

# INFLUENCE OF LONG TERM CONSERVATION TILLAGE ON FUNGAL DISEASE APPEARANCE IN WINTER WHEAT

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## ABSTRACT

When non inverting, conservation tillage is applied the development of pests and diseases can be promoted by plant residues left on the soil surface. For winter wheat this hypothesis needs to be tested for important fungal diseases like *Fusarium sp.* and *Drechslera tritici-repentis*.

Since 1994 four tillage systems are compared at 9 sites in Southern and Eastern Germany. The tillage treatments (ploughed = mouldboard ploughing 30 cm deep, loosened = non inverting loosening 30 cm deep, mulched = only shallow tillage 10 cm deep, direct drilled = no tillage except for sugar beets with 1-2 passes of very shallow tillage) are applied to all main crops of the crop rotation which includes sugar beet followed by winter wheat and one more cereal crop (mainly winter wheat).

Stubble wheat leaf infestation with *Drechslera tritici-repentis* did not differ between tillage treatments if a triazole or strobilurine fungicide was applied once during shooting. To investigate tillage effects on *Fusarium sp.* infestation the Deoxynivalenol (DON) concentration in the cereal grain was measured. Compared to the ploughed treatment this toxic metabolite of *Fusarium sp.* increased slightly with loosening, mulching and direct drilling on several sites (2001). Only on one stubble wheat site grown with a variety susceptible to *Fusarium sp.* infestation DON concentration in the grain from the mulched and direct drilled treatments exceeded the critical value of 0.5 ppm clearly.

## KURZFASSUNG

Auf der Bodenoberfläche verbleibende Erntereste können in Systemen konservierender Bodenbearbeitung günstige Bedingungen für die Ausbreitung von Krankheiten und Schädlingen schaffen. In der vorliegenden Untersuchung wird diese Hypothese für Fusariosen und andere Fruchtfolgekrankheiten wie DTR (*Drechslera tritici-repentis*) an Getreide überprüft.

Experimentelle Grundlage sind an 9 Standorten in Süd- und Ostdeutschland auf Großflächen durchgeführte Vergleiche von 4 Bodenbearbeitungsverfahren. Geprüft werden das Verfahren Pflug mit jährlich wendender Bodenbearbeitung auf Krumentiefe, zwei Verfahren der konservierenden Bodenbearbeitung mit jährlicher Lockerung bis 30 bzw. 10 cm Tiefe (Locker bzw. Mulch) sowie das Verfahren Direktsaat, bei dem bis auf eine Saattbettbereitung vor der Aussaat

von Zuckerrüben auf jegliche Bodenbearbeitung verzichtet wird. Die Fruchtfolge umfasst Zuckerrüben gefolgt von einem zweimaligen Anbau von Winterweizen.

Nach Fungizidapplikation mit Triazolen oder Strobilurinen in BBCH 31-49 wies Stoppelweizen keine Befallsunterschiede mit DTR zwischen den Bodenbearbeitungsverfahren auf. Zur Quantifizierung des Einflusses der Bodenbearbeitung auf das Auftreten von *Fusarium sp.* wurde die Konzentration des Fusariummykotoxins Deoxynivalenol im Korn vom Winterweizen gemessen. Mit abnehmender Bodenbearbeitungsintensität wurde 2001 auf mehreren Standorten eine schwache Zunahme der DON-Konzentration festgestellt. Lediglich an einem Standort mit Stoppelweizen und fusariumanfälliger Sorte überschritt die DON-Konzentration in den Bodenbearbeitungsverfahren Mulch und Direktsaat den kritischen Wert von 0.5 ppm deutlich.

## ABRÉGÉ

Les résidus de récolte restés à la surface du sol peuvent, dans les systèmes conservateurs de travail du sol, créer des conditions favorables à la prolifération de maladies et parasites. La présente étude a voulu examiner cette hypothèse, sur les céréales, pour les fusarioses et d'autres maladies de l'assolement comme la DTR (*Drechslera tritici-repentis*).

Les comparaisons effectuées de 4 procédés de travail du sol sur 9 sites à grandes surfaces, répartis dans le Sud et l'Est de l'Allemagne, constituent la base expérimentale. Les procédés étudiés sont les suivants : passage de la charrue avec retournement du sol une fois par an sur l'épaisseur de la terre végétale, deux procédés de travail conservateurs du sol avec ameublissement annuel jusqu'à 30 et 10 cm de profondeur respectivement, et le procédé du semis direct dans lequel l'agriculteur renonce à tout travail du sol hormis une préparation du lit de semence. L'assolement comprend des betteraves sucrières suivies de deux cultures successives de blé d'hiver.

Après application de fongicide aux triazoles et aux strobilurines dans BBCH 31-49, le blé sur chaume n'a présenté, entre les différents procédés de travail du sol, aucune différence d'attaque par la DTR. Pour quantifier l'influence du traitement du sol sur la survenance de *Fusarium sp.*, les chercheurs ont mesuré la concentration en déoxynivalenol (DON) - la mycotoxine du fusarium - dans les grains de blé d'hiver. Une légère augmentation de la concentration en DON a été constatée en 2001 dans les champs dont l'intensité de travail du sol avait diminué. Uniquement sur un site couvert d'une variété de blé de chaume vulnérable au fusarium et qui avait été travaillé avec les procédés ameublissement et Semence directe, la concentration du DON a dépassé nettement la valeur critique de 0.5 ppm.

## INTRODUCTION

When non inverting, conservation tillage is applied the development of pests and diseases can be promoted by plant residues left on the soil surface. In sugar beet an influence of soil tillage on the incidence of the fungal disease *Cercospora beticola* could not be observed in past (Pringas et al. 2001). For

winter wheat this hypothesis needs to be tested for important fungal diseases like *Fusarium sp.* and *Drechslera tritici-repentis*.

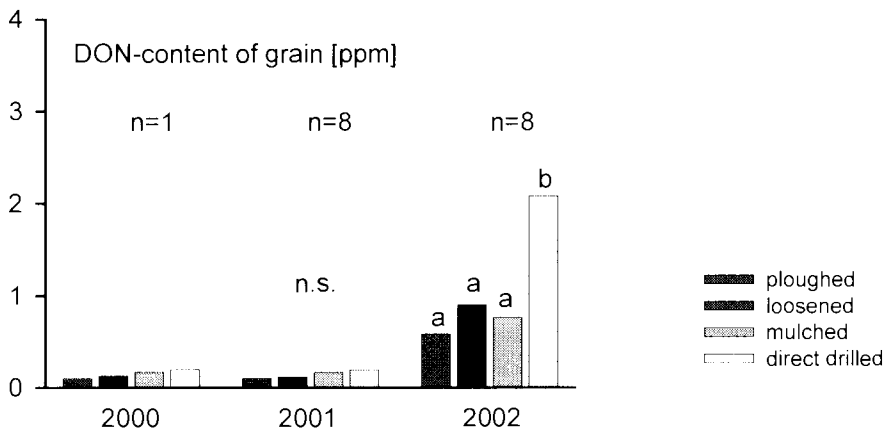
## 1.- MATERIAL AND METHODS

Since 1994 four tillage systems are compared at 9 sites in Southern and Eastern Germany. The tillage treatments (ploughed = mouldboard ploughing 30 cm deep, loosened = non inverting loosening 30 cm deep, mulched = only shallow tillage 10 cm deep, direct drilled = no tillage except for sugar beets with 1-2 passes of very shallow tillage) are applied to all main crops of the crop rotation which includes sugar beet followed by winter wheat and one more cereal crop (mainly winter wheat). To investigate tillage effects on *Fusarium sp.* infestation the concentration of the *Fusarium*-mycotoxin Deoxynivalenol (DON) in the cereal grain was measured. To describe tillage effects on *Drechslera tritici-repentis* (DTR) incidence the percentage of green area not infested with DTR of leaf F-1 was rated at grain filling (DC 71-75).

## 2.- RESULTS

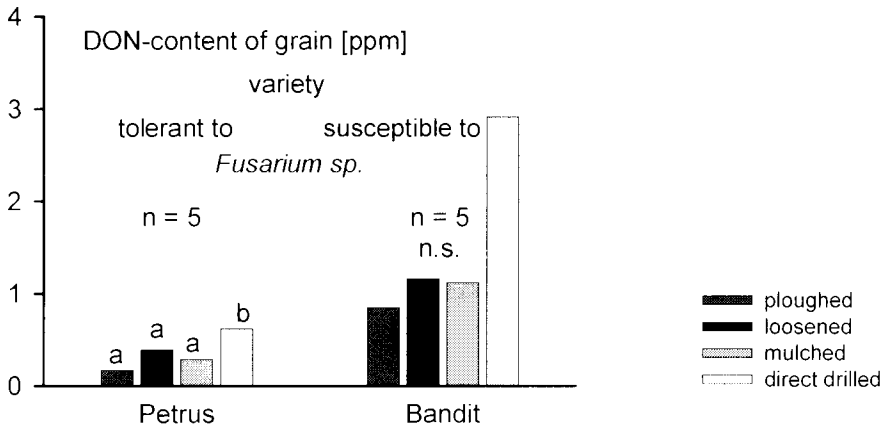
In 2000 and 2001 the Deoxynivalenol content was not affected by soil tillage (Fig. 1). In 2002 the DON-content increased in all tillage treatments compared to the years before. With direct drilling the DON-content was significantly higher compared to other tillage treatments.

Fig. 1: DON - content of winter wheat grain as affected by soil tillage and year ( $\alpha=0.05$ ; n.s. = not significant)



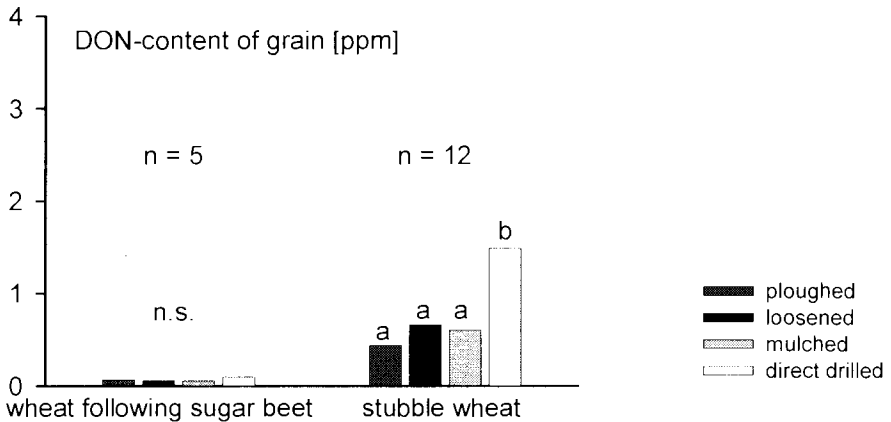
When growing a variety susceptible to *Fusarium sp.* infestation (Bandit) the DON-content exceeded the critical value of 0.5 ppm clearly in all treatments, especially with direct drilling (Fig. 2). This is contrasted by the results from the tolerant variety (Petrus), where the DON-content was lower than 0.5 ppm in ploughed, loosened and mulched tillage treatments.

Fig. 2: DON - content of winter wheat grain as affected by soil tillage and variety (2001-2002,  $\alpha=0.05$ ; n.s. = not significant)



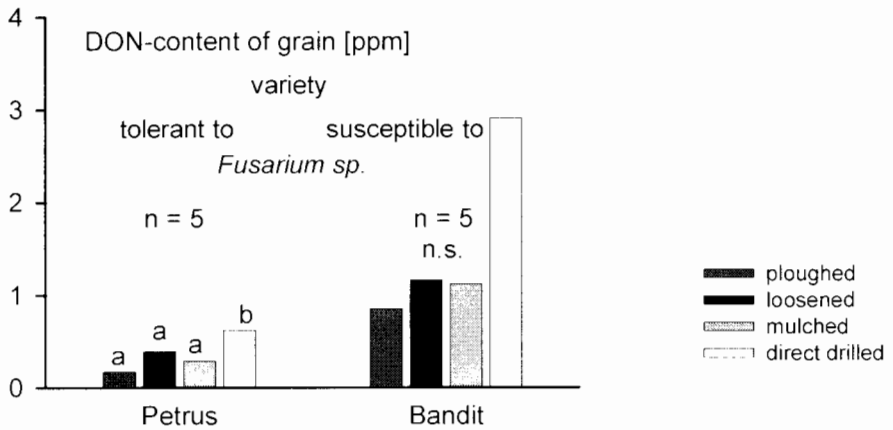
In stubble wheat grain of loosened, mulched and direct drilled treatments the DON-content exceeded the critical value of 0.5 ppm clearly (Fig. 3). With sugar beet as forecrop the DON-content was not affected by soil tillage.

Fig. 3: DON - content of winter wheat grain as affected by soil tillage and forecrop (2000-2002,  $\alpha=0.05$ ; n.s. = not significant)



Wheat leaf infestation with *Drechslera tritici-repentis* did not differ significantly between tillage treatments, if a triazole or strobilurine fungicide was applied once during shooting (Fig. 4). Green area of F-1 leaf decreased slightly when direct drilling was applied, especially in stubble wheat.

Fig. 4: Green area of F-1 leaf at grain filling (DC 71-75) due to DTR infestation as affected by soil tillage and fore crop (2000-2002, with fungicide application,  $\alpha=0.05$ ; n.s. = not significant)



## CONCLUSION

Compared to ploughing reduced tillage systems did not tend to increase the DON-content substantially. Even with direct drilling the critical DON-value of 0.5 ppm is not exceeded necessarily when growing a variety tolerant to *Fusarium sp.* infestation.

Likewise, reduced tillage systems did not tend to increase infestation with *Drechslera tritici-repentis* when common fungicides are applied. A slight decrease of green area of F-1 leaf due to DTR may occur in direct drilled stubble wheat.

## REFERENCES

PRINGAS, C., KOCH, H.-J., MILLER, H., 2001: Long term ploughless tillage in sugar beets – Formation of yield, pests and diseases. *Proceedings of the 65<sup>th</sup> IIRB Congress, February 2002*, P.513-518.

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