

DossierTècnic

Innovation and knowledge transfer

February 2021



Operational Groups in Catalonia. Call 2016



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Author: Carlos Guzmán Lorente.





Carmel Mòdol Bresolí

Director General for Food, Quality and Agri-food Industries

The Operational Groups, a tool for innovation in the agricultural and forestry sector

One of the key factors for improving the competitiveness of the agri-food and forestry sector is the promotion of innovation and the capitalisation of the results of research.

The Government of Catalonia approved the Catalan Strategic Plan for Agri-Food Research, Innovation and Transfer (PRITAC 2013-2020), an interdepartmental plan created to support the productive economy and the sustainability of the agricultural, agri-food and rural sector through innovation, aligned with the main innovation-related policies of the European Union for the period 2014-2020. The results of these seven years of PRITAC have been very positive: among others, it is worth highlighting the increase in institutional coordination between the different relevant agri-food departments and institutions, the increased volume of information available from the agri-food R&D&I system, the increased visibility of R&D&I activities in the agri-food system, the appearance of significant changes in the innovation activities of the Catalan agri-food sector during the period of implementation of the plan, and the creation of the Catalan Council for Agri-food Innovation in order to strengthen governance of the agri-food R&D&I system and guarantee the correct execution of the Plan.

To give continuity to this line of work, a new PRITAC 2020-2030 is currently being drafted to increase the transformative impact of innovation, research and transfer in the Catalan agri-food and forestry sector.

One of the instruments developed within the framework of PRITAC and the Catalan Rural Development Programme is support for cooperation for innovation, through the Operational Groups.

The Operational Groups are groups formed by various organisations, companies and agents to solve a specific sectoral or territorial problem or to take advantage of a specific opportunity. The members of these groups may include agricultural, agri-food or forestry companies and industries, cooperatives, agricultural producer groups, universities, research centres, consultants, technology companies, non-agricultural SMEs, NGOs, and other supply-chain agents. The Operational Groups constitute an instrument of innovation that enables the sector to solve specific problems or take advantage of opportunities arising from collaborative work. They also make it possible to strengthen synergies and complementarities between the sector and the different universities and research centres that work in the agri-food, forestry and environmental fields, and to promote specialisation.

Since the first call for Innovation Partnership grants in 2015, a total of 145 innovative pilot projects and 62 draft projects have been approved. These projects have involved the participation of more than 500 companies and entities from the sector in innovation projects, with grants totalling 18.9 million euros for the period of the plan.

These numbers demonstrate the good response to the call for projects, showing that the sector is genuinely interested in solving specific problems and taking advantage of the opportunities detected, based on collaborative work between different entities. The results obtained will be disseminated through the Agrifood and Rural Innovation Network of Catalonia (Xarxa-i.cat), RuralCat and the European Innovation Partnership (EIP).

This Dossier Tècnic aims to offer information on the pilot projects carried out by the Catalan Operational Groups approved in the 2016 call for proposals and implemented between 2017 and 2019, and to contribute to the transfer of the results obtained. We hope it will be of interest to you.

OPERATIONAL GROUPS AND COOPERATION FOR INNOVATION: overview of the period 2015-2019

01. Introduction

Innovation is essential to promote a resource-efficient, productive and low-emission sector, ensuring sustainable development of rural areas and increasing the competitiveness and diversification of the sector. For this reason, innovation in the agri-food and forestry area is one of the priorities of both the Government of Catalonia and the European Union.

In this regard, the Government of Catalonia has defined the promotion and coordination of R&D and innovation in the agri-food and rural sector in Catalonia as one of its priorities. This commitment was formalised with the approval of the Catalan Strategic Plan for Agri-Food Research, Innovation and Transfer 2013-2020 through Government Agreement GOV/85/2013 of 18 June.

Also, one of the objectives or challenges of the Catalan Rural Development Programme (RDP) 2014-2020 is to stimulate innovation and knowledge transfer in the agri-food and forestry sector.

To respond to these objectives, the Catalan RDP 2014-2020 envisaged different measures and operations. These include operation 16.01.01 Cooperation for Innovation, which was allocated 18.9 million euros for the period of the plan. Within the framework of this operation, during the period 2015-2019, the Catalan Ministry of Agriculture, Livestock, Fisheries and Food (DARP) provided

the sector with innovation partnership grants, through the creation of operational groups within the framework of the European Innovation

Operational Groups (OG) are groupings of several people or entities with common interests relating to a specific and practical innovation project.

The members of an Operational Group commit themselves to working actively together to solve a specific problem or to take advantage of a specific opportunity.

Operational Groups work with a commitment to disseminate the results of the project, so that others with similar problems can take advantage of this knowledge.

These projects are co-financed 43% by the European Union through the European Agricultural Fund for Rural Development (EAFRD).

Partnerships (EIPs), on agricultural productivity and sustainability and the implementation of innovative pilot projects by these groups. The innovation partnership grants comprise two types of support: firstly, support for the creation of operational groups for the planning and drafting of innovative projects. Secondly, funds for the operation of operational groups, to cover the costs of carrying out an innovative pilot project (including development of prototypes and technological contracting).

02. A programme under constant improvement: evolution 2015-2019

The first call for innovation partnership grants was in 2015, with a total of 38 projects approved (16 draft projects and 22 implementation (pilot) projects). The second call, in 2016, approved a total of 34 projects. Subsequently, the 2017 and 2018 calls for proposals, with a larger budget allocation than the previous ones, allowed for an increase in the number of projects approved. In the case of the 2017 call, a total of 42 projects were approved (10 draft projects and 32 pilot projects). In the case of the 2018 call for proposals, 49 projects were approved (11 draft projects and 38 pilot projects). In the last call, in 2019, 44 projects were approved. This gives a total of 207 projects that have been awarded grants so far (table 1) over the five successive years of annual calls by the Catalan Ministry of Agriculture, Livestock, Fisheries and Food.

Innovative projects, both for the creation of Operational Groups (draft projects) and for implementation (pilot projects) are subject to the condition that they must be innovative and involve the implementation of a joint action between at least two independent agents. They should encourage innovation, cooperation and the development of the knowledge base in rural areas, and strengthen the links between agriculture, food production and forestry on the one hand and research and innovation on the other, including the objective of improving environmental management and performance. They must also contemplate new activities and focus on the development of new products, practices, processes, technologies or services in the agricultural, food or forestry sectors. Finally, they must respond to at least one of the focal areas set out in the RDP 2014-2020 for innovation partnerships.

In terms of the type of recipient, in the projects for the creation of operational groups, cooperatives (26%), agricultural enterprises (21%) and agricultural or forestry producer groups/associations (16%) were the

During the period 2015-2019 the DARP published five calls for proposals, with a total of 207 projects approved (62 operational group creation projects and 145 innovative pilot projects). The total budget allocated was €18,877,808.

During the period 2015-2019, a total of 533 recipients were able to benefit from this type of aid.

most active in participating. In terms of pilot projects, the agri-food industry (32%) has led the way through innovative projects in different sub-sectors, followed by agricultural companies (19%) and cooperatives (17%).

03. Territorial analysis

As for the territorial distribution of the 533 grant recipients that have participated in the 207 innovative projects, Barcelona, Girona and Lleida are the main areas both in terms of draft and pilot projects (fig. 1 and 2).

The most active areas were those of Girona, Barcelona and the area around the Eix Transversal highway, which starts in Lleida and passes through the Plana de Vic (fig. 3 and 4). Camp de Tarragona, Catalunya Central and Terres de l'Ebre are also areas that have promoted innovative projects. The Alt Pirineu area and Aran have had a minority representation.

04. Distribution by sectors, sub-sectors and subject matter

Of all the 207 innovative projects developed during the period 2015 to 2019, the agri-food industry and agricultural production have been the most active sectors in terms of both draft projects and innovative pilot projects (fig. 5 and 6). However,

Type	Sector	Number of Projects	Number of recipients	Total Approved Budget
Draft (proposal)	Agriculture	19	19	€243,959
	Forestry	12	12	€159,902
	Agri-food industry	20	20	€226,758
	Livestock farming	11	11	€153,882
		62	62	€784,501
Implementation (Pilot)	Agriculture	47	151	€5,666,565
	Forestry	8	27	€ 671,246
	Agri-food industry	52	175	€ 6,557,118
	Livestock farming	38	118	€ 5,198,379
		145	471	€ 18,093,307
Total amount		207	533	€ 18,877,808

Table 1: Summary of approved projects and budget distribution by project type and sector (2015-2019). Source: <https://grupsoperatius.cat>.



Figure 1. Territorial distribution of draft/proposal projects (number of recipients). Source: <https://grupsoperatius.cat>.

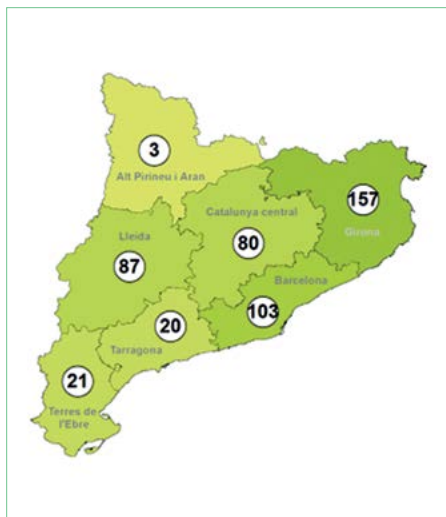


Figure 2. Territorial distribution of implementation/pilot projects (number of recipients). Source: <https://grupsoperatius.cat>.

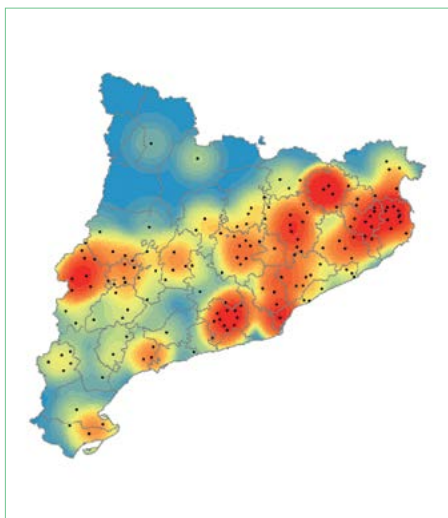


Figure 3. Geographical distribution of draft/proposal projects (number of recipients). Source: <https://grupsoperatius.cat>.

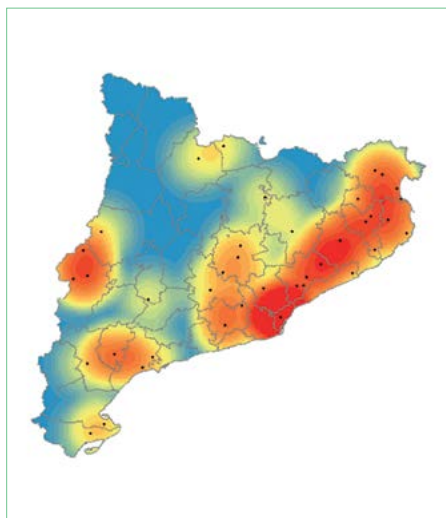


Figure 4. Geographical distribution of implementation/pilot projects (number of recipients). Source: <https://grupsoperatius.cat>.

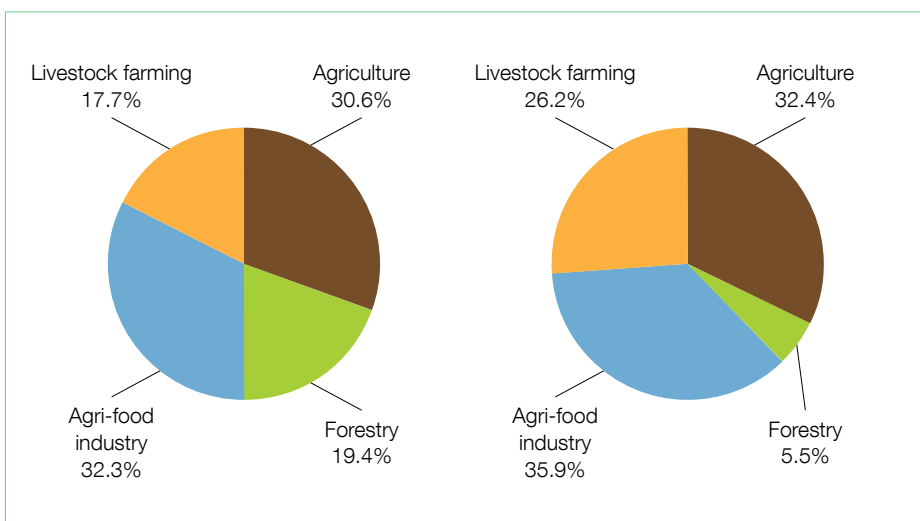


Figure 5. Distribution by sector of the 62 draft projects (left) and 471 pilot projects (right). Source: <https://grupsoperatius.cat>.

the analysis is significantly different for livestock projects, of which there were more pilot projects (26%) than draft projects (18%). The forestry sector, unlike the livestock sector, produced more draft projects (19%) than pilot projects (6%). As shown in figure 7, forestry projects are mainly located in the Girona area and in the north of Barcelona. It is worth noting the clear location of livestock projects (fig. 6), which are located along the Eix Transversal corridor (Lleida-Catalunya Central-Girona) and with a second focus of activity in Barcelona.

Distribution by sub-sectors:

- Draft projects: of a total of 62 projects approved during the period 2015 to 2019, the forestry sub-sector (with 19% representativeness) and the wine industry (with 11%), have been the most proactive. Next, the pig, horticulture and other agri-food sub-sectors have together accounted for 29% of the draft projects approved during these five years of calls.

- Innovative pilot projects: of a total of 145 projects approved during the same period, the pig sub-sector (16%), followed by the meat industry sub-sector (16%) and the sweet fruit sub-sector (14%) have been the most active in this type of project. Together they account for almost half the projects approved during the period 2015-2019. Next, in terms of participation are the beef cattle, wine and other agri-food industries, viticulture, dairy farming, forestry, olive oil production, horticulture, dairy cattle and rice sub-sectors. The sub-sectors with the lowest participation in innovative pilot projects include the ornamental/gardening and landscaping, mycology and truffle growing, fruit, winter cereals, poultry farming, fishing and aquaculture, olive growing, nuts, fodder and summer cereals sub-sectors.

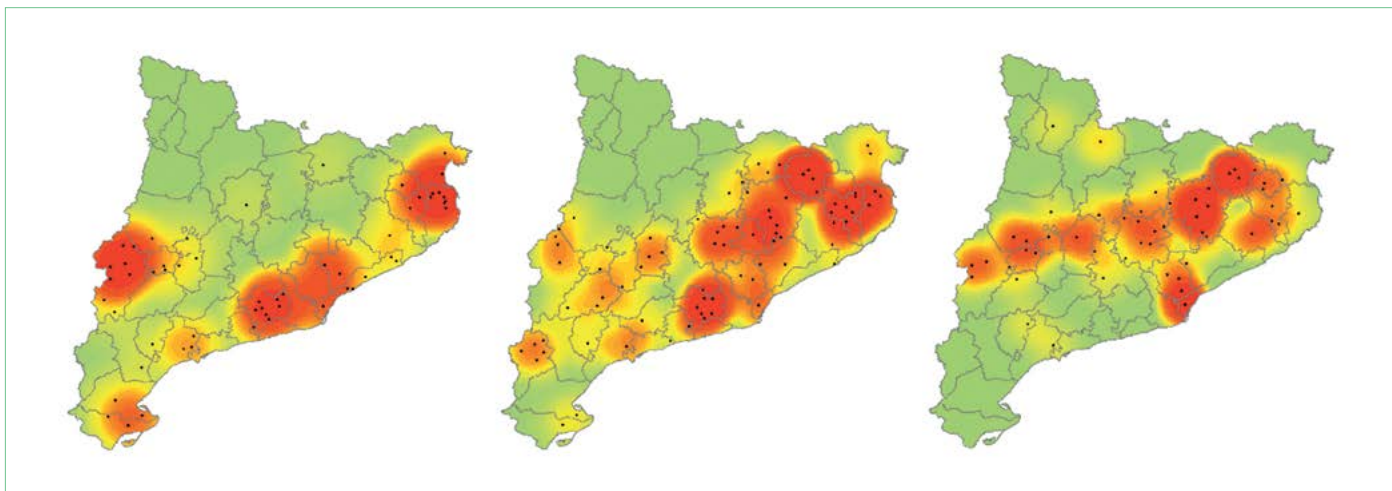


Figure 6. Geographical distribution of pilot projects in agriculture (left), agri-food industry (centre) and livestock sector (right). Period (2015-2019). Source: <https://grupsoperatius.cat>.

Distribution by subject matter:

In terms of subject matter, projects related to the development of new products, processes or services are in first place, followed by projects related to product quality and marketing. In third place are projects related to animal food, health and welfare (fig. 9).

It should be noted that around 20% of the approved projects include digitisation or big data as part of their objectives. Also, a significant proportion of the projects take into account the circular economy when defining their objectives.

05. The role of research entities, technology centres and other R&D&I ecosystem partners in the service of innovation and business competitiveness

The role played by our country's innovation, technology transfer and research centres in the 207 innovative projects approved during the period 2015-2019 has been fundamental in placing knowledge and technology at the service of companies in the sector with the aim of improving their capabilities and product competitiveness and the efficiency of their production processes. So much so, that 25 entities from the R&D&I ecosystem

have participated in the execution of the 145 innovative pilot projects approved during the period 2015-2019 (fig. 10). At least one entity participated in each project. In some cases, however, more than one entity participated in the same project. All these participations show that, as a result of an initial collaboration with the Catalan agri-food and forestry business sector, synergies and relationships have arisen, and long-lasting partnerships have been established that have made new experiences possible, continuing along this path of innovation and continuous improvement.

06. How are these results presented?

These results can be consulted through the Operational Groups Observatory, linked to the Xarxa-i.cat of the Catalan Ministry of Agriculture, Livestock, Fisheries and Food (fig. 11).

The Operational Groups Observatory allows several types of searches. Firstly, using the "Consult Operational Groups" option, you can search for projects according to different variables, such as the year of the call for proposals, the type of project (pilot project or draft project), the production sector and sub-sector and the subject matter of the projects. The

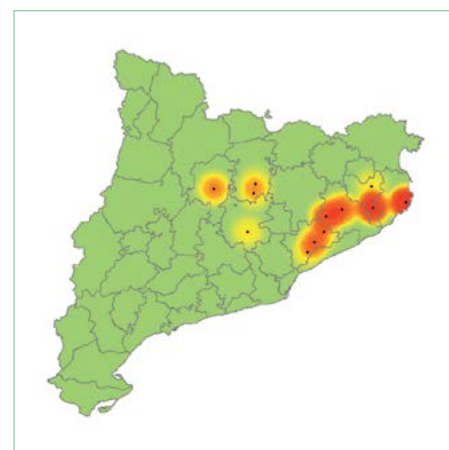


Figure 7. Geographical distribution of pilot projects in the forestry sector. Source: <https://grupsoperatius.cat>.

search results bring up a list of all the projects that meet the requested variables, with the possibility of downloading the project information sheets. The data have been graphically processed so that the Observatory contains several graphs that summarise the information (distribution of recipients by territorial area, distribution of projects according to sector and sub-sector of production and distribution of projects according to subject matter).

Furthermore, the option "Consult research centres" allows you to search for the centres that have participated in the implementation of innovative pilot projects. The search shows the projects in which each one has participated.

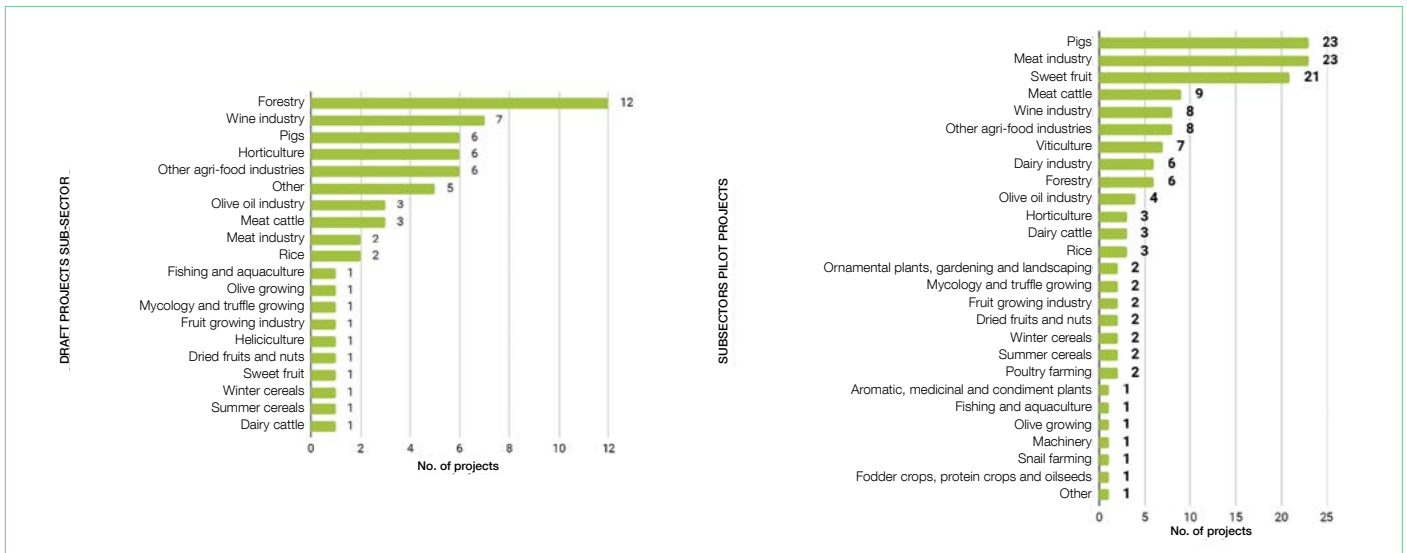


Figure 8. Distribution of projects by sub-sector (from 2015 to 2019). Source: <https://grupsoperatius.cat>.

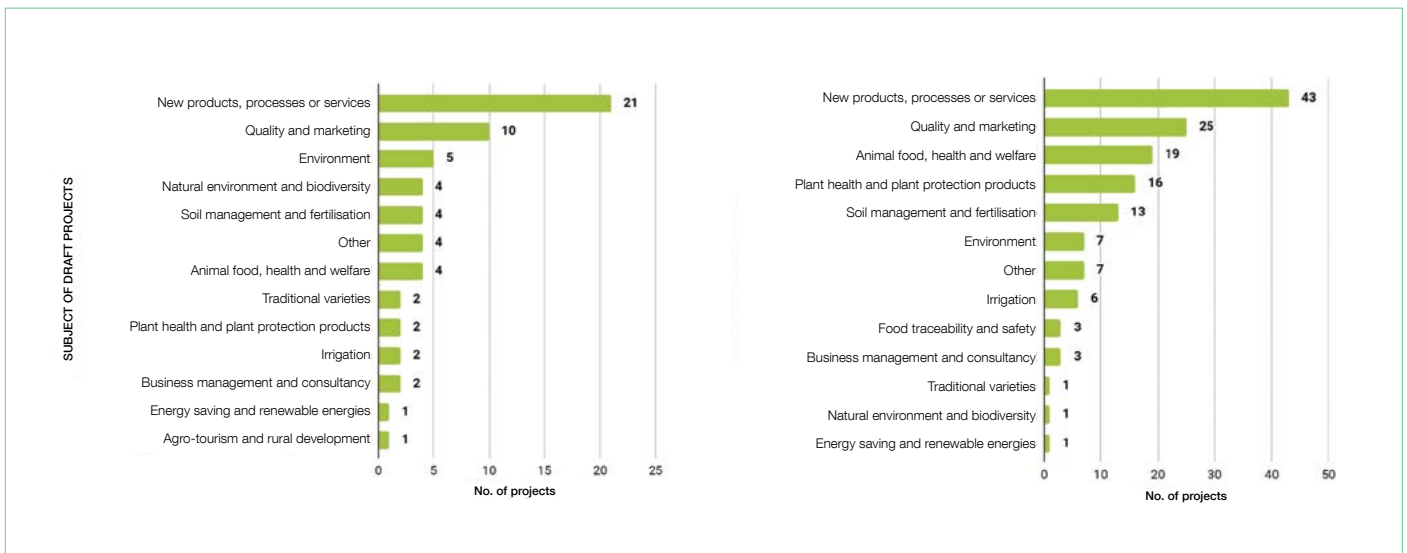


Figure 9. Distribution of projects by subject area (2015-2019) Source: <https://grupsoperatius.cat>.

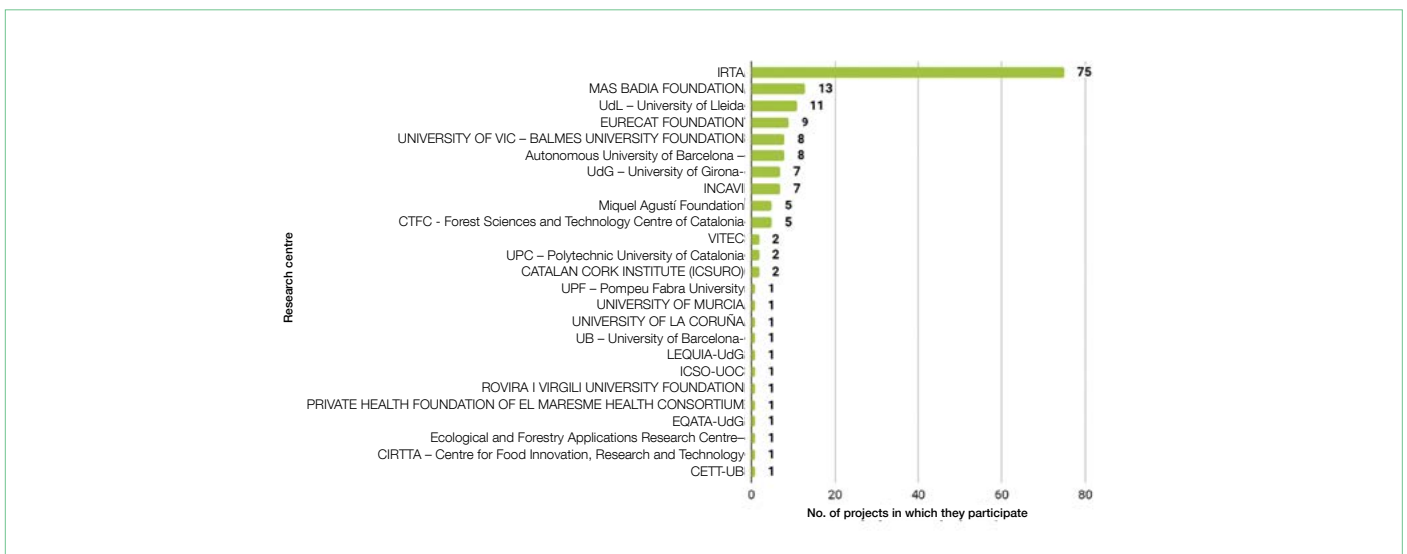


Figure 10. Ranking of participation of R&D&I system entities in innovative projects. Source: <https://grupsoperatius.cat>.

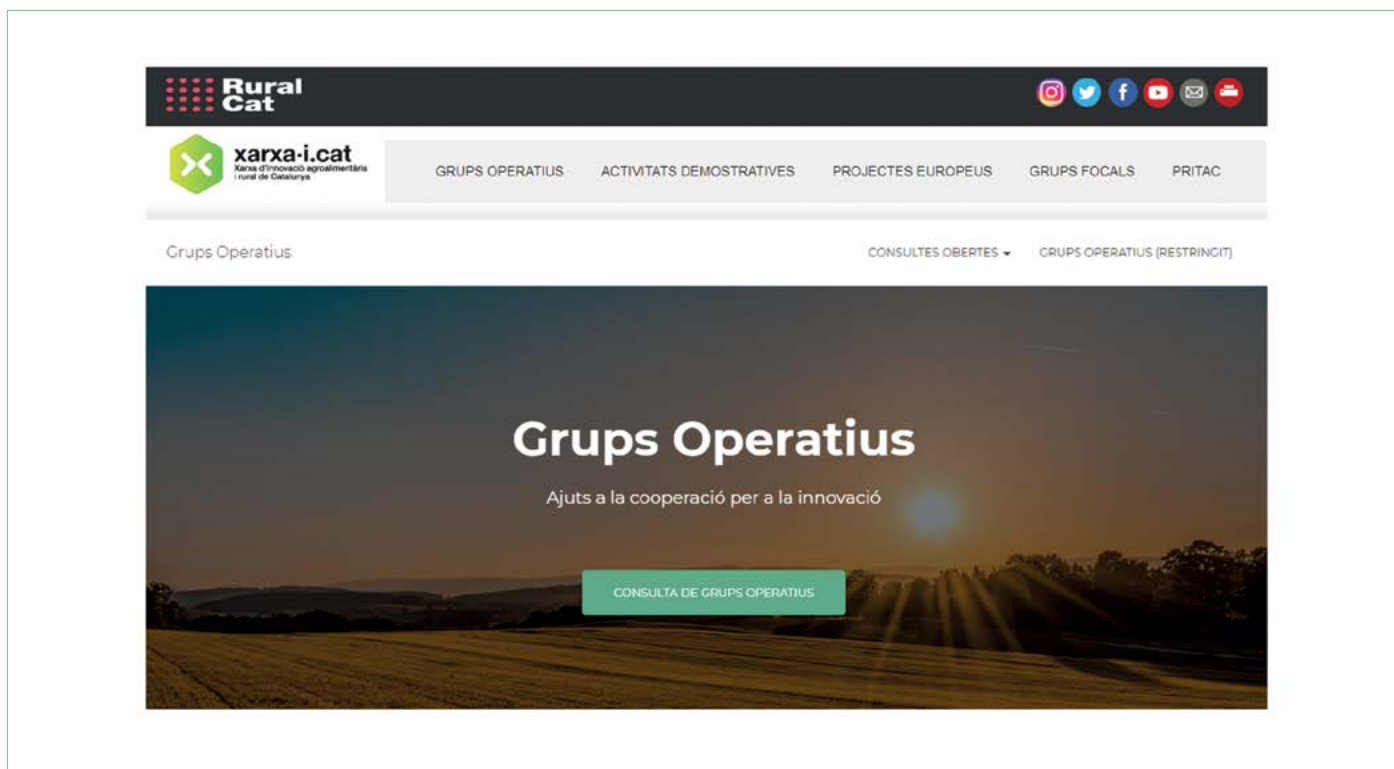


Figure 11. Home page of the Operational Groups Observatory www.grupsoperatius.cat.

Further reading

Order ARP/133/2017 of 21 June, approving the regulatory bases for grants for cooperation for innovation by promoting the creation of European Innovation Partnership operational groups in the areas of agricultural productivity and sustainability and the execution of innovative pilot projects by those groups (operation 16.01.01 of the Catalan Rural Development Programme 2014-2020) (Catalan Government Gazette (DOGC) no. 7399 of 27.06.2017).

Order ARP/240/2017 of 9 October amending the regulatory bases for aid for cooperation for innovation approved by Order ARP/133/2017 of 21 June (DOGC no. 7480, of 24.10.2017).

Order ARP/57/2018 of 4 June modifying the regulatory bases for aid for cooperation approved by Order ARP/133/2017 of 21 June (DOGC no. 7638 of 08.06.2018)

Resolution ARP/1531/2019 of 28 May establishing 2019 cooperation for innovation

grants through the promotion of the creation of operational groups within the European Innovation Partnership for agricultural productivity and sustainability and the implementation of innovative pilot projects by these groups (operation 16.01.01 of the Catalan Rural Development Programme 2014-2020) (DOGC no. 7892, of 07.06.2019)

Rural Development Programme (RDP) of Catalonia for the 2014–2020 programming period: measure 16, operation 16.01.01, subsidies earmarked for cooperation for innovation: Operational Groups of the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI).

RuralCat website - Xarxa-i.cat:
<https://ruralcat.gencat.cat/web/guest/xarxa-i.cat>

Xarxa-i.cat - Operational Groups Observatory: www.grupsoperatius.cat

RuralCat website - Operational Groups Search Engine: <https://ruralcat.gencat.cat/web/guest/xarxa-i.cat/grups-operatius>

EIP-Agri Network website:
<https://ec.europa.eu/eip/agriculture/en>

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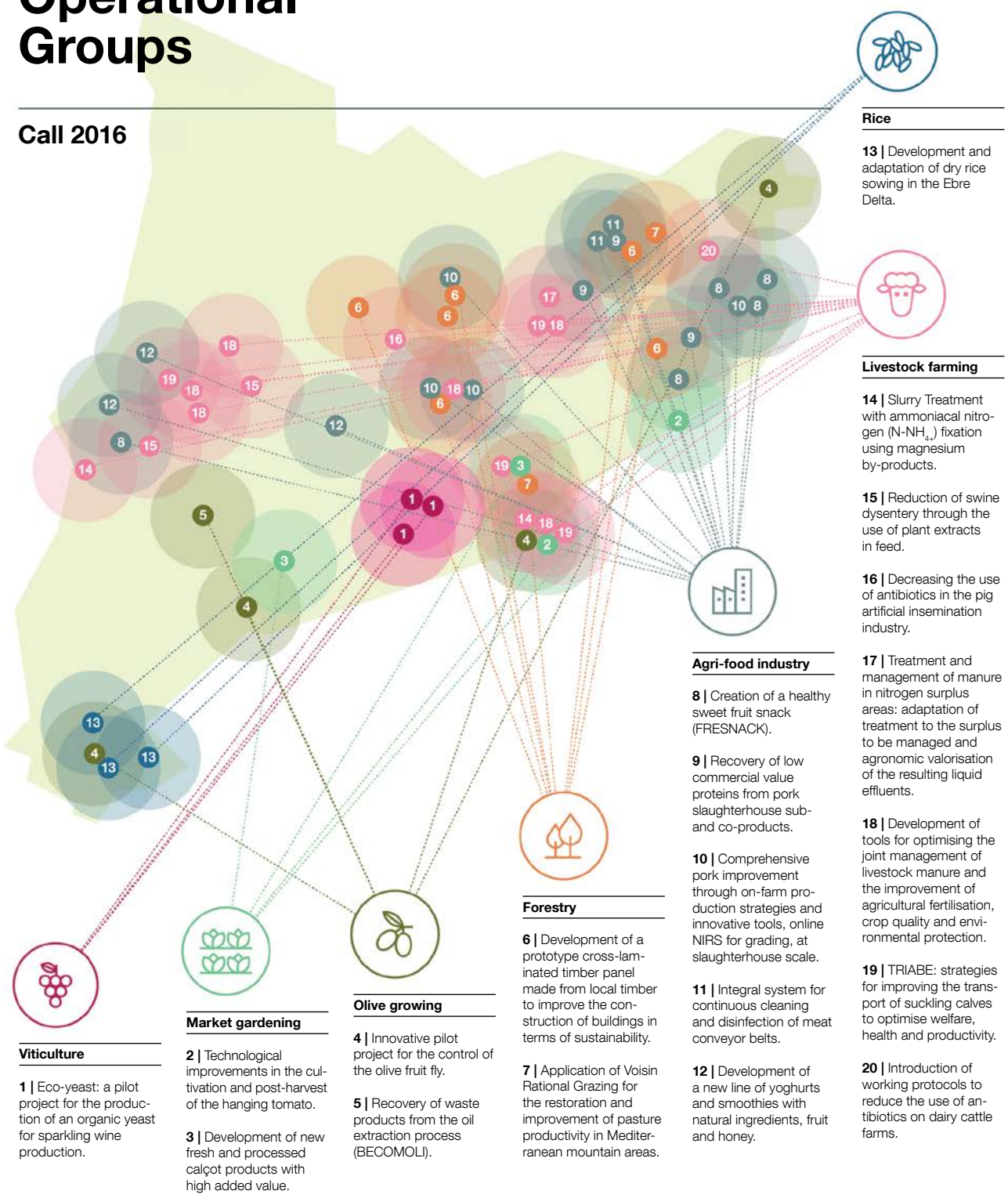
Government of Catalonia
Ministry of Agriculture,
Livestock, Fisheries and Food



European Agricultural Fund for
Rural Development:
Europe investing in rural areas

Operational Groups

Call 2016



Viticulture

1 | Eco-yeast: a pilot project for the production of an organic yeast for sparkling wine production.



Market gardening

2 | Technological improvements in the cultivation and post-harvest of the hanging tomato.

3 | Development of new fresh and processed calçot products with high added value.



Olive growing

4 | Innovative pilot project for the control of the olive fruit fly.

5 | Recovery of waste products from the oil extraction process (BECOMOLI).



Forestry

6 | Development of a prototype cross-laminated timber panel made from local timber to improve the construction of buildings in terms of sustainability.

7 | Application of Voisin Rational Grazing for the restoration and improvement of pasture productivity in Mediterranean mountain areas.



Agri-food industry

8 | Creation of a healthy sweet fruit snack (FRESNACK).

9 | Recovery of low commercial value proteins from pork slaughterhouse sub- and co-products.

10 | Comprehensive pork improvement through on-farm production strategies and innovative tools, online NIRS for grading, at slaughterhouse scale.

11 | Integral system for continuous cleaning and disinfection of meat conveyor belts.

12 | Development of a new line of yoghurts and smoothies with natural ingredients, fruit and honey.



Rice

13 | Development and adaptation of dry rice sowing in the Ebre Delta.



Livestock farming

14 | Slurry Treatment with ammoniacal nitrogen (N-NH₄) fixation using magnesium by-products.

15 | Reduction of swine dysentery through the use of plant extracts in feed.

16 | Decreasing the use of antibiotics in the pig artificial insemination industry.

17 | Treatment and management of manure in nitrogen surplus areas: adaptation of treatment to the surplus to be managed and agronomic valorisation of the resulting liquid effluents.

18 | Development of tools for optimising the joint management of livestock manure and the improvement of agricultural fertilisation, crop quality and environmental protection.

19 | TRIABE: strategies for improving the transport of suckling calves to optimise welfare, health and productivity.

20 | Introduction of working protocols to reduce the use of antibiotics on dairy cattle farms.

Treatment of livestock manure for the fixation of ammoniacal nitrogen ($\text{NH}_4^+\text{-N}$) using magnesium by-products

Leader:

SAT La Vall de Soses 829 CAT

Other non-recipient members:

IRTA

Coordinator:

Fundació Bosch Gimpera

01. Rationale

This project set out to solve the current problem of the management and treatment of livestock manure, mainly from the pig sector, due to the limitation in the application of nitrogen (N) and phosphorus (P) as fertiliser, through the application of a new environmentally sustainable technology patented by the University of Barcelona (ES2332300B1 / WO2010 / 018260A1).

The objectives of this project were:

- Demonstrate the applicability and feasibility of a low-cost continuous process for reducing the concentration of ammoniacal nitrogen (N-NH_3) in pig manure (between 70-90%).
- Develop different formulations, in order to favour their replicability and transferability.
- Obtain different solid products precipitated during the recovery of free N-NH_3 contained in livestock manure, and assess the possibility of reusing them as a slow-release organo-mineral fertiliser.
- Validate the new technology at the technical and economic levels in different treatment scenarios.
- Minimise soil and water pollution.

To achieve the objectives, work was carried out in parallel at laboratory scale, pilot scale and in the construction of a real plant for the treatment of pig manure from a livestock farm.

At laboratory scale, the formulation of the reagent was improved and subsequently used in a physical-chemical process for reducing ammoniacal nitrogen (N-NH_3). The reagent was formulated with low magnesium oxide by-products in order to



A, B and C: images of the SAT La Vall 100 m³ pilot plant. D: 1 m³ pre-pilot slurry treatment plant. Photos: Operational Group.

decrease the reagent costs and increase the sustainability of the treatment process.

The work of the pilot plant consisted of formulating the reagent used for the initial tests on the treatment of pig manure. In these initial tests, reductions in N-NH_3 content of up to 70-75% were achieved, depending on the addition of the formulated reagent.

Finally, a treatment plant was built on the livestock farm, with a treatment capacity of up to 100 m³. As well as the initial operational tests, it is planned to carry out initial tests for the treatment of the manure generated on the farm itself with the additive formulated in the pilot plant.

02. Results and conclusions

The actions carried out in the project have resulted in the possibility of a new low-cost alternative process for reducing the ammoniacal nitrogen concentration of livestock manure, mainly from the pig sector, which could also be implemented in other waste effluents with a high ammoniacal nitrogen content.

The feasibility of using low magnesium oxide by-products for the formulation of a reagent that can be easily handled and added during the treatment of pig manure in a physico-chemical plant has been demonstrated. This opens up the possibility of reducing the concentration of ammoniacal nitrogen according to specific needs and treatment costs, and slow-release fertilisers can be obtained from the N-NH_3 initially contained in livestock manure.

Thus, it has been possible, firstly, to optimise at laboratory scale the most efficient formulation of the reagent used, and secondly, in the pilot plant, to determine the technical specifications for the elimination of ammoniacal nitrogen in an efficient and easy-to-install manner.

Specifically, from the results obtained at the laboratory and pilot plant scales (500/1000 L), it has been possible to draw the following conclusions, in line with the initial objectives of the project:

- It is feasible to formulate a magnesium-phosphate compound (Fixasol) based on a secondary and more economical source of magnesium oxide.
- It is feasible to formulate a solid precursor based on newberyite which, when added to an aqueous solution with a high ammoniacal nitrogen content, allows the reduction of the NH_4 concentration and the formation of struvite that may be recovered by means of a basic filtration operation.
- The Fixasol formulation is scalable, with pH, stirring and reaction time again being the main parameters controlling the formation of the desired mineral phase (newberyite).

In short, the tests carried out at the laboratory and pilot plant scales (500/1000L) lead us to conclude that it is feasible to reduce the concentration of ammoniacal nitrogen contained in pig manure by up to 70-75%. The technical, economic and environmental optimisation that justifies the replicability of the technology developed has therefore been demonstrated.

The technical and economic feasibility, according to environmental requirements, of the new best available technology (BAT) within the livestock sector for the management of organic waste, for low-cost processes for the reduction of ammoniacal nitrogen concentration, using MgO by-products with struvite precipitation, still needs to be demonstrated so that it can be replicated on a regional, state, European and world scale.

Development and adaptation of dry rice sowing in the Ebro Delta

Leader:

Agricultural Union of the Ebro Community of Irrigators

Other recipient members:

General Irrigation Community of the Ebro Delta Right Bank Canal; Arrossaires del Delta de l'Ebre i S.C., SCCL; Cambra Arrossera del Montsià i Secció de Crèdit, SCCL; Association of Agricultural Producers of the Ebro Delta (PRODELTA)

Other non-recipient members:

Plant Protection Group for Rice and Other Crops in the Ebro Delta (ADV); Ebre Cultius, SL; IRTA/Ebro Experimental Station; Agrogalgo, SL

Coordinator:

Association of Agricultural Producers of the Ebro Delta (PRODELTA)

Website:

<http://www.advdelta.cat/GO-sembra-en-sec/>

01. Rationale

The aim was to develop the dry sowing system in the Ebro Delta. To do this, we studied how this sowing methodology affects the birth and subsequent establishment of the crop in terms of salinity, water management, soil type, sowing rate and crop varieties.

The project also aimed to assess the impact of dry sowing of the crop on apple snail populations. In this regard, by restricting the presence of water in the plots during the period of the crop's maximum sensitivity to the apple snail, the damage of this pest on the crop could be significantly controlled.

The main objective was the development and adaptation of dry rice sowing in the Ebro Delta. The specific objectives were the optimisation and management of water according to the type of soil (texture and salinity), crop variety and management, and the identification and evaluation of the impact of dry sowing on the apple snail pest.

02. Results and conclusions

Sowing rates

Sowing rate recommendations were determined for five of the most representative crop varieties in the sector according to clay or sandy soil type.

- The study of sowing rates for each variety in clay soil made it possible to evaluate two different dry sowing scenarios that farmers may consider: a high plant density (2017 trial) or a low density (2018 trial).
- In both cases, the crop was able to develop correctly and high yields were achieved, similar to those obtained from conventional sowing.
- On the basis of the results obtained over the two years of trials, the recommended sowing rate for each variety in dry sowing in clay soil would be as follows: Sirio CL, Montsianell and Argilla, rate of 500 seeds/m², and JSendra and Guara, 300 seeds/m².
- The two seasons in which the trial was carried out in sandy soil showed good germination and establishment of the crop, as a

result of the ideal degree of humidity that sandy soil usually has.

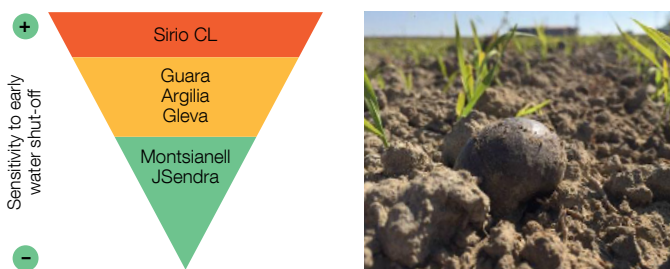
- The crop was easily established correctly and the agronomic evaluations were quite similar, which allowed conclusive results to be obtained.
- From the results obtained in the two trial years (2018-2019), the sowing rate recommendation for each variety in dry seeding in sandy soil would be as follows: Sirio CL would require a sowing rate of 500 seeds/m² and the rest of the varieties, Montsianell, JSendra, Guara and Argilla, would give competitive production with a rate of 300 seeds/m².

Water management for apple snail control (Continuous flooding vs Intermittent irrigation)

- Mill yield is not affected by early water shut-off in any of the varieties.
- Early water withdrawal executed by strategy 3 is the most advisable to avoid losing grain yield and at the same time minimise the period of apple snail activity.
- It has been determined that in order to minimise the reproduction of the apple snail pest, the flooding period can be reduced from 21 to 25 days before harvesting the crop depending on the variety.

Variety	Sowing rate soil clay (seeds/m ²)	Sowing rate soil sandy (seeds/m ²)
Sirio CL	500 (30 kg/j)	500 (30 kg/j)
Montsianell	500 (44 kg/j)	300 (26 kg/j)
JSendra	300 (26 kg/j)	300 (26 kg/j)
Guara	300 (28 kg/j)	300 (28 kg/j)
Argilla	500 (54 kg/j)	300 (32 kg/j)

Water withdrawal according to strategy 3		
Variety	Phenological stage	Days before harvest
Argilla	Hard pasty grain	24
Guara	Hard grain	21
Gleva	Hard grain	25
Montsianell	Soft pasty grain	24
Sirio CL	Hard grain	21
JSendra	Late milky grain	24



Table, graphic and photos: Operational Group.

Creation of a healthy sweet fruit snack (FRESNACK)

Leader:

Frit Ravitch SL

Other recipient members:

Girona Fruits, SCCL; Giropoma Costa Brava; Actel, SCCL

Coordinator:

IRTA

01. Rationale

The first motivating factor behind GO FRESNACK is sectoral, as it affects the entire Catalan sweet fruit production sector. The second relates to innovation, i.e. being able to offer other possibilities that allow for the diversification of sweet fruit products through the application of efficient processing technologies that are more sustainable than conventional ones.

The approach of the GO FRESNACK project is based on the experience gained from previous activities involving sweet fruit. Thus, it was known that European consumers consider fruit to be that which is unprocessed or minimally processed, and also that one of the main limitations for its consumption is that it has to be prepared, the pips or stones need to be removed, that it sometimes makes your hands dirty, etc. Therefore, GO FRESNACK

has set out to overcome the barriers expressed by consumers and to produce a product of high organoleptic quality.

The main objective has been to develop new products using sweet fruit (apple, pear and peach) sliced and dried (healthy snack) and with a shelf life of 4-6 months by applying a new technological process that combines hot air drying (conventional) and microwave technology.

02. Results and conclusions

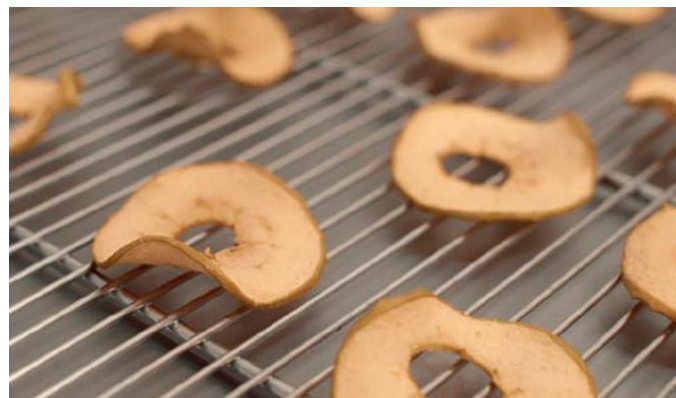
The project has consisted of two activities:

Activity 1. Design of a mixed drying process combining conventional drying and the application of microwaves.

Activity 2. Information sessions/seminars for companies in the sector and different actors involved in the agri-food chain.

The main outcome is the development of a crunchy, healthy apple, pear and peach snack of high organoleptic quality with a shelf life of between 210 and 310 days. A treatment has been developed for the production of the apple, pear and peach snack with the necessary characteristics to be considered as a high-quality dried product, using a process that combines convective drying with microwaves (vacuum microwaves in the case of pear and peach).

As far as practical recommendations are concerned, it must be stressed that it is necessary to have a good characterisation of the matrix, i.e. of the raw material, since the result depends to a large extent on the characteristics of this material.



Photos: Operational Group.

Recovery of waste products from the oil extraction process (BECOMOLI)

Leader:

Agrícola de l'Albi, SCCL

Other non-recipient members:

Centre for Biotechnological and Agri-food Development of the University of Lleida; D.O.P. les Garrigues; Catalan Federation of Agricultural Cooperatives (FCAC)

Coordinator:

Agrícola de L'Albi, SCCL

Website:

<http://www.agricolaalbi.es/wp-content/uploads/2018/09/ajuts.pdf>

01. Rationale

Agrícola de l'Albi is dedicated to the production of olive oil. The oil extraction yield is 23%. The remaining mass is a residue called pomace, which is sold to companies as biomass. Given the significant volume of pomace generated, which is a common problem for the sector, the project has implemented alternative processes in the oil mill that generate value-added by-products such as glucose and polyphenols. The innovation introduced by this project is that it focuses on the application of cascade biorefinery processes to recover higher value products from the complex biomass resulting from olive oil production, which will lead to an improvement in the economic performance of the mill and increase the sustainability of the process.

The main objective of the project was to find how to exploit and recover the pomace, applying eco-efficient cascade methods to recover the glucose and polyphenolic compounds it contains, in order to open up new market niches and improve competitiveness, providing an alternative to the current problem faced by olive oil producers, namely the high volume of waste by-products that are generated and which are generally sold as biomass. Glucose and polyphenolic compounds can be marketed to biotechnological industries. The processes used must allow the end products to be classed as natural products with a low carbon footprint.

Thus, the technical objectives of the project were:

1. To determine the influence of crop production technologies, harvesting time and mill processing parameters on the chemical characteristics and yields of the end products recovered from the pomace.
2. To fractionate the pomace using eutectic solvents.
3. To obtain glucose and polyphenolic acids from the celluloses and lignins recovered from the pomace.
4. To scale up the processes in the oil mill.

02. Results and conclusions

The conclusions that can be drawn as a result of this project are:

1. Pomace samples from different types of crops do not differ from each other in terms of chemical composition and can therefore be considered to be the same.
2. For the extraction of lignin, the highest yields are obtained with the 72% sulphuric acid treatment, although the lignin obtained is very dark and less pure than that obtained using ionic liquid; furthermore, the use of this method requires

reactors and equipment that can withstand this type of aggressive treatment.

3. NaOH treatment results in the residue with the highest percentage of cellulose enrichment.
4. The optimal conditions for extracting lignin using the ionic liquid were: 4 h, 120°C and a water content of between 5% and 20%.
5. In terms of lignin "purity", and according to FT-IR characterisation, the order of purity would be as follows: ionic liquid > sulphuric acid > alkaline, since the shape and area of the peak at 1510 cm⁻¹ for the ionic liquid treatment is larger and more Gaussian than the rest. The lignin obtained with the alkaline treatment contains a cellulose coprecipitate, as it has several very intense features at the frequencies of 890 and 1150 cm⁻¹.
6. As for the residue, the fractions obtained that are richest in polysaccharides susceptible to saccharification follow the order: alkaline ≥ ionic liquid > sulphuric acid. The alkaline treatment has a high capacity to dissolve the biomass, leaving the cellulose practically unaltered and with a moderate percentage of lignin. On the other hand, with the sulphuric acid treatment, the cellulose is hydrolysed and therefore a solid fraction rich in glucose is not obtained.
7. A sequential combination of acid (ionic liquid) and alkaline treatments does not help to increase lignin yields, but it does give a cellulose enrichment of more than 60%.
8. With regard to the tests on the saccharification of CRF from pomace, the best performing cellulase was from *Aspergillus* sp. with a 64% glucose content yield in the final solution.
9. Using CMC as a reference material may lead to some confusion when comparing different cellulases, as the activity could vary when using a different type of substrate.
10. Finally, we can say that the first scale-up to 20 g performed in the laboratory has been totally satisfactory, even improving the performance with respect to the milligram-scale samples used to fine-tune the method. The scaling to 9 kg was also performed in the company, showing that the available reactor was suitable for the corresponding extraction with these quantities of pomace. Unfortunately, the final yields could not be calculated from the initial 9 kg of pomace, as they were lost while loading the centrifuge and could therefore only be estimated from the 5 L of recovered ionic liquid.



A: Recovered raw cellulose. B: Centrifugation to separate stone and ionic liquid. C: Ionic liquid and stone. D: Ionic liquid. Photos: Operational Group.

Reduction of swine dysentery through the use of plant extracts in feed

Leader:

Grupo Premier Pigs, SL

Other recipient members:

Industrial Ganadera de Artesa, SA

Other non-recipient members:

Grupo de Saneamiento Porcí_Lleida, del Camp d'Ivars d'Urgell i Secció de Crèdit, SCCL and the University of Girona

Coordinator:

Grupo Premier Pigs, SL

Web:

<https://premierpigs.com/>

<https://premierpigs.com/colaboracion-para-la-innovacion/>

01. Rationale

The aim of this project is to carry out a study to reduce the use of antibiotics in fattening pig feed by means of therapeutic alternatives such as plant extracts and thus eradicate infections of swine dysentery, one of the gastrointestinal tract diseases with the greatest economic impact on the pig sector and the most difficult to eradicate.

The main objectives are:

- Investigate commercial products based on natural extracts for use in the production of feed for fattening.
- Determine the degree of swine dysentery infection in pig breeding

(source) and fattening farms.

- Study different natural extracts for application in the feeding of fattening pigs and the palatability and acceptance by animals of the feed with extracts.
- Evaluate the efficacy of these extracts in the control of swine dysentery.
- Optimise the dosage of the plant extract to determine if there is a cumulative effect on control.
- Analyse the results and assess the economic cost of introducing extracts into feed in relation to the results obtained.

02. Results and conclusions

The application of a product to the feed in *Brachyspira*-positive farms is proposed with the aim of reducing the use of animal health products while at the same time improving production results.

The results of this project indicate that plant extracts in the form of a mixture of essential oils, added to feed at relatively low doses, allow a better conversion rate and increased growth rates in pig fattening.

From a sanitary point of view, they have shown good performance, reducing the losses by 20%, the conversion ratio by 9 grams, the Average Daily Gain by 42 grams, as well as the medication costs (when analysed by type of loss, the losses due to dysentery decreased by almost half).

When looking at all the results obtained from this project, it can be concluded that:

- The extract containing carob seeds, thyme and chicory allows a significant improvement in production (conversion rate and growth ratios), as well as good sanitary behaviour.
- From an economic point of view, the use of this extract allows a reduction of the costs per kilo of production, due to productive improvements and fewer sanitary problems, which can be seen in the graph below.

	CR 15-110	ADG 18-110	ADFI 18-110	% Loss	Initial W. (kg)	Final W. (kg)
2015 Without plant extract	2.52	659	1.66	5.47%	15.2	103
2016 with plant extract	2.43	701.88	1.70	4.70%	14.8	109.8
Difference	-0.09	42.88	0.04	-0.70%	-0.4	6.8

Monitoring of results. CR: conversion rate. ADG: average daily gain (g/day). ADFI: average daily feed intake (kg/day). Source: Operational Group.



Photo: Operational Group.

Decreasing the use of antibiotics in the pig artificial insemination industry

Leader:

Semen Cardona, SL

Other non-recipient members:

National Association of Select Pig Breeders (ANPS).
Catalan Association of Pig Producers (PORCAT). Granja Claret, SL

Coordinator:

Semen Cardona, SL

Web:

<https://semencardona.com/es/>

01. Rationale

The main objective of this project has been to obtain a method for the sanitisation of porcine semen that allows the collection, preservation and subsequent use of chilled semen for artificial insemination in an antibiotic-free environment.

Pig reproduction is currently carried out by artificial insemination. Since porcine semen can carry micro-organisms, it is essential that the cooling diluents include antimicrobial agents in order to control bacterial growth in semen and to avoid losses, both in the semen production centres and on the pig farms where they are used. Likewise, restrictions on the use of antibiotics have been increasing in order to prevent bacteria from developing resistance. Therefore, in this project, the substitution of the current preservation media for others that contain antimicrobial peptides rather than antibiotics is proposed.



Photo: Operational Group.

The specific technical objectives were as follows:

- Evaluate the effect of antimicrobial peptides on in vitro sperm quality.
- Validate the effectiveness of peptides in the production of semen doses.
- Evaluate the effectiveness of peptides in insemination centres with different environmental conditions.
- Determine the impact of antimicrobial peptides on the fertilising power of sperm.
- Draft a working protocol for the use of antimicrobial peptides in the preparation of semen doses.

02. Results and conclusions

Antimicrobial peptides have been shown to control the growth of aerobic and anaerobic bacteria at relatively low concentrations without detrimental effects on either sperm quality or fertility. Furthermore, the effectiveness of these peptides does not vary with environment or seasonality. Therefore, they can be safely used as a substitute for antibiotics in porcine semen preservation diluents at 17°C.

According to the results obtained, the LEAP2 and PMAP23 peptides were the most suitable ones, with the highest capacity to control the growth of anaerobic bacteria.

With regard to the analysis of the impact of the presence of LEAP2 and PMAP23 peptides on the response of spermatozoa to in vitro capacitation and the progesterone-induced acrosome reaction, the highest concentrations of both peptides were ruled out, since both have a negative impact on these phenomena.

Thus, from the in vitro experimentation it was observed that, at the lowest concentration, the LEAP2 peptide does not decrease the fertilising capacity of the spermatozoa, and from the in vivo results it was concluded that the use of the LEAP2 peptide, at this con-

centration, and in a medium without antibiotics, makes it possible to control aerobic and anaerobic microbial growth and has no detrimental effects on either sperm quality or fertilising capacity. Therefore, this peptide, whose effectiveness does not vary with either environment or seasonality, could be safely used as a substitute for antibiotics in porcine semen preservation diluents at 17°C.

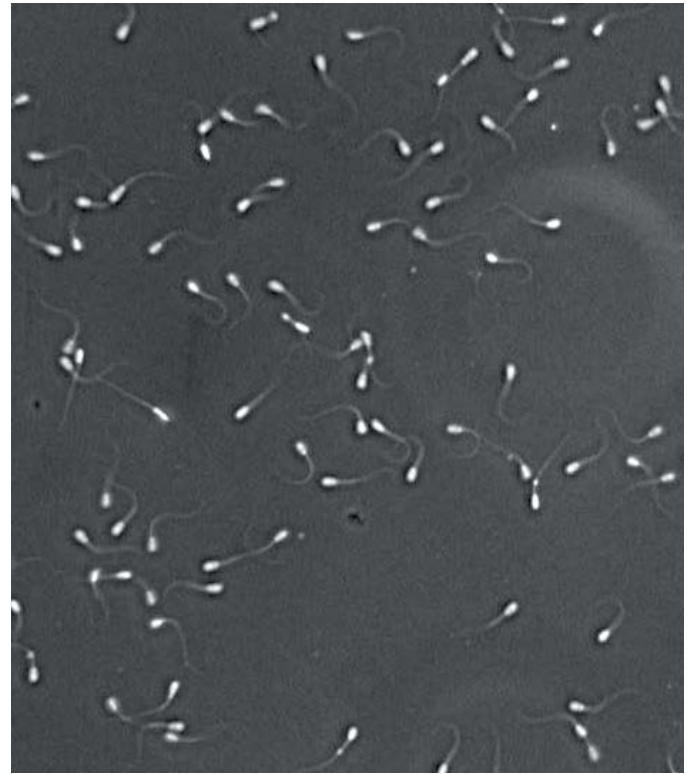


Photo: Operational Group.

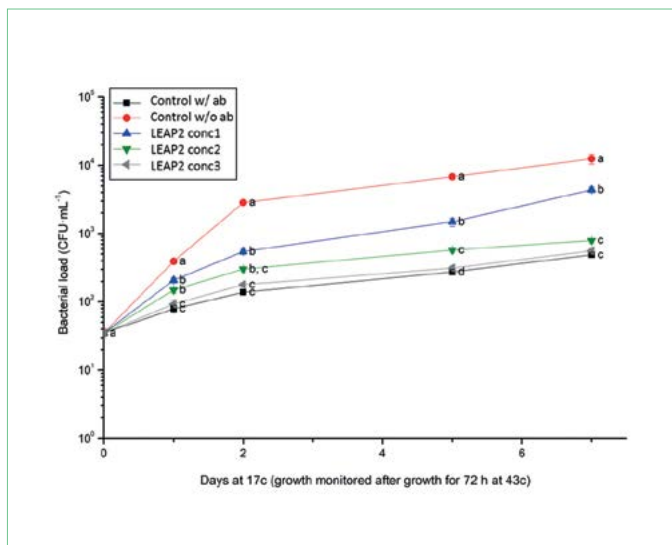


Figure 1. Growth results of anaerobic bacteria (mean \pm SEM) after culture for 72 hours at 43°C and in the presence of LEAP2 peptide. The different letters represent significant differences ($P < 0.05$) between treatments on the same day of storage. Source: Operational Group.

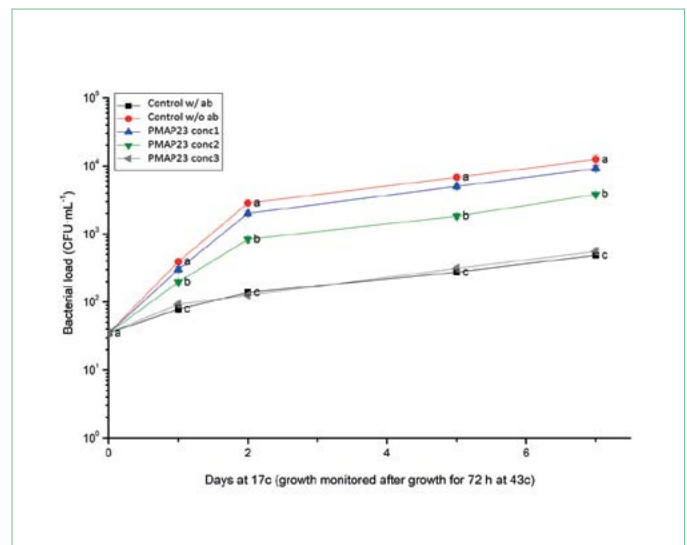


Figure 2. Growth results of anaerobic bacteria (mean \pm SEM) after culture for 72 hours at 43°C and in the presence of PMAP23 peptide. The different letters represent significant differences ($P < 0.05$) between treatments on the same day of storage. Source: Operational Group.

Technological improvements in the cultivation and post-harvest of the hanging tomato

Leader:

Conca de La Tordera, SCCL

Other recipient members:

Catalan Federation of Agricultural Cooperatives (FCAC)

Other non-recipient members:

Miquel Agustí Foundation; Selmar (Federation of groups for the defence of plants); Miquel Ramos Esgles; Josep Soms Colprim; Benjamín Alvarado Roca

Coordinador:

FCAC

Web:

<https://gotomaquetdepenjar.wordpress.com/>

01. Rationale

The hanging tomato (*Solanum lycopersicum L.*) is a traditional variety with deep roots in Catalan horticulture and gastronomy. In recent years, this variety has experienced a very significant increase in demand, which has led to stepped-up cultivation. While in the past it was grown under low-input conditions and consumed during the winter (after a post-harvest period), it is now grown using modern tomato cultivation techniques (protected cultivation, use of high-yield hybrids, high water and fertiliser inputs, consumption of freshly harvested fruit). The growing demand of the Catalan market and the loss of seasonality in consumption (it is currently consumed all year round) has led to the emergence of new production areas which compete in the market with local production, offering produce outside the harvesting cycle in our area (July-October). In this context, extending the production period and optimising yield and quality under the current production systems should make it possible to improve the competitiveness of Catalan producers.

The main objective of the project was to provide Catalan hanging tomato producers with technological improvements in relation to the pre- and post-harvest technical itinerary, to extend the production phase in our area, increase organoleptic quality and reduce the environmental impact of the cultivation systems. To this end, the following specific objectives were set:

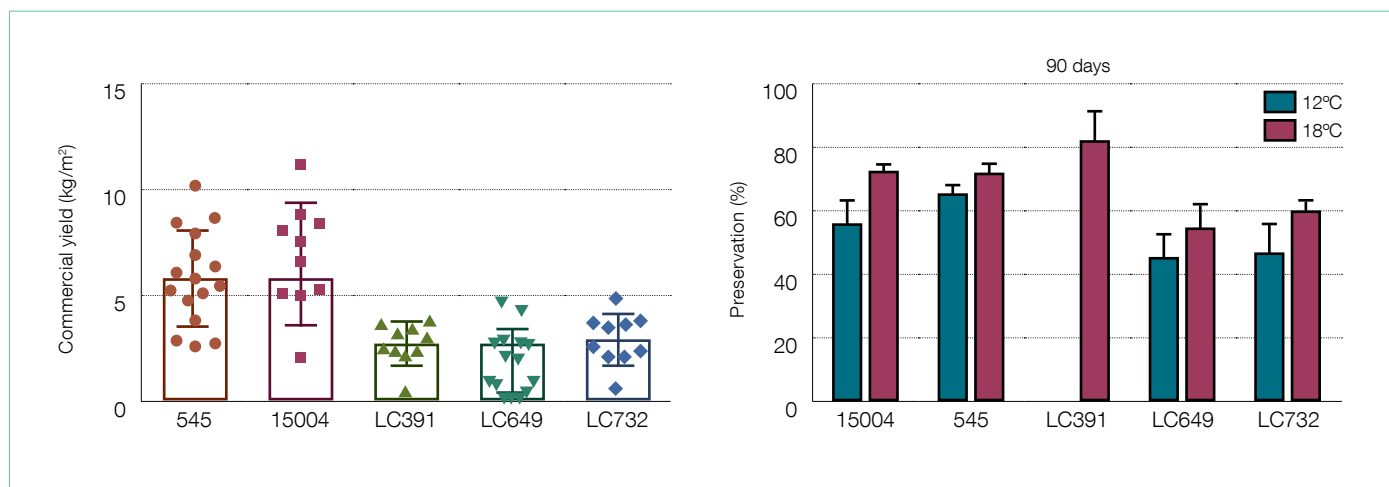
- Study different growing cycles (early, intermediate and late) under low-cost protection structures, with the aim of extending the marketing period of local products.
- Improve post-harvest storage conditions and identify the pathogens that cause rot, in order to guarantee maximum product quality and extend the storage and marketing period.
- Optimise the water consumption used in cultivation, in order to reduce the environmental impact.
- Evaluate the effectiveness of edges that act as reservoirs of useful fauna to reduce the use of phytosanitary products.
- Transfer knowledge and new technologies to the productive sector.

To carry out these studies, three traditional varieties (LC391 (from Catalonia), LC649 (Castellón) and LC732 (Majorca)) and two commercial hybrid varieties (545 and 15004, from Semillas Fitó) were used, which were grown at different irrigation doses (22-142% water requirements based on crop evapotranspiration (cET)), cycles (transplanting: 15 April, 1 May, 15 June) and cultivation systems (open air, protected cultivation in low-cost tunnels). Post-harvest studies were carried out at different storage temperatures (12°C and 18°C). The trials were carried out in the Alt Maresme area.

02. Results and conclusions

The pilot project has made it possible to optimise the technical itinerary of the hanging tomato crop, in order to lengthen the harvest and post-harvest period and improve the organoleptic and environmental quality of local production. The implementation of these measures should allow for an improvement in the competitiveness of producers, which, through the transfer actions implemented, is expected to result in an increase in the economic and environmental profitability of the crop.

In relation to pre-harvest factors, the results show that the choice of variety is the key point that determines yield, with the improved



Left: marketable yield (kg/m²) of the varieties evaluated (the error bars indicate the standard error of the mean; The dots represent the mean for each growing environment). Right: Effect of storage temperature on preservation at 90 days. Source: Operational Group.



Photos: Operational Group.

varieties studied being far superior to the traditional ones. However, the technical route used determines the final yield, which in the case of the improved varieties can range between 2.0 and 11.4 kg/m², determining the economic viability of the crop. The highest yields were obtained in early-cycle tunnel cultivation, mainly because protected cultivation reduces the incidence of cracking (the main factor that reduces the commercial value of the fruit) and the early cycle makes it possible to extend the harvesting cycle.

Unfortunately, the late growing cycle is not adapted to the growing area, so extending the harvesting period beyond November is not feasible. The highest yields were obtained at irrigation rates close to 100% cET, so it is very important to adjust water inputs to the real demands of the crop, and this has been shown to be a good method for calculating irrigation rates. Regarding the efficient use of irrigation water, consumption values between 123 and 658 l/plant were recorded, which have been translated into efficiency values between 2.4 and 36.4 kg fruit/m³ irrigation water, indicating that significant progress can be achieved in the environmental impact of cultivation. Among the variables that determine the incidence of cracking, a positive correlation has been identified between the appearance of this physiopathology and the daily oscillation of environmental relative humidity. Finally, as previously demonstrated, the use of flower edges as a reservoir of useful fauna has made it possible to significantly reduce the damage caused by *Heliothis armigera*, *Tuta absoluta* and whitefly.



In relation to postharvest behaviour, it has been observed that low temperatures (12°C) and high humidity (95%) cause higher postharvest losses. It is recommended to use temperatures of around 16-18°C and relative humidity of around 75% for the storage of hanging tomatoes. Studies on the fungi appearing during postharvest have identified the presence of *Penicillium* sp., yeast, *Alternaria* sp., *Stemphylium* sp., *Fusarium* sp., *Rhizopus nigricans* and *Geotrichum candidum* in the analysed samples, and no main fungus has been identified as the cause of rots. As for pre-harvest factors determining preservation, few significant effects have been observed, with irrigation dose being an unimportant factor, as previously described in other studies. The data collected have made it possible to draw up a Post-harvest Management Manual, which gives recommendations for the different phases (pre-harvest, harvest, transport and entry into storage, post-harvest and marketing) that should make it possible to improve the preservation of the fruit.

In conclusion, the pilot project has made it possible to gain an exhaustive insight into the pre- and post-harvest factors that determine the economic and environmental profitability of the hanging tomato crop. These results have been passed on to the sector through knowledge transfer workshops and management manuals, as well as customised technical advice for producers. The project has made it possible to gather a wealth of information on the crop, opening the door to future measures to improve the situation of a key crop for Catalan horticulture.

Innovative pilot project for the control of the olive fruit fly

Leader:

Agrícola del Camp i Secció de Crèdit Santa Bàrbara, SCCL

Other recipient members:

Unió Origen SCCL; Catalan Federation of Agricultural Cooperatives, Empordàlia, SCCL

Other non-recipient members:

IRTA

Coordinator:

Catalan Federation of Agricultural Cooperatives (FCAC)

01. Rationale

The olive fruit fly, *Bactrocera oleae*, is the most important pest species for this crop in Catalonia. Until the last few years, the most widespread control method was based on chemical aerial treatments with bait, which since 2015 have been used only exceptionally. Therefore, their replacement with other control methods has been evaluated. The mass trapping technique is based on using bait to attract adults, which die when they come into contact with the toxicant in the device used. Its efficacy lies in minimising populations of *B. oleae* (top photo) from the moment the olive is susceptible to be attacked by the fly. When populations are high, this technique needs to be supported by other control methods. This study was carried out on one farm in each of the olive oil PDOs in Catalonia: Terra Alta (Empeltre and Arbequina varieties), Empordà (Argudell var.), Siurana (Arbequina var.), Baix Ebre-Montsià (Morrut and Sevillença var.) and Les Garrigues (Arbequina var.). Each farm was divided into three plots where three trap densities per unit area were evaluated (middle photo). This density varied between 10 and 80 traps per ha, according to the varietal sensitivity and population abundance of *B. oleae* in each area. When necessary, the mass trapping technique was reinforced with chemical treatments, including the fungus *Beauveria bassiana* and kaolin. The efficacy of the method was assessed by determining the percentage of fruit affected by *B. oleae* and adult populations.

The main objective of the project was to implement control strategies for the olive fruit fly, the main olive tree pest, consisting of a combination of different alternative control methods to aerial treatments, which should make it possible to obtain a high quality olive oil, minimise the environmental impact and increase the competitiveness of the Catalan olive sector.

02. Results and conclusions

The mass trapping technique has been shown to be an alternative to aerial treatments, greatly reducing the adult populations in the field and consequently the damage to the crop. However, during the three years of the project, this technique alone was not sufficiently effective in any of the areas tested, and it was necessary to carry out supporting treatments at certain times which were justified by the monitoring of both adult populations and the percentage of fruit affected. The results obtained during the three consecutive years show a high variability between the variables, year, area and variety.



B. oleae larva inside a fruit.



Plan of plots with different trap densities per ha.



Plot of olive trees in Montsià. Photos: Operational Group.

Of the different alternative products to chemical treatments (*B. bassiana*, diatomaceous earth and kaolin) evaluated in the six field trials conducted, only kaolin was shown to be effective for the control of *B. oleae*.

The commercial characteristics and the physical and chemical and sensory analysis of the oils to assess oil quality within the same area were similar for the different treatments.

The results obtained from the pilot project have helped to define better control strategies to deal with the attacks in accordance with the area, variety and other variables that affect each campaign. Despite the validity of the mass trapping method, there is a clear need to continue working on new R&D&I actions in order to find sustainable control methods that can be combined with mass trapping in order to reduce the incidence of the pest, especially in the most severely affected areas and varieties.

Recovery of low commercial value proteins from pork slaughterhouse sub- and co-products

Leader:

Patel, SAU

Other recipient members:

Frigoríficos del Nordeste, SA; Olot Meats, SA; Friselva, SA; Frigoríficos Costa Brava, SA; INNOVACC

Coordinator:

INNOVACC

Web:

<https://www.innovacc.cat/2016/08/24/valoritzacio-de-proteines-de-baix-valor-comercial-procedents-de-sub-i-co-productes-descorxadors-de-porci/>

01. Rationale

Based on the assumption that in the near future the demand for meat proteins will tend to exceed the productive capacity of traditional sources and, taking into account that the level of use of by-products and co-products from pig slaughterhouses is far from optimal, this project proposed to develop systems to make profitable use of low commercial value products as a source of high biological value proteins and ingredients with technological functionality.

Different protein fractions were obtained from various viscera such as livers, spleens and hearts. The previously minced organs were subjected to extraction under the most suitable pH conditions to obtain two fractions: a soluble one rich in haemoproteins, and an insoluble one that still contains the discoloured tissue proteins.

A system was also developed to obtain a stable dye made from zinc protoporphyrin from livers.

The general objective of the project was to obtain proteins from porcine organs of low commercial value that, thanks to their functional properties and high nutritional value, would be useful as ingredients in the food industry.

02. Results and conclusions

- Extraction conditions that make it possible to obtain insoluble fractions with a higher protein content from pig spleens, hearts and livers, were determined.
- The best conditions for obtaining a surimi-like product from the viscera are:
 - Polishing of the viscera by removing connective tissue (splenic hilum, main heart arteries and veins)
 - Extraction at acid pH (4.5-5)
 - Washing of the insoluble fraction with water, with a water-to-product ratio of 1:2 or 1:3 (between 1 and 3 washes with stirring, depending on the desired degree of discolouration)
 - Separation of the proteins by filtration/centrifugation
 - Freezing and preservation in frozen state
- The extraction and washing to obtain the protein extracts results in a significant discolouration and loss of the characteristic viscera odour, which can facilitate the incorporation of these extracts into food formulations without causing undesirable abnormal properties.



Sausages made with spleen protein as a meat substitute. Photo: Operational Group.



ZnPP ingredient. Photo: Operational Group

- The soluble fraction, obtained under the above conditions, has functional properties, but retains the aroma-carrying molecules and haemopigments, making it difficult to introduce into food formulations, and it is therefore suggested that it be used for the manufacture of pet food.
- Substitution of soy proteins for spleen proteins, and lean meat for spleen and heart proteins in cooked pâtés has been tested.
- Pilot trials are recommended to ensure successful industrial-scale manufacture of viscera products.
- Optimal conditions for the formation of Zn-protoporphyrin from pig livers have been established and have resulted in two types of ingredients with colouring capacity.
- The application of these ingredients allows the production of meat products with an optimal colour similar to their raw and cooked analogues. Thus, they can allow the reduction and even the elimination of nitrates and nitrites.
- The application of these ingredients can improve the colour of meat products produced without nitrifying agents.
- The design of effective strategies could allow an increase in a large number of consumers in the intention to purchase meat products made with offal extracts.

Development of tools for optimising the joint management of livestock manure and the improvement of agricultural fertilisation, crop quality and environmental protection

Leader:

Agropecuària Catalana, SCCL

Other recipient members:

Linyola Agropecuària i Secció de Crèdit; Agropecuària d'Artesa de Segre, SCCL; Agrària Plana de Vic i Secció de Crèdit, SCCL; Camp i Secció de Crèdit Sant Isidre de Belcaire d'Urgell; Catalan Federation of Agricultural Cooperatives (FCAC)

Other non-recipient members:

Mas Badia Foundation; IRTA

Coordinator:

Catalan Federation of Agricultural Cooperatives (FCAC)

Web:

<https://agrocat.com/>

01. Rationale

Innovative tools and strategies for the optimisation of livestock manure management and agricultural fertilisation have been validated, focusing on both economic and environmental aspects, in a joint project with coordination between the participating cooperatives, and with the following specific objectives:

- To achieve joint management of manure and fertilisation in a careful and sustainable manner.
- To recover livestock manure for its fertiliser content and reduce its environmental impact.
- To improve the technological management tools available and adapt them to the needs of the participating cooperatives.

Various cross-cutting measures and pilot experiences have been carried out, in a joint management framework based on four fundamental areas of improvement:

1. Improving slurry application through fertilisation planning. Soil analyses, use of conductivity meters, precision machinery, GPS, etc.
2. Improving management logistics: optimisation of transport routes, registering applications, etc., by means of computer tools to facilitate tasks and to obtain traceability of the applications on the plot.
3. Improving cereal quality: increasing protein through fertilisation.
4. Reduced environmental impact.



Photo: Operational Group - IRTA.



Photos: Operational Group - IRTA.

02. Results and conclusions

For the purpose of finding out the nutrient content *in situ* and in real time by using a conductivity meter, we have obtained as many regression lines as situations represented by the selected farms, providing more accurate information on the nutrient content being applied. Depending on the type of slurry (breeding sows or fattening pigs), breed of pig or the geographical area where it was generated, the applicator will be able to select the most appropriate line. The use of conductivity meters during application for the *in situ* determination of the NPK content allows the fertilisation to be optimised.

By means of devices installed in transport tanks, tests have been carried out on real-time data access and transmission to the evaluated software. It has been possible to verify the differences and advantages in management optimisation, with real-time monitoring, control of the vehicle's location, routes, timetables, number of operations per loading and unloading point, total kilometres travelled, etc. All this information recorded in the computer application has made it possible to generate the livestock manure management book (LGDR, for its Catalan initials), as well as the fertilisation plans more quickly and accurately.

It has been shown that the application of emission reduction strategies during slurry storage, such as acidification and the addition of plant material (straw), are relatively economical tools that allow the reduction of ammonia and greenhouse gas emissions. The use of flexible bags also allows emission control, but promotes the generation of biogas. In order to minimise its impact, it will have to be used or burned with a torch.

Composting technology has also been shown to be a good alternative for the stabilisation of poultry manure. However, as it is a material with a high nitrogen content and little structure, a good choice of structuring material is necessary to obtain a quality compost and to minimise emissions.

Through the demonstration plots, improvements to be implemented in the individual and joint agricultural management of livestock manure, mainly slurry, have been identified: the use of hose equipment to apply liquid manure; the use of conductivity meters to estimate the nutrient content of slurry; the application of liquid manure in crop cover; the adequacy of the dose of nutrients to be applied to crops. The tools and management model will need to be slightly adapted to fit the specific needs for each of these situations.

The contribution of livestock manure to improving crop quality has been demonstrated. Improvements to be implemented in both individual and joint farm management of manure in relation to crop quality improvement have been identified: the adequacy of the nutrient dose to be applied to crops at each moment and the importance of livestock manure in increasing crop protein.

The application of liquid manure to crop cover brings nutrient inputs closer to the time of maximum nutrient extractions by crops and improves the efficiency of the elements applied. The use of agronomic tools and criteria to plan fertiliser applications to crops should prevail over the use of criteria of maximum doses allowed by legislation. Fertilisation is a key aspect for the improvement of crop quality and requires careful management to achieve a quality product.

The general conclusion derived from the activities carried out and from the above recommendations is that the livestock farming sector must evolve and innovate in order to carry out the correct individual or joint management (and treatment) of manure and to adapt to the new regulations, especially those farms located in vulnerable areas. Other recently published regulations, such as the regulation on fertilisers, put an end to the waste status of manure and open the door to greater agronomic recovery of manure. There are, therefore, useful tools that the sector can apply to increase its economic and environmental sustainability, complying with the established limits and those that could be established in relation to aspects such as the minimisation of emissions during storage.

Treatment and management of manure in nitrogen surplus areas: adaptation of treatment to the surplus to be managed and agronomic valorisation of the resulting liquid effluents

Leader:

Granges Terragrisa, SL

Other non-recipient members:

Ricard Torras Salvans; Mas Badia Foundation; IRTA

Coordinator:

Granges Terragrisa, SL

01. Rationale

Slurry is characterised by a high quantity of water and a nutrient content (N, P and K) which limits its agricultural application depending on the capacity of crops to absorb these nutrients.

Some current treatment systems make it possible to reduce this surplus of nutrients (especially N) and to obtain effluents with a nutrient content adjusted to the needs of each farm. However, in order to optimise the application of these effluents in the soil, it is necessary to broaden the know-how regarding their characterisation and their agronomic management, from different perspectives: [1] sustainable adjustment of the nutrient content (mainly N) of the effluents to the needs of the crops and to the basic agricultural parameters (chemical characteristics of the soil and crop typology); [2] evaluation of the effect of effluent applications on the production of different crops and crop quality, and [3] evaluation of the effect of effluent applications on the soil in the medium to long term. To obtain this experience and knowledge, collaborative management between the livestock farmer producing the slurry, the farmer that requires the fertiliser for extensive crops and research centres is key.

To achieve this goal, the following partial objectives are proposed:

- To adapt the existing slurry tanks on the farm to carry out a process based on NDN (nitrification – denitrification) that aims to obtain an effluent with the required amount of nitrogen, with a minimum treatment cost and environmental impact.
- To determine the impact of the agronomic application of different types of slurry treatment effluents (1. Liquid Fraction (LF) obtained from the solid/liquid separator, 2. Effluent from intensive NDN treatment and 3. Effluent from the new NDN-based treatment).
- Evaluate the changes that applications of pig slurry treatment effluent several times a year can bring about in the chemical and physical characteristics of the soil.

02. Results and conclusions

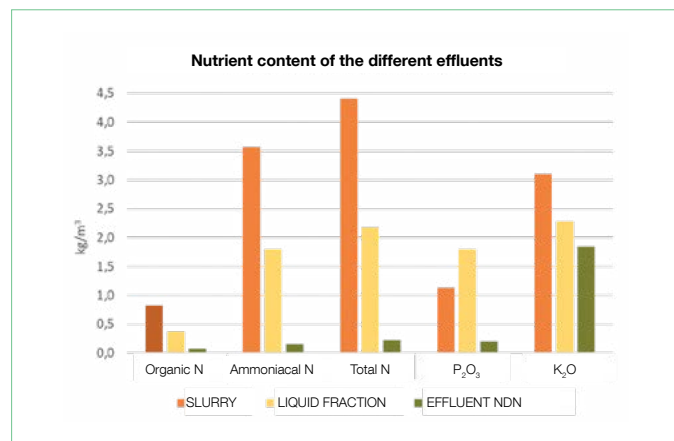
The NDN system makes it possible to eliminate part of the ammonium present in the LF of the slurry, via partial nitrification (via nitrite). However, several causes can destabilise the system and lead to emissions that must be avoided. NDN via the conventional route (via nitrate) is more stable and makes it possible to minimise emissions.

In general, higher yields are obtained in fertilisation strategies where fertiliser is split into pre- and post-sowing applications, both for grain crops (wheat and barley) and for annual forage crops (ryegrass). The application of higher doses of N (100 kg N/ha) in the post-sowing application does not increase crop production compared to lower doses (50 kg N/ha), but it does increase protein content, both in grain and forage production. In crop production, effluent from NDN treatment has a similar agronomic behaviour to the LF from pig slurry, for equivalent doses of N applied.

In the long term, it is observed that the fertilisation history of the plots shows that a continuous application of effluent based on the nitrogen needs of the crops can lead to an excessive accumulation of nutrients (P and K) in the soil. When intensive NDN effluent is repeatedly applied, an accumulation of K₂O is observed, which can become excessive, and an increase in the exchange sodium in the soil is also observed.

Thus, the treatment of manure with an NDN system and the correct agronomic management of effluents has allowed: [1] minimisation of the environmental effects of pig manure; [2] a reduction in the cost of manure treatment compared to existing systems, depending on the needs of each farm; [3] a significant saving in external fertilisers and [4] an increase in the productivity and quality of crops.

TREATMENT	PRE-SOWING DOSE (kg N/ha)	MATERIAL TYPE	POST-SOWING DOSE (kg N/ha)	MATERIAL TYPE
T1 - 0/0	0	---	0	---
T2 - 0/50 LF	0	---	50	Liquid fraction
T3 - 0/100 LF	0	---	100	Liquid fraction
T4 - 100 LF/0	100	Liquid fraction	0	---
T5 - 100 LF/50 LF	100	Liquid fraction	50	Liquid fraction
T6 - 100 LF/100 LF	100	Liquid fraction	100	Liquid fraction
T7 - 170 LF/0	170	Liquid fraction	0	---
T8 - 170 LF/50 LF	170	Liquid fraction	50	Liquid fraction
T9 - 170 LF/100 LF	170	Liquid fraction	100	Liquid fraction
T10 - 100 NDNint/0	100	NDN intensive or total	0	---
T11 - 100 NDNint/50 NDNint	100	NDN intensive or total	50	NDN intensive or total
T12 - 100 NDNint/100 NDNint	100	NDN intensive or total	100	NDN intensive or total
T13 - 100 NDNSoft/0	100	NDN adjusted or soft	0	---
T14 - 100 NDNSoft/50 NDNSoft	100	NDN adjusted or soft	50	NDN adjusted or soft
T15 - 100 NDNSoft/100 NDNSoft	100	NDN adjusted or soft	100	NDN adjusted or soft



Tables and graph: Operational Group.

Comprehensive improvement of pork meat through productive strategies at farm level and innovative, online NIRS tools for classification at slaughterhouse level

Leader:

Matadero Frigorífico del Cardoner, SA

Other recipient members:

Agropecuària Catalana, SCCL; Catalana de Pinsos, SA; IRTA

Other non-recipient members:

Lenz - Instruments, SL

Coordinator:

IRTA

Web:

www.mafrika.com

01. Rationale

This Operational Group has been created as an opportunity to address the need of some companies producing Duroc pigs to improve the quality of the carcass and meat, as well as to achieve homogeneity in the batches of these pigs of differentiated quality. The result is intended to increase both customer satisfaction and the economic performance of the sector.

To evaluate the different factors that can affect the final quality parameters in the slaughterhouse, tests have been carried out on experimental and commercial farms, taking into account aspects open to improvement such as genetics, breeding and fattening, sex, feed, suppliers, etc. The aim of these actions has been to find a homogenised system for breeding Duroc pigs in order to obtain homogenised carcasses and pieces in the slaughterhouse.

Specifically, in order to achieve the main objective of improving

the sensory and nutritional quality of the pig meat and to ensure regular and homogeneous production, different strategies have been proposed: increasing intramuscular fat up to levels of 4%, quantitative improvement of the fatty acid profile, reduction of variability in order to obtain constant and homogeneous quality throughout the chain, quantification and classification of meat quality by means of NIRS equipment at the slaughterhouse, and integration of genetic typology, production farm and slaughterhouse data.

The characterisation of the loins obtained has made it possible to know whether the actions and measures implemented are efficient in achieving the established objectives.

02. Results and conclusions

Through the creation of the Operational Group and the establishment of actions, it has been possible to evaluate those parameters that affect the homogeneity of the final product. In this regard, the tests carried out have made it possible to detect which of the paternal lines are the most suitable for achieving the objectives set by the slaughterhouse. Tests have also been carried out under commercial conditions and on experimental farms showing that fattening conditions, as well as immunocastration and feeding criteria, can affect the final homogeneity of the product. This evidence suggests that a homogenisation of the rearing process of animals from different suppliers to the slaughterhouse substantially improves the homogeneity of the final product.

One of the strategies studied was the immunocastration of female animals, which has had a positive impact on intramuscular loin fat and has made it possible to reduce the difference with regard to castrated males.

The use of a large amount of data at different levels (production, slaughter, final quality) has made it possible to establish the best breeding and fattening parameters for the animals in order to obtain an economically sustainable production and, at the same time, to improve the final quality of the product.

The tests carried out in the Operational Group have made it possible to conclude that the strategies evaluated (genetic selection, feeding and immunocastration) have succeeded in improving the quality of the meat produced by the company Porc de Palou.



Photo: Operational Group.

TRIABE: strategies for improving the transport of suckling calves to optimise welfare, health and productivity

Leader:

Vilarta, SA

Other recipient members:

Osona Vallès Carnes, SA; Agropecuaria Montgai; SL, Asoprovac Catalunya

Other non-recipient members:

Council of Veterinary Associations of Catalonia

Coordinator:

Asoprovac Catalunya

01. Rationale

This Operational Group was created, on the one hand, with the aim of studying the main risk factors affecting the welfare of suckling calves in different transport systems. On the other hand, the aim was to identify the main indicators to assess the welfare of suckling calves on arrival via transport to the farm or assembly centre and their recovery during their first few days there. The final objective was that with all this information, transport classification categories could be designed based on risk level (high, medium or low risk) for the purpose of applying management and sanitary protocols on arrival according to the category.

Three specific technical objectives were proposed:

1. Study the main risk factors (management, facilities, environment, genetics, etc.) that affect the welfare of suckling calves in different transport systems.
2. Identify the main indicators for assessing the welfare of suckling calves on arrival via transport to the farm or assembly centre and their recovery during their first few days there.
3. Design a transport classification based on risk categories (high, medium or low risk) for the purpose of applying management and sanitary protocols on arrival according to the category.

The project had three phases:

Phase 1. Validation of the surveys.

Phase 2. Collection of data before and during transport. Assessment of animal welfare and physiological parameters at 14 days post-arrival.

Ten records were made for each type of transport (direct: collection centre to farm; bus: collection centre for different destination farms; centre: from the collection centre to another collection centre and from there to the farms).

A total of 30 transports were analysed with the following information:

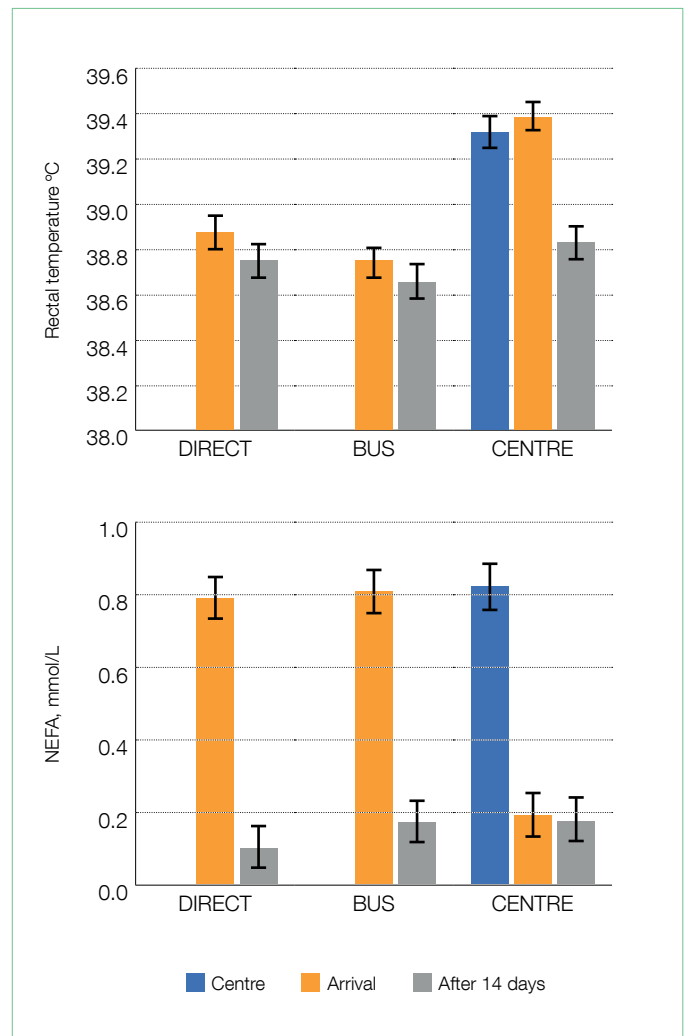
- Transport conditions and truck data (country and town of origin, kilometres travelled, day and time of origin and des-

tinuation, hours of journey, experience of the driver, type of vehicle, characteristics of the truck, presence and type of enclosure, number of animals unloaded, incidents, weather conditions during transport).

- Unloading: Evaluation of unloading, characteristics of the unloading site, handling during unloading.
- Arrival and destination farm: number of pens and animals per pen, characteristics of the sheds, evaluation of the animals' physical condition and general condition, evaluation of the animals' health status.
- Recording of body temperature and blood samples to assess energy balance and haematology on arrival and at 14 days.

Phase 3. Designing the categories

Different risk factors have been identified: duration of transport, distance of transport, sex and breed of animals, time of year, time of departure of transport, time of arrival of transport, type of truck, experience of the driver. The type of transport (direct, bus, centre) affects the parameters assessed (mainly serum concentration of non-esterified fatty acids, body temperature, percentage of slips on exiting the lorry).

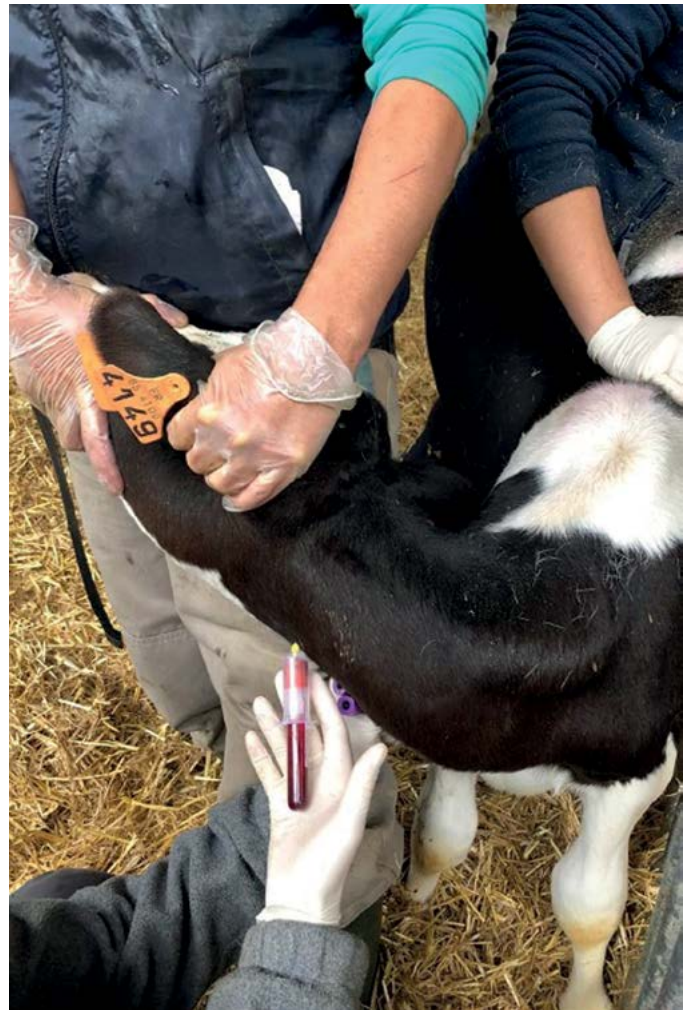


Rectal temperature and serum concentration of non-esterified fatty acid (NEFA) of calves transported directly to destination, by bus, and with a stop at an assembly centre. Source: Operational Group.

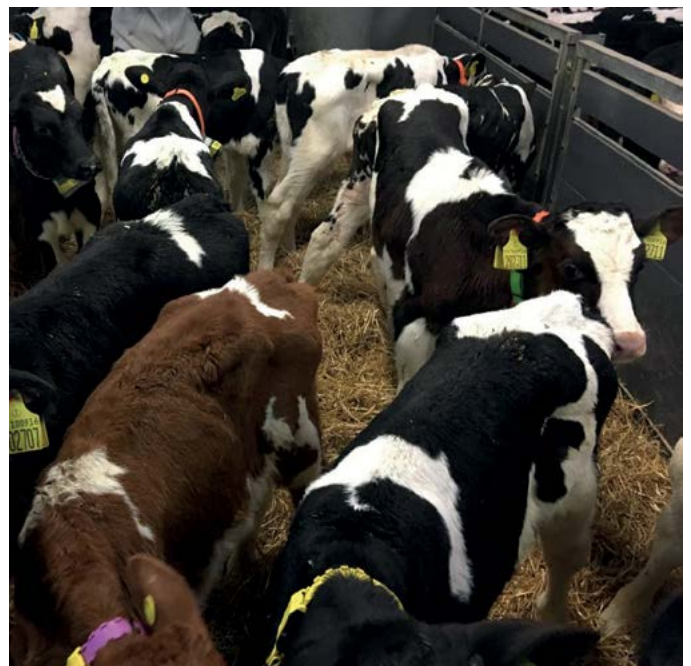
02. Results and conclusions

- a. Preliminary results in evaluating the transport of suckling calves show that factors such as hours of transport, kilometres travelled, season of the year, experience of the driver and type of truck, etc. have an effect on the parameters evaluated after transport.
- b. Based on the results obtained, protocols could be developed that would improve the welfare and physiological condition of suckling calves on arrival by following measures such as:
1. Scheduling departures from the origin in the morning, and arriving at the destination in the evening, avoiding loading and unloading in the afternoon.
 2. Using more stable trucks for the transport of suckling calves.
 3. In the case of suckling calves, it is advisable that drivers have experience (more than five years of driving).
 4. Where possible, calves should be transported from closer areas and countries.
- c. In studying the different types of transport, it has been observed that, regardless of the type of transport, all calves arrive with negative energy balance and altered haematology parameters, returning to their basal concentrations 14 days after transport. With the CENTRE-type of transport, where the animals were unloaded, fed and rested before reaching the final destination, the concentrations of NEFA and BHBA were reduced, indicating that the calves recovered their energy balance, although rectal temperature was not reduced, indicating that the stress of the transport lasted over time. The CENTRE-type transports were the longest in terms of hours of transport.

The results obtained in this project have made it possible to create a risk classification that should be validated with more trips and/or by making different protocols according to the risk and verifying whether this classification can help to improve the welfare of the animals during the days following arrival.



Photos: Operational Group.



Introduction of working protocols to reduce the use of antibiotics on dairy cattle farms

Leader:

SAT Sant Mer

Other recipient members:

Vether Girona, SL

Other non-recipient members:

Laboratori Interprofessional Lleter de Catalunya (ALLIC);
Cooperativa Lletera de L'Empordà (SCCL); Lletera
Campllong SCCL; IRTA

Coordinator:

Vether Girona, SL

Web:

<http://www.irta.cat/es/el-secado-selectivo-no-aumenta-el-riesgo-de-infeccion-intramamaria-comparado-con-el-convencional/>



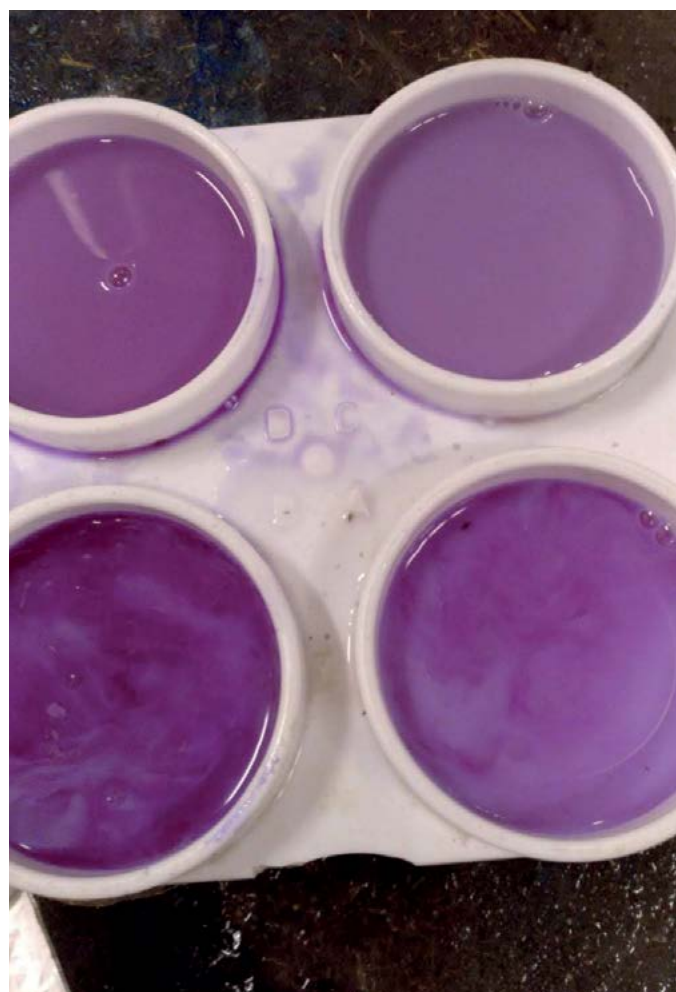
Laboratory antibiograms of milk samples from cows with high somatic cell counts using the minimum inhibitory concentration (MIC) technique. Photo: Lourdes Migura.

01. Rationale

The increase of antimicrobial resistance is a fact that has been confirmed by the European health authorities, which in 2015 drafted Regulation 2015/C 299/04 which gives recommendations for the prudent use of antimicrobials in veterinary medicine. These guidelines promote hygiene and disinfection measures for both personnel and facilities, improvements in housing and a decrease in prophylactic programmes that resort to the systematic use of antibiotics.

Of the various measures that can be taken to reduce the use of antibiotics in animal production, this project focuses on the implementation of two specific measures included in the EU recommendations: avoiding systematic treatment in drying-off and developing preventive practices (specifically for intrauterine pathologies in the post-partum period).

In addition, 2019 saw the launch of the 2019-2021 *Spanish National Plan against Antibiotic Resistance (PRAN)*, which imposed the requirement to communicate antibiotic prescriptions in the field of animal health and to publish the categorisation of antibiotics.



Performance of the California Mastitis Test (CMT) at farm level to assess the level of somatic cells prior to drying-off. Photo: Laura Blanco.

Some antibiotics widely used in the field of animal production such as third- and fourth-generation cephalosporins and fluoroquinolones have been categorised as level 2, which means their use requires bacteriological testing.

This fact has led to a third action within the working group, consisting of two controls during the course of one year to isolate bacteria in the main pathologies in the field of dairy production (mastitis and metritis) to assess the annual evolution of antibiotic resistance on farms.

The main objective of the project is to establish working protocols that allow for reduced and more rational use of antibiotics on dairy farms, specifically:

1. Assess the impact of selective drying-off as a tool to reduce the preventive use of antibiotics.
2. Evaluate the use of intravaginal probiotics in antepartum to reduce the risk of intrauterine infections during the postpartum period.
3. Use antibiotics taking into account the results of bacteriological tests (bacterial isolation and antibiogram).

02. Results and conclusions

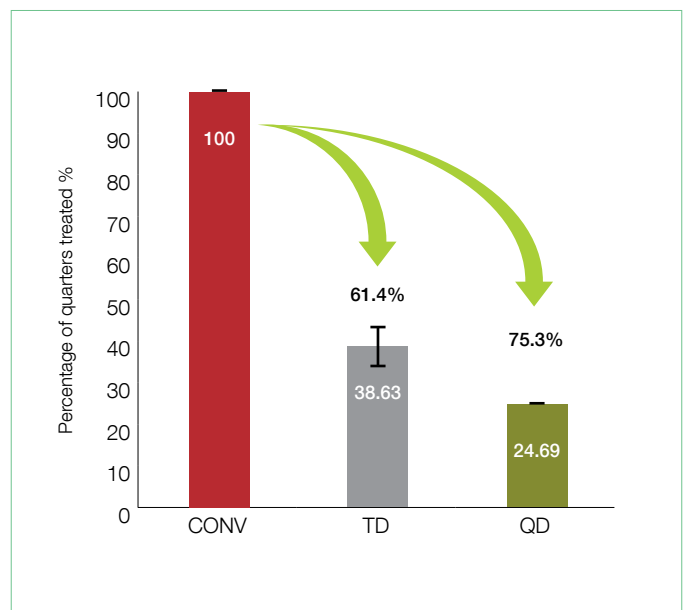
The selective drying-off protocol (antibiotic treatment of those quarters with growth of more than 15 bacterial colonies) in animals with low somatic cell counts (<200,000 cells/mL) in the last milk control and no history of mastitis throughout lactation, has shown favourable results as it does not increase the risk of intramammary infection (around 10% in this study) in the following lactation when compared to conventional drying-off using preventive antibiotics for all quarters. It should be remembered that selective drying-off must always be accompanied by management practices that keep the animals in good housing and hygienic conditions as indicated by European Regulation 2015/C299/04.

The use of probiotics in the prepartum period as a strategy to reduce postpartum intrauterine infections has not given good enough results to recommend this practice, as the incidence of metritis is low (11%) and the management strategy too complex (six applications of probiotics during prepartum) considering the scant benefit in cows of more than one lactation.

It is hoped that isolation of bacteria from mammary gland and womb infections and subsequent antibiograms can be recommended as a working tool for a more rational use of antibiotics on dairy cattle farms.

In conclusion, the introduction of selective drying-off measures on dairy cattle farms reduces the use of preventive antibiotics without increasing the risk of intramammary infections. Other measures proposed in the project, such as the reduction of the incidence of metritis, have not been shown to have sufficient benefits to justify their implementation.

Finally, it is considered that the dairy cattle sector must take action against the increase in antibiotic resistance and continue to look for strategies to reduce the use of antibiotics.



Reduction of the percentage of antibiotic use when applying a selective total drying-off (TD) treatment, where all quarters are treated if one is CMT positive, or selective drying-off at the quarter level (QD) compared to conventional drying-off (CONV) which consists of systematically treating all quarters regardless of their somatic cell count. Author: Georgina Maynou.

	Sampling March 2019	Sampling November 2019
Farm A	PIRL-TET S PIRL	ERY+PIRL+TET PEN+ERY+PIRL+TET
Farm B	SDM PEN S	TET+SDM ERY SDM PIRL ERY+PIRL+TET

Antibiotics tested: AMP: ampicillin; PEN: penicillin; CEP: cephalothin; XNL: ceftiofur; ERY: erythromycin; PIRL: pirlamycin; TET: tetracycline; SDM: sulphadimexotine; SMX: sulfamethoxazole; TMP: trimethoprim; COL: colistin; GEN: gentamicin; OXA: oxacillin; S: sensitive to all antibiotics tested

Evolution of antibiotic resistances of bacteria isolated from cows with high somatic cell counts in the March and November 2019 samplings. Source: Operational Group.

Eco-yeast: pilot project for the production of an organic yeast for producing sparkling wines

Leader:

Juvé & Camps, SA

Other recipient members:

Freixenet, SA; Segura Viudas, Gramona, SA; Torelló Llopart, SA; INNOVI Association of Innovative Companies

Other non-recipient members:

All partners of INNOVI

Coordinator:

INNOVI Association of Innovative Companies

Web:

<https://www.innovi.cat/ecollevat/>

01. Rationale

Most wineries use commercial yeast starters to initiate the fermentation of wines and sparkling wines, and nowadays, the use of organic yeasts for secondary fermentation is a minority practice. This leads to a clear homogenisation of processes related to the fermentation of sparkling wines. However, in recent years there has been a growing interest in isolating yeast strains from the vineyards themselves to increase product differentiation and obtain a company label through a system that uses the existing biodiversity of micro-organisms from the field. Moreover, there is an increasing appreciation of organic production of wines and cavas by national and international markets.

This project aims to establish an organic production itinerary for indigenous yeast strains from Catalan wine-growing areas, adapted to the *terroir* and the characteristics of the grape varieties being cultivated. In order to use these yeasts as a starter culture, spontaneous fermentation is imitated to a certain extent, but with controlled knowledge of the yeast strains that are at work, thus producing wines and cavas that are unique to the region. This itinerary can give rise to "à la carte" yeast production services for wineries interested in individualising and singling out part of their production with the prior selection of yeasts from their estates or the use of the indigenous P29 yeast from INCAVI.

The main objective of the study was the creation of an itinerary for the production of organic yeasts as starter cultures for wines and sparkling wines.

The different specific objectives were:

- Differentiate and personalise the high-end wines and cavas of different wineries through the use of indigenous yeasts.
- The multiplication of three strains of *Saccharomyces cerevisiae* (P29, FREIXENET and SEGURA VIUDAS) with known behaviour under organic conditions.
- The improvement of the final yeast population and viability, and therefore increased control over fermentation.
- The optimisation of the long-term preservation of the yeasts.

Through this project, it has been possible to carry out the following actions:

- Evaluation of the effect of different growth parameters (temperature, pH and nutrient content) and nutrient substrates, in order to select the optimal growth conditions for each yeast strain.
- Pilot tests at laboratory scale (2 L) to optimise culture media and growth parameters for strains P29, FREIXENET and SEGURA VIUDAS.
- Scale-up of the project to a 25 L volume bioreactor.
- Evaluation and optimisation of the preservation conditions of the three strains.
- Application and monitoring of the behaviour of the organic yeasts in the cellars.

02. Results and conclusions

The expected benefits or results of the project are as follows:

- Incorporation of a yeast, the P29 owned by INCAVI and some other strain to be decided within the framework of the project, with possible organic certification, to the oenological itinerary of the winemaking process of the participating wineries.
- Enhanced individualisation of the wines of each winery through the use of these yeasts.
- Incorporation of a differentiating sustainability/authenticity characteristic in the products by using indigenous, organically-produced yeasts from the wine-growing area where each company is located.
- Preference of the project's partner wineries when using INCAVI's yeast production service.
- Proximity to the sector that makes it possible to work with concentrated liquid yeasts.

With the results obtained from INCAVI and those received so far from the wineries, it can be concluded that the objective of the Operational Group, which was to obtain an itinerary for the production of organic yeasts, has been satisfactorily achieved with the three strains of *S. cerevisiae* evaluated using organic pasteurised must. Furthermore, with regard to strain P29, this micro-organism is certified as not being derived from or not containing genetically modified organisms. Therefore, a pathway has been obtained that allows reproducible production of the pied de cup with high populations with a viability always greater than 90%. Furthermore, in the cases where it was possible to compare secondary fermentation parameters with controls, these were practically identical.



Photo: Operational Group.

Development of a new line of yoghurts and smoothies with natural ingredients, fruit and honey

Leader:

El Pastoret de La Segarra, SL

Other recipient members:

Indulleida, SA; Torrons i Mel Alemany

Other non-recipient members:

University of Lleida

Coordinator:

El Pastoret de La Segarra, SL

Web:

www.pastoret.com

01. Rationale

The project entitled "Development of a new line of yoghurts and smoothies with natural ingredients, fruit and honey" is based on the design of a new line of fat-free yoghurt blended with fruit and/or fresh liquefied vegetables and with natural sweeteners. This project makes it possible to obtain a new line of high-quality, high-added-value products that will help improve the competitiveness of fruit, vegetables and honey from the Lleida area and integrate them into the agri-food chain through their treatment and processing. It will promote these local products by allowing them to be used as raw materials in the production of yoghurts.

The overall objective is to design and develop a new line of yoghurts and smoothies with natural ingredients containing fruit, vegetables and honey from local markets. As such, the following specific technical objectives have been set:

- Design and develop natural extracts with sweetening power.
- Evaluate the use of honey as a substitute for added sugars.
- Design and develop a new line of fat-free yoghurt smoothies with fresh fruit, vegetables and natural sweeteners.
- Evaluate the impact of innovative technologies for the preservation of seasonal fruit.

The activities that have been carried out in the framework of the project are shown below.

- Activity 1. Design and development of plant extracts and honey extracts.
- Activity 2. Formulation of a drinkable yoghurt with fresh fruit and/or vegetables and natural sweetening extracts at laboratory scale.
- Activity 3. Formulation of a drinkable yoghurt with fresh fruit and/or vegetables and natural sweetening extracts at pilot and semi-industrial scale.
- Activity 4. Evaluation of the stability and shelf life of the products developed.
- Activity 5. Transfer of project results to stakeholders.

02. Results and conclusions

The expected results of the project were related to the fields of

application of the participating companies. Firstly, on a general scale, the aim was to obtain knowledge for incorporating stabilised liquified fruit and vegetables that would better maintain the organoleptic and physicochemical characteristics of the final product, as well as knowledge on the use of honey as a natural sweetener in yoghurts. Secondly, using all the knowledge acquired, the aim was to develop a range of yoghurt products with low sugar content and low caloric value. Finally, the aim was to generate useful knowledge about the stability of the products developed and their susceptibility to loss of stability under adverse conditions during storage.

The project was carried out correctly and the objectives set at the beginning of the project were achieved. It is important to highlight that the project has been a success that has allowed the development of new formulations optimised on an industrial scale and new triple-free yoghurts (no fat, no added sugars and no artificial additives) with fresh vegetables from Lleida and natural sweeteners.

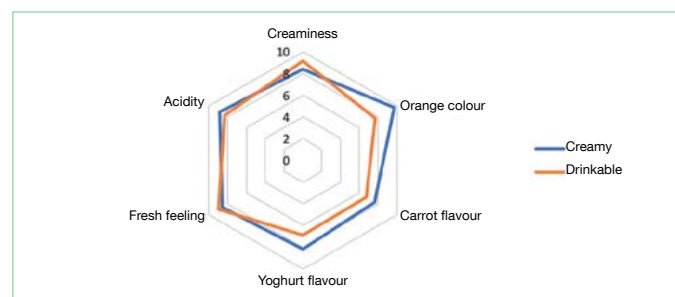
In addition, production protocols have been developed for the formulation of the new yoghurts, the formulation of the vegetable purees and the formulation of the natural sweeteners on an industrial scale. Although work could now begin to market the new products developed, the marketing department has detected that the market still finds it difficult to associate products with savoury ingredients with a sweet taste. Therefore, the new products developed are not expected to be launched onto the market immediately. However, a new line of new and industrially optimised products is now available that is ready to be launched when the forecasts are more favourable.



Dose test samples of carrot puree in drinkable yoghurt, from left to right: 8%, 10%, 15% and 20%. Photo: Operational Group.



Dose test samples, from left to right: 15% gazpacho, carrot and courgette puree in creamy yoghurt. Photo: Operational Group.



Comparison between creamy carrot yoghurt vs drinkable carrot yoghurt. Source: Operational Group.

Development of new fresh and processed calçot products with high added value

Leader:

Societat Agrícola i Secció de Crèdit de Valls SCCL

Other recipient members:

IGP Calçot de Valls; Miquel Agustí Foundation

Other non-recipient members:

IRTA

Coordinator:

Miquel Agustí Foundation

01. Rationale

The calçot is one of the most important horticultural product in Catalonia, especially in the Tarragona region. Its importance has even gone beyond the agricultural sphere, making it one of the most important tourist attractions in the Camp de Tarragona area. However, the increase in supply and the stabilisation of demand is leading to increasingly lower wholesale prices, which translates into a lower profit margin for farmers.

The main objective of this project – taking into account the current market situation of calçots and taking advantage of the experience of the research groups in this product – was to develop new calçot products with high added value that are capable of competing in terms of quality with calçots produced in other areas, and to open up new market channels with new and innovative formats, focusing on as many aspects as possible during the growing, post-harvest, processing and conservation phases. The management of the interaction between the characteristics of the fresh product and the different conservation or transformation techniques is key to developing products that have both high added value and final homogeneity that makes them suitable for marketing. These are



Photo: Operational Group.

factors that were taken into consideration when planning the actions to be carried out within the project, which consisted of:

A1: Pre-commercial cultivation to test the new varieties in different environmental conditions.

A2: Study of the ideal conservation method based on quality parameters.

A3: Study of new methods for processing fresh calçots. Determination of the efficacy of alternative treatments for sanitising the product. Development of a new minimally processed product.

A4: Development of new premium-quality pre-prepared food products.

A5: Development of new calçot-based products.

A6: Nutritional aspects of calçots depending on the intrinsic characteristics of the crop.

02. Results and conclusions

In general terms, the main results obtained from the activities carried out in this project have made it possible to:

- Establish favourable growing conditions and methods for the preservation of the fresh product.
- Prove that the environment has a greater influence on quality characteristics than genetics, and that the sensory profile of the calçot is adequate throughout the growing season. Establish that storage temperatures between 0.5°C and 4°C are ideal for keeping calçots in cold storage without alterations to the product, and the post-harvest shelf life can be extended to 60 days in a controlled atmosphere.
- Develop a sanitisation method to obtain a minimally processed product.
- Identify ultrasound technology as an alternative treatment prior to the packaging stage of pre-prepared food products, for the purpose of reducing the microbial load and maintaining the nutritional quality of the product. This physical treatment could be enhanced through combined use with a chemical disinfectant or gentle heat treatment.
- Develop pre-prepared and premium-quality pre-prepared food products and new products based on the use of non-commercial size calçots.
- Demonstrate the gastronomic potential of the calçot and its suitability for transformation processes such as freeze-drying and dehydration. In addition, it opens the door to the potential release of new products onto the market, given its good sensory acceptance by consumers.
- Define the nutritional description of calçots.
- Evaluate the nutritional aspects of the products according to the intrinsic characteristics of the crop. It has been demonstrated that calçots, similarly to onions, contain antioxidant compounds and can therefore be presented as a healthy addition to the Mediterranean diet. Further studies will have to be carried out on the nutritional value of calçots to see, for example, how they are affected by the different possible cooking or preparation methods. This will make it possible to create added value and diverse uses for calçots, which until now have been limited mainly to 'calçotades'.

In conclusion, the activities carried out as part of this project have allowed a greater understanding of the cultivation of calçots, their post-harvest and transformation. The objectives set have been favourably achieved, and the results obtained open the door to greater efficiency and productivity in the cultivation and marketing of calçots and diversification of their use, with the development of new products, always considering quality as the key characteristic.

Application of Voisin Rational Grazing for the restoration and improvement of pasture productivity in Mediterranean mountain areas

Leader:

Faustina de Solà-Morales i Capdevila, SL

Other recipient members:

Plana-Turró, SC

Other non-percipient members:

Association of Rural Landowners of La Valle de Camprodon

Coordinator:

CREAF

01. Rationale

Voisin Rational Grazing (VRG) is an intensive programmed method of pasture management that accurately monitors the phenological state of the pasture to determine the optimal time for livestock to enter to feed.

The general objective of the project was to serve as a practical reference so that any livestock farmer can assess the application of the VRG and the improvements it brings to the production and

sustainability of livestock farms in an environment that is representative of real operating conditions.

Specifically, the objectives were set:

- Demonstrate on a real scale the adaptation of the technical parameters for the application of VRG in Mediterranean mountain conditions.
- Demonstrate the adaptation of the biological parameters of application of VRG (pasture ecophysiology and animal welfare requirements) for a gradient of environmental conditions.
- Demonstrate the adaptation of VRG to the socio-economic conditions of Mediterranean mountain areas by carrying out three participatory processes with experts and livestock farmers to evaluate the pilot experiments.

For the validation and dissemination of VRG, two livestock projects were adapted, with different climatic conditions (rainfall gradient) and starting conditions (recovery of wooded terraces and existing overgrazed pastures), in order to monitor and demonstrate the role of VRG to other livestock farmers and technicians. Both the investments required and the running costs (dedication necessary for the movement of animals) have been analysed.

Moreover, the Optimal Resting Time of the pasture has been determined, which is the result of the combination of knowledge of the ecophysiology of the regrowth of the pasture and the needs of the animals. Production has been compared for different management situations: grazing at the optimum point, grazing past the optimum point, grazing with 5 days of overgrazing (keeping animals on the plot for 5 days), and grazing with 10 days of overgrazing (keeping animals on the plot for 10 days).



Image of the good quality pastures of the Plana-Turró estate. Photo: Operational Group.

Finally, joint meetings were held between experts and livestock farmers on the possibilities and particularities of applying VRG in order to identify the critical aspects for its application to the socio-economic conditions of Mediterranean mountain areas.

02. Results and conclusions

The results obtained in this project have shown that the pilot experiences of VRG, which included planning the adaptation of the technique to the environmental, social and economic conditions of Mediterranean mountain areas, with a special focus on the creation of new pastures in recovered forest areas and the improvement of overgrazed pastures, are a very efficient system for improving the condition of pastures.

Once the pastures are opened up to livestock, the system requires near daily management (at most every 3 days), but the work is considered easy to do. VRG is clearly an option to consider when setting up new projects.

We have also seen the importance of defining the biological parameters for adapting VRG to the conditions of the area, such as the growth curve of the pasture and the calculation of the optimal resting point. It should be noted that the optimal resting point between May and October ranged between 30 and 60 days, which meant that up to five grazing periods were possible. When the resting time was extended, the number of grazing periods decreased very rapidly due to the interaction with the drought, and fell to only three grazing periods. When cows were on the same plot for more than five days (overgrazing) there was a decrease in the growth curve which led to a decrease in growth and a lengthening of the optimal return time, and therefore a decrease in the number of grazing periods and the amount of

grass in each grazing. To achieve the benefits of VRG, it had to be applied in a controlled and precise manner.

With regard to the discussion of the possibilities and characteristics of applying VRG in the social and economic conditions of current farms in Mediterranean mountain areas, the technique has generated a certain amount of interest among livestock farmers. However, it has been detected that there is a significant proportion of farmers who see it as similar to what they are already doing. Despite this, no livestock farmers were found to be already applying controlled management that could be considered comparable to VRG. The most common case observed was the system of opening up a new area of pasture every day so that the animals could make better use of the new pasture, but also leaving the eaten pasture open to the animals, leading to overgrazing of the section that had already been eaten.

On the other hand, it has been detected that there is an interest among livestock farmers in VRG, but it has often been confused with controlled management practices that do not meet the criteria of VRG and do not provide the same benefits.

Finally, it is noted that VRG may be a promising technique that is well adapted to Mediterranean mountain conditions if the pastures are grouped together, easily connectable and easily accessible for daily visits. Its application has improved pasture productivity and has been found to be particularly suitable when a new project is started, new pastures are being created or overgrazed pastures are being restored.

In short, it is concluded that in order to achieve the benefits of VRG, it should be applied in accordance with the criteria that define the system.



Cows grazing in one of the plots on the Plana-Turró estate. Photo: Operational Group.

Development of a prototype cross-laminated timber panel made from local timber to improve the construction of buildings in terms of sustainability

Leader:

Aserradero Boix, SL

Other recipient members:

Association of Timber Dealers and Sawyers of Catalonia; Serreria Cunill, SL; Palets J. Martorell, SA; Fustes Jané, SL

Coordinator:

Forestry Science and Technology Centre of Catalonia

Web:

<https://www.arescat.cat>

01. Rationale

The project was designed to obtain the information needed to assess whether the manufacture of cross-laminated timber panels (CLT) in Catalonia using local timber is technically and economically feasible. To this end, a prototype panel was manufactured under real industrial production conditions. This allowed us to measure the performance of the processing and preparation of the wood (sanitisation, planing, drying), the quality of the manufactured product and its strength. Based on the technical results together with the economic and market information that has also been obtained, the evidence for and against manufacturing CLT in Catalonia with Catalan wood has been identified. The project analysed CLT manufacturing technologies, design procedures and building construction. Visits were paid to factories, CLT machining centres, adhesive producers and specialised industrial machinery manufacturers in Europe.

The objectives addressed in the framework of this project were:

1. Determine the physical and mechanical properties of the country's wood in order to determine the potential quality of the CLT that can be obtained.
2. Ascertain the wood processing yields for CLT production: drying, sawing, planing, optimisation and gluing.
3. Manufacture prototype panels with local wood and analyse their properties according to current European standards.
4. Analyse the potential market and the feasibility of implementing CLT manufacturing technologies in Catalonia.

In accordance with these objectives, the project consisted of four parts:

1. Analysis of wood yield loss as a consequence of the removal of unacceptable singularities by means of automatic optical technology for the manufacture of cross-laminated timber. This yield study was carried out with red pine wood (*Pinus sylvestris*) and was followed by a drying yield study with red pine wood and laricio pine wood (*Pinus nigra*).
2. Manufacture of prototype panels and determination of their strength properties so as to gain preliminary data on the potential and weaknesses of manufacturing cross-laminated timber with red pine (*Pinus sylvestris*) from Catalonia.
3. Characterisation of the strength of part of the material used for

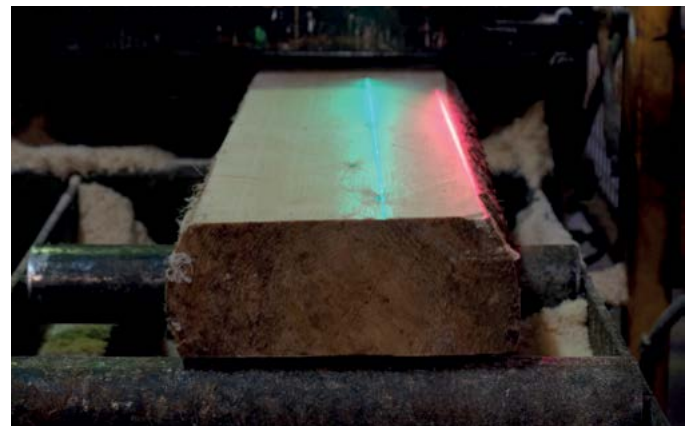
the yield study in order to know the population distribution of the strength of the batches studied, as well as the characteristic strength (fifth percentile). In addition, several hypotheses were also made on how to distribute the population in order to optimise the resulting characteristic strength and thus maximise the mechanical strength of the cross-laminated timber (CLT) boards.

4. Market study with the objective of hypothesising the future potential of CLT in the construction market in the future.

02. Results and conclusions

The results obtained show that the weaknesses are the cost of raw material, the availability of material and the relatively low yield of local wood. The strengths are the high strength of the material and the increase in demand, which is already apparent and is expected to increase even more in the near future. Therefore, further research is recommended to improve the weaknesses identified, for example through the use of automatic grading systems that identify the best structural timber for each project, or the improvement of the drying processes.

From a qualitative point of view, the industrial manufacture of CLT panels in Catalonia is technologically feasible. In terms of the strength characteristics of the material and the gluing processes, there is no reason to rule out the possibility of manufacturing this material with local wood. However, it must be borne in mind that it is necessary to achieve a processing yield comparable to that of other European factories in order to produce competitively priced panels. To achieve this, it is necessary to have enough affordable timber with a reduced amount of singularities that comes from forests managed to obtain quality wood.



Wood being sawed. Photo: Operational Group

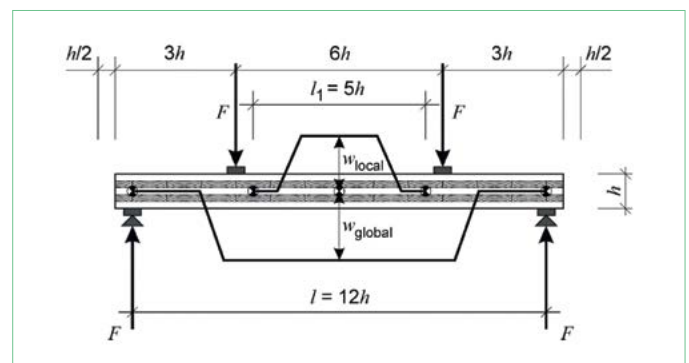


Diagram of trial panel. Source: Operational Group.

Integral system for continuous cleaning and disinfection of meat conveyor belts

Leader:

Noel Alimentària, SA

Other recipient members:

Olot Meats, SA; INNOVAC (Catalan Association of innovation in the pig meat industry)

Coordinator:

INNOVAC (Catalan Association of innovation in the pig meat industry)

Web:

<https://www.innovacc.cat/2015/01/01/noves-solucions-de-neteja-de-cintes-transportadores-en-continu/>

01. Rationale

The project was born out of the need to find a continuous cleaning system to reduce the microbial load on meat conveyor belts during the working day. This would make it possible to reduce the aggressiveness of the cleaning operations at the end of each shift and, consequently, make savings in energy, water and products.

The aim of the project was therefore to develop an integral system for continuous cleaning and disinfection of meat conveyor belts in order to significantly reduce the contamination of the conveyor belts during the operational process.

The cleaning system was developed with the collaboration of companies including Olot Meats (pig slaughterhouse), Mimasa (cleaning machinery manufacturer), Esbelt (conveyor belts),

PROQUÍMIA (chemical treatment), IRTA (steam treatment) and the Autonomous University of Barcelona (physical UV treatment), and with project coordination through INNOVACC (Catalan Association of Innovation in the Pig Meat Industry).

The actions carried out within the framework of this project were:

- Technical and economic analysis of the different cleaning and disinfection technologies available.
- Design and construction of the prototype belt cleaning and disinfection system.
- Laboratory scale pilot testing of the conveyor belt cleaning and disinfection system.
- Industrial scale pilot testing of the belt cleaning and disinfection system.

02. Results and conclusions

At pilot scale, the results obtained with the three technologies tested (UV light, chemical treatment and steam treatment) have given satisfactory cleaning and disinfection values.

On an industrial scale, the preliminary results for steam and chemical treatments are also satisfactory.

Based on these good results, the application of the pilot to the cleaning and disinfection of product parts in industrial format and various utensils (baskets and blades) is being evaluated.

The results obtained from the industrial trials have been positive, both for the continuous cleaning and disinfection of belts and for the cleaning and disinfection of tools and packaged meat product parts. In addition, sufficient new knowledge has been generated to define the basis for the design and development of an industrial system for continuous disinfection of conveyor belts, in industrial format, as well as a method of disinfecting tools and meat product parts while in operation.



Pilot design. Photo: Operational Group.

Sheets were reviewed by:

Mònica Ysanda Barón, Ma. Jesús Bejarano Gómez, Visi Garcia Ciudad, Xènia Gascón Tomas, Marta Clarella Blasco, Mireya Gracia Lafuente, Custòdia Martínez Arjona i Paula Jimeno Berdugo.

All of them are technicians of Agrifood Innovation Service (sia.daam@gencat.cat) of Agriculture, Livestock, Fisheries and Food Department

We talk to:



JOAN CASALS MISSIO

Researcher at the Miquel Agustí Foundation

Coordinator of the Operational Group
"Technological improvements in the cultivation and post-harvest of the hanging tomato" (p. 18)



MARC IBEAS HUGUET

Technical Director at PRODELTA

Coordinator of the Operational Group
"Development and adaptation of dry rice sowing in the Ebro Delta" (p. 12)



RUBÈN MASNOU RIBAS

Technician in the Agro-environment
Department of Agrocat

Coordinator of the Operational Group
"Development of tools for optimising the joint management of livestock manure and the improvement of agricultural fertilisation, crop quality and environmental protection" (p. 22)

Three of the participants from different operational groups, Joan Casals (Miquel Agustí Foundation), Marc Ibeas (Prodelta) and Ruben Masnou (Agrocat) give us a more personal view of what their participation in the different operational groups has meant. They also explain how the different projects have contributed to the participating entities and how they will affect their different fields of action in the future.

Are you satisfied with the achievement of the project objectives? Are the results of the project in line with your initial expectations?

JCM: The Operational Group had a very good dynamic, with all the actors involved in achieving results and making them relevant to the sector. The overall objective of the project was to gain an overview of pre-harvest and post-harvest management practices for hanging tomatoes and to propose improvements in each stage of the production process. The work plan was very ambitious, but I think we were able to identify the critical points and propose improvements so that producers can take a step forward with this crop.

MIH: Yes. The main objective was to shed light on a new innovative methodology for rice planting that took the opposite approach to conventional practices that had never been questioned until today. In this way, we were able to determine exactly what not to do, what to do and how to do it in the context of dry sowing of a permanently flooded crop. In addition, we were also able to assess the effects of this methodology on the crop and its impact on pests and weeds.

RMR: I am very satisfied with the objectives achieved, as they have allowed us to gain more experience and knowledge and good conclusions from the activities we have been doing, although we have realised that there is still a lot of work to do, both in terms of knowledge of the fertilising characteristics of livestock manure and the interaction between fertiliser, soil and plants. The project has helped us to obtain data, results, information and conclusions, which would be much more difficult to achieve without the involvement of different entities.

How has the project contributed to the innovation culture of your company/organisation?

JCM: The Miquel Agustí Foundation is a research centre dedicated to carrying out research and transfer projects in the agri-food sector, always with the aim that the results have a direct application in the productive sector. In this regard, lines of work such as the Operational Groups are a very good tool, because they bring producers and professionals from the world of research and

transfer to the same table. This makes it possible to define objectives based on real needs, as well as a work plan that generates transferable results on the farm scale.

MIH: Clearly, it has become a "kick-starter" for initiatives that has helped innovative ideas such as this one to be carried out through projects with the joint participation of entities from the sector (producers' associations, cooperatives and irrigation communities), private companies and research centres.

RMR: The cooperative company I work for already has this mentality of continuous innovation, but the project has made us realise even more that innovation is very important, that it allows us to advance and greatly improve within our sector and that it needs continuity.

Will what you have achieved with this project open the door to future initiatives?

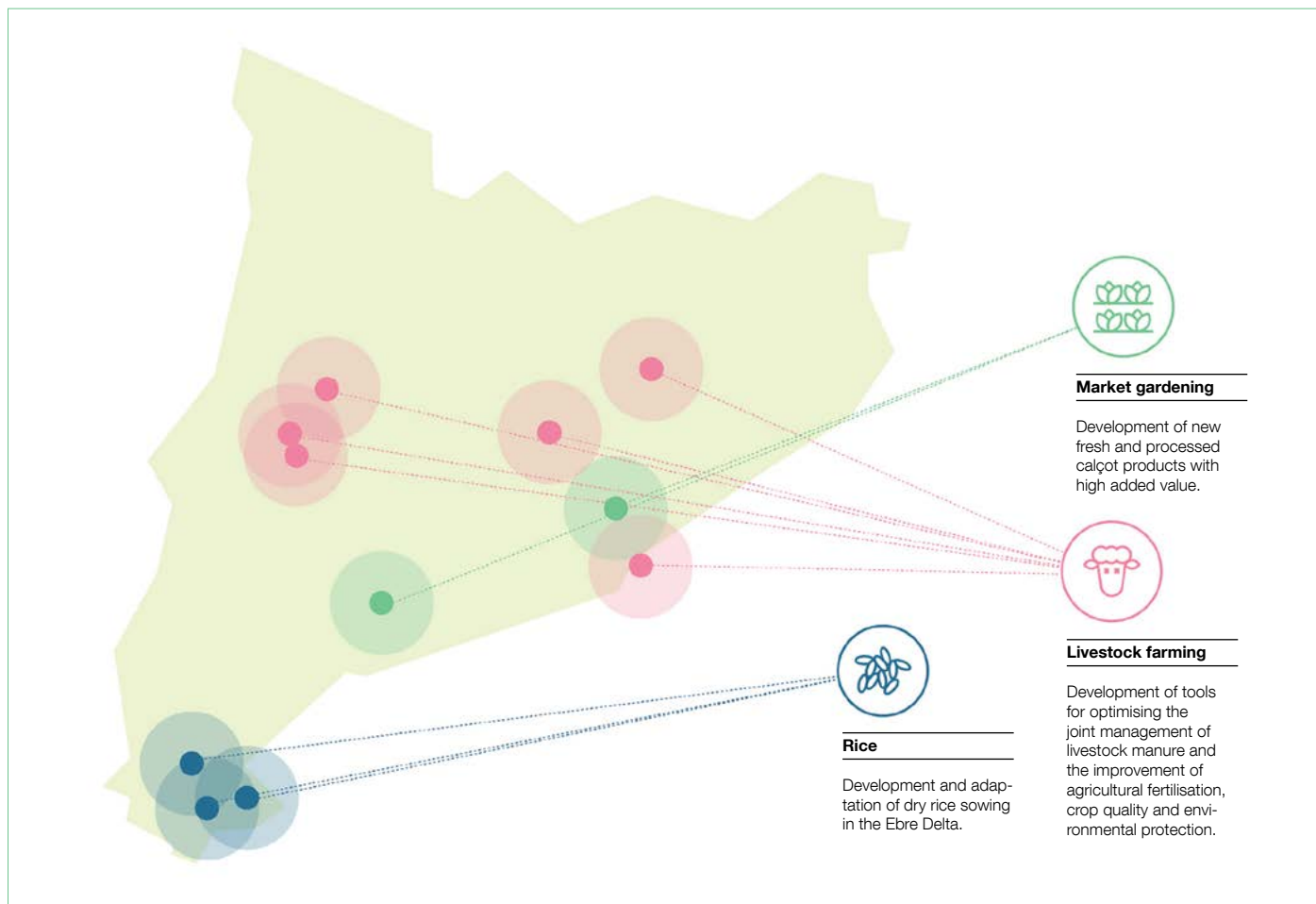
JCM: The results of the project are extensive, as we have dealt with all the factors that affect the yield and quality of the hanging tomato, from irrigation, fertilisation and plant health, to storage conditions and fungi that appear during

post-harvest. Although we have already drawn the most relevant conclusions and explained them to the sector, we are still analysing the entire volume of data obtained through the project. Furthermore, during the project, and thanks to the interaction within the working group, we have detected new needs that we are working on, as well as identifying new challenges that we believe should be included in the sector's agenda. We therefore do not consider the project to be finished, and it continues to move forward in other ways.

MIH: Yes, clearly. In fact, we are about to start a new innovative pilot project for organic rice production in areas with natural constraints and in high value systems where, among others, we incorporate the methodology of this project concerning water management and planting system as one of the strategies to be taken into account.

In this regard, this project has opened the door to new ways of managing the crop that had not been put on the table until now, and has allowed us to rethink weed and pest control, either in the framework of organic farming or in the framework of a more rational use of resources in conventional farming.

RMR: Of course, we don't yet have the final finished reports from the OG project started in 2016, and we have already



The three operational groups of the interviewees and the distribution of participants in the different groups. Source: Catalan Ministry of Agriculture, Livestock, Fisheries and Food.

applied for another one in order to be able to give continuity to a lot of things that we were not able to do with the first project, as we realised that it was necessary to obtain more studies and information.

What is your overall assessment of the experience?

JCM: We can give a very good assessment, both of the working group and the results achieved, and of the call itself, which we believe is an instrument that allows us to redirect research to the needs of the sector. Having the participation of professionals from the Selmar Federation, highly experienced agronomists, and from the Conca de la Tordera Cooperative, who are experts in post-harvest and marketing issues, has been key to the project. In addition, we have always received good support from the FECAC, which has helped us a lot by coordinating the administrative part and offering tools to transfer the results.

MIH: Overall, it has been a very positive experience for us. With this operational group and project, we have created a working framework involving entities in the sector, producers, companies and research centres that has responded to the concerns and needs of the sector, drawing on the practical experience of producers and companies with previous experience in the field.

RMR: Our overall assessment is very positive, both in terms of the results and conclusions reached, and the personal and technical relationships that have formed between the technicians from the different participating cooperatives. We have been able to get to know each other and we are still keen to share knowledge and technical queries through a WhatsApp group we created during the OG.

How would you describe your level of personal satisfaction after the project?

JCM: All projects teach you interesting aspects and end up producing both successful results and things to improve. Personally, I think that the project has provided very valuable information and now it is up to us to pass it on to the sector. I have no doubt that the working group will soon be active again.

MIH: Personally, I feel satisfied. We have been able to add to the range of agronomic practices a new technology that helps us to diversify crop management while saving water and diversifying pest and weed control.

In addition, and with respect to salinity, we have partially converted one of our worst enemies into an ally that helps us control the apple snail pest, considered one of the 30 most pernicious invasive species on the planet and which is caus-

ing havoc in rice fields in wetlands such as the Ebro Delta.

RMR: My personal assessment is very positive, as it has allowed me to interact with the different research centres and learn a lot from them, to get to know the technicians of the other participating cooperatives better and to share the tests, studies and field trials between all the cooperatives involved.

What difficulties have you encountered during the project in translating research into practice?

JCM: The participation of the Selmar Federation in the project has been essential, both due to their ability to guide the trials towards obtaining transferable results and due to the fact that they provide advice to hanging tomato producers and therefore do a very important job of transmitting knowledge in the sector.

From a more general point of view, the main limitation we have found has been the duration of the project, because a period of just two years makes it very difficult to deal with agronomic aspects, to draw conclusive results and to transfer them. However, as I said, we are continuing to work, as we are convinced that we have identified lines of work that can bring progress for the sector.

How do you rate the general work dynamic of the Operational Groups?

MIH: Very positively. Personally, I think that the structure of the operational groups has been a great success. The fact that entities in the sector (producers' associations, cooperatives, irrigation communities), companies specialising in the field and research centres can carry out projects that use innovation to respond to concerns, threats or weaknesses in the sector with the participation and incorporation of the knowledge and experience of all the agents, from my point of view, represents a working framework that aligns the sector's demands with research and promotes the use and services of the public and private resources that are assigned to it.

RMR: The truth is that I really appreciate the collaborative work between the FCAC, the research centres and the cooperative technicians as, although at the beginning it was a little difficult for us all to find the same common thread, in the end we found a good work dynamic and the presentation of the conclusions was like the end of a party, where we could see all the work done, which was no small amount, and which is sure to help us improve the management of livestock manure, gain a better understanding of its characteristics and applications and improve the environmental sustainability of its use as fertiliser.

