Synthesis report
Sustainable fruit production to minimize residues

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WP: 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 South Zealand), 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	ES 512 Girona, ES513 Lleida
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Italy	ITH10 Bozen-Bolzano, ITH54 Modena, ITH55 Ferrara, ITH57 Ravenna, ITH58 Forlì-Cesena, ITH59 Rimini, ITD20 Trentino-Alto Adige
Romania	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
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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Synthesis findings

In the EUFRUIT project, the main topic of WP3 is the reduction of pesticide residues on fruits and in the environment by implantation of new management strategies against pest and diseases. The following document is the second 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 twelve European countries (Austria, 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 2017, eleven subjects were handled :

1) Decision support systems (DSS) : pests & diseases models to predict the risks
2) Cultural management of pests and diseases
3) Biological control agents, like microorganisms
4) Pheromones
5) Beneficial insects
6) Chemical strategies to reduce the use of pesticides
7) Physical techniques
8) Organic production
9) System approach where different techniques to reduce the use of pesticides are combined
10) Innovative spray applications
11) Removing residues from fruits.

I. Decision support systems (DSS) : pests & diseases models to predict the risks

The development and use of "pest and disease" models to analyze and predict the risks and to help growers and technicians to elaborate the right crop protection strategy needs to be improved by reliable meteorological data base. In Austria for example, the LK-Warndienst (forecasting service of the agricultural chamber) is a free and independent service, open to public, financed for five years by the Ministry of Agriculture, giving pests and diseases prognosis with a network of meteorological weather station covering one square kilometer. In other countries, the meteorological data's may also come from private grower's organizations. The improvements could be at different stages i) improve the quality and availability of data for model inputs (more biological data) ; ii) improve the quality and availability of data for model evaluation (climate and agronomic data) ; iii) improve the integration with crop models; iv) improve the processes for model validation; and v) develop a network to share the tools at national and international level. Furthermore, models should be more "site specific", pest and diseases pressure and climatic conditions may be very different from one place to another.

II. Cultural management of pest and diseases

Drosophila suzukii is a good example for the importance of measures which limit conditions **favourable for pest population development**. The following practices are advised :
- Canopy management: (by winter and green pruning) in order to create a less humid microclimate in the foliage, improve the insecticide application quality, compacting the harvest
- Soil management: (by frequent grass cutting) in order to reduce the wet and cool microclimate under the canopy

- Management of neighbouring areas (to avoid shading, stagnant pools of water) in order to reduce the wet and cool microclimate in the borders.
- At harvest, it is important to remove infested fruits and to manage the fruit waste.

In the Lower Elbe region (Germany), the common green capsid (*Lygocoris pabulinus*) causes important damages on fruits in apple orchards. Obstbauversuchsanstalt Jork (Germany) demonstrated the effect of **mowing herbaceous plant borders** on his life cycle and reduced the pest level and damages. But herbaceous plant borders are known as habitat for beneficial insects, and the impact of the moving procedure on biodiversity is not well understood yet.

USAMV Bucuresti (Romania) had promising results with **weed burner on woolly aphids'** colonies.

III. Biological control agents, like 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.

IV. Pheromones

Matting disruption is an efficient alternative method to control apple codling moth and Oriental Fruit Moth on apple orchards. It is a benefit for the environment and contributes to a "cleaner" high quality fruits. When using the **mating disruption technique**, it's important to have a tool to estimate the pest pressure in the orchard and adjust the control strategy if necessary. IRTA (Spain) tested with success throughout several years **an attractant lure** for oriental Oriental Fruit Moth (*C. molesta*).

To improve the use of semiochemicals to control caterpillar pests (*Cydia pomonella, A. orana, P. heparana, A. podana*), the research institute of Wageningen (Netherland) tested a **Semios puffer system**, with only 2-3 puffers/ha and the possibility to modify online the pheromone release to get the optimal pheromone use. A low density of codling moth is kept without additional chemical treatments, but for the free-living leaf rollers there can be a reduction or suppression of moth catches or even an increase.

As a consequence of the increasing presence of *C. capitata*, the Mediterranean fly, an **attract and kill technology** is implemented in apple orchards in the Trentino region.

V. Beneficial insects

The **releases of beneficial insects** in orchards to control aphids (rosy apple aphid, green aphid and woolly apple aphid) were not efficient enough in orchards with enclosing nets. This has been tested at IRTA (Spain) in 2016 with releases of three species of *coccinelidae.* Similar results had been observed with *Chrysoperla carnea* and *Episyrphus balteatus* at Ctifl (France) in a three season trial (2012-2014). The results depends of various factors: the climate conditions at the release period ; the adequate timing between the release and the annual dynamic of the beneficial insects ; the rosy aphids populations ; the balance between prey/predator ; the stage of the crop and the use of some active substances and also of the additional preventive measures in last Autumn, like Kaolin sprayings and keeping nets closed, to reduce egg-laying activity and adults re-colonization of the apple trees.

Obstbauversuchsanstalt Jork (Germany) studied **alternate alleyway mulching** to promote beneficial insects against pear leaf sucker (*Cacopsylla pyri*). Although there seemed to be a good relation between prey and predator (like *Anthocoris*), the strategy had no effect on *C. pyri* and the damages he causes. The question is also how the mulching affects bee activity.

Emerging research at NIAB-EMR (UK) obtained a good control of spider mites (*Tetranychus urticae*) on cherries when using the **predatory mite *Amblyseius andersoni***. The introductions at a rate of 1 Gemini sachet per 5 cherry trees gave good dispersal with the potential to control mites.
Parasitoid wasps released weekly can achieve 40 to 90 % control of raspberry aphids.

VI. Chemical strategies to reduce the use of pesticides

At pcfruit (Belgium), like in other European institutes, different treatment schedules are tested to obtain a "zero" residue production. The principal is to use the chemical pesticides until limit of detection-date and during summer (close to harvest) to use alternative products against apple scab (ex. potassium bicarbonate) and storage diseases (laminarin, *Aureobasidium pullulans*) and also physical techniques (hot water treatment) This strategy is actually used in organic farming, but in IPM chemical pesticides are still the majority of the protection program.

VII. Physical techniques

<u>Rain covers</u> :

From the end of the 90th, **plastic rain cover forming a "roof" on the top of the trees** were used on cherries to protect fruits against rain cracking and limit the development of rots. On apples, the German experimental Station « Bayerische Landesanstalt für Landwirtschaft (LfL) » had trials between 2002 and 2006 in organic orchards. The protection was efficient against apple scab, sooty blotch and storage diseases, only powdery mildew was observed on one of the varieties. Compared to an uncovered orchard, sun burn was rare and the fruits have been protected against frost. A negative incidence was seen on the sugar content and the acidity of the fruits (GEIPEL, KRECKL, 2013). Another experience came from British Colombia (MITHAM, 2008) with a tunnel system to protect against diseases and sun burn. The fruit maturity was two weeks earlier and even with 15 % less luminosity, the color of the fruits was not reduced. However, due to the high costs, there were limited possibilities for the producer to adopt this system.

At Ctifl (France), trials started in 2010 on Braeburn, 2011 on Gala and 2014 on Rosy Glow. Four different types of rain covers have been studied. One concept is to place the plastic under the hail nets, the other combines the plastic cover with the hail nets in order to form only one cover. In 2016, around 25 small scale plots have been covered in French experimental station, but also by French producers. Two periods have been adopted for covering the trees : 1) starting in March without any treatment against apple scab, but 2 to10 fungicides against powdery mildew. 2) after flowering (mid-April to mid-May) with 8 to 12 treatments against apple scab before covering.

Some positive points : 30 to 40 % TFI (treatment frequency index) reduction ; globally good results against apple scab, but however possible contamination on leaves and fruits (the orchard is not in a glasshouse) ; interesting results also against *N. alba* (on Rosy Glow) ; the fruit quality (sugar, firmness, acidity) seems equivalent. The negative points are : the limited duration of the plastic (due to lacerations, and because it's getting green) ; a bad staying in difficult weather condition (like wind) ; an incidence on yield (up to three times) ; less luminosity (up to 30 %) under the rain cover providing less coloration (ex. Rosy Glow), but also more vigour and shoots, and less flowers ; Bitter Pit on Golden. The irrigation needs to be adapted, but ditches may appear because of the accumulation of rainwater in the middle of the rows. The noise due to the plastic covers when wind is beating can be inconvenient and finally the high costs break the implantation of the technique.
The University of Aarhus (Denmark) started these studies in 2012 and had encouraging results against apple scab and storage diseases on Red Elstar and Rubens. Even the Russet symptoms were reduced under rain covers. The aim is to develop the technique for organic production in order to reduce spraying not only on apples, but also on pears.

In Italy different trials are going on with rain covers (Laimburg, University of Bologna and FEM). On apples, variety Fuji for example, the % of infested leaves reached 9 % under the rain cover in 2016, when it was almost 70 % on the untreated and uncovered control modality. However three important points have to be mentioned: an important reduction of the yield (16 kg/tree under cover for 25 kg/tree in the control), a low resistance to storm situation and woolly aphids infestations under the rain covers.
Plastic tunnels protect kiwi against *Pseudomonas syringae pathovar actinidiae*, but the effect on the pathogen is better with **permanent closed tunnels**, than the **seasonally closed tunnel**, because rain is still coming on the trees.

Enclosure netting:

Long term observations (10 years) done by Agroscope (Switzerland) show 50 % reduction of damages caused by codling moth on apples when protected by **enclosure nets on the side of the orchards and combined with hail nets on the top of the trees**. But, the effect was no significant on summer fruit tortrix and smaller fruit tortrix. A smaller mesh width is needed to get a better protection. Further observation years are necessary to quantify the negative effect of the exclusion of beneficial insects naturally controlling aphids and mites. On cherries, the Swiss *Drosophila suzukii* taskforce concluded that nets provide a good protection against *Drosophila*, but the net alone may not guarantee a 100 % protection of the fruits. Therefore a combination of nets and insecticides is advised.

In Laimburg (Italy) the experience with nets has been made **on single apple rows** and the damages on fruits were reduced by around 70 %. At University of Bologna (Italy) the technique was adapted to single cherries rows. The efficacy to control *Drosophila suzukii* could reach 100 % efficacy. Micro-climate parameters were measured and a little incidence could be seen. But nets seem not to affect the pesticide use against other targets.

VIII. Organic production

For many consumers organic production is perceived as unsprayed production. When it comes to high-value crops like fruit in particular apples, this is not the case. Apples 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.

AU (Denmark) had a 6 year trial comparing sprayed and unsprayed organic production involving 10 apple varieties, half of which were Vf resistant at the start of the trial. For the last three years of the experiment, the most scab susceptible varieties were also tested unsprayed under rain roof.

- All Vf resistant varieties in the trial had the resistance overcome and most are now highly scab susceptible (Rubinstep, Santana, Pinova)
- Unsprayed organic production reduced gross return by 10-90% depending on variety. The best performing variety was ‘Aroma’ and worst was ‘Rubens’.
- Between 20-98% of unsprayed fruit were discarded due to scab (fruits with >1 cm^2 scab lesions cannot be sold for fresh consumption)
- Sprayed organic production involving 25-30 sprays of either Sulphur or potassium bicarbonate were effective at controlling scab, but not rot diseases. In average over the years, 20% of the fruits developed rots during storage and shelf-life.
- Unsprayed production under rain roofs was comparable to sprayed production in terms of gross return and effect on scab, and in addition proved effective at controlling rots as well.

At Laimburg (Italy), the working group for organic farming is testing and developing several topics like : crop regulation by mechanical flower thinning, mechanic and thermal weed control, soil management and fertilization, scab treatment through overhead irrigation, alternatives to cupper, netting systems against codling moth, and also drift-reduction techniques with nets to avoid contamination from conventional orchards.

BioREco (INRA – France) is the first production system experimented in France on fruits in order to compare conventional, low input and organic practices. It provides on a period of 10 years (2005 – 2015) agronomic and economic references. One of the conclusion for the organic system is that the production costs were higher and the yield was lower due to more fruit damages.

IX. System approach where different techniques to reduce the use of pesticides are combined

Agroscope (Switzerland) had a **5 year low-residue trial** between 2009 and 2013. Three plant protection strategies were tested : Integrated production (IP), Organic production (BIO) and Low-residue (LR), a combination of IP and BIO, and 4 varieties (Golden Delicious, Ariane, Otava, Topaz). The results were :

- No pesticide residues were detected with the Low-Residue (LR) strategy (adapted fungicide strategy, mating disruption, nets)
- Powdery mildew, scab and important pests were under control with LR strategy
- For scab resistant varieties (Vf), chemical scab control is needed to prevent resistance loss
- A switch to an organic fungicide strategy after bloom results in problems known for organic production: increased incidence of storage rots and minor diseases (e.g. *Marssonina coronaria*)
- Hot water treatment could reduce storage rots
- Economic production with LR-strategy is difficult with prices paid for integrated produced apples.

In France, Ctifl is coordinating a long term (6 years), multi-location and multi-factors apple orchards network. During the seasons, several techniques to reduce the use of pesticides are combined (ECOPHYTO modality) and compared to a reference system (called BASE). In terms of treatment frequency index reduction, to most important (> 80 % reduction) are obtained with resistant varieties combined with mating disruption or enclosure netting and the use of biocontrol agent insecticides and “green” 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. However, the limits of these experimental systems are mainly the yields and the sanitary state of the orchards with development of powdery mildew, apple scab and woolly aphids. The number of detected residues is between 1 and 4, and almost all detected concentration are at a 10 % level of the MLR (maximum level of residues).

Two other French studies were led by INRA, one called EcoPêche, a 24 systems network on peaches, and the other, named BioREco, comparing three apple systems (conventional, low input and organic).

X. Innovative spray applications and environment protection

To limit the loss of pesticides in the environment during the treatment it is essential to control annually the sprayer and his spraying quality. Therefore pcfruit (Belgium) developed a spray test service with a **movable wall** to check the nozzles (orientation, discharge, pressure) and give advices to adjust the sprayer. The aim is to obtain a good protection quality and reduce the risk to contaminate water, air and soil with pesticides treatments.

Furthermore, Pcfruit studied a process to treat the rinsing water of sprayers after the crop application. The system is based on a **Biofilter** composed of different type of soils, straw and plants to realize an “on farm bioremediation”. The goal is now to inform and sensitize the farmers to avoid point pollution.

To avoid the use of a tractor and sprayer, different **fixed spraying systems** are under evaluation on experimental orchards at Ctifl (France) and FEM (Italy). rarr

Physical barriers, like nets or hedges, are used to reduce pesticides drift out of the orchard and protect habitations, water and other crops from spray applications.

XI. Removing residues from fruits.

IRTA (Spain) tested two new products, authorized for water disinfection and food processing : **Oxone** (potassium peroxymonosulfate) and **electrolyzed water**. The study was done on two fungicides after 6 month in ULO fridgestore conditions. The highest reduction was 50 %.

At FEM (Italy), removal of pesticide residues on fruits with **ozonated water** is under investigation.

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).

Institute	Crops	Pests & Diseases / environment	Topics
FEM	apples	ceratits	attract & kill
NRI	soft fruits	Drosophila suzikii	attractant
pcfruit	stone fruits, small fruits and strawberry	Drosophila suzukii	attractive additives / baits. Attract & Kill
pcfruit	not specified	aphids / parasitoïdes	beneficial insects
pcfruit	strawberry	thrips / predatory mites	beneficial insects
OVA	apples, pears	commun green capsid ; Cacopsylla piri	beneficial insects
Laimburg	apples	codling moth, aphids	beneficial insects
NRI	stone fruits	mites	beneficial insects
NRI	strawberry	thrips / predatory mites	beneficial insects
NRI	strawberry	mites	beneficial insects
FEM	apples	mites	beneficial insects
Kob-Bavendorf	apples	mites	beneficial insects

NRI	apples	aphids	beneficial insects (plant volatils for conservation Biocontrol)
NRI	fruits s& vegetables	Botrytis cinerea	biocontrol agents (microbial)
NRI	stone fruits	Monilia	biocontrol agents (microbial)
FEM	apples	storage diseases	biocontrol agents (microbial)
UNIBO	pome & stone fruits, strawberry, kiwi	fire blight, Xanthomonas, Pseudomonas	biocontrol agents (microbial)
NRI	strawberry, blueberry	black vine weevil	biocontrol agents (microbial)
Bucarest	apples	codling moth	biocontrol agents (Trichograma)
Agroscope	apples, pears	fire blight	biocontrol agents (yeasts)
pcfruit	apples, pears	fire blight	biocontrol agents (bumble bees as vector) *remark : first stage of research*
pcfruit	apples, pears	storage diseases	biocontrol agents (nebulisation) *remark : still under research*
Agroscope	apples	codling moth	biocontrol agents (granulosis virus)
FEM	apples	codling moth	biocontrol agents (granulosis virus)
Kob-Bavendorf	apples	codling moth	biocontrol agents (granulosis virus)
OVA	apples	aphids	chemical strategies
OVA	cherries, plums	Drosophila suzukii	chemical strategies
Wageningen	Red currant	Fruit rot	chemical strategies
Lithuania	strawberries	Botrytis cinerea, Penicillium, Alternaria	chlorophyllin derivate & photosensitization
Agroscope	cherries	Pseudomonas	combination of chemical strategies & non chemical measures
Kob-Bavendorf	apples	scab	cultural management practices
UNIBO	kiwi	Pseudomonas s. actinidiae	cultural management practices
UNIBO	cherries	Drosophila suzukii	cultural management practices
NRI	stone & soft fruits	Drosophila suzukii	cultural management practices
OVA	cherries, plums	Drosophila suzukii	cultural practices at harvest, rapid cooling

Laimburg	apples	aphids	cultural practices (prunning)
Agroscope	pome & stone fruits	all	Decision support system
pcfruit	Apples, pears	safeguarding of earwigs / Psylla	Decision Support System / beneficial insects
NRI	apples	safeguarding of earwigs	Decision Support System / beneficial insects
pcfruit	apples	scab	Decision Support System / pests & diseases
pcfruit	apples, strawberry	powdery mildew	Decision Support System / pests & diseases
pcfruit	strawberry	Botrytis cinerea	Decision Support System / pests & diseases
NRI	soft fruits	sawfly	Decision Support System / pests & diseases
FEM	apples	pests & diseases	Decision Support System / pests & diseases
pcfruit	strawberry, cherries	Drosophila suzukii	Decision Support System + monitoring
Laimburg	apples	weed control	ecoherbicides
NRI	black currant	Botrytis cinerea	elicitor
Laimburg	apples	storage diseases	hot water
Agroscope	apples	scab	low input trials
pcfruit	stone fruits, small fruits, strawberry	Drosophila suzukii	mass traping ; repellent ; Push and pull
Agroscope	apples	codling moth	mating disruption
FEM	apples	codling moth	mating disruption
pcfruit	apples	codling moth	mating disruption
Kob-Bavendorf	apples	Codling moth	Mating disruption
IRTA	apples, pears	oriental fruit moth	mating disruption, attractant lures for monitoring in mating disruption orchards
IRTA	apples	oriental fruit moth, Ceratitis	mating disruption, mass traping
Agroscope	pome & stone fruits	thinning	mechanisation
FEM	apples	thinning	mechanisation

Laimburg	apples	thinning	mechanisation ; organic practices
Agroscope	pome & stone fruits	weed control	mechanisation
FEM	apples	weed control	mechanisation
Kob-Bavendorf	apples	weed control	mechanisation
Laimburg	apples	weed control	mechanisation ; thermal control ; ecoherbicides
pcfruit	apples	aphids	mix fruit cultivars
pcfruit	apples, pears	fire blight	monitoring (drones)
NRI	soft fruits	sawfly	monitoring (traps, lures)
pcfruit	stone fruits, strawberry	Drosophila suzukii	nets
Agroscope	cherries	Drosophila suzukii, fruit fly	nets
Kob-Bavendorf	cherries	Drosophila suzukii, fruit fly	nets
Laimburg	apples	codling moth	nets
Agroscope	apples	codling moth	nets
FEM	apples	codling moth	nets
UNIBO	pome & stone fruits	codling moth, Drosophila suzukii,	nets
IRTA	apples	aphids, codling moth	nets & biodiversity, beneficial insects
Laimburg	apples	aphids	organic practices
Bucarest	apples	all	organic practices
Laimburg	apples	scab	organic practices (lime sulphur, overhead irrigation, removal of leaf litter)
FEM	apples	scab	rain protection
Aarhus	apples, pears	scab, storage diseases	rain protection
Ctifl	apples	scab, storage diseases	rain protection
Laimburg	apples	storage diseases	rain protection

UNIBO	kiwi	Pseudomonas s. actinidiae	rain protection
FEM	apples	environment	removing residues
IRTA	apples	environment	removing residues (oxone; electrolized water)
FEM	apples	codling moth	SIT
Laimburg	fruits	environment	spray application (drift reduction techniques by nets)
FEM	apples	environment	spray application (drift reduction techniques with nuzzles ; TRV ; fixed spray application)
pcfruit	fruits	environment	spray application (movable wall, EVA application)
Ctifl	apples	all	system approach (combined technics to reduce TFI)
INRA	apples	all	system approach (combined technics to reduce TFI)
INRA	peaches	all	system approach (combined technics to reduce TFI)
OVA	apples	aphids	use of non synthetic products (potassium soap with potassium cocoate)
Laimburg	apples	aphids	use of non synthetic products (Neem extracts)
OVA	cherries, plums	Drosophila suzukii	use of non synthetic products (calcium chlorid ; hemp oil)
Agroscope	apples, pears	fire blight	use of non synthetic products (acid clay, potassium aluminium sulphate)
Laimburg	apples	storage diseases	use of non synthetic products (acidic clay)
Kob-Bavendorf	apples	scab	use of non synthetic products (lime sulphur, calcium bicarbonate)
pcfruit	apples, pears, strawberry	all	varieties selection
Agroscope	apples	all	varieties selection
NRI	pome, stone & soft fruits	all	varieties selection
FEM	apples	scab	varieties selection

Summary for EIP dissemination

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

Keywords: fruits, pesticide residues, alternative products and techniques, environmental friendly crop protection

Summary:

The synthesis report 2017 of WP3 provides information from 16 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 :

- the application of models to predict the of pests and diseases risks,
- the cultural management of pests and diseases,
- the use of alternative products and techniques (biological control agents, like microorganisms, or pheromones, or beneficial insects, or physical techniques),
- the organic production,
- a system approach where different techniques are combined to reduce pesticides,
- innovative spray applications to protect environment,
- Process to remove residues on fruits.

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 and invited experts, 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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Geographical 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 South Zealand), 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	ES 512 Girona, ES513 Lleida

Switzerland	CH011 Waadt, CH012 Wallis, CH021 Bern, CH022 Freiburg, CH023 Solothurn, CH024 Neuenburg,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 Tessin
Italy	ITH10 Bozen-Bolzano, ITH54 Modena, ITH55 Ferrara, ITH57 Ravenna, ITH58 Forlì-Cesena, ITH59 Rimini, ITD20 Trentino-Alto Adige
Romania	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
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

Project web page: www.eufrin.org

Annex: Scanning reports

List of the scanning reports : 22 documents (PDF file joint)

- Aarhus University (DK)
- Pcfruit (BE)
- Ctifl (F)
- OVA Jork (DE)
- St DLO Wageningen (NL)
- IRTA (ES)
- Agroscope (CH)
- Laimburg (IT)
- USAMV (RO)
- LRCAF (LT)
- UHOH (DE)
- UNIBO (IT)
- INRA (F)
- Fondazione Edmund Mach (IT)