

## Agriculture and Environment

# Sensitivity to herbicides of two spring forage pea cultivars

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**Abstract.** An important element of spring pea growing technology is weed control as the crop is highly sensitive to them, especially in the early stages of its development. The use of various herbicide preparations with a diverse mechanism and spectrum of action, changes in weed associations under the influence of various factors, as well as the selection of new varieties necessitates a constant study of the problem of the efficacy of herbicide preparations and the sensitivity of varieties to them. The aim of the present study was to investigate the sensitivity of two cultivars of spring forage pea to different herbicide preparations. During the period 2006-2008 in the village of Lyubenova mahala, Stara Zagora region, a three-factor field experiment was conducted by the fractional parcel method in four replications and size of the harvest plot 10m<sup>2</sup>. Factor A includes cultivars of spring peas, factor B – herbicide variants, factor C - doses of herbicides. It has been proven that the plants of both varieties, Pickardi and Amitie, are killed by 2,4 D, both in single and double dose. The highest average plant height was recorded in the Amitie cultivar treated with Basagran 600 SL herbicide at the double dose (3.0 L/ha). The highest were the values of the parameter number of beans per plant obtained in the Amitie cultivar treated with Basagran 600 SL and Pivot 100 SL – 0.8 L/ha, in the soil. A statistically proven highest average value of the parameter seed mass per plant was obtained in the Amitie variety treated with the Basagran 600 SL herbicide (12.667g) and the lowest – in Pickardi with the herbicide Pivot (10.330g).

**Keywords:** spring peas, chemical weed control, variety sensitivity

## Introduction

Peas (*Pisum sativum* L.) is one of the oldest and most significant grain legumes grown widely in the world under different environmental conditions. It is a desirable predecessor for all crop plants except for itself because it is a plant of the cool climate, it is sown early in spring, has a short vegetation period and frees in time the areas for the next crops (Moskov and Genova, 2005; Terziev et al., 2007; Yancheva et al., 2007; Angelova et al., 2012). Spring forage peas play an important role in stabilizing soil fertility.

Despite the agrotechnical and nutritional advantages, the distribution of peas in Bulgaria is limited and the average yields in our country are below the biological potential of the crop. Over the past two years there has been a trend of a certain increase in areas and average yields of forage grain peas: for 2016 - 18286 ha with average yields - 2548 kg/ha, for 2017 - 44945 ha, with average yields 2916 kg/ha according to data from Agrostistics (Ministry of Agriculture and Food, 2017, 2018). One reason for the low yields is the heavy weeding, especially in the early stages of the crop development. Its slow development during this period makes it uncompetitive against weeds and if not controlled, the nutritional area of the plants is reduced, conditions for the development of diseases and pests are created, as well as difficulties for the harvesting machinery (Fetvadjeva, 1973; Dimitrova, 2000; Tonev et al., 2007).

More recent studies in Bulgaria confirm that peas are highly susceptible to herbicides, and the possibilities for their use in this crop are limited. It has been proven that the use of herbicides on the same active basis creates the possibility of re-

sistance of some weeds. According to data by Fryer (1979), various pea varieties have different sensitivity to 2M-4XM and 2,4-DM. The author recommends a study of each specific variety for herbicide resistance under the conditions of the area in which it is grown. Data on the varietal susceptibility of peas to herbicides have been reported by Dimitrova (1994), Madamanchi (1994), Mishra (2008), etc.

In Bulgaria, such surveys are rather limited due to the fact that until 1980 the varietal composition of the crop was limited. The opportunities for the use of pea varieties from the European variety list determine the need to test the reaction of each individual variety to the herbicides and doses recommended for this crop. The aim of the present study is to investigate the sensitivity of two cultivars of spring forage peas (Amitie and Pickardi) to herbicide preparations administered in single and double doses.

## Material and methods

Field experiments were carried out in the village of Lyubenova Mahala, Stara Zagora region during the period 2006-2008, with a three-factor field experiment by the fractional parcel method, in four replicas and size of the harvest plot 10m<sup>2</sup>. Factor A includes cultivars of spring peas, factor B – herbicide variants, factor C - doses of herbicides (Table 1). The stages of the tested factors are imposed on each other, which makes it possible to assess the impact of both factors individually and their interactions. Herbicides have been applied with a backpack sprayer at working solution rate of 0.4 L/ha. The experiment was carried out on a weed-free area to avoid their effect.

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**Table 1.** Herbicide variants of spring pea

Factor A Variety	Factor B Herbicides	Factor C Doses
A <sub>1</sub> -Amitie	B <sub>1</sub> - Pivot 100 SL (100 g/L imazetapir), 0.8 L/ha, SSPP	C <sub>1</sub> -optimum dose
A <sub>2</sub> -Pickardi	B <sub>2</sub> - Basagran 600 SL (600 g/L bentazone) -1.5 L/ha, 2-4 leaf of weeds and crop	C <sub>2</sub> - double dose
	B <sub>3</sub> - Sencor 70 WG - (700g/kg metribuzin), 0.5 L/ha - 3 triple leaf of the crop (10-15 cm height)	
	B <sub>4</sub> - Pivot 100 SL (100 g/L imazetapir), 0.4 L/ha, leaf	
	B <sub>5</sub> - 2,4 D (600 g/L 2,4D amino salt) 0.67 L/ha, leaf	

The influence of herbicides on the growth of spring forage pea, productivity components and yield were also taken into account. The selectivity of the herbicides to the crop was reported visually at 3, 7, 14 and 30 days after treatment by the 9-point EWRS (European Weed Research Society) scale - at score 1 there was no crop damage, and at score 9 – the crop has been completely destroyed.

Plant material: two spring white flowering pea cultivars – Pickardi and Amitie, of which the second one is phylate-free (selection by National Institute of Agronomic Studies of France, Sadovo in partnership with the National Institute for Agricultural Research - INRA, France, registered in the variety list of our country).

The results obtained have been processed by standard statistical methods (Dimova and Marinkov, 1999).

## Results and discussion

The data in Table 2 show that there is proven difference between the varieties Amitie and Pickardi concerning the parameter plant height, regardless of the herbicides applied in single dose. Plant height in the Amitie variety is 50.867 cm on average, which is significantly higher than Pickardi (43.733 cm).

**Table 2.** Significance of the difference between varieties concerning the parameter plant height at the end of vegetation treated by single dose

Variety	$\bar{x}$	Difference from:	
		a <sub>1</sub>	a <sub>2</sub>
a <sub>1</sub> -Amitie	50.867	-	+
a <sub>2</sub> -Pickardi	43.733	-	-

gDp 5% = 6.08; gDp 1% = 8.28; gDp 0,1% = 11.20

The effect of the 5 herbicides applied in single dose, regardless of the variety concerning the same parameter are presented in Table 3. The highest are the plants treated with Basagran 600 SL (B<sub>2</sub>), followed by Pivot (B<sub>1</sub>). Only herbicide 2,4 D (B<sub>5</sub>) has strong phytotoxic effect on plants in both tested varieties and they die (0). Due to that reason the table states that the difference of the other herbicides B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub> and B<sub>4</sub> from B<sub>5</sub> is statistically significant.

**Table 3.** Significance of the difference between herbicides concerning the parameter plant height at the end of vegetation treated by single dose

Herbicides	$\bar{x}$	Difference from:				
		B <sub>2</sub>	B <sub>1</sub>	B <sub>3</sub>	B <sub>4</sub>	B <sub>5</sub>
B <sub>2</sub> -Basagran	61.5	-	ns	ns	ns	+++
B <sub>1</sub> -Pivot	59.3		-	ns	ns	+++
B <sub>3</sub> -Sencor	58.5			-	ns	+++
B <sub>4</sub> -Pivot	57.2				-	+++
B <sub>5</sub> -2,4D	0					-

gDp 5% = 6.08; gDp 1% = 8.28; gDp 0,1% = 11.20

The highest average plant height (65.7cm) was recorded in the Amitie variety treated with Basagran 600 SL herbicide in double dose (a<sub>1</sub>b<sub>2</sub>c<sub>2</sub>), followed by the Amitie variety with Basagran 600 SL herbicide in single dose (a<sub>1</sub>b<sub>2</sub>c<sub>1</sub>) – 65.27cm. In the same group by level of significance are the combinations (a<sub>1</sub>b<sub>1</sub>c<sub>2</sub>), (a<sub>1</sub>b<sub>3</sub>c<sub>1</sub>), (a<sub>1</sub>b<sub>1</sub>c<sub>1</sub>) and (a<sub>1</sub>b<sub>4</sub>c<sub>1</sub>). The recorded heights, 63.3cm, 63.0cm and 62.17cm, respectively, are significantly higher than all other combinations. In the combinations of both varieties with the herbicide 2,4 D in both applied doses, the plants died.

The data concerning the parameter number of beans per one plant are presented in Table 4. There is a significant difference between the Amitie and Pickardi varieties by that parameter, irrespective of the applied herbicides, in single dose. The number of beans in the Amitie variety is 8.467, and in the Pickardi variety – 7.133, which is demonstrated at significance level of gDp<sub>5%</sub>.

**Table 4.** Significance of the difference between varieties concerning the parameter number of beans per plant on the central stem, treated by different dose

Variety	$\bar{x}$	Difference from:	
		a <sub>1</sub>	a <sub>2</sub>
a <sub>1</sub> -Amitie	8.467	-	+
a <sub>2</sub> -Pickardi	7.133	-	-

gDp 5% = 1.30; gDp 1% = 2.21; gDp 0,1% = 3.35

In Table 5 the evidence of differences between the combinations of the factors variety, herbicide and treatment dose is presented. The highest mean value was recorded in the Amitie variety with Basagran 600 SL herbicide in the double dose

( $a_1B_2c_2$ ) - 11.8, followed by the combination of the same variety with Basagran 600 SL and Sencor herbicides in single dose (11.53 and 11.13). In both varieties when treated with the 2,4D herbicide the plants died, regardless of the applied doses.

**Table 5.** Significance of the difference between the combinations variety-herbicide concerning the parameter number of beans per plant on the central stem, treated by single dose

Combi-nation	$\bar{X}$	Difference from:									
		$a_1B_2$	$a_1B_1$	$a_2B_3$	$a_1B_3$	$a_1B_4$	$a_2B_2$	$a_2B_1$	$a_2B_4$	$a_1B_5$	$a_2B_5$
$a_1B_2$	11.667	-	ns	+	+	+	++	++	+++	+++	+++
$a_1B_1$	10.667		-	ns	ns	ns	+	++	++	+++	+++
$a_2B_3$	10.333			-	ns	ns	+	+	+	+++	+++
$a_1B_3$	10.000				-	0	+	+	+	+++	+++
$a_1B_4$	10.000					-	+	+	+	+++	+++
$a_2B_2$	8.667						-	ns	ns	+++	+++
$a_2B_1$	8.333							-	ns	+++	+++
$a_2B_4$	8.332								-	+++	+++
$a_1B_5$	0									-	ns
$a_2B_5$	0										-

$gDp_{5\%} = 1.30$ ;  $gDp_{1\%} = 2.21$ ;  $gDp_{0,1\%} = 3.35$

Table 6 presents the average values concerning the parameter seed weight per plant. The data in the table show that there is no significant difference between the Amitie and Pickardi varieties regardless of the applied herbicides – 9.133 ( $a_1$ ) and 8.467 ( $a_2$ ).

**Table 6.** Significance of the difference between varieties concerning the parameter seed weight per plant treated by single dose

Variety	$\bar{X}$	Difference from:	
		$a_1$	$a_2$
$a_1$ -Amitie	9.133	-	ns
$a_2$ -Pickardi	8.467		-

The combinations variety-herbicide by that parameter are given in Table 7. Here the dependence is identical to the parameter number of beans per plant. Statistically proven highest mean value of that parameter is obtained in the Amitie variety, treated with the Basagran 600 SL herbicide (12.667), and the lowest – in Pickardi with the Pivot herbicide (10.330). The 2,4D herbicide in both tested varieties has zero values recorded and the difference with the other combinations is significant.

**Table 7.** Significance of the difference between the combinations variety – herbicide concerning the parameter seed weight per plant treated by single dose

Combination	$\bar{X}$	Difference from:									
		$a_1B_2$	$a_1B_3$	$a_1B_1$	$a_2B_2$	$a_1B_4$	$a_2B_1$	$a_2B_3$	$a_2B_4$	$a_1B_5$	$a_2B_5$
$a_1B_2$	12.667	-	+	+	+	++	+	++	++	+++	+++
$a_1B_3$	11.333		-	ns	ns	ns	ns	ns	ns	+++	+++
$a_1B_1$	11.000			-	0	ns	ns	ns	ns	+++	+++
$a_2B_2$	11.000				-	ns	ns	ns	ns	+++	+++
$a_1B_4$	10.667					-	ns	ns	ns	+++	+++
$a_2B_1$	10.665						-	ns	ns	+++	+++
$a_2B_3$	10.333							-	ns	+++	+++
$a_2B_4$	10.330								-	+++	+++
$a_1B_5$	0									-	ns
$a_2B_5$	0										-

$gDp_{5\%} = 1.30$ ;  $gDp_{1\%} = 2.33$ ;  $gDp_{0,1\%} = 3.16$

## Conclusion

Plant height, number of beans per plant, seed weight per plant are parameters that can demonstrate the sensitivity of varieties to the applied herbicide preparations. The plants from both cultivars - Pickardi and Amitie, died when tested with 2,4D in both single and double dose. The highest mean plant height (65.7cm) has been recorded in the Amitie variety treated with Basagran 600SL herbicide in the double dose (3.0 L/ha), followed by Amitie variety with Basagran 600 SL variety in a single dose (1.5 L/ha) - 65.27cm. Among the Pickardi and Amitie variety there is a proven difference in the number of beans from plant parameter, irrespective of the applied herbicides. The highest values are in the Amitie variety treated with Basagran 600SL and Pivot 100SL – 0.8 L/ha, in the soil. Statistically proven highest mean value of the seed weight per plant parameter was obtained in the Amitie variety treated with Basagran 600SL herbicide (12.667g), and the lowest – in Pickardi with the Pivot herbicide (10.330g).

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