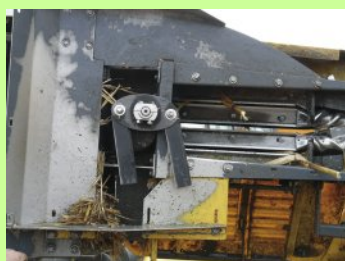


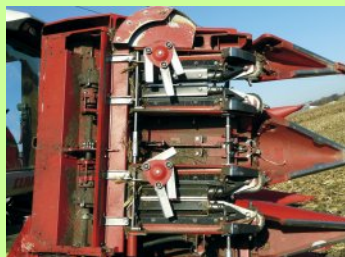
Under-header stalk choppers : how do they affect diseases and pests ?

The stalk choppers attached to combine harvesters facilitate the breakdown of maize residues after harvest, with effects, more or less apparent, on the health of the following maize crop and the development of pests. But which are the most effective models as regards quality of chopping and breakdown of residues? Trial results.

The 4 stalk choppers tested



Fantini: 2-blade chopper with its axle at the base of the rollers.



Capello: 3-blade chopper with its axle at the side of the rollers.



New Holland: 2-blade chopper with its axle at the side of the rollers.



Geringhoff: Horizon Star: shredding disks with 2-blade choppers whose axle is behind the rollers.

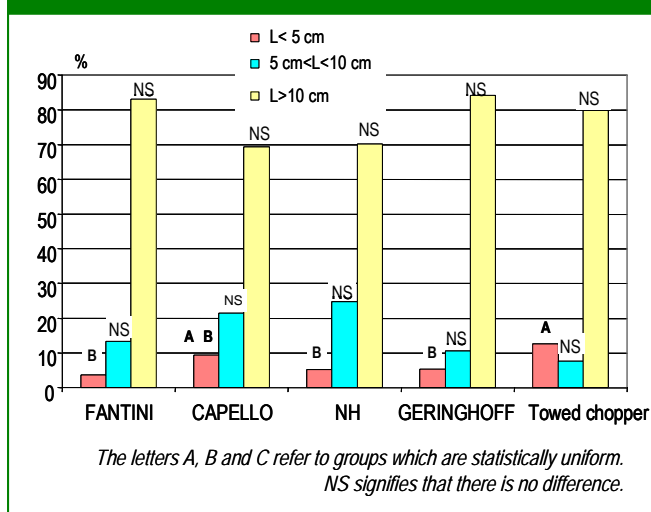
How do the different chopping systems perform? To answer this question, ARVALIS – Institut du végétal carried out a trial at Pau (64 – South of France) in November 2007, by comparing 4 types of under-header choppers (box 1) with a towed chopper (horizontal axle associated with « paddle» blades).

Favouring fine chopping

The speed of degradation of harvest residues depends on their composition (mainly lignin and cellulose), and then their size, together with their crushing (figure 1). The quicker the residues break down, the lower will be the incidence of fungi such as fusariums. Furthermore, the chopping of the harvest residues favours the destruction of stalk-boring insects (European and Corn Stalk Borer) which are one of the primary risk factors for the following maize crop.

The management of residues influences the disease status of maize, especially by encouraging a reduction in mycotoxin content (especially fumonisins).

Proportion of sizes of chopped maize stalks (Figure 1)



By comparing the size of the chopping, 3 classes of measurement were identified; only the class whose length was below 5 cm showed a significant difference in favour of the towed chopper.



In maize monoculture, the management of residues is a critical operation for the success of the next crop.

By comparing the size of the chopped stalks, statistical analysis shows a significant difference between choppers for pieces less than 5 cm long. For the other categories, statistically, no difference was found. The ranking from the trials done in 2007 put the towed chopper at the top, followed by the 3-blade chopper (Capello), the Horizon Star (Geringhoff) and then the rotary 2-blade choppers (New Holland and Fantini), which ranked equal.

Improving the decomposition of residues

The biomasses measured at harvest, which are the amounts of residues left after the passage of the combine, do not show any significant difference between the 4 chopping systems tested (figure 2).

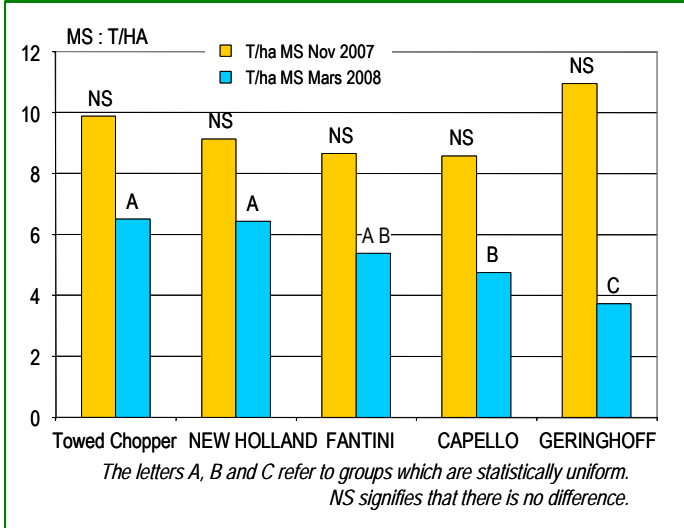
The effect of chopping maize stalks on corn borers has not been demonstrated in our trials, in which there were few pest attacks.

As regards the changes in the quantities of residues, the Horizon Star chopper comes out top of the machines tested, followed by the 3-blade chopper and the 2-blade chopper. The towed chopper is the same as the 2-blade chopper in this respect. Between November 2007 and March 2008, the organs decomposed were mainly the leaves and the spathes. The other organs (rachis, stems) had not altered much. It is important to remember that the residues had remained on the soil surface without any tillage after harvest. The towed chopper showed a greater soil coverage by the residues than for the under-header choppers. This observation is due to a more uniform distribution of the residues over the whole of the soil surface and to a larger quantity of chopped residues. Combined with the chopping height at the soil surface, the towed chopper leaves behind barely any stubble.



To favour emergence, limit pest and disease risks and ensure the decomposition of the stalks, a post-harvest chopping followed by surface tillage are essential.

Changes in the dry weight of maize residues (between November 2007 and March 2008) for various choppers (Figure 2)



The loss of dry matter measured between autumn and spring is on average 3.4 t/ha. The loss of biomass varies from 2.7 to 7.2 for the different choppers tested.



Before disking or surface tillage, chopping and stubble removal improves the decomposition of residues.

In view of the results obtained, there does not seem to be any direct relationship between the size of the choppings and the decomposition of the biomass. The latter is determined more by the fineness of the chopping combined with the rupturing of the different plant organs (especially the stem).

Chopping and pest destruction

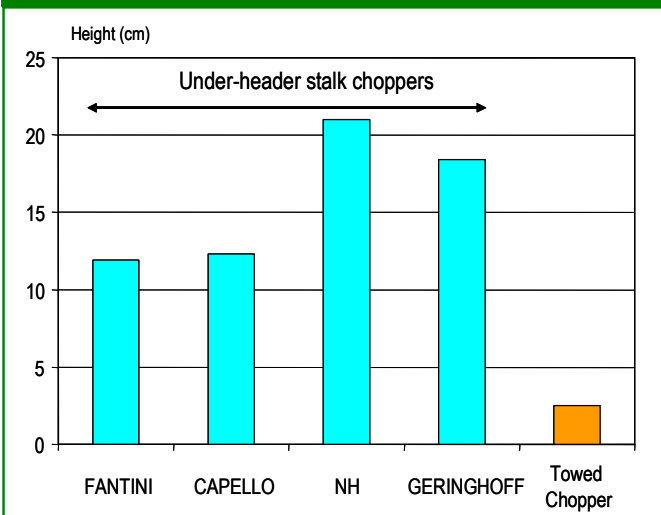
In the conditions of the trial, the number of maize plants attacked by boring insects was less than 10%. For chopping heights of more than about 10 cm, the destruction of boring insects turned out to be insufficient, especially with late harvests: the larvae would have gone down into the base of the maize plant. In the trial, the chopping heights varied between 12 and 21 cm according to the machine used (figure 3). Only the towed chopper was able to

Sowing maize, with good residue management, presents no more technical problems without ploughing than with ploughing.

effectively achieve a lower stubble height. This very low chopping height is only possible in the absence of stones and with a very level soil. The measured stubble heights are for a normal adjustment of the corn-header, in which there is contact between the soil and the edge of the corn-header.

Here we begin to see the limitations of under-header chopping at the time of harvest. In general it does not chop close enough to the soil surface to reach the larvae which have returned into the base of the plants, and eradicate the parasitic borers, particularly in years of severe attacks.

Height of maize stubble after chopping (Figure 3)



The height of maize stubble measured after the passage of the combine varies between 12 and 21 cm.

Straw chopping, disease standards and planting quality.

The introduction of min-till techniques results in the presence of concentrated residues in the surface soil layers. Regulations require certain mycotoxin thresholds not to be exceeded to assure the hygiene standards of the maize. In the case of maize monoculture, we know that the mycotoxin risk is multifactorial: it depends on varietal sensitivity, harvest date, presence of pests and cultural techniques. Hence between 2005 and 2007, ARVALIS – Institut du végétal tested the effect of a combination of cultural operations (stalk chopping, stubble removal at different periods) on the mycotoxin risks.

The results of these trials show an influence of management on maize residues (e.g. combinations of chopping and stubble removal) on the sanitary quality of the grain maize, especially on fumonisins. Stalk chopping should be combined with a stubble removal operation: alone it is not enough to limit the mycotoxin risk. In 2006 as in 2007, late chopping combined with late stubble removal was associated with a lowering of mycotoxin contents, with a smaller effect on the fumonisins.

These residue management techniques should also guarantee optimal emergence. In fact in min-till techniques, the quantities of residues left on the surface can restrict sowing quality. On the other hand the absence of ploughing makes it easier to obtain a sufficiently crumbly seed-bed to assure the emergence of maize seeds.



Apart from its action in residue decomposition, stubble clearing helps to level the soil and favour the presence of fine soil on the surface.

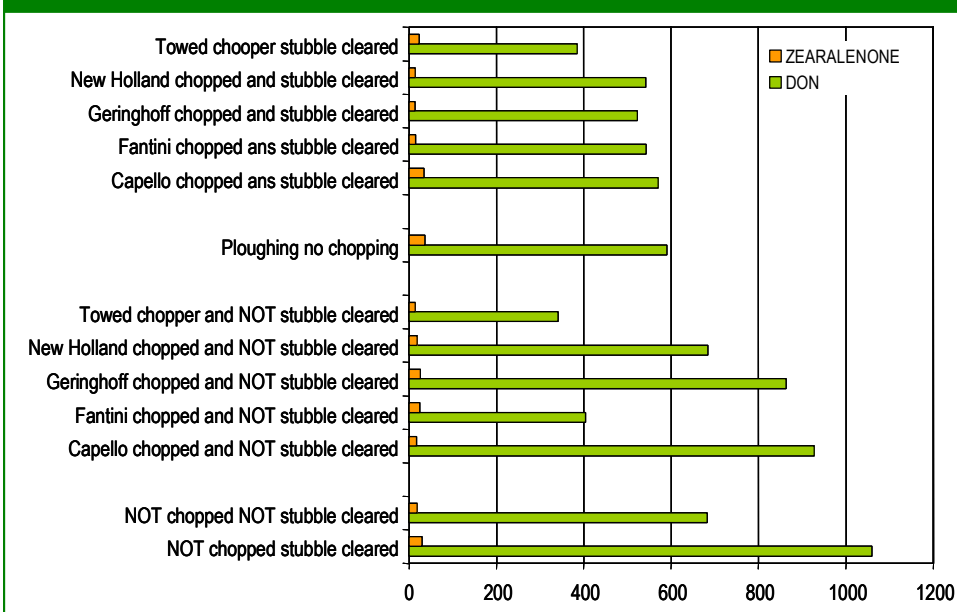
Effect of residue management of sanitary quality

Whereas the effect of the number of blades on the rotary choppers, or else the shredding system, offer the possibility of improving the decomposition of the residues, it remained to test the sanitary standards of the maize, which was monitored during the 2008 season. Thus to determine the effect of soil tillage, combined or not with stalk chopping, on the development of mycotoxins, stubble clearing, using an off-set disk harrow to 10 cm depth, was carried out on some of the fields during the 2007-8 winter. The following maize was sown without ploughing in spring 2008 in order to show the effect of management of residues on the development of mycotoxins.

To limit the mycotoxin risks, stalk chopping must be combined with stubble clearing.

The results obtained (figure 4) show the value of combining chopping with surface stubble clearing. In particular for DON type mycotoxins (deoxynavlenol), we find that the concentration is lower (< 600 µg/kg) when chopping is combined with

Effect of residue management on the sanitary quality of maize (Figure 4)



stubble clearing. Chopping by itself shows greater variability in the concentrations recorded (varying from 350 to 950 µg/kg), with higher values. Moreover, we see that ploughing alone gives similar results to the techniques which combine chopping and stubble clearance. The highest mycotoxin concentrations are observed for the « not chopped, stubble cleared » technique. These results are for the first year of study, which will have to be confirmed.

Chopping alone is not enough

The different systems of chopping are likely to influence the decomposition of residues after harvest. However the quantity of residues left behind after harvest is such that chopping alone is not enough. This technique must be combined with a surface tillage operation to increase contact between the soil and the residues if one wishes to exert a protective effect on the

Although the measurements show variability in the results, the combination of chopping and stubble clearing limits the development of mycotoxins. (N.B : mycotoxin thresholds for raw maize : DON < 1 750 µg/kg, zearalenone < 350 µg/kg, Fumonisin B1 + B2 < 4 000 µg/kg).

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sanytary quality of the maize, but also to ensure good establishment of this crop when using a no-ploughing technique. With severe parasitic attacks (Mediterranean corn borer and/or European corn borer), only the combination of the towed chopper, which cuts the stalks at the soil surface (in the absence of stones), and a surface stubble clearing, is effective.