# EFFECTS OF POST-EMERGENCE HERBICIDES ON WEEDS IN WHEAT AND THE YIELD OF THE CROP

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**Abstract**

In wheat production, it is necessary to undertake control of weeds which cause losses of wheat grain yield. A research was carried during the winter season 2004-5 to identify weed species and to investigate the efficacy of herbicides on weeds and their effect on grain yield. Three different herbicides were applied after crop emergence, namely Lintur (a.i. triasulfuron + dicamba), Granstar (a.i. tribenuron-methyl) and Optica combi (a.i. MCPA + mekoprop-P), in the wheat variety Novosadska rana 1 in the region of Prishtina (central part of Kosovo). The trial was set in a randomized block design with four replications and elementary plots of 5 $m^2$. A total number of 14 weed species was documented in the wheat crop. The highest number of individuals was recorded for *Consolida orientalis* (221 plants/$m^2$), *Bifora radians* (38 plants/$m^2$) and *Cirsium arvense* (21 plants/$m^2$). In general, all applied herbicides reduced the weed infestation and positively affected the grain yield in comparison to an untreated control. The most efficient herbicides proved to be triasulfuron + dicamba (98.6 %) and tribenuron-methyl (97.8 %), while the efficacy of MCPA + mekoprop-P (88.7 %) was markedly lower. Comparatively high grain yields were found in plots treated with triasulfuron + dicamba (3.6 t/ha) or tribenuron-methyl (3.4 t/ha). The yield in MCPA+mekoprop-P (3.0 t/ha) treated plots was lower.

**Key words:** herbicides, wheat, weeds, efficacy of herbicide, grain yield

## INTRODUCTION

Since centuries, the arable weed vegetation of Kosovo has been affected by multiple management measures and environmental features at various spatial scales. Weeds have become an increasing problem in wheat and some weed species such as: *Polygonum aviculare, Cirsium arvense, Viola arvensis, Amaranthus retroflexus* etc. are widespread all over the arable land of Kosovo (Mehmeti et al., 2009).

Pests, plant diseases and weeds cause high losses of wheat yield. Yield losses due to weeds have been reported to range from 5 % up to 50 % (Ognjanović et al., 1991; Oerke, 2006; Dangwal et al., 2010). Thus, in wheat

production, it is necessary to undertake control of weeds which cause losses of wheat grain yield. The use of herbicides may reduce such losses, as herbicides may reduce the weed infestation (Mehmeti, 2004), provided that the herbicide-treated weeds are not herbicide resistant. In general, a wide range of various herbicides is available. However, the decision which herbicide can be used principally depends on e.g., the dominant weed species, the weather conditions, the crop stage, the herbicide activity and the weed communities (Šarić, 1991; Šinžar and Tešić, 1995). The weed communities are very dynamic and variable in their floristic aspects (Mijatović and Lozanovski, 1984) and the presence and structure of weeds occurring in a field varies between fields and regions depending on e.g., climate conditions, soil, crop, weed management, and weather conditions during the vegetation period.

Given the example of an experimental field of the Agricultural Faculty in Prishtina, the aim of the research presented was to identify weed species, to investigate the efficacy of herbicides on weeds and to evaluate herbicide effects on grain yield, which is a very important crop in Kosovo.

## MATERIALS AND METHODS

During the winter season 2004-5, an experiment was conducted on a vertisol soil (pH 7.45, $pH_{KCL}$ 6.55, 2.9 % $humus_{total}$, 20.1 mg $K_2O$ /100g and 34.5 mg $P_2O_5$/100g) at a research farm of the Agricultural Faculty in Prishtina (central part of Kosovo). In the beginning of November, the wheat variety Novosadska rana 1 was sown by using 300 kg/ha seeds in good tilled soil, treated with fertilizer NPK 15:15:15 in doses of 250 kg/ha. In spring, a supplementary fertilization with ammonium nitrate in doses 200 kg/ha was applied. Herbicide treatment was carried out using the CP-3 special knapsack sprayer of the capacity of 20 l, and the amount of water used was 400 l per ha. In Tab. 1, basic data on the applied herbicides is provided. The trial was set in a randomized block design with four replications and elementary plots of 5 $m^2$.

**Table 1. Basic data on the applied herbicides**

| Variants | Active ingredient | Product | Rate/ha | Application |
|---|---|---|---|---|
| 1 | triasulfuron + dicamba | Lintur - 70 WG | 150/g | post emergence |
| 2 | tribenuron-methyl | Granstar - 75 WG | 15/g | post emergence |
| 3 | MCPA + mekoprop-P | Optica combi - SL | 2/l | post emergence |
| 4 | | Control (untreated) | | |

The estimation of weeds was conducted based on the quantity-quality method for 1 $m^2$. All three herbicides were applied at the end of tillering. 30 days after herbicide application, the number and structure of weeds and the efficacy of

herbicides were estimated by comparing sprayed plots and control plots (untreated). The efficacy of herbicides was calculated by the equation (Šarić, 1991):

$$CE\ \% = \frac{A \times 100}{B}\ \%$$

where:
CE % is the coefficient of efficacy,
A is the number of destroyed weeds per $m^2$ and
B is the number of weeds in the untreated 1 $m^2$ plots

The equation can be applied to weed species individuals ($CE_{ind.}$) and to weed species numbers ($CE_{spec.}$). The weeds were determined in the laboratory of the Faculty of Agriculture in Prishtina, Department of Plant Protection, using the atlases of Šarić (1978) and Demiri (1979).

**Statistical Analysis**

Statistical analysis was performed using one-way ANOVA (Vukadinović, 1994). Mean values were calculated and significant differences between the mean values were assessed based on LSD-tests.

**Meteorological conditions**

During the experiment in 2004-05, the air temperatures (Table 2) and the amount of rainfall (Table 3) were slightly higher than in an average year.

**Table 2. Mean air temperature (°C) in Prishtina, near to the studied field, in the year of the experiment and between 1951-1980 ('average year') (Δ: difference between 2004-05 and the 'average year')**

| | Months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IX | X | XI | XII | I | II | III | IV | V | VI | VII | |
| Year | Air temperature °C | | | | | | | | | | | Average |
| 2004-05 | 16.0 | 10.5 | 5.3 | 0.9 | 0.1 | 2.1 | 4.5 | 10.2 | 16.0 | 17.8 | 20.8 | 9.4 |
| 1951-80 | 16.1 | 11.0 | 6.4 | 1.2 | 1.5 | 1.0 | 4.7 | 10.4 | 14.6 | 18.0 | 20.2 | 9.1 |
| Δ | -0.1 | -0.5 | -1.1 | -0.3 | -1.4 | +1.1 | -0.2 | -0.2 | +1.4 | -0.2 | +0.6 | +0.3 |

**Table 3. Rainfall (mm) in Prishtina, near to the studied field, in the year of the experiment and between 1951-1980 ('average year'), (Δ: difference between 2004-05 and the 'average year')**

| | Months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IX | X | XI | XII | I | II | III | IV | V | VI | VII | |
| Year | Amount of rainfall | | | | | | | | | | | Average |
| 2004-05 | 53.8 | 34.6 | 110.1 | 33.3 | 30.7 | 34.7 | 51.0 | 54.1 | 98.2 | 55.4 | 55.6 | 611.5 |
| 1951-80 | 47 | 62 | 55 | 50 | 35 | 34 | 34 | 47 | 72 | 55 | 43 | 534 |
| Δ | +6.8 | -27.4 | +55.1 | -16.7 | -4.3 | +0.7 | +17 | +7.1 | +26.2 | +0.4 | +12.6 | 77.5 |

## RESULTS AND DISCUSSION

In the experiment, the total number of 14 weed species was recorded, indicating a species-poor weed community in the experimental field. This result is in accordance with (Susuri et al., 2001), who investigated fields cultivated with wheat in two localities, Bunari i Priftit and Vlashnje, of the region of Prizren (Kosovo). In Bunari i Priftit the authors documented 16 and in Vlashnje 12 weed species. Mehmeti et al. (2008) showed that today's weed flora in wheat crop in Kosovo is species-poor at the field scale (about 9.6 weed species per $25m^2$).

In the experiment presented here, the number of weed individuals was very high in the control plots (Table 4). For *Consolida orientalis* 221.2 plants/$m^2$, for *Bifora radians* 38.0 plants/$m^2$ and for *Cirsium arvense* 21.5 plants/$m^2$ were documented. This high weed density was due to land abandonment for several years before the experiment.

With respect to the species life forms, therophytes prevail with 50.0 %, while hemicryptophytes (28.6 %) and geophytes (21.4 %) are less important. These results are in accordance with Pejčinović (1987), who also found that therophytes dominated (57.1-74.4 %) in wheat crop.

**Table 4. Species life forms, number of individuals and coefficients of herbicide efficacy (CE) in the investigated wheat crop**

| Life form | Species name | triasulfuron + dicamba | tribenuron-methyl | MCPA + mekoprop-P | Control |
|---|---|---|---|---|---|
| H | *Adonis vernalis* L. | - | - | - | 1.5 |
| G | *Agropyron repens* P.B. | - | - | 0.5 | 7.5 |
| T | *Bifora radians* Bieb. | - | - | 6.5 | 38.0 |
| H | *Calystegia sepium* R. Br. | - | - | 2.0 | 1.5 |
| G | *Cirsium arvense* Scop. | - | 0.8 | 2.2 | 21.5 |
| T | *Consolida orientalis* L. | 6.0 | - | 18.0 | 221.2 |
| G | *Convolvulus arvensis* L. | - | - | 2.8 | 11.2 |
| H | *Holcus lanatus* L. | - | 3.0 | - | 1.2 |
| T | *Hordeum sativum* L. | - | - | 1.0 | 3.7 |
| H | *Lathyrus tuberosus* L. | - | - | 0.3 | 3.7 |
| T | *Mathricaria chamomilla* L. | - | - | 0.8 | 2.7 |
| T | *Polygonum aviculare* L. | - | - | 1.5 | 14.7 |
| T | *Sinapis arvensis* L. | - | - | 1.3 | 2.2 |
| T | *Veronica persica* Poir. | 1.5 | - | 0.5 | 2.2 |
| | Number of individuals/$m^2$ | 7.5 | 3.8 | 37.4 | 332.8 |
| | $CE_{ind.}$ (%) | 97.8 | 98.6 | 88.7 | 0 |
| | Species number/$m^2$ | 2 | 2 | 12 | 14 |
| | $CE_{spec.}$ (%) | 85.7 | 85.7 | 14.2 | 0 |
| | Wheat grain yield (t/ha) | 3.4 | 3.6 | 3.0 | 2.5 |

It is evident from the efficacy results (Table 4) that all three herbicides reduced the weed infestation in the wheat crop in comparison to the control plots. Highly efficient were tribenuron-methyl ($CE_{ind}$=98.6 %) and triasulfuron + dicamba ($CE_{ind}$ =97.8 %). Less efficient was MCPA + mekoprop-P ($CE_{ind}$ =88.7 %). MCPA + mekoprop-P had very low efficacy in the reduction of weed species numbers ($CE_{spec.}$=14.2 %). *Consolida orientalis, Bifora radians*, *Convolvulus arvensis* and *Cirsium arvense* cannot be controlled successfully by this herbicide. In contrast, tribenuron-methyl and triasulfuron + dicamba were highly efficient in the reduction of weed species numbers ($CE_{spec.}$=85.7 %).

The dominant species *Consolida orientalis* had the highest susceptibility to tribenuron-methyl. This is in accordance with Radivojević et al. (2006). However, *C. orientalis* was proved to be resistant against the MCPA + mekoprop-P and *Veronica persica* against triasulfuron + dicamba. Moreover, *Holcus lanatus* were proved to be resistant against tribenuron- methyl.

**Table 5. Yield of wheat (t/ha) depending on herbicide treatment**

| Treatment | Yield | X-2.525 | X-3.075 | X-3.641 |
|---|---|---|---|---|
| triasulfuron + dicamba | 3.414 | 0.889** | 0.339 | 0.227 |
| tribenuron-methyl | 3.641 | 1.116** | 0.566** | - |
| MCPA + mekoprop-P | 3.075 | 0.550** | - | |
| Control | 2.525 | - | | |
| | LSD (0.05) = 0.489 | | LSD (0.01)= 0.685 | |

In comparison to the control plots (2.5 t/ha), all herbicide treated plots showed increased grain yields (Table 5). This result is in accordance with e.g., Sarpe et al. (1988) and Abbas et al. (2009). In the study presented here, comparatively high grain yield were found in plots treated with triasulfuron + dicamba (3.6 t/ha) and tribenuron-methyl (3.4 t/ha). Yields were lower in MCPA + mekoprop-P treated plots (3.0 t/ha).

Based on the results presented, we recommend the usage of triasulfuron + dicamba or tribenuron-methyl in the study region for successful weed control and high wheat grain yields.

## Conclusions

1. The wheat community in wheat crop at the locality of Prishtina consisted of 14 weed species, with an average number of 332.8 individuals/$m^2$ in the control plots of the experiment.
2. Dominant weeds in the control plots were (individuals/$m^2$ are given in brackets): *Consolida orientalis* (221.1), *Bifora radians* (38.0), *Cirsium arvense* (22.1), *Polygonum aviculare* (14.7) and *Convolvulus arvensis* (11.2).
3. Highly efficient in the reduction of weed individuals ($CE_{ind.}$) were tribenuron-methyl (98.6 %) and triasulfuron + dicamba (97.8 %); less efficient was MCPA + mekoprop-P (88.7 %).
4. MCPA + mekoprop-P was also less efficient in the reduction of the number of weed species ($CE_{spec.}$=14.2 %)
5. In comparison to the untreated plots (2.5 t/ha), the wheat yield was comparatively high in triasulfuron + dicamba (3.6 t/ha) and tribenuron-methyl 3.4 t/ha treated plots. Yields were lower in MCPA + mekoprop-P treated plots (3.0 t/ha).

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