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IMPACTS OF AGROCHEMICAL TREATMENTS IN A WINTER WHEAT MONOCULTURE

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SUMMARY

Impact of pesticides and plant nutrition on wheat crop, as well as their interaction was studied in a small plot field trial run at the experimental site on eutric cambisol type soil, in 2006 and 2007. The results obtained suggest, that treatments applied – both the increasing rate of fertilizers (N0P0K0, N40P100K100, N80P100K100, N120P100K100, N160P100K100) and the increasing intensity of pesticide application (Ø, herbicide, herbicide+ fungicide, herbicide+ fungicide+ insecticide) – had significant effect on the grain yield of wheat. In case of fertilizer application each N rate resulted in a further significant yield increase in the average of pesticide applications. In 2006 the minimum yield was 2.2 t ha^{-1}, the maximum 5.5t ha^{-1}, and the average 4.3 t ha^{-1}. In 2007 the minimum yield was 1.00 t ha^{-1} and the maximum 4.6 t ha^{-1} the average 3.2 t ha^{-1}. In accordance with the increment of the level of plant nutrition and plant protection applications a decreasing magnitude of yield increase was observed. Plant nutrition applications had a more definite effect on yield figures in comparison with that of plant protection treatments. Meteorological conditions of the crop years studied were considerably buffered by agronomic applications applied.

***Key-words:** winter wheat, monoculture, plant nutrition, plant protection*

INTRODUCTION

Agrochemical applications are essential technological means in growing field crops. The most critical technological points in production of grain crops are agrochemical interventions, so that it is essential to reveal and study soundly their impacts (Ágoston-Pepó, 2005; Czövek et al., 2006).
Chemical applications are seen by the public to be both harmful to crops and environment. However, appropriate treatments are securing high yields and help to reduce serious weed infestations in our ecosystems (Hegedűs et al., 2002; Szentpétery et al., 2005a and b; Tanács et al., 2008). Weeds are in permanent competition with crop plants. Weed control is essential to establish conditions for optimum crop performance (Kazinczi et al., 2002, Knežević et al., 2008). Soils as the fundamental habitat for any plant growth provide optimal, suboptimal and hyperoptimal conditions for vegetation in relation with climatic variability (Lawlor, 2002, Jolánkai-Birkás, 2007). The aim of our trial was to evaluate the effects of ascending nitrogen applications as well as to study how plant protection treatments can influence crop yield and weed infestation of wheat crop. In this paper, results of the effect of N fertilizer and pesticide applications on grain yield of winter wheat are presented from two years (2006, 2007) of a long term trial study. Results of the previous years were published by Kismányoky (2005).

MATERIAL AND METHODS

The study was conducted in a field experiment set up by the Department of Plant Production and Soil Science of the Georgikon Faculty of the University of Pannonia, Keszthely (Hungary). The bi-factorial trial was arranged in split plot design with three replications. The "A" factor is plant protection, the "B" factor is nutrition. The main plot size is 600 m^2. The soil was Ramann-type brown forest soil

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(Eutric Cambisol) containing 41% sand, 32% silt, and 27% clay. The available phosphorus content of this sandy loam soil was low (AL- P2O5: 60-80 mgkg-1), the potassium content medium (AL-K2O: 140-160 mgkg-1) and the humus content fairly low (1,6-1,7%), with a pHKCl value of 7,3. In the experiment the effect of different rates and application methods of N fertilization as well as different variants of pesticide application was studied. The studied winter wheat cultivar was Mv Suba.

Table 1. Pesticide treatments
Tablica 1. Primjene pesticida

CH0:	Control – *Kontrola*
CH1:	Herbicide – *Herbicid*
CH2:	Herbicide+Fungicide - *Herbicid+fungicid*
CH3:	Herbicide+Fungicide+Insecticide – *Herbicid+fungicid+insekticid*

Applied pesticides:
- *Buvisild BR* (22,5 % carbendazim+7,5 % copperoxiquinolat – fungicide, seed dressing)
- *Granstar 75 DF* (75 % tribenuron metil - herbicide)
- *Artea 330 EC* (80 g/l ciproconazol+250 g/l propiconazol - fungicide)
- *Fury 10 EC* (100 g/l zeta-cipermetrin - insecticide).

Table 2. Fertilizer treatments
Tablica 2. Primjene gnojiva

	Σ N kg ha^{-1}	N			P_2O_5 kg ha^{-1}	K_2O kg ha^{-1}
		Autumn *Jesen*	Spring1 *Proljeće1*	Spring2 *Proljeće2*		
N0	0	0	0	0	0	0
N1	40	0	40	0	100	100
N2	80	40	40	0	100	100
N3	120	40	40	40	100	100
N4	160	40	60	60	100	100

The trial was run in 2006 and 2007 within a series of winter wheat monoculture since 2003. Analysis of variance was used to test the statistical significance of the treatments. In the first year seeding was on 25th of October and harvesting in 26th of July. In the second year seeding was on 21th of October and harvesting was in 4th of July. During the growing season weed monitoring was done by Balázs-Ujvárosi method each year two times, on 2006 in 31st of May (Feekes 10.54 flowering completed) and 18th of July (Feekes 11.4 ripe for cutting), and in 2007 on the 31st of May (Feekes 11,1 milky ripe) and 26th of June (Feekes 11.4 ripe for cutting). In the results' table Bayer-codes are used indicating weed species.
The 100-year average temperature in Keszthely is 10.5 ˚C, the 100-year average precipitation in the vegetation period of winter wheat (IX-VI) is 456 mm, in the 2005-2006 crop year was 10.1 ˚C, and the precipitation was 466 mm, in the 2006-2007 crop year 12.21 ˚C and 365 mm (Figure 1 and 2).

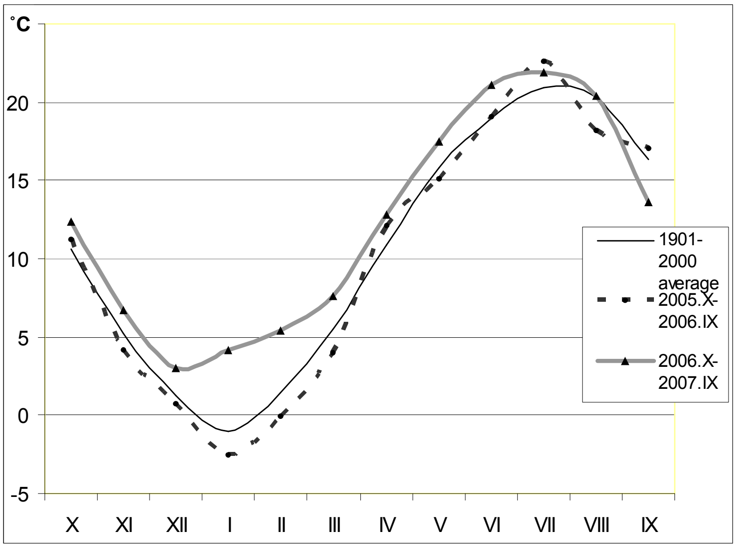


Figure 1. Long term average temperature, and in 2006 and 2007 crop year temperature
Slika 1. Višegodišnje prosječna temperature i temperature u 2006. i 2007.

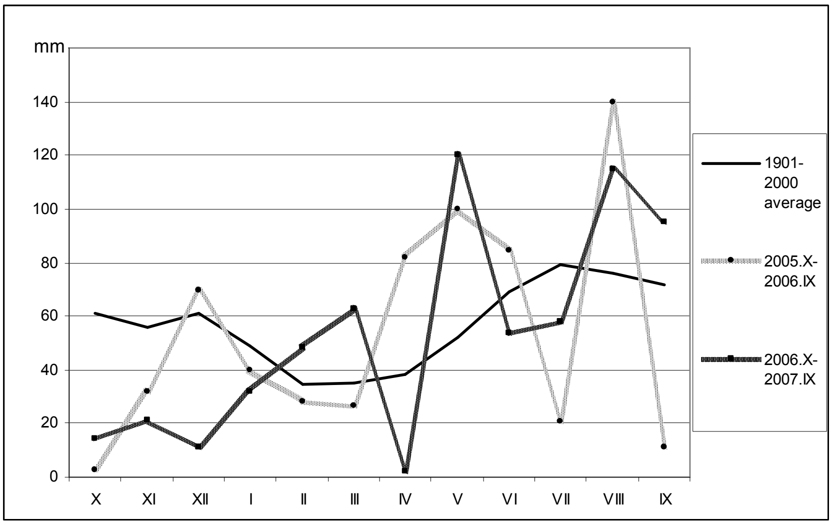


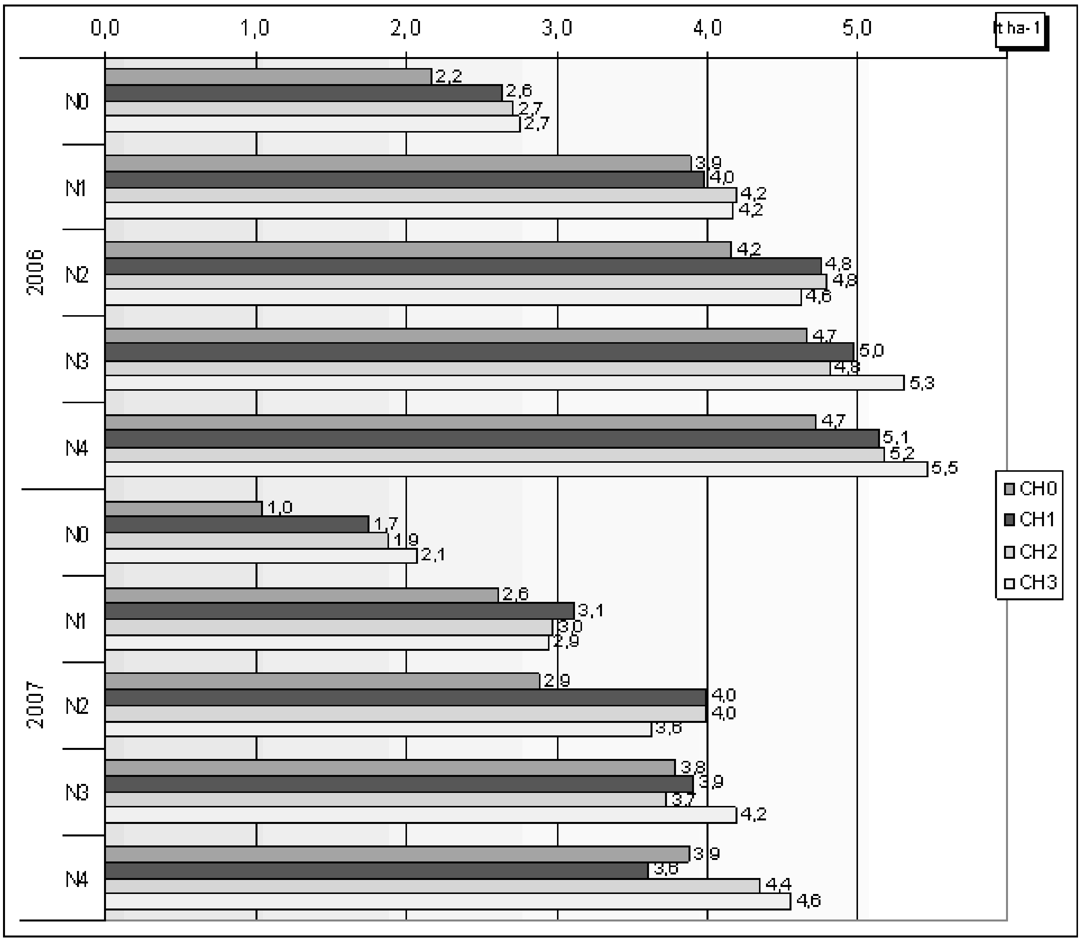
Figure 2. Long term average precipitation, and in 2006 and 2007 crop year precipitation
Slika 2. Višegodišnje prosječne oborine i oborine u 2006. i 2007.

RESULTS AND DISCUSSION

In these two years the experimental treatments - both the increasing rate of fertilizers and the increasing intensity of pesticide application - had significant effect on the grain yield of wheat. In case of fertilizer application each N rates resulted in a further significant yield increase when averaged over the pesticide application.

Between the two years there was 101 mm precipitation differences in the vegetation period. In 2006 the mean of all treatments was 4.22 t ha^{-1}, whereas in 2007 it was 3.31 t ha^{-1}. In these two years there was no significant effect on weed canopy between the N variants.

In the first year (2006) the effect of herbicide between the variants CH0 and CH1 was 0.37t ha^{-1} (109.5%). Further pesticide treatments (CH2, CH3) also raised the yield level (CH2: 110.5%, CH3: 113.8% compared to CH0 100%) when averaged over the fertilizer treatments. The effect of fungicide was not as high as we had expected in the 4th year of continuous wheat cropping. The yield increasing effect of the fertilization comparing to N0 control plots was higher than the effect of the pesticides. The difference between N0 and N1 variants was 1.537t ha^{-1} (158% growth). The higher N doses also had a significant effect (CH2 178%, CH3 192% CH4 200%) compared to the control plots (N0) when averaged over the pesticide treatments. The highest yield was 2.5 times higher, than the lowest variant (2.17 t ha^{-1}). The greatest yield, 5.47t ha^{-1} was registered by the combination of the highest fertilization and highest pesticide level (CH3 x N4) (Figure 3). From the results it can be concluded that without using fertilisers and pesticide a good yield can't be reached. However, with an adequate dose of N-P-K combined with needed one, but not more than necessary pesticide maintenance (in our experimental field this year it was herbicide treatment), we can have an optimal yield.



$LSD_{5\%}$ 2006: N: 0,36 tha^{-1} CH: 0,32 tha^{-1}2007: N: 0,84 tha^{-1}CH: 0,77 tha^{-1}

Figure 3. The effect of N fertilization and pesticide application on the grain yield of winter wheat (tha^{-1}) (Keszthely, 2006-2007)

Slika 3. Utjecaj N gnojidbe i primjene pesticida na prinos zrna ozime pšenice (tha^{-1})(Keszthely, 2006-2007)

The composition of weed species was also influenced by the experimental treatments. More weed species were found in the herbicide treatment plots (CH1) than in the control ones, but the covering was less. There were no statistically proved differences between the weed canopies on the first observation time (31st May). On the second monitoring (18th July) there were significant differences between CH0 and CH1 in weed canopy.

The dominancy of weed species were on the control plots (Ch0): *Chenopodium album* L., *Convolvulus arvensis* L. *Abutilon theophrasti* Med., and in the pesticide treated plots (CH1): *Convolvulus arvensis* L., *Cirsium arvense* (L.) Scop., and *Chenopodium album* L..

In 2007 the highest yield, 4.56t ha^{-1} was obtained in the combination of the highest fertilization dose application and at the highest pesticide level (CH3 x N4). The highest yield was 4.38 times higher than the lowest one (Figure 3).

The composition of weed species was also influenced by the experimental treatments. Less species were found in the herbicide treatment plots (CH1) than in the control ones. There were no statistically proved differences between the weed canopies on the first observation time (31st May). On the second monitoring (18th June) there were significant differences between CH0 and CH1 in weed canopy.
The canopy of the weeds observed in the control plots was 3.59 % and 6.42 % covering. On the herbicide treated plots this figure was 0.92% in both times. Dominant weed species on the first observation period (31st May) on the control plots (Ch0) were as follows: *Matricaria inodora* L., *Galium aparine* L., *Convolvulus arvensis* L. In the pesticide treated plots (CH1) they were: *Convolvulus arvensis* L., *Galium aparine* L., *Apera spica-venti* L. In the second observation period the canopy in Ch0 plots was composed of *Abuthilon theophrasti* Med., *Convolvulus arvensis* L., *Chenopodium album* L..

CONCLUSION

Pesticides and plant nutrition application impacts and their interctions on wheat crop were studied in a small plot field trial run at the experimental site on eutric cambisol type soil in Keszthely, Hungary. The experimental results suggest, that treatments applied – both the increasing rate of fertilizers and the increasing intensity of pesticide application in both year– had significant effect on the grain yield of wheat. In case of fertilizer application each N rate resulted in a further significant yield increase on the average of pesticide applications. In accordance with the increment of the level of plant nutrition and plant protection applications a decreasing magnitude of yield increase was observed. Plant nutrition applications had a more definite effect on yield figures in comparison with that of plant protection treatments. In 2006 the average yield and also the average weed canopy was higher than in 2007.

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UTJECAJ AGROKEMIJSKIH TRETMANA U MONOKULTURI OZIME PŠENICE

SAŽETAK

U mikropokusu istraživan je utjecaj pesticida i ishrane bilja na usjev pšenice, kao i njihova interakcija. Pokus se provodio na tlu tipa eutrični kambisol u razdoblju od 2006. do 2007. godine. Dobiveni rezultati ukazuju da su primijenjeni tretmani – povećane količine gnojiva (N0P0K0, N40P100K100, N80P100K100, N120P100K100, N160P100K100) i veći intenzitet primjene pesticida (Ø, herbicid, herbicid+ fungicid, herbicid+ fungicid+ insecticid) – imali značajan utjecaj na prinos zrna pšenice. Kod primjene gnojiva svaki obrok dušika rezultirao je daljnjim signifikantnim povećanjem prinosa kod prosječne primjene pesticida. U 2006. minimalan prinos bio je 2,2 t ha^{-1}, a maksimalan 5,5 t ha^{-1}, dok je prosjek iznosio 4,3 t ha^{-1}. U 2007. minimalan prinos iznosio je 1,00 t ha^{-1}, maksimalan 4,6 t ha^{-1}, a prosjek je bio 3,2 t ha^{-1}. U skladu s povećanjem gnojidbe i zaštite, došlo je do smanjenja magnitude rasta prinosa. Gnojidba pšenice imala je veći učinak na prinos nego tretmani zaštite.
Utjecaj vremenskih prilika na prinos u godinama istraživanja usjeva bio je značajno ublažen poduzetim agronomskim mjerama (gnojidba i zaštita).

Ključne riječi: ozima pšenica, monokultura, biljno hranivo, zaštita bilja

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