THE INFLUENCE OF FERTILIZATION AND DISTANCE BETWEEN ROWS ON SOME SAINFOIN (*Onobrychis viciifolia* Scop.) MORPHOPRODUCTIVE INDICATORS

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Abstract. *The research conducted during the period of March to October 2019, at the Meadows Research and Development Station, 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}) and inflorescences number (inflorescences·m^{-2}), at sainfoin (Onobrychis viciifolia* Scop.*) seeds culture, in the first year of vegetation. The organized experience was bi-factorial, 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 studied factors 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 - cattle manure 20 mg·ha^{-1}). Resulting from 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.*

Keywords*: plants height, shoots number, inflorescences number, correlation*

INTRODUCTION

Sainfoin (*Onobrychis viciifolia* Scop.) is one of the most valuable perennial fodder leguminous plants, being used in animal feed in the form of hay, green or ensilaged fodder, due to its high nutritional value (17 nutritional units per 100 kg green mass or 60.1 nutritional units per 100 kg hay) and the fact that it has good quality protein content (3.6 % in green mass and 15.4 % in hay). It contains significant quantities of mineral elements (Ca and P) and vitamins, and in the green state sainfoin does not produce bloating. Also, sainfoin is a very good honey plant, with a flowering period of about 23-27 days, reaching up to 300 kg·ha^{-1} of honey. (ROȘCA D., 1967; BORREANI G., 2003; DRĂGAN L., 2009; SHEPPARD S.C., 2010; ENE T.A., 2016).

Because it is cultivated also on the eroded, dry lands, where other plants do not give satisfactory results, the sainfoin does not compete with the alfalfa and the clover, but complements them where they do not succeed (ACAR R., 2011; JAFARI A. A., 2014).

For the sainfoin seed production, all the technological steps must be optimally completed, but finding the optimum ratio between the quantities of nutrients available to the plants is one of the main objectives when it comes to improving the culture technology (ZHANG Y., 2010; BEKOVIĆ D., 2016). This objective can be achieved by a correct land choice, proper fertilization, but also by the nutrition space allocated to each plant (achieved by establishing the distance between rows at sowing or plant density) (ĆUPINA B., 2010; STEVOVIC V., 2012; AVCI M. A., 2013; KEI M., 2013).

In the case of sainfoin, the harvest for seed is made at the first cut, starting from the second year of vegetation, when 70% of the pods have a light brown color, directly with the combine. In order to avoid shaking losses, it is recommended that harvesting should be done at night or in the morning and in the evening. After seeds separation, they are conditioned and stored in places with water content below 14% (MARTINIELLO P., 1994; SAVATTI M., 2002).

Particular attention should be given to pollinators by placing 2-6 hives per hectare, near the seed lots.

Under optimal conditions, the pods production is 500-600 kg·ha^{-1} in ordinary crops and 1000-1500 kg·ha^{-1} in special crops.

Through this study, the authors tried to improve the sainfoin seeds cultivation technology under soil - climate conditions from Meadows Research and Development Station, Vaslui, by analyzing the influence of fertilization and the distance between rows on some morphological productive elements, in the first year of vegetation.

MATERIAL AND METHODS

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

The researches analyzed the influence of fertilization and distance between rows on the plants' height (cm), shoots number (shoots·m^{-2}) and inflorescences number (inflorescences·m^{-2}), at sainfoin (*Onobrychis viciifolia* Scop.) seeds culture, in the first year of vegetation.

To achieve the proposed goal, a bi-factorial experience was organized, 3 x 5 type and 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 studied factors 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 - cattle manure 20 mg·ha^{-1}).

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

The shoots number (shoots·m^{-2}) was determined by counting the shoots, in 3 repetitions, from 1 linear meter of the rows located 1 m from the edge of the plot, then the obtained number was expressed for 1 square meter.

The inflorescences number (inflorescences·m^{-2}) was determined by counting the inflorescences of the shoots, in 3 repetitions, from 1 linear meter of the rows located 1 m from the edge of the plot, then the obtained number was expressed for 1 square meter.

The biological material used was represented by the Anamaria sainfoin variety, approved in 2006 and patented in 2009 at Meadows Research and Development Station, Vaslui.

The used manure had the following composition: N-0.415%, P_2O_5-0.220% and K_2O-0.705%.

The fertilizers were applied when the germinal bed was prepared.

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 shoots number and the inflorescences number.

RESULTS AND DISCUSSIONS

Analyzing the influence of the interaction between the distance between rows and fertilization on the plants' height at the sainfoin cultivated for seed production, in the first year of vegetation, at the first cycle of vegetation (*table 1*), it was observed that this indicator had

values between 79.0 cm in the a_2b_1 variant (sown at 37.5 cm between rows, unfertilized) and 88.0 cm in the a_3b_5 variant (sown at 50 cm between rows, fertilized with 20 mg·ha^{-1} manure), this being the only variant in which the difference was positive, compared to the control variant, and had statistical (significant) assurance.

In general, higher plants were obtained by applying mineral or organic fertilizers and sowing at smaller distances between rows.

Table 1

The influence of the distance between rows and the fertilization on the plants' height

Variant		Plants height (cm)	Differences (cm)	Differences (%)	Statistical significance
Distance between rows	Fertilization				
a_1 - 25 cm (control)	b_1 - unfertilized (control)	84.3	control	100	control
	b_2 - $N_{50}P_{50}$	85.3	1.0	101.2	
	b_3 - $N_{50}P_{50}K_{50}$	83.3	-1.0	98.8	
	b_4 - $N_{100}P_{100}K_{100}$	83.0	-1.3	98.4	
	b_5 - manure 20 mg·ha^{-1}	83.0	-1.3	98.4	
a_2 - 37.5 cm	b_1 - unfertilized	79.0	-5.3	93.7	oo
	b_2 - $N_{50}P_{50}$	86.7	2.3	102.8	
	b_3 - $N_{50}P_{50}K_{50}$	83.7	-0.7	99.2	
	b_4 - $N_{100}P_{100}K_{100}$	86.0	1.7	102.0	
	b_5 - manure 20 mg·ha^{-1}	87.3	3.0	103.6	
a_3 - 50 cm	b_1 - unfertilized	81.3	-3.0	96.4	
	b_2 - $N_{50}P_{50}$	85.7	1.3	101.6	
	b_3 - $N_{50}P_{50}K_{50}$	85.3	1.0	101.2	
	b_4 - $N_{100}P_{100}K_{100}$	83.7	-0.7	99.2	
	b_5 - manure 20 mg·ha^{-1}	88.0	3.7	104.3	*
	LSD	*0.05*	*3.7*		
		0.01	*5.0*		
		0.001	*6.6*		

Following the analysis of the influence of the interaction between the distance between rows and fertilization on the shoots number at the sainfoin cultivated for seed production, in the first year of vegetation, at the first cycle of vegetation (*table 2.*), it was observed that this indicator had values between 36.7 shoots·m^{-2} in the a_3b_3 variant (sown at 50 cm between rows, fertilized with $N_{50}P_{50}K_{50}$) and 126.7 shoots·m^{-2} in the a_1b_5 variant (sown at 25 cm between rows, fertilized with 20 mg·ha^{-1} manure).

It was obvious that sowing at smaller distances between rows led to a greater number of plants, and finally to a greater number of shoots·m^{-2}.

By applying mineral or organic fertilizers, the number of shoots·m^{-2} tended to increase.

Analyzing the influence of the interaction between the distance between rows and fertilization on the shoots number at the sainfoin cultivated for seed production, in the first year of vegetation, at the first cycle of vegetation (*table 3*), it was observed that this indicator had values between 100.0 inflorescences·m^{-2} in the a_3b_1 variant (sown at 50 cm between rows, unfertilized) and 249.3 inflorescences·m^{-2} in the a_1b_3 variant (sown at 25 cm between rows, fertilized with $N_{50}P_{50}K_{50}$).

By applying mineral or organic fertilizers, the number of inflorescences·m^{-2} had a general growth trend. It was observed that the highest values for this indicator were obtained when the sowing had a distance of 50 cm between rows.

The morphological productive parameters at the sainfoin (*Onobrychis viciifolia* Scop.) cultivated for seeds are influenced, the utmost, by the elements of the applied technology

(cultivated genotype, seeding density, fertilization etc.), but also by the interaction between them.

Table 2

The influence of the distance between rows and the fertilization on the shoots number

Variant		Shoots number (shoots·m^{-2})	Differences (shoots·m^{-2})	Differences (%)	Statistical significance
Distance between rows	Fertilization				
a_1 - 25 cm (control)	b_1 - unfertilized (control)	101.3	control	100	control
	b_2 - $N_{50}P_{50}$	94.7	-6.7	93.4	
	b_3 - $N_{50}P_{50}K_{50}$	114.7	13.3	113.2	
	b_4 - $N_{100}P_{100}K_{100}$	108.0	6.7	106.6	
	b_5 - manure 20 mg·ha^{-1}	126.7	25.3	125.0	
a_2 - 37.5 cm	b_1 - unfertilized	64.0	-37.3	63.2	
	b_2 - $N_{50}P_{50}$	56.9	-44.4	56.1	o
	b_3 - $N_{50}P_{50}K_{50}$	69.3	-32.0	68.4	
	b_4 - $N_{100}P_{100}K_{100}$	76.4	-24.9	75.4	
	b_5 - manure 20 mg·ha^{-1}	76.4	-24.9	75.4	
a_3 - 50 cm	b_1 - unfertilized	38.0	-63.3	37.5	oo
	b_2 - $N_{50}P_{50}$	43.3	-58.0	42.8	oo
	b_3 - $N_{50}P_{50}K_{50}$	36.7	-64.7	36.2	oo
	b_4 - $N_{100}P_{100}K_{100}$	44.7	-56.7	44.1	oo
	b_5 - manure 20 mg·ha^{-1}	53.3	-48.0	52.6	o
	LSD	*0.05*	*43.3*		
		0.01	*58.2*		
		0.001	*77.4*		

Table 3

The influence of the distance between rows and the fertilization on the inflorescences number

Variant		Inflorescences number (inflorescences ·m^{-2})	Differences (inflorescences ·m^{-2})	Differences (%)	Statistical significance
Distance between rows	Fertilization				
a_1 - 25 cm (control)	b_1 - unfertilized (control)	188,0	martor	100	martor
	b_2 - $N_{50}P_{50}$	246,7	58,7	131,2	*
	b_3 - $N_{50}P_{50}K_{50}$	249,3	61,3	132,6	*
	b_4 - $N_{100}P_{100}K_{100}$	236,0	48,0	125,5	
	b_5 - manure 20 mg·ha^{-1}	176,0	-12,0	93,6	
a_2 - 37.5 cm	b_1 - unfertilized	209,8	21,8	111,6	
	b_2 - $N_{50}P_{50}$	206,2	18,2	109,7	
	b_3 - $N_{50}P_{50}K_{50}$	173,3	-14,7	92,2	
	b_4 - $N_{100}P_{100}K_{100}$	241,8	53,8	128,6	*
	b_5 - manure 20 mg·ha^{-1}	176,0	-12,0	93,6	
a_3 - 50 cm	b_1 - unfertilized	100,0	-88,0	53,2	oo
	b_2 - $N_{50}P_{50}$	128,7	-59,3	68,4	o
	b_3 - $N_{50}P_{50}K_{50}$	119,3	-68,7	63,5	o
	b_4 - $N_{100}P_{100}K_{100}$	138,7	-49,3	73,8	
	b_5 - manure 20 mg·ha^{-1}	132,0	-56,0	70,2	o
	LSD	*0.05*	*52,9*		
		0.01	*71,2*		
		0.001	*94,7*		

Following the study, it was observed that the factor with the greatest influence on the analyzed parameters was the distance between rows. This will condition the sowing density, therefore the nutrition space of the future sainfoin plants and their vegetation behavior.

In addition to the obvious correlations between the studied factors and the analyzed parameters, correlations between the study parameters, such as the one between the number of shoots·m^{-2} and the number of inflorescences·m^{-2} can be highlighted. (*figure 1*).

The number of inflorescences·m^{-2} increased with the number of shoots, but after reaching the range of 80-120 shoots·m^{-2}, the number of inflorescences·m^{-2} stabilized.

It should be noted that at a small number of shoots·m^{-2} (40-60 shoots·m^{-2}), the number of inflorescences will be quite large, due to the branching of the shoots, but the flowering, respectively the maturation of the seeds will be made more staggered than in case of a greater number of shoots·m^{-2} (80-120 shoots·m^{-2}), where the shoots will be less branched (due to the competition between them) and the inflorescences will develop at the same time.

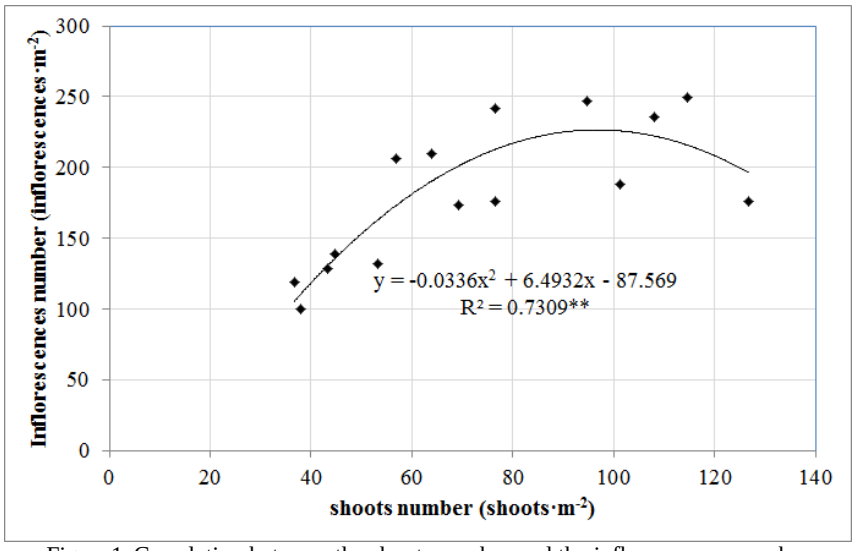

Figure 1. Correlation between the shoots number and the inflorescences number

CONCLUSIONS

Following the conducted study, it was found that by applying mineral or organic fertilizers and sowing at smaller distances between rows higher plants were obtained, with a higher number of shoots·m^{-2}.

The highest number of inflorescences·m^{-2} was obtained when the sowing was done at a distance of 37.5 cm between rows.

The number of inflorescences·m^{-2} increased with the number of shoots, but after reaching the range of 80-120 shoots·m^{-2}, the number of inflorescences·m^{-2} stabilized.

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