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# The effects of maize straw chopping and tillage techniques on fusarium infections in winter wheat

*Due to problems caused by fusarium, grain maize before winter wheat must be considered critical. Therefore, many farms use inverting tillage even though mulch tillage would often be more desirable for the sake of erosion protection. At the Institute of Agricultural Engineering and Animal Husbandry, studies were carried out in order to examine whether intensive maize straw chopping and mixing incorporation are sufficient to prevent fusarium infection. The results gained during three years showed that this requires intensive mulch tillage. Nevertheless, DON (deoxynivalenol) values were significantly above those of plough tillage.*

With regard to potential fusarium infection, grain maize before winter wheat is considered a risky forecrop. For this reason, advisers recommend that maize straw should be ploughed under before tillage after it has been chopped as well as possible [1]. With regard to soil and erosion protection, this procedure must be regarded as critical. Here, agriculture is in a dilemma because it must fulfill its legal prevention duties by observing the principles of good practice while adhering to the regulations which stipulate maximum mycotoxin quantities in Germany and the EU.

Therefore, a research project was carried out in order to answer the question of whether the intensive, complete chopping of maize straw and maize stubble combined with intensive mixing into the soil (mulch tillage) can reduce the risk of fusarium infection in wheat.

### Experimental set-up

During the maize harvest, 3 different straw chopping variants were applied. In addition to chopping by an underfloor shredder at the picking attachment (*Fig. 1: left, below*), which is common in practice, a second variant was used. This system included a shredder attached to the tractor which additionally chopped the maize straw (*Fig. 1: "separate shredder" variant*). In a third chopping variant, the maize straw was intensively chopped during threshing by flail shredders mounted to the picking attachment or the combine (*Fig. 1: "integrated shredder" variant*). These flail shredders are installed on the left and the right side of the elevator before the front tyres and work in the area of the two outer rows on each side (6-row picking attachment). The area between the tyres is covered by a shredder attached to the rear of the machine instead of the straw chopper. The spindles and husks from the combine are also fed into this mulching unit. In addition to the work and time savings at the work peak during maize threshing / wheat drilling, the system also shows advantages in work quality. Since the maize straw and the stubble are chopped before they are driven over by the combine, there is virtually no squashed stubble or (unchopped) maize straw pressed into the soil. These 3 straw chopping variants were combined with 3 tillage and cultivation techniques (*Fig. 1: right*): first, conventional tillage with a plough and a rotary harrow and, second, two mulch tillage variants (an intensive variant with a short-disc harrow, a cultivator as well as a rotary harrow/drill combination and an extensive variant with a short-disc harrow and a drawn universal drill). For the evaluation of the individual systems, numerous parameters were determined and compared.

In order to establish the degree of straw chopping, sieve analyses were carried out. For the determination of straw incorporation quality, the degree of straw coverage provided by each unit tested was measured after

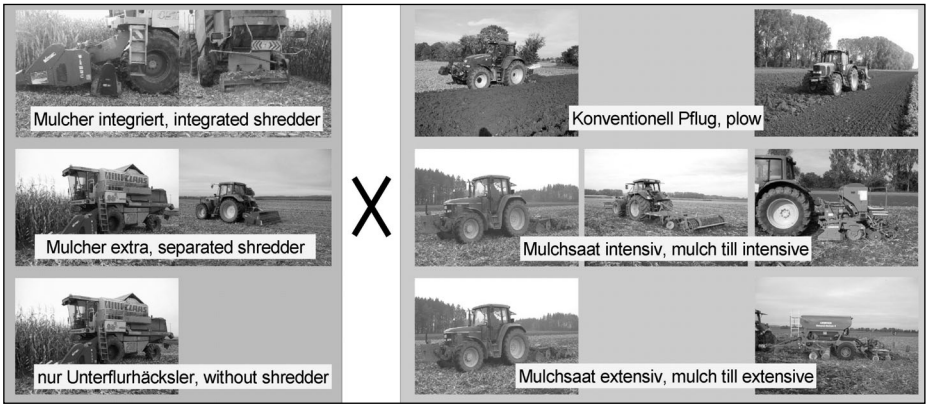


*Fig.1: Overview on experimental setup*

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**Keywords**
Maize straw, tillage, mycotoxin content

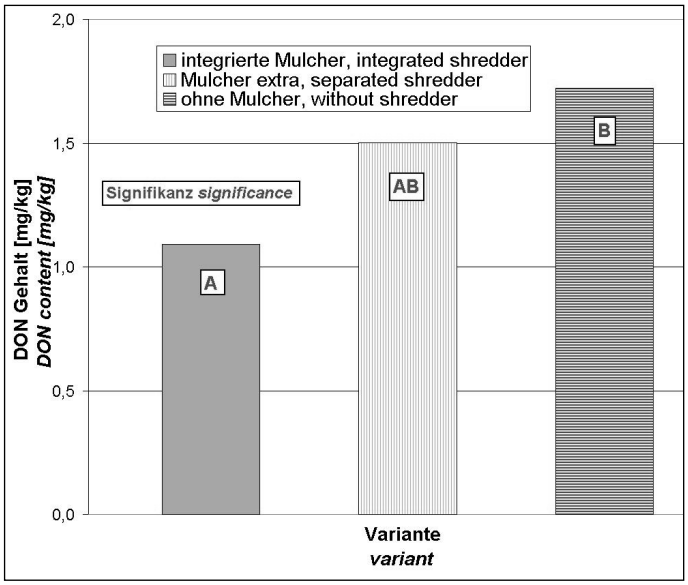


*Fig. 2: Mycotoxin content of winter wheat subject to straw chopping (all years, locations and tillage systems)*

wheat drilling. For all other assessments, 9 wire rings 0.5 $m^2$ in size were randomly put down, fixed, and marked in each lot. At these places, field emergence was determined, and fusarium infestation after blooming was documented. The stalks within these rings were harvested by hand and threshed stationarily. Afterwards, the yield parameters (thousand grain weight, number of grains per ear, yield in decitons per hectare) and the quantity of deoxynivalenol (DON) as a measure of the mycotoxin content were determined.

### Results

In addition to yield and quality, the DON content is relevant for marketing or use as feed. *Figures 2 and 3* show statistical evaluations of the results of the analyses. If the DON values of all 3 years and 2 locations are used as a common basis of calculation, the maize straw chopping variants do not show any clearly distinctive characteristics (*Fig. 2*). Only the integrated shredder variant shows a significantly smaller DON content than the variant without a shredder. The "separate shredder" variant lies in between even though it does not distinguish itself clearly from the two other techniques. It must be mentioned, however, that the lots used for the project were arranged in the direction of the maize rows. During practical use on fields with headlands or unfavourably shaped fields, an extra reduction of work quality must be expected if the separate shredder technique is applied. In practice, this means that the "integrated shredder" technique is likely to distinguish itself more clearly (i.e. significantly) from the "separate shredder" technique with regard to chopping and, hence, fusarium infestation and the DON value. The absolute amount of the DON values may not be overrated because methods which reduce infestation (Azol treatment, choice of very unsusceptible varieties) were not applied.

However, the tillage variants vary significantly over all maize straw chopping variants as well as the 3 years and 2 locations (*Fig. 3*). The plough variant shows the lowest mycotoxin content, followed by the "intensive mulch tillage" variant. The highest DON contents occurred in the "extensive mulch tillage" variant.

### Conclusion

Wheat cultivation with intensive maize straw chopping and a plough furrow offers the greatest possible protection against severe fusarium infection. The work requirements of this technique are high, and it can of course provide only little protection against erosion. One must also be aware of the possibility that maize straw or stubble can be brought up to the surface in a more or less non-rotted condition in the following year, in particular on inactive, poorly ventilated soils [2]. Mulch tillage with intensive maize straw chopping and incorporation of the harvest residues into the soil in combination with an appropriately selected variety and particular consideration of crop management and plant protection provide an alternative, in particular if the risk of erosion is increased.

A comprehensive report on these studies has been published as LfL Information and is available on the LfL homepage under the address www.lfl.bayern.de/publikationen/daten/informationen/p_28560.

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## Literature

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[2] *Lütke Entrup, N., und G. Stemann*: Der Fusariumgefahr nach dem Maisanbau ackerbaulich begegnen. Mais (2005), H. 4, S. 118 –121

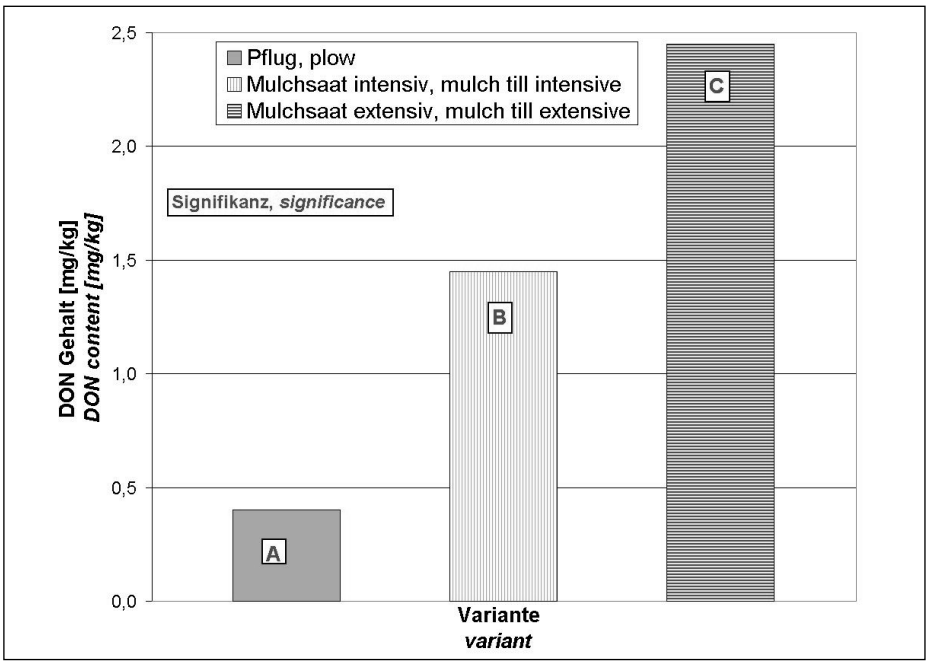


*Fig. 3: Mycotoxin content of winter wheat subject to tillage (all years, locations and straw chopping systems)*