Synthesis report
sustainable fruit production

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Covered NUTS 3 regions:

Switzerland: CH-Switzerland

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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

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Hungary: HU101, HU102

France: FR8 Méditerranée; FR81 Languedoc-Roussillon, FR6 SUD-OUEST; FR812 Gard

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No. IEG members: *Total : 15*
Male: 12
Female: 3

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1	31-08-2016		Marianne Groot
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Document overview

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Synthesis findings

This work package, sustainable fruit production, has three focus themes: thinning, water/nutrients and organic/IPM. During the meeting of the group, scanning reports were presented, giving an overview on the current status of best practices of sustainable production that growers apply today as well as recent developments in sustainable fruit production that are in the pipeline.

Developments for the future are:

Thinning: DSS, decision support models as a tool that can help growers to make decisions about thinning, through measuring the reaction of the trees

Water/nutrients: (1) modelling combined with sensors, soil and plant based and (2) a portal or service to combine and/or integrate models for several subjects

Organic/IPM: side netting against insects, biodiversity and the use of big data.

Overview of best practices:

Thinning:

For apple, chemical thinning with various products is used in Denmark, The Netherlands, Belgium, Germany, France and Switzerland.

In Denmark, mechanical thinning is fairly new, but is getting more used, sometimes in combination with chemical methods. Organic thinning, using NaCl, has been attempted on apple in Denmark.

In The Netherlands, mechanical thinning is hardly used because its results with, for example, the Darwin thinner, have shown too much fluctuation. Besides that, the often-used spindle shape (80-100 cm trees) is less suitable for this machine.

In Germany the so called crop load control or thinning can be done by the use of a few chemical compounds, resp. hormonal acting agents. As an alternative the mechanical blossom thinning becomes more common, using thinning machines like the DARWIN device or others.

In France, most of the studies for mechanical thinning have been done with Darwin machine.

In Italy, for peach no chemical thinning is available and mechanical thinning is used, but still needs improvement.

Fruit thinning is not used in the Hungarian sweet cherry production. If the crop load is heavy, the leaf – fruit ratio must be reach 8 to 9 leaves per fruit to have optimal fruit size. Thinning can be made after the petal fall with hands.

Water/nutrients

For Switzerland, irrigation is less important as for other countries with an exception for some regional cultural-specific expectations, like apricots in the canton of Valais and cherries under rain cover.

For Denmark: in fruit orchards drip irrigation every 50 cm in row or at planting position is normally applied the first 3 years after planting, and thereafter normally very limited only in draught situations. In intensive apple, pear and stone fruit drip irrigation is very common. In strawberries irrigation is necessary in harvest years, both before and after flowering and in autumn to ensure flower bud development. The Danish law sets a maximum for fertilizer application. Typically most tree fruit is fertilized less than the norm to control vegetative growth.

In The Netherlands the IRRY water model was used, but more recently watermarks are used to decide about the amount of water to be given.

Unlike in some other European countries, irrigation is not done in apple growing in Belgium. 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. 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^2) in the following week as well as whether fertigation is required.

In the south-west part of France, growers who have decided to apply precise irrigation are mainly producers of kiwi, hazelnut, walnut, prune and sometimes, apple, pears, peaches and apricots. The main reason is because they see that a better irrigation will benefit in a better quality of fruits and a longer storage possibility. The other reasons as saving water, fertilizer and energy are known but were not the main argument for the decision to invest in capacitances probes and expertise.

In southern Europe (Spain and Italy) the use of shading nets is mentioned as a method to reduce water needs.

Water scarcity in semiarid regions of Europe, like in Spain, threatens the sustainability of fruit tree orchards unless irrigation water is optimized and scheduled in deficit irrigation strategies. The correct use of the most successful deficit irrigation strategies, such as regulated deficit irrigation requires both a good understanding of demands of the crop at different phenological stages and physiological mechanisms involved in the response of plants to water stress, and the use of reliable and sensitive indicators of water stress.

In Italy an experts system for irrigation scheduling and a DSS to manage irrigation and crop level are mentioned. The service of the experts system is web and GIS based, and provides an 'irrigation advice' for a large number of water demanding crops, making use of several data sources as meteorological and soil data from local services and crop parameters. The system calculates a crop water balance at daily step and at field scale, adapted to the crop characteristic, simulated or inputted by the farmer. The DS is based on a protocol to monitor fruit growth rate during the season and forecast fruit size classes distribution at harvest. Based on these data the system releases to the grower real time feedbacks on the orchard irrigation management and indicates whether crop load needs to be adjusted.

The average Hungarian sweet cherry orchards aren't irrigated, because the natural precipitation (550 to 700 mm annual yearly precipitation) might be enough for growing this crop among extensive conditions. The intensive orchards are irrigated, the growers use drip irrigation or micro sprinklers to water them.

Research in Lithuania: major attention was concentrated for analysis of morphological, biochemical peculiarities of the aboveground part of the trees (apple tree 'Auksis' grafted on MM.106, M.26, B.118, M.9, P 60, P 59, P 2, B.396, P 22 rootstocks) and evaluation of how they are affected by water deficiency. Results showed that the drought evoked photosynthetic pigments system adaptation mechanisms of all apple rootstocks except P 22. Tendency for changes in phytohormones and sugars content under drought stress of various extent was not established. Apple rootstocks M.26, M.9, P 2 and B.396 were the most drought sensitive. P 22, B.118 and P 60 were more resistant to drought.

Organic/IPM

Organic production is increasing in Denmark following the large and increasing demand by Danish consumers. For apple 21 % of total area was organic in 2014 but only 4.9 % in pear. Organic treatment strategies for a full season are available for apple, pear, sweet and sour cherry, black and red currant and strawberries outside.

For Germany: Spraying intervals and exact timing of pesticide use in the vegetation periods of berry plants allow the fruit producers to use various pesticides and in the same time prevents detectable residues in the harvested berries. Using the recommended and developed spray schedules insures integrated fruit production and in the same time retailer demands. Holthusen (2016) estimated that 90% of apple growers in northern Germany use this method. Growing berry fruits under cover, (protected production) augments in the last two years in Northern

Germany. Advantages: less herbicide use, less insecticide use, less fungicide use, higher yield/m^2 and assured harvests without the influence of rainfall and other weather phenomena's, therefore better quality. Up to 60% of the northern strawberry producers use a reduced spraying sequence of classical fungicides supported by beneficial organisms.

In Romania, the organic agriculture increased the last years. According FAO statistics, of the organic cultivated orchards, approximately 86% are under conversion and only 14% are certified. For the organic fruit growing in Romania, six factors are important:: apple scab resistant varieties; the use of ameliorative plants in soil preparation for planting; almost all organic fruit tree growers use pheromone traps for monitoring and risk assessment of pests; the protection and monitoring of useful orchard fauna; alternative organic pesticides and in many orchards mechanical weed control is used as an alternative for herbicides.

The recent developments per theme:

Thinning:

In Denmark, mechanical thinning by hand held equipment or tractor driven machines with flower stripper is fairly new.

In research for France, the prediction of flowering time is a new development. From long time series of flowering time observation, models can be inferred and used to predict flowering time in a given year or in climatic scenarios for the future. For thinning, the integration of fruit set capability and self-thinning trait in new varieties and the use of models to predict fruit set depending on fruit load and climatic conditions are new. Making decision tool(s): the goal is to find a simple diagnostic for witch the information will directly come from molecular markers and genes expressions.

In Italy, mechanical thinning is considered a very promising approach for crop load management in peach, where chemical strategies are not available and the hand thinning is very expensive due to the high amount of hours needed. The various benefits obtained (higher fruit quality, lower needs for hand thinning) make this approach extremely convenient for peach growers who can apply it also for organic productions

The efficacy of the new thinning product Brevis is evaluated in several European countries (at least in Switzerland, The Netherlands, Belgium, Spain, Italy, France, Germany)

In Switzerland, experiments on thinning sweet cherries with a high crop load were done in 2004, 2005, 2006 and again in 2015. Besides hand thinning, also chemical products were evaluated (ATS, BA, NAA, Metamitron). So far, thinning of sweet cherries was not successful: either there was no thinning effect, or if the crop load was reduced, the increase in fruit size was not high enough to compensate a smaller harvest.

Water/nutrients:

For The Netherlands: wireless reading of Watermark: data collection in the field by sensors wired with dataloggers with electrical loading by sun cells and wireless communication to the PC via GSM and an internet based application of IRRY.

In Belgium, irrigation and fertigation in soil-grown strawberry is a standard practice, 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 leaching and at the same time improve strawberry quality.

Recent developments in France: derive indices of water stress tree status from airborne images. Applied to apple progenies and pre-selected material. Model the impact of water restriction of tree development and fruiting capability. In south-west of France the next step in irrigation is automatization of the irrigation including RDI on light soils (not verified here on clay soils).

In Italy subsurface irrigation is recently implemented. This strategy, foresees an underground water distribution thanks to pipelines and irrigators buried slightly under the cultivated row, with a frequent but low irrigation rate lasting during the daily light period. Subsurface irrigation has the clear advantage of reducing evaporative water losses, while increasing the distribution efficiency, allowing a higher volume of wet soil; a reduction in the amount of water used for irrigation; a better management of drought periods; a lower weed growth and, consequently, lower needs for herbicides treatments on the surface.

In Spain soil water evaporation should be reduced as much as possible in order to achieve high irrigation efficiency. This can be done by mulching, innovative canopy forms or reducing fruit load.

For the use of sensitive indicators of water stress, special attention has been paid in Spain to plant-based methods, since plant measurements have the advantage of integrating the soil and atmospheric water status, as well as the response of the plant to the surrounding conditions. New methods have been developed for non-destructive, automatic and continuous measurements, such as dendrometers sap flow and turgor-related probes.

Field experiments in Switzerland for sweet cherry under rain cover, the treatment “micro-sprinkler every second day” was economically most successful with the highest benefits of the four treatments, whereas the balance of the other treatments was in some years in deficit.

Organic/IPM

In Denmark, the scientific testing of covering of apple and pear with plastic roofs to avoid direct precipitation on fruit and leaves is ongoing to avoid apple scab attack and several years results seems very promising, almost an on off effect of infection. Dry fruit do not get scab at all or very limited. Challenge is cost and stability of roofs. Hot water treatment of apples to avoid storage rots has been demonstrated to be efficient and is now slowly moving into industry following development of treatment equipment.

In Germany, the berry fruit research Station northern Germany situated in Langförden (Berry compartment of the ESTEBURG) is working since two years intensely on research in protected production. Key aspects, variety and growing method testing of different species of berry fruits under cover, to find the appropriate varieties and methods for sustainable berry fruit production. An experiment of different growing containers as Air pot, Bato pot, and models from Beekenkamp is set for the next two years to evaluate root growing, plant development and phytosanitary conditions. The experiment takes place in the cultivation of Raspberries, Blueberries. Substrate aggregates and substrates are tested with different varieties to get knowledge about which variety needs which substrate and which nutrition method. Different water storing substrates are tested to avoid drain to reduce water- and fertilizer wastage. (Koschnick 2016)

In Romania, apple scab resistant varieties are tested as well as ameliorative plants in soil preparation before planting, many species of useful orchard fauna, alternatives for organic pesticides and natural compounds to induce plant resistance.

Research in Switzerland showed for hail nets with side nets that concerning pest insects, the codling moth was successfully reduced in plots with side nets compared to control plots without side nets. Effects on beneficial or other pest insects are still evaluated. Meteorological and physiological measurements have only just started

Summary for EIP dissemination

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

Keywords: thinning, water, nutrients, IPM, organic

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Project web page: www.eufrin.org

Annex: Scanning reports

See separate annex