RESULTS REGARDING THE EFFECT OF PHOSPHORUS AND NITROGEN ON RAPE YIELD

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Abstract. *The role of long-term experience with different fertilizers is to highlight the relationships established between them, yield formation and changes that occur in the soil. Two types of factors contribute to these objectives: pedoclimatic factors and technological ones.Among the technological factors, fertilization is a key element in shaping the quality and quantity of the crop and soil.This paper aims to analyze the influence of different doses of nitrogen- and phosphorus-based fertilizers on rape yield, between 2014 – 2016.The studies were performed in stationary experiences placed in a four years rotation: soybean – wheat – rape–corn.*

Keywords*: fertilization, rape, Nitrogen (N), Phosphorus (P)*

INTRODUCTION

The importance of winter rape has increased considerably in recent years due to the fact that it provides the raw material for the production of oil, which is an unconventional alternative to the sources of fossil energy and in achieving higher quality oils, used in human nutrition and not only (BUZDUGAN, 2010).

High demand for winter rape,the high yields and income achieved per hectare, the high profitability of culture have made the area occupied by this culture to be in continual growth in increasingly diverse areas (SAICU, 2013).

Scientific studies have shown that rape reacts very well both to organic and mineral fertilization, as well as a combination of the two (PAL AND GANGAWAR, 2004; RÎȘNOVEANU AND BUZDUGAN , 2011, SAICU, 2013).

Mineral fertilization is considered by most experts to be the main technological key in the culture of rape (SAICU, 2013). Studies have also shown that it is in first place among the factors on whichthe production and qualitydepend, and implicitly,it affects the economic efficiency of the rape crop (LĂNISTE, 2004, SAICU, 2013).

MATERIAL AND METHODS

The experiment was located on the land of ARDS Lovrin on a semicarbonatic, weakly-glezated chernozem, between 2014 and 2016. The previous plant was winter wheat.

The plots hada dimension of 36 m^2, seeded at a distance of 25 cm between rows and a density of 50 plants/m^2.

Phosphorus-based fertilizers (superphosphate 46%) and those with potassium (potassium salt 60%) were administered during the base plowing. The nitrogen (ammonium nitrate 33.5%) was applied fractionated: one-third of the dose during sowing and the other two thirds in the spring, after the resumption of the vegetation period.

Data was statistically analyzed using the variance analysis procedure for two factors using a split plot design, with four replications.

Means were compared using the least significant difference test (CIULCA, 2006). The significance ofdifferenceswas expressedbased on symbols and letters, beingconsidered as significantasthe differences betweenvariantsmarked withdifferent letters.

RESULTS AND DISCUSSIONS

From a climate perspective, 2013-2016 period was characterized by temperatures near the multiannual average, with higher values in the autumn months (Figure 1).

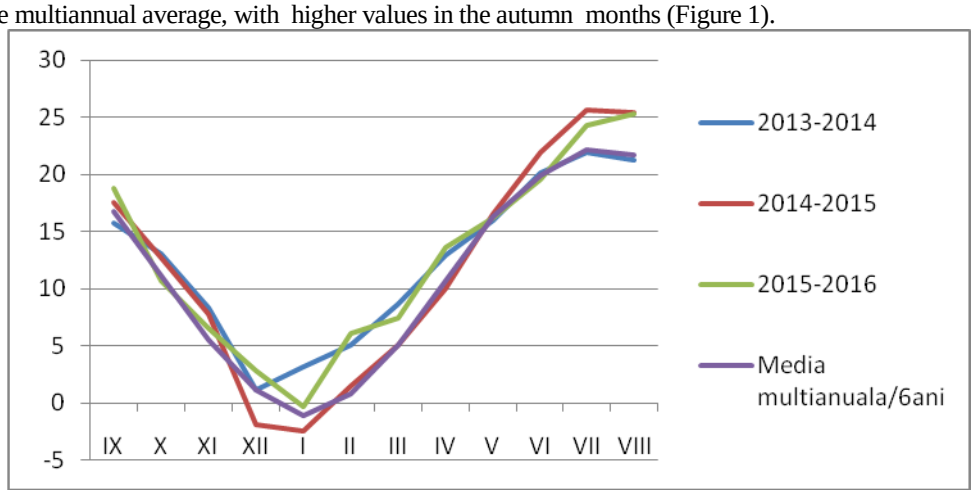

Fig . 1 The average temperature recorded at Lovrin, in the period 2013-2016

Rainfall in the period under review shows deviation from the mean. The 2013 – 2014 agricultural year recorded a deficit of rainfall, and the years 2014 - 2015 and 2015-2016 were in surplus in rainfall. (Fig 2).

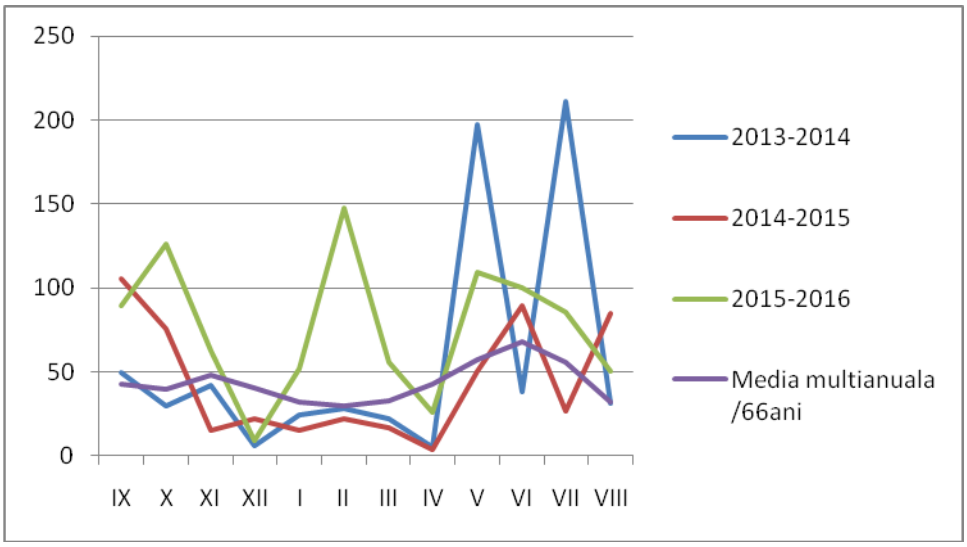

Fig.2 Lovrin rainfall registered during the period 2013-2016

However ,the three agricultural years have been satisfying for rape crops.

Considering the results of the analysis of variance (Table 1) it is noted that treatment with both phosphorus and nitrogen have had a real statistic influence ,based on the rapeseed hectolitre mass (HM), under an insignifiant influence of environmental conditions on this trait. The nitrogen had the highest contribution to the HM variability (41.36%), being significantly superior to the effect of phosphorus fertilization (8.26%).The interaction between the two treatments has also had a significant influence on said trait (4.63%), but considerably smaller effects than the separate effects.

Table 1

Analysis of variance for the effect of fertilization with phosphorus and nitrogen on rape yield

Source of variation	SS	DF	MS	F
Total	21797973	99		
Replications	1018510	3	339503	3.17
Phosphorus (P)	1414357	4	353589	3.31*
Error P	1283433	12	106953	
Nitrogen (N)	7683418	4	1920855	16.56**
P x N	3436745	16	214797	1.85*
Error N	6961510	60	116025	

Phosphorus treatments showed a low variability of 3.55%, at an amplitude of 319 kg/ha, ranging from 3127 kg / ha in the unfertilized variant, to 3446 kg/ha for the 160 kg dose. Compared with the unfertilized plot, treatment with phosphorus resulted in production increases from 4.7% for the P_0 variant to 10.2% for P_{160}, but only in the latter case the difference was statistically proven.

An additional fertilization with doses above 40 kg/ha took a more noticeable effect only for the P_{160} variant, associated with a production increase of 172 kg/ha .Further increasing the dose from 120 to 160 resulted in a production increase by 116 kg/ha.

Table 2

The effect of fertilization with phosphorus on rape yield

Phosphorus doses (kg)	Yield (kg/ha)		Relative value (%)	Difference/ Significance
P40 – P0	3274	3127	104.70	147
P80 – P0	3349	3127	107.10	222
P120 – P0	3330	3127	106.49	203
P160 – P0	3446	3127	110.20	319**
P80 – P40	3349	3274	102.29	75
P120 – P40	3330	3274	101.71	56
P160 – P40	3446	3274	105.25	172
P120 – P80	3330	3349	99.43	-19
P160 – P80	3446	3349	102.90	97
P160 – P120	3446	3330	103.48	116

$LSD_{5\%}$=225 kg $LSD_{1\%}$=316 kg $LSD_{0,1\%}$=447 kg

Regarding the effect of unilateral fertilization with nitrogen (Table 3), the production presented a variation of amplitude of 751 kg/ha, with values ranging from 2867 kg/ha for the

unfertilized variant to 3618 kg/ha in the case of variant N_{200}, under the conditions of a variability of 9.38%, higher than the phosphorus treatment.

Applying different nitrogen treatments resulted in significant increases of production, proportional to the dosage. Compared to the unfertilized variant, values of these increases are between 9.8% for N_{50} and 26.19% for N_{200} .In the variant with N_{50}, increasing the dose of nitrogen with 100-150 kg, resulted in a significant increase of 13.4% to 14.9% in production. Compared to the N_{100} treatment, applying additional quantities of 50-100 kg N/ha generated a significant increase in production of246-295 kg/ha. Increasing the dosage of nitrogen from 150 to 200 kg/ha ha had little effect on the production.

Table 3

The effect of fertilization with nitrogen on rape yield

Nitrogen doses (kg)	Yield (kg/ha)		Relative value (%)	Difference/ Significance
N50 – N0	3148	2867	109.80	281*
N100 – N0	3323	2867	115.91	456***
N150 – N0	3569	2867	124.49	702***
N200 – N0	3618	2867	126.19	751***
N100 – N50	3323	3148	105.56	175
N150 – N50	3569	3148	113.37	421***
N200 – N50	3618	3148	114.93	470***
N150 – N100	3569	3323	107.40	246*
N200 – N100	3618	3323	108.88	295**
N200 – N150	3618	3569	101.37	49

$LSD_{5\%}$=215 kg $LSD_{1\%}$=287 kg $LSD_{0,1\%}$=373 kg

On the basis of the interaction between fertilization and treatments applied (Table 4),it is noticeable that, for the N_{100} and N_{200} variants, the phosphorus fertilization showed little effects on production. The biggest influence on the production of the phosphorus treatment was observed on the plot not fertilized with nitrogen, where the application of phosphorus doses from 40 to 160 kg/ha allowed a significant increase in production, compared to the P_0 variant. In the N_{150} variant,160 kg phosphorus fertilization has generated a significant increase in production – 20.6% compared to the unfertilized variant.

Table 4

The effect of fertilization with phosphorus and nitrogen on rape yield

Phosphorus doses	Nitrogen doses					$\bar{x} \pm s_{\bar{x}}$	$S_{\%}$
	N0	**N50**	**N100**	**N150**	**N200**		
P0	y2562b	x3028ab	x3390a	x3266b	x3388a	3127±107	15.31
P40	x3111a	x3436a	x2980a	x3444ab	x3399a	3274±64	8.78
P80	y2700ab	x3365ab	x3399a	x3559ab	x3721a	3349±101	13.50
P120	y2922ab	y2894b	x3404a	x3638ab	x3792a	3330±118	15.86
P160	y3042a	y3016ab	xy3444a	x3939a	x3790a	3446±121	15.74
$\bar{x} \pm s_{\bar{x}}$	2867±114	3148±91	3323±70	3569±77	3618±70	3305±47	
$S_{\%}$	17.78	13.02	9.42	9.61	8.71	14.20	

Phosphorus - $LSD_{5\%}$=476 kg $LSD_{1\%}$=632 kg $LSD_{0,1\%}$=820 kg (a,b,c)
Nitrogen - $LSD_{5\%}$=482 kg $LSD_{1\%}$=641 kg $LSD_{0,1\%}$=833 kg (x,y.z)

In variant P_{40}, applying different nitrogen treatments did not significantly affect production. On the plots not fertilized with phosphorus, nitrogen treatments caused a significant increase in production, with increases ranging from 18% for N_{50} to 32% for N_{200}. In the P_{80} variant, nitrogen application has generated significant increases in production at 26-38%. In the case of the P_{120} plot,the effects of nitrogen treatment are reduced, so that only the dose of 100-200 kg/ha can be noted as a significant increase in production. On the P_{160}plot, nitrogen fertilization had a significant effect in production only at doses of 150-200 kg/ha.

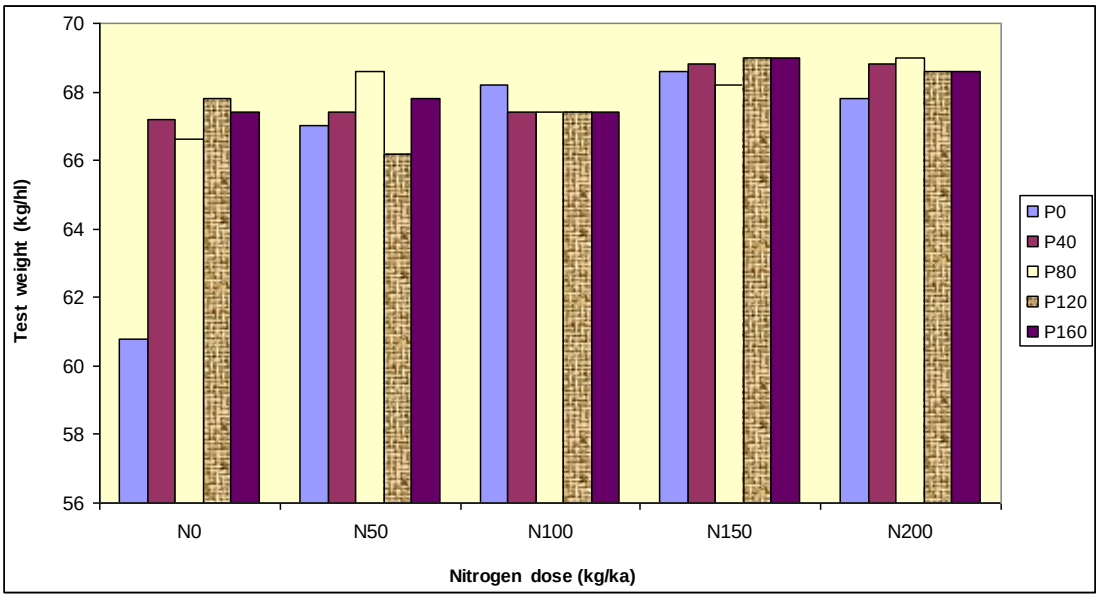

Fig. 3 The effect of fertilization with phosphorus and nitrogen on test weight for rape

Taking into account the results of Fig. 3, it can be summarised that phosphorus and nitrogen treatments have insignificant results on the MH of rapeseed. Phosphorous fertilization manifested the greatest influence on the plot not fertilized with nitrogen, with an MH increase of 9.5% – 11.5% for various dosages. On the plots previously treated with nitrogen, phosphotus had little to no effect on MH.

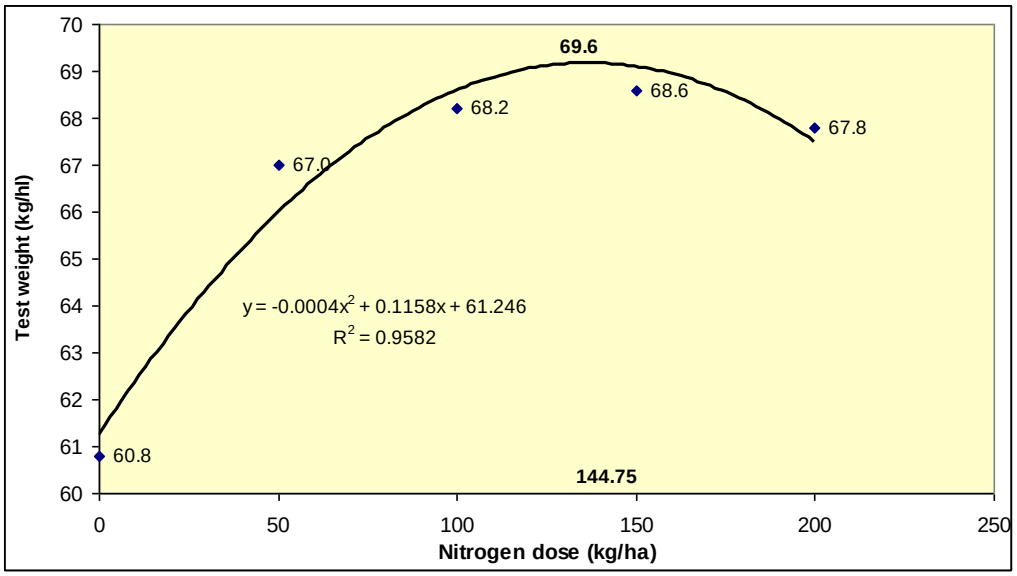

Fig. 5 The variation of test weight under different N doses on P0

Nitrogen treatment manifested a visible effect on the MHs only in the case of the plot not previously fertilized with phosphorus (Fig. 4). Thus, up to a dosage of 144.75 kg N/ha, the MH grows up to a maximum of 69.6 kg/hl, and for a greater dosage it decreases. The high precision of those estimates is based on the value of the determining coefficient R^2=0,958.

CONCLUSIONS

1. In the climatic conditions in which experiments were conducted, fertilization with nitrogen and phosphorus stimulated increased production of rapeseed, when the doses used were balanced;
2. Treatment with phosphorus and nitrogen had a realstatistic influence on the test weight of rapeseed;
3. Compared with the control variant, treatment with phosphorusled to an increase in production from 4.7% for P_{40} to 10.2% for variant P;
4. Unilateral nitrogen administration presented an amplitude of variation of 751 kg/ha, with values ranging from 2867 kg/ha for the unfertilized plot to 3618 kg/ha, in the case of the N_{200}variant;
5. Interaction between treatments applied, generated a significant production increase (20.6%), where the fertilizer background was N_{150} with 160 kg/ha phosphorus.

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