TECHNICAL GUIDE NO. 1

Cereal-legume intercropping: basic principles in practice

The problem

Better practical information on the principles of intercropping (growing two or more crop species together) needed for farmers.

The solution

Identify the practical factors that farmers can manipulate in designing, sowing and managing their crops. These are based on scientific knowledge and practical experience of intercrop field trials and summarised below.

The outcome or benefit

Intercropping can deliver economic and environmental gains due to increased resource-use efficiency, often greater total yield and improved quality (e.g. grain nitrogen), reduced chemical inputs, improved soil quality and pest and disease suppression.

Applicability box

Geographical coverage

All arable regions

Timings

Determined by the crop species and local growing season

Potential Benefits

Current and subsequent crop

Machinery

Standard farm machinery but increased options with precision adaptations.

Best in

Annual crops

Figure 1: Sowing density in wheat-faba bean intercrop.

Figure 2: Baling wheat-faba bean biomass for silage.

Practical recommendation

- Select cereal and legume species according to your desired end use. Common examples include: pea with barley for grain and straw production: faba bean with wheat or oats for grain or silage; or recently established cereal undersown with clover, or cereal direct-drilled into an existing (recently cut) clover stand. See the **DIVERSify stakeholder report** for inspiration on possible intercrop combinations.
- Select varieties depending on your desired yield, agronomy, disease resistance features and planned end use. For example, cereal and legume varieties with aligned maturation 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 project**.
- Intercrops can be sown using standard drill equipment for cultivated soil or direct-drill. Sowing density of each crop is typically half the standard rate (Fig. 1), although cereal:legume sowing ratios often range from 20:80 to 80:20 depending on end use and the competitive ability and vigour of the component varieties which can be seasonally variable and hard to predict.
- Legumes do not require 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, although could be reduced even further as some nitrogen will be provided to the cereal by the legume. If nitrogen needs to be added, consider forms with a smaller proportion of nitrogen, e.g. ammonimum sulphate.
- Intercrops are often reported to develop fewer weed, pest and disease problems than monocultures, and crop protection product might not be needed at the standard application rate or frequency. Keep in mind that cereal and legume crop protection products might not be compatible.

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- Cereal-legume intercrops can be harvested for biomass or grain using standard cutting, baling and combine equipment (Fig. 2). Grain separators may be useful for separating cereal and legume grain after harvest. If intercropping for grains, keep in mind that species with similar sized seeds are difficult to separate with a sieve, and more expensive colour sorters (or hand-sorting for low volume high value mixtures) may be needed.

Practical testing

If you would like to try intercropping on your farm, we recommend that you carry out a trial as follows:

1. Divide a field or part of a field into three similar sized trial plots. Where possible, homogenous growth conditions in the field enable a clear evaluation of the effects of this method;

2. Mark the limit between the three areas with GPS and/or physical markers at each corner of the plot, so that the limits of the trial plots are easily identifiable;

3. Sow a cereal-legume intercrop into the middle plot and manage as described in the practical recommendations. The other two plots can each be sown and managed as standard monocultures using the same cereal and legume varieties as the intercrop plot.

Evaluation and sharing of the results

- **Visual evaluation**: To evaluate the performance of the intercrop, you can visually estimate indicators such as crop greenness, disease incidence and weed density in the intercrop plot compared with the monoculture plots. Document the three plots with photographs for later evaluation.
- **Quantitative evaluation**: For a quantitative evaluation of intercrop performance, record the yield of the harvested product (biomass or grain per unit area), where possible with a yield map to help account for variation inherent in the field. Calculate the expected yield of the intercrop: for a typical intercrop sown at half the standard sowing rate, the expected yield is the sum of the cereal and legume monoculture yields divided by half. If this value is
  - approximately one, the intercrop has performed similarly to the monoculture
  - greater than one, the intercrop has performed best (sometimes termed over-yielding)
  - less than one, the monoculture has performed best

Share your experience with other farmers, advisors and scientists. Send your feedback to diversify@hutton.ac.uk.

Further information

- The DIVERSify stakeholder report provides a comprehensive list of intercrop species combinations that have been documented in countries throughout Europe and beyond. It also summarises some of the challenges of intercropping and their possible solutions.
- National and recommended lists provide information about yield, agronomic traits and disease resistance characteristics of commercially available crop varieties.
- The DIVERSify trial results provide summary information about the performance of different cereal-legume variety combinations across different European trial sites.

About this technical guide and DIVERSify

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