

Sowing into a cover Sowing conditions are crucial

Sowing into a cover consists of drilling the crop directly into the residue of a cover crop. It has the advantage of combining rapid and cost effective crop establishment and preservation of both soils and the environment.

To master the technique, here is a report on what ARVALIS - Institut du végétal has learnt from experience on that subject.

Ground cover - A component requiring careful forward planning

Used increasingly often to protect the soil and the environment, the ground cover must not be too dense at the time of sowing to guarantee good crop establishment conditions. This is particularly an issue for spring crops for which a well drained soil and dry surface at sowing time is absolutely crucial.

Even though it is rather difficult to quantify, the presence of plant residue on the ground, or of a cover crop, helps preserve the structure of the soil, especially where drought induced cracking is limited (soils containing less than 18% clay, soils which do not dry out in the summer because they are irrigated...). Ground covers have several advantages, but also some downsides (table 1). A compromise must be reached. The management of the intercropping season must therefore be adapted to suit the type of soil, the rotation and the equipment used.

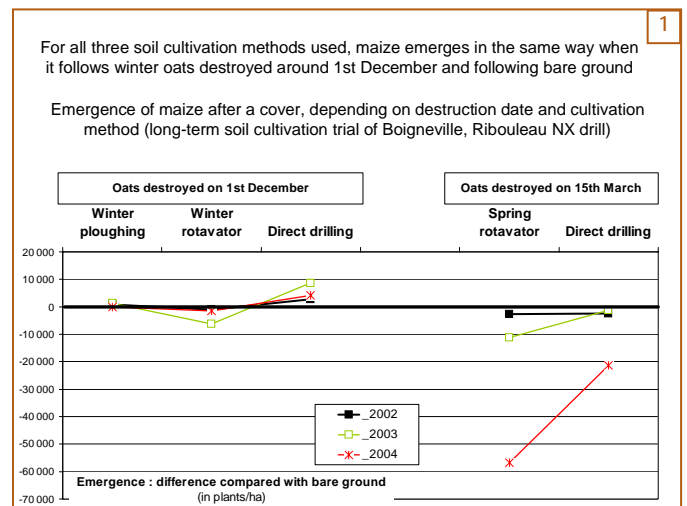
Although the main characteristic of sowing into a cover crop is sowing the new crop directly into the cover crop or its residue without cultivating the soil first, this technique includes a whole variety of practices: stubble tilling or not in the summer before the cover crop is sown, different species used as cover crops and cover crops destroyed at different dates. Such variations are crucial as they result in very different ground cover levels when it comes to sowing the crop.

Late destruction of cover often leads to disappointing results

Figure 1 shows the results of a three-year maize trial. The background of that particular trial is as follows: long-term soil cultivation established since 1970 in clayey silt, maize/wheat rotation combined with several cultivation techniques including direct drilling.

We used a heavy drill, suited to direct drilling (Ribouleau NX).

We have noted that for all three soil cultivation methods used, maize emerges in the same way when it follows winter oats destroyed around 1st December and after bare ground. Destruction of oats around 15th March resulted in poorer emergence in 2004. This was due to slugs and field mice in the direct drilling case and a coarse seedbed (seeds swelled in it before drying out) in the case of shallow cultivation.



Besides, 50% of the oats had suffered frost damage during the 2002/2003 winter. The maize emergence trends were similar to the yield patterns.

Examples of impact of cover crops with minimum tillage system		
	Positive Impact	Negative impact
Adds organic matter (OM) into the ground	<ul style="list-style-type: none"> • Addition of moderate amounts of OM • More rapid OM concentration on the surface 	
Increase in soil fauna	<ul style="list-style-type: none"> • Encourages biological activity (nutrients and more stable growing conditions) • Indirect impact on soil structure 	<ul style="list-style-type: none"> • Encourages slugs, especially in cases of abundant residue at time of sowing
Residue on the ground when crop is sown (sowing into a cover...)	<ul style="list-style-type: none"> • Fragile soils less prone to capping and erosion • Reduced run-off and associated leaching of pollutants • Reduced moisture loss through evaporation in the spring 	<ul style="list-style-type: none"> • Plant residue making sowing difficult (depending on drill used) • Drying of soil surface slower in the spring • Soil warms up more slowly

Over six spring barley trials, final emergence on soil that had had a cover were cut by 10% on average compared with emergence on bare soils (figure 2).

Two out of six trials showed that a slightly coarser seedbed resulted in more staggered emergence (25% less plants emerged at the beginning of the emergence period), following a dry spell of weather just after sowing. However, yields of spring barley sown after a cover destroyed fairly early are similar to yields obtained after bare ground. (figure 3).

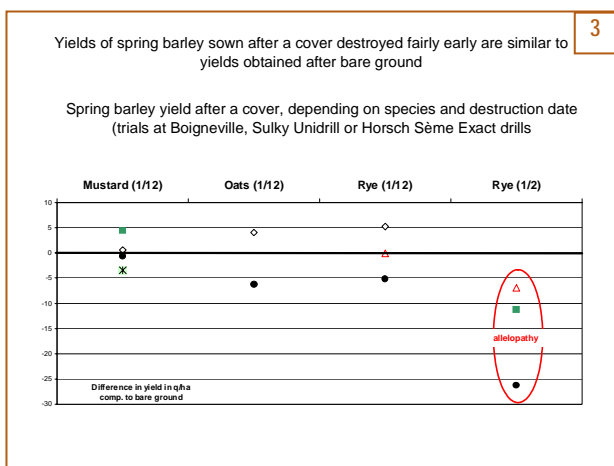
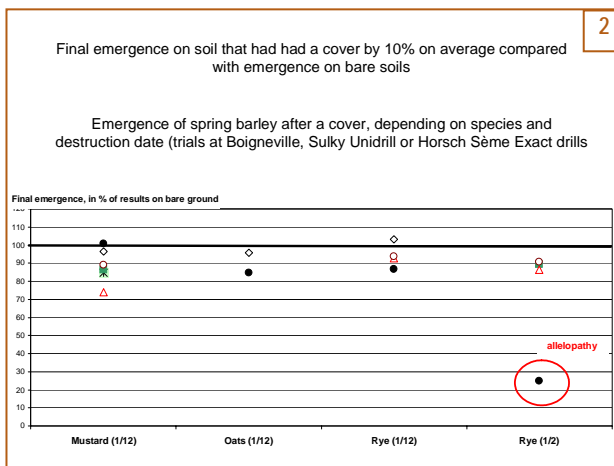
In one case noted in figure 2, after rye destroyed very late (around 1st February) with a sowing date of 16th February, very poor emergence was probably due to the effect of allelopathy (shoots were coiled and very few seedlings managed to emerge). Barley yields after rye which was destroyed around 1st February were badly affected: from -7 to -27 q/ha (figure 3). Even if growing rye before malting barley is not advisable for weed control reasons (risk of contamination), it is interesting to note the neutral impact of such a cover if it is destroyed around 1st December.

Beware of wet seedbeds

The results presented above show the impact that the date of destruction of the cover crop has on the establishment of crops sown into a cover. Late destruction can affect sowing conditions negatively and result in "plastic" soils and more active parasites. When covers are destroyed at the beginning of winter, "plastic" sowing conditions can also be encountered, especially in early spring (February-March) when sowing barley and peas.

We should add that in the results presented above, the soil cultivation techniques used were the same on bare soil and on soil with a cover. Sowing dates were the same and represent a "compromise".

2002, 2003 and 2004 had rather dry springs, which resulted in well drained soils. However, dry windy conditions after sowing bring disaster if the seeds are not positioned exactly as they should be (clods, seed depth, seedbed consolidation...).



When sowing into a cover, the seedbed (earth crumbled by the discs of the drill) is sometimes finer after cover crops thanks to the way they protected the soil structure (through their roots and covering the ground). The opposite is sometimes also true, including when the cover crop is destroyed rather late on (the root system may restrict the soil crumbling effect of the discs and the soil may remain damp). Even if there are no hard and fast rules, success nevertheless depends on well drained soils at sowing time. It may seem obvious to wait and sow in good conditions, but in reality, it is not as simple as that. It is therefore important to adapt the management of the intercropping season (stubble tilling, cover crops, destruction date...) to suit the nature of the soil and ensure it is able to drain and dry properly, especially in cases where it is naturally slow to do so, like hydromorphic or clayey soils. When possible, sowing on frozen ground makes things easier, especially to sow barley in clayey soil. It helps achieve good sowing conditions. Mulching the cover on frozen ground in winter is another way of reducing the effect the cover has on the wetness of the ground in springtime. When soil conditions allow it, shallow winter cultivation helps achieve a fine and easily drained layer of soil in the spring. The cover crop residue reduces the ability of the soil to freeze. The option to drill in good, frozen conditions will then be more limited than on bare soils.

Intercropping season and cover crop

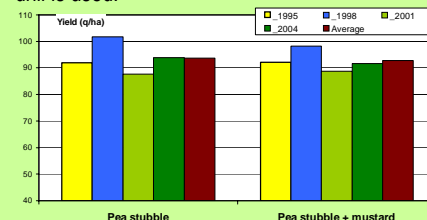
In French, intercropping season ("interculture") and cover crop ("culture intermédiaire") are often mixed up. The intercropping season is the period between harvesting of a crop and sowing of the next one. That period of time, between two main crops, can be managed with bare ground (cultivated or not) or with a cover crop.



The cover crop is given different names depending on what its main objective is: "Cover crop" (referring to the idea of soil protection), "catch crop" (in the case of a second forage or grain harvest) and "green manure" (with reference to soil fertility).

Autumn cereals sown into a cover

The practice of having a cover crop before an autumn cereal crop is slowly developing, especially after peas. Wheat sown into a cover is being tested in a long-term trial in which mustard and bare soil have been compared in a pea/wheat/spring barley rotation since 1994, with three different soil cultivation methods. With continuous direct drilling, the results obtained for wheat (emergence, yield) are similar whether it was sown into bare soil or soil with a cover. Fields containing mustard obviously offer an environmental advantage. The presence of a cover does not impede autumn establishment if a special drill is used.



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Soil with a cover loses moisture more slowly

In the spring, the soil drains and dries in two stages. Water first drains rapidly downwards. Water in excess of field capacity is removed that way. The ground then loses moisture slowly through evaporation on the surface. When crop residue is present on the ground, it restricts the evaporation process. This helps preserve water reserves in the soil, especially before a spring crop. However, it slows the drainage and drying process of the first few centimetres of soil.

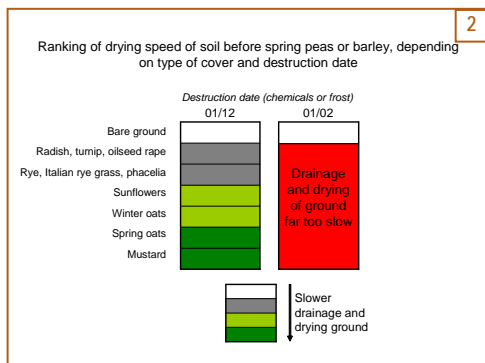
Even when the cover crop is destroyed at the last minute, the first five centimetres of soil are rarely drier than when the cover was destroyed very early on. Indeed, such late destruction results in a very close ground cover which does not allow much evaporation. (figure 4). This cover crop sweats water by pumping it from a depth of at least 60 cm, and not only from the surface. A cover crop destroyed late on in the spring can therefore have a detrimental effect on ground water reserves for the next crop, whilst affecting sowing conditions of that crop negatively in a minimum tillage system.

In figure 4, all the covers were destroyed on 20th November, except for some rye destroyed on 1st February. We can see that in the spring, there are differences in the soil surface moisture content between cover crops destroyed early. This can be explained by differences in the level of ground cover, linked to the time the cover takes to decompose. The architecture of this residue also seems to have a bearing. A cover such as mustard, even if it does not cover the ground much in the spring, (by which time there are only long dry stems left), is one of the covers restricting the evaporation process most.

For information, in February 2004, in the trial presented in figure 4 (clayey silt with 24% clay and 2% organic matter), following the pre-winter destruction of rye, sowing could take place three days later than on bare ground. This gap rose to 7 days after mustard destroyed on the same date and much more still after rye destroyed on 1st February.

In table 2, the covers have been ranked according to the speed of evaporation they allow in the spring (in February-March) before spring barley or peas are sown into a cover. Late destruction, after 1st January, is not advisable before such crops, regardless of soil type. When the cover is destroyed earlier, the difference in drainage and drying speed allowed by the different types of cover is probably not very important for soils that dry up quite quickly (sandy soils, chalk...). But it is of some importance in clayey soils if the farmer cannot sow while the ground is frozen.

Stubble tilling has a huge impact on evaporation in the spring. Generally, ground which was tilled in the summer shows half as much ground cover as ground which was not tilled. It has a significant impact on the level of moisture of the first few centimetres of ground. With direct drilling, the impact of the cover crop is actually partly hidden by the strong ground cover resulting from straw, unlike fields that have been tilled.



Early spring sowing: barley, peas and field beans

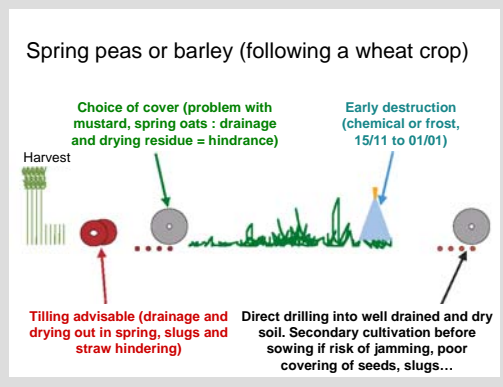
The fact that those crops are being sown just after winter makes their establishment quite tricky and sowing conditions quite difficult. When sowing cannot take place while the ground is frozen, the drainage and drying process of the soil surface is difficult to manage, especially in clayey or hydromorphic soils. If the spring season happens to be quite dry or there is a long dry spell after sowing, abundant straw in the seedbed can be a disadvantage, even if the farmer has access to specialized drills.

In order to take account of such risks, it is essential to destroy the cover before winter (from 15th November, unless there are specific regulations), regardless of soil type. The ground might otherwise become plastic, greatly delaying sowing and having an adverse effect on crop establishment conditions. In minimum tillage systems, destruction can hardly be carried out mechanically without affecting the subsequent seedbed.

Summer cultivation (stubble tilling, rotary harrow cultivating as the cover is being sown...) helps restrict the amount of straw being incorporated into the seedbed in the spring, as well as the number of slugs and field mice. It also impacts on the time the soil surface needs to dry out in the spring, which is crucial in the case of difficult soils.

The choice of cover can also shape sowing conditions in the spring, at least in certain specific situations. Cover crops which leave most residue on the surface in the spring (mustard, spring oats) can be a hindrance on soils that dry out slowly, or when using ploughs prone to choking up.

Spring sowing will have to be carried out in very good conditions in order to create a good seedbed resulting in good emergence, even if sowing is followed by a dry spell of weather. In some regions, sowing when the soil is frozen affords much better sowing conditions. Ideally, sowing should take place without any cultivation before sowing in the spring, except in some cases: choking up of drill by residue, impossibility of covering seeds properly, high risk of slugs...



Sowing maize

The choice of strategies in minimum tillage systems with cover crops is extremely varied for maize. Sowing is carried out later than for barley or peas and special single seed drill designs ease the straw and soil drainage problem at sowing time.

Stubble tilling of maize following a wheat crop can more easily be dispensed with than in spring barley or peas.

Likewise, the destruction date of the cover must take into account the soil type. It can take place at the beginning of winter in sticky soils, the structure of which is stable and for which ground cover is not crucial and good sowing conditions more difficult to achieve. More fragile and less plastic soils when wet, like silts in western France, are better suited to destruction in February.

Secondary cultivation before sowing maize is common practice for several reasons: incorporating slurry, at a time when the soil is often dry enough to make it possible, soil warming up...

This operation can however be dispensed with, if the farmer has access to a drill able to cope with the amount of plant residue on the ground.

Slugs like covers destroyed late

Slugs are much more active in an undisturbed and damp environment. The high slug activity noted in three maize trials carried out in 2004 was primarily due to the quantity of plant residue on the ground (cover crop destroyed late on and only with chemicals). Conversely, soils cultivated before sowing (in minimum tillage systems or not) did not encourage slugs. It is worth noting that covers destroyed by 15th November did not result in additional slug damage, regardless of the cultivation method.

In cases where slugs are a high risk, (soil and rotation encouraging them, sensitive crop like sunflowers), the cover must be destroyed early. A shallow cultivation of the soil before sowing will also be beneficial, provided of course it does not have too much of a clod producing effect.

Other pests, like field mice, also appreciate cover crops that are destroyed late.

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