

*Milan BIBERDŽIĆ, Miodrag JELIĆ,
Branislav KNEŽEVIĆ, Saša BARAĆ, Dragana LALEVIĆ¹*

YIELD OF WHEAT IN PSEUDOGLEY IN DEPENDENCE OF FERTILISATION WITH MINERAL FERTILISERS, LIME FERTILISER AND MANURE

SUMMARY

The goal of this paper was to investigate the effect of numerous combinations of mineral, lime and manure fertilisers on wheat yield of two varieties (Pobeda and Kruna) grown on pseudogley. As mineral feeds NPK fertilisers were used, as lime fertiliser CaCO_3 , and manure as organic fertiliser.

Results of the investigation didn't show statistical significance in grain yield at any of investigated variants of wheat, no matter what variant of fertilisation was used. With the use of mineral fertilisers, yield was rising from the lowest to the highest dose. Using the combination of mineral and lime fertilisers, especially those with higher doses of mineral feeds, higher yield was achieved which was statistically significant compared with those achieved only with mineral fertilisers. Combination of a manure, mineral and lime fertilisers gave a bigger yield, which was statistically very significant, than using of only mineral fertilisers. Also, using of that combination, but with increased dose of mineral feeds, gave a bigger yield than a combination of mineral and lime fertilisers, on a statistically very significant level. The biggest yield (5120 kg ha^{-1}) gave variety Pobeda with using of combination of manure, mineral (with higher dose) and lime fertilisers. The lowest yield (2810 kg ha^{-1}) gave variety Kruna with using of the lowest dose of mineral fertiliser.

Keywords: wheat, pseudogley, fertilisers, yield.

INTRODUCTION

With appearance of new varieties of wheat, it turned out that their demands in mineral nutrition were considerably higher (Sarić and Kovačević, 1981). Yield of wheat mostly depends on weather conditions in critical phases of growth and development, cultivation practices (Blue et al., 1990), used doses of nitrogen (Fagan et al., 2006), as well as various combinations and ratios of NPK nutrients (Rehman et al., 2006; Ragasits et al., 2000). Sarić and Jocić (1993) emphasize that nitrogen, phosphorus and potassium are the most important, therefore is necessary to use them in certain quantity and ratio, mostly in all types of soils.

¹ Milan BIBERDŽIĆ, (corresponding author: mbiberdzic@gmail.com), Miodrag JELIĆ, Branislav KNEŽEVIĆ, Saša BARAĆ, Dragana LALEVIĆ, University in Prishtina, Faculty of Agriculture, Kopaonička bb, 38232 Lešak.

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The biggest role in increasing of yield in cultivated plants has the nitrogen (Malešević et al., 1994., Kastori et.al., 2005). The best effect nitrogen shows when is used together with phosphorus and potassium, while these two elements used without nitrogen, often decrease the yield (Sarić and Jocić, 1993).

In our country, acid soils are serious problem in plant production. They have bad water-air and physical-mechanical properties and therefore plant production is unstable. According to Aniola and Madea (1996) highest tolerance acid soils showed rye, then triticale and wheat, while the barley was most sensitive. Numerous researches in our country and abroad point out that adequate use of lime fertilizers along with mineral and manure fertilizers is most efficient way in preventing negative production properties in acid soils and have influence on yield increasing (Jovanović et al., 2006; Kovačević et al., 2006; Jelić et al., 2006). The goal of this paper was to investigate the effect of numerous combinations of mineral, lime and manure fertilizers in pseudogley on yield of two varieties wheat.

MATERIAL AND METHODS

The research was conducted in the vicinity of Kraljevo during the 2011-2013. The trial, in addition to two varieties of wheat (Pobeda and Kruna), included nine fertilization variants of different combinations. So there were three variants of only mineral fertilizers (V1-N70 P60 K60; V2-N120 P100 K100 i V3-N120 P120 K120), three variants of both mineral and lime fertilizers (V4-N70 P60 K60 + 2.5 t ha⁻¹ CaCO₃; V5-N120 P100 K100 + 2.5 t ha⁻¹ CaCO₃ i V6-N120 P120 K120 + 2.5 t ha⁻¹ CaCO₃), and finally three variants consisted of mineral, lime and manure fertilizers, together (V7-N70 P60 K60 + 5 t ha⁻¹ CaCO₃ + 20 t ha⁻¹ manure; V8-N120 P100 K100 + 5 t ha⁻¹ CaCO₃ + 20 t ha⁻¹ manure i V9-N120 P120 K120 + 5 t ha⁻¹ CaCO₃ + 20 t ha⁻¹ manure). Mineral fertilizers were represented with NPK fertilizer, lime with CaCO₃ and organic with manure.

The trial was set according to a block system in three repetitions. Before the basic land cultivation, mineral, lime and manure fertilizers were distributed on the soil surface, and then ploughed in. Other half of nitrogen fertilizer was used in top dressing in a form of ammoniacal nitrogen. Basic land cultivation was carried out in a classic way, on 25 cm depth. Sowing was carried out in October. Harvest was carried out in the phase of dead ripe, and yield was corrected on 14% of moisture. Results were presented as an average of two years experiment and analysed with ANOVA.

RESULTS AND DISCUSSION

Soil and climatic conditions

Soil at Kraljevo location belongs to the pseudogley soil type. This soil has very bad physical properties (compacted, having high content of silt and clay particles, with slow water percolation) and extremely acid pH value (pH<4.5). Its total humus content is relatively fair, but microbiological activity is low, because of its poor physical properties. That causes low mineralization of organic nitrogen, and so nitrogen fertilizers show a great effect on such soils. It is

characterized by low content of available phosphorus (6.70-6.90 mg/100g of soil) and potassium (7.80-9.80 mg/100g of soil). In table 1 are shown chemical properties of the soil.

Table 1. Chemical properties of the soil

Depth (cm)	pH		Humus	Available (mg/100g of soil)	
	H ₂ O	nKCl		P ₂ O ₅	K ₂ O
0-20	5.24	4.34	0.12	6.70	7.80
20-40	5.55	4.48	0.05	6.90	9.80

Table 2. Meteorological conditions during the conduct of an experiment (2011-2013)

Months	Average monthly temperature of air (°C)		Monthly sum of precipitation (mm)	
	2011/12	2012/13	2011/12	2012/13
X	10.4	13.7	30.4	56.7
XI	3.2	9.1	1.7	11.1
XII	3.3	0.4	63.7	97.6
I	-0.1	1.2	107.1	95.4
II	-4.2	1.9	54.9	48.7
III	8.8	8.4	24.5	56.7
IV	12.7	13.4	69.1	73.2
V	16.0	17.0	105.5	90.3
VI	23.1	24.4	17.8	13.8
Average Sum	8.1	9.9	474.7	553.5

Average monthly temperature of air, u 2011-12 were slightly lower, especially in January and February, compared with 2012-13. However, in both years, temperatures ranged as optimal and did not have a negative impact on yield. Higher precipitation and their better distribution were noted in the 2012/13 year, especially in October, November and December, which contributed to a better application and the decomposition of fertilizers applied.

Yield of wheat in pseudogley

Production of wheat on acid soils, as pseudogley, is quite unstable and unreliable. Therefore is necessary to get down to working on amelioration chemical properties on such soils, in order of achieving satisfactory yields. The following table presents the actual yield of two wheat varieties, depending on the mineral fertilize, lime and organic fertilizers and their combinations.

The results of the research (table 3) show that between varieties there were no statistically significant differences in grain yield, even with a different fertilizer rates. Both varieties, in all fertilization variants had significantly higher yield compared to the control. With application of mineral fertilizers, average

yield grew from the lowest to the highest dose, so that the variant V3 achieved significantly higher yields than the variant V1, while there was no significant difference between variants V1 and V2, and V2 and V3 respectively. By using a combination of lime and mineral fertilizers, especially those combinations with a higher doses of mineral fertilizers (variants V5 and V6), a higher average yield was achieved that was statistically significantly higher than the one achieved by using only mineral fertilizers.

Table 3. Wheat yield depending on the mineral fertilizer, lime and organic fertilizers

A. Variants of fertilizing	B. Varieties		Average A
	Pobeda	Kruna	
K- control	1582	1420	1501
V1-N70 P60 K60	2870	2810	2840
V2-N120 P100 K100	3130	3059	3095
V3-N120 P120 K120	3390	3300	3345
V4-N70 P60 K60 + 2.5 t ha ⁻¹ CaCO ₃	3290	3370	3330
V5-N120 P100 K100 + 2.5 t ha ⁻¹ CaCO ₃	4220	4340	4280
V6-N120 P120 K120 + 2.5 t ha ⁻¹ CaCO ₃	4450	4170	4310
V7-N70 P60 K60+5 t ha ⁻¹ CaCO ₃ +20 t ha ⁻¹ manure	4480	4330	4405
V8-N120 P100 K100+5 t ha ⁻¹ CaCO ₃ +20 t ha ⁻¹ man.	4790	4710	4750
V9-N120 P120 K120+5 t ha ⁻¹ CaCO ₃ +20 t ha ⁻¹ man.	5120	4770	4945
Average B	3732.2	3627.9	
LSD	A	B	A x B
5 %	480.7	510.3	620.4
1 %	650.9	670.5	798.6

Combination of mineral, lime and organic fertilizers, recorded a higher average yield that was statistically significantly higher than the one achieved by using only mineral fertilizers. Also, with using of this combination, but with an increased dose of mineral fertilizers (especially phosphorus and potassium), there has been achieved a significantly higher yield than using a combination of lime and mineral fertilizers. The highest average yield (4945 kg ha⁻¹) was achieved in the variant V9 and it was significantly higher compared to all other variants except variant V8. The highest yield (5120 kg ha⁻¹) was achieved with the variety Pobeda, using a combination of mineral fertilizers (with higher doses), limestone (higher dose) and manure. The lowest yield (2810 kg ha⁻¹) was recorded in the variety Kruna, using the lowest dose of mineral fertilizers (variant V1). In all variants, where comes to increasing doses of nitrogen, there is also an increase in yield, which once again points to the importance of this element in plant nutrition. However, it is interesting to emphasize, that the application of increased doses of phosphorus, while at the same nitrogen content, lime and manure, there is an increase in the yield of wheat. This effect phosphorus particularly manifest in acid soils.

Positive effect of increased doses of phosphorus fertilizer on grain yield of wheat were given earlier by other authors (Jelić et al., 1998; Jovanović et al., 2006; Kovačević et al., 2006).

Numerous previous studies have shown that the in acid soils, full use of NPK, lime fertilizer and manure has a positive effect on grain yield (Ognjanović et al., 1994; Jelić et al., 1995; Jelić et al., 2004), of which are in compliance and our results.

The average yield of wheat achieved with using of mineral fertilizers was 3093 kg ha⁻¹, with using a combination of mineral and lime fertilizers 3973 kg ha⁻¹, and with using of a combination of mineral fertilizer, lime and manure, the yield was 4700 kg ha⁻¹ (Figure 1). This is one more example of the necessary application of lime and organic fertilizers on acid soils.

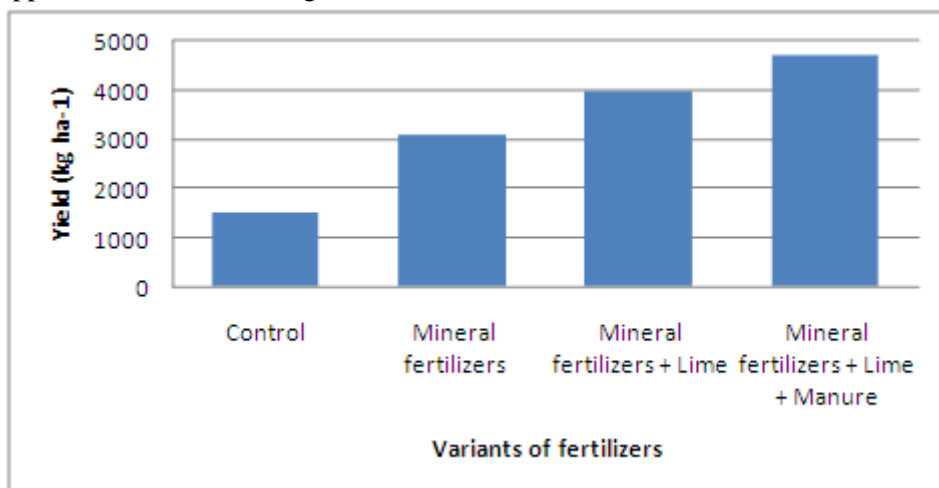


Figure 1. Wheat yield expressed in kg ha⁻¹ depending on the mineral fertilizer, lime and organic fertilizers

CONCLUSIONS

On the basis of studying the influence of mineral, lime and organic fertilizers and varieties on grain yield of wheat, it can be concluded that:

Between varieties there were no statistically significant differences in grain yield, even with different fertilizer variants. With the application of mineral fertilizers, the average yield grew from the lowest to the highest dose.

By using a combination of lime and mineral fertilizers, especially those combinations with a higher doses of mineral fertilizers (variants V5 and V6), a higher average yield was achieved that was statistically significantly higher than the one achieved by using only mineral fertilizers.

Combination of mineral, lime and organic fertilizers, recorded a higher average yield that was statistically very significantly higher than the one achieved by using only mineral fertilizers. Combination of mineral, lime and organic fertilizers, but with an increased dose of mineral fertilizers (especially

phosphorus and potassium), there has been achieved a significantly higher yield than using a combination of lime and mineral fertilizers.

The highest yield (5120 kg ha⁻¹) was achieved with the variety Pobeda, using a combination of mineral fertilizers with higher doses), limestone (higher dose) and manure. The lowest yield (2810 kg ha⁻¹) was recorded in the variety Kruna, using the lowest dose of mineral fertilizers (variant V1). The average yield of wheat achieved with using of mineral fertilizers was 3093 kg ha⁻¹, with using a combination of mineral and lime fertilizers 3973 kg ha⁻¹, and with using of a combination of mineral fertilizer, lime and manure, the yield was 4700 kg ha⁻¹.

These results point out on the necessity of application of lime and organic fertilizers on acid soils.

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