THE INFLUENCE OF FERTILIZATION AND DISTANCE BETWEEN ROWS ON SEED PRODUCTION OF SAINFOIN (*Onobrychis viciifolia* Scop.), IN THE FIRST YEAR OF VEGETATION

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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 seeds production (kg·ha^{-1}), seeds 1000 grains mass (g) and seeds germination (%), at sainfoin (*Onobrychis viciifolia* Scop.) seeds culture, 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 higher quantities of seeds were obtained, with higher values of 1000 grains mass and germination and by sowing at longer distances between rows smaller quantities of seeds were obtained with higher values of 1000 grains mass and germination.

Key words: seeds production, seeds 1000 grains mass, seeds germination

Sainfoin (*Onobrychis viciifolia* Scop.) is one of the most valuable perennial fodder legumes, being used in animal feed in the form of hay, green or ensilaged 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) and the fact that it has good quality protein content (3.6 % in green mass and 15.4 % in hay) and contains significant quantities of mineral elements (Ca and P) and vitamins, and in the green state sainfoin does not produce weathering. 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. *et al*. 1967; Sheppard S.C. *et al*, 2010).

The fodder obtained from the sainfoin crop has a high nutritional value expressed by a balanced energy-protein ratio, which means that it can be fully consumed even at later stages of vegetation (Dumitrescu N., 1991).

For the sainfoin seed production, all the technological steps must be made optimally, 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. 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) (Stevovic V. *et al*, 2012; Avci M. A. *et al*, 2013).

In the case of sainfoin, in some favorable years, a certain amount of seeds can be obtained from the 1st year of vegetation, at the first harvest, but the harvest for the 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.

Seed yield obtained in special crops is 1000-1500 kg·ha^{-1} (Moga I., Schitea M., 2005).

Through this study, it was tried to improve the sainfoin seeds cultivation technology under pedoclimatic conditions from Meadows Research and Development Station, Vaslui, by analyzing the influence of fertilization and the distance between rows on seeds production and some seed quality parameters, in the first year of vegetation.

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MATERIAL AND METHOD

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).

Following the researches were analyzed the influence of fertilization and the distance between rows on the seeds production (kg·ha^{-1}), 1000 grains mass (g) and germination (%), at sainfoin (*Onobrychis viciifolia* Scop.) 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·ha^{-1}).

The seeds production (kg·ha^{-1}) was determined by manual harvesting and weighing production on the harvestable area of each plot, then reporting per hectare.

The seeds 1000 grains mass (g) was determined for each experimental plot by weighing 100 seeds (pods) in eight repetitions, then their average was multiplied by 10.

The seeds germination (%) was determined at Territorial Inspectorate for Seed and Planting Material Quality Vaslui.

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

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.

RESULTS AND DISCUSSIONS

The results obtained on the influence of the interaction between rows spacing and fertilization on seed yield in the first year of vegetation in the first growing cycle (*table 1*) showed that the values obtained were between 74.5 kg·ha^{-1} at a_3b_3 variant (50 cm between rows, $N_{50}P_{50}K_{50}$) and 334.0 kg·ha^{-1} at a_1b_3 variant (25 cm between rows, $N_{50}P_{50}K_{50}$). From a statistical point of view, the largest positive differences compared to the control variety were obtained at 25 cm between rows, fertilized with $N_{50}P_{50}K_{50}$ and with $N_{100}P_{100}K_{100}$. The largest negative differences compared to the control variant with statistical assurance were determined at 50 cm between rows, regardless of fertilization variant, and at 37.5 cm between rows, unfertilized or under low-dose mineral fertilization conditions.

Table 1

The influence of the distance between the rows and the fertilization on the seeds production

Variant		Seeds production (kg·ha^{-1})	Differences		Statistical significance
Distance between rows	Fertilization		(kg·ha^{-1})	(%)	
a_1 - 25 cm (control)	b_1 - unfertilized (control)	167.1	control	100	control
	b_2 - $N_{50}P_{50}$	171.6	4.4	102.7	
	b_3 - $N_{50}P_{50}K_{50}$	234.0	66.8	140.0	***
	b_4 - $N_{100}P_{100}K_{100}$	231.9	64.8	138.8	***
	b_5 - manure 20 Mg·ha^{-1}	185.6	18.4	111.0	*
a_2 - 37.5 cm	b_1 - unfertilized	122.0	-45.1	73.0	ooo
	b_2 - $N_{50}P_{50}$	143.6	-23.5	86.0	oo
	b_3 - $N_{50}P_{50}K_{50}$	144.6	-22.5	86.5	oo
	b_4 - $N_{100}P_{100}K_{100}$	182.2	15.1	109.0	*
	b_5 - manure 20 Mg·ha^{-1}	157.3	-9.8	94.1	
a_3 - 50 cm	b_1 - unfertilized	86.4	-80.8	51.7	ooo
	b_2 - $N_{50}P_{50}$	95.3	-71.8	57.0	ooo
	b_3 - $N_{50}P_{50}K_{50}$	74.5	-92.6	44.6	ooo
	b_4 - $N_{100}P_{100}K_{100}$	105.4	-61.7	63.1	ooo
	b_5 - manure 20 Mg·ha^{-1}	119.7	-47.4	71.6	ooo
LSD		*0.05*	*14.1*	*kg·ha^{-1}*	
		0.01	*19.0*		
		0.001	*25.3*		

Studies conducted by Martiniello P., Ciola A., 1994; Savatti M. *et al*, 2002; Zhang Y. *et al*, 2010; Olar M.V., 2012, on the influence of fertilizers on the behavior of sainfoin in forage and seed lots were confirmed by the study conducted in the 2018-2019 agricultural year at the Meadows Research and Development Station, Vaslui.

Seeds 1000 grains mass (g) is one of the most important indicators of seed quality. Seeds with an above average value of this indicator will store more energy. From a practical point of view, in sainfoin cultivation technology, the use of seeds with a higher MMB under normal soil and climatic conditions will result in a faster and more uniform sprouting of the plants, and in conditions of soil water deficit at the time of sowing, the seeds can be sown deeper in the soil.

By improving the *Onobrychis viciifolia* Scop. seed cultivation technology, the aim is also to create seed material with higher 1000 grains mass.

Analyzing the influence of the interaction between rows spacing and fertilization on seeds 1000 grains mass in the first year of vegetation in the first growing cycle (*table 2*), showed that the values obtained were between 15.9 g at a_1b_1 variant (25 cm between rows, unfertilized - control variant) and 17.5 g at a_3b_4 variant (50 cm between rows, $N_{100}P_{100}K_{100}$). From a statistical point of view all the differences compared to the control version were positive, but the largest positive differences compared to the control variety were obtained at 50 cm between rows, fertilized with $N_{100}P_{100}K_{100}$ and with manure 20 $Mg \cdot ha^{-1}$.

By sowing at larger distances between rows and by applying mineral or organic fertilizers the seeds 1000 mass values of grains have tended to increase.

Table 2

The influence of the distance between the rows and the fertilization on the seeds 1000 grains mass

Variant		Seeds 1000 grains mass (g)	Differences		Statistical significance
Distance between rows	Fertilization		(g)	(%)	
a_1 - 25 cm (control)	b_1 - unfertilized (control)	15.9	control	100	control
	b_2 - $N_{50}P_{50}$	16.5	0.6	103.6	
	b_3 - $N_{50}P_{50}K_{50}$	16.6	0.7	104.4	*
	b_4 - $N_{100}P_{100}K_{100}$	16.6	0.7	104.4	*
	b_5 - manure 20 $Mg \cdot ha^{-1}$	16.5	0.6	104.0	
a_2 - 37.5 cm	b_1 - unfertilized	16.1	0.2	101.5	
	b_2 - $N_{50}P_{50}$	16.3	0.4	102.3	
	b_3 - $N_{50}P_{50}K_{50}$	16.9	1.0	106.1	**
	b_4 - $N_{100}P_{100}K_{100}$	16.9	1.0	106.5	**
	b_5 - manure 20 $Mg \cdot ha^{-1}$	16.7	0.8	105.2	*
a_3 - 50 cm	b_1 - unfertilized	16.1	0.2	101.5	
	b_2 - $N_{50}P_{50}$	16.3	0.4	102.3	
	b_3 - $N_{50}P_{50}K_{50}$	16.0	0.1	100.6	
	b_4 - $N_{100}P_{100}K_{100}$	17.5	1.6	109.9	***
	b_5 - manure 20 $Mg \cdot ha^{-1}$	17.3	1.4	109.0	***
LSD		*0.05*	*0.7*	*g*	
		0.01	*1.0*		
		0.001	*1.3*		

The most important indicator of seed quality is seed germination.

By improving the cultivation technology of *Onobrychis viciifolia* Scop. for seed, the aim is also to create seed material with better germination.

The results obtained on the influence of the interaction between rows spacing and fertilization on seeds germination in the first year of vegetation in the first growing cycle (*table 3*) showed that the values obtained were between 72.1 % at a_3b_3 variant (50 cm between rows, $N_{50}P_{50}K_{50}$) and 82.1 % at a_3b_4 variant (50 cm between rows, $N_{100}P_{100}K_{100}$). From a statistical point of view, the largest positive differences compared to the control variety were obtained at 50 cm between rows, fertilized with $N_{100}P_{100}K_{100}$ and with manure 20 $Mg \cdot ha^{-1}$. The single negative differences compared to the control variant without statistical assurance were determined at 50 cm between rows, fertilized with $N_{50}P_{50}K_{50}$.

By sowing at larger row spacing and applying mineral or organic fertilizers germination values tended to increase.

Table 3

The influence of the distance between the rows and the fertilization on the seeds production

Variant		Seeds germination (%)	Differences		Statistical significance
Distance between rows	Fertilization		(%)	(%)	
a_1 - 25 cm (control)	b_1 - unfertilized (control)	74.7	control	100	control
	b_2 - $N_{50}P_{50}$	77.4	2.7	103.6	
	b_3 - $N_{50}P_{50}K_{50}$	78.0	3.3	104.4	
	b_4 - $N_{100}P_{100}K_{100}$	78.0	3.3	104.4	
	b_5 - manure 20 Mg·ha^{-1}	77.7	3.0	104.0	
a_2 - 37.5 cm	b_1 - unfertilized	75.8	1.1	101.5	
	b_2 - $N_{50}P_{50}$	76.5	1.7	102.3	
	b_3 - $N_{50}P_{50}K_{50}$	79.3	4.5	106.1	*
	b_4 - $N_{100}P_{100}K_{100}$	79.6	4.9	106.5	*
	b_5 - manure 20 Mg·ha^{-1}	78.6	3.9	105.2	
a_3 - 50 cm	b_1 - unfertilized	75.8	1.1	101.5	
	b_2 - $N_{50}P_{50}$	76.5	1.7	102.3	
	b_3 - $N_{50}P_{50}K_{50}$	72.1	-2.7	96.4	
	b_4 - $N_{100}P_{100}K_{100}$	82.1	7.4	109.9	**
	b_5 - manure 20 Mg·ha^{-1}	81.5	6.7	109.0	**
LSD		*0.05*	*4.3*	*%*	
		0.01	*5.8*		
		0.001	*7.7*		

Morpho-productive parameters in seeds sainfoin fields are mostly influenced by the elements of the technology applied (genotype grown, sowing rate, fertilization, etc.), but also by their interaction.

CONCLUSIONS

Following the study, it was found that by applying mineral or organic fertilizers higher quantities of seeds were obtained, with higher values of 1000 grains mass and germination.

By sowing at smaller distances between rows smaller quantities of seeds were obtained with higher values of 1000 grains mass and germination.

The study showed that the factor with the greatest influence on the parameters analyzed was the rows spacing. This determines the sowing spacing and the feeding space of the future sainfoin plants and their behavior in vegetation.

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