Investigation of the phytotoxic effect of herbicide 2,4-D with hormonal function on winter wheat

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Abstract: The wheat is one of the most important grain crop in Hungary. It is grown in every year on 1.1 million hectare in Hungary. The Hungarian grain production sector has a lot of technologies to reduce the weed infection on grain fields. One of the most important work to protect against the broad leaves weeds.

We have some active agents, which can solve this problem, among these are the herbicides with hormonal function, like MCPA and 2,4-D. These herbicide we can spray until tillering, because of late application can cause a hard side effect. Recently some studies indicated that there is an opportunity to spray these herbicides after the stem elongation without serious plant deformation.

Our purpose was investigate the phytotoxic side effect on a field experiment. We settled 4 treatments beside the control. We used a normal and a double dosage from the herbicide 2,4-D in usual application time at tillering, and at late time in full flowering. The double dosage was required because of the potential double coverage.

Our experiment shows, that in time spraying has less negative effects than the late, independently from the double dosage. The treatments causes minimal effect on the plant height, but causes considerable damage on the ear length, the number of grains in the ear and the thousand seed weight. But we observed that the treated plots had a bigger dominancy of crop, because the control plots had a lot of weeds in it, so the competition was strong between wheat and weeds.

Keywords: wheat, 2,4-D, herbicide, phytotoxicity, grain

Introduction

In our country, it is the highest proportion of crops, which represents approximately 1.121 million hectares of cultivated land. This ratio is due Hungary favourable conditions, as well as multi-annual yields prove. With these capabilities, knowledge and work can be added to the growing reputation of Hungarian wheat to produce remarkable results (Koháry, 2003).

In order to maintain our competitiveness in the market as in other countries, high-quality bread wheat cultivation target should be set, possibly with a smaller cost.

Our thesis aims – a small-plot field experiment- to examine the effect of active ingredient 2,4-D-containing hormonal herbicide for wheat production. The 2,4-D is used in cereal grains from the age of 4-6 leaves until the end of tillering. If we spread over the early spring, it is effective against broad leaf weeds. Today, due to the extreme weather conditions, the optimum time for application on weeds, as well as the crop is getting more difficult to meet. Hormonal agents have an undesired characteristic that the delayed treatment negatively influence the further development of the plant, whereas on crops can be phytotoxic. However, the advantage is, that the effect can be obtained appropriate and favourable price. In our thesis we analyzed that if it causes damage can we measure, and how to act economically. The winter wheat is used in our country especially bread and other food grain as feedstock (including a variety of pasta, bakery products, cereals, puffs, biscuits etc) and a significant amount will became animal food (Koltay - Balla, 1975). Its importance increases to adaptability - as well as our country's "qualities" - almost the entire country allows the cultivation. Our country has always been significant wheat export in our history wheat (Lelley - Rajháthy, 1955).

In recent years, domestic wheat acreage was formed around 1.1-1.2 million hectares, although the more profitable crops grown increasingly pushes down this area. It is important that a crop, grown on such a large area need special treatment, and needs the many year cultivation experiments

Considering the expected population growth of 1.14% forecast for the year, further increasing the production of cereals will be needed in the future and thus increasing the per hectare yield level could be the basis (Láng - Bedő, 2012).

Materials and Methods

The experiment took place in the fall 2015th on a field near Sümegprága. The size of the area was 3 ha. The forecrop was sunflower. The varieties for the experiment were selected from among the currently cultivated varieties.

We chosed the winter wheat named Amerigo, which variety has outstanding productivity and stable milling quality, and also has a high-yielding, very good yield stability, middle-late maturing, shredded wheat.

The plant is medium height, leg strength, their stamina is good, and it has an average tendency to shatter. Above-average winter-hardiness. Has high gluten content, protein content, falling number of good quality, and has a flour mill I. quality.

The object of the experiment was based on the 2,4-D herbicide impact assessment. The 2,4-D is a selective hormonal herbicide, used against the dicotyledonous, broad-leaved weed species (Erdei, 2011). During the experiment, we selected twenty parcels, and we studied the effect and phytotoxic symptoms of the U-46D Fluid SL agent, which contains 2,4-D (Tab.1). We used on the parcels several treatments, including normal and double dosage in suggested application time (in the stage of 3-5 leaves, in the second decade of march) and normal and double dosage in overdue application (just before the flovering, in the end of april). With the double treatment we studied the effect of herbicide on occasional double-sprayed parts of the fields. And also, the experiment contained control parcels too. Normal dosage was 1,4 l/ha^{-1}, double dosage was 2,8 l/ha $^{-1}$.

Table 1.: Distribution of treatments

	Treated parcels				
1. Repeat	1	2	3	4	5
2. Repeat	3	5	1	2	4
3. Repeat	5	4	2	3	1
4. Repeat	4	3	5	1	2

Abr.: 1: Normal time, normal dosage, 2: normal time, double dosage, 3: overdue time, normal dosage, 4: overdue time, double dosage, 5: Control parcels.

Aims our experiment were investigation phytotoxic effect of hormonal products on winter wheat. In support of this action or refute the following measurements were performed:

- plant height
- ear length
- thousand seed weight
- seed number per ear

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After the measurements were carried out a comparative analysis, which credibility factor we supported analysis of variance.

Results and Discussion

The weed infection was weak on the field (under 10 % before the threatment), the most common weeds were tipical grain weeds, including *Papaver rhoeas, Tripleurospermum inodorum*, but the weed with the highest coverage was *Ambrosia artemisiifolia* and the *Chenopodium* and *Amaranthus* species. After the treatment only the control parcel left infected, the other parcels were clear, with under 1 % weed coverage.

First we measured the plant height. The results we obtained shows, that the active ingredient 2,4-D does not affected the height of the plants in the single dose plots. In the double dose in normal and delayed-time plots the plant heights were decreased. This decreasing was statistically justified. It was also observed, that in the control plot plant height was significantly lower than the rest of the parcels. This significant decrease is caused by the continuous weed competition (Fig. 1).

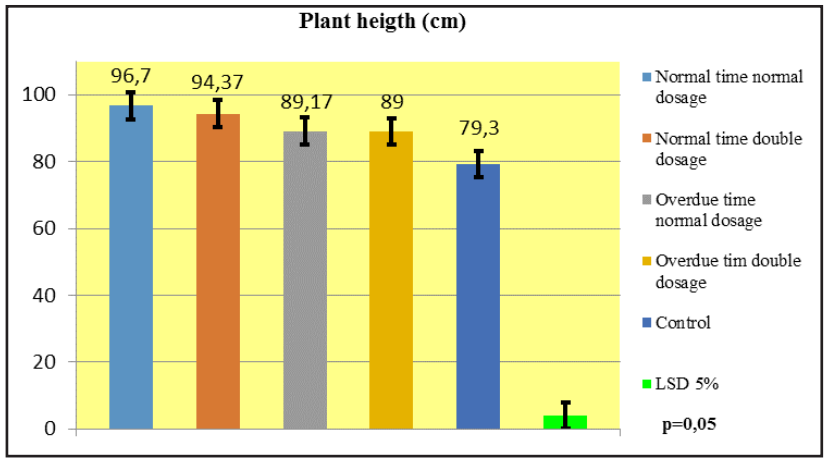

Figure 1.: Effect of treatments on the plant heights

When the harvest started, we measured the ear length, the seed number per ear and the thousand seed weight. The ear length between the normal treatments and the delayed treatments was different (approx. 1 cm). In the late-treated plots we found deformed and bent ears too. The reason for this is the phytotoxic effect of the applied herbicide. But, on the control parcels the measured values was significantly lower than the treated parcels. Our opinion is, that the reason of the weak results that on the control parcels were under strong competition of weeds (Fig. 2). The seed number per ear was also affected by the herbicide, but the weakest production was by the control plot, because of the competition between wheat and weeds. We found clear correlation between the number of ears per eye and ear length. The difference was also statistically justified. The herbicide causes yield loss, because the number of seeds within the ear decreased in any case. The last treatment, just before flowering causes fertility problems, and because of that the ear length decreased (Fig.3). We observed, that in those ears were shrivelled, shrunken seeds too.

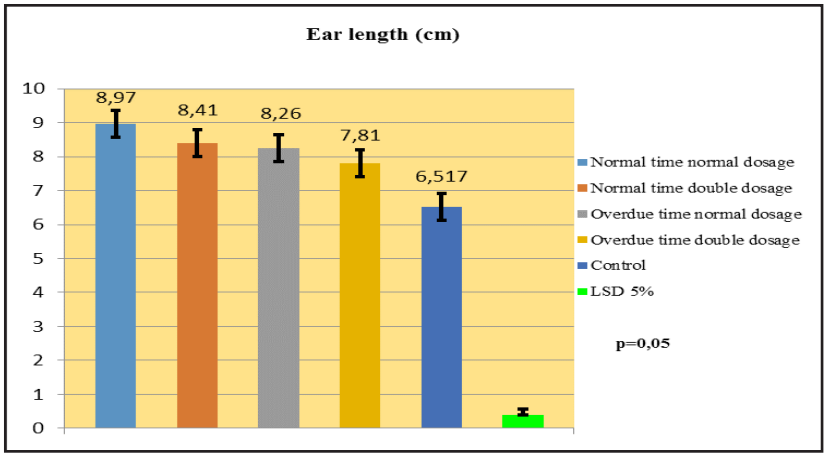

Figure 2.: The length of the ears in differently treated parcels

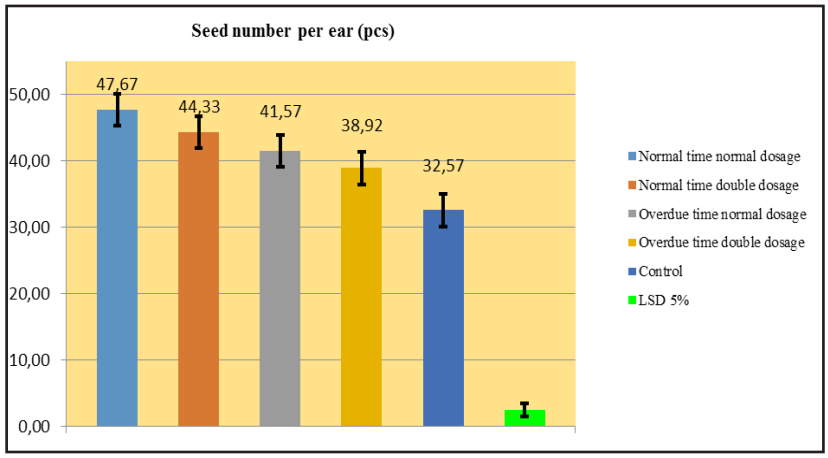

Figure 3.:The number of the seeds per ears influenced by 2,4-D

The seed number per ear was also affected by the herbicide, but the weakest production was by the control plot, because of the competition between wheat and weeds. We found clear correlation between the number of ears per eye and ear length. The difference was also statistically justified. The herbicide causes yield loss, because the number of seeds within the ear decreased in any case. The last treatment, just before flowering causes fertility problems, and because of that the ear length decreased (Fig.3). We observed, that in those ears were shrivelled, shrunken seeds too.

The last factor, that we observed, was the thousand seed weight. We observed, that in the plots, where we used the herbicide, produced less seeds than the control parcels. The control showed an improved value compared to the delayed treatments. Statistically verifiable results were obtained in the single and double-dosed treatments to the normal treatment time. The result of the delayed treatment was statistically not justified. This means that the harmful effects of 2,4-D has not been proved in this case (Fig. 4).

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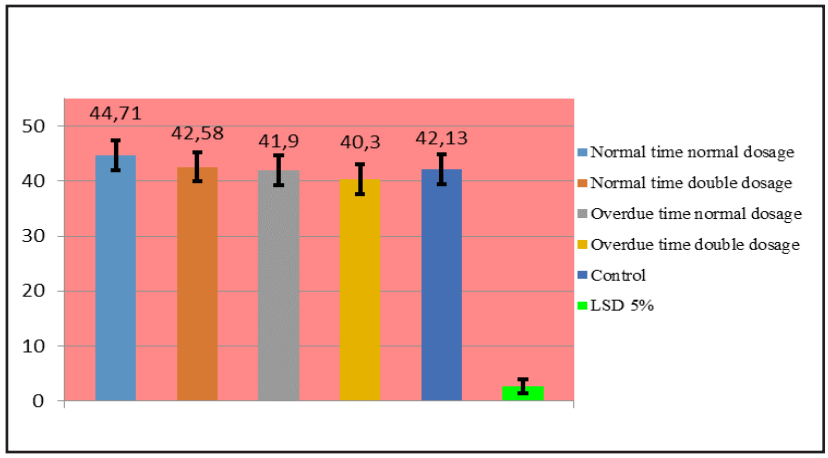

Figure 4.: The thousand seed weights of wheat in the treatments

Conclusions

Our goal was to analyze the problem with the double dosage, if it occurs, when the spraying accuracy or in case of insufficient air movement causes overlapping. The conclusion is, that the treatments occurred phytotoxic symptoms. The ear length and the thousand seed number is demonstrably reduced in the treated area, and therefore the double dose showed yield reducing effect on wheat. On the environmental and economic point of view, in all cases, we need to use the rules set out in the spraying, the spraying machine maintenance should be carried out, and we need to use precise application. The delayed doses shows the problem, when because of the event of wet weather we cannot perform a normal treatment. In these plots we can clearly see the phytotoxic symptoms.

With the delayed, double dosage treatment we wanted to prove the problem with the overlapping. In this case, the plants showed an increased phytotoxic symptoms, including ear deformations, spike shortening and varying degrees of distortion. The results show, that if we need those delayed treatments, we must do it with utmost care.In the control plots , however, were all results weaker then the treated plots, for example the plant height was 18 percent lower than in the parcel threated with normal time and normal dosage. The seed number per ear was also affected, the weeds caused 32 percent of loss in the seeds in one ear. Those values were proven significant.Weeds cause an adverse effect to the wheat, it was falling behind in development. It follows, that the weeds can cause serious problems, especially in large groups from the T_4 weeds, and mixed with perennial weeds.

Overall, the evaluation of the experiment proved that we cannot grow wheat under extensive growing conditions. There is a need to intervene early weed control. On the control parcels were the biggest loss, and this loss was also proven signicifant. It was proved by the measurements, that the double-dose treatment causes the biggest rate of decline (for example the number of seeds per ear was affected by the double dosage and overdue time threatment, the loss was high - 20 % - , but the magnitude of declining is still not bigger, than in the control plot value (32 %). It is clearly established, that the treatment undergone by the non-optimal time is still better than the missed treatment. In any case, we need to use the applied regulations, so neither the environment nor the plant will be not damaged.

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