

Combining techniques Integrated weed control which will last ?

To reduce weed populations whilst limiting the use of herbicides, researchers are exploring various possibilities. Most of the ongoing work is concerned with rotations and cultural practices.



Ryegrass is a nitrophile plant : it reacts positively to fertilisation (in terms of biomass and seed production etc.).

Weed control, as practiced today, comes up against several limitations: increasing resistance of grasses to certain families of herbicides; regulation of active ingredients (Ecophyto plan 2018) and fear of an evolving weed flora, complicating its control.

In this context, could mechanical weed control present a credible and viable alternative for the arable cropping regions? Although this could be so for the southern half of France, it is not so clear for the arable areas of the northern half. Because of the higher rainfall and lower temperatures, the effectiveness of these techniques on the weed flora is often uncertain. On the other hand a combination of methods (*figure 1*) can give very good results. Associated with chemical control, mechanical weed control can, in certain situations, reduce the quantity of herbicides applied per hectare.

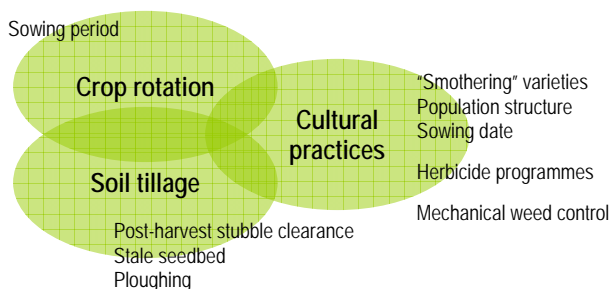
More crops, fewer weeds

The alternative techniques rely mainly on agronomy and aim to reduce the weed pressure. These techniques are well-known: lengthening rotations, making more use of soil tillage, and keeping modifying cultural practices.

Crop rotation allows an alternation of sowing periods and techniques. By increasing the number of crops in a rotation, the soil seed bank cannot be replaced and one encourages a smaller but more varied weed population. At each sowing period in fact there is a corresponding precise weed emergence: bromes and ryegrass emerge mostly in the autumn, whereas nightshade and amaranthus emerge in spring. The alternation of sowing periods breaks the weed cycle and restricts their proliferation.

Cultural practices such as the use of smothering varieties or bringing forward sowing dates help in the management of weeds.

The combinations of partially-effective control measures (figure 1)

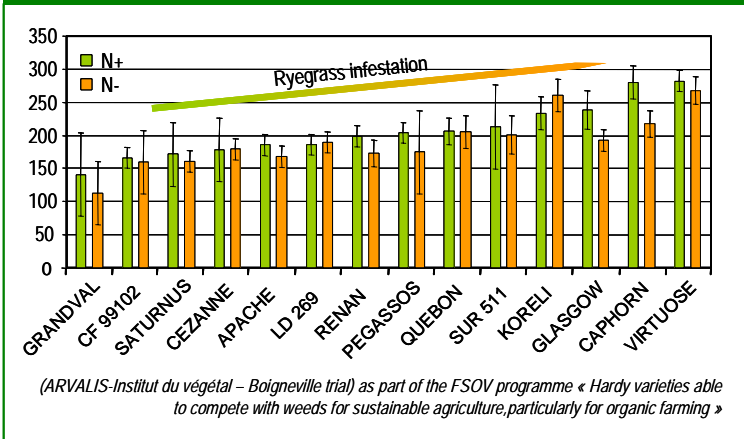


With a combination of crop rotation, cultural practices and soil tillage, one can limit the use of herbicides.

The value of tillage between successive crops

Soil tillage consists of post-harvest stubble clearance, stale seedbed creation and ploughing. Too often forgotten, these techniques ought to be rediscovered: they reduce the soil seed bank and hence the dependence of the system on herbicides. Post-harvest stubble clearing stimulates the emergence of weed seeds (perennial grasses and annual weeds). This is a particularly effective technique if the field is weed-infested at harvest and if it is known that the soil seed bank is large. The tool used is the secret of success of the operation: surface-tilling tools are the best for germinating the weed seeds.

Figure 2 : Comparison of ryegrass populations at flowering according to fertilisation. Increasing grading according to varieties as a function of the number of ryegrass ears in N +



(ARVALIS-Institut du végétal – Boigneville trial) as part of the FSOV programme « Hardy varieties able to compete with weeds for sustainable agriculture, particularly for organic farming »

Coupled with fertilisation, the variety has an established role, but the ranking of the agronomic factors which influence the ryegrass population is poorly understood.

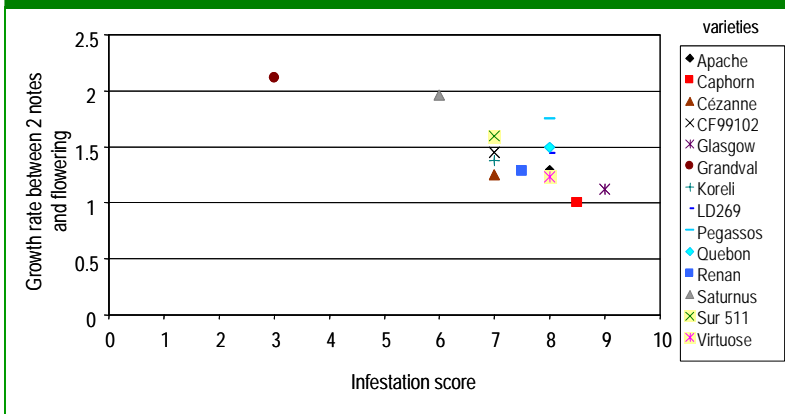
Stale seed-beds are especially effective for reducing the soil seed bank when growing winter cereals: for oilseed rape, it is valuable for controlling slugs and preparing the seed-bed. Ploughing is also a useful technique. In particular it will bury the seeds of annuals at depth (>15 cm), inhibiting their germination and inducing dormancy in persistent species. It also interferes with the development of rhizomes of hardy species. Meanwhile, the plough may bring to the surface some persistent seeds, but also buries them, thus favouring their conservation in the soil (mainly dicotyledons).

The more fertiliser is used, the higher the number of ryegrass plants.

Smothering wheat varieties

Cultural practices, at the time when the crop is established, are the final lever. The varietal type is also a tool for the management of weeds. The combination of variety, sowing date and density aims to give the wheat growth an edge over that of the weeds by smothering them.

Influence of growth rate at the end of winter on the presence of ryegrass in a plot of wheat (Figure 3)



Varieties like Saturnus have the lowest infestation score, apart from the Triticale control, whose score was much lower

Among the most promising is the smothering power of wheat varieties. Trials

FSOV is the French plant breeding support fund

carried out at La Minière (78) and Boigneville (91) – Parisian basin, as part of a FSOV1 project reveal the important varietal factors of wheat as regards competition against weeds. In these trials, different varieties of wheat were established, and their behaviour towards ryegrass (an artificial infestation) was regularly monitored. They were compared with a triticale control (Grandval). Triticale is very aggressive at tillering, has broad leaves and a spreading habit.

At optimal density and identical spacing, the trials have shown a varietal difference : for Grandval and Apache, there was very little ryegrass ; for Virtuose and Caphorn, there was a great deal (figure 2).

By combining the varieties with the infestation scores and the growth rate at the end of winter (between two

nodes and flowering), we find that the varieties with very rapid growth are the ones which compete best against ryegrass (figure 3). The smothering power of varieties associated with aggressiveness at tillering is equally important - the two factors are cumulative. Note however that despite the value of these results, the smothering power of varieties alone will not be enough to resolve the infestation problem. Its effect on a high population will not exceed 10% of weed suppression. The trial also showed a direct relationship between the level of nitrogen fertilisation and the ryegrass population. Hence the ryegrass confirmed its status as a nitrophile species.



The harrow is especially suited to row crops, at wide inter-row spacing

What to think about mechanical weed control?

Mechanical weeding is very fashionable just now. On certain crops, the effectiveness of implements like the light spiked chain harrow or the rotary hoe is encouraging.

Fitted with long, flexible, and very close tines, the spiked harrow scuffles the soil surface, destroying young weeds and encouraging emergence. By using it before the 2-leaves stage of the weeds, the efficiency is more than 80%. Made up of independent notched wheels, the rotary hoe is used after planting the crop, by avoiding the sensitive stages of crops, to destroy young weeds at the 2-leaf stage. Used in widely-spaced crops such as rape, sugar beet, maize and sunflower, hoes with shares, tines, or notched discs are used for weed control between the rows. The flexible-tined hoe is used within and between the rows. Its effectiveness depends on when it is used and the stage of the crop: 3-4 leaves for rape, 2 pairs of leaves for sunflower, and always before the height of the crop reaches that of the toolbar. The technological advance permitted by guidance systems (notably cameras) suggests that these techniques will be usable on crops with narrower row spacing (notably small-grain cereals). Trials will be set up in 2009-10 to evaluate the optimal row spacing, the efficacy to be expected and the operating conditions necessary for this type of tool.

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From Perspectives Agricoles n° 361 Nov. 2009

Combining the techniques

Some long-term trials have been set up by ARVALIS – Institut du végétal, ITB (French technical institute for sugar-beet) and CETIOM (French technical institute for oilseed crops) on the efficacy of mechanical weed control implements (see *interviews and box 1*), with the first interesting results.

However for cereals the limitations of these tools in terms of work rate or number of available days seems to limit their popularization in southern France. There also the best prospects are to be found in the combination of techniques.



The use of wheat varieties with broad leaves and a spreading habit helps with the competition against weeds like ryegrass.