

Intercropping winter durum wheat and rapeseed with legumes to diversify cropping systems.

Problem

Continuous cereal cropping systems are dependent on external inputs: this is hardly sustainable in the long term. Indeed, the limited nature of synthetic resources such as mineral fertilisers, together with their increasing price, jeopardises the sustainability of agricultural systems and global food security.

Potential solution

In low inputs contexts, intercropping cereals with legumes can increase cereals yield and protein content (Hauggaard-Nielsen et al., 2001), and reduce disease and weed incidence (Brooker et al., 2015). Intercrop rapeseed with pea leads to increased productivity of more than 50% compared to sole crops in 70% of the cases in Mediterranean climate (Fletcher et al., 2016).



Figure 1: Mixture of winter pea with durum wheat (left), winter fababean with durum wheat (center) and winter pea with rapeseed (right) in the on-farm trial located in Sucs (Lleida, NE Spain)

Outcome

The intercropping of durum wheat with legumes (pea and fababean) resulted in a drop in yield per area of -19% in the case of the wheat-pea and of -28% in the case of wheat-fababean. The fact that these species are similar in architecture, cycle and phenology created conditions conducive to competition between both. Wheat competing better resulted in a decrease in legume yields, partially compensated by an increase in wheat production in the case of the wheat-pea.

Rapeseed-pea intercropping allowed yield increases of up to 9%. This was made possible by the large difference between species, which allowed a better access to resources between the two crops. This complementarity was more important when each crop was sown at the appropriate date, in “relay-sowing”, extending the total cultivation period of the cropping system.

Practical recommendations

- **Select mixture species that:**
 - Are adapted to local pedoclimatic conditions;
 - Have active ingredients authorised for both species.
- **Select cultivars, according to local seed costs and availability on the market, with:**
 - The same maturity time.

For wheat-legume intercropping:

 - A similar grain size to avoid losses at harvest;
 - A different grain shape if cropped for grain, to ease grain separation (if mechanical); in the case of optical sorting, the grain shape is less important, but a different colour is preferable;

For rapeseed-pea intercropping:

 - A short rapeseed variety;
 - A large pea and/or a pea with a good ability to cling to a host plant thanks to numerous tendrils.
- **Weed control**
 - Apply herbicide in accordance with weed pressure, make sure that the product is authorized for both species at the phenological stages they are at the time of treatment;

Applicability box

Geographical coverage

Mediterranean climate, continental trend (Spain)

Application period

Winter crops

Required time

When not using seeders/planters adapted to multi-sowing rates additional time during sowing for an extra pass can be required. No additional time during crop development. Crops are harvested together. If cropped for grain, additional time is needed to separate the mixture in a collection point.

Period of impact

Duration of crop

Equipment

Standard machinery used for cereal cultivation, both seeders and planters are convenient.

Combine regulation adapted to the presence of two types of grain.

- Be particularly attentive if the plots are fertilised with mineral N, as weed pressure tends to increase with fertilizer availability.

- **Sowing**

For wheat-legume intercropping:

- When intercropped, cereal outcompete grain legume when using half of the sowing rate of sole crops;
- Use a narrow row spacing if the objective is to reduce weeds pressure (15 to 20 cm), a conventional seed drill is convenient.

For rapeseed-pea intercropping:

- Sow each species at the appropriate date, even if this means sowing twice: in September for rapeseed and in October for pea.
- A precision planter is preferable, as it allows a sufficient width between rows (30-40 cm) for each species to grow without compromising the development of the other at the beginning of the crop cycle.

- **Fertilization**

- Prioritize pre-sowing N fertilization with organic sources available (slurry for instance).
- Avoid high rates of N fertilization to prevent cereals lodging, which can result in grain losses and penalise the legume maturation. Legumes with a more erect architecture, such as faba bean, will withstand it better.

- **Harvest**

- Adjust harvester cutter bar height to pick up grain legume pods close to ground.
- Use an intermediate clearance between concave and cylinder adapted to the grain size of each crop.

- **The success of the intercropping** is affected by different factors such as soil and climate conditions, choice of species and cultivars, organic vs conventional management system, weeds/pests/diseases control, technical equipment and type of intercropping.

Further Information to test intercropping under farm conditions

- Choose preferently a field with a low weed seed bank, so it be possible to avoid herbicide use (figure 2)
- Consider cultivating on other neighbouring plots the same species as sole crops, to evaluate qualitatively the performance of intercropping (figure 3).

Figure 2: Mixture of winter pea and durum wheat at flowering stage with 75 kg N/ha, without herbicides (within the flags, delimited by the orange square), and with weed control (outside the flags)



Figure 3: Mixture of winter pea and durum wheat at maturity stage with 75 kg N/ha top dressed, wheat lodged on pea.

Further Information

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About this practice abstract and Biodiversify

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Biodiversify is a PRIMA 2019 project (<https://www1.montpellier.inra.fr/wp-inra/biodiversify/>) investigating how agricultural biodiversification (i.e. mixed cropping, cover cropping and agroforestry) can increase ecosystem services, sustainability and resilience of Mediterranean agriculture.