

## POSSIBILITIES OF ROOT AND STEM BASE DISEASES LIMITATION IN CONTINUOUS WHEAT UNDER CONVENTIONAL TILLAGE AND NO-TILLAGE SYSTEM

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**Abstract:** A 3-year field experiment was conducted to study the effect of seed treatment (Raxil 060 FS and Raxil 060 FS + Latitude 125 FS) and plowing down stubble crop (white mustard) on wheat infestation by root and stem base diseases. Wheat was grown in the same field for two consecutive years with two tillage systems: conventional and no-tillage. The occurrence of root and stem base diseases was significantly reduced due to additional seed treatment with Latitude 125 FS (siltiofam). This suggested the presence of *Gaeumannomyces graminis* (Sacc.) Arx et Olivier in disease complex. The occurrence of infection was reduced to a lesser extent by soil tillage and plowing down stubble crop. These additional agronomic practices resulted in significant grain yield increase of wheat, on the average 13.8% after seed treatment with Raxil 060 FS + Latitude 125 FS, and 8.3% after plowing down white mustard. Grain yield and thousand grain weight of winter wheat were strongly negatively correlated with a degree of stem infestation, but they were not significantly dependent on root infestation. This indicated on a significant role of *Pseudocercospora herpotrichoides* [Fron.] Deighton in pathogenesis. Effectiveness of both regenerative practices was slightly lower under no-tillage than under conventional tillage treatment with plough.

**Key words:** winter wheat, continuous cropping, root and stem base diseases, conventional tillage, no-tillage, stubble crop, seed dressing

### INTRODUCTION

A progressive increase in cereals share in sowing area, especially wheat, forces continuous cropping of the species. An increased infestation of stem-base diseases is one of the most visible effects of repeated wheat growing (Colbach and Huet 1995; Sieling and Hanus 1992). Limiting this negative phenomenon can be achieved by applying various agricultural treatments, i.e. seed-treatment against diseases, applying fungicides or rotation with stubble crop (Wojciechowski 1998; Parylak and Kordas 2002). Their effectiveness in conditions of conventional tillage

is usually visible, although its range is diverse. There are no reports on the range of infestation of stem base disease threat and effectiveness of regenerative practices in case of continuous wheat cropping with usage of tillage reductions—more and more popular in agricultural practice. The goal of the research was to estimate the effect of seed treatment and plowing down stubble crop on infestation of stem base diseases as well as on productiveness of winter wheat grown in the same field for two consecutive years with two tillage systems: conventional and no-tillage.

## MATERIALS AND METHODS

Three-year experiment was following years: 2000, 2001, and 2003 on medium soil of very good rye complex. The experiment was conducted using split-plot method in four replications on plots measuring 32 sq.m. The first factor was the method of seed treatment, which took into consideration diverse wheat protection against stem-base diseases: standard treatment with Raxil 060 FS (tebukonazole) and additionally Latitude 125 FS (siltiofam) treatment against take-all. The second factor was a diverse soil tillage (conventional tillage or no-tillage), which takes into consideration presence or lack of stubble intercrop (white mustard) intended for plowing down. In conventional tillage plowing after harvest was done at a depth of 10–15 cm, and plowing before sowing wheat at a depth of 20–22 cm. In no-tillage no agricultural treatments were done. Stubble crop and wheat sowing were done, depending on tillage system, with traditional drill or drill for direct sowing. In traditional tillage system stubble crop mass (0.8 t of dry mass/ha on average) was plown down with pre-sow ploughing, and in reduced tillage intercrop mass was sprayed with Roundup 360 SL herbicide, 10 days before sowing and left on the surface of the field.

The evaluation of wheat infestation by stem base diseases was conducted on 40 plants per plot. The infestation of wheat roots was evaluated in early dough stage in 5-point scale; obtained data were then used for the calculation of take-all index (TAI) (Beale et al. 1998). In case of evaluation of stem base infestation a 4-point scale was used; then infestation index was estimated (Townsend and Heuberger 1943). The results were subjected to the analysis of variance with 0.05 level of significance. The relationships between investigated features were estimated with correlation coefficient.

## RESULTS AND DISCUSSION

Infestation of winter wheat by stem base diseases was significantly affected both by the type of seed treatment which had been used and by tillage system. After using Latitude 125 FS for seed dressing, along with standard treatment, the index of root infestation of wheat decreased on average from 28.9 to 22.6 (Tab. 1). Even bigger, threefold, decline in the infestation index was noticed after applying Latitude seed treatment in earlier research done by Parylak and Kordas (2002). Beale et al. (1998) claims that effectiveness of Latitude treatment depends mainly on the initial level of take-all threat.

Root infestation of wheat cultivated in traditional way was lower than infestation of wheat grown from direct sowing, nevertheless significant differences were observed only after plowing down stubble crop. The influence of the stubble crop it-

Table 1. Root and stem base infestation of winter wheat by disease complex

Cropping system		Infestation index					
		roots		stem bases			
Tillage	stubble crop	seed treatment					
		Raxil	Raxil + Latitude	mean	Raxil	Raxil + Latitude	mean
Conventional	no	31.5	22.3	26.9	33.7	30.5	32.1
	yes	26.2	19.1	22.6	29.9	26.7	28.3
No-tillage	no	29.8	25.8	27.8	29.3	28.8	29.1
	yes	28.2	23.3	25.7	27.5	27.1	27.3
Mean		28.9	22.6		30.1	28.3	
LSD (0.05) for seed treatment			1.0			1.1	
LSD (0.05) for cropping system			1.7			1.8	
LSD (0.05) for interaction			2.4			ns	
ns – not significant differences							

self was significant. Incorporating biomass of white mustard into soil resulted in decrease of root infestation index under conditions of conventional tillage on average by 26.9%, and in extremely reduced tillage by 22.6%. A significant improvement in health of root system was observed as a result of plowing down stubble crop, especially in case of wheat treated with two seed treatments at the same time. Roots of wheat cultivated after stubble crop and additionally dressed with Latitude 125 FS were definitely less infested as compared to other treatments.

Both factors of the experiment also modified the infestation of stem base of wheat (Tab. 1). As a result of using two seed treatment preparations the level of infestation was significantly (on average by 1.8%) lower as compared to wheat seed dressing only with standard product. Relationship between infestation intensity and tillage system in case of stem base was different than in case of roots. In no-tillage, infestation of lower parts of stem was lower than in conventional tillage, nevertheless a significantly lower infestation index (by 3.0%) was noticed only in wheat that had not been preceded by stubble crop, tillage. However, Kreuz and Engelhardt (1992) noticed an important increase in stem base infestation in no-tillage system. Although statistically proved, the beneficial influence of incorporation stubble crop mass into soil on limiting stem base infestation by pathogens (on average by 1.8%) was confirmed in both tillage systems.

The result of implementing additional regenerative practices into cultivation technology was statistically proved in increasing grain yield of wheat (Tab. 2). After additional application of Latitude 125 FS treatment for seed dressing, the seed yield increased on average by 13.8%. Similar increase in wheat yielding level after using this substance was noticed by Parylak and Kordas (2002) in fields of various farms, while Weber (2002) and Spink et al. (1998) observed the yield increase not higher than 6%–8%. According to Beale et al. (1998) the amount of saved yield after using Latitude increases as the level of infestation decreases. The yield of continuous wheat with an application of no-tillage was on average higher by 1.9% as compared to standard technology. Similar decrease in wheat yield in extreme no-tillage conditions was observed by Murdock et al. (2000), while McLeod et al. (1992) proved yield decrease as high as 30%–40%. According to Maillard and Vez

Table 2. Winter wheat productivity

Cropping system		Grain yield [t/ha <sup>-1</sup> ]			1000 grain weight [g]		
		Raxil	Raxil + Latitude	mean	Raxil	Raxil + Latitude	mean
Conventional	no	3.91	4.62	4.27	39.4	40.0	39.7
	yes	4.37	4.87	4.62	38.5	40.6	39.5
No-tillage	no	3.97	4.41	4.19	37.9	37.9	37.9
	yes	4.24	4.83	4.54	37.6	38.0	37.8
Mean		4.12	4.69		38.4	39.1	
LSD (0.05) for seed treatment			0.23		n.s.		
LSD (0.05) for cropping system			0.22		0.8		
LSD (0.05) for interaction			ns		ns		

ns – not significant differences

(1993) a sporadic use of direct sowing does not cause decline in wheat yielding. However, a significant increase in grain yield, on average by 8.3%, was recorded after plowing down stubble crop mass. Stubble crop effectiveness in this case was similar in both tillage systems. Yielding of winter wheat cultivated twice on the same field did not depend on the influence of tillage system as well as on type of seed treatment.

Analysis of the results did not show any significant correlation between yielding level and degree of root infestation in any of two tillage systems. However, a definite, negatively correlated relationship between yield of wheat grain and a degree of stem base infestation was noticed (Fig. 1). This negative relationship was insignificantly stronger in case of wheat grown from direct sowing than when plow tillage was used. The same practices consisting of new seed treatment and plowing down stubble crop biomass did not cause a significant improvement in grain plumpness (Tab. 2). A thousand grain weight of wheat dressed with Latitude 125 FS increased

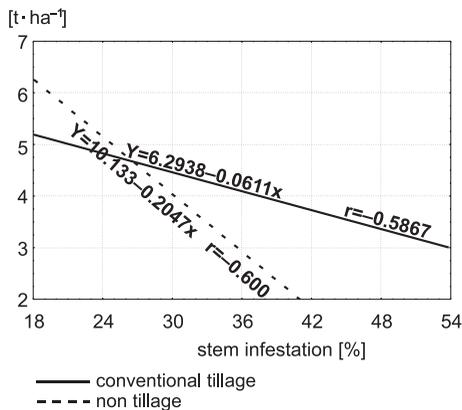


Fig. 1. Relation between base stem infestation and grain yield of winter wheat

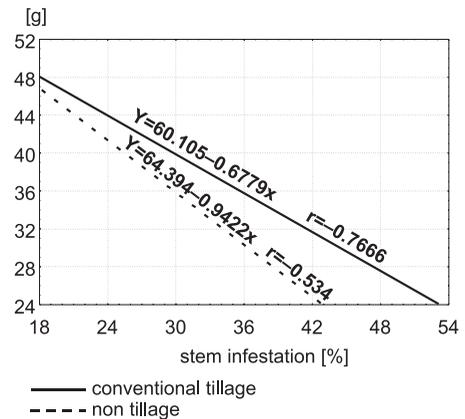


Fig. 2. Relation between base stem infestation and weight of 1000 grains of winter wheat

only by 1.8% in comparison to wheat treated in a standard way. A clear increase of thousand grain weight of wheat (7%) after application of this substance by Parylak and Kordas (2002) was formerly observed. Thousand grain weight decreased significantly under conditions of extreme tillage reductions. Regardless of stubble crop presence, thousand grain weight of wheat from direct sowing was lower on average by 4.4% in comparison to wheat cultivated in plow tillage system. No significant relationship between grain plumpness and root infestation degree was proved, however, a visible negative correlation with the degree of stem base infestation was observed (Fig. 2). An increase by 1% in stem infestation index caused a decrease in thousand grain weight of wheat on average by 0.7g in traditional technology and by 0.9%g in no-tillage system.

## CONCLUSIONS

1. Infestation of root and stem-base pathogens as well as productivity of continuous winter wheat strongly depended on both: seed treatment applied and tillage system.
2. Intensification of stem-base disease occurrence was reduced by additional seed dressing with Latitude 125 FS co-applied with Raxil 60 FS. Soil tillage and plowing down stubble crop from white mustard were not that important in terms of phytosanitary functions. This indicates the presence of *Gaeumannomyces graminis* fungus in pathogen complex causing infestation of stem base bases.
3. A significant increase in grain yielding was obtained by implementing additional agricultural treatments – on average by 13.8% after additional seed treatment with Latitude 125 FS, and by 8.3% after plowing down stubble crop.
4. Grain yield and thousand grain weight of winter wheat showed visible negative correlation with the degree of stem infestation, however it did not depend on the intensity of root infestation, which indicates an important participation of *Pseudocercospora herpotrichoides* fungus in pathogen complex causing stem base diseases.
5. The most effective way to reduce wheat infestation by stem base diseases and increase its yielding, apart from treatment recommended to control rot root, is to use additional seed treatment to control take-all and to grow stubble crop simultaneously. Effectiveness of both regenerative practices is slightly lower under no-tillage and direct sowing conditions than under treatment with plow tillage.

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## POLISH SUMMARY

### MOŻLIWOŚCI OGRANICZANIA CHORÓB KORZENI I PODSTAWY ŻDŹBŁA W PSZENICY UPRAWIANEJ PO SOBIE W TECHNOLOGII TRADYCYJNEJ I ZEROWEJ

W 3-letnim doświadczeniu polowym badano wpływ zastosowanej zaprawy nasiennej Raxil 060 FS oraz Raxil 060 FS + Latitude 125 FS i przyorywania międzyplonu ścierniskowego (gorczyca biała) na porażenie przez choroby korzeni i podstawy źdźbła oraz plonowanie pszenicy ozimej uprawianej dwukrotnie na tym samym polu z zastosowaniem tradycyjnej i zerowej uprawy roli. Występowanie chorób podsuszkowych na korzeniach i podstawie źdźbła zostało wyraźnie ograniczone poprzez zaprawianie ziarna preparatem Latitude 125 FS (siltiofam). Świadczy to o obecności *Gaeumannomyces graminis* w kompleksie chorób. Stopień porażenia został ograniczony w mniejszym stopniu poprzez uprawę i przyorywanie międzyplonu ścierniskowego. Rezultatem tych dodatkowych zabiegów agrotechnicznych była także istotna wyżka plonu ziarna pszenicy – średnio o 13,8% po zastosowaniu zaprawy nasiennej Raxil 060 FS + Latitude 125 FS, a o 8,3% po przyoraniu gorczycy białej. Plon ziarna i masa 1000 ziaren pszenicy ozimej wykazywały wyraźną ujemną korelację ze stopniem zainfekowania źdźbła, natomiast nie zależały istotnie od porażenia korzeni. Wskazuje to na istotną rolę *Pseudocercospora herpotrichoides* w kompleksie patogenów. Efektywność obu zabiegów regeneracyjnych była nieznacznie mniejsza w warunkach uprawy zerowej i siewu bezpośredniego niż w tradycyjnej uprawie pluznej.