

Cereal fungicides

Timing of treatments targeting

Septoria leaf spot: 500 kg/ha of yield at stake

The timing of fungicide treatments against Septoria enables one to respond to an environmental challenge and to the existing resistance to fungicides. Trials carried out in 2008 and 2009 have quantified the effect of successful timing in terms of yield, but also in terms of the optimisation of fungicide use. Furthermore they have allowed us to evaluate the quality of the recommendations made by Septo-LIS®.



Through his distributor, the user can use an extranet to refer to daily advisory maps.

The timing of fungicidal treatments is a key parameter for optimising the efficiency of a programme aimed at controlling Septoria. To quantify the yield difference between the best and the less good fungicide timings, 30 trials in 21 departments were done in 2008 and 2009. They compared 5 different timings of the 1st treatment and of the 2nd treatment (*table 1*). The measured yields indicated a mean effect of timing of 500-600 kg/ha. In certain situations, it approaches 1 tonne/ha. In 2008, a year with a lot of damage, the effect of timing over 12 trials was 600 kg/ha. In 2009, a year with less damage, the effect of timing was smaller but remained significant at 480 kg/ha (*figure 1*).

Against Septoria, the main objective is to protect the green surface of the last two leaves

Working out the timing

The treatment of the last leaf, done at about the stage when this leaf is expanded, constitutes the basis of a protection programme against leaf diseases. The aim is to protect the last leaf, and to a lesser extent, the next youngest one (L2). The first treatment aims to limit the development of the disease on leaves L3 and L4, which serve as a springboard for the disease to reach these two last leaves. Hence the calculation of the timing of the first treatment is made from the observations on the first leaf stages (contamination).

If no triggering has occurred until the appearance of the last leaf, from that moment one can only tolerate small amounts of infection before starting to spray. In fact it is these first infections which, once mature, produce a huge number of spores to explode the disease onto the last leaf. The first treatment being aimed at keeping the disease at a low level on the lower leaves; this can be deferred if the weather conditions make it possible to reach this objective without spraying. This is what Septo-LIS® can evaluate, by taking account of the local temperature and rainfall (*box 1*).

The timing of treatments can improve the profitability of a programme for a given dose, and can even allow some sprays to be omitted.

How to simulate the effect of the weather on Septoria ?

To take account of the development of the disease and of the plant, models such Septo-LIS® are valuable. Septo-LIS® includes the timing of leaf emergence (the phyllotherm model) and a model for the winter development of the inoculum based on the daily temperature and rainfall from the beginning of tillering. For each leaf, the amounts of infection received are calculated every day as a function of the weather, the winter inoculum and the symptoms present on the leaves. In short, this tool allows one to decide with great precision the date for applying the first treatment.

The timing of this protection is thus dependent on the stage of development of the disease at the beginning of stem elongation: if its development is slow enough, notably due to the winter weather, the potential transfer of inoculum to the last leaves will be reduced, allowing the first spray to be deferred.

Table 1: Theoretical timing and products used in the Treatments fungicides trial

Modality	Treatment stage				
	2 nodes (Z32)	Latest emerging leaf (Z37)	Latest expanded leaf (Z39)	Ear emergence (Z55)	Beginning of flowering (Z61)
1	Menara 0.4 l/ha + Bravo 1 l/ha		Opus 0.6 l/ha + Pyros 0.6-0.7 l/ha or Fandango S 1.2 l/ha		
2	Menara 0.4 l/ha + Bravo 1 l/ha			Opus 0.6 l/ha + Pyros 0.6-0.7 l/ha or Fandango S 1.2 l/ha	
3		Menara 0.4 l/ha + Bravo 1 l/ha		Opus 0.6 l/ha + Pyros 0.6-0.7 l/ha or Fandango S 1.2 l/ha	
4		Menara 0.4 l/ha + Bravo 1 l/ha			Opus 0.6 l/ha + Pyros 0.6-0.7 l/ha or Fandango S 1.2 l/ha
5			Menara 0.4 l/ha + Bravo 1 l/ha		Opus 0.6 l/ha + Pyros 0.6-0.7 l/ha or Fandango S 1.2 l/ha

The trials were done with three replicates and each had an untreated control.
 Fandango (prothioconazole 100 g/L; fluoxastrobine 50 g/L) – Opus (epoxiconazole 125 g/L) – Menara (propiconazole 25 g/L ; cyproconazole 160 g/L) – Bravo (chlorothafonil 500 g/L) – Pyros (prochloraze 450 g/L)



By optimal timing of treatments one can be sure of improving profitability and/or reducing their number.

Next, the protection of the last leaf is of major importance : it alone can contribute up to 45% of grain filling. The best protection of the last leaf is generally obtained with a treatment made shortly after it is fully expanded.

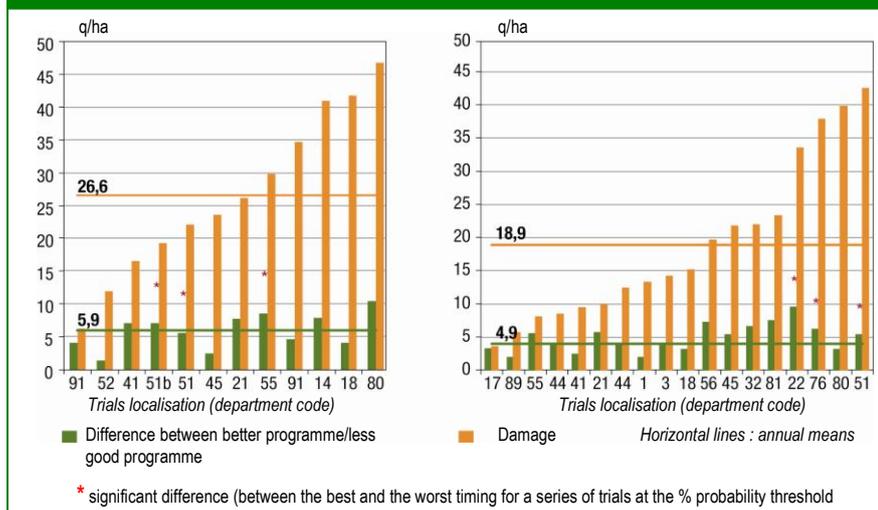
What have the trials shown?

The ideal timing of the first treatment can vary greatly from one year to another or from one site to another. In 2008 the coincidence of rain events with developmental stages resulted in contrasting epidemics. Starting early in the centre and the west of France, they necessitated a first spraying at the 2-nodes stage. In the north and east, the attacks came later: the ideal timing could in some cases be as late as the ligulated last leaf.

In 2009, the cold dry winter slowed down the progress of the disease so that it was possible to defer the T1 until the emergence of the last leaf. Then it only needed a period of heavy rain (at the end of April in the early regions and mid-May for the later sites), coinciding with the expansion of the last leaf, to infect the upper leaves. This is why the key fungicide applications must be made at this stage.

Conversely, on a network of thirteen trials on the same topic at the end of the eighties and in 1999 and 2000, earlier attacks were observed, requiring sprays to be made at the 2-nodes stage. The ideal timing of T2 also varies and can also have an effect on yield. Results obtained in England, showing that the greatest efficiency is generally obtained as the ligule is forming on the last leaf, do not always appear to be true in the French context.

Damage in the trials and yield difference between better and less good timing treatments (Figure 1)





The control of Septoria (*Mycosphaerella graminicola*) requires chemicals, but can be modified according to varietal resistance and sowing date.

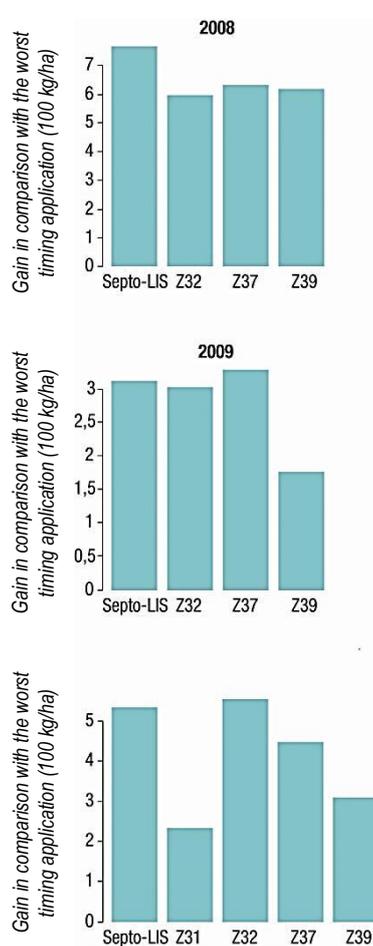
The weather conditions of France, sometimes unfavourable to the development of the disease, have a significant effect. In certain years such unfavourable weather can also delay the protection of the last leaf. This final spray will then protect the canopy for the whole grain-filling period. However other factors, and in particular rust, should be taken into account in the reasoning.

The use of predictive models like Septo-LIS® can optimise the timing of fungicide treatments.

Approaching the best time to start

In 2008, the model triggered treatments starting from the « two-node » stage until just before the « last leaf expanded » stage. In 2009, because of the cold winter followed by intense infection at the end of stem elongation, triggerings were much more compacted between the « last leaf emerging » and the « last leaf expanded » stages. In 19 cases out of 28, the triggering recommended by the model was nearest to the best found in the trials. Thus, compared with the 500-600 kg/ha benefit from timing, Septo-LIS® allowed an approach to the best timing within about 110 kg/ha. Furthermore, the maximum difference between the Septo-LIS® method and the best never exceeded 300 kg/ha.

Summary of timing trials (Figure 2)



The triggering of treatments using Septo-LIS® can help to approach the ideal timing. For each trial, we calculated the yield gain between the strategy for triggering T1 (Septo-LIS® recommendations or different stages) and the worst strategy.

What gains can be expected?

The trials have allowed us to compare different strategies for triggering treatment : by using Septo-LIS® or by starting according to the growth stage (figure 2). We see that Septo-LIS® approaches or exceeds the best timing stage. Furthermore, according to the year, this best stage is not the same – 2 nodes in the old trials and « last leaf emerging » in 2009 for example: one could not have known this in advance. Hence the value of the model for getting closer to it. Another approach to measuring the gain to expect from using Septo-LIS® is to compare it with a standard programme. This indicates a gain of 100-500 kg/ha. Finally, this type of approach can also reduce the use of chemicals, for example when the first treatment is deferred until the last leaf is expanded. One can also measure the gain in product by comparison with a « response curve » (box 2).





If no triggering occurs until the appearance of the last leaf, from that time Septo-LIS® will only allow small amounts of infection before triggering.

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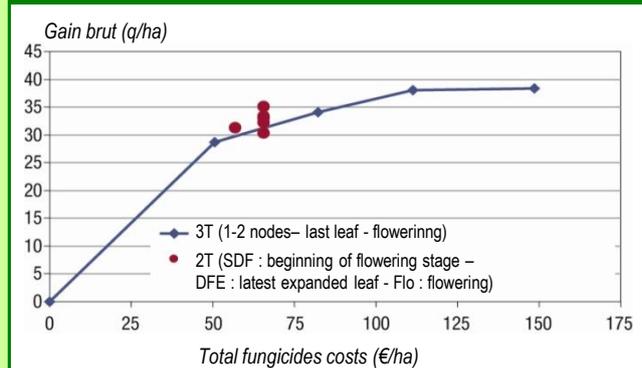
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How much fungicide is saved ?

In some trials it was possible to compare timing treatments with fields with increasing fungicide levels. One could thus see that for a given level of technical performance (the same yield), the best timing treatment does as well as a programme with an expenditure on fungicide of more than 20 €/ha (figure 3). In 2008, we even saw two trials in which the best timing treatment was evenly matched with one with twice the amount of fungicide.

Yield gain as a function of the cost of the Septoria programme in 2009 (Figure 3)



Thanks to a decision support tool, two well-timed treatments could give a better performance with a smaller dose.

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