DIVERSify Factsheet no. 3

AGRONOMY

Close up on weed control using plant teams

ABSTRACT

Intercropping legumes with cereals or other crop(s) can be an efficient means to control weeds and enhance soil fertility, with significant reductions in the need for herbicide and fertiliser applications. **The most promising plant teams show contrasting root architectures and high capacity to absorb soil nitrate early in the growing season before the legumes start to fix nitrogen.** Such plant teams can be highly competitive with weeds and significantly reduce weed pressure particularly when compared to weed-sensitive legume crops grown in monoculture. This is due to complementarity or facilitation between crop species.

Below, we consider the example of **winter white lupin and triticale** as a case study plant team combining efficient weed suppression with satisfying yields. It is important to bear in mind that trade-offs between weed competition and yield can exist. In certain agronomic conditions, intercropping may conversely enhance weed problems. The causes for such variable performance of plant teams on weed control are in many cases linked to fertilisation and management of soil nitrogen. It is important to **consider the nitrogen responses of common local weed species**, especially 'nitrophilic' ones.

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CONTEXT

European agriculture is seeking to diversify its crops and cropping systems. In this context, including grain legumes such as peas, faba bean or lupins in cereal cropping systems can lead to improved soil fertility and reduce the use of nitrogen fertilisers. However, **legumes are known to be weak competitors against weeds** when grown as monocrops. Mixing cereals or other crops with legumes within the same field can be a sustainable solution. Indeed, **weed suppression has been proposed as one explanation for the intercropping yield advantage** that is often observed from growing two or more crops together in the same area of land versus separately. Many plant teams have been shown to be highly competitive against weeds, regardless of weed species, crop biomass or soil nitrogen availability as introduced in DIVERSify Factsheet no. 2. However, farming practice reports **variable results** including cases with increased weed suppression but also enhanced weed problems when growing species mixtures.

PLANT TEAMS FOR WEED CONTROL?

Fig. 1 Weed infestations can be challenging when growing lupins but intercropping with a cereal, such as triticale, can prevent weeds from getting a hold

Cereal-legume plant teams can be effective at reducing weed biomass even when the proportion of the cereal in the mixture is low. The most efficient plant teams comprise of crops with **contrasting shoot and root architectures**. This allows for **complementarity** of plant traits that maximise space or resource utilisation. For example, roots of different companion species can explore different parts of the soil, especially at crop establishment, and collectively absorb larger quantities of nitrate and other nutrients. This leaves as little as possible in terms of space and/or resources for exploitation by weeds and is an example of **more efficient resource use**. In the DIVERSify project, in experimental trials across Europe, we explored many different mechanisms by which **plant team complementarity, or facilitation** (benefiting the performance of one another either directly or indirectly) might occur[1].

Figure 2 highlights an efficient plant team. Winter white lupin monocrop was compared to winter white lupin and triticale, and winter white lupin and wheat intercrops across experimental trials at eleven sites over a two-year period in western France. **Intercropping with triticale reduced weed biomass at lupin flowering by an average of 63%.** The rapid growth and high soil nitrate acquisition of triticale compensated for the low competitive ability of lupin against weeds. Competition from triticale in the intercrop reduced lupin grain yield (–34%) but intercropping produced a higher total grain yield (+37%) than the lupin monocrop and maintained the total protein grain

yield. In addition, the intercropped legumes were found to often fix 10 to 15% more atmospheric nitrogen compared to the monocrop[2].

FURTHER CONSIDERATIONS

More generally, in intercropping research and farming practice, cases of increased weed suppression have been reported, but weed problems are also observed. The causes of the variable results are in many cases **linked to the availability of nutrients, especially nitrogen**, together with the nitrogen response characersitics of the weed species that are common in a given area. For instance, in pea-barley intercrops grown in Central Sweden, it has been shown that high soil nitrogen supply favours highly nitrogen responsive – nitrophilic – weed species, such as goosefoot (*Chenopodium* spp.), over those with a lower nitrogen response, such as hemp-nettle (*Galeopsis tetrahit*)[3]. As a consequence, in many cases, nitrogen fertilisation may favour only the nitrogen-responsive weeds and not the other weeds or the crop[4].

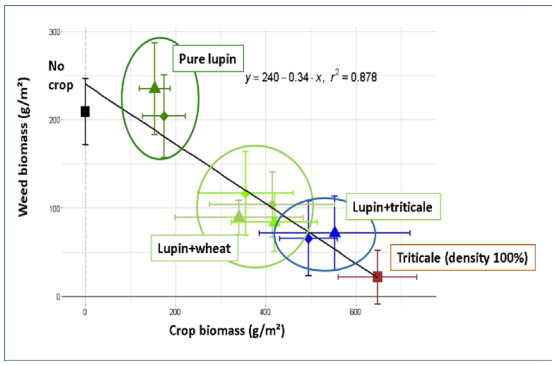

Fig. 2 Intercropping with cereals has been found to lead to reduced weed biomass (at flowering) when growing winter white lupin in western France

To ensure optimal performance of cereal-legume plant teams, legumes should be grown in **favourable conditions to ensure the production of active nodules on their roots**. This is necessary to limit nitrogen competition between the companion crops during their growth; a pink colour inside the nodules indicates that the plants can fix nitrogen from the air. Low soil nitrate levels favour nodule formation, but a good availability of phosphorus, sulphur, potassium, micronutrients and water, a pH around 6 to 6.5, and the presence of nitrogen-fixing bacteria (Rhizobium) are also necessary. Also see DIVERSify Factsheet no. 4.

Spatial crop design can also exert a strong influence on crop yields and the weed suppression capacity of intercrops. For instance, in soybean intercrops, the greatest weed suppression was achieved with buckweat, followed by sunflower, sorghum and lentils, whilst the opposite order was obtained for soybean yields. In this case, a design using alternate-rows helped to increase soybean production without compromising weed suppression capacity[5]. Further study is needed to understand how to better manage trade-offs between crop yields and weed control, or between crop yields and soil fertility. Solutions can be found in the **choice of cultivars** and spatial arrangements.

Fig. 3 Soybean intercropped with sunflower and sorghum

CONCLUSION

Mixing a cereal, or another crop, with a legume can be a way to suppress weeds and enhance soil fertility, reducing nitrogen fertiliser costs as well. However, whilst research and farming practice have revealed cases of increased weed suppression, there are also cases where weed problems occur when growing mixtures. **Increased knowledge of the relationships between local weed flora and soil fertilisation practices, spatial arrangements to mitigate the trade-offs between weed control and yields and suitable cultivar choice will help to improve plant team performance with respect to their capacity to suppress weeds and support high crop yields at the same time.**

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FURTHER INFO

> Read on to discover more about intercropping and soil fertilisation: DIVERSify Factsheet no. 4

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