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Influence of Some Herbicides on the Growth and Development of Winter Oilseed Rape

Maya DIMITROVA, Dochka DIMOVA, Ivan ZHALNOV, Dimitar STOYCHEV, Plamen ZOROVSKI, Tonya GEORGIEVA

Agricultural University - Plovdiv, Bulgaria

*Corresponding author: mayadimitrova30@yahoo.com

Abstract

Within the period 2011-2014 in the experimental field of the Agricultural University, Plovdiv, were conducted field experiments using the herbicides Teridox (500 g/1 dimetochor), Butizan S (500 g/1 metazachlor), which were applied to the soil after planting the crops and before their germination, and also Modaon 4F (48 g/1 bifenox) and Butizan S, which was applied to the leaves during the vegetation period of the rape. The experiments were made using the block method over an area of 25 m^2 in three repetitions. It has been established that the herbicides demonstrate excellent selectivity for this crop, and have excellent control: Amaranthus retroflexus L., Portulaca oleraceae L., Chenopodium album L., Solanum nigrum L., Setaria spp., Stellaria media L. and self seeded wheat plants. Herbicides dimethachlor, bifenox and metazachlor not have a negative impact on growth and phenological development of rapeseed hybrid Xenon. In the three years experienced plant height in the treated variants statistically proven to exceed zero control. Depending on weather conditions the vegetation period of plants occurs for 263 days (in 2012/2013) to 279 days (2011/2012)

Keywords: oilseed rape, development, growth, herbicides

Introduction

Oilseed rape is regarded as an important oleaginous crop in our country and in other countries as well. One of the reasons for the reduction of the yield and the deterioration of the quality of the production are the weeds, especially during the early stages of the development of this crop. Over the last few years a number of surveys have been conducted concerning the control over weeds and the influence of the herbicides on the growth and the phenological development of the crop. Based on data provided by Bernotas S. and S. Kalvaitine (1997), by applying Butizan 400 in a dose of 250 ml/dka we can control weeds up to 82%, achieving good growth of the oilseed rape plants and higher yield compared to the untreated sample. According to Franek M. (2001), when using *clomazone, metazachlor, alachlor, dimetachlor, napropamide, propyzamide, benzolin, metizoline and clopyralid* separately or in combination on oilseed rape, there are no negative effects which reduce the height, the yield and the weight of 1000 seeds. Andersson B., A. Bengtsson (1992) and Zawadzki J et al. (2001) have established that the application of the herbicidal mixture *benzolin* and *clopyralid* during the vegetation period of the crop, especially on light soils, causes slight phytotoxicity which reduces the growth of the oilseed rape and the timely removal of the weeds increases the yield by 11 to 15% on average. Based on data provided by Majchizak L., et all (2008), the application of the herbicidal mixture Fox 480 SC (*bifenox)* – 100 ml/dka + Fuego 500 SC (*metazachlor)* – 100 ml/dka causes the emergence of slight blight on the leaves of the crops, which is remedied in spring. In our country, Todorov J. et al. (2010) have established that the treatment with some biologically active substances applied to the rape hybrid Elvis do not have a negative influence on the running of the individual phenophases. The same authors have also conducted a survey on the phenological development and the productivity of some French hybrids of oilseed rape under the conditions of Southern Bulgaria Todorov J. et al. (2010). However, there is no data regarding the influence of the herbicides on the growth and the development of winter oilseed rape, which was the purpose of this survey.

Materials and Methods

During the period 2011-2014, in the experimental field of the Agricultural University, Plovdiv, we conducted a field experiment with herbicides applied to the soil after sowing and before the germination of the crops and also to the leaves during the vegetation period of the oilseed rape, the Xenon hybrid, grown on a piece of land previously planted with wheat. The experiment was made using the block method, with an area of 21m^2 of the experimental field, in 4 repetitions (table 1).

Results and Discussion

The agro-technical activities were conducted in accordance with the common technology for growing oilseed rape (processing of the soil, fertilization, sowing, rolling). The soil and leaf herbicides were applied using a knapsack sprayer and a working solution of 25-30 l/dka. Phenological studies have been made on 10 plants for variants in 4 repetitions.

The experimental year 2011 was characterized by a warm and humid autumn. The rainfall within the period September – November was 74,7 mm but it was unevenly distributed (70,4 mm of the rainfall was in October) – fig. 1, fig. 2.

In 2012, the pre-sowing processing of the soil was conducted under optimal conditions. The rainfall within the period September – November was 65,2 mm but unlike the year 2011, it was evenly distributed: September – 15,1 mm, October – 39,4 mm and November – 10,7 mm – fig. 1.

The autumn of 2013 was characterized as being cool and humid, with rainfall of 85,4 mm as the largest quantity of rainfall was registered in November – 47,2 mm. In September and October the rainfall was 10,2 mm and 28,1 mm, respectively.

Table 1. Variants of experiment

Variants	Active substance	Dose, ml/ha
1. Zero control	-	-
2. Modaon 4Φ (on the leaves)	*48 g/l bifenox*	1000
3. Teridox (soil)	*500 g/l dimethachlor*	2000
4. Butizan S (soil)	*500 g/l metazachlor*	2000
5. Butizan S (on the leaves)	*500 g/l metazachlor*	2000

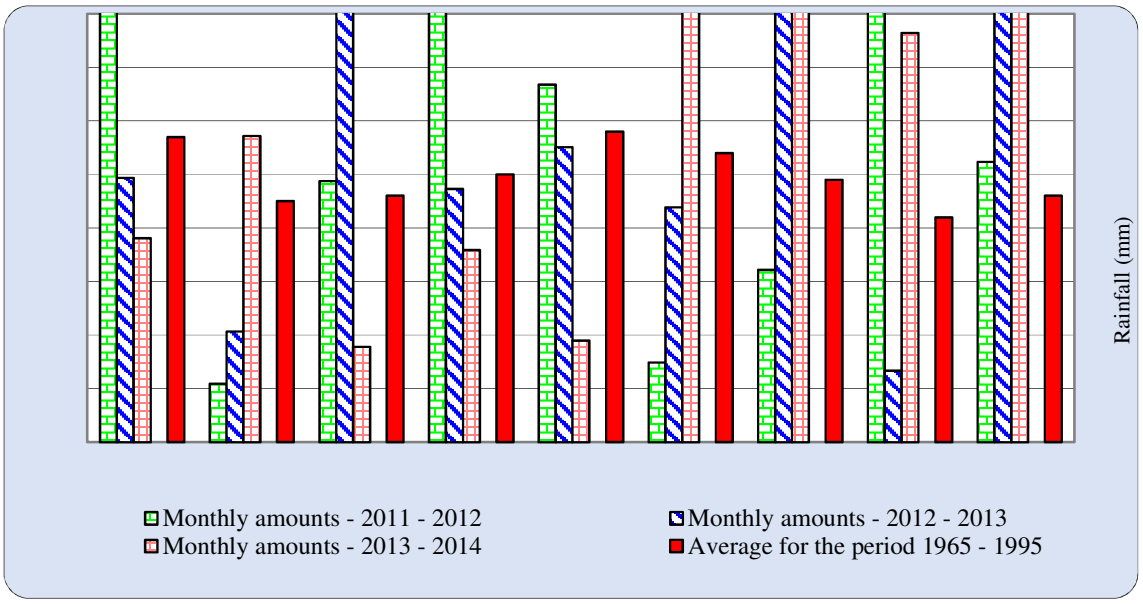

Figure 1. Amount of the rainfall during the vegetation period (mm), period 2011- 2014

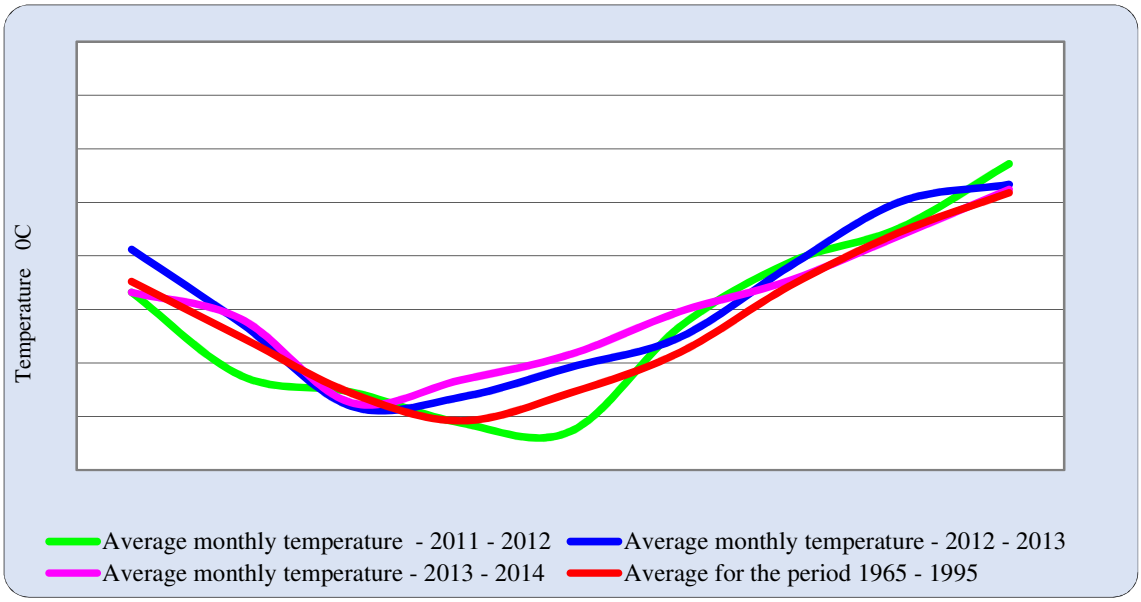

Figure 2. Average diurnal temperature in periods 2011 – 2014

Table 2 shows the values of the height of the testes variants for the harvest year 2011/2012. We have evaluated the provedness of the differences compared with the untreated control sample. We can see that the biggest is the height of the plants from variant 3 (Teridox in a dose of 200 ml/dka) – 109,8 cm, and the smallest is the height of the plants from the untreated variant 1. The differences are statistically verified despite the different level of importance ($P_{5\%}$ and $P_{1\%}$). We should note that with reference to this indicator, the order of the variants is identical for the harvest year 2013/2014. In the zero control sample (without any herbicides) the plants at the end ofthe vegetation period reach a height of 134,37 cm. For all variants treated with herbicides the values of this indicator are the highest during the three years of the experiment and have been proved to exceed the control sample with a level of provedness of ($P_{0,1\%}$). The registered low values of the rainfall during March and April 2012 (the first year of the experiment), in combination with high temperatures, had a negative influence on the height of the plants. For that reason, we registered the lowest value of this indicator for all variants over the entire period of the experiment (tables 2, 3 and 4). Depending on the combination of weather conditions during the vegetation period of the year, the plants reach their biggest height during the year 2014, followed by the year 2013 and the lowest values were registered in the year 2012.

The second year of the experiment was characterized by the lowest quantity of rainfall during October and November (Fig.2). The highest value of the height - 126,0 cm was registered in variant 5 (Butizan S – 200 ml/dka) applied on the leaves. This can be explained by the fact that as a result of the low moisture of the soil in the beginning of the vegetation period, the effectiveness of the soil herbicides is reduced. Regardless of this, in the zero control sample the differences in the height have been proven on the highest level ($P_{0,1\%}$).

Table 2. Provedness of the differences compared to the zero control sample regarding the height in the ripening stage, 2011/2012

Variants	$\bar{x} \pm S_{\bar{x}}$	D	t	Significance
3	109,76 ±1,8	8,19	2,75	++
5	109,42 ±1,4	7,85	2,80	++
2	108,09 ±2,0	6,52	2,03	+
4	107,80 ±1,8	6,23	2,02	+
1	101,57 ±2,5			

$tp_{5\%}$ = 2,024 $tp_{1\%}$ = 2,711 $tp_{0,1\%}$ = 3,565

Table 3. Provedness of the differences compared to the zero control sample regarding the height in the ripening stage, 2012/2013

Variants	$\bar{x} \pm S_{\bar{x}}$	D	t	Significance
5	126,0±1,32	18,2	9,15	+++
3	121,9±1,48	14,1	6,71	+++
4	117,6±1,28	9,8	4,97	+++
2	115,6±1,52	7,8	3,66	+++
1	107,8±1,50			

$tp_{5\%}$ = 2,021 $tp_{1\%}$ = 2,704 $tp_{0,1\%}$ = 3,551

Table 4. Provedness of the differences compared to the zero control sample regarding the height in the ripening stage, 2013/2014

Variants	$\bar{x} \pm S_{\bar{x}}$	D	t	Significance
3	189,80±5,2	55,43	7,61	+++
5	179,53±6,3	45,15	5,57	+++
2	174,87±5,8	40,50	5,24	+++
4	172,65±4,9	38,27	5,41	+++
1	134,37±5,1			

$tp_{5\%}$ = 2,024 $tp_{1\%}$ = 2,711 $tp_{0,1\%}$ = 3,565

The weather conditions during the years are a factor that influences the growth and the phenological development of the crop. The longest period of germination of the plants was registered during the vegetation year 2011-2012. They germinated in 26 days owing to the relatively lower average temperatures in October (1ºC under the norm), regardless of the sufficient quantity of rainfall (23,4 l/m^2 more than that in the long term). The most favourable conditions for the germination of the plants were registered in 2013-2014, when the plants germinated in 14 days and in 2012-2013 they germinated in 24 days. For the period of germination and also for the other phases of the development of the crop there were no registered differences in the time of initiation and the duration of the separate interphase periods of the plants in the zero control sample and those in the treated variants (table 5). In 2011, the rosette phenophase started 47 days after the germination of the plants (05.12). This delay was due to the low average temperatures of 3,8 ºC in November, which is 3,6 ºC under the norm in the long term. Over the next few years, the rosette phenophase started on the 51st day (in 2012-2013) under temperatures above the norm and insufficient quantity of the rainfall in October and November 2012 and on the 35th day after the germination of the plants in the year 2013.

The most favourable winter months were those in 2012 with positive temperatures for the period November- February (fig. 1). The spring vegetation was resumed in the beginning of March and owing to the high average monthly temperatures, the buttoning stage started on 24.03 in 2012, on 20.03 in 2013 and on 19.03 in 2014. During all three years of the experiment, the flowering stage started during the first ten days of April. In 2012, the period of grain formation was accompanied by heavy precipitations in May (160,8 mm), which provided favourable conditions for the nurturing of the grains and extended the phases of milk and wax maturity. Under these conditions, the full maturity stage started on 28.06 for the plants of all treated variants and the control sample. Unlike the year 2012, May in 2013 was characterized by extremely low values of the rainfall (3, 4 mm), which shortened the phases of formation and nurturing of the grains and the full maturity stage started earlier on 8.06. Depending on the combination of the weather conditions, we registered different duration of the vegetation period in the separate years of the experiment – 279 days in the year 2012; 263 days in the year 2013 and 272 days in the year 2014. We registered no negative influence of the tested herbicides on the phenological development of the hybrid Xenon compared with the untreated control sample.

Table 5. Phenological observations for hybrid Xenon over the years of the survey 2011-2014 r.

Phenological observation	Vegatation period		
	2011-2012 year	2012-2013 year	2013-2014 year
Sowing	23.IX	19.IX.	02.X.
Prouing	20.X.	13.X.	16.X.
6^{st} – 8^{th} leaf	05.XII.	02.XII.	30.XI.
Bud stage	24.III.	20.III.	19.III.
Full flowering	05.IV.	01.IV.	01.IV.
Full maturity	28.VI.	08.VI.	29.VI
Vegetation period, days	279	263	272

Conclusion

The herbicides dimethachlor, bifenox and metazachlor do not have a negative influence on the growth and the phenological development of the oilseed rape, hybrid Xenon.

During all three years of the experiment, the height of the plants in the treated variants has been statistically proven to exceed the zero control sample.

Depending on the weather conditions, the vegetation period of the plants lasts 263 days (in 2012/2013) up to 279 days (in 2011/2012).

Herbicides dimethachlor, bifenox and metazachlor not have a negative impact on growth and phenological development of rapeseed hybrid Xenon.

In the three years experienced plant height in the treated variants statistically proven to exceed zero control.

Depending on weather conditions the vegetation period of plants occurs for 263 days (in 2012/2013) to 279 days (2011/2012).

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