THE INFLUENCE OF SOME NITROGEN AND POTASSIUM FERTILIZER RATES ON OILSEED WINTER RAPE YIELD AND SOME QUALITY INDICATORS ON A KASTANOZEM

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A***bstract:*** *Within 2008-2011 period there have been carried out experiments on typical kastanezem from Central Norther Plateau of Dobrogea with oilseed winter rape crop including two experimental factors:- the A factor, the potassium fertilizer rate with two graduations: a1=K_0; a2=K_{50}; a3=K_{110};- the B factor, the nitrogen fertilizer rate with five graduations: b1 = N_0; b2 = N_{16}; b3 = N_{50}; b4 = N_{100}; b5 = N_{150}. From the combination of these two factors there resulted 15 variants. The yields obtained, on average, during three years of experimentation (2008-2011) have indicated the fact that the oilseed winter rape recorded very good feedback to nitrogen fertilization and the applying of potassium strenghtened the nitrogen influence by helping developing a good root system that capitalise the nitrogen much better. This way, on K_{100} fertilizer background the yield outputs have been statistically proven with N_{100} (1,362 kg/ha), respectivelly, N_{150} (1,875 kg/ha), the yield increase being of 37.59%. The applying of potassium has determined significant outputs of the oil content of the yield per hectare with K_{100}, this increase being of 24.03%. It has increased from 40.75% with K0 to 42.01% with K100. The nitrogen has negatively influenced the oil content, it decreased from 42.71% to 40.75%. The highest value of the hectolitrical mass and the mass of a thousand grains have been reported with $K_{100}N_{150}$ rate (67.41 kg/hl and, respectivelly, 3.62 g). The applying of a high rate of potassium (K_{100}), on average during three years of experimentation has decreased the protein content from 23.62% to 22.88%, yet the differentiated applying of nitrogen (N_{100}-N_{150}) has determined the increase of this parameter from 21.78% to 25.37%. This way, on K 50 and K100 fertilizer background the protein content has increased as compared with the control treatment without nitrogen by 1.06 – 16.47% and, respectively, by 0.88 – 14.74%. Statistically, there were recorded differences when 50 and 100 kg N/ha were applied.*

Key words**:** *oilseed rape, kastanozem, potassium, nitrogen, protein content oil content*

INTRODUCTION

Taking account that energy production at global scale generates over 60% of greenhouse gases that are considered the main cause of climatic change, there is considered that one of the most rationale solution is the substitution of the fosil fuels by vegetal fuels – biodiesel.

At the end of March 2011 the EU has presented the strategy of transport „Transport 2050" that assume that in 2020 Europe' s biodiesel consumption to reach 20% and in 2050 to replace totally the fosil fuels. Nowadays, EU is world leader in biodiesel production, with 9.5 million tones in 2010 and in 2016 will reach 37.5 million tones.

Biodiesel demand is continually increasing and the most important raw matter for this fuel is oilseed rape oil. In these conditions the pressure on the obtaining high yields of oilseed rape must determine scientifically preoccupation related with the genetical progress of the new cultivars yet by technology optimization where the fertilizer use takes an important role.

Although oilseed rape is considered a culture with risk because of clime sensitivity as drought from seeding time, strong frosts during winter and high temperature during ripening time, in the last 10-15 years this crop became a very attractive crop in Romania, due its ecological adaptability and, especially, due to steady incomes (Bâlteanu, 2006).

MATERIAL AND METHODS

In order to identify and scientifically prove some principles and methods of rationale and efficient use of fertilizers based on nitrogen and potassium with winter oilseed rape in the conditions of soil and clime of Central-Northern zone of Dobrogea, we have carried out an experiment in commune Cerna, County Tulcea, in period 2008-2011.

The soil where the experiment was located is a typical kastanozem cu the following soil profile:Amk-A/C, CK-Cca with the following features:

- the texture is silty – sandy with a clay content of 15.9-18.9% in the upper horizons 63.9-65.4% fine sand and 16.4-18.9% loam;
- the bulk density is of 1.25 g/cm^3 and the total porousity 50-54%;
- the wilting point, the water field capacity and the available water capacity are between 5-9%, 19-25% and 15-19%;
- the soil reaction is low alkaline (pH=8.1);
- it is low supplied by nitrogen (N% = 1.8 and IN = 0.92) and well supplied by phosphorus and potassium (67 ppm P and 217 ppm K).

The clime of this zone is pronounced arid with around 445 mm annual rainfall. As regard climatically conditions the 2008-2009 agricultural year has been not favorable, the 2009-2010 has been low favorable for oilseed rape crop.

The biological material was the Triangle KWS hybrid that is a semi-late hybrid.

Within this experiment there has been studied the following two researching factors:

- A factor: potassium rate with three graduations, a1=K0, a2=K50, a3=K100;
- B factor: nitrogen rate with 5 graduations, b1=N0, b2=N16, b3=N50, b4=N100, b5=N150.

After combining these two factors there resulted 15 treatments.

RESULTS AND DISCUSSIONS

1. The oilseed rape on average during three years of experiment (2008-2011) in function of the studied factors

The influence of A factor (potassium rate)

In function of the potassium rate the yield on average during three years of experimentation is presented in table 1

Table 1

The influence of A factor (potassium rate) on seed yield, kg/ha (average 2008-2011)

A factor, K rate	The yield, kg/ha	Difference, kg/ha	Relative yield, %	Signification
a1 = 0 kg K2O/ha	1,843	-	100.00	
a2= 50 kg K2O/ha	2,048	205	111.12	
a3= 100 kg K2O/ha	2,214	371	120.13	*
Average	2,035			
DL 5%=290 kg/ha; DL 1%=445 kg/ha; DL 0,1% = 617 kg/ha				

The applying of potassium in different rates contributes to the obtaining of yield outputs of 205 kg/ha with K50 rate and 371 kg/ha with K100 rate (significant).

The influence of the B factor (nitrogen rate)

On average, during three years of experimentation the applying of nitrogen has determined levels of yield that have varied from 1,323 kg/ha with N0 to 3,019 kg/ha with N150 (table 2).

In comparison with the control treatment (N0), when there were applied 100 kg N/ha the yield has increased to 1,200 kg/ha and when there were applied 150 kg N/ha the increasing has been of 1,694 kg/ha; these yield increases have been very significant statistically.

Table 2

The influence of A factor (potassium rate) on seed yield, kg/ha (average 2008-2011)

A factor, K rate	The yield, kg/ha	Difference, kg/ha	Relative yield, %	Signification
b1=N0 kg/ha	1,323	-	100.00	
b2=N0 kg/ha	1,513	190	114.36	
b3=N0 kg/ha	1,797	474	135.83	*
b4=N0 kg/ha	2,523	1,200	190.70	***
b5=N0 kg/ha	3,019	1,696	228.19	***
Average	2,035			
DL 5%=334 kg/ha; DL 1%=542 kg/ha; DL 0,1% = 835 kg/ha				

The influence of the interaction between potassium and nitrogen

On the K50 background the nitrogen applying has determined significant yield outputs only with N100 and N150 rates (1,746 kg/ha). On the K100 fertilizer background there were only recorded significant yield outputs with N100 (1,362 kg/ha) and, respectively, N150 (1,875 kg/ha); this thing was confirmed in other papers, e.g. Foster (1977) and Berglund (2007).

Table 3

The influence of the interaction between potassium and nitrogen (average 2008-2011)

Studied factors		Yield, kg/ha	Difference, kg/ha	Relative yield, %	Signification
A (K rate)	B(N rate)				
a1 = K0	b1-N0	1,249	-	100.00	
	b2-N16	1,389	140	111.21	
	b3-N50	1,614	365	129.22	
	b4-N100	2,244	995	179.66	**
	b5-N150	2,718	1,469	207.61	***
a2 = K50	b1-N0	1,317	-	100.00	
	b2-N16	1,493	176	113.36	
	b3-N50	1,809	492	137.36	
	b4-N100	2,560	1,243	194.38	***
	b5-N150	3,063	1,746	232.57	***
a3=K100	b1-N0	1,402	-	100.00	
	b2-N16	1,658	256	118.26	
	b3-N50	1,967	565	140.30	
	b4-N100	2,764	1,362	197.15	***
	b5-N150	3,277	1,875	233.74	***
DL 5%=625 kg/ha; DL 1%=978 kg/ha; DL 0,1% = 1,123 kg/ha					

The oil content of the seeds

It is a quantitative important parameter of the oilseed rape seeds that influence, along with the seed yield the oil production on the surface unit.

The results obtained within 2008-2011 period on the kastanozem from Northern Dobrogea have shown the facte that in the conditions of the experimentation place, the oil content (%) of the oilseed rape seeds of Triangle hybrid has been significantly influenced by nitrogen and potassium fertilization as well as by their interaction.

In the case of potassium fertilization the highest oil content was recorded when K100 rate was applied (42.01%) over 40.75% with K0.

Nitrogen fertilization has had a negative impact on the oil content of the seeds, on average during three years of experimentation. The value of this parameter has decreased from 42.75 with N0 to 41.13 with N150 (table 4) (Yusuf and Bullock, 1993).

Table 4

The influence of several potassium and nitrogen rates and their interaction on the oil content of oilseed rape seeds (average 2008-2011)

Studied factors	Oil content, %	Difference, %	Relative content, %	Signification
a1 = K0	40.75		100.00	
a2= K50	41.53	0.78	101.91	
a3= K100	42.01	1.26	109.69	*
b1-N0	42.75	-	100.00	
b2-N16	42.07	-0.68	98.41	
b3-N50	41.52	-1.23	97.12	0
b4-N100	40.67	-2.08	95.13	000
b5-N150	41.13	-2.62	93.87	000
Interaction K0N0	42.34	-	100.00	
K0N16	41.48	-0.86	97.97	
K0N50	40.78	-1.56	96.32	0
K0N100	39.88	-2.46	94.19	000
K0N150	39.28	-3.06	92.77	000
Interaction K50N0	42.81	-	100.00	
K50N16	42.18	-0.63	98.53	
K50N50	41.62	-1.11	97.22	0
K50N100	40.79	-2.02	95.28	000
K50N150	40.25	-2.56	94.02	000
Interaction K100N0	43.10	-	100.00	
K100N16	42.56	-0.54	98.75	
K100N50	42.16	-0.94	97.82	
K100N100	41.35	-1.75	95.94	00
K100N150	40.86	-2.24	94.80	000
DL 5%=0.989 kg/ha; DL 1%=1.383 kg/ha; DL 0,1% = 1.814 kg/ha				

Analyzing the interaction between potassium and nitrogen there can be noticed that on all backgrounds of potassium the oil quantity has decreased along with the increasing of the nitrogen rate.

The lowest decreasing of the oil content has been recorded with K100 background being comprised between 1.25 and 5.2 %. Significant differences were recorded when 100 kg/ha nitrogen rate was applied (distinctively significant negative) and 150 kg/ha nitrogen (very significant negative), so, the increasing of the potassium rate diminishes the negative effect of the nitrogen on the oil content of the seeds.

The protein content

The protein is another qualitative indicator of the oilseed rape seeds, especially of nitrogen fertilization (Foster, 1977; Holmes, 1980; Yousheng, 1991).

As regard the potassium influence on the protein content of oilseed rape seeds, the results obtained during three years of experimentation (2008-2011) have indicated that the applying of an increased rate of potassium (K100) can conduct to the diminishing of the protein content, and that confirms the researches made by other researchers (Foster, 1997; Holmes, 1980). This way, the protein content has decreased from 23.62% (K0) to 22.88% with K100.

The nitrogen rate ranging from N0 to N150 have determined the increasing of the protein content from 21.78% to 25.37%.

The interaction between potassium and nitrogen has emphasized that the protein content of the seeds increases along with the increasing of the nitrogen rate with all potassium backgrounds.

This way, on K50 and K100 backgrounds, the protein content has increased over the control treatment without nitrogen with 1.06-16.47% and, respectively, with 0.88-14.74. Statistically significant differences have been recorded when there were applied N50 (significant positive), N100 (distinctively positive significant) and N150 (very significant positive) (table 5).

Table 5

The influence of several potassium and nitrogen rates and their influence on the protein content from oilseed rape seeds (average 2008-2011)

Studied factors	Protein content, %	Difference, %	Relative content, %	Signification
a1 = K0	23.62	-	100.00	
a2= K50	23.16	-0.46	98.05	
a3= K100	22.88	-0.74	96.87	*
b1-N0	21.78	-	100.00	
b2-N16	22.02	0.24	101.10	
b3-N50	22.13	1.15	104.13	**
b4-N100	24.01	2.23	104.71	***
b5-N150	25.37	3.59	105.66	***
Interaction K0N0	21.9	-	100.00	
K0N16	22.26	0.30	101.37	
K0N50	23.36	1.40	106.38	*
K0N100	24.54	2.58	111.75	***
K0N150	25.98	4.02	118.31	***
Interaction K50N0	21.73	-	-	
K50N16	21.96	0.23	101.6	
K50N50	22.87	1.14	105,25	*
K50N100	23.95	2.22	110.22	***
K50N150	25.31	3.58	116.47	***
Interaction K100N0	21.64	-	100.00	
K100N16	21.83	0.19	100.88	
K100N50	22.56	0.92	104.25	*
K100N100	23.53	1.89	108.73	**
K100N150	24.83	3.19	114.74	***

CONCLUSIONS

The using of different potassium rates (K50-K100) with the winter oilseed rape on the kastanozem from the Central – Northern part of Dobrogea has contributed to the obtaining of yield outputs of 205-371 kg/ha on average during three years of experimentation (2008-2011).

The using of nitrogen in rates of N16, N50, N100 and N150 has determined much higher yield outputs than potassium rates, from 190 to 1,696 kg/ha; the nitrogen applied alone has given higher outputs than potassium.

The interaction between potassium and nitrogen has increased the yield more than potassium alone or nitrogen alone. The highest yields were obtained with K50N150 rates = 3,063 kg/ha and K100N150=3,277 kg/ha.

The oil content has been positively influenced by potassium rates from 40.75% with K0 to 42.01% with K100 and negatively by nitrogen ones, from 42.75 % with N0 to 40.67% with N100.

The protein content from oilseed rape seeds has been positively influenced by nitrogen fertilizer from 21.70 with N0 to 25.37% with N150 and negatively by potassium rates. The interaction potassium – nitrogen has contributed to the increasing of the protein content only when nitrogen rate increased and the potassium rate decreased.

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