

## Scanning report (EIP format for practice abstracts)

**\*Project title (native language):** EUFRUIT - Fruitkennisplatform

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

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### Section A. Summary for EIP dissemination

**\*Keywords:** apple, cherry, evaporation, fertigation, irrigation, pear, soil water

**\*Main geographical location:** BE221 (Hasselt), BE223 (Tongeren), BE242 (Leuven), BE236 (Sint-Niklaas)

**Other geographical locations:**

**\*Summary (native language):**

Onderzoek heeft aangetoond dat irrigatie bij 'Conference' leidt tot grotere vruchten waardoor opbrengst en economische omzet verhogen. Om peer telers te helpen om hun opbrengsten te optimaliseren hebben de Bodemkundige Dienst van België en pcfuit de irrigatie en fertigatie adviesdienst PWARO opgericht die boomgaard specifiek advies geeft op basis van bodemstaal analyse, blad minerale analyse, vruchtzetting en een bodem waterbalans model. De telers krijgen een wekelijks irrigatie advies dat rekening houdt met de weersvoorspellingen. Bovendien wordt het model regelmatig gevalideerd door het actuele watergehalte in bodemstalen te meten die genomen worden in een representatieve zone van de boomgaard. Maar er treden veel verschillen (in bodem textuur, leeftijd bomen, enz.) op in een boomgaard en om die meer in rekening te brengen in het advies zal vanaf 2017 satelliet beeldanalyse worden aangeboden. De water toestand in de boomgaard kan afgeleid worden uit een satellietbeeld en er is een sterke relatie tussen de water toestand en de vruchtgrootte. Deze beeldanalyse zal toelaten om droogte gevoelige zones in de boomgaard te lokaliseren, water gebruik te optimaliseren en bijvoorbeeld het effect van wortelsnoei beter in te schatten. Daarnaast wordt het PWARO advies systeem uitgebreid naar zoete kers.

Proeven in vollegrond aardbei op pcfuit zijn lopende om de irrigatie en stikstof grenswaarden te bepalen evenals de optimale toepassing strategieën om de dosissen en verliezen te minimaliseren en de vruchtkwaliteit te maximaliseren. Tegelijkertijd wordt ook het KNS bemesting systeem aangepast aan de Vlaamse (bodem)condities getest in aardbei. Met behulp van sensoren worden de irrigatie grenswaarden voor verschillende bessensoorten in substraat bestudeerd, terwijl bemesting optimalisatie bij framboos ook gebeurt.

**Summary (english):**

Research has shown that irrigation in 'Conference' pears increases fruit size resulting in a higher yield and higher economic turnover. To assist pear growers in optimizing their yields the Soil Service of Belgium and pcfuit established an irrigation and fertigation service system PWARO that gives orchard specific advice based on soil sample analysis, leaf mineral analysis, fruit set and a soil water balance model. Every week the growers get advice for steering their irrigation system taking the weather predictions into account and the model is regularly validated by measuring the actual water content in soil samples taken in a representative reference zone of the orchard. However, variations (in soil texture, tree age, etc.) exist in orchards and to better take these variations into account in the PWARO advise satellite image analysis will be offered to pear growers as a new service. The water status can be derived from the satellite images and there is a strong relation between water status and fruit size. This analysis will allow to locate the drought sensitive zones in the orchard, optimize water use and better assess for instance the effect root pruning. In addition, the PWARO service is extending to sweet cherry growers in 2017.

Trials in soil-grown strawberry are ongoing at pcfuit to determine the irrigation and nitrogen thresholds as well as the optimal application strategies to minimize inputs and drainage losses and maximize fruit quality. Concurrently, the KNS fertilization system adapted to the Flemish growth conditions is under testing in strawberry. Using sensors irrigation thresholds for several berries growing in substrate are being investigated, while optimization of raspberry fertilization is ongoing, too.

**Section B. Project information**

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**\*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 (Waremmе-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, NI322 Alkmaar en omgeving, NL338 oost Zuid-Holland, NL33A zuidoost Zuid-Holland, NL341 Zeeuws-Vlaanderen, NL342 overig Zeeland, NI411 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 Hampshire, 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. Ontwikkeling en implementatie van een systematische aanpak voor het in kaart brengen en het ontsluiten van wetenschappelijke en praktische kennis.
3. Ontwikkeling van een permanente dialoog met de relevante Europese, nationale en regionale beleidsorganen.
4. Identificatie en ondersteuning van nieuwe prioritaire onderzoeksgebieden door voortdurend bestaande en toekomstige onderzoeks- en innovatieactiviteiten te monitoren en te analyseren.

**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) • Pcfuit
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<sup>1</sup>

## Scanning report 'Water & Nutrients'

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**Country:** BE

**NUTS 3 region(s)<sup>2</sup>:** BE221 (Hasselt), BE223 (Tongeren), BE242 (Leuven), BE236 (Sint-Niklaas)

**WP no. and title:** WP5 secure sustainable fruit production

**Date:** 04-05-2017

#### Source materials and methodology

Pcfruit npo is a research station specialised in fruit growing and encompasses two experimental gardens (pip and stone fruit, strawberry and woody small fruits), a service division for growers and industry as well as an applied scientific research division all located in one place in Sint-Truiden. The department of pomology within the applied scientific research division is dealing amongst others with sustainable fruit production themes including fruit thinning as well as water and nutrient management.

An irrigation and fertigation service system referred to as PWARO is operational at pcfruit since 2012 and is being run in collaboration with the Soil Service of Belgium (SSB). Based on earlier collaborative research between SSB and the pomology department on irrigation and fertigation of 'Conference' pear orchards yearly around 60 pear growers get orchard specific advice for irrigation and fertigation. Despite the demonstrated positive effects of irrigation on fruit size, this number of supported 'Conference' growers is only increasing slowly. Unlike in some other European countries, irrigation is not done in apple growing in Belgium. Several initiatives to improve the existing irrigation and fertigation practices in small fruit production in Belgium are ongoing at pcfruit, too.

The source materials for this scanning report are amongst others:

- Helsen J., Janssens P., Odeurs W., 2013. De aansturing van vocht en nutriënten in 'Conference' met PWARO in 2012. *Fruitteeltnieuws* 06: 10-11
- Helsen J., Janssens P., 2016. PWARO, Hoe belangrijk was een correcte irrigatie en fertigatie in 2015? *Fruitteeltnieuws* 05: 18-21
- Janssens P., Deckers T., Elsen F., Elsen A., Schoofs H., Verjans W., Vandendriessche H., 2011. Sensitivity of root pruned 'Conference' pear to water deficit in a temperate climate. *Agricultural Water Management* 99: 58-66
- Janssens P., Helsen J. 2017. Verbetering van irrigatiesturing met hulp van satellietbeelden. *Fruit* 6: 6-8
- Melis P., Stoffels K., Vervoort M., Van Delm T., Boonen M., Latet G., & Bylemans D. 2016. KNS fertilisation system of strawberry soil cultivation in Belgium – abstract book ISHS Strawberry Symposium, Canada : 175
- Gallace N. & Lieten F. 2016. EC-effect bij doordragers. *Fruitteeltnieuws* 29: 26-27
- Van Aert R., Verjans W., Boonen M., Janssens P. & Hertog M. 2016. Irrigatie en fertigatie in vollegrondsaardbeien. *Fruitteeltnieuws* 29: 12-16

#### Best practice findings

Via soil sample analysis, leaf mineral analysis, fruit set and a soil water balance model a weekly advice is given to pear growers that subscribe to the PWARO service, which tells them how much irrigation should be done (in mm/m<sup>2</sup>) in the following week as well as whether fertigation is required. Research showed that the following soil water potential (the under pressure by which water is bound to the soil matrix that needs to be overcome by an equal or larger pressure in the roots for the plant to take up water) profile is optimal for pear trees: -30 kPa from bloom until beginning of June (cell division phase), -60 kPa (mild drought stress) in June and July (shoot growth phase) and finally -30 kPa during fruit thickening (cell elongation phase) in August. The

<sup>1</sup> Equivalent to 'final report' in EIP-AGRI format.

<sup>2</sup> Please see [ec.europa.eu/eurostat/ramon/nomenclatures/](http://ec.europa.eu/eurostat/ramon/nomenclatures/) for details on NUTS regions, level 3

aim is to approach this profile as much as possible by monitoring soil water content. On a daily basis the soil water content is calculated by making a balance between water input (rainfall, irrigation, capillary raise) and output (evaporation from the soil, transpiration of the tree, run off, drainage). The actual soil water content in the orchard is measured in soil samples taken three weekly and compared to the soil water balance model to verify the accurateness of the model and thus, of the irrigation advise that is given. Linking the model to the weather predictions allows a relatively accurate calculation of the irrigation period required in the following week. In addition, based on the maximum moisture content of a specific soil care can be taken to avoid that during irrigation this threshold is exceeded and thus, drainage of water and nutrients is prevented. The soil water evolution is monitored in one reference zone within the orchard, but intra orchard variations in soil texture, height above sea level, tree age, planting distance etc. are common. To visualize these variations the Soil Service Belgium and pcfruit are starting in 2017 with the analysis of satellite images within the PWARO service. Research has shown a good relation between satellite images and water status in the orchard and between water status and pear size. A vegetation index (NDVI, ReNDVI) derived from the satellite image reveals differences in biomass which are linked to drought stress. The aim is to locate the optimal reference zone and the drought sensitive zones in the orchard. Finally, irrigation and other management practices like root pruning can be better assessed. Mainly orchard location, and soil type, but also the amount of rising ground water, amount and type of water and root pruning determine if irrigation is profitable, but in view of the increasing number of longer drier periods in the last years in Belgium it becomes more attractive in pear production. Comparison between irrigated and non-irrigated 'Conference' trees revealed that irrigation reduces the number of small fruits, increases the average fruit size (up to 5 mm) and weight (10 g on average) leading to a higher yield (up to >5 ton per ha) and turnover (up to 5.000 €/ha/yr). Besides pear, PWARO is extending in 2017 to sweet cherry because the total acreage is continuously growing the last years in Belgium (above 800 ha in total) but often orchards are planted on soils with a too high water content resulting in excessive fruit loss.

Irrigation and fertigation in soil-grown strawberry is a standard practice in Belgium, but precise steering of the system is lacking and is based on the grower's experience and interpretation of the plant growth and production, as well as the (predicted) rainfall. Within the framework of an ongoing project at pcfruit guidelines are under development to determine the irrigation and nitrogen thresholds as well as the optimal application strategies with the final aim to minimize water and nitrogen inputs and losses due to drainage and at the same time improve strawberry quality. The control of the irrigation and fertigation will be based on measurements rather than observations, which should allow to reach a more stable and higher production of high quality fruits. Different yield systems (tunnel planting, August planting, etc.), soil types and pre-treatments (organic fertilizer, fumigation, etc.) are investigated. The fertilization system KNS (Kultur Begleitendes Nmin Sollwerte) adapted to the Flemish conditions is under validation for soil-grown strawberries and should be optimized per strawberry cultivar. Irrigation thresholds for raspberries, black berries and red currants grown on substrate are also being determined using a soil moisture and temperature sensor (PlantCare Ltd). Optimization of fertilization is ongoing for the raspberry reference cultivar 'Kwanza'.