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UDC 633.11:631.82

INFLUENCE OF TIMING, RATES, AND METHODS OF PHOSPHORUS AND POTASSIUM FERTILIZATION ON NPK CONTENT IN PLANTS

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https://doi.org/10.5281/zenodo.23065397

Abstract: The study examined the influence of various rates and application methods of phosphorus and potassium fertilizers on the mineral nutrition of the "Gozgon" winter wheat variety. Changes in the amount of total nitrogen, phosphorus, and potassium in the plant were determined.

Keywords: winter wheat, phosphorus, potassium, mineral nutrition, nitrogen, fertilization, sierozem-meadow soil.

Introduction: Mineral nutrition plays an important role in the growth, development, and formation of winter wheat yields. In particular, phosphorus and potassium perform important physiological functions in the development of the plant root system, metabolism, efficient water use, and increasing resistance to unfavorable environmental conditions.

The ratio of nitrogen, phosphorus, and potassium elements is important in providing winter wheat with mineral fertilizers. In the research of Sh.O. Abdurakhimov, it was noted that improving mineral nutrition conditions positively affects the growth and development of winter wheat plants [1].

B.M. Khalikov and A.A. Iminov noted the possibility of improving plant nutritional conditions by optimizing mineral fertilizer rates when growing winter wheat varieties[2]. Research conducted by I.N. Khoshimov and co-authors demonstrates the importance of differentiated application of mineral fertilizers depending on soil conditions and its fertility level [3].

In the studies of Sh.I. Kadyrova and K.M. Muminov, it was established that the application of phosphorus and potassium fertilizers affects the mineral nutrition of plants [4].

The above studies show that the use of phosphorus and potassium fertilizers can improve the mineral nutrition of winter wheat. However, in the conditions of sierozem-meadow soils, it is of particular importance to determine the influence of phosphorus and potassium application methods on NPK content in plants alongside fertilizer rates.

Research material and methods: The studies were conducted on the "Gozgon" winter wheat variety under serozem-meadow soil conditions.

Three backgrounds of mineral fertilizers in the experiment:

- - $N_{150}P_{75}K_{50}$ kg/ha;
- $N_{180}P_{90}K_{60}$ kg/ha;
- $N_{210}P_{105}K_{70}$ kg/ha.

Phosphorus and potassium fertilizers were tested in subsoil, intra-soil with sowing, and supersoil application methods. Control variants without phosphorus and without potassium were also identified.

The level of mineral nutrition of winter wheat plants was assessed by determining the total amount of nitrogen, phosphorus, and potassium in the plants during the tubing, spike formation, and milk-wax ripening periods.

Research results and discussion: The research results showed that increasing mineral fertilizer rates and the effective application of phosphorus and potassium fertilizers had a positive impact on the absorption of nutrients by winter wheat plants.

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In the phosphorus-free control variant with a mineral fertilizer background of $N_{180}P_{90}K_{60}$ kg/ha, the total nitrogen, phosphorus, and potassium content in the plants during the tubing period were 1.65; 1.30 and 1.35% respectively. During the ear-bearing period, these indicators were 1.68; 1.35 and 1.40%, and in the milk-wax stage 1.95; 1.38 and 1.50%.

On this background, as a result of the application of phosphorus and potassium fertilizers along with sowing, the indicators of mineral nutrition of plants increase. During the tubing stage, the total nitrogen, phosphorus, and potassium content were 1.88; 1.57 and 1.65% respectively, and 1.95; 1.52 and 1.70%, and in the milk-wax stage 2.31; 1.55 and 1.72% respectively.

Thus, insolation of phosphorus and potassium against a background of $N_{180}P_{90}K_{60}$ kg/ha increased the total nitrogen content by 0.36%, phosphorus by 0.17%, and potassium by 0.22% during the milk-wax ripening period compared to the phosphorus-free control.

High results were obtained when applying phosphorus and potassium fertilizers simultaneously with sowing against a background of $N_{210}P_{105}K_{70}$ kg/ha. During the milk-wax ripening period, the total nitrogen content in the plant reached 2.35%, phosphorus 1.75%, and potassium 1.78%.

At the same time, with an increase in mineral fertilizer rates from $N_{150}P_{75}K_{50}$ kg/ha to $N_{180}P_{90}K_{60}$ kg/ha, the difference in plant nutrient absorption was more significant compared to the difference from $N_{180}P_{90}K_{60}$ to $N_{210}P_{105}K_{70}$ kg/ha.

According to the research results, in the topsoil application variants of phosphorus and potassium fertilizers, the indicators of plant nutrient absorption were lower than in the intra-soil application variants (Table 1).

This situation is explained by the mobility of phosphorus and potassium in the soil, as well as the characteristics of the plant root system's absorption of nutrients depending on the fertilizer distribution zone.

Table 1

Change in the amount of total nitrogen, phosphorus, and potassium in winter wheat plants depending on the norms, timing, and methods of applying phosphorus and potassium fertilizers, % 2023-2025

№	Mineral fertilizer rate (Background)	Application of PK fertilizers (duration/method)	Tubing			Earling			Milk-wax ripening		
					K		P	K	N	P	K
	$N_{150}P_{75}K_{50}$	Control (phosphorus-free)	,60	,24	1,33	,62	1,30	1,35	1,85	1,35	1,45
		Control (potassium-free)	,62	,26	1,36	,63	1,31	1,36	1,90	1,40	1,50
		Underground	,70	,35	1,46	,85	1,40	1,61	2,00	0,95	1,40
		From within the soil	,80	,41	1,60	,90	1,48	1,65	2,20	1,50	1,65
		Above the ground	,61	,25	1,34	,63	1,32	1,35	1,81	1,32	1,44
	$N_{180}P_{90}K_{60}$	Control (phosphorus-	,65	,30	1,35	,68	1,35	1,40	1,95	1,38	1,50

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		free)									
		Control (potassium-free)	,68	,32	1,36	,70	1,36	1,42	1,98	1,40	1,52
		Underground	,75	,40	1,50	,90	1,45	1,65	2,25	1,48	1,70
		From within the soil	,88	,57	1,65	,95	1,52	1,70	2,31	1,55	1,72
0		Above the ground	,65	,31	1,36	,65	1,32	1,40	1,85	1,38	1,50
1	$N_{210}P_{105}K_{70}$	Control (phosphorus-free)	,68	,33	1,38	,75	1,40	1,62	2,05	1,60	1,62
2		Control (potassium-free)	,70	,33	1,40	,77	1,42	1,65	2,10	1,62	1,63
3		Underground	,80	,45	1,62	,95	1,60	1,65	2,28	1,65	1,70
4		From within the soil	,90	,52	1,66	,08	1,75	1,75	2,35	1,75	1,72
5		Above the ground	,68	,33	1,38	,75	1,41	1,63	2,00	1,60	1,63

Overall, the research results established that the application of phosphorus and potassium fertilizers simultaneously with sowing is an effective method for the mineral nutrition of winter wheat. The conclusion of the dissertation also notes that the optimal option for winter wheat on sierozem-meadow soils is the application of $N_{180}P_{90}K_{60}$ kg/ha and intra-soil application of phosphorus-potassium with sowing.

Conclusion: In the conditions of sierozem-meadow soils, the level of mineral nutrition in the "Gozgon" winter wheat variety changed depending on the norms and methods of applying phosphorus and potassium fertilizers.

High indicators of total nitrogen, phosphorus, and potassium in the plant composition were noted in variants where phosphorus and potassium fertilizers were applied simultaneously with the sowing.

Intra-soil application of phosphorus and potassium along with sowing against a background of $N_{180}P_{90}K_{60}$ kg/ha improved the mineral nutrition of plants and ensured a high total NPK content during the milk-wax ripening period.

Thus, to optimize the mineral nutrition of winter wheat in sierozem-meadow soils, the use of mineral fertilizers at a rate of $N_{180}P_{90}K_{60}$ kg/ha and the application of phosphorus and potassium fertilizers simultaneously with sowing are recommended as effective agrotechnical measures.

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