Scanning report (EIP format for practice abstracts)

*Project title (native language): EUFRUIT: European Fruit Network

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

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Section A. Summary for EIP dissemination

*Keywords: top fruit, stone fruit, irrigation, UK, precision

*Main geographical location: 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,

Other geographical locations:

*Summary (native language):

Summary (english):

The top fruit industry within the UK mainly consists of apple and pear production in a variety of growing systems, the older systems are in traditional orchards but many newer orchards are now being planted as high intensity orchards. Stone fruit mainly consist of cherries and plums, with cherries mainly grown under protection during the cropping phase (May-August). All crops are soil grown and are predominantly grown in the South East of England, although cider apples are mainly grown in the South West of England. Traditionally orchards were not irrigated relying solely on rain fed but in recent years some of the older orchards have begun to be irrigated and the majority of newly planted high intensity orchards do receive irrigation. Irrigation to the crops is fundamental to maximizing cropping potential and consistency from one year to the next, and is key to maximizing fruit quality and uniformity. Irrigation is especially important in years where there is low rainfall during the summer months. Grower interviews conducted by NIAB EMR has shown that growers rank efficient irrigation as key to their crop performance but there is a wide variation in the amount of water that is applied to a particular crop. Research trials/experiments at NIAB EMR has shown that precision irrigation tools and techniques results in significant savings in the amount of water and fertilizer applied to the crop, with improvements in yield and fruit quality also being achieved.

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):

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
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Country: UK

NUTS 3 region(s)[2]: 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,

WP no. and title: WP5 secure sustainable fruit production

Date: 11-05-2017

Source materials and methodology

This scanning document will be restricted to top and stone fruit precision irrigation management projects conducted in the UK over the last 10 years in the first instance. The best practice discussed is principally sourced from two major funding streams in the UK; Agriculture Horticulture Development Board and Innovate UK.

Agriculture Horticulture Development Board (AHDB) are a major funder of research, development and knowledge transfer in the UK's horticulture sector. AHDB is funded through levy collected annually from the growers as a proportion of farm gate value. AHDB Horticulture looks after the different crop interests across all sectors, of which soft fruit and tree fruit sectors are relevant to the remit of EUFRUIT.

Innovate UK is a UK government funding body that focuses on projects that support commercial innovation. The projects are business lead and a proportion of the project costs are funded by the commercial companies. The Agritech Catalyst has become a major funder of projects in the horticulture sector since its inception 5 years ago replacing it's forerunner, DEFRA HORT-LINK. Both have funded numerous projects on soft fruit and tree fruit projects relevant to the remit of EUFRUIT.

Irrigation businesses reviews were carried out by the 'Water Advisory Team for Efficient Resource Recovery' (WATERR) project, which was parlyt funded by the European Regional Development Fund (ERDF) as part of the South East ERDF competiveness programme 2007-2013. More information can be found at http://www.emr.ac.uk/projects/waterr-water-advisory-team-efficient-resource-recovery/

Access to information: AHDB publishes reports on funded research on its website (www.horticulture.ahdb.org.uk) mostly freely available across the EU however some factsheets, wall charts, DVDs and publications may need to be paid for. Innovate UK projects are partly commercially funded and as such their outputs can be commercially confidential. The gateway to research is an online database which enables the searching of funded projects (http://gtr.rcuk.ac.uk/). HORT-LINK project summaries are available through http://randd.defra.gov.uk/

Best practice findings

The top fruit sector within the UK mainly consists of desert apples (main varities being Gala, Cox's orange pippin and Braeburn) and culinary apples (Bramley's seedling being the main variety) and pears (mainly Conference) with these being mainly grown in the South East of England. Cider apples and perry pears are mainly grown in the South West of England. Stone fruit mainly consist of Plums (main varitey being Victoria) and Cherries (with a large varitey of cultivars being grown to extend the cropping

[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

season from June until end August), again most of the production is in the South East of England. The top/stone fruit sector that has the largest production area is cider apples/pears and has doubled in production area since the 1990's; whilst the area under deset apples has halved, however, the amount of desert apples being produced has been maintained and therefore the tonnes per hectare has increased in recent years, largely due to the expansion of high intensity orchards. The production area and yield of cherries has increased since the early 2000's with the introduction of new varities, dwarfing rootstocks and use of protected cropping. The move to more high intensity orchards for apples, pears and cherries, along with the use of protected cropping for cherries means that irrigation to tree fruits is essntial to maximise cropping potential, to improve year to year consistency, and to maximize fruit quality and uniformity. The majority of irrigation to tree fruit orchards is via drip/trickle irrigation with irrigation lines running along the tree rows with emitters spraced regularly along the line. When required irrigation is applied for a number of hours at a time to wet up the soil to depth.

The irrigation Business Reviews (IBRs), in depth interviews, that were conducted during 2014-2015 with irrigators as part of 'Water Advisory Team for Efficient Resource Recovery' (WATERR) project identified current irrigation water use efficiency, the impact of irrigation on financial returns, and opportunities for improvement. In brief, the IBRs reveal:

- Over a 3 year period desert apple growers use on average 9 cubic meters of irrigation water tonne, far less than that required by soft fruit, partly due to fruit trees having an extensive, deep root system that is able to access rainfall and ground water reserves. Water use productivity differed between the 3 years and ranged from 5 to 12.5 cubic meters per tonne of apples with a 1.5 - 2.5 fold difference between growers in any one year. The amount of water being applied per hectare between the 3 years ranged from 150 to 375 cubic meters, differences largely driven by the differences in the amount of rainfall in the summer months between the 3 years; there was a 1.5-4 fold difference between growers in any particular year
- The production of pears require less water per tonne of fruit than that of apples, over a 3 year period requiring on average 3.5 cubic meters of irrigation per tonne. Water use productivity differed between the 3 years and ranged from 2 to 5 cubic meters per tonne of pears with a 1-3 fold difference between growers in any one year. The amount of water being applied per hectare between the 3 years ranged from 55 to 120 cubic meters with a 1.5-4 fold difference between growers in any particular year.
- The water use in the production of cherries is very variable from year to year, during cropping the trees are under protection and rely solely on water reserves in the soil from winter rainfall and irrigation supplied by the grower in the summer months. Water use productivity differed between the 3 years and ranged from 15 to 150 cubic meters per tonne of cherries with a 0.5-3 fold difference between growers in any one year. The large disparity between the 3 years in water use is also due to the inconsistency in yield of fruit cropped between the years, with average yield ranging between 5 to 21 tonnes per ha. The amount of water being applied per hectare between the 3 years ranged from 200 to 500 cubic meters with a 0.5-3 fold difference between growers in any particular year

In tree fruit, growers indicated that irrigation is fundamental in meeting retailer quality and fruit uniformity requirements and to optimise yields from year to year. The top performing growers used more water per tonne than other growers but with proceeds less irrigation costs that were 100% higher than in other growers in apples, 40% higher in pears and 35% higher in cherries.

Work carried out by EMR in a HDC (now AHDB) project demonstrated that pears grown in 4 different growing systems, a traditional and 3 high intensity growing systems in the concept pear orchard at NIAB EMR, that irrigation scheduling strategies developed during the project for the pear 'Conference' delivered water savings of between 62 and 85% without reducing Class 1 yields or key aspects of fruit quality. As fertiliser was also applied at each irrigation event savings in fertiliser of between 62 and 85%. In this system soil matric potential sensors were connected to loggers and soil matric potential recorded continiously. Irrigation being applied when the matric potential reached the irrigation setting point and with only enough water being applied to bring the soil in the rooting zone back to field. Another project tested these irrigation scheduling strategies on a commercial farm, resulted in water savings of 60 % when compared to the commercial regime, with no effect on Class 1 yield. The savings in water were often achieved through less frequent water events but also in many cases with a reduction in the length of time the irrigation event was applied: in the water saving strategies the aim was to ensure that the water applied was not lost below the rooting zone and therefore not unavailable to the trees.

Work carried out by EMR in another HDC project developed irrigation scheduling strategies for desert apples 'Cox orange pippin' and 'Braeburn' and desert cherries 'Kordia' and 'Merchant', again using soil matric potential sensors to continiously record the matric potential and irrigation applied at a level before the first physiological effects are seen. In both cherries and apples there was a significant saving in water when compared to commercial practice with water savings of up to 95% in apples

and 88% in cherries, whilst maintaining fruit yields. Another project has tested these irrigation strategies on a commercial cherry orchard, with water applied to to the orchard using the NIAB EMR irrigation scheduling strategy, resulting in a 50% water saving when compared to that of the commercial regime.

In the IBR interviews, growers were asked to identify and rank those 'Best Practices' which are most important in optimising irrigation performance and financial returns. Regularly checking equipment condition and that it operates at design pressure and flow rates came out top followed by irrigation application depending on cropping status and weather conditions. Monitoring soil moisture using scientific tools to schedule irrigation only coming out third with tree fruit growers, unlike in soft fruit substrate growers where monitoring substrate moisture content in was ranked as the most important activity and highly critical to the success of soft fruit growing, and indicates that optimal irrigation of tree fruit, although important, is less critical than that in the soft fruit sector. Consequently, the use of probes and computerised tools to optimise irrigation frequency and duration is not as extensive as in the soft fruit growng industry, but when used a mixture of techniques are used, with some growers using a mixture. Tools commonly used are: soil moisture probes with permanent access tubes inserted at key locations across the orchard to allow readings to be obtained across the rooting depth, using for e.g. neutron probe, environscan, and allows a soil moisture deficit (SMD) to be calculated. Readings are most commonly taken by agronomists who advise the growes when the SMD that requires irrigation to be applied for the stage of cropping is reached. Some growers use augers to remove soil cores from depth to calculate volumetric moisture content. Other tools used are weather stations that record evaporative demand, irrigation being applied when a cumulative value has been reached. Growers make decisions on irrigation requirements depending on the crop status. Irrigation based on the growers own experinces is also commonly used. Most growers use some form of mulching to improve water retention and tree establishment. In the IBR interviews growers were also asked to identify which areas were important to adopt to ensure Best Practice and the need monitor soil moisture, crop status and weather conditions through the use of moisture probes, weather stations and specialist equipment was highlighted by a high percentage of growers but that there was a need to intergrate all the different technologies and systems to achieve this goal.

More information about irrigation management in top fruit production in the UK can been found at:

https://horticulture.ahdb.org.uk/sites/default/files/research_papers/TF%20198_Report_Final_2013.pdf

https://horticulture.ahdb.org.uk/sites/default/files/research_papers/TF%20210_Report_Annual_2014.pdf

https://horticulture.ahdb.org.uk/sites/default/files/research_papers/TF%20210_Report_Annual_2015.pdf

https://horticulture.ahdb.org.uk/sites/default/files/research_papers/TF%20210_Report_Final_2016.pdf

https://horticulture.ahdb.org.uk/news-item/water-survey-starts-build-picture-abstraction