

## Dossier on min-till techniques and water quality

### Transfer of phosphorus

# Min-till finds its limitations

Minimum tillage cultivation techniques help to restrict erosion. However, this positive impact does not necessarily result in reducing phosphorus transfers into surface water. There are a few options to limit fluxes. The first one is to apply as low a dose of phosphorus as is strictly necessary.



*Buffer zones implementation have an immediate effect on phosphorus transfer, but long term efficacy is not obvious.*

The control of phosphorus has long since been identified as the key factor in controlling eutrophication of aquatic environments. This phenomenon, which sees an excessive proliferation of algae, can result in the water not being usable for certain purposes.

As well as being the main factor limiting the growth of algae, the control of phosphorus is also the only truly sustainable way of controlling eutrophication. Whatever its origin, it is crucial to limit its transfer into the hydrographic network. The transfer of agricultural phosphorus into watercourses can be due to point source pollution (direct flow of farm effluent), or non point source pollution, and is mainly carried by run-off water, and the resulting erosion, as well as by drainage.

Minimum tillage Techniques help to limit the amount of soil lost through erosion, but they can also cause significant transfer of phosphorus dissolved in run-off water, in greater quantities than those observed in ploughed fields.

One of the characteristics of phosphorus is that some minerals in the soil fix it very firmly. This is why it does not tend to be drawn underground through leaching, and is concentrated in ploughed layers, or, in the total absence of ploughing, in a thin top layer of soil.

### The phosphorus content of surface layers increases

The first impact of soil cultivation techniques concerns the distribution in the soil of phosphorus supplied by fertilisers, organic wastes and crop residue. When no tillage takes place, phosphorus concentration is higher in the top layer of the soil and decreases with depth, in a similar way to what happens with organic matter.

High concentrations of phosphorus and organic materials in the top layer of soil makes it easier for run-off water, as well as drainage water, to pick them up.

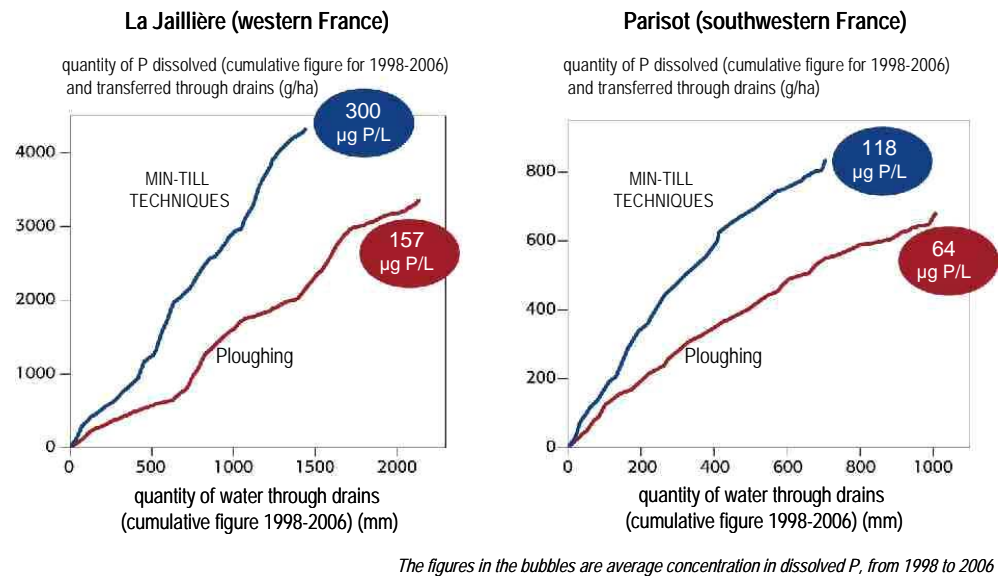


*During in depth infiltration, water grows poorer in phosphorus*

## Beware of well-drained fields!

Minimum tillage techniques have a greater negative impact on phosphorus transfer in fields with artificial drainage (figure 1). Ploughing helps to break most preferential flow pathways (cracks due to soil desiccation, earthworm and root channels...). It therefore slows down the flow of water, and part of the phosphorus contained in the water can then be fixed onto the soil before it reaches drains. When Non Inverted Tillage Techniques are used, those transfer pathways are likely to carry mineral or organic phosphorus very quickly from the surface where it has just been applied, to drains that will carry it towards the outlet.

Quantities of phosphorus transferred through drains, depending on the soil cultivation method used, on the Pariset (southwestern France) and La Jaillière (western France) sites (fig. 1)



In the absence of ploughing, the amount of dissolved phosphorus transferred through drainage is multiplied by two.



On well-drained fields, no tillage makes easier phosphorus transfer.

## Increase in transfer through run-off

Min-till techniques preserve soil cohesion and mean that its surface stays covered by plant residue. They therefore limit erosion and loss of particular phosphorus. However, they increase the transfer of "dissolved" phosphorus, which is most active in encouraging eutrophication. From this point of view, the highest risk comes from rain falling soon after the spreading of organic fertiliser (manure, liquid manure, sludge...) or mineral fertiliser containing phosphorus. It is possible to incorporate slurry and mineral fertilisers into the soil using localization techniques. This greatly reduces the risk of losses through run-off. For instance, placement of ammonium phosphate when sowing a

The incorporation of phosphate fertiliser and of manure, liquid manure or other effluents into the soil, is an important factor in limiting phosphorus transfer in the absence of ploughing.

maize crop established without ploughing, is most probably the most effective solution for reducing both erosion and the risk of transfer through surface water.

Pierre CASTILLON  
p.castillon@arvalisinstitutduvegetal.fr

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The following people contributed to the "phosphorus" chapter of the ADEME study:  
Castillon P. (1), Dorioz J.M. (2), Hanocq D. (3)

(1) ARVALIS-Institut du végétal, (2) INRA, (3) Chambre d'Agriculture du Finistère