



Cereal-legume intercropping: basic principles in practice

ABSTRACT

Intercropping is the practice of growing two or more crops together. It can deliver economic and environmental gains due to increased resource-use efficiency. It often leads to greater total yield and improved quality (e.g., grain nitrogen), reduced chemical inputs, improved soil quality and pest and disease suppression.

Below, we provide information about the practical factors that farmers and growers can manipulate when **designing, sowing and managing** cereal-legume intercrops. The information is based on scientific knowledge and practical experience of intercrop field trials. Links to further sources of information and visual guides are also provided.

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CONTEXT

Crop diversity can be increased by intercropping, i.e., growing two or more crop species together. Intercropping has the potential to:

- improve crop resource use efficiency
- stabilise yields
- suppress pests and diseases
- provide resilience to climate stress

The [DIVERSify legacy website](#) provides an overview of the evidence generated during the research project to support these potential outcomes.

Despite the potential contribution to agricultural sustainability, intercropping is not practiced widely in many parts of Europe. This is partly due to lack of practical information about the sowing, management and harvesting of intercrops.

Often, intercropping involves mixing cereal and legume crops because legumes reduce the amount of nitrogen fertiliser needed for crop growth and following crops. Here, we provide some advice on growing cereal-legume intercrops.



Fig. 1 Wheat-faba bean intercrop being trialled in 2017 at the James Hutton Institute's Balruddery Farm, UK

PRACTICAL RECOMMENDATIONS

- Select **cereal and legume species** according to your desired end use (grain, biomass, cereal or legume as the main cash crop). Common examples include:
 - pea with barley for grain and biomass for silage
 - faba bean with wheat or oats for grain or silage
 - recently established cereal undersown with clover, or cereal direct-drilled into an existing (recently cut) clover stand for resource use efficiency.

The DIVERSify stakeholder report contains many ideas of possible intercrop combinations¹.

- Select **varieties** depending on your desired **yield, agronomy, disease resistance features and planned end use**. For example, cereal and legume varieties with aligned maturity times might be needed for grain production, although some convergence can be expected. Useful resources include national recommended variety lists and trial results from the DIVERSify project².
- Intercrops **can be sown using standard drill equipment** for cultivated soil or direct drill. **Sowing density and proportion** of each crop varies depending on end use and the **competitive ability and vigour** of the component varieties, which can be variable between seasons and hard to predict. It can range from a proportion of

20:80 to 80:20 (legume:cereal) depending on if the cereal or the legume is the main crop, and could include one crop at a standard density (e.g. 30:100 cereal:legume). Consider higher densities of one component to enhance features such as weed competition.

- Legumes require little nitrogen fertiliser, so nitrogen inputs in cereal-legume intercrops can be minimised. As a rule-of-thumb, **nitrogen fertiliser can be reduced by the same extent as the cereal sowing density**. [DIVERSify Factsheet no. 4](#) provides a detailed example. If fertiliser needs to be added, consider forms with a smaller proportion of nitrogen, e.g. ammonium sulphate rather than ammonium nitrate.
- Intercrops are often reported to develop fewer weed, pest and disease problems than monocultures, and **crop protection products might not be needed at the standard application rate or frequency**. Check compatibility of cereal and legume crop protection products and permitted use regulations if applications are necessary. [DIVERSify Factsheet no. 2](#) provides more information on the potential benefits of intercropping when it comes to control of disease, pest and weed problems.
- Cereal-legume intercrops **can be harvested for biomass or grain using standard cutting, baling and combine equipment**. Grain cleaning kit may be useful for separating cereal and legume grain after harvest. If intercropping for grains, keep in mind that **species with similar sized seeds or seed fragments are difficult to separate** with a sieve. More expensive colour sorters may be needed. Bespoke kit or hand-sorting may be an option for low volume high value mixtures; however, it may



Fig. 2 Lentil trialled in 2018 as an intercrop with barley at the James Hutton Institute's Balruddery Farm, UK



Fig. 3 Oat-pea-rye mixture grown for biomass at a farm in the east of Scotland

also be possible to negotiate with buyers who might have access to suitable equipment. Visit and watch [this Agricology video](#) to learn more, or go to [DIVERSify Factsheet no. 14](#).

Keen to try more? Consider how a cereal-legume intercrop fits best within your **rotation or crop sequence**, seeking advice where needed.

CONCLUSION

Overall, our trials have shown that cereal-legume mixtures suppress weeds, often have fewer pest and disease problems, and require less nitrogen fertiliser, which improves crop growth particularly when pesticides and herbicides are not used. The mixture can potentially produce more yield than if each crop is grown separately.

Although intercropping is not a new practice, there are many things we still need to learn to optimise intercropping practice. **The DIVERSify project has worked with researchers and farmers across Europe to gather evidence of different intercrops' performance and information about optimal management for cereal-legume and grassland crops in different farm and environmental conditions.** You can read case studies from some of these trials from across Europe at plant-teams.org.

Bearing in mind the desired end-use for the crop(s), adjustments can be made to agronomic practice to accommodate intercrops. Although not always necessary, adaptations of existing drilling, harvesting and seed cleaning equipment could provide solutions to some of the practical challenges imposed by intercropping.

REFERENCES

1. Pearce B. et al. (2018) [D1.1 - Synthesis report on national stakeholder meetings](#). Developed by the EU-H2020 project DIVERSify
2. Scherber C. et al. (2019) [D2.10 - Summary report on performance of stakeholder-driven plant teams](#). Developed by the EU-H2020 project DIVERSify

FURTHER INFO

- > [This short film](#) outlines the benefits of intercropping and how to intercrop in some more detail
- > Read on to discover more about intercropping and crop protection: [DIVERSify Factsheet no. 2](#) - [DIVERSify Factsheet no. 3](#)



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