Brassicas limited in weed control

Paul Kristiansen of the University of New England in NSW, discusses the limitations of using brassica cover crops for weed control.

Cover crops, or green manure, have played a vital role in organic agriculture due to their wide variety of benefits in the farming system.

Having them in the crop rotation contributes to nitrogen fixation by legumes, remobilising unavailable nutrients (for example, those too deep in soil for cash crops or bound to clay), bulky carbon inputs from cereals, breaking pest and disease cycles, hosting beneficial organisms, and maintaining ground cover, thereby conserving soil moisture and reducing erosion.

Many benefits from using cover crops are closely related. For example, increasing soil organic matter with green manures provides better nutrient and water-holding capacity as well as improving soil structure. The overall improvement in soil conditions allows for better plant vigour out competing weeds) and hardiness (pest and disease resistance or tolerance).

The extra soil organic matter also provides more food for soil microbes to consume, increasing overall microbial activity, reducing the impact of harmful soil organisms and further improving crop performance.

The benefits of cover crops are many but a successful cover crop requires good management and attention to detail. Establishing and maintaining cover crops also needs to be closely integrated with other aspects of the production system over time and space, just as for a cash crop.

While cover crops commonly have no direct cash benefit, the benefits or ecosystem services listed above provide a valuable indirect contribution to the farm budget. Many of these benefits can be measured (for example, soil nitrogen produced, disease severity) but there are several other potential advantages with off-farm implications, such as atmospheric carbon sequestration and total energy consumption, that are more difficult to estimate.

The cover crop needs to be well-planned within the farm’s rotation schedule to maximise the range of benefits achieved, such as weed suppression by rye versus nitrogen gain with vetch. In many cases, a mixture of annual plants would be appropriate.

Selecting crop varieties suited to local soil and climatic conditions often requires trial and error. While it is easy to stick with a regular formula, using cover crops from a mix of plant families — not just legumes and cereals — introduces a greater level of biological and agricultural diversity to the farm’s ecosystem.

Other crops such as marigolds in the daisy family, buckwheat in the dock family and the various mustards, radishes, turnips and so on in the brassica family offer unique characteristics such as nematode, weed and fungal control.

BRASSICA, BIOFUMIGATION AND BIOHERBICIDES

Use of plants from the Brassicaceae family, or brassicas, as cover crops has long been observed to have a cleansing effect on soils with certain plant pests, including

root-knot nematode and cereal take-all, whether through release of chemicals (allelopathy) by the cover crop or through absence of a suitable host for the pest.

Researchers in Australia looking at the effect of brassicas in conventional crop rotations on various pests and diseases have anecdotally reported that cover crops appeared to have a suppressive effect on weeds in the subsequent crop, presumably due to a group of chemicals called glucosinolates (GSL).

Other reports from Europe and North America have also suggested brassicas can be used for integrated weed management due to their apparent allelopathic effect on weeds. However recent work on brassica cover crops in Finland, Italy, the United States and Australia has found very little evidence of a reliable effect on weed numbers, even using high GSL varieties.

Although weeds may be effectively controlled during the time the cover crop is growing, weed levels in the following cash crops are the same as those for cash crops grown after various fallows or other cover crop varieties. The absence of an effect on weeds may be attributed to:

• insufficient plant material grown in a season to achieve effective weed control;

• incorrect timing of operations related to the cover crop, including termination and incorporation;

• lack of persistence by GSLs in the soil after incorporating the cover crop, especially where cover crop residues are mulched and turned into the soil; and

• disturbance of soil due to tillage practices in annual cropping.

Several signs show allelopathy was probably not even a significant factor in inhibiting weeds during the cover-crop phase. They include a strong link between shading and weed levels, weeds continuing to emerge very close to the cover crop without inhibition, and impacts not being correlated with the amount of brassica plant material added, or to measured GSL levels.

CONCLUSION

The inhibitory effects of allelochemicals are very specific to particular target plants and not others. Even when some weed suppression has been observed, certain weed species are susceptible and others are not inhibited at all.

This incomplete control is a normal aspect of an integrated whole-farm weed management program, where reliance is not placed on a single tool for broad-spectrum weed control. However, the number of reports indicating no effect on weed control by brassica cover crops provides a warning that allelopathic crops do not necessarily offer a simple, non-chemical “silver bullet” to weed control.

Indeed, very careful management is required to achieve success with any cover crop. After all, weeds have defied the silver bullets of tillage for centuries, herbicides for decades, and transgenic crop manipulation for several years.

Brassicas are a suitable alternate green manure to diversify rotations, add nutrients and improve soil structure and health. Brassica cover crops should be sown at the

seed supplier's recommended rate (or greater if the germination rate is unknown or doubtful) into well-prepared seed beds in order to maximise biomass production and out compete weeds. ■

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RESOURCES

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Cover Crop Resource Page by SAREP, UC-Davis has a cover crop database, links to publications and other web sites
http://www.sarep.ucdavis.edu/ccrop/search_ccrop.html