THE IMPORTANCE OF MOBILE PHOSPHATES IN THE SOIL AND THE EFFECT OF NITROGEN FERTILIZERS ON INCREASING THE MOBILITY OF PHOSPHORUS UNDER DIFFERENT AVAILABILITY OF TYPICAL SEROZEMS

Pirakhunova Farida Nurmamatovna
International school of finance technologyand scince
https://doi.org/10.5281/zenodo.8349072

Abstract. *The article presents data on the study of the content of mobile phosphorus in the soil, extracted by ammonium carbonate, dated in the early periods of the growing season, the beginning of the year, April-May, and the later months in autumn. The researchers found that the use of nitrogen fertilizers (urea), under cotton and prickly artichoke, especially ammonium sulfate in relation to ammonium nitrate and calcium nitrite, contribute to an increase in mobile phosphates in the soil due to the mobilization of the first groups of phosphates. Accordingly, the mobile phosphates extracted by ammonium carbonate solution, when ammonium sulfate and urea are added to the plants we study, increase with this nutrition element to a greater extent on medium-rich than on low-rich soil. Thus, the use of urea and especially ammonium sulfate, in comparison with other forms of nitrogen fertilizers, especially in comparison with low-availability phosphorus in the soil, enhances the growth, development and productivity of cotton and prickly artichoke, as well as biologically active substances (rutin, luteolin) in their tissues.*

Keywords: *nitrogen fertilizers, phosphorus fertilizers, typical gray soil, urea, ammonium sulfate, poor soils, cotton, prickly artichoke.*

Target. According to many years of research, it is known that mineral fertilizers, namely phosphate fertilizers, play an important role in creating high yields of agricultural crops, since in the CIS countries, including Uzbekistan, most of the surveyed soil is poorly provided with this nutrient. [1]. All this limits the yield level of both agricultural and medicinal plants and reduces the effectiveness of nitrogen and potash fertilizers.

In Central Asia, most of the studies conducted, in particular in Uzbekistan, considered the effectiveness of the use of phosphorus fertilizers on cotton, depending on the dose, timing, methods of application, as well as their rational placement in crop rotation. [1,2,3]

Research has established that water-soluble salts of phosphoric acid, introduced into the soil with fertilizers, saturated with calcium, magnesium, aluminum, and partly with iron, are converted into two- or three-substituted phosphates. With prolonged interaction with the soil, these phosphate compounds transform into more basic, hard-to-reach forms for the plant, so the coefficient of use of phosphorus fertilizers by cotton does not exceed 15–20% per year of action, and taking into account the aftereffect, 30–35% [4,5].

At present, as a result of the systematic use of phosphorus fertilizers, especially in high doses, many times greater than the need for phosphorus in cotton, a large amount of this nutrient has accumulated in the soils of the gray soil belt in forms that are difficult for plants to access (more than 10 t/ha in the arable horizon).

Therefore, under the conditions of such soils, the search for ways to mobilize phosphates from their accumulated hard-to-digest forms would help improve the phosphorus nutrition of

cotton and prickly artichoke and increase the efficiency of phosphorus fertilizers. With a partial transfer of these phosphates, which are difficult for the plant to digest, into prickly forms accessible to cotton and artichoke, high yields can be obtained and, to some extent, the doses of phosphate fertilizers can be reduced. In this regard, the scientific substantiation and development of methods for the mobilization of soil phosphates is of particular relevance. [6,7,8].

Research methods. To study the mobilization of phosphates on typical gray soils using various forms of nitrogen fertilizers, vegetation and field experiments were carried out (Table 1) on typical gray soils with different availability of mobile phosphorus (low -24, medium - 42 mg per 1 kg of soil). The annual rate of nitrogen and potash fertilizers was respectively: N - 200, P ~ 140 and K - 90 kg/ha [8,9,10].

The soil is a typical sierozem of old irrigation, medium loamy mechanical composition, with a high content of coarse dust (40-60%), silty soil fractions make up 25-30% and are in an aggregated form. The content of humus and gross nitrogen in the arable and subsurface horizons (0-30, 30-50 cm) was 1.01 and 0.71, 0.72 and 0.09, 0.06, respectively, and the content of gross phosphorus was 0.12 and 0.08, gross potassium in the range of 170 - 171 and 1.10% to dry soil.

The content of ammonia nitrogen in the soil - in negligible quantities - 1.1 and 2.3 mg / kg of soil; nitrates - 17 - 18 mg / kg in the arable and 11.0 - 12.5 - in the subsurface horizons. Exchangeable potassium in the soil was at the level of 160-165 in the arable and 110-115 mg/kg in the subsurface horizon [7,8].

Table 1

Scheme of vegetation and field experiments

Variant number	Soil availability of mobile phosphorus	Forms of nitrogen fertilizer	Annual rate of fertilizers					
			Vegetation experience g/vessel			Field experience kg/ha		
			N	P	K	N	P	K
	Low	$CO6(NH_2)_2$	5	4	1,5	200	140	90
	Low	NH_4NO_3	5	4	1,5	200	140	90
	Low	$Ca(NO_3)_2$	5	4	1,5	200	140	90
	Low	$(NH4)_2SO_4$	5	4	1,5	200	140	90
1	Medium	$CO(NH_2)_2$	5	4	1,5	200	140	90
2	Medium	NH_4NO_3	5	4	1,5	200	140	90
3	Medium	$Ca(NO_3)_2$	5	4	1,5	200	140	90
4	Medium	$(NH_4)_2SO_4$	5	4	1,5	200	140	90

The creation of backgrounds for the availability of soil (low - 24, medium - 42 mg / 1 kg of soil) with phosphorus was carried out as follows: a plot of 0.7 ha was allocated with a content of mobile phosphorus of 17 mg / kg of soil, i.e., the soil is close to very low supply of this nutrient. Every year in autumn, after harvesting the studied plants, phosphorus fertilizers were applied in the order of 100, 200, and 300 kg/ha P2O5; then, mobile phosphorus was determined in soil samples with the introduction of different norms of phosphorus fertilizers [3,4].

As a result of the interaction of applied different doses (100, 200 and 300 kg/ha) of phosphorus fertilizers in the soil, the level of mobile phosphorus content increased from 17 (initial) to 24.36.42 mg/kg of soil, respectively.

Vegetation and field experiments are laid in 2017 - 2022. on low (24 mg/kg) and medium-supplied (42 mg/kg) soils with mobile phosphates with annual application of phosphorus fertilizers in vegetation and field experiments, respectively, 4 g/vessel and 140 kg/ha P2O5 on soils low in phosphorus and 3 g/vessel and 105 kg/ha P2O5 on the average.

Forms of phosphorus readily available to plants, extracted by 1% ammonium carbonate in gray soils, are small and amount to 1-3% of its total content. According to many researchers [4,5,6], ammonium carbonate extracts mainly calcium mono- and diphosphates, partially affecting tricalcium phosphorus compounds, and they constitute the main part of the phosphorus consumption fund by cotton and other plants.

Research results. The results of vegetation and field experiments have established that the content of mobile phosphorus in the soil, extracted by 1% ammonium carbonate, is higher in the first half of the vegetation of the studied plants than in the second (flowering - fruiting). [9,10].

When making prickly urea and ammonium sulfate under cotton and artichoke, the content of mobile phosphorus is higher than when using ammonium nitrate and calcium nitrate. Urea and ammonium sulfate increase the content of mobile phosphorus more on medium phosphorus soil than on low soil. The difference in the content of mobile phosphates in the soil when different forms of nitrogen fertilizers are used under cotton and artichoke prickly remains at the end of the plant growing season; however, during this period it is somewhat smoothed out. [5,6,10,11].

Phosphates of various groups isolated [5, 6] are known to be equally available to plants. Phosphates, soluble in water saturated with carbon dioxide, are available and absorbed by them very vigorously, and phosphates, soluble in acetic extract, are used by plants differently depending on soil conditions; Salt-soluble phosphates do not belong to the category of assimilable form of phosphates and are considered a reserve of phosphorus nutrition for plants.

The results of the analyzes (the end of the growing season) showed that the amount of phosphorus content in the soil, extracted by carbon dioxide extract, varies markedly depending on the use of various forms of nitrogen fertilizers. When urea and ammonium sulfate are introduced, compared with the introduction of calcium nitrate and ammonium nitrate, the content of phosphorus extracted by carbon dioxide is noticeably reduced. [12,13].

This, apparently, is due, on the one hand, to the transition of phosphorus, extracted by carbon dioxide extract, to ammonium carbon, and, on the other hand, to an increase in the absorption of this nutrient by the plant. (table 2)

Table 2

The content of phosphates of different solubility when using various forms of nitrogen fertilizers for cotton and prickly artichoke.

mg/kg (end of growing season.)

Form of phosphorus	Low endowment				Average security			
	1	2	3	4	1	2	3	4
Vegetation experiments Cotton								
General	1174	1172	1165	1283	1242	1238	1233	1247
Soluble in carbon dioxide extract	61,7	70,3	68,7	61,3	65,0	70,0	67,8	66,0
Soluble	689	693	698	686	703	718	720	706

in 0.5n acetic acid								
Soluble in 5n hydrochloric acid	208	211	206	208	232	229	230	231

prickly artichoke

General	1184	1191	1158	1293	1253	1244	1239	1251
Soluble in carbon dioxide extract	62,3	71,9	70,8	63,4	67,2	69,4	68,6	67,7
Soluble in 0.5n acetic acid	695	702	710	694	711	731	735	712
Soluble in 5n hydrochloric acid	214	218	209	213	217	220	224	223

Field experiments

Cotton

Form of phosphorus	Low endowment				Average security			
	1	2	3	4	1	2	3	4
Field experiments cotton								
General	1170	1172	1178	1268	1240	1248	1251	1238
Soluble in carbon dioxide extract	70	78	75	68	73	79	81	72
Soluble in 0.5n acetic acid	680	693	695	682	721	731	733	720
Soluble in 5n hydrochloric acid	215	214	217	214	231	235	233	230

prickly artichoke

General	1176	1187	1191	1180	1293	1302	1309	1286
Soluble in carbon dioxide extract	73	78	79	73	82	89	93	83
Soluble in 0.5n acetic acid	687	696	693	679	788	799	806	789
Soluble in 5n hydrochloric acid	218	220	224	218	239	243	245	239

Variants: 1) $CO(NH_2)_2$, 2) NH_4NO_3, 3) $Ca(NO_3)_2$, 4) $(NH_4)_2SO_4$,

With the introduction of urea, especially ammonium sulfate, the content of phosphates in the soil, soluble in acetic acid extract, also noticeably decreases in relation to the content of phosphates in the soil with the introduction of ammonium nitrate and calcium nitrate.

These data indicate that when the amide and ammonia forms of nitrogen fertilizers are applied, phosphates are mobilized from their carbon-soluble and acetic-soluble fractions to a greater extent than when using the nitrate and ammonium-nitrate forms. This is confirmed by data on the use of both cotton and prickly artichoke, depending on the source of nitrogen nutrition.

The mobilization of soil phosphates, soluble in the acetic acid extract, depends on the level of soil phosphorus supply, and it occurs to a greater extent on the soil with medium phosphorus than with low soil, which is associated with a high content of the reserve fund of phosphorus extracted by acetic acid extract.

Approximately the same data were obtained in a field experiment, where the content of phosphorus extracted by carbonic and acetic acid extracts was less when prickly amide and ammonia forms of nitrogen were introduced under cotton and artichoke than nitrate and ammonium nitrate forms. The data of our studies are consistent with the materials of studies obtained by other researchers [8.9].

Therefore, the phosphate mobilizing ability of various forms of nitrogen fertilizers is arranged in the following sequence: ammonium sulfate, urea, ammonium nitrate, calcium nitrate.

Table 3

The growth of the main stem, the accumulation of fruit elements and the yield of raw cotton, depending on the provision of soil with phosphorus and the application of various forms of nitrogen fertilizers

Field experiments

Variant number	Soil availability of mobile phosphorus	2017 y.		Number of boxes	Harvest of raw cotton c/ha	2018y.		Number of boxes	Harvest of raw cotton c/ha
		Height of main stem cm.				Height of main stem cm.			
		1.VIII	1.IX			1.VIII	1.IX		
1	Low	73	83	9,1	38,6	75	84	9,5	39,0
2	Low	71	80	9,0	35,8	73	82	9,2	37,5
3	Low	68	75	8,5	34,9	69	80	8,7	37,0
4	Low	74	83	9,3	39,3	76	97	9,8	39,8
HCP 0,95					1,15 c/ha				1,20 c/ha
1	Medium	75	87	10,8	41,4	78	89	11,0	43,5
2	Medium	73	83	10,0	38,7	75	85	10,8	40,5
3	Medium	72	82	9,6	38,0	74	86	10,0	40,0
4	Medium	76	91	11,0	40,8	80	94	11,2	43,3
HCP 0,95					1,50 c/ha				1,13 c/ha

Field experiments also established that the growth of the main stem and the number of fully formed bolls depend on the level of soil availability with mobile phosphorus and forms of nitrogen fertilizers (Table 3).

Growth processes and the formation of fruit elements proceed more intensively on soil with medium phosphorus than on low soil. Here again, urea and ammonium sulfate had a more positive effect on accelerating the growth of the main stem, increasing the number of bolls and the yield of raw cotton than ammonium nitrate and especially calcium nitrate.

Thus, the above data show that the use of different forms of nitrogen fertilizers has a different effect on the growth, fruiting and yield of raw cotton, the same data for prickly artichoke. In terms of effectiveness, the forms of nitrogen fertilizers used were arranged in the following sequence: ammonium sulfate, urea, ammonium nitrate and calcium nitrate.

At the same time, the effectiveness of the use of ammonium sulfate and urea in comparison with ammonium nitrate, especially calcium nitrate, manifests itself to a greater extent against the background of medium-supplied soil than on low-sufficiency soil.

Conclusions. Thus, our studies have shown that the content of phosphorus compounds in the soil depends on the availability of mobile phosphorus. With an increase in the availability of soil phosphorus from low to medium, increases in. soil, the content of phosphates extracted in carbon and acetic acid and hydrochloric acid extracts, respectively, from 79, 708 and 210 mg / kg of soil to M, 746 and 233 mg / ha.

When urea, especially ammonium sulfate, is introduced, compared with the introduction of ammonium nitrate and calcium nitrate, the content of phosphates extracted by aqueous solutions of carbon and acetic acids decreases, while under these conditions the content of mobile phosphates extracted by ammonium carbonate increases.

On soil with medium supply of mobile phosphorus, the mobilization of phosphates from the first and second groups according to Chirikov, with the use of urea and ammonium sulfate, is greater than on soil with a low supply of this nutrient. The content of phosphates extracted with a solution of hydrochloric acid, when using various forms of nitrogen fertilizers for cotton and prickly artichoke, did not change significantly and remained at the level of their initial content.
A higher content of mobile phosphorus in the soil, extracted by ammonium carbonate, is confined to spring periods, and a low content in autumn. The use of prickly urea for cotton and artichoke, especially ammonium sulfate in relation to ammonium nitrate and calcium nitrate, contributes to an increase in mobile phosphates in the soil due to the mobilization of the first groups of phosphates.

Mobile phosphates, extracted with a solution of ammonium carbonate, when prickly ammonium sulfate and urea are introduced under cotton and artichoke, increase to a greater extent on soil that is moderately supplied with this nutrient than on soil that is low. The introduction of urea and especially ammonium sulfate, compared with the introduction of ammonium nitrate and calcium nitrate, contributes to increased stem growth, an increase in the fruit elements of both cotton and prickly artichoke.

REFERENCES

1. Zikiryaev A. Features of metabolic processes in the fruiting organs of cotton: Monograph. Tashkent. Publishing house "Fan va technologylar" 2011. 123-134p.
2. Kuziev A. Fractional composition of phosphates of serozem-oasis soils. On Sat. “Uzbek soils and some guidelines of their use”. Tash GAU publishing house. Tashkent 1998. S. 41.45.
3. Makhmudova M.A. Mobilization of phosphates on typical gray soils when using various forms of nitrogen fertilizers for cotton. Author's abstract competition of agricultural sciences. Tashkent. 1990. pp. 5-8
4. Pirakhunov T.P. Phosphorus nutrition of cotton in various soil conditions. Ed. "Science", Tashkent, 1977. pp. 36-37

5. Pirakhunov T.P., Makhmudova M.A., Abzalov A.A. Phosphorus in soil and ways to increase its mobility. Tash GAU publishing house. 1990. Tashkent. pp. 79-84.
6. Teuchezh A.A. Influence of soil profile on the distribution of mobile phosphorus in ordinary chernozem / A.A. Teuchezh // Ekol. Vestnik Sev. Caucasus. - 2017. - T. 13. - No. 1. - P. 72–79.
7. Teuchezh A. A. Studying the role of mobile phosphorus in the soil-fertilizer-harvest system Scientific journal KubSAU, No. 127 (03), 2017. From 1-13
8. Klimyakin E. N. The importance of phosphorus in the life of winter wheat plants. Collection of articles of the IV International Scientific and Practical Conference "SCIENTIFIC RESEARCH OF STUDENTS AND STUDENTS" Penza, 2021. Publisher: Science and Education (IP Gulyaev G.Yu.) Penza, November 23, 2021. P.74-77.ноября 2021. С.74-77.
9. Pirakhunova F.N. Abzalov A.A., Nurmukhamedov A.A. The value of mineral fertilizers in reducing the abscission of cotton fruit elements. Proceedings of the St. Petersburg State Agrarian University, No. 3 (60) 2020. P. 60-67.
10. Armor, B.A. Field experience methodology (with the basics of statistical processing of research results). B.A. Armor. - 6th ed. add. and reworked. - Agropromizdat, 2011. -352 p.
11. Sidikov S., Akbarov F., Akbarov N. Influence of various agricultural backgrounds on the content of humus and nitrogen in old-irrigated typical gray earth soils. Materials of the V-Congress of the Society of Soil Scientists and Agrochemists of Uzbekistan. 2005/ (September 9-10). Tashkent. pp. 275-277.
12. Sattorov Zh.S., Kholiqulov Sh. Scientific bases for calculating the annual norms and timing of the introduction of various fertilizers under winter wheat. Materials of the V-Congress of the Society of Soil Scientists and Agrochemists of Uzbekistan. 2010. (September 16-17). Tashkent. S.23-26.
13. Ermokhin Yu.I. Optimization of mineral nutrition of sorghum crops: monograph. Yu.I. Ermokhin, I.A. Bobrenko. - Omsk: OmGAU Publishing House, 2000. - P.118