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EFFECT OF PHOSPHORUS AND POTASSIUM FERTILIZERS ON DRY MATTER ACCUMULATION IN WINTER WHEAT PLANTS

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Abstract: This study investigated the effect of different rates, application timings, and methods of phosphorus and potassium fertilizers on dry matter accumulation in winter wheat plants of the "G'ozg'on" variety. The dynamics of dry matter accumulation during the growing season were determined, and the relationship between mineral nutrition conditions and changes in dry matter accumulation was evaluated. The results showed that the application of phosphorus and potassium at appropriate rates and by suitable methods contributes to the formation of vegetative biomass and improves the process of dry matter accumulation in winter wheat plants.

Keywords: winter wheat, "G'ozg'on" variety, dry matter, phosphorus, potassium, mineral nutrition, growing season, fertilization.

Introduction and literature review: The growth, development, and productivity of winter wheat largely depend on the level of mineral nutrition of plants. In particular, phosphorus and potassium play an important role in root system development, active photosynthesis, dry matter formation, and the development of generative organs. Maintaining an optimal level of mineral nutrition increases the ability of plants to accumulate biomass during the growing season and form yield [1, 3].

M.T. Abdullayeva studied the effect of plant density and mineral fertilizers on wheat productivity under the light sierozem soil conditions of the Fergana Valley and reported a direct relationship between nutritional conditions and plant development processes [1]. Similarly, Sh.O. Abdurahimov established that optimization of mineral fertilizer rates in winter wheat production has a positive effect on plant growth and development [2].

In the studies of B.K. Atoyev and S.K. Makhammadiev, the effects of winter wheat varieties and fertilization conditions on soil nutrient regimes were investigated. The authors demonstrated that a properly organized fertilization system is important for efficient utilization of nutrients by plants [3]. Bairov et al. studied the effect of mineral and organic fertilizers on the uptake of major nutrients by crops in the "cotton–winter wheat" cropping system [4].

According to N.M. Ibragimov, Sh.Z. Hakimov, and L.A. Mirzayev, increasing mineral fertilizer rates affects the uptake of N, P, and K by winter wheat as well as the formation of aboveground biomass [5]. This determines the scientific and practical importance of studying the dynamics of dry matter accumulation at different stages of plant development.

M. Raximov and G'. Uzoqov investigated the effect of phosphorus fertilizer rates and application methods on yield formation in cereal crops and emphasized that the efficiency of phosphorus nutrition depends on its application rate and method [6]. Sh.I. Qodirov and K.M. Mo'minov also studied the effects of fertilization rates on the growth and productivity of winter wheat [7].

B.Q. Qoldosheva evaluated the efficiency of fertilization technologies for winter wheat varieties within the "variety-soil-fertilizer" system. The results demonstrated the necessity of combining mineral nutrition conditions with the biological characteristics of the variety and soil conditions [8].

The above studies indicate that dry matter accumulation in winter wheat depends on mineral nutrition conditions, fertilizer rates, application timing, and application methods. However, a comprehensive assessment of the effects of different rates and application methods of phosphorus and potassium fertilizers on dry matter accumulation during the major growth stages of winter wheat remains an important scientific and practical issue. Therefore, this study investigated the effects of

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phosphorus and potassium fertilizers applied at rates of $N_{150}P_{75}K_{50}$, $N_{180}P_{90}K_{60}$, and $N_{210}P_{105}K_{70}$ and by different methods on the dynamics of dry matter accumulation in winter wheat plants.

The literature analysis indicates that dry matter accumulation in winter wheat is closely associated with the level of mineral nutrition, the ratio of nutrients, and their application methods. At the same time, studying the effect of different rates of phosphorus and potassium fertilizers specifically on the "G'ozg'on" variety during different growth stages is of significant scientific and practical importance under local conditions.

Purpose and methods of research: The main objective of the study was to determine the effect of different rates, application timings, and methods of phosphorus and potassium fertilizers on dry matter accumulation in winter wheat plants of the "G'ozg'on" variety.

The following mineral fertilizer rates were studied: $N_{150}P_{75}K_{50}$ kg/ha; $N_{180}P_{90}K_{60}$ kg/ha; and $N_{210}P_{105}K_{70}$ kg/ha.

Phosphorus and potassium fertilizers were studied under the following treatments: phosphorus-free control, potassium-free control, application below the soil, application into the soil simultaneously with sowing, and application on the soil surface. Dry matter accumulation in plants was determined during the main developmental stages of the growing season, and the results were expressed in g/m².

Results of the study: The results showed that dry matter accumulation in winter wheat plants varied depending on the rate of mineral fertilizers and the method of phosphorus and potassium application.

At the $N_{150}P_{75}K_{50}$ kg/ha rate, dry matter accumulation during the tillering stage was 122.8 g/m² in the phosphorus-free control and 123.5 g/m² in the potassium-free control, whereas application of phosphorus and potassium into the soil simultaneously with sowing resulted in 134.3 g/m².

At the $N_{180}P_{90}K_{60}$ kg/ha rate, the highest dry matter accumulation was also observed when phosphorus and potassium were applied into the soil simultaneously with sowing. Under this treatment, dry matter accumulation amounted to 153.4 g/m² at tillering, 390.3 g/m² at stem elongation, 1033.9 g/m² at heading, 1393.9 g/m² at milk-wax ripening, and 1448.1 g/m² at full ripening.

Table 1.

Effect of phosphorus and potassium fertilizers on dry matter accumulation in winter wheat plants, g/m²

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№	Mineral fertilizer rate (Background)	Application of PK fertilizers (duration/method)	Accumulation		Tubing		Earling		Milk-wax ripening		Ripening	
			g/m²	s/ha	g/m²	s/ha	g/m²	s/ha	g/m²	s/ha	g/m²	s/ha
1	$N_{150}P_{75}K_{50}$	Control (phosphorus-free)	122,8	12,2	261,6	26,7	912,1	91,2	1141,5	114,1	1233,5	123,4
2		Control (potassium-free)	123,5	12,3	262,8	26,8	916,3	91,7	1142,1	114,2	1241,4	124,1
3		Underground	133,1	13,3	289,1	29,9	935,8	93,5	1200,9	120,4	1296,4	129,6
4		From within the soil	134,3	13,4	303,9	30,3	975,3	97,5	1278,9	127,8	1335,1	133,5
5		Above the ground	123,0	12,3	261,4	26,1	915,3	91,3	1136,3	113,6	1223,1	122,3
6	$N_{180}P_{90}K_{60}$	Control (phosphorus-free)	137,4	13,7	280,3	28,0	932,1	93,2	1291,9	129,1	1382,1	138,2
7		Control (potassium-free)	138,0	13,8	282,9	28,2	932,8	93,4	1293,9	129,3	1386,1	138,6
8		Underground	153,5	15,3	306,4	30,6	1005,3	100,3	1321,9	132,9	1407,1	140,7
9		From within the soil	153,4	15,3	390,3	39,0	1033,9	103,3	1393,9	139,1	1448,1	144,8
10		Above the ground	137,8	13,7	281,8	28,1	931,9	93,1	1292,1	129,9	1381,2	138,1
11	$N_{210}P_{105}K_{70}$	Control (phosphorus-free)	141,2	15,1	296,5	29,6	930,1	93,0	1395,1	139,5	1407,1	140,7
12		Control (potassium-free)	141,3	15,1	301,2	30,1	933,1	93,3	1396,3	139,6	1410,1	141,0
13		Underground	152,1	16,9	324,5	32,4	1021,8	102,8	1421,9	142,9	1419,4	141,9
14		From within the soil	152,4	17,4	341,8	34,8	1041,2	104,1	1390,1	137,0	1449,1	144,9
15		Above the ground	152,3	15,2	298,1	29,8	938,1	93,5	1381,9	138,3	1384,3	138,4

At the $N_{150}P_{75}K_{50}$ kg/ha rate, application of phosphorus and potassium into the soil simultaneously with sowing resulted in 1335.1 g/m² of dry matter at full ripening. This was 101.6 g/m² higher than the phosphorus-free control and 93.7 g/m² higher than the potassium-free control.

At the $N_{180}P_{90}K_{60}$ kg/ha rate, the effectiveness of this application method was even more pronounced. Dry matter accumulation at full ripening reached 1448.1 g/m², which was 66.0 g/m² higher than the phosphorus-free control and 62.0 g/m² higher than the potassium-free control.

At the $N_{210}P_{105}K_{70}$ kg/ha rate, dry matter accumulation at full ripening following application of phosphorus and potassium into the soil was 1449.1 g/m². This value was only 1.0 g/m² higher than the 1448.1 g/m² obtained at the $N_{180}P_{90}K_{60}$ kg/ha rate. Thus, a further increase in the fertilizer rate did not provide a substantial additional effect on dry matter accumulation.

Dry matter accumulation was relatively lower when phosphorus and potassium were applied on the soil surface. This may be associated with the accessibility and uptake of nutrients in the soil layer where the active roots are predominantly located.

Overall, the experimental results demonstrated that, in addition to the fertilizer rate, the method of delivering phosphorus and potassium to the plant root nutrition zone plays an important role in dry matter accumulation in winter wheat.

Conclusion: Dry matter accumulation in winter wheat of the “G‘ozg‘on” variety was found to vary depending on the mineral fertilizer rate and the method of phosphorus and potassium application.

At the $N_{150}P_{75}K_{50}$ kg/ha rate, application of phosphorus and potassium into the soil simultaneously with sowing resulted in 1335.1 g/m² of dry matter at full ripening.

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At the $N_{180}P_{90}K_{60}$ kg/ha rate, the same application method resulted in dry matter accumulation of 153.4 g/m² at tillering, 390.3 g/m² at stem elongation, 1033.9 g/m² at heading, 1393.9 g/m² at milk-wax ripening, and 1448.1 g/m² at full ripening.

At the $N_{210}P_{105}K_{70}$ kg/ha rate, dry matter accumulation reached 1449.1 g/m², while the additional increase compared with the $N_{180}P_{90}K_{60}$ kg/ha treatment was only 1.0 g/m².

Under the conditions of the study, application of phosphorus and potassium into the soil simultaneously with sowing at the N180P90K60 kg/ha mineral fertilizer rate was identified as an effective method for improving dry matter accumulation in winter wheat.

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