

## Valorising European Research for Innovation in Agriculture and Forestry



### VALERIE Stakeholder Trials:

## Demonstration of combined cropping of wheat and lentils

#### The problem

In France, as in much of Europe, many farmer cooperatives are dependent on the import of protein crops for livestock feed. Demand for protein crops is high in organic and conventional sectors and some farmers are growing lentils and high protein wheat to meet their protein deficit, although problems associated with establishment of lentils and lodging of both crops remains a challenge in both sectors in the Midi-Pyrénées region.

#### The proposed solution

Developing lentil production and supply in organic and conventional sectors can partially meet farmer demand and offer diversification opportunities. In particular, growing wheat in combination with lentils provides an opportunity to maximize lentil production and increase protein content in the wheat. However applied field experiments and demonstrations are still needed to determine the most effective establishment methods to achieve the best outcome for both crops. This research has been enabled and facilitated by the Qualisol cooperative, which has acquired an optical sorter to help harvest the combined crops. The development of this technology has allowed the cooperative to justify testing wheat and lentil intercropping at a large scale.

#### Stakeholders

The main stakeholder groups are the farmers and supply chain actors of the Qualisol cooperative. One of the aims of the cooperative and its members is to diversify the crops in conventional and organic agriculture and to develop markets to secure agricultural income within the territory. The Toulouse agroecology platform (located at Auzerville agricultural college) supports the Qualisol Technical Service in testing the technical feasibility of intercropping. The different ideas tested in the field have originated from Qualisol farmer groups, including the EEIG (Economic and Environmental Interest Group), Post-Maet Gimone project partners and farmers in organic farming systems.



## Aims and Method

The main aim of the trial was to assess the effect of wheat and lentil intercropping on wheat protein and lentil performance, specifically examining different establishment methods and seed rates. These trials can be considered more as demonstrations as they are primarily intended to support discussions between Qualisol technicians and farmers. Indeed the co-development process involving farmer groups and students preparing a diploma on Agronomy Crop Production was one of the main innovations reported here. All the stakeholders were involved in field trial implementation.

The trial aims to evaluate how different sowing and establishment methods for intercropped wheat and lentils affect lentil performance (yield and quality) and wheat protein content.

Three treatments were tested:

- Testing different lentil seeding methods (oversown into established wheat or undersown with the wheat)
- Testing a winter improved soft wheat variety and a spring wheat variety
- Testing 3 sowing densities of both wheat varieties



Sowing with a single seed drill  
(wheat and lentil mixed in the seed drill box)

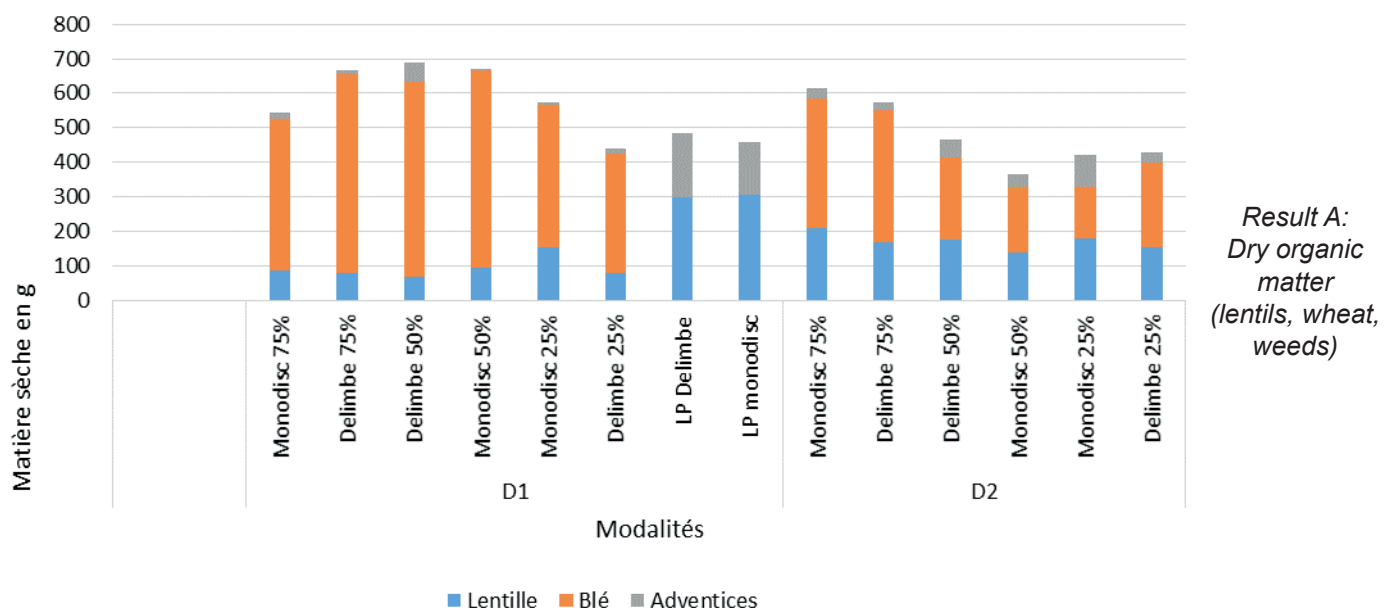


Sowing with a weeder harrow & delimbe type seed drill  
after sowing wheat with a single disc seeder

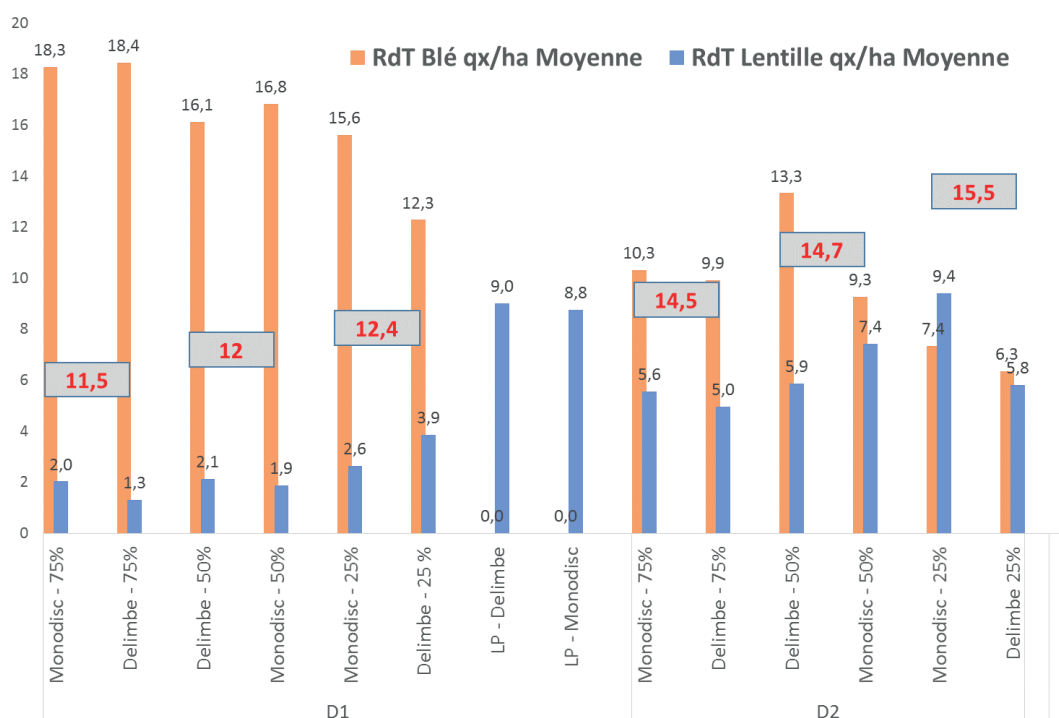
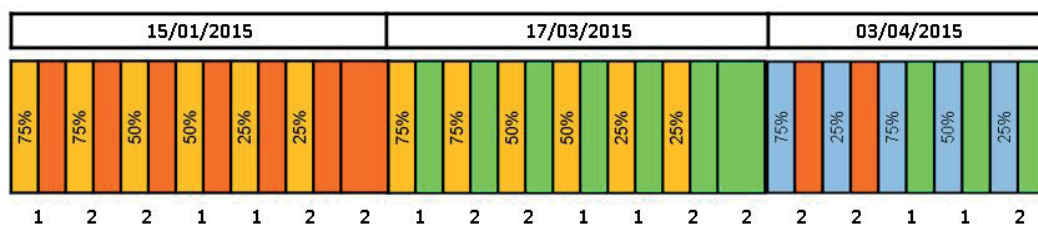
The wheat varieties were matched separately with specific crop establishment methods: lentils were oversown into the winter wheat variety, and undersowing of lentils was carried out with spring wheat. Both varieties of wheat were sown at three seeding rates: 75%, 50% and 25% of the recommended dose in monovarietal plantings. For the wheat sown on January 15, the lentils were oversown into the established wheat on March 17. Prior to the lentil sowing, a rotary hoe was used to facilitate soil to lentil seed contact.

## Results

### Matière sèche pour 3\*0,36 m<sup>2</sup>



100%	Valbona 230kg/ha
100%	Septima 204kg/ha
	Lentille verte 100kg/ha
	Lentille corail 100kg/ha
1	Monodisque
2	Delimbe



**Result B:**  
Average yield in wheat and lentils for each modality (n=3).  
Protein content refers to an average sample of each modality

### Different modes of crop establishment

**Undersown lentils after wheat establishment.** The aim was to optimise wheat emergence by drilling in the optimum period for germination (i.e. in mid-January) and to sow lentils in the wheat (mid-March). However, oversowing the lentils created too much competition for the lentils and resulted in reduced lentil yield. Wheat outcompetes lentils for light, water and nutrients in this type of sowing. The poor rooting of the lentils sown in wheat did not allow good establishment resulting in losses at the seedling emergence stage. During periods of soil moisture deficit, the wheat, which was well rooted, outcompeted the lentil crop for water. There were no differences in yield between sowing with a single-disc or weeder harrow.

**Lentils undersown with wheat (simultaneous drilling).** This method involves sowing wheat and lentil crops simultaneously at the optimum time for lentil establishment, thereby reducing the workload for the farmer. Sowing with a single-disc provides better quality seedlings (securing the emergence of the wheat and the lentils) compared to sowing with a weeder harrow; and better lentil rooting, development and yield. It also improves the lentil stem height. This treatment resulted in higher wheat protein content, most probably due to the N fixed by the lentils. There were also indications that this intercropping establishment method reduced pest pressure.

**Sowing density.** Lentils are sensitive to competition from any other plant species, thus oversowing into a growing crop resulted in significant yield penalties for the lentil crop (> 50% loss compared to the monocropped control: "single lentils"). Simultaneous sowing secured lentil yields, provided that the wheat seed rate was less than 50% of the recommended rate to limit the competition from the wheat crop.

### Next steps

The results from the field trial show that it is also necessary to adjust the seed rate according to the soil type. The high sensitivity of the lentils to water stress should be taken into account both in the choice of field plots and the seed rates recommended by technicians. Intercropping helped to reduce pest pressure. Nevertheless when pest pressure was high, it still had a significant (negative) impact on yield. In an attempt to better control disease pressure on wheat, some new formulations designed to stimulate the natural crop defence mechanisms will be introduced in the next intercropping experiments. The intercropping trials will be extended, with research into using companion plants such as wild flax (*Camelina sativa*) to provide support to the cash crops and reduce lodging.



The proposed trials are aligned with Qualisol's aim to diversify farming systems by integrating different techniques such as cover cropping and intercropping, and supporting new innovations to develop appropriate crop management on each farm.

This project aimed to have an impact across the whole area covered by the Qualisol cooperative and was validated through an EIP-Operational Group in September 2016 (a project for Total Quality Agriculture).



## Overall stakeholder involvement and feedback

The involvement of farmers, students, field technicians and the development service throughout the trial ensured engagement and interest from all stakeholder groups and a good level of understanding. This led to an increase in the area growing intercropped wheat and lentils in organic and conventional agriculture. More than 300 ha of intercropped wheat and lentils have now been established within the Qualisol territory. In conventional agriculture, more than 700 ha of lentils were introduced. The results in terms of lentil and wheat yields were very encouraging, demonstrating real economic benefits to the farmer. However some technical difficulties in sorting grains post-harvest do remain.

Farmers visited the demonstrations during the AgroEcology platform open days at the agricultural college. The trials were presented by Agronomy and Crop Productions Diploma students to more than 150 farmers in the Midi-Pyrénées region; there was also a specific visit with technicians and development services (5 leader farmers and 3 Qualisol technicians). Feedback on the trials from Qualisol farmers was conducted in February 2017 for the launch of the new campaign.

## Key findings

- Oversowing lentils into an established wheat crop created too much competition for the lentil crop and resulted in significant yield losses.
- Simultaneous undersowing of lentils with spring wheat provided more positive results and sowing with a single-disc resulted in better emergence.
- Simultaneous sowing secured good lentil yields, provided the wheat density was less than 50% of the recommended seed rate.
- Strong farmer and student involvement throughout the development of the trial ensured engagement and interest.
- More than 300 ha of intercropped wheat and lentils have now been established within the Qualisol territory.



## Acknowledgements

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