

# Efficacy and selectivity of herbicides for broadleaf weeds control at winter wheat (*Triticum aestivum* L.)

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## ABSTRACT

During 2015-2016 a field trial with the winter wheat variety "Enola" was conducted. The study was stated on the experimental field of the base for training and implementation of the Agricultural University of Plovdiv, Bulgaria. Efficacy and selectivity of the herbicides Secator OD (100 g/l amidosulfuron + 25 g/l jodosulfuron + 250 g/l mefenpyr-diethyl-antidote) and Biathlon 4 D (714 g/kg tritosulfuron + 54 g/kg florasulam) + the adjuvant Dash, applied at registered and higher rates, was evaluated. The herbicide application was done in two phenophases of the crop – 1<sup>st</sup> – 2<sup>nd</sup> stem node (BBCH 30-32) and flag leaf (BBCH 37-39). The efficacy of the products by the 10 score scale of EWRS was recorded. The results were compared with adjacent untreated controls. The herbicide selectivity for the winter wheat by the 9 score scale for phytotoxicity of EWRS was reported. The highest herbicide efficacy and the highest yield were obtained at the variant treated with Biathlon 4 D + Dash in rate of 0.14 kg/ha + 1.0 l/ha applied in phenophase 1<sup>st</sup> – 2<sup>nd</sup> stem node (BBCH 30-32). For both herbicides (Secator OD and Biathlon 4 D) at all evaluated rates signs of phytotoxicity for the crop were not observed.

**Key words:** winter wheat, weeds, herbicides, selectivity, efficacy

## Introduction

The intensive weeding at wheat (*Triticum aestivum* L.) can decrease the yield up to 70% (Bekelle, 2004; Tonev et al., 2007; Tonev et al., 2011). In the modern agriculture the weed management is accomplished mostly by chemical means. The choice of appropriate herbicide, optimal time and phenophase of application is one of the most important parts of the crop management (Sherawat et al., 2005; Khalil et al., 2008; Abbas et al., 2009). Chopra et al. (2008) reported that carfentrazone at rate 20 g/ha and metsulfuron at rate 4 g/ha have 83.7% and 84.1% respectively broadleaf weed control. Sufficient control of annual dicotyledonous weeds, including the resistant of 2,4-D and 2M-4X after the treatment with iodosulfuron at 150-200 g/ha and amidosulfuron + iodosulfuron potassium methyl at 200-250 g/ha was recorded (Soroka and Soroka, 2003). Wang Cang et al. (2016) establish that the combine application of 29 % fluroxypyr WP + 5% carfentrazone-ethyl WP, 50 g florasulam + 40% carfentrazone-ethyl have excellent efficacy against *Descurainia sophia* (L.) Webb ex Prantl, *Capsella bursa-pastoris* (L.) Med. and *Galium aparine* L. and are selective for the wheat. The most efficient herbicide for *Galium* sp. control is fluroxypyr. High efficacy against *Galium aparine* was observed after the combined treatment with carfentrazone + MCPP, tritosulfuron + dicamba, piraflufen + isoproturon, amidosulfuron + iodosulfuron (Cirujeda et al., 2008).

The goal of the experiment was to study the herbicide efficacy and selectivity of Secator OD and Biathlon 4 D applied in registered and high rates at winter wheat.

## Materials and Methods

The study was stated on the experimental field of the base for training and implementation of the Agricultural University of Plovdiv in 2015-2016. The experiment was performed by the randomized block design with

16 variants in 3 replications. The size of the harvesting plot was 20 m<sup>2</sup>. The efficacy of Secator OD (100 g/l amidosulfuron + 25 g/l jodosulfuron + 250 g/l mefenpyr-diethyl-antidote) and Biathlon 4 D (714 g/kg tritosulfuron + 54 g/kg florasulam) applied in registered and high rates was evaluated. The results were compared with adjacent untreated controls. The herbicides were applied in two phenophases of the crop - 1<sup>st</sup> - 2<sup>nd</sup> stem node (BBCH 30-32) and flag leaf (BBCH 37-39).

In the study the winter wheat variety "Enola" was grown. The plant density was 450 plants/m<sup>2</sup>. Herbicides were applied with back sack sprayer for plot trails (brand "Solo"). The expense of spray solution was 250 l/ha. Predecessor of winter wheat in the crop rotation was sunflower. Immediately after the sunflower harvest fertilization with 450 kg/ha P<sub>2</sub>O<sub>5</sub> and 400 kg/ha K<sub>2</sub>O was done. Before the wheat was sown, twice disking and cultivation, as well as fertilization with 650 kg/ha N, was accomplished. The efficacy of the herbicides was recorded on the 14<sup>th</sup>, 28<sup>th</sup> and 56<sup>th</sup> day, and the selectivity was reported on the 7<sup>th</sup> day after treatments.

Statistical analysis of the yields was performed by using Duncan's multiple range test of SPSS program. Statistical differences were considered significant at p<0.05.

Table 1. Variants of the trial

Variants/Herbicides	Rates l (kg)/ha	Phenophase (BBCH)
1. Untreated control	-	-
2. Secator OD (100 g/l amidosulfuron + 25 g/l jodosulfuron + 250 g/l mefenpyr-diethyl-antidote)	0.1	30-32
3. Secator OD	0.2	30-32
4. Secator OD	0.13	30-32
5. Secator OD + NH <sub>4</sub> NO <sub>3</sub>	0.1 + 2.0	30-32
6. Secator OD + NH <sub>4</sub> NO <sub>3</sub>	0.13 + 2.0	30-32
7. Secator OD	0.1	37-39
8. Secator OD	0.2	37-39
9. Secator OD	0.3	37-39
10. Biathlon 4 D (714 g/kg tritosulfuron + 54 g/kg florasulam) + the adjuvant Dash (406 g/l c-65 Methylesters + 244 g/l klearfac AA-270)	0.04 + 0.5	30-32
11. Biathlon 4 D + Dash	0.055 + 0.5	30-32
12. Biathlon 4 D + Dash	0.07 + 0.5	30-32
13. Biathlon 4 D + Dash	0.14 + 1.0	30-32
14. Biathlon 4 D + Dash	0.055 + 0.5	37-39
15. Biathlon 4 D + Dash	0.07 + 0.5	37-39
16. Biathlon 4 D + Dash	0.14 + 1.0	37-39

## Results and Discussion

The weed associations existing on the fields were ivy-leaved speedwell (*V. hederifolia* L.), shepherd's purse (*C. bursa-pastoris*), chickweed (*S. media* (L.) Vill.), common poppy (*P. rhoeas* L.), thistle (*Cirsium arvense* (L.) Scop.) and field bindweed (*C. arvensis* L.). In Table 2 is shown the efficacy of Secator OD and Biathlon 4 D against these weeds. In 2016 average density of the weeds was as follows: *V. hederifolia* - 7.0; *C. bursa-pastoris* - 5.5; *S. media* - 5.0; *P. rhoeas* - 6.5; *C. arvense* - 6.0 and *C. arvensis* - 8,5 specimens per 1 m<sup>2</sup>. There is large number of chemical applications for weed control (Fetvadzieva et al., 1991). The most sensitive to the studied herbicide rates were the weeds shepherd's purse and chickweed. The product Secator OD applied in phenophase spindling of the wheat showed unsatisfactory results of efficacy against common poppy (65 - 70%). At the phenophase flag leaf of the crop the control of the weed was more diminished and varied from 50 to 70 %. It was observed that the common poppy acquired resistance to the sulfonylurea herbicide Secator OD. Biathlon 4 D showed higher efficacy against the common poppy in comparison to Secator OD. That was probably due to the active substance florasulam, belonging to triazolepyrimidine group of herbici-

des. Even though in phenophase flag leaf of the wheat Biathlon 4 D showed slight efficacy against common poppy (70-85%).

Among the annual weeds, the ivy-leaved speedwell was the most resistant (Table 2). The biological efficacy of Secator OD against this weed varied from 25 to 55%. For the late application at phenophase flag leaf (exclusively late treatment) the efficacy was from 0 to 50%. Biathlon 4 D also was not effective enough against ivy-leaved speedwell. Only at the high rate of 0.14 kg/ha in phenophase spindling of the wheat, barely 75% efficacy was recorded. Similar results by Wysmiek and Ciesielska (2012) and Rouag et al. (2015) were reported.

Higher biological efficacy against the creeping thistle was obtained after the application of Biathlon 4 D in comparison with Secator OD. The combination of Secator OD +  $\text{NH}_4\text{NO}_3$  increased the herbicide effect for 5-10% in comparison with the alone application. The least susceptible weed species in the trial was the field bindweed. Practically the weed was not controlled by any of the products, independently of the application rates and phenophases of the crop.

Table 2. Herbicide efficacy against the weeds (by EWRS scale)

Variants/Herbicides	Rates 1 (kg)/ha	Pheno-phase of the crop (BBCH)	Efficacy on 56 <sup>th</sup> day after treatments					
			<i>Veronica hederifolia</i>	<i>Capsella bursa-pastoris</i>	<i>Stellaria media</i>	<i>Papaver rhoeas</i>	<i>Cirsium arvense</i>	<i>Convolvulus arvensis</i>
1. Untreated control	-	-	-	-	-	-	-	-
2. Secator OD	0.1	30-32	25	100	90	65	80	0
3. Secator OD	0.2	30-32	55	100	95	80	90	0
4. Secator OD	0.13	30-32	40	100	90	70	85	0
5. Secator OD + $\text{NH}_4\text{NO}_3$	0.1+2.0	30-32	40	100	95	70	90	0
6. Secator OD + $\text{NH}_4\text{NO}_3$	0.13+2.0	30-32	50	100	95	75	90	0
7. Secator OD	0.1	37-39	0	90	85	50	70	0
8. Secator OD	0.2	37-39	25	95	90	60	85	0
9. Secator OD	0.3	37-39	50	100	95	70	90	0
10. Biathlon 4 D	0.04+0.5	30-32	20	100	95	80	85	5
11. Biathlon 4 D + Dash	0.055+0.5	30-32	35	100	100	85	90	15
12. Biathlon 4 D + Dash	0.07+0.5	30-32	55	100	100	90	95	20
13. Biathlon 4 D + Dash	0.14+1.0	30-32	75	100	100	100	100	35
14. Biathlon 4 D + Dash	0.055+0.5	37-39	10	90	90	70	70	0
15. Biathlon 4 D + Dash	0.07+0.5	37-39	20	95	95	75	90	0
16. Biathlon 4 D + Dash	0.14+1.0	37-39	60	100	100	85	95	0

For both herbicides (Secator OD and Biathlon 4 D) at all evaluated rates signs of phytotoxicity for the winter wheat variety grown in the trail were not observed.

The influence of the herbicides Secator OD and Biathlon 4 D on biological yields was also evaluated (Table 3). It was established that the differences in the yields was predetermined from the efficacy of the studied herbicide products. The natural weed infestation with aggressive species led to decreasing of the yields at the untreated control (2.686 t/ha).

Based on statistical analysis of obtained yield data, 13 separate groups (a, b, c, d, e, etc.) were distinguished. It was found that variant 13 (Biathlon 4 D + Dash) was from group (m) and gained the highest yield in the study. By using Duncan's multiple range test it was established that the lowest yields among the treated variants after the application of Secator OD in rates of 0.1 and 0.2 l/ha, as well as Biathlon + Dash in 0.055 kg/ha + 0,5 l/ha, applied at flag leaf of the crop were obtained. The increase of the yields at the variants with combined application of Secator OD +  $\text{NH}_4\text{NO}_3$  was also statistically proved with the variant with alone application of Secator OD. Despite the lower efficacy of the herbicides against some of the weeds, the yields in these variants were higher and with statistically proved differences compared to the untreated control. Similar results were obtained in the study of Adamczewski and Miklaszewska (2001).

Table 3. Comparative analyses of the biological yield (t/ha)

Variants/Herbicides	Rates l (kg)/ha	Phenophase (BBCH)	Compared control	Duncan's test
1. Untreated control	-	-	2.686	a
2. Secator OD	0.1	30-32	3.971*	c
3. Secator OD	0.2	30-32	4.300*	i
4. Secator OD	0.13	30-32	4.036*	d
5. Secator OD + $\text{NH}_4\text{NO}_3$	0.1 + 2.0	30-32	4.129*	f
6. Secator OD + $\text{NH}_4\text{NO}_3$	0.13 + 2.0	30-32	4.243*	h
7. Secator OD	0.1	37-39	3.879*	b
8. Secator OD	0.2	37-39	3.893*	b
9. Secator OD	0.3	37-39	4.157*	g
10. Biathlon 4 D + Dash	0.04 + 0.5	30-32	4.164*	g
11. Biathlon 4 D + Dash	0.055 + 0.5	30-32	4.336*	j
12. Biathlon 4 D + Dash	0.07 + 0.5	30-32	4.464*	l
13. Biathlon 4 D + Dash	0.14 + 1.0	30-32	4.545*	m
14. Biathlon 4 D + Dash	0.055 + 0.5	37-39	3.886*	b
15. Biathlon 4 D + Dash	0.07 + 0.5	37-39	4.086*	e
16. Biathlon 4 D + Dash	0.14 + 1.0	37-39	4.414*	k

All variants with \* have proved difference in comparison with the untreated control. The values with different letters in one column are with proved difference according to Duncan's multiple range test.

## Conclusions

The most sensitive to the application of the herbicides Secator OD and Biathlon 4 D were the weeds shepherd's purse and chickweed. Secator OD applied at rate of 0.1 l/ha showed unsatisfactory efficacy against the common poppy and creeping thistle. Biathlon 4 D showed higher efficacy against these two weeds in comparison with Secator OD. At the addition of 2.0 kg/ha  $\text{NH}_4\text{NO}_3$  to Secator OD at rate of 0.1 l/ha the efficacy of the herbicide was increased with 5-10 % in comparison with the alone herbicide application. The least susceptible weed species in the trial was the field bindweed.

Both herbicides (Secator OD and Biathlon 4 D) at all evaluated rates did not cause phytotoxicity for the winter wheat variety "Enola".

The highest yield was obtained at the variant treated with Biathlon 4 D (0.14 kg/ha) + adjuvant Dash (1.0 l/ha), applied in phenophase 1<sup>st</sup> to 2<sup>nd</sup> stem node.

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