

A10. Keywords

Max. 5 keywords to describe the project activity.

Productivity, disease & pest management, robotic weeding, quality

A11. Short project description/summary on objectives, activities, and expected results, both in Danish and English language (max 1500 characters, incl. spaces for both languages)

Den danske økologiske produktion af frugt og bær finder sted på 502 ha, den største afgrøde er æbler på 282 ha. FruitGrowth har valgt at arbejde med de hovedbarrierer i økologisk produktion, som er fremkommet i rapporten: *Analyse af rammevilkår for økologisk frugt, grønt og bær i Danmark, 2009*. Projektet fokuserer på sunde sorter af æble, nye innovative metoder til ukrudtsbekæmpelse, samt udvidelse af sæsonen og dermed udbuddet og tilgængeligheden af æbler ved ny teknologi ved lagring. Vi arbejder med løsninger på kort- og langt sigt for de alvorligste skadevoldere (æblevikler, æblebladhvæpse og æbleskurv i æble), nyttedyr i blomsterbræmmer, samt naturstoffer til bekæmpelse af de alvorligste skadevoldere. FruitGrowth indeholder forskning, udvikling, demonstration og vidensformidling af resultaterne. Resultaterne forventes at bidrage til en markedsdrevet vækst af unikke højværdiprodukter af friske æbler, fra lokale miljøvenlige og rentable produktionssystemer, via en øget tillid fra avlere, forarbejdningsindustrien og forbrugerne til danske økologiske produkter.

Currently the Danish organic fruit & berry production area is 502 ha with the main crop being apples at 282 ha. FruitGrowth will address the main barriers identified by the 'Working Group report, 2009', by focussing on robust cultivars in apples, new innovative weeding methods and extending the fruit season & thereby product availability for consumers we will introduce new cultivars & technologies in storage. We work on short & long time solutions of the key pests & diseases (codling moth, apple sawfly & apple scab in apples), natural beneficial's in flower strips, & natural compound to control key pest. FruitGrowth includes research, development, demonstration & dissemination of the results to fruit growers. Outcomes are expected to contribute to a market-driven growth of unique, high value fresh organic apples from local sustainable & profitable production systems, through increasing grower, industry and consumer confidence in Danish grown organic apples.

A12. Project description

(All parts of A12 must be filled out. Use "Garamond" as font, and font size 12, single spaced)

A12.1 The project objectives (2-3 lines).

To increase the Danish production of high quality organic apples by delivering new robust cultivars & storage solutions to extend seasonality, implement novel mechanical & biological technologies & compounds to optimally manage weed, diseases, pests & beneficials during production.

A12.2 The background and idea (hypotheses) incl. the national and international "state of art" and incl. references relevant for the section (max. ¾ page).

Danish organic fruit & berry production covers 502 ha. Production is small & unstable, due to yield & quality loss from pest & diseases. To increase productivity & the ability to successfully compete in the market, focus must be placed on delivering superior fruit, overcoming pest & disease threats, reducing labour costs & extending the fruit season.

Robust production systems are needed to provide credibility to organic systems for consumers. New innovative methods such as robust cultivars & robotic automated weed control & new storage technologies need to be implemented to deliver maximum productivity, cost efficiency & product quality.

Hypothesis 1: Increased high quality yield will be delivered by robust cultivars suited for Danish organic production systems.

Hypothesis 2: Labour costs & use of energy will be reduced by new methods for weed control. Postharvest innovation is needed to expand the organic sector, enabling it to be competitive & to deliver a quality product that encourages consumer purchase. Dynamic controlled atmosphere (DCA) is a new storage approach that increases quality, & reduces postharvest diseases resulting in lower fruit loss.

Hypotheses 3: DCA will reduce fruit respiration resulting in improved shelf-life of organic apples.

Risk & pest management is based on natural regulation. Studies are needed of how ecological infrastructures as flower strips can be managed to augment natural enemies of insects pests. Direct control is required when pests escape natural regulation. New methods are needed to control key pests and diseases eg codling moth, apple sawfly & apple scab.

Hypothesis 4: Flower strips will be managed to increase beneficial insects & reduce the incidence of codling moth by i. distance from flower strip, ii. floral value to beneficials vs. pests & iii. landscape diversity.

Hypothesis 5: New innovative methods of mass-release of *Trichogramma* in apples will improve yield & reduce costs.

Hypothesis 6: Apple scab can be controlled by a) irrigation provoking sporulation & b) rain cover of trees or fruit.

Hypothesis 7: Plant extracts will control apple saw fly.

Ref:Analyse af rammevilkår for økologisk frugt, grønt og bær i Danmark. FødevarerErhverv, 2009.

A12.3 The projects contribution to solving important challenges for the organic food, agriculture and aquaculture sectors and the general political goals regarding food, agribusiness and environment as expressed in the governments Green Growth programme. Including an explanation of the projects focus on respectively the entire product/value chain or selected parts here of (e.g. primary production, processing, trade and transport) – max. ½ page.

Danish organic production of apples is currently small & unstable. To strengthen the position of the industry it is critical to cover the whole value chain. It is important to overcome risks from poor cultivar productivity, pest & disease threats & to find long term sustainable production solutions to increase profitability.

Overcoming production risks would improve yield, profitability, fruit quality, seasonality & consumer confidence in Danish organic products, as consumers would be provided with a more reliable supply of quality organic fruit over a longer market window. An increased & reliable Danish based production would become more competitive against imported organic apples & provide future export opportunities.

FruitGrowth is designed to resolve current risks to the organic apple industry by focussing on delivering a robust production system for apples. This systems will be developed by identifying superior robust cultivars to deliver a high yield saleable quality fruit.

We reduce key pest & disease losses by establishing ecological infrastructures that conserves beneficial insects & by developing new mechanical, biological & biochemical control methods. This approach balances the need for short term control with development of long term prevention strategies. We will contribute to weed control by developing innovative autonomous vendor independent robots in the orchards. We will add value to the sector through developing novel post harvest storage & transport technologies. Our focus is to strengthen consumer confidence in Danish fruit products by delivering a credible & reliable supply of quality organically grown apple. It is important that we can deliver these into the market place over a longer time period & strategies to underpin this are including in our project. Our strategy is to carry out quality research by experts in the organic area & to partner these experts with industry participants who will demonstrate & implement the knowledge for the benefit of the fruit industry.

A12.4 The projects innovative value, relevance and effect including the specific barriers and development potential for the organic sector the project will solve and/or support (max. ½ page).

FruitGrowth will increase the production of high quality apple fruit. We have focussed our approach on delivering new innovative scientific knowledge on the key pest & disease challenges for this key crop. We have designed a suite of activities including novel & superior cultivar evaluations & demonstrations, new biological control solutions, natural pest & disease solutions, state-of-art energy efficient robotic weeding & new postharvest technologies including specialised storage methodologies. FruitGrowth will deliver short term solutions (eg . compound to control apple sawfly) balanced with long term strategies (eg. use of robust cultivars and ecological infrastructures). In apples we must increase productivity by a min. 30% to be competitive with conventional production systems. To achieve this we will focus on overcoming apple scab & apple sawfly through the use of natural approaches, novel biological control solutions & to increase profitability we will evaluate & demonstrate novel atmosphere storage conditions & energy efficient robotic weed control technologies.

Together these sustainable solutions will underpin greater confidence by growers in organic systems, by retailers in that the supply & volume of quality organic apples will be more reliable, & by consumers in that quality organic products will be more readily available in the market over a longer time period, thereby increasing familiarity & increased likelihood for repeat purchase.

A12.5 Description of activities, methods and expected results divided into work packages with clear denotion of which activity the applicant consider to be either Research, Development or Demonstration. The coherence between work packages must be clearly described and the relation between activities and the tables with milestones and deliverables must be logical and consistent. Moreover, the primary target groups should be clearly identified with a description of how these will be met by the project (max. 1 page per WP and max. 3 pages in total).

The primary target group of all WP's is fruit & berry growers. The participation of the 3 main advisory groups fruit growers & Organic Denmark ensure a strong coherence between research, development & demonstration in the project. See also A12.9. For partner acronyms see A12.10.

WP1. Leadership, communication, implementation. WP-leader Michelle Williams AU-DH

There will be annual meetings of the Project Steering Group & 6 mo meetings of the Project Coordination Group. Reports & communication with The Ministry of Food, Agriculture & Fisheries will be written & overall coordination & dissemination of the results from FruitGrowth will be organised. The three advisory participants will disseminate knowledge from the project to their growers. Expected results are a good communication between the WP's & to the authorities & a fast & broad dissemination of the project results.

WP2. Robust Plant Production & Extended Season Supply. WP-leader Hanne Lindhard Pedersen AU-DH
WP2 has 3 subprojects; each led by the respective expert.

WP2.1 Robust apple cultivars suited for Danish organic production systems (Hanne Lindhard Pedersen, AU-DH). An existing planting, in a newly developed Organic Research Area, AU, of 45 apple cultivars will be kept unsprayed to identifying superior robust cultivars suited for Danish organic production systems. New promising cultivars of apples from international breeding programs will be planted in spring 2011 & will be included in the evaluations. Cultivars will be evaluated for susceptibility to pest & diseases on leaves & fruit, yield, fruit quality & storage potential. Results: recommendations for planting of robust cultivars of apples in organic systems.

WP2.2 New innovative methods for weed control (Hanne Lindhard Pedersen, AU-DH). A trial optimising weed control in respect to labour & energy saving will be established in organic apples at organic research area (AU-DH). Treatments will include several mechanical approaches & soil covering with rape straw on 4 replicates with a plot size of 15 trees. Energy used & labour time will be estimated. Tree growth, yield & yield quality will be determined. One of the treatments will be a joint autonomous implement carrier (ASuBot) consisting of a commercial garden tractor equipped &/or prepared for carrying different Local Positioning Sensors (LPS) & Global Navigation Satellite Systems (GNSS). SDU-KBM are responsible for building the machinery. The platform may be steered by Topcon's AES-25 Steer. The ASuBot will be equipped with the sensor needed to navigate within the selected orchard system at AU-DH. When the ASuBot is capable of navigating along the tree rows & making headland turns, the weed burner from Envo-Dan will be mounted & demonstrated. The efficiency of the overall system will be evaluated performing successive flame weeding sessions using the modified ASuBot. Results: knowledge on new innovative methods for weed control & development of a unique autonomous implement carrier for orchard systems.

WP2.3 Extended season & supply of Danish organic apples. (Lillie Andersen, AU-DH). Organic apples of 2 different cultivars will be stored after harvest in large closed foil bags & flushed with different composition of atmosphere (O₂:CO₂:N₂) with continuous monitoring of fluorescence. Threshold levels for development of anaerobic conditions will be determined in relation to composition of atmosphere & cultivar. Quality of the apples before & after storage (2-4 month) & 1 week shelf-life at room temperature will be determined (Brix, firmness, weight-loss, sugars, ethanol, ethyl acetate, acetaldehyde). The effect of DCA, during storage on quality & development of storage diseases will be determined. Effect of short-term high temperature before storage on disease development & quality (firmness, sugars) will be evaluated. Additional apple cultivars, suitable for organic production will be tested for storage possibilities under DCA. Results will be extended sales season & improved shelf-life of organic apples.

WP3. Risk & pest management. WP-leader Lene Sigsgaard KU-IJØ

WP3 has 4 subprojects; each led by the respective expert.

WP3.1 Ecological infrastructures (Lene Sigsgaard, KU-IJØ). The landscape composition & management of at least 8 organic apple orchards will be characterised by farm data & orthomaps in ArcGIS. Orchard vegetation will be recorded once. Codling moths (*Cydia pomonella*) & predators (Earwigs, Heteropterans, Coccinellids, Chrysopids, spiders) will be sampled 3 times/y (at May, June/July & Aug). Harvest yield & codling moth damage will be assessed. Detailed studies on the role of flower strips as a supplier of natural enemies as a function of distance will be carried out at KU-IJØ & 2 commercial orchards. Sentinel eggs of codling moth, placed in trees 0, 4, & 8 m from flower strips will be collected & predation & parasitism assessed in the lab. Dietary value of flowers for *Trichogramma dendrolimi/cacoeciae* & codling moth adults will be tested to identify flowers with the highest value for parasitoids. Results: knowledge of the effect & scale of landscape & field components on pests & beneficials. Detailed knowledge necessary to decide flower strip floral composition & spacing will be generated.

WP3.2 New mass-release methods of *Trichogramma* (Lene Sigsgaard, KU-IJØ). Current & new mass-release methods, developed for field crops, will be tested in small scale, then in field plots (4 reps). Parasitism rate will be assessed on sentinel eggs of codling moth placed in distances of release points. Results: Potential new mass-release methods against codling moth identified.

WP3.3 Plant extracts for apple sawfly (Klaus Paaske, AU-IPM). Plant extracts will be tested in field trials according to GEP & EPP standards. Trials will be located at growers where apple sawfly is a problem. The

trial design will focus on optimal efficacy & timing of the products & damage cause by apple sawfly will be assessed. Results: Efficient extracts & doses for sawfly control identified.

WP3.4 Mechanical protection of apples scab (Maren Korsgaard, KU-IJØ & Hanne Lindhard Pedersen, AU-DH). Irrigation systems will be established in rows of apples. Strategic irrigation against apple scab will be evaluated w./wo. sulphur. Effects of irrigation & deep sounds on spore release & the effect of irrigation on infection will be evaluated. Rain protection will be tested on a) tree plots w./wo. roof (10 trees & 4 replicates) for 2-3 y, & b) individual fruits wrapped in different material at different timing & periods (10 fruits/4 trees/treatment). Quality will be assessed based on scab infection, fruit size, colour & sugar content. Results will be knowledge on a) the effect of strategic irrigation & sound on the release of ascospores & scab infestation, & b) the physical protection against rain & spores as a means to reduce scab infection & improve fruit quality.

A12.6 Description of how it will be ensured that the project results can be implemented in practice and perhaps commercialized (max. ½ page).

FruitGrowth has been developed to ensure close connectivity between researchers, industry advisors, postharvest facilities, companies & growers to ensure that scientific results & knowledge will be developed & implement quickly & within the life of the project. Some research activities will be carried out directly at growers sites & therefore will be directly implemented within the project period. All research activities will be carried out in an open & transparent way, whereby all project partners can view & discuss the experiments. To ensure effective communication & implementation from the project activities open days, talk at growers meetings, informed industry advisors, workshops with growers, other scientists & interested sales organizations, will occur on a regular basis to show case & discuss treatments, responses & implications with interested end users. Open days will focus on demonstration of technologies, approaches, research findings & to discuss best practise opportunities & risks. A project web site will be established at AU-DH and results will also be published through the web sites and news letters from GartnerRådgivningen, Gefion and DanskeFrugtavlere.

Results will also be communicated through written articles for end users in industry journals including Frugt og Grønt & Praktisk Økologi.

Denmark is currently perceived as being a leader in organic research, therefore research outcomes will be published in scientific peer-reviewed international journals & conferences, to strengthen this position.

Public popular press articles will focus in the areas of: organic solutions for food products, new organic production technologies for fruit, environmental sustainability in fruit production & novel strategies in the organic fruit sector, these will support increased consumer confidence in organic fruit products & inform consumers of relevant research activities providing credibility to our Danish organic systems.

Commercialisation

We expect the Envo-Dan weed burner, which is to be developed & demonstrated in FruitGrowth, to be commercial available shortly after the end of the project. IP to Envo-Dan will be held by SDU. Also new effective plant extracts to control pest & diseases & mass-released beneficials are expected to be made commercially available, IP to these plant protection products will be held by KU-IJØ.

A12.7 Description of possibilities for a general utilisation of the results (max. ½ page).

The industry, society & environment: The overall project goal is to increase the yield & quality of organic apples, thereby increasing profitability. Utilisation of the results will mainly be by primary producers. The processing industry will also benefit from successful project outcomes through accessing reliable volumes of quality organic fruit for processing & to use in developing new products. Danish organic fresh fruit will provide consumers with healthy choices and a larger selection & variety of organic products on a more regular basis, all contributing to an increased familiarity & increased likelihood for repeat purchase of organic products. In addition society will benefit from the increased sustainability of production practises on the Danish environment; reduced reliance on chemicals in organic fruit production, and an overall increased awareness on the balance needed between soil, water, insects & plants. The scientists: Successful project outcomes will help to retain Denmark in a world leading position in organic fruit research. New knowledge in the scientific area

will be utilized to strengthen international collaborations & to build future networks & projects. Successful publication & communication of these results will increase the likelihood of attracting additional regional & EU funding to Denmark. Scientific knowledge will be transferred to advisors & growers & industry as planned in the development & implementation activities within FruitGrowth. Knowledge will also be used in capability development through teaching courses at the three participating universities for students both at Bachelor & Master levels.

The advisers: Industry advisors will have relevant & credible knowledge to be able to advise new & experienced growers both on long & short term solutions to the most important problems.

A12.8 Description of the coherence between the research, development and demonstration activities in the project, including involvement of relevant users of the results (max. ½ page).

FruitGrowth is a research, development and demonstration project. The research is to be carried out at three universities. The trials will be based either at university or growers sites. All trials are to be used both for scientific & demonstration purposes. Open days & group advice will take place in the research plots. The advisors will be free to access the experimental plots. Visitors will be welcome at the university sites. WP1 will ensure communication across FruitGrowth and within the WPs & subprojects to ensure full collaboration & full dissemination & implementation of results from research to the end users. Most trials will be located at the newly established 8 ha Organic Research Area for fruit and berries, AU. At University of Copenhagen, field trials will be placed with growers, and some at the Pometum. The development of the energy efficient & autonomous weeding system in WP2.3 will take place at the Organic Research Area, AU. Fruit for Extended Season & Supply of Danish organic apples (WP2.3) will originate from apple trials in WP2 or WP3.

A12.9 Project organisation, management and administration (max. ½ page). Michelle Williams (Aarhus University, CV1) is the Project Leader, she has extensive leadership experience with people (currently over 70 staff) & international projects (currently valued at over 80 M Dkr). The Department of Horticulture is leading over 70 projects & they have the necessary auditable systems for financial & administrative reporting on this project. Secretarial & administrative staff are included in the program to fulfill all administrative functions. This program is organised into 3 work packages (WP) and 7 subprojects, see Appendix 1, with WP1: Management, Administration & Implementation led by Michelle Williams, WP2: Robust Plant Production & Extended Season Supply led by Hanne Lindhard Pedersen (Aarhus University, CV2) & WP3: Risk & Pest Management led by Lene Sigsgaard (University of Copenhagen, CV3). Each WP Leader is responsible for the coordination of the research, advisors & industry partners & activities within their WP. The three leaders will form a Project Coordination Group, that together with Jan Jensen Hass (GartnerRådgivningen) will meet twice each year to report on progress, monitor performance, opportunities, communication & implementation strategies. The Coordination group will meet once each year with a Program Steering Group, this group is formed by interested stake holders, end users & research partners critical for the full implementation of project outcomes, including representatives from Organic Denmark, GartnerRådgivningen, Gefion, Danske Frugtavlere & University of Southern Denmark.

A12.10. The technical competences of the partners and their contribution to the project including how they complement each other (max. 5 lines per partner).

Aarhus University, Dept. of Horticulture (AU-DH) is internationally recognised for fruit & berry research & especially in organic horticulture. AU-DH leads & participates in many national & international fruit based projects, & has experience in large multidisciplinary research projects. Hanne Lindhard Pedersen, senior scientist has 24 y experience in research in organic apple. AU-DH will contribute with 8 ha organic research area, highly skilled scientific & technical staff, project leadership & administration, & WP Leadership (WP1 & 2).

Aarhus University, Dept. of Integrated Pest Management (AU-IPM) is known for research in efficient & environmentally acceptable prevention & control of weeds, plant diseases & pests in plant production. Academic employee Klaus Paaske is responsible for research in horticultural crops and for WP3.3. Experiments will be carried out at organic growers sites.

University of Copenhagen, Department of Agriculture & Ecology (KU-IJØ) has capability in crop cultivation, physiology & applied ecology. Lene Sigsgaard, Associated Professor has 20 y experience in natural regulation & biological control of insect pests also in fruit & berries (WP3). Maren Korsgaard is working in projects concerning plant genetic resources & provides expertise in organic fruit production (WP3).

University of Southern Denmark, Inst. of Chemical Eng., Biotechnology & Environmental Tech. (SDU-KBM), has core competences in robotics & is responsible for development of a unique autonomous implement carrier for orchard systems.

The Danish Horticultural Advisory Service (DHAS) provides advice for the Danish fruit & vegetable producers, as well as producers of ornamentals through direct advisory service & through communication in newsletters, articles, & trade groups. DHAS will contribute with demonstration of trials at producers & dissemination of new knowledge.

Landboforeningen Gefion, Gefion is an association of approx. 2300 farmers running an advisory service company with app. 245 employees. Ecoadvice is a department in Gefion. It was founded in 1995 & employs 7 advisers. Ecoadvice works exclusively with organic farms, giving direct production advice, carrying out farm research, projects, courses, training, newsletters, articles etc. Gefion will contribute with demonstration of trials at producers & dissemination of new knowledge.

DanskeFrugtavlere (DFA) is the main Danish growers organisation for storage, distribution & sales of Danish produced apples, peas & fresh berries. They have a large percentage of the organic production especially on apples. Their quality advisor Birgitte Pedersen will contribute to the project by dissemination of the new knowledge to the growers delivering fruit to DFA.

ENVO-DAN ApS, founded in 1995, produces gas burner systems for environment friendly weed control on the farm & in the city, & has over time developed a comprehensive product line of gas burners for different applications. The company has an annual turnover of 1M DKK on weed burners. In this project, ENVO-DAN's core contribution will be new innovative technology for weed control in orchards.

Strandegaard orchard is run by Bent Jensen. It is a major organic farm of 1300 ha. The organic apple orchard of 1 ha has well-established flower strips (> 5 y). Strandegaard will contribute to the project by assisting in experiments on ecological infrastructures & flower strip management as a means to augment beneficials & pest control in apples. Strandegaard will assist with experiments including yield & quality assessment (WP3). Strandegaard will also host demonstrations on infrastructures & pest management strategies in apple (WP3).

Ventegodtgaard I/S Ventegodtgaard I/S Søren Thorsen, is an organic farm with 1 ha of apples with a well-established central flower strip (> 5 y). Ventegodtgaard will assist in experiments in apples as described for Strandegaard (WP3). Ventegodtgaard will also host demonstrations on new pest control strategies and ecological infrastructures in apple (WP3).

A12.11. Expected collaboration with other research institutions/companies nationally and internationally (max. ½ page). Planned collaborations with research institutions include: Bioforsk Ekologisk, Trondheim & Bioforsk, Ås (Head of Research Atle Wibe, Dr. Nina Trandem) Norway; Swedish Agricultural University, Sweden; East Malling Research, UK (Jerry Cross, Jean Fitzgerald); USDA-ARS, USA

(Drs. Matt Greenstone, Mark Brown); Universidad Lleida, Spain (Dr. Jesus Avila); INRA, France; Marc Trapman (the inventor of Rimpro-scab-warning programme link: www.fruitweb.info), Netherlands; IOBC-WPRS WG on Fruit crops (SG Soft fruits & SG Pome fruit arthropods) & IOBC-WPRS WG “Landscape management for functional biodiversity”; Fruit Research & Extension Centre Jork, Germany; Department of Food Science, KU-LIFE, Denmark. Polli Experimental Fruit & Berry Processing Centre, Estonian University of Life Sciences; Research Centre Geisenheim, Germany.

Cooperation is planned with members of the graduate school 3R: Residual Resources Research (DTU, Inst. of Environmental Engineering, SDU- KBM). The ASuBot is a joint platform between SDU-KBM & AU-IBT on which both parties are cooperating. There will also be synergy to the high-technology project “The intelligent sprayer boom” with respect to the dynamic mapping & navigation within a semi-structured environment.

Collaboration is expected with The Danish Ministry of the Environment, Environmental Protection Agency: Efficacy assessments of pesticides for approval in Denmark. EU Expert Group: Technical Group on Minor Uses.

Collaboration is planned with AGCO, Denmark; Thorsen-Teknik DK, & Topcon (via AGCO).

Collaboration is expected with Organic Denmark, & Organic Denmark marked section.

A12.12. The relation to previous projects within the projects focus areas (if any) including references to these (max. ½ page).

FØJO II. (2000-2004): Development of sustainable production system for organic apple growing (AU-DH) and Control of scab in organic apple growing (AU-DH & AU-IPM).

FØJO III. (2005-2010): Quality & Integrity of Organic Eggs, Chicken Meat & Pork. WP 3: Integrated broiler & apple production (AU-DH).

Ministry of Food, Agriculture & Fisheries. (2009-12): Sustainable future for Danish apples, pears & strawberry, WP 2.2 Intensive organic apple growing. WP 3.2. Hot Water Treatment. WP 3.3 Storage under controlled atmosphere (AU-DH).

EU-QLIF. (2003-2005): (QualityLowInputFood). FOOD.CT.2003-506358. WP3.5.1 Apples (AU-DH).

EU-REPCO. (2003-2007): Replacement of Copper fungicides in organic production of grapevine & apple in Europe (AU-DH & AU-IPM).

YdunJuice: Potential for Specialty Juices in Local Danish Apple Varieties. Project no 3304-FVFP-08-K-15-01 (KU-IJØ).

EU- ENDURE. European Network for the Durable Exploitation of Crop Protection Strategies, WP RA1.2 Case Study Pome Fruit (KU-IJØ).

Directorate of the Environment (2008-09): Buffer zones for biodiversity of plants & arthropods: is there a compromise on width? (KU-IJØ). (2006-07): Field margins in cultivated areas –a review study in Danish (KU-IJØ).

The Directorate for Food, Agricul. & Fisheries (2002-05): Fruit, biological control of insect pests (KU-IJØ).

A13. Tables with milestones and deliverables with information as requested in the table in A16.

1.1. March 2011. WP1. First coordination meeting. Project launch. Agreement on experimental plans, activities and deliverables. 0-6 month. Responsible AU-DH. Participants: KU-IJØ, Jan Jensen Hass.

1.2. November 2011. WP1. Second coordination meeting. Monitoring status, agreement on activities and deliverables. 6-12 month. Responsible AU-DH. Participants KU-IJØ, KU-FOI, Poul Rytter Larsen, Jan Jensen Hass.

1.3. December 2011. WP1. First Steering group meeting. Summery year 1. Activities, results, current status. Plan for year 2. Responsible AU-DH. Participants All.

- 1.4. March 2012. WP1. Third coordination meeting. Monitoring status, agreement on activities and deliverables. 12-18 month. Responsible AU-DH. Participants KU-IJØ, Jan Jensen Hass.
- 1.5. November 2012. WP1. Fourth coordination meeting. Monitoring status, agreement on activities and deliverables. 18-24 month. Responsible AU-DH. Participants KU-IJØ, Jan Jensen Hass.
- 1.6. December 2012. WP1. Second Steering group meeting. Summery year 2. Activities, results, current status. Plan for year 3. Responsible AU-DH. Participants All.
- 1.7. March 2013. WP1. Fifth coordination meeting. Monitoring status, agreement on activities and deliverables. 24-30 month. Responsible AU-DH. Participants KU-IJØ, Jan Jensen Hass.
- 1.8. November 2013. WP1. Sixth coordination meeting. Monitoring status, agreement on activities and deliverables. 30-36 month. Responsible AU-DH. Participants All.
- 1.9. December 2013. WP1. Final project report. Responsible AU-DH. Participants All.
- 2.1. March 2011. WP2.1. Planning and establishment of cultivar experiments. Responsible AU-DH.
- 2.2. October. 2013. WP2.1. Completion of cultivar trial experiments. Responsible AU-DH.
- 2.3. March 2011. WP2.2. Planning and establishment of weeding experiment. Responsible AU-DH. Participants SDU-KBM.
- 2.4. October 2012. WP2.2. ASuBot is capable of following the straight tree rows with a speed of 1½ m/s and an accuracy of +/- 0.1m. Responsible SDU-KBM. Participants AU-DH.
- 2.5. October 2012. WP2.2. ASuBot is capable of performing headland turns enabling following several tree rows (as above) in a sequence. Responsible SDU-KBM. Participants AU-DH.
- 2.6. November 2013. WP2.3. The ASuBot is capable of functioning with the Envo-Dan flame weeder mounted. Responsible SDU-KBM. Participants AU-DH, ENVO-DAN.
- 2.7. August 2011. WP2.3. Storage research methods planed and evaluated. Responsible AU-DH.
- 2.8. December 2011. WP2.3. Storage data collected. Responsible AU-DH.
- 2.9. August 2012. WP2.3. Storage methods evaluated on basis of results & modified. Responsible AU-DH.
- 2.10. December 2012. WP2.3. Storage data collected. Responsible AU-DH.
- 2.11. December 2013. WP2.3. Storage other cultivars. Responsible AU-DH.
- 3.1. February 2012. WP3.1. Apple orchards characterized with respect landscape (ecological infrastructures) and management practices. Responsible KU-IJØ. Participants Gefion, DHAS, Danske FrugtAvlere, Ventegodtgaard, Strandegaard.
- 3.2. December 2012. WP3.1. Population densities of codling moth and beneficial, fruit yield and codling moth damage assessed (1-y study). Responsible KU-IJØ. Participants Ventegodtgaard, Strandegaard.
- 3.3. February 2013. WP3.1. Orchard data analyzed and interpreted, identifying orchard and landscape factors with an impact on natural pest control. Responsible KU-IJØ.
- 3.4. March 2012. WP3.1. Codling moth and Trichogramma rearing established. Responsible KU-IJØ.
- 3.5. December 2012. WP3.1. Flowers dietary value assessed for Trichogramma and Codling moth. Responsible KU-IJØ.
- 3.6. September 2013. WP3.1. Distance effect trials for flower strips completed (2-y). Responsible KU-IJØ. Participants Ventegodtgaard, Strandegaard.
- 3.7. November 2013. WP3.2. Analysis and interpretation of results completed providing recommendations for floral composition and distances between flower strips. Responsible KU-IJØ.
- 3.8. September 2012. WP3.2. Mass-release trials with Trichogramma against codling moth completed. Responsible KU-IJØ. Participants Ventegodtgaard, Strandegaard.
- 3.9. April 2013. WP3.2. Analysis and interpretation of mass-release data completed. Responsible KU-IJØ.
- 3.10. October 2012. WP3.3. Trials with plant extracts for apple sawfly control finished and analysed. Responsible AU-DIPM.
- 3.11. March 2012. WP3.4. Planning of research and establishing irrigation-systems. Responsible. KU-IJØ. Participant AU-DH.
- 3.12. September 2013. WP3.4. Strategic irrigation trials with water amounts and sounds completed (2-y). Responsible KU-IJØ. Participant AU-DH.
- 3.13. June 2011. WP3.4. Trial with mechanical protection against apple scab established. Responsible AU-DH.

3.14. October 2013. WP3.4. 3-years trial with mechanical protection against apple scab completed. Responsible AU-DH.

A14. List of deliverables from the project (also fill out the table in A17)

1. January 2012. P1. Article in grower journal on storage of apples. Responsible: AU-DH. D&Dm. 1 VIP, 2 TAP.
2. March 2012. P2. Presentation at industry meeting on 1) inundative biological control of codling moth with *Trichogramma*. Responsible: KU-IJØ, D&Dm. 1 VIP, 1 TAP.
3. May 2012. P1. Article in grower journal on orchard ecological infrastructures. Responsible: KU-IJØ. R. 1 VIP, 2 TAP.
4. July 2012. P2. Industry Open Day on apples cultivar evaluations. Responsible: AU-DH. D&Dm. 0.5 VIP, 0.5 TAP.
5. August 2012. S4. Presentation at scientific meeting (IOBC-WPRS WG) on landscape management for functional biodiversity. Responsible: KU-IJØ. R. 2 VIP, 2 TAP.
6. September 2012. P2. Industry Open Day at Pometet. Responsible: KU-IJØ. D&Dm. 0.5 VIP, 0.5 TAP.
7. October 2012. P2&C2. Industry presentation on orchard ecological infrastructures & flower strips to growers/advisors & KU courses. Responsible: KU-IJØ. D&Dm. 1 VIP, 2 TAP.
8. December 2012. P1. Article in grower journal on apple cultivars. Responsible: AU-DH. D&Dm. 1 VIP, 2 TAP.
9. December 2012. C1&C2. Project results incorporated into BSc, MSc & PhD courses at AU & KU. Responsible: KU-IJØ, AU-DH. D. 2 VIP, 2 TAP.
10. July 2103. S3. Two scientific reports on 1) trials with plants extracts & natural products for control of foliar diseases & 2) trials with plant extracts for apple sawfly control. Responsible: AU-IPM, R. 3.0 VIP, 4 TAP.
11. July 2013. P1. Article in grower journal on control of apple sawfly in organic apple orchards. Responsible: AU-IPM. D&Dm. 1 VIP, 2 TAP.
12. August 2013. S1. Two scientific publications on 1) preventive management of Codling moth *Cydia Pomonella* in organic apple orchards & 2) optimal composition & spacing of flower strips for codling moth control. Responsible: KU-IJØ. R. 5.0 VIP, 6 TAP.
13. August 2013. P2. Industry Open Day on apples. Responsible: AU-DH. D&Dm. 0.5 VIP, 0.5 TAP.
14. September 2013. P2. Industry Open Day on apples. Responsible: KU-IJØ, AU-DH. D&Dm. 0.5 VIP, 0.5 TAP.
15. November 2013. S1. Two scientific publications on 1) inundative biological control of codling moth with new *Trichogramma* mass-release methods & 2) weed control strategies in organic fruit production. Responsible: KU-IJØ, AU-DH. R. 5.0 VIP, 6 TAP.
16. November 2013. C1. MSc thesis on pest control in organic apples. Responsible: KU-IJØ. R. 1 VIP, 1 TAP.
17. November 2013. P1. Article in grower journal on storage solutions for organic apples. Responsible: AU-DH. D&Dm. 1 VIP, 2 TAP.
18. December 2013. P2. Presentations at industry meetings in Gefion. Responsible: KU-IJØ. D&Dm. 1 VIP, 1 TAP.
19. December 2013. S1. Scientific publication on strategic irrigation against apple scab. Responsible: KU-IJØ. R. 2.5 VIP, 3 TAP.
20. December 2013. C4. AsuBot prototype. Responsible: SDU-KBM. R. 3 VIP, 3 TAP.

21. February 2014. C1&C2. Project results incorporated into BSc, MSc & PhD courses at AU & KU. Responsible: KU-IJØ, AU-DH. D. 4 VIP, 4 TAP.
22. February 2014. S1. Two scientific publication on 1) optimization of storage for organic apples, & 2) superior apple cultivars for organic production in Denmark. Responsible: AU-DH. R. 5.0 VIP, 6 TAP.
23. March 2014. S3&P1. Final project report. Responsible: All. R&D. 5.9 VIP, 7.6 TAP.

A15. List of appendices

1. Appendix: Project organisation scheme, Organogram
2. Appendix: Budgets
3. Appendix: CV's
4. Appendix: Participation form partners

A16. Milestones and time schedule for the entire project

wp no.	Milestone no.	Title/activity	Responsible project participant	Date/year	Other participants
1	1.1	First coordination meeting. Project launch. Agreement on experimental plans, activities and deliverables. 0-6 month	AU-DH	Mar. 2011	KU-IJØ Jan Jensen Hass
1	1.2	Second coordination meeting. Monitoring status, agreement on activities and deliverables. 6-12 month.	AU-DH	Nov. 2011	KU-IJØ Jan Jensen Hass
1	1.3	First Steering group meeting. Summary year 1. Activities, results, current status. Plan for year 2.	AU-DH	Dec. 2011	All
1	1.4	Third coordination meeting. Monitoring status, agreement on activities and deliverables. 12-18 month.	AU-DH	Mar. 2012	KU-IJØ Jan Jensen Hass
1	1.5	Fourth coordination meeting. Monitoring status, agreement on activities and deliverables. 18-24 month.	AU-DH	Nov. 2012	KU-IJØ Jan Jensen Hass
1	1.6	Second Steering group meeting. Summary year 2. Activities, results, current status. Plan for year 3.	AU-DH	Dec. 2012	All
1	1.7	Fifth coordination meeting. Monitoring status, agreement on activities and deliverables. 24-30 month.	AU-DH	Mar. 2013	KU-IJØ Jan Jensen Hass
1	1.8	Sixth coordination meeting. Monitoring status, agreement on activities and deliverables. 30-36 month.	AU-DH	Nov. 2012	KU-IJØ Jan Jensen Hass
1	1.9	Third Steering group meeting. Summary year 2. Activities, results, current status. Plan for year 3.	AU-DH	Dec. 2012	All

1	1.10	Final project report.	AU-DH	Dec. 2013	All
2.1	2.1	Planning and establishment of cultivar experiments	AU-DH	Mar. 2011	
2.1	2.2	Completion of cultivar trial experiments	AU-DH	Oct. 2013	
2.2	2.3	Planning and establishment of weeding experiment	AU-DH	Mar. 2011	SDU-KBM
2.2	2.4	ASuBot is capable of following the straight tree rows with a speed of 1½ m/s and an accuracy of +/- 0.1m	SDU-TEK	Oct. 2012	AU-DH
2.2	2.5	ASuBot is capable of performing headland turns enabling following several tree rows (as above) in a sequence	SDU-TEK	Oct. 2012	AU-DH
2.2	2.6	The ASuBot is capable of functioning with the Envo-Dan flame weeder mounted	SDU-TEK	Nov. 2012	AU-DH, ENVO-DAN
2.3	2.7	Storage research methods planed and evaluated	AU-DH	Aug. 2011	
2.3	2.8	Storage data collected	AU-DH	Dec. 2011	
2.3	2.9	Storarage methods evaluated on basis of results & modification	AU-DH	Aug. 2012	
2.3	2.10	Storage data collected	AU-DH	Dec. 2010	
2.3	2.11	Other cultivars	AU-DH	Dec. 2013	
3.1	3.1	Apple orchards characterized with respect landscape (ecological infrastructures) and management practices	KU-IJØ	Feb. 2012	Gefion, DHAS Danske FrugtAvlere Ventegodtgaard, Strandegaard,
3.1	3.2	Population densities of codling moth and beneficial, fruit yield and quality assessed (2y study)	KU-IJØ	Dec. 2012	Ventegodtgaard, Strandegaard.
3.1	3.3	Orchard data analyzed and interpreted, identifying orchard and landscape factors with an impact on natural pest control	KU-IJØ	Feb. 2012	
3.1	3.4	Codling moth and Trichogramma rearing established	KU-IJØ	Mar. 2012	
3.1	3.5	Flowers dietary value assessed for Trichogramma and Codling moth	KU-IJØ	Dec 2012	
3.1	3.6	Distance effect trials for flower strips completed (1y)	KU-IJØ	Sep. 2013	Ventegodtgaard, Strandegaard.
3.1	3.7	Analysis and interpretation of results completed providing recommendations for floral composition and distances between flower strips	KU-IJØ	Nov 2013	

3.2	3.8	Mass-release trials with Trichogramma against codling moth completed	KU-IJØ	Sep 2012	Ventegodtgaard, Strandegaard,
3.2	3.9	Analysis and interpretation of mass-release data completed	KU-IJØ	April 2013	
3.3	3.10	Trials with plant extracts for apple sawfly control finished and analysed	AU-DIPM	Oct. 2012	
3.4	3.11	Planning of research and establishing irrigation-systems	KU-IJØ	Mar. 2012	AU-DH
3.4	3.12	Strategic irrigation trials with water amounts and sounds completed (2-y)	KU-IJØ	Sep. 2013	AU-DH
3.4	3.13	Trial with mechanical protection against apple scab established	AU-DH	Jun. 2011	
3.4	3.14	3-years trial with mechanical protection against apple scab completed	AU-DH	Oct. 2013	

A17. List over deliverables (D=deliverables) for the entire project, stating whether the deliverable belongs to the research part of the project (R); the development part (D); and/or demonstration (Dm).

D. no.	Deliverable	Responsible project participant	Date/year	R, D, or Dm Effective working time, months ¹	Type of deliverable*
1	Articles in grower journal on storage of apples	AU-DH	Jan. 2012	D&Dm 1 VIP 2 TAP	P1
2	Presentations at industry meeting on inundative biological control of codling moth with Trichogramma	KU-IJØ	Mar. 2012	D&Dm 1 VIP 1 TAP	P2
3	Article in grower journal on orchard ecological infrastructures	KU_IJØ	May 2012	R 1 VIP 2 TAP	P1
4	Industry Open Day on apple cultivar evaluations	AU-DH	Jul. 2012	D&Dm 0.5 VIP 0.5 TAP	P2
5	Presentation at scientific meeting (IOBC-WPRS WG) on landscape management for functional biodiversity	KU-IJØ	Aug. 2012	R 2 VIP 2 TAP	S4
6	Industry Open Day at Pometet	KU-IJØ	Sep 2012	D&Dm 0.5 VIP 0.5 TAP	P2
7	Industry presentation on orchard ecological infrastructures & flower strips to growers/advisors & KU courses	KU-IJØ	Oct. 2012	D&Dm 1 VIP 1 TAP	P2&C2
8	Article in grower journal on apple cultivars	AU-DH	Dec. 2012	D&Dm 1 VIP 2 TAP	P1
9	Project results incorporated into BSc, MSc & PhD courses at AU & KU	KU-IJØ, AU-DH	Dec.2012	D 2 VIP 2 TAP	C1&C2
10	Two scientific reports on 1) trials with plants extracts & natural products for control of foliar diseases, & 2) trials with plant extracts for apple sawfly control	AU-IPM, KU-FOI	Jul 2013	R 3 VIP 4 TAP	S3
11	Article in grower journals on control of apple sawfly in organic apple orchards	AU-IPM	Jul. 2013	D&Dm 1 VIP 2 TAP	P1
12	Two scientific publications on 1) preventive management of Codling moth <i>Cydia Pomonella</i> in organic apple orchards, & 3) optimal composition & spacing of flower strips for codling	KU-IJØ	AUG 2013	R 5 VIP 6 TAP	S1

¹ The total amount of months must be consistent with the total number of months in the budgets, and will therefore show the relative working effort per work package.

	moth control				
13	Industry Open Day on apples	AU-DH	Aug. 2013	D&Dm 0.5 VIP 0.5 TAP	P2
14	Industry Open Day on apples	KU-IJØ	Sep. 2013	D&Dm 0.5 VIP 0.5 TAP	P2
15	Two scientific publications on 1) inundative biological control of codling moth with new Trichogramma mass-release methods, & 2) weed control strategies in organic fruit production	KU-IJØ, AU-DH	Nov 2013	R 5 VIP 6 TAP	S1
16	MSc thesis on pest control in organic apples	KU-IJØ	Nov 2013	R 1 VIP 1 TAP	C1
17	Articles in grower journal on storage solutions for organic apples	AU-DH	Nov 2013	D&Dm 1 VIP 2 TAP	P1
18	Presentations at industry meetings in Gefion	KU-IJØ	Dec 2013	D&Dm 1 VIP 1 TAP	P2
19	Scientific publication on strategic irrigation against apple scab	KU-IJØ	Dec 2013	R 2.5 VIP 3 TAP	S1
20	AsuBot prototype	SDU-KBM	Dec 2013	R 3 VIP 3 TAP	C4
21	Project results incorporated into BSc, MSc & PhD courses at AU & KU	KU-IJØ, AU-DH	Feb 2014	D 4 VIP 4 TAP	C1&C2
22	Two scientific publication on 1) optimization of storage for organic apples, & 2) superior apple cultivars for organic production in Denmark	AU-DH	Feb 2014	R 5.0 VIP 6 TAP	S1
23	Final project report	All	Mar 2014	R&D 5.9 VIP 7.6 TAP	S3&P1

* Fill in the type of deliverable. Use the List of type of deliverables on the last page in Annex 3 "Instructions for filling in the application form".