RESEARCH ON THE INFLUENCE OF SOME ELEMENTS OF TECHNOLOGY ON SOME MORFOPRODUCTIVE INDICATORS OF SAINFOIN (*Onobrychis viciifolia* Scop.) IN SEED CROPS, IN THE FIRST YEAR OF VEGETATION

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Abstract

The research conducted during the period of March to October 2019, at the Research and Development Station for Meadows, Vaslui (46°40'-36°10' north latitude and 27°44'-20°40' east longitude) followed the influence of fertilization and the distance between rows on the plants height (cm), shoots number (shoots·m^{-2}), inflorescences number (inflorescences·m^{-2}), and seeds production (kg·ha^{-1}) at sainfoin (Onobrychis viciifolia Scop.*) VLAMAR variety, in the first year of vegetation. The organized experience was bifactorial, 3x5 type, placed according to the method of subdivided plots, with the plot harvestable area of 13.5 m^2 (1.5 m x 9 m), in three replications, and the factors studied were: A - the distance between rows with three graduations (a_1 - 25 cm, a_2 - 37.5 cm and a_3 - 50 cm) and B - fertilization with five graduations (b_1 - unfertilized, b_2 - $N_{50}P_{50}$, b_3 - $N_{50}P_{50}K_{50}$, b_4 - $N_{100}P_{100}K_{100}$ and b_5 - cow manure 20 Mg·ha^{-1}). Following the study, it was found that by applying mineral or organic fertilizers and by sowing at smaller distances between rows higher plants were obtained, with a higher number of shoots·m^2. The seed production varied between 91.2 kg·ha^{-1} for the variant sown at a distance of 50 cm between rows, unfertilized and 324.1 kg·ha^{-1} for the variant sown at a distance of 25 cm between rows, fertilized with $N_{100}P_{100}K_{100}$.*

Key words**: **distance between rows, fertilization, plant height, number of shoots·m^{-2}, number of inflorescences·m^{-2}, seed production.

INTRODUCTION

Sainfoin (*Onobrychis viifolia* Scop.) is one of the most valuable perennial forage leguminous species, being used in animal nutrition in the form of hay, green mass or ensilated fodder, due to the high nutritional value of the feed (17 nutritional units per 100 kg green mass or 60,1 nutritional units per 100 kg hay, where a nutritional unit represents the energy equivalent of a kg of oat grains) and the fact that it has a good protein content (3,6% in green mass and 15,4% in hay) and contains significant amounts of mineral salts and vitamins, and as a green mass forage sainfoin does not produce bloating. Also, sainfoin is a very good melliferous plant, with a flowering period of about 23-27 days, achieving up to 300 kg·ha^{-1} honey (Roșca D., 1967; Sheppard S.C., 2010). Research in the field of seed crops shows that seed production is largely conditioned by climatic conditions, especially rainfall and temperatures during vegetation. Apart from climatic factors, numerous studies show that technological factors (fertilization, depth and space between rows) have a significant effect on the productivity elements at the sainfoin seed. Sowing sainfoin seeds at longer distances between rows regularly generates better quality seeds, mainly with a higher weight of 1000

seeds mass and high germination (Stanisavljević R. *et al*. 2004; Beković D. *et al*., 2016). Under balanced fertilization conditions, the effects of row spacing on the production and quality of sainfoin seed material are greater than the separate effect of the two technological elements (Moga I. and Schitea M., 2005; Zhang Y.M., 2011).

As a rule, in the first year of vegetation can be obtained seed only in the species of *Trifolium pratense* L., and in other species (*Lotus corniculatus* L., *Medicago sativa* L. and s *Onobrychis viifolia* Scop.) only hay is obtained (Potter M.V., 2012), but in the years favorable to the installation of seed lots of sainfoin can be obtained an economically justified quantity of seeds.

Through this study, it's been tried to improve the sainfoin seed technology under the soil conditions at the Research and Development Station for Meadows, Vaslui, by analyzing the influence of fertilization and the distance between rows on some morpho-productive elements, in the first year of vegetation.

MATERIALS AND METHODS

The research was conducted at the Research and Development Station for Meadows, Vaslui (46°40'-36°10' north latitude and 27°44'-20°40' east longitude) during March-October 2019.

Following the researches were analyzed the influence of fertilization and the distance between rows on the plants height, shoots number and inflorescences number, at sainfoin (*Onobrychis viciifolia* Scop.) in seeds culture, in the first year of vegetation.

To achieve the proposed purpose, it was organized a bifactorial experience, 3x5 type, placed according to the method of subdivided plots, with the plot harvestable area of 13.5 m^2 (1.5 m x 9 m), in three replications. The factors studied were: A - the distance between rows with three graduations (a_1 - 25 cm, a_2 - 37.5 cm and a_3 - 50 cm) and B - fertilization with five graduations (b_1 - unfertilized, b_2 - $N_{50}P_{50}$, b_3 - $N_{50}P_{50}K_{50}$, b_4 - $N_{100}P_{100}K_{100}$ and b_5 - cow manure 20 $Mg \cdot ha^{-1}$).

The plants height (cm) by measuring, in 3 repetitions, the shoots on the rows located 1 m from the edge of the plot.

The number of shoots$\cdot m^{-2}$ was determined by counting the shoots, in 3 repetitions, from 1 linear m of the rows located 1 m from the edge of the plot, then the obtained number was expressed to m^2.

The number inflorescences$\cdot m^{-2}$ was determined by counting the inflorescences of the shoots, in 3 repetitions, from 1 linear m of the rows located 1 m from the edge of the plot, then the obtained number was expressed to m^2.

Seed production (kg/ha) was determined by weighing the manually harvested pods on each plot, then referring to the area unit.

The biological material used was represented by the Vlamar sainfoin variety, variety created in 2011 and patented in 2014 at UASMV Cluj-Napoca (Savatii M. and Olar M., 2012).

Manure used had the following composition: N-0.415%, P_2O_5-0.220% and K_2O-0.705%. The fertilizers were applied at the time of preparation of the germinal bed.

In the area where the researches were carried out, the agricultural year 2018-2019 was favorable for the sainfoin crop, even if the rainfall did not have a uniform distribution (there were short periods of water stress, in October 2018, March and July 2019).

The results were statistically interpreted by analyzing the variance and calculating the least significant differences and by analyzing the correlation between the inflorescences number and the Seed production.

RESULTS AND DISCUSSIONS

Plants height

In the first year of vegetation, at the Research and Development Station for Meadows, Vaslui and against the background of specific climatic conditions to the agricultural year 2018-2019, at the sainfoin seed crop was achieved a single

seed harvest and a cleaning cut.

Analyzing the influence of the interaction between rows spacing and fertilization on the height of plants at sainfoin seed crop, in the first year of vegetation, at the first cycle of vegetation (tab. 1), it was determined that this indicator had values between 77.0 cm in the control variant a_1b_1 (sown at 25 cm between rows, unfertilized) and 94.8 cm in the a_3b_5 variant (sown at 50 cm between rows, fertilized with manure 20 $Mg \cdot ha^{-1}$).

Except for the variants sown at 25 cm between rows fertilized with mineral fertilizers, for all other variants taken in the study the height differences from the control variant were statistically ensured (very significant).

In general, by sowing at longer row distances and by applying mineral or organic fertilizers, higher-height plants were obtained.

Table 1. *The influence of the distance between the rows and the fertilization on the plants height*

Variant		Plants height (cm)	Diferences (cm)	Diferences (%)	Statistical significance
Distance between rows	Fertilization				
a_1 - 25 cm (control)	b_1 - unfertilized (control)	77.0	control	100	control
	b_2 - $N_{50}P_{50}$	78.7	1.7	102.2	
	b_3 - $N_{50}P_{50}K_{50}$	80.3	3.3	104.3	
	b_4 - $N_{100}P_{100}K_{100}$	80.0	3.0	103.9	
	b_5 - manure 20 $Mg \cdot ha^{-1}$	87.0	10.0	113.0	***
a_2 - 37.5 cm	b_1 - unfertilized	84.5	7.5	109.7	***
	b_2 - $N_{50}P_{50}$	85.3	8.3	110.8	***
	b_3 - $N_{50}P_{50}K_{50}$	86.3	9.3	112.1	***
	b_4 - $N_{100}P_{100}K_{100}$	89.0	12.0	115.6	***
	b_5 - manure 20 $Mg \cdot ha^{-1}$	89.2	12.2	115.8	***
a_3 - 50 cm	b_1 - unfertilized	87.2	10.2	113.2	***
	b_2 - $N_{50}P_{50}$	88.0	11.0	114.3	***
	b_3 - $N_{50}P_{50}K_{50}$	90.7	13.7	117.8	***
	b_4 - $N_{100}P_{100}K_{100}$	91.1	14.1	118.3	***
	b_5 - manure 20 $Mg \cdot ha^{-1}$	94.8	17.8	123.1	***
LSD 0.05 = 4.1 cm; LSD 0.01 = 5.5 cm; LSD 0.001 = 7.3 cm.					

Shoots number

Following the analysis of the influence of the interaction between rows spacing and fertilization on the number of shoots$\cdot m^{-2}$ at the sainfoin seed crop, in the first year of vegetation, at the first cycle of vegetation (tab. 2), it turned out that this indicator had values ranging from 42.0 shoots$\cdot m^{-2}$ on a_3b_2 variant (sown at 50 cm between rows, fertilized with $N_{50}P_{50}$) to 128.7 shoots$\cdot m^{-2}$ on a_1b_4 variant (sown at 25 cm between rows, fertilized with $N_{100}P_{100}K_{100}$).

Obviously, sowing at smaller row distances resulted in a larger number of plants, and finally a larger number of shoots$\cdot m^{-2}$.

By applying mineral or organic fertilizers the number of shoots$\cdot m^{-2}$ had a increasing tendency.

Inflorescences number

From the analysis of the results obtained regarding the influence of the interaction between rows spacing and fertilization on the number of inflorescences$\cdot m^{-2}$ at the sainfoin seed crop, in the first year of vegetation, at the first cycle of vegetation (tab. 3), it was highlighted that this indicator had values between 124.7 inflorescences$\cdot m^{-2}$ on a_3b_1 variant (sown at 50 cm between rows, unfertilized) and 282.3 inflorescences$\cdot m^{-2}$ on a_1b_4 variant

(sown at 25 cm between rows, fertilized with $N_{100}P_{100}K_{100}$).

Table 2. *The influence of the distance between the rows and the fertilization on the shoots number*

Variant		Shoots number (shoots·m^{-2})	Diferences (shoots·m^{-2})	Diferences (%)	Statistical significance
Distance between rows	Fertilization				
a_1 - 25 cm (control)	b_1 - unfertilized (control)	116.0	control	100	control
	b_2 - $N_{50}P_{50}$	118.7	2.7	102.3	
	b_3 - $N_{50}P_{50}K_{50}$	122.7	6.7	105.7	
	b_4 - $N_{100}P_{100}K_{100}$	128.7	12.7	110.9	
	b_5 - manure 20 Mg·ha^{-1}	114.7	-1.3	98.9	
a_2 - 37.5 cm	b_1 - unfertilized	54.2	-61.8	46.7	ooo
	b_2 - $N_{50}P_{50}$	50.7	-65.3	43.7	ooo
	b_3 - $N_{50}P_{50}K_{50}$	54.2	-61.8	46.7	ooo
	b_4 - $N_{100}P_{100}K_{100}$	56.0	-60.0	48.3	ooo
	b_5 - manure 20 Mg·ha^{-1}	52.4	-63.6	45.2	ooo
a_3 - 50 cm	b_1 - unfertilized	42.7	-73.3	36.8	ooo
	b_2 - $N_{50}P_{50}$	42.0	-74.0	36.2	ooo
	b_3 - $N_{50}P_{50}K_{50}$	50.0	-66.0	43.1	ooo
	b_4 - $N_{100}P_{100}K_{100}$	54.7	-61.3	47.1	ooo
	b_5 - manure 20 Mg·ha^{-1}	64.7	-51.3	55.7	ooo
LSD 0.05 = 32.5 shoots·m^{-2}*; LSD 0.01 = 43.7* shoots·m^{-2}*; LSD 0.001 = 58.1* shoots·m^{-2}.					

By applying mineral or organic fertilizers the number of inflorescences·m^{-2} had a general trend of growth. It was noted that the highest values at this indicator were obtained when the sowing was 25 cm between rows.

Seed production

Synthesis of the study conducted in 2019 at Research and Development Station for Meadows, Vaslui, on the influence of the interaction between row spacing and fertilization on the sainfoin seed production, in the first year of vegetation, at the first cycle of vegetation (tab. 4), pointed out that it had values ranging between 91.2 Mg·ha^{-1} on the a_3b_1 variant (sown at 50 cm between rows, unfertilized) and 324.1 Mg·ha^{-1} at the a_1b_4 variant (sown at 25 cm between rows, fertilized with $N_{100}P_{100}K_{100}$).

Differences ranged from -36.4% to 44.0%. The most significant production differences from the statistical-insured control variant (distinctly significant or very significant) were obtained when the sowing had a distance of 25-37.5 cm between rows and was fertilized with $N_{50}P_{50}K_{50}$ or $N_{100}P_{100}K_{100}$.

The morpho-productive parameters of sainfoin plants are influenced, to the greatest extent, by the elements of the applied technology (cultivated genotype, sowing depth, fertilization, etc.), but also by the interaction between them.

Following the study, it was observed that the factor with the greatest influence on the analyzed parameters was the row spacing. It conditions the density of plants, so the space of nutrition of future sainfoin plants and their behavior in vegetation.

In addition to the obvious correlations between study factors and analyzed parameters, correlations between study parameters such as the number of inflorescences·m^{-2} and seed production can also be shown (fig. 1).

Table 3. *The influence of the distance between the rows and the fertilization on the inflorescences number*

Variant		Inflorescences number (inflorescences ·m^{-2})	Diferences (inflorescences ·m^{-2})	Diferences (%)	Statistical significance
Distance between rows	Fertilization				
a_1 - 25 cm (control)	b_1 - unfertilized (control)	196.0	control	100	control
	b_2 - $N_{50}P_{50}$	245.3	49.3	125.2	*
	b_3 - $N_{50}P_{50}K_{50}$	281.3	85.3	143.5	***
	b_4 - $N_{100}P_{100}K_{100}$	282.3	86.3	144.0	***
	b_5 - manure 20 Mg·ha^{-1}	217.3	21.3	110.9	
a_2 - 37.5 cm	b_1 - unfertilized	206.4	10.4	105.3	
	b_2 - $N_{50}P_{50}$	211.6	15.6	107.9	
	b_3 - $N_{50}P_{50}K_{50}$	248.9	52.9	127.0	*
	b_4 - $N_{100}P_{100}K_{100}$	257.8	61.8	131.5	**
	b_5 - manure 20 Mg·ha^{-1}	255.3	59.3	130.3	**
a_3 - 50 cm	b_1 - unfertilized	124.7	-71.3	63.6	ooo
	b_2 - $N_{50}P_{50}$	132.7	-63.3	67.7	oo
	b_3 - $N_{50}P_{50}K_{50}$	153.3	-42.7	78.2	o
	b_4 - $N_{100}P_{100}K_{100}$	190.7	-5.3	97.3	
	b_5 - manure 20 Mg·ha^{-1}	175.3	-20.7	89.5	
LSD 0.05 = 39.7 inflorescences·m^{-2}*; LSD 0.01 = 53.4* inflorescences·m^{-2}*; LSD 0.001 = 71.0* inflorescences·m^{-2}*.*					

Table 4. *The influence of the distance between the rows and the fertilization on the seed production*

Variant		Seed production (Mg·ha^{-1})	Diferences (Mg·ha^{-1})	Diferences (%)	Statistical significance
Distance between rows	Fertilization				
a_1 - 25 cm (control)	b_1 - unfertilized (control)	190.5	control	100	control
	b_2 - $N_{50}P_{50}$	259.8	69.3	136.4	**
	b_3 - $N_{50}P_{50}K_{50}$	290.1	99.6	152.3	***
	b_4 - $N_{100}P_{100}K_{100}$	324.1	133.6	170.1	***
	b_5 - manure 20 Mg·ha^{-1}	229.1	38.5	120.2	
a_2 - 37.5 cm	b_1 - unfertilized	119.5	-71.0	62.7	oo
	b_2 - $N_{50}P_{50}$	124.8	-65.8	65.5	oo
	b_3 - $N_{50}P_{50}K_{50}$	142.5	-48.0	74.8	o
	b_4 - $N_{100}P_{100}K_{100}$	195.8	5.2	102.7	
	b_5 - manure 20 Mg·ha^{-1}	161.3	-29.3	84.6	
a_3 - 50 cm	b_1 - unfertilized	91.2	-99.3	47.9	ooo
	b_2 - $N_{50}P_{50}$	95.4	-95.2	50.0	ooo
	b_3 - $N_{50}P_{50}K_{50}$	102.8	-87.8	53.9	ooo
	b_4 - $N_{100}P_{100}K_{100}$	141.1	-49.4	74.1	o
	b_5 - manure 20 Mg·ha^{-1}	129.8	-60.7	68.1	oo
LSD 0.05 = 43.4 Mg·ha^{-1}*; LSD 0.01 = 58.4* Mg·ha^{-1}*; LSD 0.001 = 77.7* Mg·ha^{-1}*.*					

The number of inflorescences·m^{-2} increased with the number of shoots·m^{-2}, but at a small number of shoots·m^{-2} (40-60 shoots·m^{-2}), the number of inflorescences per shoots will be higher due to the branching of shoots, and the flowering and maturing of seeds will be more staggered than at a higher number of shoots·m^{-2} (80-120 shoots·m^{-2}), where the shoots will be less branched (due to competition between them), and the inflorescences will develop at the same time. This can also be seen in the correlation between the number of inflorescences·m^{-2} and seed production.

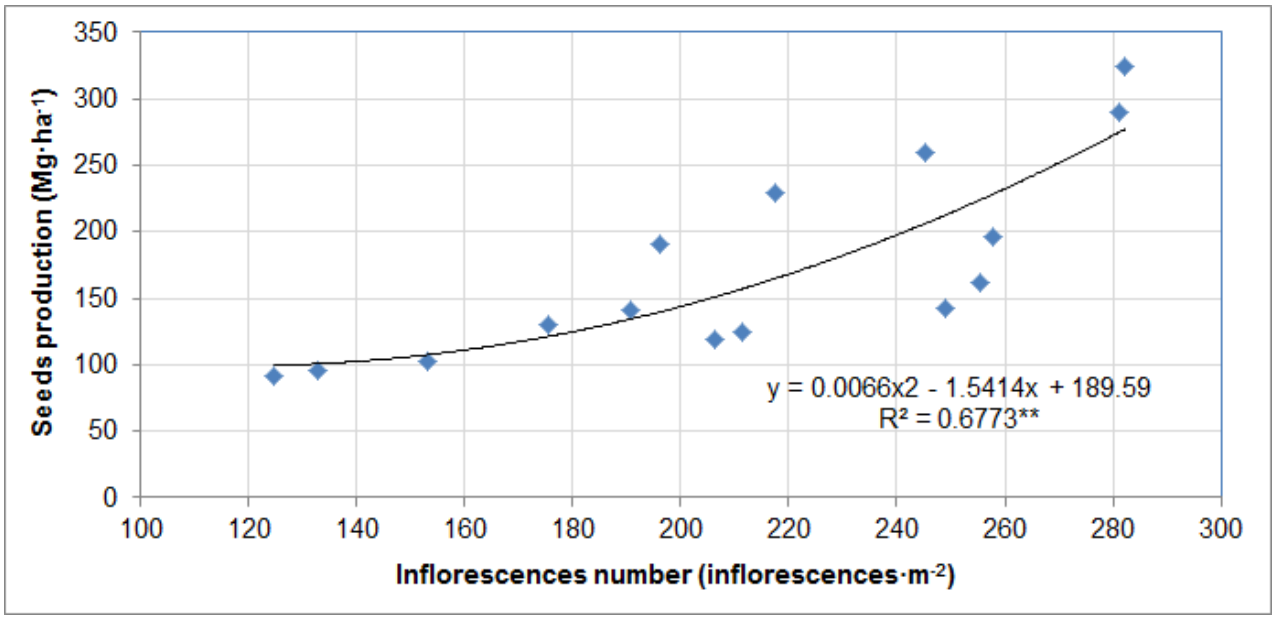

Figure 1. *Correlation between the inflorescences number and the seeds production*

CONCLUSIONS

The study found that by applying mineral or organic fertilizers, higher-height plants with a higher number of shoots·m^{-2} were obtained, and the seed yields were also higher.

The greatest number of inflorescences·m^{-2} were obtained when sowing was carried out at distances of 25 cm and 37.5 cm between rows, and the highest yields were obtained when sowing was carried out at a distance of 25 cm between rows.

When the sainfoin was sown at the 50 cm between rows the number of inflorescences developed by the shoots was greater than for sowing at distances of 25 cm and 37.5 cm between rows, but the inflorescences had a staggered bloom, this makes it difficult to determine the optimal time to harvest the seed crop.

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