

FRI-8.121-1-AMT&ASVM-03

STUDY CONCERNING THE EFFECTIVENESS OF SOME SOIL HERBICIDES TO WHEAT VARIETY "VENKA 1"

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Abstract: During 2013-2016 in the experimental field of the Institute of Agriculture and Seed Science "Obraztsov Chiflik" - Ruse, in field experiment on soil type strongly leached chernozem, on the experimental field on the density and species composition of weeds in wheat variety „Venka 1”. For this purpose the effectiveness at three soil herbicides - Afalon 45CK (450g.l⁻¹ linuron), Stomp 330EK (330 g.l⁻¹ pendimethalin) and Zenkor 70VG (700 g.kg⁻¹ metribuzin), applied in optimal and double increased doses was studied. The experiment was started after the block method in four replications, the experimental plot being 50 m². The objective of the study was the establish effectiveness at three soil herbicides, applied in optimal and double increased doses on the species composition of weed associations in wheat variety „Venka 1”. The highest effectiveness against mixed type of weedness is showed by herbicides Stomp 330EK (98%) and Zenkor 70VG (95%), in the double increased dose. The lowest effectiveness against annual grassy weeds is showed by soil herbicide Afalon 45CK, average for the period from 72 to 77%. All three soil herbicides inhibit the growth and development of *Convolvulus arvensis* (L.), *Cirsium arvense* (L.) and *Cardaria draba* (L.) at the tested doses but do not reduce their density.

Key words: wheat, weeds, herbicides, efficiency, grain yield

INTRODUCTION

Wheat is a basic cereal-cereal crop, used to make bread and bakery products. At the modern stage in the development of agriculture in our country the creation of high-yielding wheat crops and the production of high quality grain requires effective weed control. For this reason, it occupies an important place in growing technology, especially in seed crops. Therefore, it is necessary to thoroughly study the biological characteristics of weeds, their relationships with the crop plants and between them, their relations with the environment and their distribution in the country (Kolev, 1963; Sabev, 2000). The realization of the biological potential of crop plants is closely related to the elimination of the harmful effects of weeds (Senior and Dale, 2002). The highest results in weed control are obtained by combining agrotechnical and chemical methods using environmentally safer herbicides with their new formulations (Delchev, 2001; Delibaltova et al. 2009; Tityanova et al., 2007; Tonev, 2012).

The objective of the study was the establish effectiveness at three soil herbicides, applied in optimal and double increased doses on the species composition of weed associations in wheat variety „Venka 1”.

EXPOSITION

During the period 2013-2016 in the experimental field of IASS "Obraztsov Chiflik" - Ruse on a soil type of strongly leached chernozem, with low humus content (1.98%), slightly stocked with N and P₂O₅ and well stocked with K₂O, is displayed experiment with herbicides in wheat variety "Venka 1".

For research purposes of herbicides - Afalon 45CK (450g.l⁻¹ linuron), Stomp 330EK (330 g.l⁻¹ pendimethalin) and Zenkor 70VG (700 g.kg⁻¹ metribuzin), a field experiment was started after the block method in four replications, harvesting plot being 50m² and randomized location of the variants (Shanin, 1977).

The herbicides were fertilized by back mounted sprayer at a solution flow of 30 l.da⁻¹, applied after wheat sowing before emergence at optimal and increased doses (Table 1). The control plot was kept clean, without weeds throughout the vegetation period by manual weeding.

Table 1. Variants of the experiment

Variants		Doses - herbicides, ml/da (g.da ⁻¹)	Doses - active substance, g.da ⁻¹
1	Doses - active substance	-	-
2	Afalon 45 CK (450 g.l ⁻¹ linuron)	300	135
3	Stomp 330 EK (330 g.l ⁻¹ pendimethalin)	400	132
4	Zenkor 70 VG (700 g.l ⁻¹ metribuzin)	80	56
5	Afalon 45 CK (450 g.l ⁻¹ linuron)	600	270
6	Stomp 330 EK (330 g.l ⁻¹ pendimethalin)	800	264
7	Zenkor 70 VG (700 g.l ⁻¹ metribuzin)	160	112

The sowing took place on dates, optimal for the region - October 7-14 after predecessor - winter oilseed rape, and cultivation without inter-row machining during fertilization with N – 10 kg.da⁻¹, P – 6 kg.da⁻¹ и K - 4 kg.da⁻¹ a.v. (Popov et al., 1966).

The species composition of weeds was registered by the method of visual estimation and the degree of weed infestation - by quantity - weighting method and yield of seed, kg.da⁻¹.

Mathematical processing of the experimental data was performed by dispersion and correlation analysis with SPSS.

“Venka 1” variety is a white awned spike wheat variety with red grains. The spike is semi large, well grained. The grain is middle size with a good vitreousness - 70%, mass of 1000 grains - 41 g, hectoliter mass - 80 kg.hl⁻¹. The variety showed a very good layering capacity. Its vegetation period is averagely short, the stem is with good resistance to lodging and with middle height. The cold resistance is high. Very good bread baking qualities were observed. The average grain yield obtained at the stations of the Executive Agency for Variety Testing, Field Inspection and Seed Control (EAVTFISC) in North Bulgaria in 2007 was 552 kg.da⁻¹. The exceeding according to the average standard Sadovo 1 + Vratsa was 10.9%. During the same year at the experimental stations in South Bulgaria the average yield obtained was 556 kg.da⁻¹. The exceeding compared to the average standard was 10.8%. The average grain yield obtained at the stations of EAVTFISC in North Bulgaria in 2008 was 874 kg.da⁻¹, and in South Bulgaria - 994 kg.da⁻¹. The exceeding was 115.6 and 121.8%, respectively.

The agrometeorological conditions in the years of study varied, which determined the specific plant development and the differences of yield by year. The characteristics for the period of study include the sum of the average monthly air temperature and the amount of precipitation.

2013-2014 was characterized with a warm and wet autumn, which allowed timely and uniform emergence of wheat. In the winter, extremely low temperatures were not observed and the precipitation (46.84 mm²) was slightly above the norm for the region (38.6 mm²). The whole spring was characterized with precipitation (99.8 mm²) and temperatures (429.7°C) about the climatic norm for the region (58.6 mm² and 363.9°C) (Fig. 1).

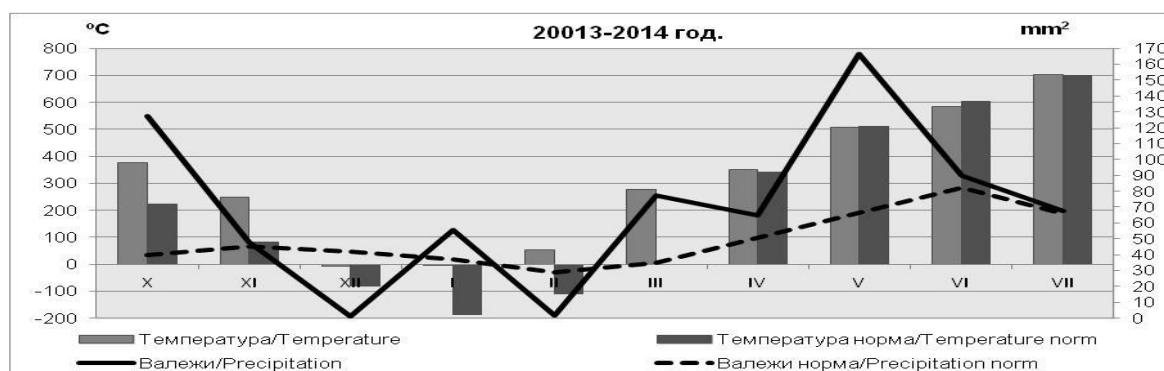


Fig. 1. Average monthly air temperatures and precipitation by month for the period 2013-2014

The autumn-winter of the harvesting 2014-2015 was characterized with extremely low temperatures and precipitation slightly above the climatic norm (38.6 mm²). The summer months were dry and hot, as the precipitation was below the norm (60.2 mm²) (Fig. 2).

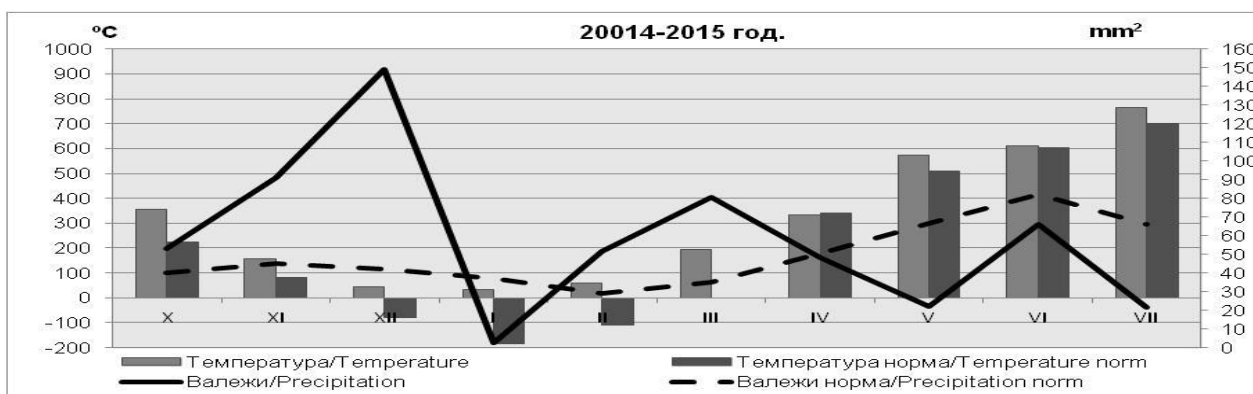


Fig. 2. Average monthly air temperatures and precipitation by month for the period 2014-2015

2015-2016 was characterized with temperatures and precipitation in the autumn-winter period above the norm (38.6 mm²), cool and rainy spring, and dry and hot summer, which had a negative impact on plant growth and grain yield.

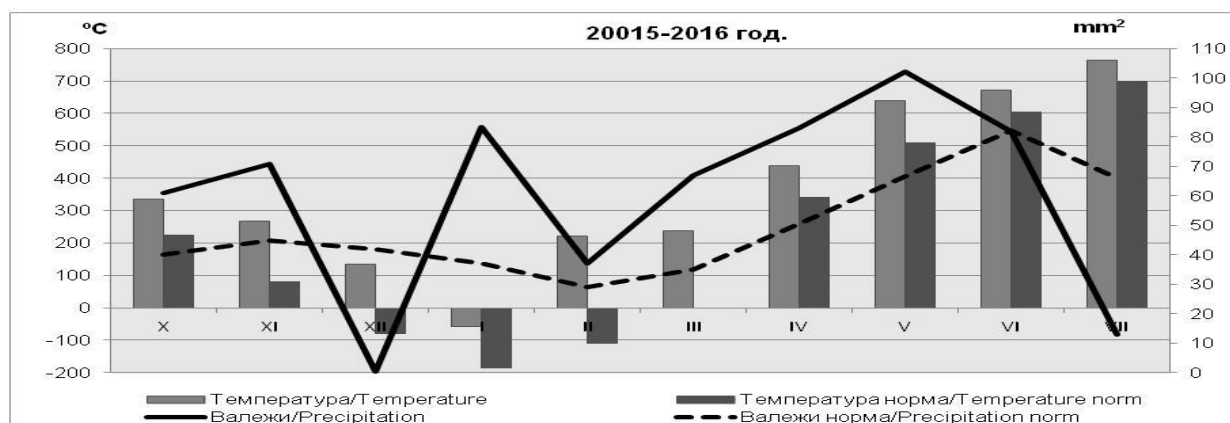


Fig. 3. Average monthly air temperatures and precipitation by month for the period 2015-2016

The area where the study was conducted had a natural background of weed infestation, 13 weeds being dominant, that conditionally could be divided into 2 groups: annual broad-leaved and perennial weeds.

In the experimental plots during the period of study as the following of them showed the highest density showed the annual broadleaved weeds: *Anthemis arvensis* (L.), *Lamium purpureum* (L.), *Viola tricolor* (L.), *Veronica hederifolia* (L.), *Capsella bursa-pastoris* L. and *Stellaria media* (L.).

In wheat crops very rarely (as single items) meet representatives of *Chenopodium album* (L.), *Anagalis arvensis* (L.) and *Galium aparine* (L.). From perennial broadleaf weeds, the following species have been reported: *Convolvulus arvensis* (L.), *Cirsium arvense* (L.) and to a lesser extent *Cardaria draba* (L.) and *Sonchus arvensis* (L.).

No representatives were counted in the trial of annual cereal and perennial cereal weeds such as *Avena fatua* (L.), *Alopecurus myosoroides* (L.), *Lolium temulentum* (L.), *Sorghum helepense* (L.), *Cynodon dactylon* (L.), *Elytrigia repens* (L.) and other.

The effect on annual broad-leaved weeds, on average on average, varies from 26 to 82% (Table 2).

Due to the unilateral spectrum of action of the herbicides used, higher resistance was shown *Convolvulus arvensis* (L.), *Cirsium arvense* (L.) and *Cardaria draba* (L.), which forced at a later stage of the development of wheat to be removed manually.

None of the soil herbicides used destroyed 100% of the existing species.

For example, Afalon 45 CK affects faintly, administered in both tested doses *Veronica hederifolia* (L.), *Anthemis arvensis* (L.) and *Lamium purpureum* (L.), with the herbicidal effect, averaged over the period is 26 and 68%. This means that its use must be consistent with the species composition of the prevailing annual broadleaf weeds.

The herbicides Stomp 330 EK and Zenkor 70 VG applied at an overdose to one-year-old dicotyledonous weeds reached 78-82%, with higher resistance *Convolvulus arvensis* (L.), *Cirsium arvense* (L.) and *Cardaria draba* (L.).

The herbicides applied at optimal dose averaged over the period showed good efficiency with respect to weeds destroyed from 67% to 77%. Of the variants with the application of Zenkor 70VG, phytotoxicity has been reported, which is expressed in crop sowing and suppression of plant growth.

Table 2. Number and species composition of weeds, pcs.m⁻¹ (average 2013 - 2016)

Variants	Doses ml.da ⁻¹ g.da ⁻¹	Annual weeds		Perennial weeds	Total infestation s	% Destroyed weeds
		Cereals	Broad- leaved			
Control (K)	-	-	71	12	83	0
Afalon 45 CK (450 g.l ⁻¹ linuron)	300	-	66	8	74	26
Stomp 330 EK (330 g.l ⁻¹ pendimethalin)	400	-	20	3	23	77
Zenkor 70 VG (700 g.l ⁻¹ metribuzin)	80	-	27	6	33	67
Afalon 45 CK (450 g.l ⁻¹ linuron)	600	-	25	7	32	68
Stomp 330 EK (330 g.l ⁻¹ pendimethalin)	800	-	15	3	18	82
Zenkor 70 VG (700 g.l ⁻¹ metribuzin)	160	-	15	7	22	78

The yield of grain averaged over the period was 403 kg.da⁻¹ with a variation of 306 kg.da⁻¹ in 2014-2015 to 492 kg.da⁻¹ in 2013-2014 (Table 3). The explanation for this fact is related to the unfavorable agro-climatic conditions during the year.

Table 3. Grain yield from wheat variety "Venka 1", kg.da⁻¹

Variants	Doses ml.da ⁻¹ g.da ⁻¹	Grain yield, kg.da ⁻¹						Average for the period	
		2013-2014		2014-2015		2015-2016		Yield	%
		Yield	%	Yield	%	Yield	%		
Control (K)	-	459	-	357	-	343	-	386	-
Afalon 45 CK (450 g.l ⁻¹ linuron)	300	492 ^a	7.2	380 ^a	6.4	379 ^a	10.5	417 ^a	8.0
	600	470 ^a	2.4	438 ^a	22.7	381 ^a	11.1	429 ^{a*}	11.1
Stomp 330 EK (330 g.l ⁻¹ pendimethalin)	400	483 ^a	5.2	386 ^a	8.1	377 ^a	9.9	415 ^a	7.5
	800	483 ^a	5.2	377 ^a	5.6	364 ^a	6.1	408 ^a	5.7

Zenkor 70 VG (700 g.l⁻¹ metribuzin)	80	471 ^a	2.6	385 ^a	7.8	378 ^a	10.2	411 ^a	6.5
	160	448 ^a	-2.4	306 ^a	-14.3	313 ^a	-8.7	356 ^a	-7.8
Average	-	472	-	375	-	362	-	403	-

Legend: All variants without “*” had no significant differences with the control. The values in a column, followed by different letters (a, b, c, etc.) differed significantly at $p < 0.05$.

The data in Table 3 showed that both - by year and on average over the period of study, grain yield in the variants using Afalon 45CK (at both tested doses) exceeded the other variants and the control. Maximum grain yield was formed in 2013-2014 in the variant where Afalon 45CK was applied at a dose of 300 ml.da⁻¹ - 492 kg.da⁻¹, and the lowest - in 2014-2015 - 306 kg.da⁻¹ in the variant where Zenkor 70VG was applied at a dose of 160 g.da⁻¹. That was due to the fact that Zenkor 75VG soil herbicide showed a negative effect on wheat plants, which was expressed in thinning the stand and suppression of plant growth (5 grades, acc. to EWRS scale). The effects of the application of soil herbicides were most pronounced in 2014-2015, as in the variant, where Afalon 45CK was applied at a dose of 600 ml.da⁻¹, the yield increased by 22.7% compared to the control variant (K) and reached 438 kg.da⁻¹.

Average for the period Afalon 45CK, at a dose of 600 ml.da⁻¹, increased grain yield by 11.1% relative to the control variant. Its use in wheat crops is associated with a mathematically proven increase in yield at GD 5%

From the trifactorial analysis (Table 4) regarding the yield, it was found that the years had the greatest impact of 59.25% of the total variation. Herbicide and dose had very little effect on grain yield - 1.94% and 1.57%. In the three tested factors, the power of influence was statistically significant.

There was a well-proven relation between the conditions of the year and the tested herbicides (AxB) at $P \leq 0.01$, as confirmed by the fact that the weather conditions during different years influenced differently on the soil herbicides applied.

The influence between the conditions of the years and the doses of applied herbicides (AxC) was not proven. The latter acted unidirectionally throughout the years and had not influenced the grain yield.

The interaction between the factors: herbicides and doses of application (BxC) also was proven - 0.526%, at $P \leq 0.05$, i.e. the applied herbicides at optimal and increased doses had negative effects on wheat plants. We could say that varietal susceptibility to the tested herbicides and doses was observed.

Table 4. Analysis of variance for grain yield

Source of variation	Degrees of freedom	Sum of squares	Influence of factor, %	Mean square
Total	83	1664.960	100	-
Factor A-Years	2	975.916	59.255	487.958**
Factor B-herbicides	2	32.020	1.944	16.010**
Factor C-dose	1	12.971	1.575	12.971**
AxB	4	17.774	0.540	6.750**
AxC	2	13.499	0.820	4.331
BxC	2	8.662	0.526	4.443*
AxBxC	4	21.372	0.649	5.343
Pooled error	63	518.795	6.959	8.235

CONCLUSION

In terms of destroyed weeds, Afalon 45 CK, at both tested doses, has the lowest herbicidal effect.

The use of Afalon 45CK (450 g.l⁻¹ linuron) and Stomp 330 EK (330 g.l⁻¹ pendimethalin) resulted in higher grain yield compared to the application of Zencor 70VG (700 g.kg⁻¹ metribuzin) soil herbicide.

The highest yield compared to the untreated control was obtained in the variant with Afalon 45CK soil herbicide at a dose of 600 ml.da⁻¹ - 429 kg.da⁻¹.

ACKNOWLEDGEMENT

The report reflects the results of the project No 18-AIF-01 funded by the Research Fund of the University of Ruse

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