

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Improving The Nutrition Of Non-Traditional Leguminous Crops For The Conditions Of The Central Ciscaucasia.

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ABSTRACT

The results of experiments on the study of the responsiveness of wintering peas and varieties of lentils to various doses of mineral fertilizers are presented. It was established that a significant increase (0.19-0.80 t / ha) of wintering pea yields relative to the control was ensured by the use of types and combinations of fertilizers: P₆₀, N₆₀P₆₀ and N₆₀P₆₀K₆₀. By analyzing the quality of the obtained grain of wintering pea grains, it was found that the use of mineral fertilizers contributed to a reliable (0.5-2.3%) increase in the protein content in the grain relative to the control on variants N₆₀, N₆₀P₆₀, N₆₀K₆₀ and N₆₀P₆₀K₆₀. The maximum (22.3%) protein content in the grain from the experimental plots was observed against the background of the dose of N₆₀P₆₀. Regarding the productivity of varieties of lentils, it was recorded that at the estimated dose of fertilizer N₂₅P₄₅K₁₈, on average, by experience, there was a significant increase in yield relative to the control and the dose of P₄₀K₃₀, respectively, by 0.68 and 0.22 t / ha. Of the varieties of lentils under consideration, on average, in nutritional backgrounds, the highest yield (1.86 t / ha) was observed in the Vekhovskaya variety, which was significantly higher than the Kanadskaya variety by 0.41 t / ha. When analyzing the quality of the harvest, it was established that the use of fertilizers contributed to a significant increase in the concentration of protein in the grain relative to the control by 0.89-1.06%. The estimated dose of fertilizer increased the protein content in lentils, but the difference was within the experimental error.

Keywords: plant nutrition, legumes, yield, grain quality, Stavropol Territory.

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INTRODUCTION

In the food industry of many countries of the world, leguminous crops serve as the main source of vegetable protein, and therefore the technology of their cultivation is becoming increasingly important [1, 2]. The practice of agriculture indicates a high degree of responsiveness of leguminous crops to the application of moderate doses of mineral fertilizers. At the same time, if large doses of organic and mineral fertilizers were applied to the field, the wintering peas and lentils form a large above-ground mass, which contributes to the uneven ripening of the grain, while the seed yield usually decreases [3,4,5,6 7,8,9]. Growing wintering peas and lentils when using mineral fertilizers in the conditions of the Stavropol Territory is poorly studied, since these crops were not previously in demand.

Research objective: optimization of nutrition of leguminous crops (wintering peas and lentils) in the conditions of the Central Ciscaucasia.

MATERIAL AND METHODS

Experiments with wintering peas were carried out from 2009 to 2012, with varieties of lentils from 2014 to 2016. Both experiments were established on the territory of the experimental station of the Stavropol State Agrarian University. The soil of the experimental plot is represented by leached chernozem, powerful, low-humus heavy loamy, with an average supply of humus (5.1-5.4%), as well as an average supply of basic macronutrients: nitrate nitrogen (N-NO₃) - 16-30 mg / kg, mobile phosphorus (P₂O₅) - 20-25 mg / kg and exchangeable potassium (K₂O) - 220-270 mg / kg. The reaction of the soil solution in the topsoil is neutral, the pH varies between 6.1 and 6.5. The land use of the experimental station, according to the conditions of moisture supply, belongs to the third agroclimatic area.

The object of research was the so-called non-traditional Stavropol conditions for legumes, which at the same time have a rather high value in the food and processing industry: wintering peas (Phaeton variety) and lentils (Vekhovskaya and Kanadskaya varieties). According to the developed research methodology, the responsiveness of these crops to various types and combinations of mineral fertilizers was studied. In order to optimize the food system against the background of control, the following options were studied on wintering pea crops: N₆₀, P₆₀, K₆₀, N₆₀P₆₀, P₆₀K₆₀P₆₀K₆₀ and N₆₀P₆₀K₆₀. On lentil crops on the background of the control without fertilizers, two doses of mineral fertilizers were studied: P₄₀K₃₀ recommended for this zone and calculated - N₂₅P₄₅K₁₈, for a planned crop yield of 2.0 t / ha (according to the method of V.V. Ageyev).

The repetition of the experiments is 4-fold, the placement of the plots is multi-tiered, the repetitions are continuous. The area of the plot in the experiment with wintering peas was 36 m², with varieties of lentils - 45 m². The main observations and surveys were carried out in the main phases of plant development.

Yield accounting was carried out by direct combining with subsequent recalculation to standard humidity and purity by the method of GSI (1991). Analysis of grain quality - accounting for protein content - according to GOST 10846-86.

RESULTS AND DISCUSSION

It was established that the level of productivity and the quality of the obtained grain depended significantly on the weather conditions of the period of the experiment. Thus, in the experience of optimizing the nutrition of wintering peas, the favorable moisture regime that developed in 2011 contributed to an increase in the level of crop productivity relative to the similar indicators of the other years of research, on average, by experience, by 0.22–0.88 t / ha.

Mathematical processing of the data obtained on average over the study period indicates that among the options analyzed in the experiment, the highest yield was obtained against the background of applying a full dose of fertilizer - 2.62 t / ha, which significantly exceeded the same indicator of control and the rest of the nutritional backgrounds by 0, 27-0.82 t / ha. It should be noted that in the variant with doses of P₆₀ and N₆₀P₆₀ fertilizers, the yield significantly exceeded the same indicator of control by 0.19-0.53 t / ha. The maximum yield of wintering peas was obtained against the background of a full dose of fertilizers in 2011 and amounted to 3.03 t / ha (Table 1).

Table 1: Yield (t / ha) of wintering pea grains depending on the species and combination of mineral fertilizers on leached chernozem

Variant	Years of research			On average for 2010-2012.
	2010	2011	2012	
control	1,84	2,07	1,54	1,82
N ₆₀	1,95	2,29	1,41	1,88
P ₆₀	1,99	2,21	1,82	2,01
K ₆₀	1,80	2,15	1,46	1,80
N ₆₀ P ₆₀	2,34	2,78	1,93	2,35
N ₆₀ K ₆₀	1,93	2,38	1,50	1,94
P ₆₀ K ₆₀	1,97	2,31	1,67	1,98
N ₆₀ P ₆₀ K ₆₀	2,67	3,03	2,15	2,62
HCP ₀₅	0,08	0,15	0,14	0,17
Sx, %	4,2	4,8	3,8	4,0

Along with the level of yield of legumes, the biochemical composition of the obtained grain is essential. Based on the results of the laboratory assessment of the quality of the obtained grain, it can be stated that a significant increase in the protein content relative to the control in the experiment was noted on variants N₆₀, N₆₀P₆₀, N₆₀K₆₀ and N₆₀P₆₀K₆₀, where the increase was 0.5-2.3%. It should be noted here that the maximum protein concentration in the grain was noted against the background of N₆₀P₆₀, where the indicator significantly exceeded the control and the rest of the fertilized variants by 2.3 and 0.5-2.8%, respectively (Table 2).

According to the content of carbohydrates in the grain, a somewhat different picture was observed in the experiment. The use of phosphorus-containing species and combinations of fertilizers contributed to a significant increase in the concentration of carbohydrates in the wintering pea grains relative to the control. So, on variants P₆₀, N₆₀P₆₀ and N₆₀P₆₀K₆₀ a significant increase in the content of carbohydrates in the wintering pea grains relative to the control by 7.0-14.0% was noted. The maximum content was noted against the background of a full dose of fertilizers, significantly exceeding the results of the control and other options in the experiment by 14.0 and 4.0-18.0%, respectively.

Analysis of data on the study of the effects of doses of mineral fertilizers on the yield and quality of grain of lentil varieties showed that the highest level of crop productivity, regardless of the choice of variety, was obtained in the most favorable conditions for moisture supply in 2016.

Table 2: Effect of species and combination of mineral fertilizers on the biochemical composition of wintering pea grains on leached chernozem, 2009-2012.

Variant	Content in seeds, %	
	protein	carbohydrate
control	20,0	40,0
N ₆₀	20,6	36,0
P ₆₀	20,1	47,0
K ₆₀	19,5	42,0
N ₆₀ P ₆₀	22,3	50,0
N ₆₀ K ₆₀	20,5	40,0
P ₆₀ K ₆₀	20,0	46,0
N ₆₀ P ₆₀ K ₆₀	21,8	54,0
HCP	0,50	3,5
Sx, %	3,1	4,2

It was established that the use of mineral fertilizers provided a reliable increase in the yield of varieties of lentils relative to the control, on average, by experience by 0.46-0.68 t / ha. It should be noted that, against the background of the estimated dose of fertilizers N₂₅P₄₅K₁₈, the maximum yield was noted, which significantly exceeded the same indicator of the control and variant P₄₀K₃₀ by 0.68 and 0.22 t / ha, respectively (Table 3).

Table 3: Yield (t / ha) of lentil varieties depending on the doses of mineral fertilizers, on average for 2014-2016

Variety, A	Fertilizer dose, B			A, HCP ₀₅ =0,28
	control	P ₄₀ K ₃₀	N ₂₅ P ₄₅ K ₁₈	
Vekhovskaya	1,43	1,98	2,17	1,86
Kanadskaya	1,12	1,50	1,74	1,45
B, HCP ₀₅ =0,16	1,28	1,74	1,96	HCP ₀₅ =0,47

According to the data of mathematical processing of the data obtained for factor B, it can be noted that, on average, among the varieties of food studied, among the varieties analyzed in the experiment, the highest level of productivity was found in the Vekhovskaya variety, which significantly exceeded the Kanadskaya indicator by 0.41 t / ha. On this basis, it can be concluded that the Vekhovskaya variety is more responsive to the use of fertilizers by increasing yields. Of the options considered in the experiment, the highest yield of grain of lentils was also noted in the Vekhovskaya variety on the fertilizer calculation system with a dose of N₂₅P₄₅K₁₈, which amounted to 2.17 t / ha, which indicates the achievement of the goal - a yield level of 2.00 t / ha.

One of the main food and energy characteristics of the quality of the harvest of lentils is the content of protein in the grain. According to the results of laboratory quality tests, it can be concluded that the use of mineral fertilizers contributed to a significant increase in the protein concentration in the grain relative to the control, on average, by 0.89-1.06% (Table 4).

Table 4: Effect of doses of mineral fertilizers on the protein content (%) in lentil grain, 2014-2016

Variety, A	Fertilizer dose, B			A, HCP ₀₅ = 0,65
	контроль	P ₄₀ K ₃₀	N ₂₅ P ₄₅ K ₁₈	
Vekhovskaya	24,94	25,67	25,91	25,51
Kanadskaya	25,31	26,36	26,46	26,04
B, HCP ₀₅ = 0,75	25,13	26,02	26,19	HCP ₀₅ =1,6

According to the results of a comparative evaluation of lentil varieties analyzed in the experiment, it can be noted that the choice of varieties in the experiment did not have a significant effect on the protein content in the grain, but it should be noted that the highest level was observed in the Kanadskaya variety, exceeding the result of the Vekhovskaya variety by 0.53%.

The analysis of indicators of all variants showed that the highest protein content in lentil grain in the experiment was noted against the background of the use of the computational system of fertilizer in the Kanadskaya variety and was 26.46%.

CONCLUSION

Thus, we can conclude that the use of mineral fertilizers in the cultivation in the experience of so-called non-traditional leguminous crops contributes to increasing their productivity. However, it should be noted that a reliable increase in the yield of wintering peas relative to the control was ensured by the use of the following types and combinations of fertilizers: P₆₀, N₆₀P₆₀ and N₆₀P₆₀K₆₀, which averaged 0.19-0.80 t / ha by experience. The maximum grain yield was noted against the background of the use of a full dose of fertilizers, which significantly exceeded the control and the other backgrounds, respectively, by 0.80 and 0.27-0.82 t / ha.

Analysis of the quality of the crop suggests that the use of mineral fertilizers contributed to an increase in the protein and carbohydrate content of the resulting grain. The maximum protein content in the grain was noted against the background of the dose of $N_{60}P_{60}$ and was 22.3%. The highest content of carbohydrates in the grain of wintering peas in the experiment was noted against the background of a full dose of fertilizer and was 54.0%.

Regarding the productivity of varieties of lentils, it can be noted that the estimated dose of fertilizer $N_{25}P_{45}K_{18}$ averaged by experience was a significant increase in yield relative to the control and the dose of $P_{40}K_{30}$ fertilizers, respectively, by 0.68 and 0.22 t / ha. The highest yield was recorded for the Vekhovskaya variety - 1.86 t / ha, which was significantly higher than the Kanadskaya variety by 0.41 t / ha.

The use of mineral fertilizers contributed to the improvement of the quality indicators of the obtained grain: an increase in the protein concentration in the lentil grain relative to the control was 0.89-1.06%. The estimated dose of fertilizer increased the protein content in lentils, but the difference was within the experimental error.

ACKNOWLEDGEMENT

The study was carried out with the support of the Ministry of Agriculture of the Stavropol Territory on the implementation of research, development and technological work to meet the state needs of the Stavropol GC 194/18.

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