

Final report

for the CORE Organic Cofund funded project

**“Dynamic sod mulching and use of recycled amendments to increase biodiversity, resilience and sustainability of intensive organic apple orchards and vineyards”
(DOMINO)**

Period covered:
1st May 2018 – 02 August 2021



CORE Organic Cofund is an ERA-NET funded by the European Commission's Horizon 2020 Framework Programme for Research and Innovation Contract No. 727495. Project period: December 2016 - May 2022

Index

Contents

1. General information.....	3
1.1 Project information.....	3
1.2 Consortium.....	3
2. Summary	5
2.1 Final project summary suitable for web publication for a wider audience	5
2.2 Process update of the whole project	6
3. Outcomes of the project	7
3.1. Main results, discussion, conclusions and fulfilment of objectives	7
3.2 Deliverables and milestones status.....	21
4. Publications and dissemination activities.....	28
4.1 List extracted from Organic Eprints	28
4.2 Stakeholders-oriented articles in the CORE Organic newsletter	33
4.3. Practice abstracts	34
4.4 Other dissemination activities and material	34
4.5 Future dissemination actions	37
4.6 Specific questions regarding dissemination and publications	38
5. Project impact.....	42
6. Added value of the transnational cooperation in relation to the subject.....	43
7. Suggestions for future research.....	43

1. General information

1.1 Project information

Project information			
Project acronym	DOMINO	Project ID	1939
Project title	Dynamic sod mulching and use of recycled amendments to increase biodiversity, resilience and sustainability of intensive organic apple orchards and vineyards		
Project website	http://www.domino-coreorganic.eu/ AND https://projects.au.dk/coreorganiccofund/core-organic-cofund-projects/domino/		
Details of the project coordinator			
Name	NERI	First name	DAVIDE
Telephone	+39 0712204431	E-mail address	d.neri@univpm.it
Institution	UNIVPM	Country	Italy
Start of project	1 May 2018	End date of project	30 April 2021
Duration in months	39	New end date in case of a project extension due to COVID-19	2 August 2021

1.2 Consortium

Partner no.:	Country:	Institution/organisation name:	Type of institution/organisation ¹ :	Functions ² :	Involved in WPs:	Contact person
1	Italy	Università Politecnica delle Marche (UPM)	University	Project coordinator	1,2,3,6	Davide Neri d.neri@univpm.it
2	Switzerland	Research Institute of Organic Agriculture (FBL)	Public research centre	Work package leader WP2	1,2,3,5,6	Michael Friedli michael.friedli@fibl.org
3	France	French technical Interprofessional Centre for Fruits and Vegetable (CTIFL)	Public research centre	Work package leader WP3	1,2,3,6	Maria-Martha Fernandez maria-martha.fernandez@ctifl.fr
4	Germany	University Hohenheim UHOH	University	Work package leader WP4	1,2,3,4,6	Sabine Zikeli sabine.zikeli@uni-hohenheim.de
5	Italy	Laimburg Research Centre (LAIM)	Public research centre	Work package leader WP5	1,2,3,4,5,6	Markus Kelderer Markus.Kelderer@laimburg.it
6	Poland	Research Institute of Horticulture (Instytut Ogrodnictwa) INHORT	Public research centre	Work package leader WP6	1,2,3,4,6	Eligio Malusa eligio.malusa@inhort.pl

¹ University, Public research centre, Private research centre, Company, Other

² PC = Project coordinator, WPL = Work package leader, WPCL = Work package co-leader, P = Participant

Partner no.:	Country:	Institution/organisation name:	Type of institution/organisation ¹ :	Functions ² :	Involved in WPs:	Contact person
7	Bulgaria	Fruit Growing Institute (FGI)	Public research centre	Participant	1,2,3,4,6	Vassiliy Dzhuvinov vcd@valan.net Hristina Kutinkova Kutinkova@abv.bg
8	Italy	BioSüdtirol (BioS) ³	Company	Participant	1,2,6	Werner Castiglione
9	Italy	Bio Vinschgau (Vi.P) ⁴	Company	Participant	1,2,6	Christian Gamper christian.gamper@vip.coop.it
10	Italy	Bioland Südtirol (Bland)	Company	Participant	1,2,6	Reinhard Verdorfer reinhard.verdorfer@bioland-suedtirol.it
11	Italy	SBR organic	Company	Participant	1,2,6	Ulrich Kiem ulrich.kiem@beratungsring.org
12	Italy	Associazione Italiana Agricoltura Biologica (AIAB) ⁵	Company	Participant	1,2,6	Vincenzo Vizioli v.vizioli@aiab.it
13	Germany	Fördergemeinschaft Ökologischer Obstbau e.V (FÖKO) ⁶	No-profit farmer association	Participant	1,2,6	Christoph Hofflin christoph@suedhof.de

³ BioS BioSüdtirol is the largest marketing cooperative for organic apples in Europe, and includes 200 members. It contributed to WP2 and WP6

⁴ Vi.P Bio is the marketing service for the 150 organic orchardists of Val Venosta – Südtirol. Vip contributed to WP2 and WP6

⁵ AIAB is an Italian association of producers, consultants and consumers. It contributed to WP1 and WP2

⁶ FÖKO is coordinator of a network of growers, researchers and consultants aiming at the extension of the production system in organic fruit growing. It consists of 200 organic fruit growers in Germany. FÖKO's main task is promoting knowledge transfer and dissemination.

2. Summary

2.1 *Final project summary suitable for web publication for a wider audience*

The DOMINO project aimed to reduce external inputs in intensive organic fruit orchards for pest control and fertilisation and to improve the overall productivity and sustainability of this agroecosystem. Our aim was tackled by increasing orchard biodiversity, adaptation of plant protection strategies to new demands and more adapted fertilisation strategies using efficient recycling of organic residues. In addition, these new management practices were expected to give a possible additional cash flow by the introduction of secondary cash crops. The project results should lead to the design of mixed orchard systems more resilient to climatic and socio-economic challenges.

To increase the impact of the results achieved during the research, a multi-stakeholder approach was embedded in all the activities of the project. The possible trial options were selected after discussing with farmers and advisors e.g. the trials with living mulches on the row or those with local organic fertilisers or the leguminous cover crops. Trials were carried out in commercial farms, after discussing with the farm's owners what solution could be feasible for them, taking into consideration the cropping system and the agronomical practices they commonly applied. Also, in the selection of ecosystem services to be considered in the economic (monetisation) analysis different stakeholder were consulted.

The innovative management strategies were developed and examined in intensive organic fruit orchards: i) dynamic "living mulches" in the row, such as cash crops with vegetative organs (stolons), and the sod with leguminous between the rows for weed control; ii) fertilisation by recycled soil amendments and leguminous crops to increase resource use efficiency and improve ecosystem services and iii) partly closed covering net systems to support non-chemical pest and diseases control.

Living mulches, namely herbaceous plants prone to cover the soil, showed their capability for establishing and maintaining a "good degree of biodiversity", providing several additional ecosystem services with limited competition against the main crop. The transnational experiments highlighted that mulching species are highly site-specific. Species taken from local ecosystems provided significant advantages in terms of plant resilience, weed control and soil cover under the tree rows. For example, wild strawberry plants gave excellent results in Central Italy. Similarly, *Potentilla* was capable to fully cover the strips within three months in Switzerland. Mint was tested in Poland, Germany and France with excellent (or, at least, quite good) results in terms of soil covering capacity, weed control, and biomass production, without problem for fruit quality and apple root growth. From the results achieved by the project we can state that living mulches contributed to a good soil coverage and weed control; increased biodiversity in the orchard and in the soil; provided additional income (additional food – fruits, herbs), and ecosystem services, namely aesthetic value, and weed control and did not negatively affect the growth of the trees.

Winter peas (*Pisum sativum*) are currently widely used in regions where the climatic conditions allow for their seeding in autumn due to changes in climate (warmer winters) and improvement in breeding as leguminous cash crop or as a winter cover crop. They yielded very good results either in the German and the Swiss experiments. Nitrogen was released after mowing, just in time to satisfy at least partly the needs of the trees. The different alternative fertilisers and fertilisation strategies, namely recycled organic matters and nutrients, clover grass-based materials, leguminous intercrops and non-contentious commercial fertilisers demonstrated to be effective nutrient sources in intensive organic apple orchards.

The *organic fertilisers with a higher rate of mineralisation* (and mostly likely those in liquid form) appeared to positively stimulate different "layers" of the soil biodiversity, namely different levels of the soil life web. Lower layers include microorganisms (bacteria and fungi) while higher layers include nematodes and meso-fauna, up to the plant layer. In general, soil bacteria population was increased, and consequently the bacteria feeding nematodes. The structure of the nematodes population was modified, reducing the plant feeders and increasing both bacterial and fungal feeding species. The liquid fertilisers such as biogas digestates, "Lumbreco" (from earthworm compost) and stillage (a liquid residue from microbial fermentation processes) showed very good fits to the N demand of the trees in spring due to a quick N release after application. The exploitation of alternative organic fertilisers in the project hence assured the recycling of nutrients and provided externalities valuable for the processes related to management of wastes and safe water supply.

Hereby, the project looked to fertilisers which can be produced locally: biogas digestate, compost, clover grass silage, clover grass / clover pellets, winter and summer peas, mulch from the inter row in situ, organic fertilisers obtained from fermentation processes of horticultural fruits processing wastes or from production of microbial inocula (stillage) to limit the use of organic amenders and fertilizers from distant production sites. A specific guideline for the use in apple orchards was provided for the studied fertilisers according to their mineralization rate. However, a full assessment of the whole production process would be needed to fully appraise the carbon footprint of the organic fertilisers.

The orchard performance under partly closed covering systems was quantified to validate the reduction of external inputs use. Trials were carried on apple and under different environmental and managing systems. Top plastic covering and lateral netting systems were applied to reduce foliage wetting and to prevent insect attacks. The tested system (Keep-in-touch®) allowed to reduce losses, or at least produced the same results of the organic sprayed plots, in terms of both infected fruits and infection intensity. The system induced reduction on number of fruits damaged by the codling moth, and more generally the feeding damages were markedly lower, while no significant difference was found for 'other feeding' damages, mainly caused by grubs and caterpillars. The rain-proof roof allowed to reduce the wetting of the fruits mainly in the top part of the trees limiting post-storage losses caused by post-storage scab. The effect of covered systems on beneficial insects, whether they are free to move across the canopies or not, was not clear.

The added value of the different strategies was appraised in terms of generation of eco-services and biodiversity improvement, considering soil microbiota, meso-fauna, entomo-fauna and flora diversity. Both organic fertilisers and living mulches represented a sustainable solution for organic orchards management as long as they were adapted to the specific orchard conditions. It is expected that the establishment of the proposed solutions can cause a positive "domino" effect on biodiversity, better fruit quality and overall sustainability of the fruit cropping systems. The appraisal of the monetary value of the ecosystem services released by the project showed in some cases a net income for the farmer due to reduced costs and/or additional yield (from the living mulching species).

Diversified and stratified mixed cropping systems in highly intensive organic orchards can exploit different layers above and below ground, in contrast with the current partially conventionalised monoculture. The results were not showing a clear influence on beneficial insects, which resulted to depend on the season. However, the short period of the project (i.e. for establishing the living mulches to such extent sufficient to show an impact on above-ground biodiversity or beneficial arthropods – not only insects, but also mites) did not allow to confirm the effect observed in some cases (e.g. in case of mint). For this reason, trials have been continued.

2.2 Process update of the whole project

The objective of the DOMINO project to develop innovative management strategies in intensive organic fruit orchards was overall achieved. Biodiversity of the orchard was increased and new plant protection strategies were identified together with more adapted fertilisation strategies, based on the use of efficient recycling of organic residues, which allowed to reduce and make more efficient the external inputs.

The project started with a very limited delay because financing from some of the National funding bodies took time to be activated. The planned activities for each partner were all set in time with very limited changes which were decided at the kick off meeting. After designing the detailed action plan, the number of partners participating in WP4 and WP5 was slightly reduced with respect to the plan foreseen in the original proposal in order to use the resources in a more efficient way.

The state of the art of organic fruit farming was studied in all the countries but the questionnaire for the farmers was applied only in 4 countries because it was not reasonable to apply where similar questionnaires were applied in the same period. Finally, also this activity got an appreciable result improving the knowledge about the applicability of the innovation pursued by Domino project.

During the first year, all the activities were carried out in physical presence, including the field visits of the coordinator, meetings and the dissemination initiatives. Web meetings were limited to some partners' project activities and coordination. In fact, before the occurrence of the COVID pandemic, the coordinator of

the project had personally visited all the partners' experimental sites, except the one of CTIFL who held in the first year preliminary trials while planned orchard trials for the second year.

These activities helped to develop common experimental layouts and protocols and ensured that all partners understood the "management guidelines" which were prepared at project's beginning.

Formal and informal meetings among partners have been held throughout the duration of the project; since the first lockdown due to COVID pandemic (March 2020), meetings have been organised online. Therefore, for the dissemination we produced three Practice abstracts instead of one only, as foreseen, plus several webinars and one farminar. The latter is a "webinar" organised in a farm. During the farminar, the researchers and the experts, together with the farmers, were reporting in livestream from a farm, showing new farming practices or new farming machines.

These remote communication strategies helped in filling the gap created by the pandemic, which has impeded field days in-presence with farmers and advisors as well as dissemination initiatives for the large public. To allow more time to dissemination initiatives, the project has been extended by 3 months (from 31/04 to 02/08/2021). The project eventually identified useful elements for designing mixed orchard systems more resilient to climatic and socio-economic challenges.

3. Outcomes of the project

3.1. *Main results, discussion, conclusions and fulfilment of objectives*

WP1	Project Management
WP leader: UPM Responsible partner: UPM	
Overall summary of main results, discussion and conclusions of WP1 <p>The project started in time with the signature of the Consortium Agreement. However, activities initiated with some delay because financing from the National funding bodies took time to be activated. Before the occurrence of the COVID pandemic, the WP1 leader (coordinator of the project) had personally visited all the partner's experimental sites, except the one of CTIFL who held in the first year preliminary trials and orchard trials in the second year. The coordinator could not visit the CTIFL orchard trials because of pandemic.</p> <p>These activities helped to develop common experimental layouts and protocols and ensured that all partners understood the "management guidelines" which were prepared at project's beginning. The coordination was facilitated by the specific financial support of CORE Organic. Formal and informal meetings among partners have been held throughout the duration of the project. But since the first lockdown (March 2020), meetings have been organised online only. Three Practice abstracts were produced (instead of one only, as foreseen) with the aim of filling the gap created by the pandemic, which has impeded field days in-presence with farmers and advisors as well as dissemination initiatives with the large public.</p> <p>After the kick-off meeting, held online in April 2018, the first annual project meeting was held in Ancona in November 2018. The second annual project meeting was organized in Hohenheim in November 2019, then the Mid-term report was released. Third and final project meetings were held online, respectively in November 2020 and June 2021. The extension of the project due to the COVID pandemic was limited to three months.</p>	
Report on the results obtained (A), and fulfilment of objectives (B) comparing to the original project proposal. A- results obtained and structured in relation to the user groups they are relevant for: <p>Obtained results refer to management operations which had the purpose to efficiently implement the project proposal:</p>	

- Consortium agreement with all partners signed;
- Efficient collaboration within the team ensured with all participants complying with contractual obligations;
- Three annual and final project meetings organised. Minutes are available on Organic E-prints;
- Contact point between the DOMINO consortium and Core-Organic secretary,
- Within-project communication ensured (project website, kick-off meeting, project meetings and exchange visits among partners);
- Coordinator personally participated to the dissemination in several seminars, workshops and field days in-presence and remote;
- Foreseen progress reports delivered in time to CORE Organic secretariat and monitoring person;
- Administrative and financial procedures properly designed and implemented;
- Within-project problems properly managed, which included the difficulty of the Bulgarian research group not promptly financed by local donor;
- Experimental protocols drafted and activities in all sites properly supervised.

B- fulfilment of objectives:

Overall, the stated objectives have been fulfilled. Foreseen deliverables produced and milestones achieved: and most of them consistently with the planned timeline. Communication/dissemination activities were weaker at the beginning of the CORE-Organic DOMINO consortium, but they were strengthening after the first annual meeting. To face some delay due to the pandemic, there was the need for three months prolong.

WP2	Multi-stakeholder approach and dissemination
WP leader: FiBL	
Responsible partners: UHOH, INHORT	
Overall summary of main results, discussion and conclusions of WP2 <p>The work consisted of carrying out a comprehensive analysis of the state of the art of fruit organic farming in the partners' countries for the different crops and agronomical aspects addressed in the project. After this initial study, a questionnaire-based survey was performed in Switzerland, Italy, Poland and Bulgaria. The dissemination of project results was then addressed to the widest possible number of interested stakeholders (farmers, manufacturers, advisors, researchers, consumers, students, policy-makers, etc.). The project was made known via the created website and a project leaflet in the six different languages of the project partners, and other visibility materials (roll up, folders, notes, pencils with the Domino logo etc.). Furthermore, a social media (Facebook) account was created and regularly updated with information about events or outcomes.</p> <p>Additionally, through presentations, technical and scientific articles, lectures, and videos, using different channels (project website, newsletter, partner countries websites, national magazines, international journals, organic e-prints, Youtube) project results were broadly disseminated. The practices, methods and new technologies developed by the project were also demonstrated during field visits and individual trainings.</p> <p>To enable the exchange between the interested stakeholders, workshops, seminars, webinars and one farminar were organised in the different partner countries. The project contributed to an establishment of transnational networks of stakeholders in organic fruit growing.</p>	
Report on the results obtained (A), and fulfilment of objectives (B) comparing to the original project proposal A- results obtained and structured in relation to the user groups they are relevant for: Task 2.1: Analysis of the state of the art <p>The analysis of the state of the art was performed in the different countries by the project partners. The collected information was compiled in a common report. Through this information about the state of the art in the regions of the project partners, the diverse situations of the organic fruit production in the</p>	

WP2	Multi-stakeholder approach and dissemination
	<p>different countries can clearly be shown. In all countries, fertilisation strategies in fruit production are strongly based on external fertilisers from conventional farming or from food production.</p> <p>Nowadays, the fertilisers are almost exclusively produced far distant and then shipped to the fruit farms. For example, poultry dry manure is in most cases of unknown origin, but if organic source is needed, they are transported from the Netherlands or horn grit with overseas origin like India, Pakistan etc. In countries like Germany, where Bovine Encephalitis occurred in the 1990's, the value chain for bovine keratin products is not existing any longer, and therefore the origin is overseas. Also vinasse (from sugar production or as a stillage from microbial fermentation processes) is normally produced in large distances from organic fruit production areas. Other commercial fertilisers like Bioilsa (based on pig bristles) are produced in one European country and are shipped to others.</p> <p>Moreover, in all countries, fungal infections (in most cases apple scab) were a major issue in plant protection. In addition, insect pests played a big role with varying species being the most important ones. It became clear that the use of curative products differs depending on the national regulations on crop protection. This implies that specific products are permitted in one country but not in the other. Measures for the enhancement of biodiversity start to establish in countries like Switzerland, Germany and France but are not wide spread yet. Partly covered systems are not in commercial use in the partner countries so far.</p> <p>Task 2.2 Multi-stakeholder approach</p> <p>A comprehensive questionnaire was compiled by different project partners at the beginning of the project. In a second phase the project partners performed a survey with organic fruit farmers in their country. Different channels were used to perform the survey: electronic survey via the internet with e.g. "Google Forms", personal interviews on-farm or by phone, written answers on paper at different occasions. The results of the survey were presented and discussed at the project meeting from the 20th to the 22nd November 2019 in Hohenheim (Germany) and an article was written about the results within the project newsletter in January 2020 (http://www.domino-coreorganic.eu/download/newsletter/newsletter-no3-january-2020.pdf)</p> <p>The survey showed a great variability in the size of the farms from country to country. Regarding biodiversity elements, hedges are more often present in the orchard compared to flower strips, and farms having hedges often have flower strips as well. Other biodiversity elements are more widespread and implemented in German-speaking regions with the most common biodiversity elements being nesting boxes, cairns (piles of stones) and insect hotels. Most farmers are using a decision support system, with soil analyses being the most common. As for fertilisers, depending on the country either farmyard manure overweighs as fertilisers, or commercial fertilisers. The most common farmyard manure is cattle dung (compost), chicken dung, or green compost. Fertilisers are mostly applied in spring and/or fall, and usually only into the tree row. Overall, only a limited number of fertilisers is used. The use of legumes (e.g. clover, faba beans, peas, and vetch) as intercrops in the orchard is barely practiced. One reason is the difficulty of establishment of the legumes. The survey indicated a need for research activities to control the main diseases (e.g. apple scab, sooty blotch) and pests (e.g. codling moth, aphids, and invasive species such as stink bugs or <i>Pseudococcus comstocki</i>). Furthermore, farmers expressed a need for new resistant varieties suited for organic farming, and an early apple variety with good storability. Another ongoing topic is a solution for the tree strip management and weed control. Farmers asked for alternatives to the widely-used copper and lime sulphur, for new plant protection products including biological control products, and for an extension of the list of plant protection products allowed for organic farming. Moreover, producers want more research concerning the ecologisation of the orchard, including biodiversity, ecological control of pests with beneficial insects, birds and animals, and extensive farming, but without forgetting the economic viability of the farm. Farmers are interested in research focused on the relationship between soil health and diseases.</p> <p>https://projects.au.dk/coreorganiccofund/news-and-events/show/artikel/in-which-areas-is-research-needed-within-organic-fruit-producing-farms-in-europe/</p>

WP2	Multi-stakeholder approach and dissemination		
	<p>The multi-stakeholder approach was embedded in all the activities of the project as several of them were performed after discussing with farmers and advisors the possible trials options to be selected (e.g. for the trials with living mulches on the row or those with local organic fertilisers or the leguminous cover crops). Moreover, trials were also carried out in commercial farms, after discussing with the farm's owners which solution could be feasible for them, taking into consideration the cropping system and the agronomical practices they commonly applied. The multi-stakeholder approach was also applied when defining the ecosystem services to be considered in their economic (monetization) analysis.</p> <p>Our dissemination targets and stakeholder engagement activities were met and exceeded :</p>		
	<table border="1"> <tr> <td data-bbox="276 521 1422 1160"> <p>What was foreseen and achieved:</p> <ol style="list-style-type: none"> 1) Website (http://www.domino-coreorganic.eu/) in six different languages. Number of visits: 6,398 (03.11.21). 2) Project leaflet in the six different languages. 3) 6 DOMINO Newsletters, published on the project website (December 2018, June 2019, January 2020, June 2020, December 2020, July 2021, December 2021). 4) A brochure containing the concepts of innovative management was prepared, which summarises the project results of WP3 and WP4 in a practical-oriented way for farmers. The brochure is in English and it is being translated in other 5 languages. 5) 9 field visits (we promised at least 2) of DOMINO field trials in the different partner countries. 6) Results were presented and discussed at the biennial Conference on Organic Fruit Growing (http://www.ecofruit.net/) in 2020 and during a project webinar on 16 March 2021 instead of the cancelled Biofach trade fair. 7) 4 Videos were compiled to give insight into the project activities. 8) 12 technical articles published in national magazines in partner countries and 3 scientific articles in English. More scientific papers are in progress to publish all the achievements by the different partners. </td><td data-bbox="276 1171 1422 1697"> <p>What was not foreseen (extra) but done:</p> <ol style="list-style-type: none"> 9) Several visibility materials were prepared by the different partners: project paper (heading), project visual format (slides). Some partners have also prepared a roll up, folders, notes, and gadgets (e.g. pencils with the Domino logo). 10) Social media: a Facebook account was created and regularly updated with information about events or outcomes (106 followers, all posts reached 784 people). 11) 44 Presentations in the different countries of the project partners during conferences, symposia, congresses, open days, workshops, etc. 12) 3 Practice abstracts. 13) 3 articles for the CORE Organic Newsletter (October 2019, May 2020, July 2021). 14) 9 Workshops, 9 seminars, 5 webinars, and 1 farminar with farmers and/or researchers in the difference partner countries or online. 15) 3 individual trainings. 16) 2 lectures for students about findings from DOMINO trials. </td></tr> </table>	<p>What was foreseen and achieved:</p> <ol style="list-style-type: none"> 1) Website (http://www.domino-coreorganic.eu/) in six different languages. Number of visits: 6,398 (03.11.21). 2) Project leaflet in the six different languages. 3) 6 DOMINO Newsletters, published on the project website (December 2018, June 2019, January 2020, June 2020, December 2020, July 2021, December 2021). 4) A brochure containing the concepts of innovative management was prepared, which summarises the project results of WP3 and WP4 in a practical-oriented way for farmers. The brochure is in English and it is being translated in other 5 languages. 5) 9 field visits (we promised at least 2) of DOMINO field trials in the different partner countries. 6) Results were presented and discussed at the biennial Conference on Organic Fruit Growing (http://www.ecofruit.net/) in 2020 and during a project webinar on 16 March 2021 instead of the cancelled Biofach trade fair. 7) 4 Videos were compiled to give insight into the project activities. 8) 12 technical articles published in national magazines in partner countries and 3 scientific articles in English. More scientific papers are in progress to publish all the achievements by the different partners. 	<p>What was not foreseen (extra) but done:</p> <ol style="list-style-type: none"> 9) Several visibility materials were prepared by the different partners: project paper (heading), project visual format (slides). Some partners have also prepared a roll up, folders, notes, and gadgets (e.g. pencils with the Domino logo). 10) Social media: a Facebook account was created and regularly updated with information about events or outcomes (106 followers, all posts reached 784 people). 11) 44 Presentations in the different countries of the project partners during conferences, symposia, congresses, open days, workshops, etc. 12) 3 Practice abstracts. 13) 3 articles for the CORE Organic Newsletter (October 2019, May 2020, July 2021). 14) 9 Workshops, 9 seminars, 5 webinars, and 1 farminar with farmers and/or researchers in the difference partner countries or online. 15) 3 individual trainings. 16) 2 lectures for students about findings from DOMINO trials.
<p>What was foreseen and achieved:</p> <ol style="list-style-type: none"> 1) Website (http://www.domino-coreorganic.eu/) in six different languages. Number of visits: 6,398 (03.11.21). 2) Project leaflet in the six different languages. 3) 6 DOMINO Newsletters, published on the project website (December 2018, June 2019, January 2020, June 2020, December 2020, July 2021, December 2021). 4) A brochure containing the concepts of innovative management was prepared, which summarises the project results of WP3 and WP4 in a practical-oriented way for farmers. The brochure is in English and it is being translated in other 5 languages. 5) 9 field visits (we promised at least 2) of DOMINO field trials in the different partner countries. 6) Results were presented and discussed at the biennial Conference on Organic Fruit Growing (http://www.ecofruit.net/) in 2020 and during a project webinar on 16 March 2021 instead of the cancelled Biofach trade fair. 7) 4 Videos were compiled to give insight into the project activities. 8) 12 technical articles published in national magazines in partner countries and 3 scientific articles in English. More scientific papers are in progress to publish all the achievements by the different partners. 	<p>What was not foreseen (extra) but done:</p> <ol style="list-style-type: none"> 9) Several visibility materials were prepared by the different partners: project paper (heading), project visual format (slides). Some partners have also prepared a roll up, folders, notes, and gadgets (e.g. pencils with the Domino logo). 10) Social media: a Facebook account was created and regularly updated with information about events or outcomes (106 followers, all posts reached 784 people). 11) 44 Presentations in the different countries of the project partners during conferences, symposia, congresses, open days, workshops, etc. 12) 3 Practice abstracts. 13) 3 articles for the CORE Organic Newsletter (October 2019, May 2020, July 2021). 14) 9 Workshops, 9 seminars, 5 webinars, and 1 farminar with farmers and/or researchers in the difference partner countries or online. 15) 3 individual trainings. 16) 2 lectures for students about findings from DOMINO trials. 		
	<p>Task 2.3: Dissemination</p> <p>Following demonstration and communication activities were performed within the DOMINO project during the project time (2018-2021):</p> <ul style="list-style-type: none"> • Website (http://www.domino-coreorganic.eu/) in six different languages. Number of visits: 6,398 (03.11.21). • Project leaflet in the six different languages. 		

WP2	Multi-stakeholder approach and dissemination
	<ul style="list-style-type: none"> • Several visibility materials were prepared by the different partners: project paper (heading), project visual format (slides). Some partners have also prepared a roll up, folders, notes, and gadgets (e.g. pencils with the Domino logo). • Social media: a Facebook account was created and regularly updated with information about events or outcomes (106 followers, all posts reached 784 people). • 44 Presentations in the different countries of the project partners during conferences, symposia, congresses, open days, workshops, etc. • 12 technical articles published in national magazines in partner countries. • 3 scientific articles in English. • 3 Practice abstracts. • 6 DOMINO Newsletters, published on the project website (December 2018, June 2019, January 2020, June 2020, December 2020, July 2021, December 2021). • 3 articles for the CORE Organic Newsletter (October 2019, May 2020, July 2021). • 4 Videos were compiled to give insight into the project activities. • 9 Workshops, 9 seminars, 5 webinars, and 1 farminar with farmers and/or researchers in the difference partner countries or online. • 9 field visits of DOMINO field trials in the different partner countries. • 3 individual trainings. • 2 lectures for students about findings from DOMINO trials. • A brochure containing the concepts of innovative management was prepared, which summarises the project results of WP3 and WP4 in a practical-oriented way for farmers. The brochure is in English and it is being translated in other 5 languages.
	<p>B- fulfilment of objectives:</p> <p>In Germany and France no surveys with the questionnaire were carried out. In Germany similar data was already collected earlier and is available in the "Poseidon"-publications (in German): https://www.foeko.de/publikationen/gesunderhaltung-der-pflanzen-im-oeko-apfelanbau/. In France, the survey was not performed since many different surveys from other projects were ongoing in 2019 and the risk of low return of filled in questionnaires was high.</p> <p>Because of restrictions due to the COVID-19 pandemic, no physical meetings with farmers to show and discuss the activities could be held in 2020 and only a few were possible in 2021. To inform the farmers about the activities, nevertheless, videos about the activities were released. During various online events, information about the activities were given.</p> <p>The results of the project were discussed during the ECOFRUIT (biannual Conference on Organic Fruit Growing, held on 17.02.2020 and 21st February 2022); during a Europe-wide digital stakeholder-oriented workshop (entitled "Making organic fruit growing more resilient: lessons learned from the Project DOMINO") on 16.03.2021; during the International symposium for organic horticulture (ISHS) in Catania Dec. 2021. In total, despite the COVID-19 pandemic, the targeted dissemination activities were not only fulfilled but even surpassed. Overall, the original objectives of involving stakeholders in the project activities and sharing the results with them, together with the dissemination of the results, were achieved. The foreseen deliverables have been produced and milestones achieved.</p>

WP3	Improving diversity in the cropping system
WP leader: CTIFL	
Responsible partners: CTIFL, UHOH, UPM	
Overall summary of main results, discussion and conclusions of WP3	
<p>This WP focuses on row and inter-row management methods that can be used to improve weeds control, yield and quality of main and of second crops eventually with a financial return. Two fruit orchards (apricot, apple) and vineyards have been studied with several row managements depending on the trial regions. The soil management practices through living mulches and/or, cover crops and green manures play a role in covering the soil and making a new equilibrium with different species with regarding to biodiversity, crops physiology (i.e. biomass production), yield and quality and soil fertility. To enable a not contaminated second crop under the main crop requires a different input management, thus the interaction with W4 and WP5 plays a key role. Some of the species in the first years were tested for the rapidity in covering the soil and the capacity to control the weed in arable land. The most suitable species were tested in the second/third year in the orchards. Living mulches, namely herbaceous plants with good attitude in covering the soil, showed their capability for establishing and maintain a "good degree of biodiversity" and take advantage of all the environmental benefits associate to it. Three main effects of living mulch on the agro-ecosystem were weed control, fertilisation and provision of additional income when the cover crop has also character of cash crop. About 44 different plant species were tested in field trials on apricot, apple and grapevine as living mulches. Species taken from local biodiversity provide significant advantages in terms of plant resilience and soil cover. For example, wild strawberry plants collected in the Sibillini Mountains gave excellent results in Central Italy, even with very low planting density, but they required the use of mechanical horizontal blade tillage and few manual interventions for improving the initial soil cover and to control the competition of aggressive weeds. Similarly, <i>Potentilla</i> transplanted from the orchard environment to the rows of FIBL's trial was capable to fully cover the strips within three months. Either on the row or on the interrow, it could be recommended to the farmers to start testing the use of living mulches in small areas, to verify their adaptation to local conditions, and then to extend the practice to larger superficies.</p> <p>The new techniques to manage the soil under the trees along the rows have been also discussed in one Practice abstract, published on Organic Farming Knowledge to disseminate the most useful research findings for practical field application. The title of the practice abstract is "The use of strawberries as living mulch in organic orchards and vineyards" (available at https://organic-farmknowledge.org/tool/39679).</p>	
Report on the results obtained (A), and fulfilment of objectives (B) comparing to the original project proposal	
<p>With all the living mulches the use of complementary weed control measures during the establishment can greatly help them to compete with weeds and thus to properly settle down. But, either through manual either mechanical preliminary weeding, these additional measures can be costly and the work done by the project did not demonstrate whether the transition phase would be really limited to 1 or 2 years.</p> <p>Some species like mint proved to be rather ubiquitous and gave excellent (or, at least, quite good) results in terms of soil covering capacity, weed control, and biomass production. Other species yielded good results during the trials, such as dwarf white clover, <i>Achillea millefolium</i>, <i>Gallium album</i>, <i>Hieracium aurantiacum</i>, <i>Hieracium lactucella</i>, <i>Tropaeolum sp.</i>, <i>Alchemilla vulgaris</i>, <i>Cucurbita pepo</i>, <i>Fragaria sp.</i> (with specific climatic and pedological requirements) and <i>Potentilla sp.</i> (when transplanted from the surrounding environment). Other species however failed in improving agro-ecosystems. The experiments highlighted that species are highly site-specific hence their adaptation to local conditions must be carefully checked in advance, through testing the potential species in small areas to verify in situ their growth.</p> <p>Macro- and micro-nutrients in the fruit crop were not affected by living mulches, at the end of the carried out short-term trials. Moreover, some allelopathic species showed interesting action on tree root</p>	

WP3	Improving diversity in the cropping system
	<p>development, with potential beneficial impact on nutrients uptake. However, reduced soil nitrogen availability was observed in some cases, in conjunction with not negligible yield loss, especially when the living mulch was not well established and overgrown by weeds. In addition, in some cases cover crops attracted the wild fauna, with damages to the trees. Official plants, strawberries, and pumpkin also showed good potential as cash crops in specific orchards and vineyards.</p> <p>Winter pea grown on the row of apple trees yielded very good results either in the German and the Swiss experiments, with high nitrogen releases after mowing, just in time to satisfy at least partly the needs of the trees. However, the efficacy of legume crops, grown in the row and/or in the interrow as an internal source of nitrogen supply, can be reduced by the timing of mineralisation of the green manure which may not match the actual need of the fruit tree crop. Further constraints are represented by the soil tillage/crop protection operations, periodically carried out in the orchard and implying the use of tractors and machinery, which may undermine the cover crop.</p> <p>Living mulches grown on the rows of an apple orchard did not affect nutrient status of the trees. Roots of the cover crop and the apple trees proved to explore same soil layer in this system (i.e. mainly the upper one), and this did not affect negatively the uptake of nutrients by the trees, showing that the association of the living mulch with the trees is an interesting example of mutualism.</p>
	<p>A- results obtained and structured in relation to the user groups they are relevant for:</p> <p>Results, detailed conclusion and recommendations for the farmers are summarised below. They are explained in detail in the Final deliverable 3.9 (available at https://orgprints.org/id/eprint/42743/) in the project's brochure (D2.15) and in the relevant Practice abstract produced by the project.</p>
	<p>Task 3.1: Trials with comparison of different crops for row management suitable for additional uses</p> <ul style="list-style-type: none"> • Flowers of living mulch species can provide additional nectar sources for pollinators and improve the aesthetic aspect of orchards. In addition, some living mulches provide habitats for antagonists of pests. • Certain species can also represent an additional source of income, for example when they are utilised as food crops as well. However, plant protection measures on the main crop (fruit trees) must be adapted in order to avoid pesticide residues on the living mulch. • Despite the presence of living mulches, no symptoms of water stress were observed on the fruit trees under the different tested conditions. • Root density of the apple fruits trees was higher when using certain living mulch species like mint or <i>Alchemilla vulgaris</i> (lady's mantle). • No significant differences, neither on fruit yield nor on macro- and micronutrients contents of tree leaves, were found between treatments with or without living mulch. • The process of soil coverage in the tree-row is slower and more heterogeneous than in open field, because the environment is more shaded (especially in older orchards), (often) irrigated and very rich in nutrients. • Results achieved by the project DOMINO emphasise the potential of living mulches in a wide range of growing conditions. But the performance of the living mulch species is always site-specific. Therefore, the challenge is to identify the species that is vigorous enough to compete against weeds in a specific agro-environment which comprises soil, climate, weed pressure and type of orchard management.
	<p>Task 3.2: Trials for row and inter row management with legume intercrops</p> <ul style="list-style-type: none"> • The efficiency of the leguminous species used in the inter-row and row for providing green manure is strongly bound to appropriate seeding and proper seed germination. Key factors are: a) Correct sowing time, b) adapted seeding machine, c) minimising soil disturbance after seeding until the cover crop is fully established, d) sufficient water and light availability for seed germination, e) sow leguminous species with a high seed density or as a mixture with fast establishing cover crops to avoid an invasion by weeds.

WP3	Improving diversity in the cropping system
<ul style="list-style-type: none"> • In the inter-row, a perennial legume crop is a better option than an annual one, thus reducing the workload and the risk of problems in crop establishment. Alternatively, the legume can be sown in the tree row, therefore minimising disturbance by machinery. • When enough biomass is produced, the legume must be incorporated into the soil, at the latest in July (depending on the specific site), otherwise the nitrogen is mineralised too late for the needs of the trees. <p>Task 3.3: Tests on the effect of living mulching on fruit trees' root growth and belowground interactions</p> <p>Root parameters were quantified in the second growing season of the living mulches. In comparison with the control, apple trees had 30% higher root dry weight densities when <i>Alchemilla</i> was grown on the rows, and 46% more with the mint. Considering the total root community (i.e. herbaceous and apple roots), the root parameters were all significantly higher in the upper soil depth (0 to –20 cm) than in the lower (–20 to –40 cm). In these non-limiting fertilisers conditions, the impact of the plant covers on the root system of apple trees was expressed in two opposite behaviours: while the root surface area (RSA) and the root volume (RV) of apple were both significantly higher in the [0 to –20 cm] layer in the plots covered by <i>Alchemilla</i>, higher apple RV values were measured in the deeper soil layer below the mint and the spontaneous vegetation of the control. Nutrient leaf analyses were performed on the apple leaves and no difference was observed on the primary nutrient contents (N, P, K) between the plots with living mulches and the control, even if <i>Alchemilla</i> and mint produced both 42% more biomass than the control. So, even if the roots of <i>Alchemilla</i> and apple trees showed to co-habit in the same soil layer in this system (i.e. mainly the upper one), that did not negatively affect the uptake of nutrients by the trees.</p> <p>The observed results obtained with two different plant covers show that the plasticity of the root system of trees involves more complex mechanisms. While the role of roots is to capture water and nutrients from the soil, they also act by releasing exudates, which can modify the soil microbiome and thus increase the availability of nutrients. This kind of mechanisms could be involved in the cases of <i>Alchemilla</i> or mint, which are known to impact some soil bacterial or fungal populations involved in the nutrient cycles. The association of these two living mulches species with the apple trees is therefore an interesting example of mutualism. Further year assessments would be required to observe if these results will persist over time.</p> <p>B- fulfilment of objectives:</p> <p>The original objectives about developing innovative management strategies in intensive organic fruit orchards by the use of dynamic “living mulches” in the row and with leguminous between the rows for weed control were achieved. The foreseen deliverables have been produced and milestones achieved. A slight delay was due to the need of a meeting to define univocal methodology and that was possible just in November 2018.</p>	

WP4	Fertilisation management
<p>WP leader: UHOH</p> <p>Responsible partners: UHOH, INHORT, LAIM, FGI</p> <p>Overall summary of main results, discussion and conclusions of WP4</p> <p>This work package focused on the evaluation of alternative fertilisers based from locally available waste materials (composts, biogas digestates, mushroom waste), legume-based materials (clover pellets, silage from clover grass, green manure from peas sown at different dates) and a liquid solution from vermicompost production as alternatives for commonly used animal-based fertilisers from conventional agriculture like horn grit, dried poultry manure or stillage, namely the exploited growing media of the yeasts. The target crop was apple. Different methods for data assessment were used: (i) A comparison of all fertilisers used in an incubation experiment (LAIM); (ii) pot experiments (LAIM, FIBL); and (iii) field experiments in different apple orchards (INHORT, UHOH, FGI). In addition, we did a survey on nutrient budgets in organic fruit growing in Germany including soil sampling and analysis for the main nutrients. Results indicate that biogas digestate and clover-based fertilisers, like silage and clover pellets, show the</p>	

best fit in the N:K ratios with fruit trees. The trials also emphasised the critical aspect of determination of the best time for the field application of the organic fertilisers, as generally the actual availability of nutrients (mainly N) from the fertilisers does not completely match the temporal requirements of the tree. To this purpose, the organic fertilisers were also tested in microcosmos to characterise their mineralisation rate under controlled conditions. It was also observed that those with higher rate of mineralisation (and mostly likely those in liquid form) appear to positively stimulate different “layers” of the soil biodiversity, namely different levels of the soil life web. The new alternative fertilisers have been also discussed in one Practice abstract, published on Organic Farming Knowledge to disseminate the most useful research findings for practical field application. The PA is “Organic fertilisation of young apple orchards”, available at <https://organic-farmknowledge.org/tool/42596>

Report on the results obtained (A), and fulfilment of objectives (B) comparing to the original project

A- results obtained and structured in relation to the user groups they are relevant for:

For technicians and farmers.

If inputs of base fertilisers (manure, compost) were higher, surpluses of Ca and K occurred, while for the farms relying on commercial fertilisers, K deficits occurred. In the incubation trials, only biogas digestates released N fast enough to be considered suitable fertilisers to substitute horn meals / grits and stillage in organic apple production. On the contrary, clover grass silage and mushroom wastes even immobilized N while composts and clover pellets release N, but at very low levels. In the pot trials, biogas digestates and stillage had the fastest N mineralization, however, the biogas digestates differed in their pattern depending on their source. In field trials, we found differences related to the locations in terms of nitrogen release, but we detected the following pattern: N release from silage and clover pellets was slower compared to the release from biogas digestates, vermicompost solution and the control materials horn grit and stillage and therefore may not match the trees’ demand at flowering. N availability from peas as green manure in the tree row depends strongly on the time of tillage. Overall, nitrogen release of legume-based fertilisers depends much more on local site conditions compared to the commercial fertilisers, like horn grit or stillage. However, all alternative fertilisers reached yield levels similar to those of the current commercial fertilisers with no or only very little differences in leaf nutrient contents and fruit quality. Biogas digestates are a suitable product to fulfil the trees’ nutrient demand at flowering and to close urban-rural nutrient cycles, but it may be difficult to acquire them in a quality that is accepted for organic production.

Considering all pros and cons, we conclude that using fertilisers based on legumes (clover grass silage, clover biomass from the inter row or peas mulching on the row) reduces soil contamination risks in comparison to other sources (biogas digestates, stillages, composts) and enhances farm internal N cycles leading to an overall higher N efficiency in organic fruit growing systems. However, there is no fertiliser that solves the problem of the unbalanced nutrient budgets. To overcome this problem, farmers have to alternate different fertilisers per year or in subsequent years, based on soil analyses to improve the long-term sustainability of the cultivation system.

Biogas digestate (unseparated and preferably from plant materials) as well as clover-based fertilisers, like silage and clover pellets, show the best fit in the N:K ratios with fruit trees. These fertilisers help to reduce K deficits at comparatively low P supply, minimising the risk of P accumulation. In case of a high level of available P in the soil, living mulches based on dense seeding of grain legumes, as well as compost and farmyard manure, are less suitable due to their high P inputs when fertilisation rate is calculated on the N demand of the apple trees.

Regular soil analyses together with nutrient budget calculations are the key tools to developing a fertilisation strategy that is sustainable in mitigating nutrient imbalances in the long-term.

Details on the carried-out trials and results are described in the Final deliverable 4.8 (<https://orgprints.org/id/eprint/42725/>) Deliverable 4.9 describes guidelines for strategies to improve fertilisation (<https://orgprints.org/id/eprint/42727/>).

For Policy makers.

Obtained results on the agronomic effectiveness of recycled organic matters, reused as fertilisers, contribute to the implementation of the EU Circular Economy Action Plan hence to the European Green Deal. In addition, results on ways of field application of the organic fertilisers may facilitate the implementation of the Regulation (EU) 2019/1009 on the making available on the market of EU fertilising products, which will come into force in July 2022.

B- fulfilment of objectives:

The original objectives about developing innovative management strategies in intensive organic fruit orchards with use of fertilisation approaches, based on recycled soil amendments and leguminous crops to increase resource use efficiency, have been fulfilled. The foreseen deliverables have been produced and milestones achieved.

WP5 New plant protection systems

WP leader: LAIM

Responsible partners: LAIM, FiBL

Overall summary of main results, discussion and conclusions of WP5

The orchard functioning under partly closed covering system (Keep-in-Touch®, System *antiacqua*, KT) was quantified in order to validate the reduction of external inputs use. Plastic covering on the top and lateral netting systems were applied to reduce foliage wetting and to prevent insect attacks, compared with treatment based on spraying organic chemicals and treatment control without any spray. Trials were carried on apple under two different environmental and managing systems in South Tyrol and Switzerland. Obtained results are controversial and do not allow to conclude that such systems are absolutely more effective than the plant protection protocol based on spraying permitted agro-chemicals in organic farming. The covering systems proved to properly control certain species of pest and disease but in general no great differences were found between the covered and the treatments based on organic agro-chemicals. Nets caused more fruit breakage and were less effective against aphids, while the effect on beneficial insects has not been elucidated and requires further investigation. For what concerns the shelf life of the fruits, no differences were found for *C. acutatum*, *P. cactorum*, bitter pit, post-storage scab and *Neofabraea alba* in 2020, between the covered and the organic treatments. In general, the rain-proof roof allowed to reduce the post-storage losses caused by post-storage scab.

With the above in mind, it is not possible to conclude whether the tested netting systems are able to effectively reduce sulphur and copper use in the organic apple orchard, as initially hypothesized.

The new plant protection system has been also discussed in one Practice abstract, published on Organic Farming Knowledge to disseminate the most useful research findings for practical field application (<https://organic-farmknowledge.org/tool/42597>).

Report on the results obtained (A), and fulfilment of objectives (B) comparing to the original project proposal

A- results obtained and structured in relation to the user groups they are relevant for:

For technicians and farmers. The partly closed covering system KT to support non-chemical pest and diseases control were tested on apple orchards. Obtained results are controversial and do not allow to conclude that such systems are absolutely more effective than the plant protection protocol based on spraying permitted agro-chemicals in organic farming.

The partly closed covering system KT proved to properly control certain species of pest and disease but in general no great differences were found between the covered and the treatments based on organic agro-chemicals. Nets were less effective against aphids, while the effect on beneficial insects has not been

elucidated and requires further investigation. Furthermore, this system might increase the presence of secondary pests, like *E. lanigerum*.

Some very specific results were:

Scab infections were sharply reduced if compared to the “control” and were lower than the “organic” treatment at FiBL, but not significantly different from the “organic” one at LAIM. To obtain a more efficient protection by the KT system it would be important to expand the upper plastic cover or to reduce the height of the trees so to have a better lateral protection. In fact, the infection was significantly lower in the top part of trees.

The yield and the share of marketable fruits was highest for the “Keep in touch” system, closely followed by the “organic” treatment at FiBL, but significantly higher than the “organic” one at LAIM. In both trials, the lowest level was reached by the not sprayed control.

As for the fruit assessment, rotting diseases, sooty blotch, fallen fruits, and insect damages on fruits were reduced in the “Keep in touch” treatment, but there were more underdeveloped and deformed fruits.

At FiBL, fruit weight, sugar content, and the overcolour were lower for the partly closed covering system, but the firmness was comparable; at LAIM no significant differences were detected between firmness, acidity and sugar content.

Nitrogen and potassium contained in the fruit significantly increased, whereas zinc decreased. All other macro- and micronutrients were not significantly affected.

It is worth noting that physical protection barriers require high initial investments, as the structure and the materials are expensive. It is important to assemble the support system on well-fixed poles, as the nets under strong winds condition might act as a sail, causing damages to the barriers and the orchard rows.

The barrier needs to be opened in the right moment, before the main infections start to spread, but it is important to remember how lateral nets strongly reduce the pollinators’ activity. The ideal opening moment is immediately after the full bloom.

Until the nets opening, preventive plant protection products should be sprayed, to avoid earlier fungal infections and future pest infestations (i.e. *D. plantaginea*).

Even if the shade caused by the barrier increase the June fruit drop, it might be necessary to open the barriers to perform further hand thinning. In case of pest infestations this could be the right moment to spray, as the nets will be partially closed.

Before the harvest, might be useful to anticipate the nets closure, to increase fruit coloration and, if necessary, to remove leaves.

For the ecophysiology researchers. Despite a few significant differences in the light quality and quantity on both sides of the tree for the partly closed covering system and the “control”, photosynthetic activity did not highlight any significant difference neither in sunny nor in shaded side. But when light data were normalized with the external solar radiation in order to obtain the percentage of light increase/decrease, there was a clear reduction in the total light due to KT system in the sun and shaded side, while the diffuse light increased in the first two meters of the sunny side and remains almost equal to the control in all the measures taken in the shaded side.

Significant differences were found in N and K content of the fruits, both higher in the partly closed covering system treatment compared to the organic one, while Zn was significantly lower. The other macro- and micro- nutrients did not differ between these two treatments. No significant differences were found for what concern acidity, TDS (°Brix), pH and starch index, even if the last one showed lower values in the partly closed covering system treatment.

For Policy makers. Protecting the trees with physical barriers presents a few concerns about the environmental and social impact. From other research work, life cycle analysis of the partly closed covering system highlighted the negative impact of such systems on the CO₂ budget of apple production. Moreover,

the presence of these systems can negatively affect the aesthetic value of apple orchards in areas with high tourist intensity.

B- fulfilment of objectives:

It is not possible to conclude whether the tested partly closed covering system is able to effectively reduce sulphur and copper use in the organic apple orchard, as initially hypothesized. So, it is not possible at the moment to suggest to generalize the use of covering systems in organic farming. But in specific situation this system may help in controlling some pest and diseases. In any case a system approach indicates to realize local experiments to see the best way to apply the covering system.

WP6 Environmental and economic effects

WP leader: INHORT

Responsible partners: INHORT, LAIM, FiBL, UPM, FGI, UHOH

Overall summary of main results, discussion and conclusions of WP6

Data on microbial activity, nematodes and weeds populations dynamics were collected on the trials of WP3 (living mulches for row management) and WP4 (locally available organic fertilisers). Several living mulches plants limited weed infestation in the rows of trees. Some of them resulted to increase the soil bacterial activity and modify both nematode populations, increasing non-parasitic species, and above-ground entomofauna. These effects allowed to conclude that living mulches can improve biodiversity and weeds management, positively affecting the tree crop health and nutrient status. The different fertilisers resulted to have a diverse dynamic of soil N availability with the following mineralization ratio: bio-digestates and stillages > horn grit > clover pellet > manure and compost. The effect on soil biodiversity of the tested fertilisers was consistent with their mineralization rate underlining the relations between the fertiliser composition and the different chains of the soil life web.

The economic assessment of profitability of new management systems pointed out differences related to territorial and social environments. However, in some cases the living mulches resulted to be able providing an economic benefit to the organic fruit producer compared to common methods of organic orchard management. A method for the monetization of ecosystem services was developed considering the outcomes of a qualitative assessment of the potential impacts of the innovative orchards' management practices on the ecosystem services. Considering nine selected ecosystem services, which value was calculated using different methods, and the results of the agronomical, biodiversity and economic analyses allowed to point out a contribution to social costs savings, energy savings and overall increase of the orchard biodiversity of the tested practices, thus supporting the achievement of the objectives of the European Green Deal strategy.

Report on the results obtained (A), and fulfilment of objectives (B) comparing to the original project proposal

A- results obtained and structured in relation to the user groups they are relevant for:

Task 6.1: Eco-services appraisal and assessment of biodiversity improvement

The application of different kinds of organic fertilisers (manure, clover pellets, horn grit, biogas digestate and a stillage from yeast production) affected quite significantly the soil biodiversity. Considering the microorganism's biodiversity, the results showed a significant increase in both microbiological activity and diversity after application of the stillage and, to a much lower extent, of biogas digestate in comparison to the untreated control. An increased biodiversity, as expressed by the operational taxonomic units (OTU) number and Shannon diversity index, was also found with the soil DNA analyses. However, the different groups of microorganisms were differently affected depending on the fertiliser: bacteria were promoted by the liquid amendments (stillage and biogas digestate) while fungi were more affected by solid fertilisers (e.g. manure). Nevertheless, a certain influence of the sampling period also emerged. The nematodes community, being dependent on microbial populations, was also affected by the bio-fertilisers. Even though an effect of the season could be observed also for these organisms, in general the number of taxa recorded was always the highest in the soil treated with the stillage than the control. Biogas digestate

could be considered as intermediate for the effect on taxa number, while all others resulted either in the same level as the control or even reduced the diversity in terms of taxa number. Interestingly, this was paralleled by an opposite trend in the total population size. Such trends affected the population ecology as defined by two indexes of biodiversity (H and D). Considering the composition of the nematodes' trophic groups, horn grit induced the lowest percentage of plant feeders, with all other products sharing a similar value to that of the control. Nevertheless, the highest value of the plant parasite index was observed in control plots, significantly higher than any other treatment.

The impact of different living mulch species used for row management was evaluated for soil biodiversity, considering microbial and microfauna, and above ground biodiversity (weeds, pests and beneficial arthropods).

A significant increase of the overall bacterial biodiversity was observed in the plots with mint and Alchemilla compared to the control, while the other living mulches did not affect these parameters. The composition of the soil nematode communities resulted to be affected by the different types of living mulches and almost every examined plant species increased the biodiversity of the soil nematodes' community in comparison to natural cover. However, as in the case of bio-fertilisers, a seasonal effect was also observed. All living mulch species were characterized by a similar population size and pumpkin and Alchemilla resulted also in a lower PPI (Plant Parasite Index, it is the ratio between parasite of the plant and the parasite of other nematodes) in summer and autumn with respect to the other species. Ground cover with three living mulches (dwarf white clover, *Mentha spicata* or *Hieracium pilosella* in association with dwarf alfalfa) resulted not modifying earthworm's abundance with respect to the soil tillage. However, a significant increase of the soil porosity compared to the tillage was observed. Concerning the above ground biodiversity, the living mulch species affected weed pressure population size to varying degrees. On average, during summer, which is the most critical period of weed competition in apple orchards, living mulches reduced the number of weeds plants by 20-50% reducing also the number of taxa (by 16% on average). Moreover, the weed infestation determined at the level of class (dicotyledonous and monocotyledonous) and growth behaviour (annual, biennial and perennial) was strongly influenced by the different living mulch species. The highest share of perennial weeds occurred in the control, and all living mulch species limited the weed infestation in the tree rows: the best effects were produced by mint, wild strawberry and Alchemilla. The impact of three kinds of ground covers combined with 6 dwarf legume ecotypes, in comparison with a standard organic practice (rows weeded by shallow tillage and fertilized with commercial organic fertilisers) allowed to conclude that the dwarf white clover effectively controlled weeds without any additional measures, from the beginning of the season. Pest and beneficial arthropods' incidence was assessed through monitoring moths, aphids and leaf roller species as well as predatory mites. In all sites (PL, D, F), the results were not always consistent even though a certain positive impact was observed, particularly on aphid species (reduced population with mint) and predatory mites (increase with mint). No positive impact of the living mulches was observed on other above ground beneficial arthropods populations. The assessment of the impact of partly closed covering systems on biodiversity revealed an overall higher diversity of insects after fruitlet fall than after bloom, with on average 18 families present in the orchard compared to 13 families in the unprotected control, respectively. However, the majority of insect specimens belonged to 3-5 families (particularly Formicidae, Aphididae, Curculionidae). Interestingly, some beneficials that were found in the control and the organic treatment, were not observed under KT or vice versa. However, a higher incidence under the KT (woolly apple aphid) or the untreated control (rosy apple aphid) was observed.

Task 6.2: Economic assessment

The analysis of production costs at farm level was done based on the data provided by each partner where trials were performed. The collected data referred only to the activities necessary to apply the innovative methods introduced by the project that diverged from the organic baseline. The main finding from the analysis was that the costs of implementing innovations in soil management depend very much on the cropping system, the type of innovation introduced and the labour costs to be applied. For example, in case of machinery costs, the working capacity of the machine on a single side of the row or on two sides (two adjacent rows) can impact for about 30% of the cost. However, the need of labour is much higher

with living mulches, particularly when establishing the mulch, thus the impact on the total costs can vary accordingly. Considering that ecosystem services are taken as the contributions that ecosystems make to human well-being, the innovations tested in the DOMINO project would thus be expected to integrate the management of ecosystem services into the crop production system. On the basis of such conceptual framework, the activities performed aimed at implementing it using both social science and economic approaches: the first useful to capture the practitioners' perception of the innovative practices and the second needed to monetize the value of the ecosystem services.

An initial qualitative assessment of the potential impacts of DOMINO innovative orchards management on selected ecosystem services made with a survey among practitioners showed a quite diversified perception depending on the country and the practice concerned.

The survey was conducted in Italy (76 respondents, 70 from South Tyrol), Bulgaria (21), Poland (30) and Switzerland (13). The survey consisted of open questions, single and multiple-choice questions. The questions revolved around some general information about the orchard, and the specific questions about management strategies (biodiversity, fertilisation, plant protection, machinery). Farmers were asked to fill in the survey via an online tool for South Tyrol (70 respondents), whereas in-person interviews were performed with farmers for all other respondents.

While the impact of the temporary net system on biodiversity and aesthetics was assessed negatively everywhere the impact of the row management on ecosystem services was highly dependent on the country of the respondent. Considering the different services, the respondents in general indicated a positive score of the practices toward provisioning and regulating services. Contrasting perception emerged in case of cultural services, while no major impact was perceived for supporting services. The analysis of the questionnaire indicated a high consideration of the added value of the living mulches in terms of aesthetic value and marketing claims for farmers selling directly their products on-farm. The valuation of ecosystem services was carried out identifying the best techniques for the estimation of their economic value, since not all ecosystem services have market prices. Only the mulching species that were able to provide a practical and feasible implementation at farm level were selected, namely wild strawberry, mint and alchemilla, comparing them to the baseline method of organic orchard management. When considering the two-provisioning ecosystem services food (apples and fruits of wild strawberry) and raw materials (leaves for herbal preparations), in the scenario where no differences in apple yield were set, the three living mulches allowed to produce an additional revenue ranging from 42 to 238% compared to the organic baseline. However, when the production and operational costs were considered, growing mint as living mulch resulted in a negative gross margin, while that of alchemilla and wild strawberry was about 3 and 10 times higher than the baseline, respectively. Nevertheless, considering the value of regulating services (reduced number of pesticides application and pollination service) as a positive externality for the living mulch species, the loss in gross margin for mint was halved, but still negative; on the other hand, it further increased to about 10 or 80% in case of wild strawberry or alchemilla, respectively.

Results from the different assessments were presented at scientific conferences and articles have been published or submitted (see list of dissemination materials). Currently other articles are drafted and outcomes from nematodes analyses were also summarized in a chapter that is expected to be published in the coming months by Springer.

B- fulfilment of objectives:

All objectives planned were fulfilled. In particular:

- a) The alternative fertilisers tested can substitute existing fertilisers, even though the site specific pedoclimatic conditions as well as the crop management system can impact on their mineralization dynamic and nutrient availability. Their effect on soil biodiversity were consistent with the mineralization rate underlining the relations between the fertiliser composition and the different chains of the soil life web.
- b) The ideal ground cover that will perform in any situation does not exist: the challenge is to find the species that grow enough to compete with weeds for a specific environment and cropping

system. However, several species performed and could be potentially utilized to provide ecosystem services useful for different purposes (food production, pollination, phytoremediation, pest control). In this respect, the impact on soil biodiversity is an aspect frequently underestimated, but with a huge potential impact on the tree crop health and nutrient status, and yield as well.

- c) Considering the economic evaluations, the living mulches could provide a direct economic benefit to the organic fruit producer compared to common methods of organic orchard management, which would be a convincing reason to foster their adoption.
- d) The results of the agronomical, biodiversity and economic analyses allow to recommend the adoption of policies supporting the introduction of living mulches in organic fruit production.

3.2 Deliverables and milestones status

Deliverable No.	Deliverable name	Link to the document ²⁾	Planned delivery month ¹⁾	Actual delivery month ¹⁾	Reasons for changes/delay and explanation of consequences
D1.1	Consortium Agreement and Management Guidelines	available on request	M2	M1	
D2.1	Collaborative platform – Internet-Based Knowledge System-Project website	http://www.domino-coreorganic.eu/	M3	M8	Activities initiated with some delay because financing from the National funding bodies took time to be activated.
D2.2	Literature survey and experimental design of all trials	http://www.domino-coreorganic.eu/download/others/DOMINO-trials-description.pdf https://orgprints.org/36988/ https://orgprints.org/36983/	M3	M10	The literature survey was presented in the kick off meeting in Ancona in November 2018 where we discussed the experimental design of all the trials
D2.3	Questionnaire for stakeholders	https://orgprints.org/id/eprint/36986/	M3	M5	Delay due to financing from the National funding bodies took time to be activated
D3.1	Guidelines for standardized crop and fruit sampling and analyses	http://www.domino-coreorganic.eu/download/others/Guideline-for-analysis-on-plant-and-mulches.pdf https://orgprints.org/36987/ https://orgprints.org/36994/	M6	M8	The slight delay was due to the need of a meeting to define univocal methodology and that was possible just in November 2018
D4.1	Guidelines for standardized soil sampling and analyses	http://www.domino-coreorganic.eu/download/others/DOMINO_guidelines_4.1-Soil-analyses.pdf https://orgprints.org/37002/	M6	M8	

Deliverable No.	Deliverable name	Link to the document ²⁾	Planned delivery month ¹⁾	Actual delivery month ¹⁾	Reasons for changes/delay and explanation of consequences
D6.1	Guidelines for standardized economic and environmental data collection	http://www.domino-coreorganic.eu/download/other/DOMINO_guidelines_economic%20assessment.pdf https://orgprints.org/36999/	M6	M8	
D2.4	Project flyer	http://orgprints.org/34376/	M6	M2	
D2.5	Social Media accounts	https://www.facebook.com/Domino-Project-Core-Organic-1069708459868113/	M6	M6	
D2.6-D2.11	Biannual newsletter (6 issues)	http://www.domino-coreorganic.eu/download/newsletter/Newsletter-no-1-december-2018.pdf http://www.domino-coreorganic.eu/download/newsletter/newsletter-no2-june-2019.pdf Newsletter - Domino (domino-coreorganic.eu)	M6, M12, M18, M24, M30, M36	M6, M12, M18, M24, M30	Last newsletter was published on the website after project's end (November 2021)
D2.12	Regional stakeholder workshops	http://www.domino-coreorganic.eu/news-events/83-open-day-at-the-competence-centre-for-fruit-growing-bavendorf-7th-of-july-2018 15 to 20 fruit farmers; http://www.domino-coreorganic.eu/news-events/29-technical-workshop-at-laimburg-research-centre 150-180 people, mainly farmers and technicians; http://www.domino-coreorganic.eu/news-events/121-ecosystem-services-how-to-evaluate-them About 10 of the members were present of the producers' association with which INHORT established the collaboration http://www.domino-coreorganic.eu/news-events/163-workshop-soil-management-in-rows-and-inter-rows-in-organic-apple-orchards-research-institute-of-	M2, M17, M31	M3, M4, M10, M18, M34	In-physical presence workshops have to be reduced because of the COVID-19 pandemic. Last workshop was organised in March 2021, online because of the pandemic.

Deliverable No.	Deliverable name	Link to the document ²⁾	Planned delivery month ¹⁾	Actual delivery month ¹⁾	Reasons for changes/delay and explanation of consequences
		horticulture,-skierniewice,-poland 50 participants, members of organic producer associations, agricultural advisors and farmers from various regions of Poland Digital workshop organised by UHOH for the general public. 100 participants from 12 European countries https://orgprints.org/id/eprint/42726/			
D1.3- D1.5	3 Annual meeting minutes	available on request	M3, M16	M6, M18, M30, M38	
D1.6- D1.7	2 Annual interim reports to EU		M13		Replaced with Midterm and annual report
D4.2-D4.4	3 Yearly reports of soil assessment data	http://www.domino-coreorganic.eu/download/reports/Yearly_report_of_crops_yield_and_quality_data_as_influenced_by_soil_management_2019.pdf https://orgprints.org/37001/ https://orgprints.org/id/eprint/40022/			These deliverables were merged with D3.2-D3.4 and with D4.5-D4.7
D3.2-D3.4	3 Yearly reports of crops' yield and quality data as influenced by soil management	https://orgprints.org/37001/ https://orgprints.org/id/eprint/40022/ https://orgprints.org/id/eprint/40022/	M12, M24, M34	M12, M24, M34	These deliverables are the result of the merging of deliverables D4.2-D4.4 with D3.2-D3.4 and with D4.5-D4.7
D3.5-D3.7	3 Yearly reports of biodiversity data	https://orgprints.org/36993/ https://orgprints.org/id/eprint/38520/ https://orgprints.org/id/eprint/40216/	M12, M24, M34	M12, M29, M39	
D6.2-D6.4	3 Yearly reports of economic and environmental impact of	https://orgprints.org/id/eprint/42864/ https://orgprints.org/id/eprint/38199/ https://orgprints.org/id/eprint/40219/	M12, M24, M34	M12, M24, M39	

Deliverable No.	Deliverable name	Link to the document²⁾	Planned delivery month¹⁾	Actual delivery month¹⁾	Reasons for changes/delay and explanation of consequences
	management practices				
D4.5-D4.7	3 Yearly reports of crops' nutrition data				These deliverables were merged with D3.2-D3.4 and with D4.2-D4.4
D5.1- D5.3	3 Yearly reports of crops' yield and quality data as influenced by overhead netting				Merged with D5.4
D5.4- D5.6	3 Yearly reports of plant physiological status as influenced by overhead netting				Merged with D5.1
D5.1- D5.6	3 Yearly reports of plant physiological status, crops' yield and quality data as influenced by overhead netting	https://orgprints.org/37000/ https://orgprints.org/id/eprint/38122/ https://orgprints.org/id/eprint/42804/	M12, M24, M34	M12, M24, M39	These deliverables are the result of the merging of deliverables D5.1- D5.6. D5.6 (M39) has been in turn merged with D5.7 (Final deliverable), because the partner in charge of it, LAIM, has left the project on 31/03/2021.
D2.13	Report on field demonstration trials set up	http://www.domino-coreorganic.eu/download/others/DOMINO-trials-description.pdf see D2.2. The two reports have been merged	M12	M10	
D1.8	Mid-term assessment	https://orgprints.org/id/eprint/42397/	M18	M18	The same as mid-term report
D3.8	Mid-term report on combined alternative agronomical practices of row management	https://orgprints.org/cgi/users/home?screen=EPrint%3A%3AView&eprintid=42397	M18	M18	This report has been included in the MtR
D2.14	An array of video clips for training and	https://orgprints.org/id/eprint/40220/	M30	M39	The document provides links to the videos produced by the project. The delay was due to

Deliverable No.	Deliverable name	Link to the document ²⁾	Planned delivery month ¹⁾	Actual delivery month ¹⁾	Reasons for changes/delay and explanation of consequences
	communication purposes	Other available materials - Domino (domino-coreorganic.eu)			pandemic and difficulty to make the field meeting
D2.15	A brochure on integrated soil management in six languages	<p>ENGLISH VERSION https://orgprints.org/42737/1/D2.15_DOMINO_Brochure_integrated_soil_management.pdf</p> <p>ITALIAN VERSION https://orgprints.org/id/eprint/42843/</p> <p>POLISH VERSION https://orgprints.org/id/eprint/42866/</p> <p>FRENCH VERSION https://orgprints.org/id/eprint/42867/</p> <p>GERMAN VERSION https://orgprints.org/id/eprint/42878/</p> <p>BULGARIAN VERSION https://orgprints.org/id/eprint/42865/</p>	M35	M39	The document is available on E-prints in English, Italian, Polish, German Bulgarian and French. The delay was due to pandemic and difficulty to work in presence for several partners. Finally, it was not possible to assemble everything in perfect time.
D2.16	Report on participatory trainings delivered				Merged with D2.18
D2.18	Report on demonstration and communication activities				Merged with D2.16
D2.16 – 2.18	Report on demonstration and communication activities, and on participatory training delivered (2018-2021)	Uploaded on Organic Eprints, status: under review	M35	M39	D2.16 and D2.18 were merged in this deliverable
D2.17	Strategic document for policy stakeholders	https://orgprints.org/id/eprint/42738/1/D2.17_Strategic%20document%20for%20policy%20stakeholders.pdf	M36	M39	Delay due to pandemic

Deliverable No.	Deliverable name	Link to the document²⁾	Planned delivery month¹⁾	Actual delivery month¹⁾	Reasons for changes/delay and explanation of consequences
D3.9	Final report on combined alternative agronomical practices of row management	https://orgprints.org/id/eprint/42743/1/D3.9_Final%20report%20on%20alternative%20row%20management.pdf	M36	M39	Delay due to pandemic
D6.5	Final report on economic and environmental sustainability management practices at farm level	https://orgprints.org/id/eprint/42722/1/D6.5.Fin%20Rep%20on%20economic%20and%20environ%20sustainability%20mngm%20practices%20at%20farm%20level.pdf	M36	M39	Delay due to pandemic
D4.8	Final report on new fertilisation management improving soil fertility and health in orchards	https://orgprints.org/id/eprint/42725/1/Deliverable%204.8%20FR%20on%20new%20fert%20management%20to%20improv%20soil%20fertility%20and%20health.pdf	M36	M39	Delay due to pandemic
D5.7	Final report on new protection management adopting overhead netting in orchards	https://orgprints.org/id/eprint/40217/	M36	M34	Merged with D5.6, as LAIM left the project end of March 2021
D.5.8	Guidelines for strategies to improve plant protection		M36	M34	These guidelines were included in D5.6
D.4.9	Guidelines for strategies to improve fertilisation	https://orgprints.org/id/eprint/42727/1/Del%204.9%20Guidelines%20for%20strategies%20to%20improve%20fert%20in%20intensive%20org%20apple%20orc.pdf	M36	M39	Delay due to pandemic
D1.9	Final Report		M42		

Milestone No.	Milestone name	Planned delivery month¹⁾	Actual delivery month¹⁾	Reasons for changes/delay and explanation of consequences
M1.1	Consortium agreement	M1	M1	
M1.2	Project kick off meeting	M1	M1	
M1.3	Management guidelines approved	M2	M7	The slight delay was due to the need of a meeting

Deliverable No.	Deliverable name	Link to the document²⁾	Planned delivery month¹⁾	Actual delivery month¹⁾	Reasons for changes/delay and explanation of consequences
					to define univocal management guidelines and that was possible just in November 2018
M2.1	Project website and visibility leaflet launched		M3	M3	
M1.4	Common protocols for experimental trials		M3	M8	The financing acceptance of several partners was largely delayed, so it was difficult to assess all the protocols without knowing where the exp trials would be located.
M2.2	Fields demonstration sites definition		M3	M10	The financing acceptance of several partners was largely delayed. Most of the sites were defined by month 3, but in Bulgaria the site was identified after month 10.
M1.5	Project meetings organised		M3, M16	M6, M18, M30, M38	Delay due to pandemic
M1.6	Management reports and financial statements delivered		M3, M16	M18	included in the MtR
M1.7	Annual field trials performed		M12	M12	
M1.8	Mid-term evaluation		M18	M18	
M.2.3	Demonstration activities performed		M12	From month 3	Activities started already in month 3 in some countries.
M.1.9	Description and assessment of efficient integrated soil management		M24, M36	M24, M39	Leaflet/brochure and 2 technical articles
M.1.10	Description and assessment of plant protection strategies		M24, M36	M24, M39	Leaflet/brochure and 2 technical articles

1) Measured in months from the project start date (month 1)

2) E.g orgprints.org/33121

4. Publications and dissemination activities

4.1 List extracted from Organic Eprints

Number of items at this level: 73.

Journal paper

Md Jebu, Mia; Ewa M., Furmanczyk; Joanna, Golian; Joanna, Kwiatkowska; Eligio, Malusa and Davide, Neri (2021) [Living Mulch with Selected Herbs for Soil Management in Organic Apple Orchards](#). *Horticulturae*, 7 (59), pp. 1-12.

Neri, Davide; Polverigiani, Serena; Zucchini, Matteo; Giorgi, Veronica; Marchionni, Fabio and Jebu Mia, Md (2021) [Strawberry Living Mulch in an Organic Vineyard](#). *Agronomy*, 11 (11), pp. 2-11.

Shtai, Walaa; Tagliavini, Massimo; Holtz, Thomas; Abdelkader, Ahmed Ben; Petrillo, Marta; Zanotelli, Damiano and Montagnani, Leonardo (2020) [Total and diffuse light distribution within the canopy of an apple orchard as affected by reflective ground covers](#). *Italus Hortus*, 27, pp. 69-84.

Newspaper or magazine article

Friedli, Michael; Boutry, Clémence; Kelderer, Markus; Holtz, Thomas; Sabine, Zikeli; Lepp, Birgit; Malusa, Eligio; Fernandez, Maria-Martha; Hristina, Kutinkova; Neri, Davide; Zucchini, Matteo; Polverigiani, Serena and Ponzio, Carlo (2020) [Newsletters produced by DOMINO and published in the website, from 2018 to 2020](#). *none*, 2020, 0-0. [draft]

Holz, Thomas; Kelderer, Markus; Casera, Claudio and Topp, A. (2018) [Mehr Nachhaltigkeit dank DOMINO](#). *SÜDTIROLER LANDWIRT*, 11 November 2018, 20, pp. 68-70.

Malusa, Eligio; Sas, Lidia and Tartanus, Małgorzata (2020) [Inoculi microbici per migliorare la fertilità biologica del suolo](#). *Frutticoltura*, 2020 (2), pp. 2-4.

Malusa, Eligio and Tartanus, Małgorzata (2019) [W sadach ekologicznych](#). [In organic orchards.] *Hasło Ogrodnicze*, January 2019, 2019 (1), pp. 37-40.

Md Jebu, Mia; Massetani, Francesca; Monaci, Elga; Facchi, Jacopo; Amadio, Luca; Lancianese, Fabio; Murri, Giorgio and Neri, Davide (2021) [Sfalcio e lavorazioni per la gestione sostenibile del cotico erboso](#). *Frutticoltura*, July 2021, pp. 34-39.

Neri, Davide (2018) [Analizada la relación entre árbol y suelo en la X Jornada de fruticultura ecológica de Alfarràs](#). *Revista de Fruticultura*, August 2018 (63), pp. 88-92.

Neri, Davide; Polverigiani, Serena; Zucchini, Matteo and Marchionni, Fabio (2019) [Pacciamature vive per la gestione del sottofila: un caso applicativo](#). *Vigne, Vini & Qualità*, November 2019, 7, pp. 34-37.

Polverigiani, Serena; Ceccarelli, Danilo and Neri, Davide (2019) [Migliorare la biodiversità di frutteti e vigneti collinari in biologico](#). *Rivista di Frutticoltura e ortofloricoltura*, May 2019, 4, pp. 46-50.

Polverigiani, Serena and Marchionni, Fabio (2019) [Il Progetto Fragolina Collestefano: le fragoline usate per limitare le infestanti nel sottofila delle vigne](#). *vino da bere*, July 2019, published on line.

Łabanowska-Bury, Dorota (2019) [Dla ekologicznego sadownictwa](#). [For the organic fruit grower.] *SAD*, January 2019, pp. 60-62.

Łabanowska-Bury, Dorota (2018) [Dla ekologicznego sdownictwa](#). [For the organic fruit producer.] *TMJ*, December 2018, p. 6.

Conference paper, poster, etc.

Dzhuvinov, Vasiliy; Staneva, I.; Gandev, S.; kutinkova, Hristina; Stefanova, D.; Kornov, G. and Stoeva, M. (2020) [Fertilisation of apple trees with organic fertilizers “Keratin” and “Lumbreco” in Bulgaria - preliminary results](#). In: *Proceedings ECOFRUIT 2020*, pp. 81-85.

Furmanczyk, Ewa; Tartanus, Małgorzata; Holtz, Thomas; Kelderer, Markus and Malusa, Eligio (2020) [Soil nutrient availability of new organic fertilizers formulations](#). In: *Proceedings of XIX International Conference on Organic Fruit Growing, Hohenheim, Germany*, pp. 181-183.

Holtz, Thomas; Casera, Claudio; Lardschneider, Ewald; Schmid, A. and Kelderer, Markus (2020) [Physical protection barriers against pests and diseases, a multi crop experience](#). Short communication at:

Kozacki, D.; Soika, Grażyna; Tartanus, Małgorzata and Malusa, Eligio (2020) [The impact of different organic fertilizers on the soil nematode assemblages in an organic apple orchard](#). In: *Proceedings of XIX International Conference on Organic Fruit Growing, Hohenheim, Germany*, pp. 184-186.

Lepp, Birgit; Zikeli, Sabine; Hartmann, Tobias Edward; Buchleither, Sascha and Möller, Kurt (2020) [Improving Fertilisation Strategies in Organic Apple Cultivation](#). In: *Proceedings of XIX International Conference on Organic Fruit Growing, Hohenheim, Germany*, pp. 179-180.

Neri, Davide (2019) [Light spectrum modifications under photo-selective hail-nets](#). Workshop at: SOLUZIONI TECNICHE ORIENTATE ALLA FRUTTICOLTURA DI PRECISIONE, Faenza, 23/01/2019.

Neri, Davide and Zikeli, Sabine (2018) [Start-Up Workshop of the CORE Organic project “DOMINO”](#). Workshop at: 18th International Conference on Organic Fruit-Growing, Schloss Hohenheim, Aula, Schloß Hohenheim 1,D-70599 Stuttgart, 19-21/02/2018.

Polverigiani, Serena and Neri, Davide (2019) [Utilizzo di fragoline come pacciamature vive nel sottofila degli arboreti e dei vigneti](#). Poster at: workshop held at the Agriculture Faculty of Bologna in June 24 2019. [Submitted]

Polverigiani, Serena and Neri, Davide (2019) [DOMINO: Dynamic sod mulching and use of recycled amendments to increase biodiversity, resilience and sustainability of intensive organic fruit orchards and vineyards](#). Poster at: CORE Organic Cofund Research Seminar, Bari, Italy, 29 January 2019.

Report

Boutry, Clémence; Friedli, Michael; Malusa, Eligio; Lepp, Birgit; Zikeli, Sabine; Hristina, Kutinkova; Neri, Davide and Ponzio, Carlo (2021) [D2.15- Opzioni Efficaci per una Gestione Integrata del Terreno \(project brochure\)](#). .

Boutry, Clémence; Michael, Friedli; Davide, Neri and Carlo, Ponzio (2021) [D2.15- Effective Options on Integrated Soil Management \(project brochure\)](#). DOMINO, Core Organic.

Boutry, Clémence; Michael, Friedli; Maria-Martha, Fernandez; Sabine, Zikeli; Lepp, Birgit; Hristina, Kutinkova; Malusa, Eligio; Davide, Neri and Carlo, Ponzio (2021) [D2.17-Strategic document for policy stakeholders resulting from the DOMINO project \(2018-2021\)](#). DOMINO, Core Organic.

Boutry, Clémence; Michael, Friedli; Sabine, Zikeli; Lepp, Birgit; Malusa, Eligio; Fernandez, Maria-Martha; Hristina, Kutinkova; Neri, Davide and Ponzio, Carlo (2021) [Report on demonstration and communication activities, and on participatory training delivered \(2018-2021\)](#). .

Davide, Neri; Michael, Friedli; Markus, Kelderer; Maria-Martha, Fernandez; Sabine, Zikeli; Eligio, Malusa and Hristina, Kutinkova (editor): Davide, Neri (Ed.) (2020) [DYNAMIC SOD MULCHING AND USE OF RECYCLED AMENDMENTS TO INCREASE BIODIVERSITY, RESILIENCE AND SUSTAINABILITY OF INTENSIVE ORGANIC FRUIT ORCHARDS AND VINEYARDS - Deliverable 3.6.](#) .

Eligio, Malusa; Sabine, Zikeli; Maria-Martha, Fernandez; Davide, Neri; Carlo, Ponzio; Boutry, Clémence; Michael, Friedli and Kelderer, Markus (2021) [D6.5 - Final Report on economic and environmental sustainability management practices at farm level.](#) .

Fernandez, Maria-Martha; Malusa, Eligio; Friedli, Michael; Boutry, Clémence; Lepp, Birgit; Zikeli, Sabine; Kelderer, Markus; Holtz, Thomas; Neri, Davide and Ponzio, Carlo (2021) [D 3.7 - Yearly report of biodiversity data.](#) .

Fernandez, Maria-Martha; Neri, Davide and Ponzio, Carlo (2021) [Effective Options on Integrated Soil Management \(project brochure\). French version.](#) .

Friedli, Michael; Boutry, Clémence; Malusa, Eligio; Hristina, Kutinkova; Dzhuvinov, Vasiliy; Neri, Davide and Ponzio, Carlo (2019) [Outcomes from the stakeholder surveys \(2019\).](#) .

Holtz, Thomas; Kelderer, Markus; Friedli, Michael; Boutry, Clémence; Zucchini, Matteo and Neri, Davide (2020) [Deliverables number 5.2-5.5. YEARLY REPORT OF PLANT PHYSIOLOGICAL STATUS, CROPS' YIELD AND QUALITY DATA AS INFLUENCED BY OVERHEAD NETTING.](#) .

Hristina, Kutinkova; Dzhuvinov, Vasiliy; Neri, Davide and Ponzio, Carlo (2021) [Effective Options on Integrated Soil Management \(Project brochure\). Bulgarian version.](#) .

Kelderer, Markus; Holtz, Thomas; Friedli, Michael; Boutry, Clémence; Maria-Martha, Fernandez; Zikeli, Sabine; Lepp, Birgit; Hristina, Kutinkova; Neri, Davide and Ponzio, Carlo (2021) [D5.6 Yearly report of plant physiological status, crops' yield and quality data as influenced by overhead netting and D5.7 Final report on new protection management adopting overhead netting in orchards.](#) .

Malusa, Eligio; Boutry, Clémence; Friedli, Michael; Zikeli, Sabine; Lepp, Birgit; Kelderer, Markus; Holtz, Thomas; kutinkova, Hristina; Fernandez, Maria-Martha; Neri, Davide and Ponzio, Carlo (2021) [D6.4 Yearly reports of economic and environmental impact of management practices.](#) .

Malusa, Eligio; Friedli, Michael; Boutry, Clémence; Sabine, Zikeli; Lepp, Birgit; Kelderer, Markus; Holtz, Thomas; Hristina, Kutinkova; Dzhuvinov, Vasiliy; Neri, Davide and Ponzio, Carlo (2019) [D6.2 - DOMINO Yearly report economic impact 2019.](#) .

Malusa, Eligio; Neri, Davide and Ponzio, Carlo (2021) [Effective Options on Integrated Soil Management \(project brochure\). Polish version.](#) .

Malusa, Eligio; Zucchini, Matteo and Neri, Davide (2020) [Deliverable 6.3.](#) .

Maria-Martha, Fernandez; Sabine, Zikeli; Lepp, Birgit; Boutry, Clémence; Friedli, Michael; Eligio, Malusa; Hristina, Kutinkova; Kelderer, Markus; Holtz, Thomas; Davide, Neri and Ponzio, Carlo (2021) [D3.9 - Final report on combined agronomical alternatives of row management \(2021\).](#) Final report. DOMINO, Core Organic.

Neri, Davide; Friedli, Michael; Maria-Martha, Fernandez; Sabine, Zikeli; Kelderer, Markus; Holtz, Thomas; Eligio, Malusa; Dzhuvinov, Vasiliy; kutinkova, Hristina; Polverigiani, Serena and Zucchini, Matteo (2020) [Mid-term report of the DOMINO Project.](#) .

Neri, Davide; Malusa, Eligio; Kelderer, Markus; Friedli, Michael; Fernandez, Maria-Martha; kutinkova, Hristina; Dzhuvinov, Vasiliy; Polverigiani, Serena; Lepp, Birgit and Holtz, Thomas (2019) [D3 1.Guideline-for-analysis-on-plant-and-mulches.](#) .

Neri, Davide; Malusa, Eligio; Kelderer, Markus; Friedli, Michael; Zikeli, Sabine; kutinkova, Hristina; Fernandez, Maria-Martha; Holtz, Thomas; Lepp, Birgit; Polverigiani, Serena and Dzhuvinov, Vasiliy (2019) [D4 2-D4 5-D3 2.Yearly report of crops yield and quality data as influenced by soil management 2019](#) .

Neri, Davide; Malusa, Eligio; Kelderer, Markus; Holtz, Thomas; Zikeli, Sabine; Lepp, Birgit; kutinkova, Hristina; Friedli, Michael; Polverigiani, Serena; Dzhuvinov, Vasiliy and Boutry, Clémence (2019) [D5 1-5 4.Yearly reports of plant physiological status, crops yield and quality data as influenced by overhead netting](#) .

Neri, Davide; Malusa, Eligio; Kelderer, Markus; Zikeli, Sabine; Friedli, Michael; kutinkova, Hristina; Fernandez, Maria-Martha; Dzhuvinov, Vasiliy; Holtz, Thomas; Lepp, Birgit and Polverigiani, Serena (2019) [D4 1.Guidelines for standardized soil sampling and analysis](#) .

Neri, Davide; Malusa, Eligio; Zikeli, Sabine; Friedli, Michael; kutinkova, Hristina; Fernandez, Maria-Martha; Kelderer, Markus and Polverigiani, Serena (2019) [D6 1.Guidelines economic assessment](#) .

Neri, Davide; Malusa, Eligio; Zikeli, Sabine; Kelderer, Markus; Friedli, Michael; Fernandez, Maria-Martha; kutinkova, Hristina; Dzhuvinov, Vasiliy; Polverigiani, Serena and Lepp, Birgit (2019) [D3 5.Yearly reports of biodiversity data 2018 2019](#) .

Neri, Davide and Polverigiani, Serena (2018) [D1 3.meeting-minutes Ancona 2018](#) .

Neri, Davide; Zikeli, Sabine; Malusa, Eligio; Friedli, Michael; Kelderer, Markus; Holtz, Thomas; Fernandez, Maria-Martha; kutinkova, Hristina; Dzhuvinov, Vasiliy and Polverigiani, Serena (2019) [D2 2.DOMINO trials description](#) .

Neri, Davide; Zikeli, Sabine; Malusa, Eligio; Friedli, Michael; Kelderer, Markus; kutinkova, Hristina; Fernandez, Maria-Martha and Polverigiani, Serena (2019) [D6 2.Yearly report economic impact 2019](#) .

Neri, Davide; Zikeli, Sabine; Malusa, Eligio; Kelderer, Markus; Friedli, Michael; kutinkova, Hristina and Fernandez, Maria-Martha (2018) [Domino - Consortium agreement](#) .

Sabine, Zikeli; Lepp, Birgit; Boutry, Clémence; Dzhuvinov, Vasily; Fumanczyk, Ewa; Holtz, Thomas; Malusa, Eligio; Neri, Davide and Ponzio, Carlo (2021) [Deliverable 4.8: Final Report on new fertilisation management to improve soil fertility and health in intensive organic orchards](#) .

Sabine, Zikeli; Lepp, Birgit; Friedli, Michael; Boutry, Clémence; Neri, Davide and Ponzio, Carlo (2021) [D2.15- Effective Options on Integrated Soil Management \(project brochure\). German version](#) .

Sabine, Zikeli; Lepp, Birgit; Malusa, Eligio; Boutry, Clémence; Friedli, Michael; Dzhuvinov, Vasily; Fumanczyk, Ewa; Holtz, Thomas; Kelderer, Markus; Neri, Davide; Fernandez, Maria-Martha and Ponzio, Carlo (2021) [Deliverable 4.9 Guidelines for strategies to improve fertilisation in intensive organic apple orchards](#) .

Zikeli, Sabine; Lepp, Birgit; Malusa, Eligio; kutinkova, Hristina; Kelderer, Markus; Holtz, Thomas; Neri, Davide and Ponzio, Carlo (2021) [Yearly reports of crops' yield and quality data as influenced by soil management _D 3.4](#) .

Zikeli, Sabine; Lepp, Birgit; kutinkova, Hristina; Dzhuvinov, Vasiliy; Malusa, Eligio; Kelderer, Markus; Holtz, Thomas; Zucchini, Matteo and Neri, Davide (2020) [DELIVERABLE N. 3.3 - 4.3 – 4.6](#) .

Zikeli, Sabine; Neri, Davide; Malusa, Eligio; Kelderer, Markus; Friedli, Michael; Fernandez, Maria-Martha; Lepp, Birgit; Holtz, Thomas; Boutry, Clémence; kutinkova, Hristina and Dzhuvinov, Vasiliy (2019) [D2 2. Status Quo Analysis all Countries](#) .

Research Programme description

{ Programme part} [DOMINO trials description](#). Runs 2019 - 2021. Programme Leader(s): Polverigiani, Serena and Neri, Davide.

{ Programme part} [Multilingual questionnaire on stakeholder practices and priorities](#). Runs 2019 - 2022. Programme Leader(s): Polverigiani, Serena.

Project description

{Project} DOMINO: [Dynamic sod mulching and use of recycled amendments to increase biodiversity, resilience and sustainability of intensive organic fruit orchards and vineyards](#). Runs 2018 - 2021. Project Leader(s): Neri, Prof. Davide, UNIVPM .

{Project} [Guideline for analysis on plant and mulches](#). Runs 2019 - 2022. Project Leader(s): Polverigiani, Serena and Neri, Davide.

{Project} [Presentation of the project DOMINO at Laimburg Research Centre](#). Runs 2018 - 2021. Project Leader(s): Neri, Davide; Kelderer, Markus; Malusa, Eligio; Brachet, Marie Lisa; Friedli, Michael; Zikeli, Sabine and Kutinkova, Hristina, Laimburg Research Centre .

Practice tool

{Tool} [Organic fertilisation of young apple orchards \(DOMINO Practice Abstract\)](#). Creator(s): Holtz, Thomas and Kelderer, Markus. Issuing Organisation(s): Laimburg Research Centre - Italy. CORE Organic Practice Abstracts. (2021)

{Tool} [Physical protection barriers to reduce fungal and pest damages \(DOMINO Practice abstract\)](#). Creator(s): Holtz, Thomas and Kelderer, Markus. Issuing Organisation(s): Laimburg Research Centre - Italy. CORE Organic Practice Abstracts. (2021)

{Tool} [The use of strawberries as living mulch in organic orchards and vineyards \(DOMINO Practice abstract\)](#). Creator(s): Polverigiani, Serena; Zucchini, Matteo; Murri, Giorgio; Neri, Davide and Marchionni, Fabio. Issuing Organisation(s): Università Politecnica delle Marche. DOMINO Practice Abstract. (2019)

Web product

Malusa, Eligio; Boutry, Clémence; Friedli, Michael; Fernandez, Maria-Martha; Zikeli, Sabine; Lepp, Birgit; Hristina, Kutinkova; Kelderer, Markus; Holtz, Thomas; Neri, Davide and Ponzio, Carlo (2021) [D2.14 - An array of video clips for training and communication purposes](#). . [Submitted]

Video

Polverigiani, Serena; Zucchini, Matteo and Neri, Davide (2019) [Using strawberry as living mulches](#). UNIVPM , D3A.

Other

Friedli, Michael (2018) [Questionnaire on stakeholder - practices and priority](#). .

Holtz, Thomas and Kelderer, Markus (2018) [DOMINO - Innovative orchard management enhances soil fertility, biodiversity and economic sustainability](#). .

Neri, Davide; Kelderer, Markus; Polverigiani, Serena; Zikeli, Sabine; Malusa, Eligio; Holz, Thomas; Friedli, Michael; Fernandez, Maria-Martha and Kutinkova, Hristina (2018) [DOMINO project flyer](#). UNIVPM.

Neri, Davide and Ponzio, Carlo (2021) [The DOMINO Project: Minutes of the 3rd Annual Meeting, 25-27/11/2020, Poland](#). . [Submitted]

Neri, Davide; Zikeli, Sabine; Malusa, Eligio; Friedli, Michael; Kelderer, Markus; Fernandez, Maria-Martha; Kutinkova, Hristina; Dzhuvinov, Vasily and Polverigiani, Serena (2018) [DOMINO PROJECT GUIDELINES FOR EXPERIMENTAL PRACTICE](#) .

Sabine, Zikeli; Lepp, Birgit; Neri, Davide and Ponzio, Carlo (2021) [Summary of the Online-Workshop: Making organic fruit growing more resilient – lessons learned from the Project DOMINO, March 2021](#) . [Submitted]

Davide Neri, Fabio Marchionni, Matteo Zucchini, Serena Polverigiani, Veronica Giorgi, Md Jebu Mia. Agricultural, food and environmental sciences, Università Politecnica delle Marche, Ancona, Italy. STRAWBERRY LIVING MULCH IN ORGANIC VINEYARDS. Presentation at the Organic World Congress, France on 08/09/2021 - <https://orgprints.org/id/eprint/42191/>

C. Boutry, F. Baumgartner, and M. Friedli (2020). Testing the effect of a rainproof protection net on the apple production regarding disease and pest damages. <https://orgprints.org/id/eprint/39454/>

4.2 Stakeholders-oriented articles in the CORE Organic newsletter

(Please insert links to the articles and order them according to the user groups addressed)

1) DOMINO – new strategy for sustainable fruit orchards and vineyards

<http://projects.au.dk/coreorganiccofund/news-and-events/show/artikel/domino-new-strategy-for-sustainable-fruit-orchards-and-vineyards/>

February 2018

2) Sustainable orchard and vineyard intensification – by an agro-ecological approach

<http://projects.au.dk/coreorganiccofund/news-and-events/show/artikel/sustainable-orchard-and-vineyard-intensification-by-an-agro-ecological-approach/>

February 2019

3) Nitrogen rich waste and by-product used as organic fertilisers

<http://projects.au.dk/coreorganiccofund/news-and-events/show/artikel/nitrogen-rich-waste-and-by-product-used-as-organic-fertilisers/>

February 2019

4) DOMINO Video: 'Living mulch' in vineyards <https://projects.au.dk/coreorganiccofund/news-and-events/show/artikel/domino-video-living-mulch-in-vineyards/>

July 2019

5) Technical tips for the use of strawberry as living mulch

<https://projects.au.dk/coreorganiccofund/news-and-events/show/artikel/technical-tips-for-the-use-of-strawberry-as-living-mulch/>

October 2019

6) Living mulches for weed control under the row – technical tips for the selection of suitable species

<https://projects.au.dk/coreorganiccofund/news-and-events/show/artikel/living-mulches-for-weed-control-under-the-row-technical-tips-for-the-selection-of-suitable-species/>

October 2019

7) In which areas are research needed within organic fruit producing farms in Europe?

<https://projects.au.dk/coreorganiccofund/news-and-events/show/artikel/in-which-areas-is-research-needed-within-organic-fruit-producing-farms-in-europe/>

May 2020

8) Pest and disease control in organic apple production with a temporary cover system

<https://projects.au.dk/coreorganicofund/news-and-events/show/artikel/pest-and-disease-control-in-organic-apple-production-with-a-temporary-cover-system/>

July 2021

9) Main results from the DOMINO Project. December 2021.

4.3. Practice abstracts

Physical protection barriers to reduce fungal and pest damages

<https://organic-farmknowledge.org/tool/42597>

Organic fertilisation of young apple orchards (DOMINO Practice Abstract)

<https://organic-farmknowledge.org/tool/42596>

The use of strawberries as living mulch in organic orchards and vineyards (DOMINO Practice abstract)

<https://organic-farmknowledge.org/tool/39679>

4.4 Other dissemination activities and material

UPM:

1) Webinar 04/06/2020

“Copertura frutteto e gestione della fertilità”. Organized by UPM to present the DOMINO’s results and assess possibility of transferring them in the context of Valdaso (Marche region), a fruit district located in the south of the region. Seminars:

- Gestione delle coperture per la difesa da eventi abiotici e biotici in frutticoltura Markus Kelderer - Laimburg research center
- Gestione dell'inerbimento e della fertilizzazione nei frutteti biologici Thomas Holtz – Laimburg research center

The webinars were followed by dozens of advisors, farmers and agricultural students.

2) Webinar 25/06/2020

Lecture at the UPM Course of “Fruit tree growing” (webinar), held by Eligio Malusà (INHORT). “DOMINO’s findings: Bioproducts for organic and integrated management of horticultural crops: opportunities and challenges”. The webinar was also open to users other than UPM’s students.

The webinars was followed by dozens of advisors, farmers and agricultural students.

3) Webinar 06/06/2021

Presentations within a webinar organized by UPM about orchard covering and fertility management. Kelderer M. “Gestione delle coperture per la difesa da eventi abiotici e biotici in frutticoltura. Accordo agroambientale d’area per la tutela delle acque della bassa e media Valdaso », Università Ancona. Online conference, (https://www.youtube.com/watch?v=4K-xqP_w_wU&t=4305s).

The webinar was followed by dozens of advisors, farmers and agricultural students.

4) Webinar 19/06/2021

Farminar (interview seminars and videos, from the orchards). Project’s results of GECO VALDASO about the sustainable soil management in fruit orchards with the interview to Markus Kelderer about “Domino living mulch in orchards and netting systems” and Fabio Marchionni about the “Strawberry living mulch in vineyard”

The farminar was followed by hundreds of advisors, farmers and agricultural students.

5) Presentation

Presentation of project's activities and results at Macfrut, Rimini. Title: "Coperture multifunzionali in frutticoltura"

The presentation was followed in presence by 60 advisors and farmers.

6) Journal article

Davide Neri, Veronica Giorgi, Matteo Zucchini, Samuele Crescenzi, Arash Koshravi, Jebu MD Mia, Giorgio Murri, Gestione sostenibile della fertilità e del suolo nei frutteti. 2021. Jornada Fruticultura IRTA, Mas Badia.

The presentation was followed in presence by 80 advisors and farmers in Mas Badia, Spain.

INHORT

1) Workshop 17/02/2020

Workshop Session "Soil Management (projects Domino and Excalibur)" organized during the Ecofruit Conference in Hohenheim, to discuss about the approach for row (using functional plants) and nutrition (using leguminous species) management (about 50 participants).

2) Seminar 04/02/2020

Organization of a seminar during a training for farmers and advisors (about 30) organized in Tomaszów Lubelski by the publisher of the specialized magazine WiOM and the fruit processing company SVZ Tomaszów sp. z o.o

3) Seminar 19/09/2020

A lecture on "Soil fertility under monoculture: how to maintain it?" where the results of the row and intra-row management obtained from the project trials were presented to farmers and advisors (about 30) at a workshop co-organized by the publisher of the technical magazine "WiOM" and the company Hodowla Roślin Kalinowa sp. z o.o. in Kalinowa

4) Seminar 20/04/2021

The experiences and results gained within the project dealing with the use of alternative, novel organic fertilisers and the use of living mulches for the management of the tree rows were presented at the XII Jornada de fruticultura ecològica (XII Day of Organic Fruit Production) attended by about 90 Catalan farmers and advisors involved in organic fruit production.

5) Poster + video 18/05/2021

Presentation of a poster along with a short video, titled "Agroecological approach in soil management of apple organic orchards" described the concept of growing aromatic plants as living mulches on the tree rows that has been tested at INHORT was presented at the 5th European Agroforestry Conference (<https://www.euraf2020.eu/>)

6) Presentation 22/06/2021

Scientific (oral) Presentation. Title: „Valutazione di fertilizzanti alternativi da materiali di scarto per la produzione di mele in agricoltura biologica“ Malusà E., Zikeli S., Holtz T., Fumanczyk E., Lepp B., Kelderer M., Buchleither S., Neri D. at the XIII Giornate Scientifiche SOI.

7) Poster presentation 23/06/2021

Scientific (poster) Presentation. Title: "Effetto della pacciamatura vivente con piante officinali sulla biodiversità della fauna del suolo di un meleto biologico" by Kozacki D., Tartanus M., Furmanczyk E., Malusà E. at the XIII Giornate Scientifiche SOI.

8) Seminar 30/06/2021

The results dealing with the use of alternative organic fertilisers and the use of living mulches for tree rows management were presented at the annual Open Day of INHORT, attended by farmers and advisors.

9) Workshop 27/07/2021

Workshop at the National Centre of Agricultural Advisory Service – Radom (specialized in organic farming) "DOMINO: innowacje w ekologicznym zarządzaniu sadami - podejście agroekologiczne w celu zwiększenia zrównoważonego rozwoju i bioróżnorodności" (DOMINO: innovation in organic orchard management - an agroecological approach to increase sustainable development and biodiversity) attended by about 70 advisors

10) Workshop 29/07/2021

Workshop at the headquarter of the Biopomorski association of organic farmers (Chrzanowo) “Innowacje w ekologicznym zarządzaniu sadami: bioróżnorodności i zrównoważonego rozwoju w projekcie DOMINO” (Innovations in organic orchard management: biodiversity and sustainable development in the DOMINO project) with visit to the farm trial with *C. pepo* living mulches. Attended by 15 farmers

CTIFL:

1) Webinar 23/03/2021

#LesLIVEduCTIFL Webinar on the topic: “Growers: are you ready for agroecology?”, open to farmers (fruits and vegetables), researchers, technical advisors and to the agricultural press (more than 140 participants). Included two presentations related to the topics and results of DOMINO project:

- “Use of plant ground covers for weed management” (MM Fernandez)
- “Impact of plant material on the resilience of a production system based on the use of ground covers” (MM Fernandez)

Replay available on the CTIFL - Web TV YouTube channel : Agroécologie: Comment accompagner l'agriculteur dans la modification de ses pratiques? <https://www.youtube.com/watch?v=61K288-AnvE>

2) Articles in a technical magazine

- a) Delgado M., 2021. Gérer l'enherbement en fonction des besoins. Arboriculture Fruitière. Les enjeux Hors-série N°34. p.19-21
- b) Even C., 2021. Engrais verts, enherbement. Les couverts se discutent. Arboriculture Fruitière. Les enjeux Hors-série N°34. p.16-18

FiBL:

1) Presentation 24/01/2020

Presentation of the DOMINO project and activities at FiBL within the Yearly organic fruit conference in Switzerland organized by FiBL, and writing of the small article about the event for the DOMINO website. The presentation of DOMINO activities was included in the world wide spread FiBL dissemination system and the DOMINO coordinator is not able to separate the specific number.

UHOH:

- 1) **Poster on Open field day** at KOB in July 2018 presenting the DOMINO project to farmers and advisors
 - a. An open farm day was organised in April 2019, at one of the farms on which the on-farm-trials in WP 4 in Germany were performed (approx. 120 participants, farmers and wider public).
 - b. In autumn 2018 DOMINO was presented during the Landwirtschaftliche Hauptfest in Stuttgart, Germany (regional agricultural fair with approx. 200.000 visitors in total),
 - c. A workshop (All the workshops were conducted by FÖKO e.V. and their Farmers' Working on Group Soil fertility) on soil fertility presenting the first results of WP 4 in DOMINO including a short field exercise was done in Germany in April 2019 at KOB (20 farmers and advisors).
- 2) **Presentation 12/03/2020:** Presentation of the results of DOMINO WP4 at the annual Conference on Organic Farming in Baden-Württemberg (Conference Topic “How to nourish the soil – fertilisation strategies in stockless organic farming”. 130 participants (farmers, advisors, researchers, administration).
- 3) **Presentation 27/01/2021:** Presentation of the results of DOMINO WP4 on the use of plant-based fertilisers and living mulches at the Organic Fruit Conference in Switzerland organized by FiBL (130 participants, online)
- 4) **Workshop 10/03/2021:** Organisation and implementation of a farmer-oriented workshop for the members of the association FÖKO (Fördergemeinschaft Ökologischer Obstbau e.V.) and other interested farmers
- 5) **Digital workshop 10/03/2021:** Organisation and implementation of a farmer-oriented workshop for the members of the association FÖKO (Fördergemeinschaft Ökologischer Obstbau e.V.) and other interested farmers on soil testing and nutrient budgets.

LAIM:

Presentation 11/02/2021

Presentation within the yearly organic fruit conference in South Tyrol (online) about cover crops in the tree row (WP3). The yearly presentation reaches hundreds of organic fruit farmers, advisors and policy makers both in Italian and German language.

Holtz T. Erfahrungen mit Einsaaten im Unterstockbereich als alternative Beikrautregulierung. Bio Vinschgau und Südtiroler Beratungsring für Obst- und Weinbau. Bioobstbautagung, Online Veranstaltung.

ALL PARTNERS

Workshop 16/03/2021.

Organisation and implementation of a Europe wide digital stakeholder-oriented workshop. Title "Making organic fruit growing more resilient: Lessons learned from the Project DOMINO".

The dissemination activities were followed by several participants according to the different targets:

In the case of **INHORT** dissemination activities were followed by researchers, advisors, farmers and general public:

- Dissemination events targeted to researchers and advisors (workshops, seminars, conferences): 11 for a total audience of about 550 persons.
- Dissemination events targeted to farmers (open days, workshops): 13 for a total audience of about 1100 persons.
- Dissemination events targeted to general public (agricultural fair): 3 for a total audience of about 2500 persons.
- Dissemination events targeted to policy makers (seminars): 2 for a total audience of 20 persons.

All the events are listed in the project webpage, with the numbers of involved persons mentioned for the majority of them.

For **FIBL**: Presentation 24/01/2020: dissemination event targeted to farmers, 80 participants.

For **CTIFL**: Webinar 23/03/2021 was followed by farmers and advisors.

For LAIM:

- Presentation 11/02/2021 and several activities like open days in August every year.
- All partners Workshop 16/03/2021.

The yearly presentation reaches hundreds of organic fruit farmers, advisors and policy makers both in Italian and German language.

For Bulgaria:

The national fruit fair within the organic day with thousands of participants, farmers, advisors, researchers, general public.

For UPM:

- The open field days and seminars were followed by dozens of farmers, advisors, researchers and students.
- The farminar was followed by hundreds of people, advisors, farmers and students and the registration is still available with several view.
- Several technical and scientific papers about the strawberry living mulches were published including Vigne e vini, Frutticoltura as technical journals with 10,000 readers.

4.5 Future dissemination actions

Project's partners will participate in the following forthcoming scientific events:

- **III International Organic Fruit Symposium and I International Organic Vegetable Symposium**, December 14th-17th, 2021, Catania (Italy)

The following contributions will be presented by the partners:

- INHORT: “Effect of living mulches on the above ground biodiversity of an organic apple orchard” by Sekrecka M., Piotrowski W. and Tartanus M. Submitted to III Intern. Organic Fruit Symposium (Catania OrgHort2020)
- INHORT + all partners: “Innovative agricultural management and perception of ecosystem services in orchards” by Borsotto P, Borri I., Tartanus M., Zikeli S., Lepp B., Kelderer M., Holtz T., Friedl M., Boutry C., Neri D. and Malusa E. Submitted to III Intern. Organic Fruit Symposium (Catania OrgHort2020)
- INHORT: Changes in weed population in organic apple orchard as a result of soil management with living mulches” by Aniszka Z., Golian J., Kwiatkowska J., Furmanczyk E. Submitted to III Intern. Organic Fruit Symposium (Catania OrgHort2020)
- UHOH: Presentation of the results of the WP 4 pot trial on the impact of Sulphur on nutrient and heavy metal mobility in the soil at the III International Organic Fruit Symposium in Catania
- UPM : “Weed management in organic orchards with strawberry species as living mulch. Giorgi V., Zucchini M., Straccia F., Neri D. - Submitted to III Intern. Organic Fruit Symposium (Catania OrgHort2020)

The Proceedings of the III International Organic Fruit Symposium (Catania OrgHort2020) are quoted on Scopus (Elsevier), so ensuring dissemination through the international scientific community.

- **International Conference on Organic Fruit Growing - ECOFRUIT** (online), February 21 to 23, 2022
Topics to be presented at the conference are being discussed among partners. The Proceedings of ECOFRUIT have typically direct impact on organic farmers and field technicians in charge of assisting them.
- WP4/UHOH will publish at least three scientific publications after the end of the project in 2022. It was not possible to do these publications earlier for the following reasons:
 - The publication on the nutrient management in field trials needs three years of fertilisation and of data collection, otherwise the data base is not sufficient for publishing.
 - The data collection for the publication on the nutrient budgets on organic apple orchards in Germany was delayed due to the late employment of scientific staff; it is currently completed and will be submitted.
 - The pot trial on the effect of sulphur applications on nutrient availability and nutrient leaching in organic fruit growing was delayed due to Corona restrictions in the labs by one and a half years resulting a corresponding delay in the writing and submission of scientific publications.
- **INHORT** is also preparing two publications dealing with soil biodiversity, which include data collected in 2021 under a different project that is continuing the trials established within DOMINO.

4.6 **Specific questions regarding dissemination and publications**

The Core Organic page of DOMINO contains the link to the project website (<http://www.domino-coreorganic.eu/>). The website is updated and relevant dissemination and scientific materials are available for downloading.

Project Facebook account is: <https://www.facebook.com/pages/category/Science-Website/Domino-Project-Core-Organic-1069708459868113/>

Videos produced by the project are available at the following links:

<http://www.domino-coreorganic.eu/downloads/other-available-materials>

<https://www.youtube.com/watch?v=OqX1UGk1yPw>

- *List the categories of end users relevant to the research results and how they have been addressed or will be addressed by dissemination activities (Please order them according to the user groups).*

Most important dissemination events organised by the project or with active participation of project's partners are listed below, according to the category of the end users. For more detail, see Deliverable D2.16-D2.18 - Report on demonstration and communication activities, and on participatory training delivered (2018-2021)

Farmers and advisors

- Poster on an Open field day at KOB in July 2018 presenting the DOMINO project to farmers and advisors
- A workshop presenting the first results of WP 4 in DOMINO including a short field exercise on soil fertility was done in Germany in April 2019 at KOB.
- Presentation of the project DOMINO during the “organic farm open day” at Laimburg Research Centre. 9 August 2018
- Presentation of the project with a roll up and leaflets (English and Polish) at the Annual Horticultural Fair in Skierniewice (about 30'000 visitors). 16 September 2018
- Field day and poster presentation at the Organic Research Orchard at the Kompetenzzentrum Obstbau Bavendorf, Ravensburg, Germany (120 participants). 2018
- Individual trainings on spade diagnosis on partner farms using alternative fertilisers (organized by FÖKO e.V. – subcontractor UHOH). 2018
- Presentation of the DOMINO project at the Yearly organic fruit conference in Switzerland organized by FiBL and dedicated for farmers, and writing of the small article about the event for the DOMINO website. 30 January 2019
- The DOMINO project was presented during a meeting of a group of organic fruit producers (7) from the Polish EkoOwoc Association in Biala Rawska. 27 February 2019
- Organisation and implementation of a farmer- oriented workshop for the members of the association FÖKO (Fördergemeinschaft Ökologischer Obstbau e.V.) and other interested farmers. 4 April 2019
- In the framework of the workshop "Cropping for the future: networking for crop rotation and crop diversification" organized by Agricultural European Innovation Partnership (EIP-AGRI) in Almere, the DOMINO project was selected to be presented to the participants (about 30) coming from all EU countries. 4 June 2019
- During the Open Day organized by the Research Institute of Horticulture (INHORT) the DOMINO project was presented to the several hundreds of fruit growers and advisors present at the event. 24 June 2019
- The project concept and the established trials were presented to a group of inspectors from certifying bodies and of agricultural advisors (about 20) during a second module of seminars related to

researches in organic farming organized by the Polish Ministry of Agriculture and Rural Development at the premises of the Ministry. 13 November 2019

- Organisation of a seminar during a training for farmers and advisors (about 30) organized in Tomaszów Lubelski by the publisher of the specialized magazine WiOM and the fruit processing company SVZ Tomaszów sp. z o.o. 4 February 2020
- “Copertura frutteto e gestione della fertilità”. Organized by UPM to present the DOMINO’s results and assess possibility of transferring them in the context of Valdaso (Marche region), a fruit district located in the south of the region. Seminars:
 - 1 - Gestione delle coperture per la difesa da eventi abiotici e biotici in frutticoltura Markus Kelderer - Laimburg research center
 - 2 - Gestione dell'inerbimento e della fertilizzazione nei frutteti biologici Thomas Holtz – Laimburg research center. 4 June 2020
- A lecture on “Soil fertility under monoculture: how to maintain it?” where the results of the row and intra-row management obtained from the project trials were presented to farmers and advisors (about 30) at a workshop co-organized by the publisher of the technical magazine “WiOM” and the company Hodowla Roślin Kalinowa sp. z o.o. in Kalinowa. 10 September 2020
- Organisation and implementation of a Europe wide digital stakeholder-oriented workshop. Title “Making organic fruit growing more resilient: lessons learned from the Project DOMINO”. 16 March 2021
- #LesLIVEduCTIFL Webinar on the topic: “Growers: are you ready for agroecology?”, open to farmers (fruits and vegetables), researchers, technical advisors and to the agricultural press (more than 140 participants). Included two presentations related to the topics and results of DOMINO project:
 - “Use of plant ground covers for weed management” (MM Fernandez)
 - “Impact of plant material on the resilience of a production system based on the use of ground covers” (MM Fernandez)
 - Replay available on the CTIFL - Web TV YouTube channel: Agroécologie : Comment accompagner l’agriculteur dans la modification de ses pratiques ? March 2021
- The results dealing with the use of alternative organic fertilisers and the use of living mulches for tree rows management were presented at the annual Open Day of INHORT, attended by farmers and advisors. 30 June 2021
- Workshop at the National Centre of Agricultural Advisory Service – Radom (specialized in organic farming) “DOMINO: innowacje w ekologicznym zarządzaniu sadami - podejście agroekologiczne w celu zwiększenia zrównoważonego rozwoju i bioróżnorodności” (DOMINO: innovation in organic orchard management - an agroecological approach to increase sustainable development and biodiversity) attended by about 70 advisors. July 2021
- Workshop at the headquarter of the Biopomorski association of organic farmers (Chrzanowo) “Innowacje w ekologicznym zarządzaniu sadami: bioróżnorodności i zrównoważonego rozwoju w projekcie DOMINO” (Innovations in organic orchard management: biodiversity and sustainable development in the DOMINO project) with visit to the farm trial with C. pepo living mulches. Attended by 15 farmers. July 2021
- Presentation at Macfrut, Rimini (Italy). Title: “Coperture multifunzionali in frutticoltura”. September 2021

Researchers and students

- Seminars at Polytechnic University of Marche (Ancona, Italy)

- “The organic farming and agroecology group” was founded inside the National society of horticultural science, Bologna Italy June 2019.
 - Field trip at the ColleStefano organic winery hosting one of the DOMINO trials, with researchers and technicians from the CREA of Rome, Catania and Forlì. 11 June 2018
 - Field visit at the organic farm “Madonna delle Api” and at the experimental farm of the Università Politecnica delle Marche, both hosting DOMINO trials. Numerous researchers and technicians attended the event. 12 June 2018
 - In the session “Biological methods, organic farming and zoology” the concept and activities of the DOMINO project were presented to the audience made of researchers, phytosanitary inspectors and agricultural advisors (about 50) of the 59th Conference of the Institute of Plant Protection - PIB “Modern solutions in plant protection”. 13 February 2019
 - The concept of DOMINO research activities and its assumptions were presented at a group of students (about 30) taking the course on biological control of horticultural crops at the Department of Applied Entomology of the Life Science University in Warsaw. 11 April 2019
 - The Workshop Session “Soil Management (projects Domino and Excalibur)” organized during the Ecofruit Conference in Hohenheim, to discuss about the approach for row (using functional plants) and nutrition (using leguminous species) management (about 50 participants). 17 February 2020
 - International Webinar
 “Covid 19 Reinventing sustainability to achieve food security” (Bangalore University, India). UPM presented 2 seminars including some of the activities of Domino project
 - Sustainability in fruit production (Davide Neri – UPM)
 - Precision fruit farming (Arash Khosravi – UPM)
- The webinar was organized by prof. K. Muthuchelian, Vice Rector of Bangalore University. 20 June 2020
- Presentation of the results of DOMINO WP4 on the use of plant-based fertilisers and living mulches at the Organic Fruit Conference in Switzerland organized by FiBL (130 participants, online). January 2021
 - Presentation within the yearly organic fruit conference in South Tyrol (online) about cover crops in the tree row (WP3).
 - Holtz T. Erfahrungen mit Einsaaten im Unterstockbereich als alternative Beikrautregulierung. Bio Vinschgau und Südtiroler Beratungsring für Obst- und Weinbau. Bioobstbautagung, Online Veranstaltung. 11 February 2021
 - The experiences and results gained within the project dealing with the use of alternative, novel organic fertilisers and the use of living mulches for the management of the tree rows were presented at the XII Jornada de fructicultura ecològica (XII Day of Organic Fruit Production) attended by about 90 Catalan farmers and advisors involved in organic fruit production. 20 April 2021
 - Presentations within a webinar organized by UPM about orchard covering and fertility management. Kelderer M. “Gestione delle coperture per la difesa da eventi abiotici e biotici in frutticoltura. Accordo agroambientale d’area per la tutela delle acque della bassa e media Valdaso », UPM. Online conference, (https://www.youtube.com/watch?v=4K-xqP_w_wU&t=4305s). 6 June 2021
 - Farminar (interview seminars and videos, from the orchards). Project’s results of GECO VALDASO about the sustainable soil management in fruit orchards with the interview to Markus Kelderer about “Domino living mulch in orchards and netting systems” and Fabio Marchionni about the “Strawberry living mulch in vineyard”. 19 June 2021

Policy makers

In public symposium in Piacenza WHICH AGRICULTURE TO FEED HUMANITY AND PROTECT THE PLANET: facing Italian agriculture. May 2019

In public symposium in Plovdiv “Organic farming”. Inside the national agricultural fair. February 2019.

Presentation at SANATECH, Bologna. Title: “Gestione resiliente e protezione sostenibili in frutticoltura e viticoltura biologica”. September 2021

General Public

The general public was informed about the project goals and activities particularly during the participation to fairs (e.g. three times in Poland). These events were useful to describe the project approach and the information about the role of biodiversity in environmental protection.

Presentation of the DOMINO project at the International Agricultural Exhibition AGRA among the major economic events for agribusiness in Southeast Europe.

5. Project impact

The dissemination activities of the project were designed and performed to achieve the highest possible impact on all end-users of the project activities. Therefore, the different kinds of activities have been carried out always having in mind what was/were the specific group of stakeholders targeted.

In the Lake Constance region, some fruit farmers are considering to convert to vegan organic farming. For these farmers, the use of clover-based fertilisers and peas is very interesting. For instance, some farmers started to experiment with clover grass silage and compost. Several farmers already use peas as fertilisation strategy. Based on the interventions of FÖKO e.V. in the DOMINO project we could establish a closer contact between advisors from other organic associations (Bioland e.V.) specialised in soil fertility who are more familiar with the use of clover-based fertilisers and biogas digestates which will increase the overall acceptance of such fertilisers. In 2021, the German Demeter association decided to phase out all commercial N fertilisers from conventional farming until 2030.

From this date on, only N fertilisers from organic farming systems will be accepted, resulting e.g. in the prohibition of keratin fertilisers like horn grit. We expect that based on this rather recent decision of Demeter, the fertilisation strategies developed in DOMINO will be picked up by organic fruit farmers in the years to come. The findings from DOMINO will help the fruit farmers to cope with the challenges of changing organic association's standards.

In Poland, the innovations proposed by DOMINO (living mulches, leguminous cover crops and local organic fertilisers) have found interest and were introduced into practice by farmers belonging to the Polish Organic Fruits Producers Association (Eko-Owoc) and by farmers of the association of organic producers BioPomorski. The use of these three innovations is now promoted by the Foundation Ekoton with trials that are used for demonstration and with technical articles. Advisors for organic farming from the National Agricultural Advisory Center in Radom and in each Voivodship are also promoting these innovations and have planned to establish demonstration trials within the network of demonstration farms. The general public as well as the professional operators (farmers and advisors) were successfully reached via the multilingual project website (more than 6,000 views up to October 2021). Before the Covid 19 pandemic the participation to fairs or the organization of workshops was highly effective while during the pandemic, the web seminars and workshops were the best way to reach our main target stakeholders (farmers and advisors) with in some cases 30-40 participants.

After the end of the project, we started again to have seminars and workshop in physical presence, as it was done by UPM for the workshop in IRTA Mas Badia in October 2021. The organizers requested a presentation

about the sustainable management of the orchard, based on Domino activities. The workshop was participated by more than 80 local farmers and advisors. It is important to underline that the original target of the project was organic farmers and advisors but during project there was an increasing interest also in Integrated Fruit Management. This was because the aims of Domino project, written almost 5 years ago, are now in the agenda of the Green Deal and NGEU and our data are important for introducing the requested increase in sustainability of orchard systems, including a wider biodiversification and a more circular use of fertilisers.

The researchers were reached through the presentation of the project concepts and results during several conferences as well as meetings and (web)seminars. Students were also targeted through several seminars or lectures, and similarly the policy makers with few specific meetings. The scientific articles about living mulch originated by Domino are being highly viewed. Strawberry mulch in vineyard was viewed by 57 persons in the first two months in google scholar, and Living Mulch with Selected Herbs for Soil Management in Organic Apple Orchards 132 full reads in 7 months.

Regarding the impact obtained through the dissemination activities, it should be mentioned that they allowed to collect a significant number of questionnaires (WP2) from operators, to promote the involvement of farmers' association in field trials (e.g. in Poland where there was not such involvement at the project start) or farmers (e.g. in Bulgaria where initially the trials were planned to be only at the experimental field). The interest in the project emerged also during seminars and workshops when individual farmers declared the willingness to host trials and asked about advices on the new species for row and nutrient (nitrogen) management proposed by the project.

6. Added value of the transnational cooperation in relation to the subject

The Domino project enhances the importance of functional biodiversity, including the possibility that in orchards and vineyards it is possible to have a soil cover under the row to prevent erosion and limit the competition of particularly aggressive grasses. The transnational cooperation has made possible to highlight that there is not a single species suitable for all environments but it is necessary to use different species (coenosis) in each environment suitable to cover the soil without competing too much with the main tree crop. This made possible to develop lines of action based on the functionality of the proposed species rather than on a specific list and rigid rules.

The circularity of the economy highlighted in the Domino project through the possibility of using different local organic products to increase soil fertility and improve fruit production is also strengthened by transnational cooperation as it has allowed the development of common protocols to study the mineralization of organic matter and the possible impact on fruit growth of different sources of nutrients. This is also important for the future exchange of materials between neighbouring areas and to solve some problems related to the use of different organic matrices in similar production protocols (for example for vegan products).

Finally, some of the ideas of Domino project are now being carried forward through farming activities and in operational groups (PEI) funded by Regions, and by European research projects carried on by some of the Domino partners.

7. Suggestions for future research

For future research, it is necessary to study the long-term behaviour of the herbaceous coenosis within the orchards and the vineyards, including the impact on insects on the tree crop and, more widely, the importance of increasing biodiversity on organic orchard sustainability. In addition, the organic matrices available in the different environments and the possibility of avoiding any excesses and deficiencies of specific elements (imbalances) must be studied in the long term.