

## RESEARCHES CONCERNING THE INFLUENCE OF DISTANCE BETWEEN THE ROWS AT SOWING ABOVE THE WINTER RAPESEED CROP YIELD UNDER EXISTING CONDITIONS OF THE MOARA DOMNEASCĂ DIDACTIC FARM

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### Abstract

*The paper present research want to show which is the influence of distance between the rows at sowing above the productivity elements as: average number of ramification per plant, average number of pots per plant, average number of beans per plant, average weight of beans per plant and TWK, as the influence of the distance between the rows at sowing above the plants flowering. The experience was made at Didactic Farm Moara Domneasca, between 2009 – 2012. There been studied four distance between rows: 12.5 cm, 25 cm, 37.5 cm and 50 cm, and their influence above two rapeseed cultivars : Alaska variety and Exagone hybrid. The cultivation technology was the same for all variant and experimental years. The results obtained in the experimental years shows that the best results was obtained at rapeseed variety and hybrid when the distance between the rows at sowing was 25 cm,37.5 cm and 50 cm.*

**Key words:** distance between rows, sowing period, TWK, variety, yield.

### INTRODUCTION

In the last 10 years, winter rapeseed has a very important place in the economy as a source of vegetable oil used in industry as aliment or to obtain fuel oil (biodiesel) and as an important agrotechnical plant for farmers (Borcean, 1995; Budoï and Penescu, 1996; Sandoiu, 2008; Bâlțeanu, 2011; Buzdugan, 2011; Roman, 2012). The expanding area of the rapeseed cultivation, the high offer of cultivation, the new varieties and hybrids and the variety of conditions during sowing period the research to clarify and determine the exact influence of each technological link such as: the seeding, the distance between rows, density and rate of seed, production and quality. The technological links with great influence over production include the distance between rows at seeding. Until the emergence of hybrids, it was recommended 12.5 cm for varieties with low branching capacity and 25 cm for those with strong branching, so at the harvest time we could obtain 60-110 plants/m<sup>2</sup> (Picu and Tianu, 1983; Pop, 1988; Borcean, 1991; Sin et al., 2007; Muntean, 2008; Sandoiu, 2008;

Bâlțeanu, 2011; Roman, 2012). The occurrence of rapeseed hybrids with higher potential of branching and the development of selective herbicides segment that can controle weeds in this culture, allowed us to study the various distances between rows at sowing and to investigate which is their influence on production. Thus, between 2009-2012, we organized the experimental field of the discipline Agrotechnics at Moara Domneasca, an experiment in which we have studied the influence of four sowing distance between rows (12.5 cm, 25 cm, 37.5 cm, 50 cm) on the variety of Alaska and the hybrid Exagone. This study aims to establish the influence of the distance between rows at sowing over the productivity elements and the production of rapeseed varieties and hybrids for Southern Romania.

### MATERIALS AND METHODS

The research was conducted during 2009-2012, at Moara Domneasca, in a typical red preluvosol with 2.5% humus, pH 5.5 and clay content of 38%.

The experience was bifactorial, located on plots subdivided into four replication method. Factor A was represented by the varieties and hybrids, and factor B – the sowing distances. Throughout the 3 years of study we used the same technology in a rotation of 4 years of wheat-rapeseed-corn-sunflower. The preceding plant was wheat, after plowing was performed at 25 cm. The soil was fertilized manually with N100 and P80 kg/ha. The seedbed was prepared with the harrow discs and combiner. The sowing was done in optimal time prior to September 10 of each year. The weeds were controlled with herbicides products specific to the rapeseed culture, also there were executed operations against pests and diseases. The harvesting was done manually on each plot in early July.

The following determinations were made:

- no. of weed species determined at their arising and harvesting time
- phenological measurements for the rapeseed varieties and hybrids
- no. of plants/m<sup>2</sup> at the arising, leaving the winter and before harvesting
- no. of branches / plant
- no. of pods / plant
- no. of grains in the pod and pod's length
- weight of 1000 grains (TWK)
- production.

It should be stressed that the rising of the rapeseed culture was made uniformly throughout the experience only in 2010, in 2011 and 2012, there were extremely dry autumns and the rising was staggered.

## RESULTS AND DISCUSSIONS

The observations made during the three years of research on the phenological development of the studied cultivars are presented in Table 1.

We can draw a conclusion after three years of research on phenological development of the tested varieties and hybrids as follows:

- number of leaves per plant increases with distance of seeding between rows (25, 37.5 and 50 cm);
- the plant height becomes typical for the variety or hybrid when the seeding distances between rows are larger (25, 37.5 and 50 cm);

- the flowering starts earlier for closely sown variants in rows of 12.5 and later for larger sowing distances (37.5 and 50 cm);
- the pods begin to form faster at the variants sown closely (12.5 and 25 cm) and extended for larger distances (37.5 and 50 cm) between rows;
- the full maturity and beginning of harvesting is done 2-3 days earlier when rapeseed is sown in close rows (12.5 and 25 cm) and extended by 2-3 days when seeding is done at larger distances between rows (37.5 and 50 cm).

*The influence of seeding distance between rows on the level of weeds in winter rapeseed culture between 2009-2012 at Moara Domneasca.*

The results on the level of weeds in the three years of study (2009 - 2012), are presented in Table 2. On the level of weeds we can say that in the three years of study, the spectrum of weeds remained about the same with a dominance of annual and perennial dicotyledonous weeds. One can notice the abundance of species of both dicotyledonous and monocotyledonous weeds when used larger distances between rows (25 cm, 37.5 cm and 50 cm), for both cultivated variety and hybrid. We can draw a conclusion that must be taken into account when rapeseed is grown at larger spacings between rows, namely that the culture's success is conditioned by the success of weed control. To illustrate the level of weed depending on seeding distance between rows, we depict graphically the level of annual dicotyledonous and annual monocotyledonous weeds in Figures 1 and 2. In terms of the proportion of participation of weed species in the rapeseed culture it is observed:

Annual dicotyledonous weeds 40%	Annual monocotyledonous weeds 25%
Perennial dicotyledonous weeds 25%	Perennial monocotyledonous weeds 15%

The results obtained in the three years at Moara Domneasca, referring to the influence of seeding distance between rows for the winter rapeseed, are presented in Table 3.

There was a higher density for the variety Alaska when compared to hybrid Exagone, especially when it was sown at a distance of 12.5 cm between rows.

Table 1. The influence of seeding distance between rows on the phenological development in Alaska variety and Exagone hybrid between 2009-2012 at Moara Domneasă

Variety / hibrid cultivated	Distance between rows (cm)	Average no. of leaves at flowering time	Plants' height (cm)	Flowering time	Forming pods	Forming grains	Full maturity
Alaska	12.5	8	88	14.04-30.05	25.04-30.05	27.04-14.06	6.07
	25.0	11	80	16.04-28.05	20.04-30.05	25.05-14.06	8.07
	37.5	13	82	18.04-29.05	21.04-31.05	28.04-10.06	9.07
	50.0	14	85	18.04-28.05	22.04-30.05	28.04-8.06	10.07
Exagone	12.5	9	100	20.04-25.05	24.04-26.05	08.05-10.06	8.07
	25.0	10	102	21.04-26.05	24.04-27.05	06.05-10.06	9.07
	37.5	12	105	21.04-27.05	25.04-28.05	03.05-10.06	11.07
	50.0	13	108	20.04-28.05	24.04-29.05	04.05-10.06	12.07

Table 2. Weed species present in the experiment with seeding distances between rows for winter rape (Average 2009-2012) Moara Domneasă

Annual dicotyledonous	No weeds / m <sup>2</sup>				Perennial dicotyledonous	No.weeds / m <sup>2</sup>			
	12.5	25	37.5	50		12.5	25	37.5	50
<i>Amaranthus retroflexus</i>	4	7	12	14	<i>Cirsium arvense</i>	2	3	5	6
<i>Chenopodium album</i>	3	5	7	11	<i>Convolvulus arvense</i>	5	7	8	10
<i>Xanthium strumarium</i>	4	8	12	13	<i>Sonchus arvense</i>	2	3	4	6
<i>Matricaria matricarioides</i>	0	2	4	8	<i>Lepidium draba</i>	1	3	5	7
<i>Papaver rhoeas</i>	2	3	5	6	<i>Poligonum aviculare</i>	6	9	12	14
<i>Sinapis arvensis</i>	0	2	3	4					
<i>Portulaca oleracea</i>	2	5	6	7					
<i>Fumaria scleicheri</i>	3	5	6	7					
<i>Hibiscus trionum</i>	5	7	8	9					
Total	23	44	63	79	Total	16	23	35	47
Annual monocotyledonous	No.weeds / m <sup>2</sup>				Perennial monocotyledonous	No.weeds / m <sup>2</sup>			
	12.5	25	37.5	50		12.5	25	37.5	50
<i>Setaria glauca</i>	3	5	10	14	<i>Sorghum halepense</i>	5	9	11	16
<i>Setaria viridis</i>	4	5	7	12	<i>Cynodon dactylon</i>	0	2	4	4
<i>Echinochloa crus gali</i>	4	5	7	9					
<i>Digitaria sanguinalis</i>		5	7	9					
Total	15	20	31	44	Total	5	11	15	20

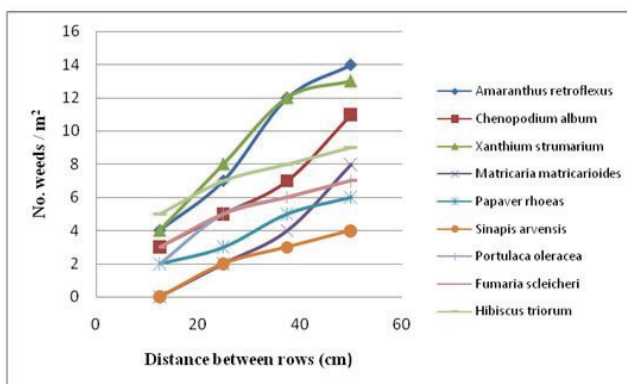


Figure 1. Level of annual dicotyledonous weeds in experience (Average 2009-2012) Moara Domneasca

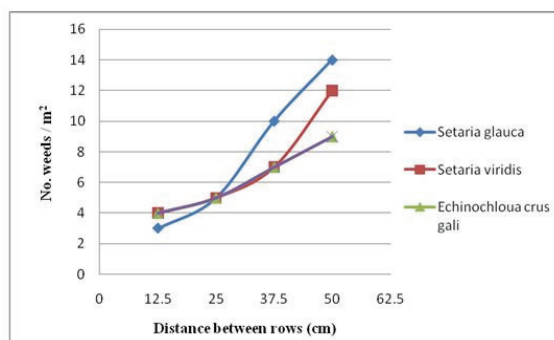


Figure 2. Level of annual monocotyledonous weeds (Average 2009-2012) Moara Domneasca

Table 3. The influence of seeding distance between rows on winter rapeseed plant density Average 2009-2012) Moara Domneasca.

Cultivated variety / hybrid	Distance between rows (cm)				Average
	12.5	25.0	37.5	50.0	
AUTUMN					
Alaska	67.5	58.7	60.1	60.2	61.63
Exagone	65.0	66.0	58.9	58.0	61.9
SPRING					
Alaska	60.1	58.2	59.0	60.4	60.43
Exagone	60.5	57.7	56.0	54.0	57.8
				DL 1% 4.7	DL 0.1% 5.2

The influence of seeding distance between rows on branching level in rapeseed crop.

Another problem in our research has been the influence of seeding distance between rows on

the level of branching in Alaska variety and Exagone hybrid, as presented in Table 4.

Table 4. The influence of seeding distance between rows of plants branching rape. Average 2009-2012 (Moara Domneasca)

Cultivated variety / hybrid	Number of branches / plant											
	Seeding distance between rows (cm)											
	12.5			25.0			37.5			50.0		
	RP	RS	Average/pl	RP	RS	Average/pl	RP	RS	Average/pl	RP	RS	Average/pl
Alaska	4	28	31.0	5.1	32	37.1	5.7	38	43.7	6.1	40	46.1
Exagone	3.8	26	29.8	4.2	31	35.2	6.2	43	51.3	7.5	46	52.4
Media	3.9	27	30.4	4.65	31.5	36.5	5.95	39.5	47.45	6.8	43	49.25

RP-Main branch

RS-Secondary branch

Thus when sown at 12.5 cm between rows number of main branches is 3.9 and the secondary branches is 27, and when planted at 50 cm between rows, number of main branches was 6.8 and the secondary branches 43, with significant differences. In other words, the larger distance between rows (25.0 cm, 37.5 cm, and 50 cm), the higher number of ramification, the number of pods will be higher, and the production will be bigger.

*Influence of seeding distance between rows on the number of pods/plant, their length and number of grains in pods.* An important objective of the research was the influence of seeding distance between rows on the number of pods / plant and their length. The results are presented in Tables 5, 6 and 7.

The analysis of the results on the number of pods / plant highlights that the sowing distance has a great influence on the number of pods / plant, both in Alaska variety and especially in

Exagone hybrid. Thus, when sown at 12.5 cm between rows, pods average number per plant was 26 in Alaska and 28 in Exagone, and when sown at 50 cm, pods average number per plant was 66 in Alaska variety and 76 in Exagone hybrid. Very suggestive are the differences in Figure 3.

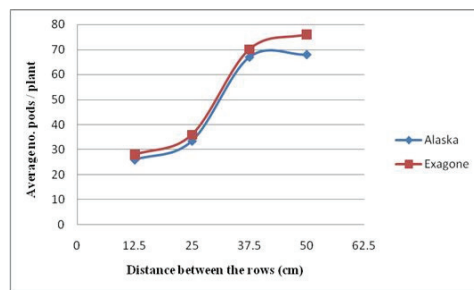


Figure 3. Influence of distance between rows on the number of pods / plant

Table 5. The influence of sowing distance between rows on the number of pods of the winter rapeseed plants. Average 2009-2012 (Moara Domneasca)

Cultivated variety / hybrid	Pods number / plant											
	Sowing distance between rows (cm)											
	12.5			25.0			37.5			50.0		
	RP	RS	Medie/pl	RP	RS	Medie/pl	RP	RS	Medie/pl	RP	RS	Medie/pl
Alaska	5.5	8	26	11	14	33.5	12	16	67	15	20	68
Exagone	8	10	28	12	15	36	14	18	70	21	24	76
Average	6.75	9	27	11.5	14.5	34.75	13	17	68.5	18	22	72

RP-Main branch

RS-Secondary branch

Table 6. The influence of sowing distance between rows on the pods

Cultivated variety / hybrid	Pods length (cm)											
	Sowing distance between rows (cm)											
	12.5			25.0			37.5			50.0		
	RP	RS	Total	RP	RS	Total	RP	RS	Total	RP	RS	Total
Alaska	4.65	4.7	4.67	5.01	5.36	5.18	5.31	5.78	5.54	5.46	6.1	5.78
Exagone	3.85	4.2	4.02	5.17	6.01	6.15	5.94	6.25	6.10	6.11	6.26	6.12
Average	4.25	4.45	4.35	5.09	5.68	5.66	5.62	6.01	5.82	5.78	6.18	6.0

RP-Main branch

RS-Secondary branch

Table 7. The influence of sowing distance between rows on the average number of grains in the pod in Alaska variety and Exagone hybrid. Average 2009-2012 (Moara Domneasca)

Cultivated variety / hybrid	Average number of grains in pods											
	Sowing distance between rows (cm)											
	12.5			25.0			37.5			50.0		
	RP	RS	Total	RP	RS	Total	RP	RS	Total	RP	RS	Total
Alaska	16.8	15.7	16.25	16.6	14.3	15.45	16.8	13.4	15.1	17.3	17.1	17.2
Exagone	15.7	14.3	15.0	16.4	17.8	17.5	21.6	19.2	19.85	19.5	19.7	19.7
Average	16.25	15.0	15.6	16.5	16.05	16.41	20.7	16.45	17.47	18.4	18.4	18.45

We say that, after three years of research, the winter rapeseed has the largest number of pods/plant when sown at larger distances between rows (25 cm, 37.5 cm and 50 cm).

The results of research on pods' length and number of grains in pods are presented in Table 6. The values obtained in the three-year research clearly shows that sowing distance

between rows has a big influence on pods' length and the number of grains in pods.

Thus, for the Alaska variety, when sown at 12.5 cm distance between rows, the pods' average length was 4.65 cm, with an average number of grains in pod of 16.25, and when sown at 50 cm between rows, the pods' average length was 5.88 cm and the average number of grains was 17.2 / pod.

For Exagone hybrid, when sown at 12.5 cm between rows, the pods' average length was 4.02 with an average number of 15.0 grains / pod and when it was planted at 50 cm between rows, the pods' length was an average of 6.12 cm with an average number of 19.7 grains / pod. In other words, the sowing distance between rows is larger (25.0 cm, 37.5 cm and 50 cm) and the length of pods and number of grains per pod is higher.

This statement is supported by higher nutrition space and all the other factors of vegetation of rapeseed are improved when sowing distances between rows are larger.

An important studied parameter was related to the size and weight of seeds / plant, depending on the seeding distance between rows. Values obtained on grain weight per plant and MMB are shown in Table 8, Figures 4,5 and 6.

*Influence of sowing distance between rows on plant density, grain weight/plant and TWK.*

Table 8. The influence of sowing distance between rows on plant density at harvest, grain weight / plant and TWK. Average 2009-2012 (Moara Domneasca)

Cultivated variety / hybrid	Density of plants				Grain weight/plante (g/pl)				TWK			
	Sowing distance between rows (cm)											
	12.5	25.0	37.5	50.0	12.5	25.0	37.5	50.0	12.5	25.0	37.5	50.0
Alaska	65.0	60.0	52.0	58.0	3.9	5.2	5.8	6.4	3.5	4.8	5.7	6.0
Exagone	60.5	56.5	54.4	50.4	4.7	5.7	6.4	6.9	4.2	5.95	6.9	7.1

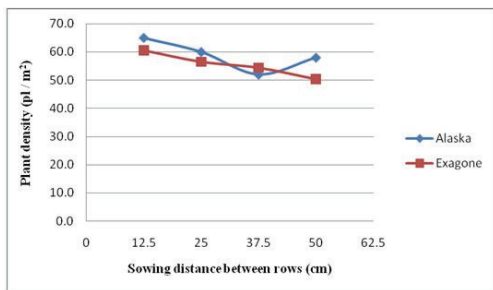


Figure 4. Influence of seeding distance between rows on plants density

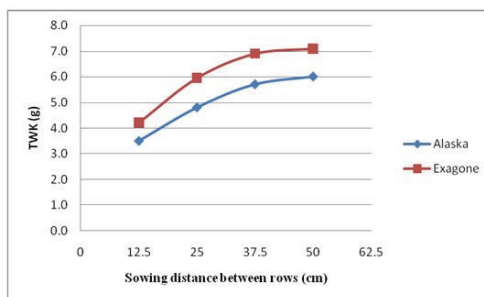


Figure 6. Influence of seeding distance between rows on MMB

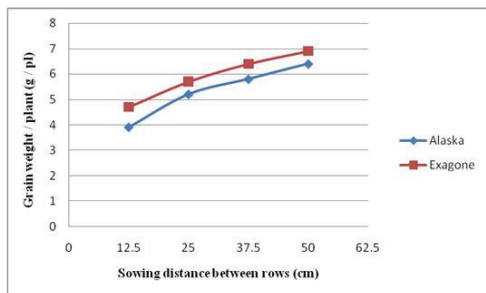


Figure 5. Influence of seeding distance between rows on the grain weight / plant

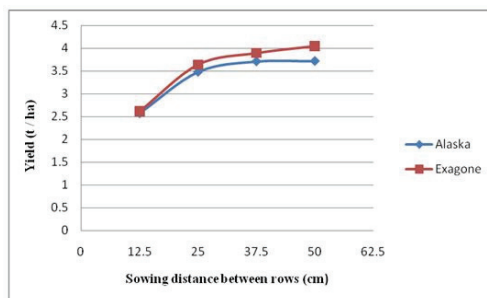


Figure 7. Influence of seeding distance between rows on yield

Production results, obtained in the three years of experimentation, highlight the importance of seeding distance between rows of winter rapeseed (Table 9).

Table 9. The influence of sowing distance between rows of winter rape production. Average 2009-2012 (Moara Domneasca)

Cultivated variety / hybrid	Yield (kg/ha)											
	Distance between rows (cm)											
	12.5		25.0		37.5		50.0		12.5		50.0	
						Dif (kg/ha)	Semnif	Dif (kg/ha)	Semnif	Dif (kg/ha)	Semnif	
Alaska	2570	3481	3712	3719	Mt	911	*	1142	***	1149	***	
Exagone	2610	3641	3896	4050	Mt	1031	**	1286	***	1440	***	
DL 1% = 875 kg/ha							DL 0.1% = 1090 kg/ha					

Analysis of the obtained production results highlight the following:

- for the Alaska variety, when sown at 12.5 cm distance between rows, the obtained production was 2570 kg/ha, and when sown at 50 cm distance between rows, the obtained production was 3719 kg/ha, with a difference of 1149 kg/ha.
- for the Exagone hybrid, when sown at 12.5 cm distance between rows, the obtained

production was 2610 kg/ha, and when sown at 50 cm between rows, the obtained production was 4050 kg/ha, with a most significant difference of 1440 kg/ha. We can thus draw a conclusion, which is that larger sowing distances between rows, can bring significant gain production to both varieties and especially for the rapeseed hybrids.

## CONCLUSIONS

The researches carried on at Moara Domneasca Didactic Farm during the period 2009-2012 regarding the influence of the sowing distance between the rows for the autumn rape crop allowed us to formulate the following conclusions adapted for southern part of Romania.

The sowing distance between the rows of 12.5 cm can be successfully used for all cultures no matter their branching potential. For the hybrids cultivated in the Southern part of the country, the distance of 12.5 cm is not recommended. Sowing distances of 25 cm; 37.5 cm and 50 cm can be used.

The usage of sowing distances between the rows of 25cm; 37.5 cm and 50 cm can be successfully made in all the farms where the weed control technology is well implemented.

The best plants density values, number of pods / plants, the height of the pods, the weight of the grains and MMB were obtained for the hybrid Exagone for sowing distances of 25 cm; 37.5 cm and 50 cm between the rows.

The influence of the sowing distances between the rows is very important for the new types and hybrids of rape cultivated in the Southern

part of Romania, on condition that this culture is sown in the optimal period, it emerges in due time; so that by the first frost a heat constant of  $\Sigma = 550-700^{\circ}\text{C}$  utile grades is achieved, thing that leads to a good resistance of the rape culture for the winter period.

## REFERENCES

- Băltesanu Gh., 2011. Fitotehnie vol 2, Ed. Ceres, București.
- Borcean I. și colab., 1995. Cultura plantelor de câmp, Ed. de Vest.
- Budoș Gh., Penescu A., 1992. Agrotehnică, Ed. Ceres, București.
- Buzdugan L. 2011. Teză de doctorat „Cultura rapiței de toamnă în zona Insulei Mari a Brăilei”.
- Picu I., Tianu Al. 1983. Aspecte privind cultura rapiței de toamnă pentru ulei, Revista Cereale și Plante Tehnice, no 8.
- Pop I. 1985. Influența unor elemente tehnologice asupra producției de rapiță de toamnă, INCDA Fundulea, vol LII.
- Roman Gh.V., 2012. Fitotehnie, vol. 2, Ed. Universală, București.
- Sândoiu D.I., și colab. 2008. Stabilirea influenței soiului/hibridului, a distanței între rânduri și a eficienței erbicidelor asupra producției de rapiță pe preluvosolul roșcat din Câmpia Română, Lucrări științifice, vol LI, Seria A, București.
- Sin Gh. și colab., 2007. Tehnologia culturilor agricole, Ed. Ceres, București.