

Investigation on herbicides' effect on the productivity in spring oat (*Avena sativa* L.)

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Abstract

The efficiency of the herbicides Arat, Derby 175 SK, Lintur 70 WG, Lotus D, Sekator WG, Strech 60 WP and Kougar on the productivity in spring oat variety Obrzatzoc chiflik has been investigated in field conditions. It has been proved that biggest influence on the grain yield of winter oat has the climate conditions and much lower is the effect of herbicide's application.

Key words: spring oat, weeds, herbicides, productivity, yield.

Introduction

The weed control in cereal crops is conducted mainly by chemical treatments. Grain yield in plots where herbicide were applied are greater by 28-30% then the untreated control as reported by Georgieva and Dimitrova (1998), Dimitrova and Georgieva (1998), and Saveb and Antonova (2001).

Some herbicides have narrow limits of selectivity (Petunova and Trofimovskaja, 1978). Compared with other crops the oat has better tolerance to herbicides. (Reeves, 1988; Fisher, et. al., 1999; Subev, Antonova, 2001, MacRae, et al., 2007). In oat fields until now chemicals based on 2,4D and 2M-4X in concentration 80 – 120 g/dka were applied after 3rd leaf developed to the end of tillering (Liubenov, 1987; Nesterenko, 1988). Great effectiveness and selectivity is established for the chemical Derbi 175 SK in concentration 7 ml/dka (Georgieva and Dimitrova, 2000; 2001). Investigating numerous herbicides on hullless oat genotypes Subev and Antonova (2001) find best effects in application of chemicals from the group of dikamba.

As well known the application of the same herbicides against weedy species results in compensative processes and resistant forms occurs (Monstvilaite, 1980; Gospodinov, 1983). This imposes the necessity of investigation of new herbicides and establishment of their effectiveness against weed and selectivity to the main crop.

The aim of this study is to determine the influence of some new herbicides against broad leaf weeds on the spring oat productivity.

Material and methods

The research was conducted during the period 2004-2006 at the experimental field of the Institute of Agriculture, Karnobat, Bulgaria, on pellic vertisols. The spring oats variety Obrzatzoc chiflik were used as tested crop.

The experiment design comprise 10 variants: **1** - K₁ - weedy control, **2** – K₂ – untreated and without weeds; **3** - 1.25 % *Jodosulfuron* + 5 % *Amidosulfuron* + *antidote* (Sekator WG- 15 g/ dka); **4** - 1.25 % *Jodosulfuron* + 5 % *Amidosulfuron* + *antidote* (Sekator WG - 20 g/ dka); **5** - 4.1 % *Triasulfuron* + 65.9 % *Dicamba* (Lintur 70 WG -15 g/ dka); **6** - 50 % *Dicamba* + 25 % *Tritosulfuron* + Desh (Arat – 10 g/ dka); **7** -50 g/ l

Cinedon-ethyl + 420 g/l 2,4 D (Lotus D – 60 ml/ dka); **8** - 60 % *Metsulfuron Metil* (Strech 60 WP - 1 g/ dka); **9** - 7.5 % *Florasulam* + 10 % *Flumetsulam* (Derby 175 SK - 5 ml/ dka), **10** – 100 g/l diflufenican + 500 g/l izoproturon (Kougar).

The experiment was set down in lettuce design in 4 replicates. The plot size was 10 m². The sowing is done in the optimal term (20 - 25th of February). The precrop was pea - sunflower mixed crop. The herbicides were applied during oat tillering and only Kougar was applied after sowing before emergence. The treatment is done by back sprayer “Matabi” with working solution 40l/dka. Indexes taken account of herbicides selectivity by the scale of EWRS – note 1 – no damage inflicted, note 9 – cultivar was completely damaged).

Grain yield in kg/ dka at 13 % humidity was measured. 40 plants were taken for individual biometrics from each plot before harvest. Main traits as productive tillering (nb/ m²), number of grains in the panicle, weight of grains form one panicle (g) and thousand kernel weight (TKW) (g) are measured.

Results and discussion

The environmental conditions in the successive years were different and had big influence on the development of spring oat variety Obratzov chiflik (Figure 1).

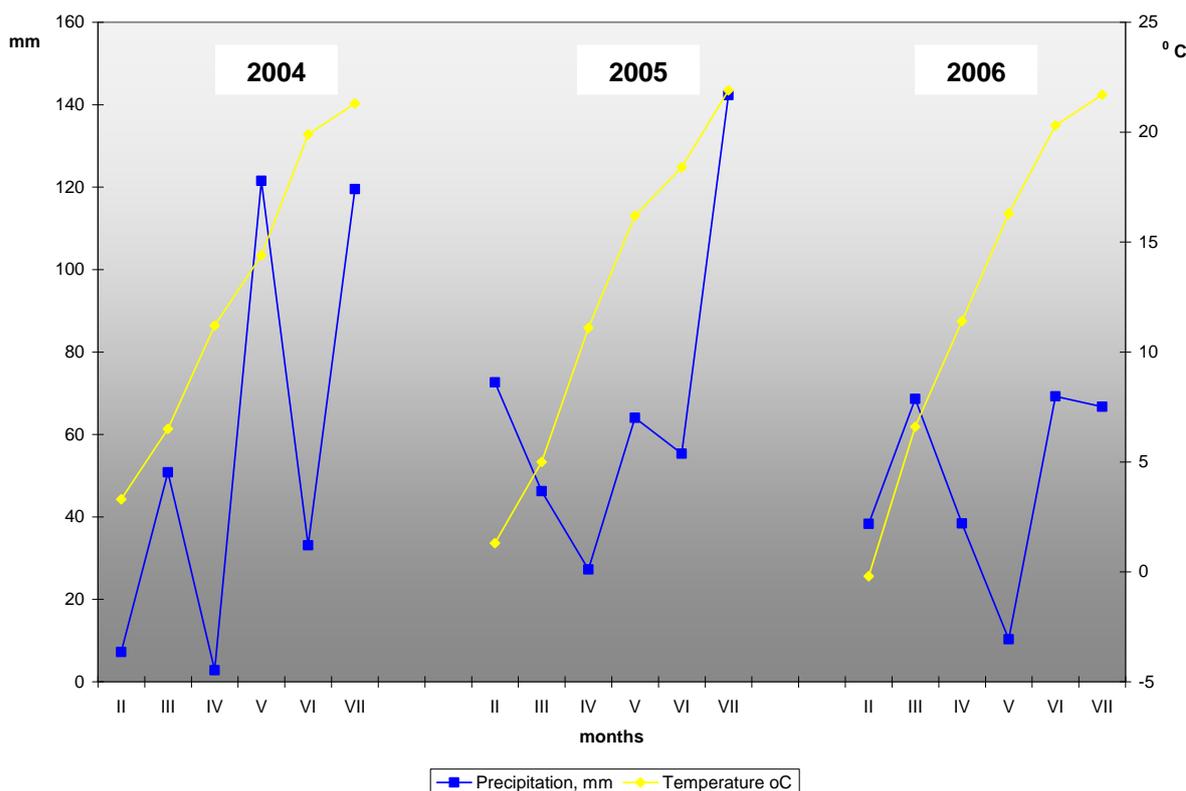


Figure 1. Climatogramm the period of study

The climate in the first testing year was not favorable for the growth and development of spring oat. The rainfalls were unsteady distributed. Severe drought occurred in April and abundant rainfalls fell down in May. During the seed development the weather was better and facilitated the realization of the productive potential of oat.

The second year was characterised by cold spring and lots of rainfalls in the summer. The total rainfall for the vegetation period was 407.6 mm at average value of 290.6 mm. This provokes crop's lodging.

The third year has dry spring and hot summer. Unfavorable effect had the drought in April – May but the June rainfalls contributed for better grain formation and growth and achievement of biggest yields then the previous years.

The experimental plots were weeded by the same species by composition and density. Predominant were monocarp broad leaf weeds as *Anthemis spp.*, *Scandix pecten-veneris L.*, *Papaver rhoeas L.*, *Thlaspi arvensis L.*, *Sinapis arvensis L.*, *Veronica hederifolia L.* and *Fumaria officinalis L.*, and polycarp - *Cirsium arvense (L.) Scop.*

In the research period all herbicides but Strech 60 WP in concentration 1.5 ml/dla and Sekator WG - 15 g/dka were very effective at suppression of weed development. Strech 60 WP and Sekator WG in lower concentration have weaker effect on the weed species *Papaver rhoeas L.* and *Cirsium arvense (L.) Scop.*

Phenological observations on the 3rd, 7th and 14th days after the treatment with Lotus D in concentration 60 ml/ dka shows small chlorotic stains on the leaves which are easily overcome by the plants.

Data analyses in Table 1 shows that all treated variants yielded better (110.4 to 120.4 %) then the untreated and weeded control. Highest yield for the period has the variant treated with Kougar 200 ml/ dka. The oat has prolonged emergence period then wheat and barley which cause weaker cropping. Variants with Kougar stay clear during most of the vegetation period.

Table 1. Analysis of grain yield, kg/ dka

| Treatments | Doses (g, ml ai.dka ⁻¹) | 2004 | 2005 | 2006 | Average for the period | | |
|--|---|--------|--------|--------|------------------------|--------------------|--------------------|
| | | | | | kg/dka | % - K ₁ | % - K ₂ |
| K ₁ - weedy check | - | 182 | 155 | 266 | 211 | 100 | 79.6 |
| K ₂ – untreated and without weeds | - | 227*** | 218*** | 352*** | 265 | 125.6 | 100 |
| Arat + Desh | 10 | 215*** | 175** | 328** | 239 | 113.3 | 90.2 |
| Derby 175SK | 5 | 202** | 182*** | 342*** | 242 | 114.7 | 91.3 |
| Lintur 70 WG | 15 | 207** | 182*** | 322** | 237 | 112.3 | 92.6 |
| Lotus D | 60 | 195ns | 172** | 338*** | 235 | 111.4 | 88.8 |
| Sekator WG | 15 | 215*** | 183*** | 317* | 238 | 112.8 | 89.8 |
| Sekator WG | 20 | 218*** | 182*** | 326** | 242 | 114.7 | 91.3 |
| Strech 60 WP | 1.5 | 207** | 177*** | 317* | 233 | 110.4 | 87.9 |
| Kougar | 200 | 247*** | 185*** | 330** | 254 | 120.4 | 95.8 |
| GD 5 % | | 14.79 | 11.83 | 19.26 | | | |
| GD 1 % | | 19.98 | 15.99 | 26.02 | | | |
| GD 0.1 % | | 26.62 | 21.30 | 34.60 | | | |

Lowest yields are achieved when Strech 60 WP and Lotus D were applied. At Strech 60 WP this could be explained with the lighter phytotoxicity to the weeds. Lotus D provokes negative reaction in the oat.

The other herbicides have good efficiency against the present weeds and allow yields' increase by 11 – 14 % relating to the weedy control.

The yield variation under climate conditions influence is significant. The difference between the average yields in the unfavorable 2005 and the favorable 2006 is around 140 kg/ dka.

The analysis of variance (Table 2) shows that the yield variation is determined in larger degree by the environmental conditions (94.25 %) and the herbicides' effect in the testing period is significantly lower (4,26 %).

Table 2. Analysis of variance for grain yield from spring oat Obraztcov chiflik treated with herbicides in 2004 - 2006.

| Variance | Dispersion SQ | DF | η^2 (%) |
|-------------------|---------------|----|--------------|
| Total | 125364.80 | 29 | - |
| Years | 118155.80 | 2 | 94.25 |
| Herbicides | 5342.13 | 9 | 4.26 |
| Accident | 1866.87 | 18 | 1.49 |

The acquired data confirm the research of Sabev an Antonova which clam that biggest influence on the oat grain yield has the year and much lower is the herbicide's effect.

Data for herbicides' effect on the productive elements are shown in Table 3.

Biggest productive tillering is observed in the control which was mechanically weeded and the variant with Kougar treatment. When chemicals are applied during oat tillering the weeds rarefied the crops and in the other variants the tillering is lower but not significantly proven.

Application of Sekator WG (15 g/dka), Lotus D, Lintur 70 WG, Srtech 60 WP and Kougar does not influence the plant height and the plants are equal to the one in the clear control. Plants from variant treated with Sekator WG (920 g/ dka), Arat +Desh and Derbi 175 CK have the same height as the one in the weeded control.

The number of grains in one panicle and their weight are different in clear control and the variants where Strech 60 WP, Lintur 70 WG and Lotus D were applied. Treatments with Kougar, Sekator Wg, Derby 175 SK and Arat + Desh do not provoke significant divergences from the clear control.

Conclusions

Biggest influence on the grain yield of winter oat has the climate conditions and much lower is the effect of herbicide's application.

Treatment with soil herbicide Kougar is related to increase of the yield in winter oat by 20.4 %.

Lowest productivity is observed in variants treated with Strech 60 WP and Lotus D. Strech 60 WP has lower phytotoxicity against weed species, and Lotus D provokes negative reaction in oat plants.

The herbicides Sekator WG, Derby 175 SK and Arat + Desh are selective to this crop and facilitate yield increase by 13 – 14 %.

Table 3. The influence of some herbicides on productivity index at spring oat Obratcov chiflik (2004 - 2006)

| <i>Treatments</i> | Rate, g, ml ai.dka⁻¹ | Productive Tillering, nb/m² | Plant height, cm | Length of panicle, cm | Grains from panicle, nb | Weight of the grain, g |
|--|--|---|---------------------------------|--|--|---|
| K ₁ - weedy check | - | 532.75 | 105.88 | 22.33 | 52.90 | 1.57 |
| K ₂ – untreated and without weeds | - | 621.75 | 113.63 | 23.99 | 65.64 | 1.96 |
| Arat + Desh | 10 | 555.75 | 109.63 | 23.93 | 61.17 | 1.76 |
| Derby 175SK | 5 | 572.25 | 106.38 | 23.03 | 62.04 | 1.70 |
| Lintur 70 WG | 15 | 571.00 | 113.88 | 24.08 | 58.20 | 1.77 |
| Lotus D | 60 | 579.75 | 114.25 | 23.57 | 57.15 | 1.65 |
| Sekator WG | 15 | 574.25 | 114.88 | 23.50 | 67.67 | 1.84 |
| Sekator WG | 20 | 578.00 | 110.75 | 24.11 | 67.11 | 1.82 |
| Strech 60 WP | 1.5 | 551.75 | 113.13 | 22.96 | 58.80 | 1.78 |
| Kougar | 200 | 629.75 | 112.63 | 23.43 | 68.59 | 2.05 |
| GD 5 % | | 55.66 | 6.51 | 0.89 | 6.82 | 0.13 |
| GD 1 % | | 74.03 | 8.65 | 1.23 | 9.35 | 0.18 |
| GD 0.1 % | | 96.29 | 11.26 | 1.67 | 12.72 | 0.25 |

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