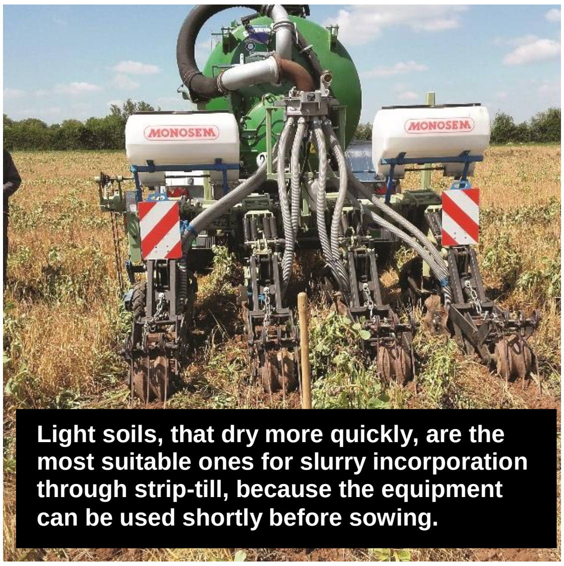
FERTILISATION

IMPROVING THE EFFICIENCY of organic inputs

Using strip-till to incorporate liquid effluents (slurry, digestates, etc.) gives the opportunity to combine seed bed preparation with incorporation of organic fertilisers while limiting ammonia volatilisation.



Light soils, that dry more quickly, are the most suitable ones for slurry incorporation through strip-till, because the equipment can be used shortly before sowing.

On mixed farms with various crops and livestock, the management of organic effluents is a recurring problem. There are many technical issues, including which spreading method gives crops the best chance of benefiting from it. There are also several constraints such as regulations, work management and cost effectiveness.

Previously, farmers wishing to switch to strip-till while continuing to apply liquid effluents had to incorporate them superficially. This technique left the soil surface in a state that did not suit the strip-till, which is only meant to cultivate what would become the drill. One solution is a one pass strip-till and effluent incorporation, which is common practice in Germany and the Netherlands where strip-till was introduced for this application.

Major environmental benefits but also technical constraints

Arvalis studied liquid effluent management using the strip-till technique at its research station in La Jaillière (western France) over three consecutive seasons (from 2016 to 2018), on a forage maize crop for silage.

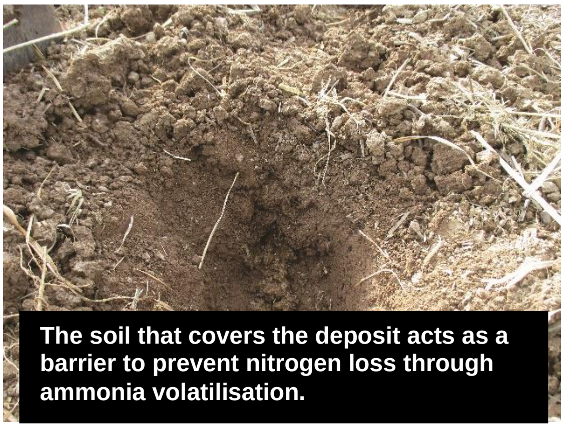
The strip-till is first used to prepare strips of ground on which the crop will be sown. A friable soil needs to be achieved through cultivation, to ensure it is crumbly enough for sowing. Light soils are therefore particularly suitable.

Pairing up slurry inputs with a cultivation tool, the working parts of which will serve as an injection device, has one main advantage: it reduces ammonia volatilisation. In fact, the soil on top of the slurry deposit serves as a physical barrier to prevent gas losses. The more the barrier is impermeable or the deposit is deep, the more those losses will be reduced. However, this new objective introduces technical constraints.

The extra weight of the slurry tank requires increased tractor power to ensure the pace is sufficient. In the trial, the tool was set for cultivation work at a depth of about 22 cm, with a forward speed around 8 km/h.

The weight of the machinery means that the soil has to be properly dry in order to limit compaction as this is detrimental to the crop. In the trial, wide tyres and a wheel spacing different from the spacing between maize rows resulted in wheels going over some cultivated rows. This meant that those strips may not be as crumbly as they should be, or even that they may not contain any fine soil; but on the whole, this was not the case during the three-year trial.

The final point to consider is the slurry injection. Dozens of cubic metres of slurry per hectare are incorporated into fairly narrow strips of soil. There must therefore be a gap of a few days between application and sowing, to allow the soil to absorb the effluent and for its moisture content to get back to normal, so that the single-seed drill can work properly. In the trial, with a silty soil on a shale base, a two-day gap was required. As a result, incorporation and sowing are not simultaneous.



The soil that covers the deposit acts as a barrier to prevent nitrogen loss through ammonia volatilisation.

A much more efficient technique

Several fertilisation strategies were compared on soil that was cultivated evenly and in the same way in every case, with a strip-till pass. A mineral nitrogen response curve was recorded each year, following nitrogen surface applications (in the form of ammonium nitrate) in maize taking place around the 3-4 to 5-6 leaf stages depending on the year. At the same time, two methods of cattle slurry application were tested. The first one consisted of incorporating it precisely while strip-tilling, and the second in depositing it on the surface with a band spreader. Finally, the last method combined a mineral fertiliser application and strip-till sowing, supplemented by an input at the 3-4 leaf stage. With this methodology, it is then possible to assess whether effluent incorporation is advisable or not.

The three-year trial saw different summer weather conditions, with dry periods in 2016 and 2018, while 2017 was wetter. Yields reflect these more or less favourable years and range from 12 T to 15 T DM/ha. However, regardless of weather conditions, the strip-till slurry incorporation method is consistently more successful than the surface slurry method. In 2016, which was the most favourable year, the yield obtained with the incorporated slurry method represented 108% of the yield obtained with surface slurry spreading.

Those experimental results are quite consistent with the nitrogen equivalence coefficients (K_{eq}) that have been disseminated for many years. This coefficient corresponds to the amount of nitrogen provided by a mineral fertiliser with the same effect on a crop's nitrogen uptake as a kilo of waste product (slurry, digestate, etc.). In this trial, with a spring surface spreading of cattle slurry on forage maize for silage, the K_{eq} is 0.5. Slurry injection into the soil is usually considered to increase the K_{eq} by 10% compared with a surface application. In other words, to obtain a given level of fertilisation, less slurry should be applied if it is being incorporated.

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April 2019