabdirect.org/?target=%2fcabdirect%2fsearch ;- Google Scholar: https://scholar.google.com/; ISI-WOS: www.webofknowledge.com; JSTOR: https://www.jstor.org/; ORCID: https://orcid.org/, PUBMED: https://www.ncbi.nlm.nih.gov/pubmed?otool=iitamsublib; SCOPUS: https://www.scopus.com/Best practice findings

[3] Equivalent to 'final report' in EIP-AGRI format.
[4] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Best practice findings

The modern holistic view on fruit quality is that it should not only have a nutraceutical value, but should also be free from contaminants such as pesticide residues, achieved through ensuring agricultural practices that reduce pesticide impacts on the environment and promote biodiversity. To achieve this aim, a key step is the adoption of efficient agricultural practices aiming on one hand to obtain high production of quality fruits and on the other in reducing disease development. Indeed, the cultural management is an indispensable component of an efficient disease control strategies. Recently, several studies provided an in-depth understating of the influence of agricultural practices on disease development and spread. Therefore, the role of pollination and the most important cultural management techniques, such as irrigation, fertilization, use of bio-regulators and pruning on the incidence and epidemiology of sieases were examined. All of these cultural management practices, affecting the plant vegetative and reproductive performances, are exploited to force productivity, at the expense of other physiological investigate the influence of agricultural practices on host susceptibility and disease development. The information gathered in this trials allowed to design the successive field trials that were performed under natural infection.

From a "multitasking" approach it was observed that contamination during the pruning and nitrogen nutrition (dose and form) are the most critical points in field management, influencing the infection process and promoting the spread of disease from infected to healthy plants. The vegetative-productive balance is difficult to determine, but it is the most important factor to influence the susceptibility of fruit trees to disease. For an agronomical control of disease, avoid all kind of excess, that can make plant more efficient from the agronomic point of view, but also more vulnerable to bacterial canker, is necessary.

IPM strategies harmonizing control methods and cultural management have been developed for cherry and grapes against *Drososphila suzukii* and they include clean harvest strategies, fruit removal, edge rows management and use of consociation (e.g. soya beans) inside the orchards. Extensive studies have also been conducted on kiwifruit and *Pseudomonas syringae* pv. *actnidiae* (http://content.iospress.com/articles/journal-of-berry-research/jbr115).

Moreover, the IPM strategies also included DSS systems allowing to tailor the agriculture management and the control inputs on plant phenological stage and susceptibility, forecasting risk models and risk maps (including CLIMAX models) and early diagnosis of the diseases on asymptomatic materials. Concerning the latter, mass trapping is widely used to monitor pest diffusion such as in the case of *Drososphila suzukii* via DroskiDrink trap. Also bio-VOCs monitoring for diagnosis (e.g. e-nose) has been used for early diagnosis in apple, pear (*Erwinia amylovora*, fire blight) and grapes (*Agrobacterium tumefaciens*). Other early diagnostic methods currently deployed are based on LAMP technology. LAMP diagnostic kit allows a very quick and rather inexpensive in field diagnosis on plant diseases. LAMP diagnostic tools have been developed and validated for PPV (Sharka) on stone fruits and for (*Erwinia amylovora* on pome fruits

LIMITATIONS. The most appropriate cultural management of fruit crop needs to be tailored on each specific crop, geographical areas and diseases. Moreover, the same cultural tool may have opposite effects on different pests or pathogens affecting the same crop. Thus, a precise risk forecasting model needs to be developed to allow to balance the cultural management on the basis of the relative risks of the different pests and diseases.

DSS system are often not available for all pest and diseases. Moreover, they are not always readily accessible to growers.

Currently early diagnostic methods such as LAMP systems have been developed only for a limited number of pathogens. Moreover, the cost of the equipment and diagnostic kits is still to high for small-medium growers that the represent the great majority of stakeholders.

RESEARCH NEEDS TO PROGRESS BEYOND THE STATE OF THE ART. Develop crop specific cultural tools for the different pest and pathogen. Implement the availability of early diagnostic system such LAMP and/or electronic noses. Increase the availability of reliable ex-ante, user friendly DSS. Increase the adoption of IPM among the highest number of growers to maximize a sort of "herd immunity" to pests and pathogens specialized on a specific crop.

Section C. Annex: Scanning report[5]

Scanning report
[Francesco Spinelli, UNIBO]

Author: [Dr Francesco Spinelli, Department of Agricultural Sciences, Alma Mater Studiorum -University of Bologna, viale Fanin 46, 40127 Bologna – Italy, Phone: +39 051 2096436; Email: Francesco.spinelli3@unibo.it]]

Country: [Italy]

NUTS 3 region(s)[6]: [ITH51, ITH52, ITH53, ITH54, ITH55, ITH56, ITH57, ITH58, ITH59]

WP no. and title: [WP3 – biocontrol products]

Date: [14-07-2017]

Source materials and methodology

I am leading the working package on "Practical Solution for Control" inside the FP7 project DROPSA "Strategies to develop effective, innovative and practical approaches to protect major European fruit crops from pests and pathogens" (Grant Agreement: 613678). I was also UNIBO principal investigator for the FP6 project QDETECT: "Developing quarantine pest detection methods for use by National Plant Protection Organizations (NPPO) and inspection services" (Grant Agreement: 245047). The participation to these projects allowed a constant update of the most effective and innovative control strategies. Moreover, in cooperation with the Technical University of Munich, we created and coordinate the "HortAlliance", a group of stakeholders and academic bodies. The group have constant information exchanges with the major fruit growers' association. Other updates have been obtained by the participation to scientific meeting and symposia and extension workshops both at national and international level. Extensive bibliographic researches have been performed on the major online databases.

The following databases were consulted (alphabetically listed):CABI: https://www.cabdirect.org/?target=%2fcabdirect%2fsearch ;- Google Scholar: https://scholar.google.com/; ISI-WOS: www.webofknowledge.com; JSTOR: https://www.jstor.org/; ORCID: https://orcid.org/, PUBMED: https://www.ncbi.nlm.nih.gov/pubmed?otool=iitamsublib; SCOPUS: https://www.scopus.com/Best practice findings

Best practice findings

Biological control of plant diseases by the use of microorganisms antagonistic to pathogen is a widely diffused control method of fruit crop diseases. The main adavantege of biocontrol is the reduction of xenobiotic pesticides, the lack of residues in fruits and the minimization of the risk of development of resistance among pathogen population.

Biological control agents (BCA) against fire blight of pome fruits (*Erwinia amylovora*), *Xanthomonas* of stone fruits and strawberry and *Pseudomonas* diseases in apple and kiwifruit are commercially available. The most diffused products are based on bacterial antagonists, but they also include lytic bacteriophages that are effective against citrus canker. Bacterial

BCA have different mode of action such as competitive exclusion of the pathogen, production of antimicrobial compounds such as cyclolipopeptides in *Bacillus spp.*, phenolics in *Pseudomonas fluorescens*, and pseudopeptides in *Pantoea agglomerans* and *Pantoea vagans.* Other mode of action relies on interferences on pathogen signalling system or induction of plant resistance against diseases. The latter mode of action is exploited by *Trichoderma harzianum* and plant growth promoting rhizobacteria (PGPR), which are control methods, widely used to increase fruit crop defences and fitness.

Lactic acid bacteria are very promising BCAs known to have no environmental and consumers' concerns because they are already used as food additives to control food-borne pathogenic bacteria in fresh fruit and vegetables. Lactic acid bacteria effective again *Erwinia amylovora*, *Xanthomonas arboricola* and *Pseudomonas syringae* pv. *actnidiae have* already been identified and tested.

[5] Equivalent to 'final report' in EIP-AGRI format.
[6] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

Nowadays a number of BCAs is also depoyed for the control of pests, being *Bacillus thuringiensis* (Bt) the most studied entomopathogenic species. More recently, other entomopathogenic bacteria, such as *Serratia* spp, *Pseudomonas entomophila*, *Burkholderia* spp., *Chromobacterium*, *Xenorhabdus* and *Photorhabdus* spp. have been studied for the pratical conrol of different pest. *Photorhabdus luminescens*, a Gammaproteobacteria, is a gram-negative and mutualistic bacterium that lives in the gut of entomopathogenic nematodes belonging to the *Heterorhabditidae* family. Both *P. luminescens* alone and its symbiotic *Heterorhabditis* spp. nematode are known to be highly pathogenic to insects. *Photorhabdus luminescens* has been succesfully used to control *Drososphila suzukii* in cherry. Another entomopathogenic microorganism widely used *Metarhizium anisopliae* that has the advantage of shwoing a very limited activity against useful insects such as pollinators. In fact, this fungus can even be used to control Varroa in beehives

As far is concerned the traditional biological control of pest of fruits trees, three different approaches exist. In a classical biological control program, the potential of parasitoids to control the pest is used. In augmentative biological control, the regular release of natural enemies is used for temporary control of the pest. Conservation biological control includes all methods that enhance the effect of natural enemies already present in the natural environment.

LIMITATIONS. Biocontrol agents are still more expensive than chemical pesticides. Moreover, their efficacy is more prone to the host conditions and environmental factor. Moreover, biocontrol agents are usually negatively affected by chemical pesticides such as copper. Finally, despite of biocontrol of pest is standard practice of controlling infestation in IMP strategies. no biocontrol method is yet available for a number of invasive species such as the two most important emerging pests of fruit crop: *Drososphila suzukii* and *Halyomorpha alys*. Understanding the natural enemy complex and other biotic factors that cause mortality in these two pests is clearly essential for the development of biological control and IPM. Unsurprisingly, little is known on the natural enemies of these two pests in Europe, other than in laboratory tests which have shown that *D. suzukii* is resistant to most known European parasitoids of Drosophilidae, except the most polyphagous species. Many studies are now focusing on these aspects.

RESEARCH NEEDS TO PROGRESS BEYOND THE STATE OF THE ART. New BCA need to be selected for their higher plasticity and adaptability to the ever-changing climatic conditions. A special attention should be paid to those microbial BCA that are classified as GRAS to allow the release of commercial product readily available for growers. New production and formulation methods to reduce BCA costs are also needed. The role of host physiology on BCA survival, adaptation and effect has not yet receive enough attention. Also, the interaction of BCAs with other organisms in the agroecosystem still need to be investigated in order to enhance BCA efficiency and prolong their beneficial effect.

Finally, the possible use of SYNTHETIC MICROBIAL COMMUNITY for biological control of pests and pathogens and to increase plant adaptability, productivity and fruit quality need to be investigated.

Thus, a shift of conceptual paradigms is needed and future rresearches need to focus on the system (holobiont) formed by the host plant and the microbial community associated to it, rather than on single plant or microbe species.
The biological functions expressed by plant-associated microbes may affect plant production and crop quality, by improving water use efficiency, plant nutrition, defence responses. The complex interactions occurring inside the microbial community in the rhizosphere and in the phyllosphere contribute to plant phenotypes, health, fitness and adaptability. The major microbial functions can be summarized as five pillars: (1) improving nutrient acquisition and growth, (2) sustaining plant growth under biotic and/or abiotic stress, (3) inducing resistance against pathogens, (4) interacting with plant or human pathogens, and (5) interacting with other trophic levels like insects and/or pathogens.

Scanning report (EIP format for practice abstracts)

***Project title (native language):** **[EUFRUIT: Réseau thématique européen sur les fruits]**

***Project title (English):** **EUFRUIT: European Fruit Network**

***Author/native language editor:** [Lacroix Christelle, UR 0407 Plant Pathology, INRA PACA, Domaine Saint Maurice, 67 Allée des Chênes CS 60094, 84143 Montfavet Cedex, christelle.lacroix@inra.fr, 0033432722885]

Section A. Summary for EIP dissemination

***Keywords:** [Functional biodiversity, hedgerows, pear orchard, conservation biocontrol, natural enemy, pest]

***Main geographical location:** [FR713 Drôme']

Other geographical locations: [copy other NUTS 3 region from section C, below, 'NUTS 3 region(s)']

***Summary (native language):**

La biodiversité est un élément clé pour la conservation des auxiliaires et le biocontrôle des ravageurs, mais les applications sont encore rares par manque de consensus sur les approches à développer. A partir de travaux d'expérimentation, nous proposons trois principes généraux pour concevoir des haies en bordure de verger : i) pas de plantes hôtes de bio-agresseurs de quarantaine ou du verger ; ii) choix d'espèces hébergeant un cortège d'auxiliaires riche et diversifié et iii) assemblage d'espèces offrant aux auxiliaires habitat et ressources en nourriture tout au long de la saison.

Summary (english):

Biodiversity is a key-stone to enhance conservation biocontrol but field applications are still scarce and debated. From surveys and experimental work, we propose three main principles to design 'pest suppressive' hedgerows around orchards through the selection of tailored plant assemblages: i) ban plants hosting quarantine or key-pests and diseases of the orchard and surrounding crops; ii) select plants hosting a rich and/or abundant natural enemy complex; and iii) provide natural enemies with habitat and/or food ressources such as pollen, nectar and alternative preys all year round.

Section B. Project information

***Project coordinator:** Michelle H. Williams; Aarhus University, Department of Food, Kirstinebjergvej 10, 5792 Aarslev, Denmark; mw@food.au.dk; +45 25170049

***Project period:** 2016 - 2019

***Project status:** Ongoing

***Funded by:** Horizon 2020

***Total budget:** €1.8m

***Geographical regions:** 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, BE211 (Arrondissement. Antwerpen), BE212 (Mechelen), BE213 (Turnhout), BE221 (Hasselt), BE222 (Arr. Maaseik), BE223 (Tongeren), BE231 (Aalst), BE232 (Dendermonde), BE233 (Eeklo), BE234 (Gent), BE235 (Oudenaarde), BE236 (Sint-Niklaas), BE241 (Halle-Vilvoorde), BE242 (Leuven), BE251 (Brugge), BE253 (Ieper), BE254 (Kortrijk), BE255 (Arr. Oostende), BE256 (Arr. Roeselare), BE257 (Tielt), BE258 (Veurne), BE310 (Nivelles-Nijvel), BE331 (Huy-Hoei), BE332 (Liège- Luik), BE334 (Waremme-Borgworm), BE335 (Verviers), FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST, FR512 Maine et Loire, FR611 Dordogne, FR812 Gard, DE6 (Hamburg), DE8 (Mecklenburg-Vorpommern), DE9 (Niedersachsen), DEF0 (Schleswig-Holstein), DEE0 (Sachsen-Anhalt), DEA (Nordrhein-Westfalen), DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE119, E11A, DE11B , DE11C, DE11D, DE121, DE122, DE123, DE124,

DE125, DE126, DE127,DE 128, DE129, DE12A, DE12B, DE12C, DE131, DE132, DE133, DE134, DE135, DE136, DE137, DE138, DE139, DE13A, DE141, DE142, DE143, DE144, DE145, DE146, DE147, DE148, DE149, DE600 Hamburg, DE932 Cuxhaven, DE933 Harburg, DE939 Stade, DEF09 Pinneberg, NL1-NL4 + NLZ Holland; NL 224 zuidwest Gelderland, NL 226 Arnhem/Nijmegen, NL230 Flevoland, NL310 Utrecht, NL321 Kop van Noord-Holland, Nl322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, Nl411 west Noord-Brabant, NL413 noordoost Noord-Brabant, NL414 zuidoost Noord-Brabant, NL421 noord Limburg, NL422 Midden-Limburg, NL423 zuid Limburg, ES620 Murcia, 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, UKJ42 Kent, UKJ43 Kent Thames Gateway, UKJ44 East Kent, UKJ45 Mid Kent, UKJ46 West Kent, ES618 Sevilla, ES511 Barcelona, ES512 Gerona, ES513 Lérida, ES514 Tarragona, CH0 Schweiz/Suisse/Svizzera, ITH51-59 Emilia Romagna region, ITH10 Bolzano-Bozen, HU101 Budapest, HU102 Pest, RO111, RO112, RO113, RO114, RO115, RO121, RO122, RO123, RO124, RO125, RO126, RO211, RO212, RO213, RO214, RO215, RO216, RO221, RO222, RO223, RO224, RO225, RO226, RO311, RO312, RO313, RO314, RO315, RO316, RO317, RO321, RO322 RO411, RO412, RO413, RO414, RO415, RO421, RO422, RO423, RO424. HU101, HU102, 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.

Project web page: http://www.eufrin.org/index.php?id=55

***Project Objectives (native language):**

1. Créer un réseau européen sur le secteur des fruits
2. Développer et mettre en place une approche systémique pour le recensement et la synthèse de connaissances pratiques et scientifiques existantes
3. Mettre en place un dialogue avec les instances politiques européennes, nationales et régionales pertinentes
4. Identifier et promouvoir de nouvelles thématiques de recherche grâce à une veille et une analyse des activités de recherche et d'innovation existantes et à venir

Project Objectives (English):

1. Establish a European network focused on the fruit sector.
2. Develop and implement a systematic approach for scanning and synthesizing existing scientific and practical knowledge.
3. Establish an ongoing dialogue with relevant EU, national and regional policy bodies.
4. Identify and support new priority areas of research by continually monitoring and analysing existing and upcoming research and innovation activities.

***Project partners:**

1. Aarhus University, Department of Food Science (Denmark) • AU
2. Research Station for Fruit npo (Belgium) • Pcfruit
3. Centre Technique Interprofessionnel des Fruits et Légumes (France) • CTIFL
4. Obstbauversuchsanstalt Jork (Germany) • OVA
5. Stichting Wageningen Research (Netherlands) • WR
6. ~~East Malling Research (United Kingdom) • EMR~~ (terminated 08-02-2016)
7. Institut de Recerca i Tecnologia Agroalimentàries (Spain) • IRTA
8. Federal Department of Economic Affairs, Education and Research (EAER), acting through Agroscope Institute of Plant Sciences (Switzerland) • Agroscope
9. Laimburg Research Centre for Agriculture and Forestry (Italy) • Laimburg
10. University of Agronomic Sciences and Veterinary Medicine of Bucharest (Romania) • USAMV
11. National Agricultural Research and Innovation Centre Fruitculture Research Institute (Hungary) • NARIC
12. Lithuanian Research Centre for Agriculture and Forestry (Lithuania) • LRCAF
13. Assemblée des Régions Européennes Fruitières, Légumières et Horticoles (France) • AREFHL
14. Variety Innovation Consortium South Tyrol (Italy) • SKST
15. Freshfel Europe (Belgium) • FRESHFEL
16. Elbe-Obst Erzeugerorganisation r.V. (Germany) • EO

17. Fruitconsult BV (Netherlands) • FC
18. University of Greenwich (United Kingdom) • UoG
19. University of Hohenheim (Germany) • UHOH
20. Università di Bologna (Italy) • UNIBO
21. Institut National de la Recherche Agronomique (France) • INRA
22. NIAB EMR (new 09-02-2016)

Section C. Annex: Scanning report[1]

Scanning report
[Christelle Lacroix, INRA]

Author: [Lacroix Christelle, UR 0407 Plant Pathology, INRA PACA, Domaine Saint Maurice, 67 Allée des Chênes CS 60094, 84143 Montfavet Cedex, christelle.lacroix@inra.fr, 0033432722885]

Country: [France]

NUTS 3 region(s)[2]: [FR713]

WP no. and title: [WP3]

Date: [03/05/2018]

Source materials and methodology

I searched two literature databases, the Web of Science and ProdINRA, for studies and results relevant to the Eufruit WP3. I then contacted various colleagues, including Sylvaine Simon [sylvaine.simon@inra.fr, UERI 0695 Gotheron, INRA], who proposed to share results about how to design multi-species hedgerows for controlling pests in orchards. Below is a list of documents attached to this scan:

- Book chapter in English:

  Simon S, Rusch A, Wyss E, Sarthou J.P. (2014) Conservation biocontrol: principles and implementation in Organic Farming, pp. 83-105. In: Bellon S, Penvern S (eds) Organic Farming, prototype of sustainable agricultures. Springer.

- Review paper in English:

  Simon S, Bouvier J.-C., Debras J.-F., Sauphanor B. (2010) Biodiversity and pest management in orchard systems. A review. Agronomy Sust. Developm. 30, 139–152

- Oral Communication in French:

  Simon S., Capowiez Y, 2014. Le verger, milieu complexe et pérenne, favorable à la régulation naturelle des ravageurs ?. Colloque TransBioFruits, Lille, France. 2014.
  http://www.fredon-npdc.com/diaporamas_colloque_biodiversite/microsoft_powerpoint__15sylvaine_simon.pdf

- Paper in French:

  Simon S., Sauphanor B., Defrance H., Lauri P.E., 2009. Manipulations des habitats du verger biologique et de son environnement pour le contrôle des bio-agresseurs. Des éléments pour la modulation des relations arbre-ravageurs-auxiliaires. Innovations Agronomiques 4, 125-134.
  http://www6.inra.fr/ciag/Revue/Volumes-publies-en-2009/Volume-4-Janvier-2009

Best practice findings

The design and evaluation of an experimental hedgerow (1995-2005) in pear orchard in South-Eastern France as well as entomological surveys of various tree-species permitted to identify three main principles to consider in the design of 'pest suppressive' hedgerows around orchards. Beside soil and climate adaptation of plant species, important criteria to design tailored plant assemblages are:

i) The ban of plants hosting quarantine or key pests and diseases of the orchard and surrounding crops, to avoid detrimental effects due to an increased density of host-plants of bio-aggressors in the orchard surroundings (e.g., ban hawthorn *Crataegus monogyna* that hosts fireblight);

[1] Equivalent to 'final report' in EIP-AGRI format.
[2] Please see ec.europa.eu/eurostat/ramon/nomenclatures/ for details on NUTS regions, level 3

ii) The selection of plants hosting a rich and/or abundant natural enemy complex; local references from previous surveys are important in that objective. Some specific plant traits such as hairy leaves are generally associated with a rich arthropod community since hairs offer shelter and/or trap pollen as alternative food, e.g., hazelnut trees *Corylus avellana* host a rich and abundant natural enemy complex. Food resources such as pollen and nectar are also important for natural enemy fecundity and fitness. Lastly, local rather than exotic species are likely to be a source of natural enemies for the orchard.

iii) The provision of natural enemies with habitat and/or food resources such as pollen, nectar and alternative preys all year round. This encompasses evergreen leaves and hollow or intertwined stems (e.g., ivy *Hedera helix*) as wintering habitat, early, season and late flowering, and specific herbivores as alternative preys as food resources. Because many tree-species offer several types of resources, a 'moderate' diversity (e.g., 12 species in our case study) permitted to have more than one tree-species to support each type of resource all year round.

From our experience, this approach was successful in managing orchard pests such as mites, pear psyllids and some aphids; other (bio)control methods are to be associated to control pests such as Tortricids (e.g. codling moth *Cydia pomonella*) that can cause severe fruit damage at low population levels.