ANALYSIS OF THE INFLUENCE OF SOME DOSES OF POTASSIUM AND NITROGEN ON NO. OF BRANCHES/PL. AND ON THE NUMBER OF PODS/PL. ON THE ARHITECT RAPESEED HYBRID CROPED IN THE S-E AREA OF ROMANIA

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Abstract

In the south-eastern area of Romania, the Arhitect rapeseed hybrid was tested, in order to determine its adaptability to the pedo-climatic conditions specific to this geographical area. In the present study, there were studied the influence of potassium and nitrogen on characters such as no. of branches./pl. and no. of pods/pl. Thus, related to no. of branches/pl., only a very high dose of potassium and, respectively, doses of 100 and 150 kg N a.s./ha. value significantly influence this character. Related to the number of pods/plant, this character is influenced significantly in value especially by the increase in the nitrogen dose and less by the potassium dose.

Also related to the variation of the correlation coefficient between the no. of brnches/pl. and of no. of pods/plant depending on the with potassium and nitrogen fertilizing level, the highest values of this index were calculated especially for the highest doses of nitrogen.

Key words**: **rapeseed, branches/plant, pods/plant

INTRODUCTION

Autumn rapeseed has become a particularly important plant due to its seeds containing 42-49% oil, used for various purposes, starting with human nutrition, biodiesel, up to the chemical industry.

At the same time, thanks to the success of breeding programs carried out over the last 25 years, researchers have managed to increase the percentage of polyunsaturated fatty acids, such as linoleic acid and linolenic acid from 15% to 20% and from 8% to 12% respectively (Trautwein, 1997; Trautwein and Erbersdobler, 2007).

Apart from the multiple uses of the extracted oil, the autumn rapeseed offers growers a series of agrophytotechnical advantages (Zamfirescu et al., 1965; Bîlteanu, 2003; Aglae Mogârzan, 2004; Halmajan, 2006; Ștefan, 2009; Buzdugan, 2011), namely:

• sow and harvest outside crowded campaigns;

• excellent precursor for autumn cereals due to the fact that it is harvested early (June-July);

• due to the early harvest, rape leaves enough time, in the irrigated southern areas, for double crops (corn for grains or soybeans) (Picu, 1984, cited by Bîlteanu, 2001);

• makes very good use of sloping lands, having an anti-erosion action similar to natural meadows (Berca, 2008; Buzdugan, 2011);

• reacts well to fertilization (Halmajan, 2006).

In addition, in biological agriculture, rapeseed infusion (leaves and roots) is used to combat moniliosis in apricot and plum by spraying at flowering (Iacomi Beatice, 1998, cited by Cernea, 2008).

In the conditions of southern Romania, on a chernozem soil, without irrigation, factors like nitrogen fertilization doses, phosphorus fertilization doses and sowing density were experimented on 2 isogenic lines of wheat, by Păniță O. et al., 2023 mention that concerning the trend models between Nitrogen doses and wheat yield, all the models are mathematically correct, what differs is the regression coefficient. This is

higher under phosphorus fertilization and on high sowing density.

However, rapeseed also has some shortcomings that must be taken into account: first of all, the insecurity of yield, caused by the poor resistance to wintering, to the attack of numerous pests, the uneven emergence when it is sown in dry soil, as well as the losses due to shaking in the less delay in harvesting.

It is not recommended to be grown after soybeans and sunflowers due to common diseases. Rapeseed can return to the same land after 3 years, and in the case of the attack of the pathogen Sclerotinia sclerotiorum after 7-8 years (Bîlteanu, 2003; Ștefan, 2003; Halmajan, 2006).

The general objective of the present study was to optimize the conditions of nutrition and fertilization in autumn rapeseed on the typical calcareous, loamy-sandy castanosium, so that the cultivated hybrid (Architect – Limagrain) capitalizes with higher yields, in the pedo-climatic conditions specific to the area, its genetic potential, by creating a complex and integrated fertilization system.

Other pursued objectives referred to:

• Highlighting the doses of nitrogen and potassium with the greatest impact on biological potential.

• Verification of the yield capacity of the Arhitect hybrid in the pedo-climatic conditions of the Central-Northern Plateau area of Dobrogea, Cerna-Mircea Vodă Depression, Cerna commune, Tulcea county, under the action of applying different doses of nitrogen and potassium.

• Formulation of recommendations to farmers in the central-northern area of Dobrogea, respectively in the research area, in order to use the most effective fertilization schemes for the rapeseed crop, so that they have vigorous crops, able to cope with stress factors biotic and abiotic.

MATERIALS AND METHODS

The biological material was represented by the Arhitect-Limagrain hybrid, which is characterized by excellent branching capacity, superior resistance to silique shaking and very good winter resistance. It also has a very good start when the vegetation resumes in the spring. This hybrid has a very good adaptability to the different climate conditions in Romania, achieving large and stable productions from one ecological zone to another.

The experimented factors were nitrogen dose and potassium dose, respectively.

Factor A – Dose of potassium (K_2O) with three graduations:

a_1 - K_2O 0

a_2 - K_2O 50

a_3 - K_2O 100

Factor B: Nitrogen dose (N) with five graduations:

b_1 - N 0

b_2 -N 16

b_3 -N 50

b_4 -N 100

b_5 -N 150

The experience was located in an experimental plot on Ulmului Vally, in Tulcea county, in 2021-2023 the period, according to the method of subdivided plots with 2 factors, 15 variants x 3 repetitions. The dimensions of the experimental plots were 35 m^2, 3.5 m wide (15 rows) and 10 m long.

The determinations were made on a number of 5 plants from each variant/repetition. At maturity, the plants were harvested individually on each plot, the number of branches/plant, the number of pods/plant, the number of grains/silique were determined and the resulting samples were weighed.

As a result of the influence of the solification factors, soils were formed in the experimental area that have a brown Am horizon (soft) as a diagnosis, with chromes and values higher than 3.5 in the wet state and lower than 5.5 in the dry state, followed by a sub-horizon, which shows, at least in the upper part, mollic horizon colors (lighter brown) both at the surface and within the structural aggregates.

The climate in the research area is one with pronounced aridity, accentuated by the low level of precipitation (approx. 380 mm annually).

The aridity is also accentuated by the intensity of solar radiation, which here reaches the highest values in the country, namely 400÷500 Kj/cm^2.
The multiannual average temperature is 11.3^{o}C, the absolute minimum was -26.8^{0}C, and the absolute maximum was 39.8^{0}C.
From the point of view of statistical processing, there were calculated the Perason's coefficients correlation between nitrogen doses and seed yield according to the potash soil reserve. The regression coefficents were also calculated between the two variables, as well.
The significance of the differences was estimated by LSD tests at the p equal 0.05, 0.01 and 0.001 conffidence level. The correlation coefficients between the analyzed characters were also calculated, their significance being determined by Pearson values.

RESULTS AND DISCUSSIONS

Related to no. of branches/pl., the results obtained on castaneous in the experimental area showed that on average over three years (2021-2023) the number of branches/plant can be influenced by the fertilization system in which potassium plays a well-defined role.
Thus, due to the application of potassium, the number of branches/plant increased compared to the control (K_2O – 0 kg/ha) by 0.54 when 50 kg K_2O/ha were used and by 0.95 when 100 kg were applied K_2O/ha (Table 1).

Table 1. The influence of factor A (potassium dose) to branches number/plant for Arhitect rapeseed hybrid (average 2021-2023)

A Factor (Potassium dose)	Branches no./pl.	±d	Relative values	Statistical significance
a_1- K_2O_0	5.57	-	100.00	
a_2- K_2O_{50}	6.11	0.54	109.69	
a_3- K_2O_{100}	6.52	0.95	11706	*
Average	6.066			
LSD 5% = 0.745 branches/pl.; LSD 1% = 1.125 branches/pl.; LSD 0.1% = 1.326 branches/pl.				

In the case of nitrogen fertilization, it was observed that when low doses of nitrogen were applied (N - 16 kg/ha and N - 50 kg/ha) no significant value increases of character were recorded, instead when used increased doses of nitrogen (100 – 150 kg N/ha), this character increased significantly in value by 0.84, respectively by 1.26 (significantly distinct) compared to the control without nitrogen (N-0 kg/ha) (Table 2).

Table 2. The influence of factor B (nitrogen dose) to branches number/plant for for Arhitect rapeseed hybrid (average 2023-2023)

B Factor (Nitrogen dose)	Branches no./pl.	±d	Relative values	Statistical significance
b_1-N_0	5.51	-	100.00	
b_2-N_{16}	5.67	0.16	102.90	
b_3-N_{50}	6.06	0.55	109.98	
b_4-N_{100}	6.34	0.83	115.12	**
b_5-N_{150}	6.75	1.24	122.50	***
Average	6.07			
LSD 5% = 0.575 branches/pl.; LSD 1% = 0.802 branches/pl.; LSD 0.1% = 1.155 branches/pl.				

The results regarding the influence of the potassium and nitrogen dose interaction on the number of branches/plant, recorded on average over three years (2021-2023) on the castanium in the area of Dobrogea, are presented in table 3.
In the experimental conditions, the potassium dose x nitrogen dose interaction determined, compared to the control (N – 0 kg/ha), positive differences on all nitrogen fertilizer trails fields. Thus, on the no potassium fertilizer trials fields (K_2O – 0 kg/ha) statistically ensured increases in the number of branches/plant were observed when 100 kg N/ha (significant) and 150 kg N/ha (distinct significant).
It was observed that the application of the dose of 100 kg N/ha brought to both the potassium soil fertilizer base with 50 kg K_2O/ha and the one with 100 kg K_2O/ha a statistically ensured increase in the number of branches (Table 3).
The nitrogen dose of 150 kg/ha caused an increase in the number of branches/plant, statistically assured as highly significant. Basically, the potassium dose x nitrogen dose interaction can positively influence this character when increased doses of fertilizers are applied.
At the establishment of yield performance and their correlation with some quality characteristics in some mutant or

recombinant wheat lines, Pănișă, O., et al., 2020, stated that applying of fertilization during growing is essential for optimal plant development and nitrogen (N) fertilization is, in particular, important for common wheat, because a high N supply provides high protein content.

Table 3. The influence of the interaction potassium dose x nitrogen dose to branches number/plant for Arhitect rapeseed hybrid (average 2021-2023)

Analyzed factors		Branches no./pl.	±d	Relative values	Statistical significance
A (Potassium dose)	B (Nitrogen dose)				
a_1- K_2O_0	b_1-N_0	5.12	-	100.00	
	b_2-N_{16}	5.17	0.05	100.98	
	b_3-N_{50}	5.65	0.53	110.35	
	b_4-N_{100}	5.71	0.59	111.52	*
	b_5-N_{150}	6.20	1.08	121.09	**
a_2- K_2O_{50}	b_1-N_0	5.55	-	100.00	
	b_2-N_{16}	5.74	0.19	103.42	
	b_3-N_{50}	5.98	0.43	107.75	
	b_4-N_{100}	6.37	0.82	114.77	*
	b_5-N_{150}	6.90	1.35	124.32	**
a_3- K_2O_{100}	b_1-N_0	5.85	-	100.00	
	b_2-N_{16}	6.10	0.25	104.27	
	b_3-N_{50}	6.55	0.7	111.97	
	b_4-N_{100}	6.95	1.1	118.80	**
	b_5-N_{150}	7.15	1.3	122.22	***
Media		6.066			
LSD 5% = 0.585 branches/pl.; LSD 1% = 0.988 branches/pl.; LSD 0.1% = 1.275 branches/pl.					

Regarding the influence of the nitrogen x potassium dose interaction, on all potassium soil fertilizer base, the application of potassium determined the development of this character.

Table 4. The influence of the interaction *nitrogen dose* x *potassium dose* to branches no./pl. for Arhitect rapeseed hybrid (average 2021-2023)

Analyzed factors		Branches no./pl.	±d	Relative values	Statistical significance
A (Potassium dose)	B (Nitrogen dose)				
b_1-N_0	a_1- K_2O_0	5.12	-	100.00	
	a_2- K_2O_{50}	5.55	0.43	108.40	
	a_3- K_2O_{100}	5.85	0.73	114.26	*
b_2-N_{16}	a_1- K_2O_0	5.17	-	100.00	
	a_2- K_2O_{50}	5.74	0.57	111.03	
	a_3- K_2O_{100}	6.1	0.93	117.99	*
b_3-N_{50}	a_1- K_2O_0	5.65	-	100.00	
	a_2- K_2O_{50}	5.98	0.33	105.84	
	a_3- K_2O_{100}	6.55	0.90	115.93	*
b_4-N_{100}	a_1- K_2O_0	5.71	-	100.00	
	a_2- K_2O_{50}	6.37	0.66	111.56	*
	a_3- K_2O_{100}	6.95	1.24	121.72	**
b_5-N_{150}	a_1- K_2O_0	6.2	-	100.00	
	a_2- K_2O_{50}	6.9	0.7	111.29	*
	a_3- K_2O_{100}	7.15	0.95	115.32	**
Average		6.066			
LSD 5% = 0.648 branches/pl.; LSD 1% = 0.950 branches/pl.; LSD 0.1% = 1.26 branches/pl.					

Compared to the control (K_2O–0 kg/ha) only the application of the dose of 100 kg K_2O/ha determined an increase in the number of branches/plant statistically ensured (Table 4). In general, it can be stated that the application of potassium under the conditions of fertilization with all five doses of nitrogen had a positive impact on the development of this character.

Related to the no. of pods/plant, the results obtained on average over three years (2021-2023) showed that both nitrogen and potassium have a positive impact on the number of pods/plant.

It was observed that compared to the number of pods/plant recorded in the control variant without potassium fertilization (K_2O – 0 kg/ha), the application of 50 kg K_2O kg/ha determined an increase in the number of pods/plant by more than 10 pods, difference statistically uncertain. When the dose of potassium applied was doubled (K_2O – 100 kg/ha) the number of pods/plant increased by 37,276 pods compared to the control, the value being considered statistically significant. Practically, the fertilization level K_2O – 100 kg/ha determined the highest desolation of this character (Table 5).

Table 5. The influence of factor A (potassium dose) to pods number/plant for Arhitect rapeseed hybrid (average 2021-2023)

A Factor (Potassium dose)	No. of pods/plant	±d	Relative values	Statistical significance
a_1- K_2O_0	146.298	-	100.00	
a_2- K_2O_{50}	157.248	10.95	107.485	
a_3- K_2O_{100}	183.574	37.276	125.479	*
Average	162.37			
LSD 5% = 16.52 pods/pl.; LSD 1% = 42.381 pods/pl.; LSD 0.1% = 75.451 pods/pl.				

Depending on the graduations applied, the experimental factor nitrogen dose also determined increases in the number of pods/plant compared to the control without nitrogen (N – 0 kg/ha), results presented in table 6.

On average over three years, compared to the control, the increases in the number of pods/plant due to differentiated fertilization with nitrogen were between 14.53 (N16) – 50.55 (N_{150}) pods/plant, increases statistically ensured as significant when it was applied 50 kg N/ha, distinctly significant at the dose of 100 kg N/ha and very significant when 150 kg N/ha were used.

The highest increase in the number of pods/plant (50.55) was recorded at the dose of 150 kg N/ha, an increase of 36.97% compared to the control.

Table 6. The influence of factor B (nitrogen dose) to pods number/plant for Arhitect rapeseed hybrid (average 2021-2023)

B Factor (Nitrogen dose)	No. of pods/plant	±d	Relative values	Statistical significance
b_1-N_0	136.73	-	100.00	
b_2-N_{16}	151.26	14.53	110.63	
b_3-N_{50}	161.99	25.26	118.47	*
b_4-N_{100}	174.61	37.88	127.70	**
b_5-N_{150}	187.28	50.55	136.97	***
Average	162.37			
LSD 5% = 16.47 pods/pl.; LSD 1% = 26.16 pods/pl.; LSD 0.1% = 47.62 pods/pl.				

The results regarding the influence of the potassium x nitrogen dose interaction on the number of pods/plant are presented in table 7.

On average, over three years (2021-2023) it was observed that on all three potassium soil fertilizer base the application of nitrogen caused increases in the number of pods/plant, the highest number of pods/plant (215.47 siliques) being recorded in the version fertilized with $K_{100}N_{150}$.

Table 7. The influence of the interaction *potassium dose* x *nitrogen dose* to pods number/plant for Arhitect rapeseed hybrid (average 2021-2023)

Analyzed factors		No. of pods/plant	±d	Relative values	Statistical significance
A (Potassium dose)	B (Nitrogen dose)				
a_1- K_2O_0	b_1-N_0	126.48	-	100.00	
	b_2-N_{16}	138.74	12.26	109.69	
	b_3-N_{50}	145.11	18.63	114.73	*
	b_4-N_{100}	155.64	29.16	123.06	**
	b_5-N_{150}	165.52	39.04	130.87	***
a_2- K_2O_{50}	b_1-N_0	131.21	-	100.00	
	b_2-N_{16}	147.80	16.59	112.64	*
	b_3-N_{50}	155.74	24.53	118.70	*
	b_4-N_{100}	170.64	39.43	130.05	***
	b_5-N_{150}	180.85	49.64	137.83	***
a_3- K_2O_{100}	b_1-N_0	152.5	-	100.00	
	b_2-N_{16}	167.25	14.75	109.67	*
	b_3-N_{50}	185.11	32.61	121.38	**
	b_4-N_{100}	197.54	45.04	129.53	***
	b_5-N_{150}	215.47	62.97	141.29	***
Average		162.37			
LSD 5% = 14.281 pods/pl.; LSD 1% = 25.410 pods/pl.; LSD 0.1% = 33.421 pods/pl.					

On the no potassium fertilizer trials fields, the differentiated application of nitrogen determined increases in the number of siliques/plant that varied between 12.26 and 39.04 siliques, the positive differences recorded compared to the control being statistically ensured starting from the dose of 50 kg N/ha.

On the potassium soil fertilizer base with 50 kg K_2O/ha, the differentiated application of nitrogen determined increases in the number of siliques/plant statistically ensured for all doses of nitrogen compared to the variant without nitrogen, the values recorded in the variants fertilized with 100 and 150 kg N a.s./ha being very significant compared to the value recorded in the variant without fertilization without nitrogen, the same situation being found in the case of the values recorded in the variants on the potassium soil fertilizer base with 100 kg/ha K_2O a.s.

Regarding the influence of the interaction nitrogen x potassium dose on the number of siliques/plant, it was observed that on all nitrogen soil fertilizer base the application of potassium determined value increases of this character, the highest increase with 215.47 siliques/plant registering when 100 kg K_2O/ha were applied to a soil fertilizer base with 150 kg N/ha, this value being statistically assured as very significant (Table 8).

Table 8. The influence of the interaction *nitrogen dose* x *potassium dose* to pods number/plant for Arhitect rapeseed hybrid (average 2021-2023)

Analyzed factors		No. of pods/plant	±d	Relative values	Statistical significance
B (Nitrogen dose)	A (Potassium dose)				
b_1-N_0	a_1- K_2O_0	126.48	-	100.00	
	a_2- K_2O_{50}	131.21	4.73	103.74	
	a_3- K_2O_{100}	152.5	26.02	120.57	**
b_2-N_{16}	a_1- K_2O_0	138.74	-	100.00	
	a_2- K_2O_{50}	147.8	9.06	106.53	
	a_3- K_2O_{100}	167.25	28.51	120.55	**
b_3-N_{50}	a_1- K_2O_0	145.11	-	100.00	
	a_2- K_2O_{50}	155.74	10.63	107.33	*
	a_3- K_2O_{100}	185.11	40	127.57	**
b_4-N_{100}	a_1- K_2O_0	155.64	-	100.00	
	a_2- K_2O_{50}	170.64	15	109.64	**
	a_3- K_2O_{100}	197.54	41.9	126.92	***
b_5-N_{150}	a_1- K_2O_0	165.52	-	100.00	
	a_2- K_2O_{50}	180.85	15.33	109.26	**
	a_3- K_2O_{100}	215.47	49.95	130.18	***
Average		162.37			
LSD 5% = 10.52 pods/pl.; LSD 1% = 19.65 pods/pl.; LSD 0.1% = 28.56 pods/pl.					

Related to the variation of the correlation coefficients between the no. of branches/pl. and no. of pods/plant depending on the soil

fertilizer base with potassium and nitrogen, from table 9 it can be seen that the value of the correlation coefficients increases with the dose of nitrogen and less with the increase of the dose of potassium, the highest values being observed at high fences of the two analyzed factors.

Table 9. The variation of the correlation coefficients between the no. of branches/pl. and no. of pods/ plant depending on the soil fertilizer base with potassium and nitrogen for Arhitect rapeseed hybrid

	b_1-N_0	b_2-N_{16}	b_3-N_{50}	b_4-N_{100}	b_5-N_{150}
a_1- K_2O_0	0.425^{ns}	0.452^{ns}	0.508^{ns}	0.525^{ns}	0.748**
a_2- K_2O_{50}	0.498^{ns}	0.501^{ns}	0.518^{ns}	0.656*	0.709*
a_3- K_2O_{100}	0.524^{ns}	0.512^{ns}	0.556*	0.707**	0.801***

P 5%=0.532; P 1%=0.661; P 0.1%=0.780.

CONCLUSIONS

Related to no. of branches/pl., the results showed that the number of branches/plant can be influenced by the fertilization system in which potassium plays a well-defined role. In the case of nitrogen fertilization, it was observed that when low doses of nitrogen were applied no significant value increases of character were recorded, instead when used increased doses of nitrogen (100 – 150 kg N/ha), this character increased significantly in value by 0.84, respectively by 1.26 (significantly distinct) compared to the control without nitrogen (N-0 kg/ha)

Related to no. of pods/plant, the results obtained on average over three years (2021-2023) on the castanozone in the central area of Dobrogea, where the experiment was carried out, showed that both nitrogen, but especially potassium, have a positive impact on the number of pods/plant. Also, the application of the dose of 100 kg K_2O/ha also determined an increase of 19.21 siliques/plant compared to the average of the experiment (158.79 siliques/plant), which translates into relative values as an increase of 12.09%. Regarding the influence of the interaction nitrogen dose x potassium dose on the number of siliques/plant, it was observed that on all nitrogen soil fertilizer base the application of potassium caused increases in this yield structure, the highest increase with 49.30 siliques/plant (30 .87%) being recorded when 100 kg K_2O/ha were applied to a soil fertilizer base with 150 kg N/ha, this value being statistically assured as very significant.

Related to the variation of the correlation coefficient between the no. of branches/pl. and no. of plant siliques depending on the potassium and nitrogen soil fertilizer base, the value of the correlation coefficients increases with the dose of nitrogen and less with the increase of the dose of potassium.

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