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M. A. ZHOLMAGANBETOVA [1,], S. USMANOV [2], Sh. BAYBASHCHAEVA [2], K. U. MAKHMUDOV [3], R. U. MAKHMUDOV [3], H. USMANOV [3]*

[1] Kazakh National Women's Pedagogical University, Almaty, Republic of Kazakhstan;
[2] A.B. Bekturov Institute of Chemical Sciences JSC, Almaty, Republic of Kazakhstan;
[3] LLP "Scientific and Production Association" Ana-Zher ", Almaty, Republic of Kazakhstan.
*E-mail: marzhan.zholmaganbetova.75@mail.ru

RESEARCH OF PRODUCTION TECHNOLOGIES, MICROBIOLOGICAL AND AGROCHEMICAL CHARACTERISTICS OF FERTILIZERS BASED ON MONO-, DYCALCIUM PHOSPHATE WITH ZINC PHYTO-COMPOUND

Communication 2. Study of microbiological and agrochemical characteristics of a composition based on mono-, dicalcium phosphate with a phytocompound of zinc

Abstract. On model soil samples, the positive effect of the composition based on mono-, dicalcium phosphates with a phytocompound of zinc on the number of soil microorganisms affecting the nitrogen and phosphorus nutrition of plants and the accumulation of easily hydrolyzable nitrogen and mobile forms of phosphorus pentoxide in the soil was established. Achieved: an increase in the number of nitrogen-fixing microorganisms in comparison with the standards in 3.14-3.2 times and phosphate-mobilizing 3.4-3.42 times; accumulation of soil 11.5-12.7% of easily hydrolyzable nitrogen and 6.9-8.1% of mobile forms of phosphorus pentoxide. In the reference variants, there is a decrease in the content of phosphorus pentoxide mobile forms by 6.9-8.3%, which is associated with the retrogradation of phosphorus pentoxide. A decrease in the number of oligotrophs and denitrifiers, decomposing humus, and nitrate nitrogen of the soil by 2.18-2.15 times and 2.5-2.56 times is the basis for the preservation of soil fertility. Under the conditions of a microplot experiment, it was determined that the compositions containing a Phyto compound of zinc provide an increase in the yield of raw cotton in comparison with the standards – mono-, dicalcium phosphates 3.9 and 4.3 c/ha. The data obtained are in good agreement with phenological observations, the content of nutrients in the middle of the growing season, and the results of microbiological studies.

Keywords: monocalcium phosphate, dicalcium phosphate, zinc phytocompounds.

One of the main disadvantages of phosphorus-containing fertilizers is the low utilization rate of nutritious phosphorus pentoxide, which does not exceed 20-22% [1-2]. The fact of low efficiency of phosphorus pentoxide fertilizers is associated with its retrogradation in the soil with the formation of compounds not assimilated by the plant.

The purpose of this communication is to study the microbiological and agrochemical characteristics of the basis of mono-, dicalcium phosphate with the phytocomposition of zinc.

Tasks: a study on model soil samples the effect of compositions based on mono-, dicalcium phosphate and zinc phytocompounds on the number of soil microorganisms, accumulation of nitrogen and phosphorus pentoxide in the soil; studying the microbiological and agrochemical characteristics of the compositions on a micro-plot experiment on sowing cotton [3-4].

1. Study of the microbiological characteristics of fertilizer compositions on model soil samples, determination of the accumulation of nitrogen and phosphorus pentoxide in soil. In model soil samples, the effect of mixtures of ammonium nitrate (AN) and monocalcium phosphate (MPP), AC and dicalcium phosphate (DCP), compositions of MCP with a phyto zinc compound (PZC) and DCP with PZC on the number of soil microorganisms providing plant nutrition and decomposing nitrogen was studied soil, as well as the accumulation of nitrogen phosphorus pentoxide in the soil.

Input parameters for research:

1. Soil from - for sowing cotton, containing N-22.5 mg/kg of soil. P_2O_5 – 15.1 mg/kg soil, humus – 1.5%;

2. A mixture of ammonium nitrate and monocalcium phosphate (mass ratio N: P_2O_5 = 1: 0.5, the amount of N is 200 kg/ha, P_2O_5 is 100 kg/ha);

3. A mixture of ammonium nitrate and dicalcium phosphate (mass ratio N: P_2O_5 = 1: 0.5, the amount of N is 200 kg/ha, P_2O_5 is 100 kg/ha);

4. A fertilizer composition obtained on the basis of ammonium nitrate and monocalcium phosphate with a phyto-zinc compound (mass ratio N: P_2O_5 = 1: 0.5, the amount of N-200 kg/ha, P_2O_5-100 kg/ha);

5. Fertilizer composition obtained on the basis of ammonium nitrate and dicalcium phosphate with a phyto-zinc compound (mass ratio N: P_2O_5 = 1: 0.5, amount of N-200 kg/ha, P_2O_5-100 kg/ha).

Research output parameters:

1. The number of soil microorganisms providing nitrogen and phosphorus nutrition, as well as decomposing humus and nitrate nitrogen of soils.

2. Accumulation of nitrogen and phosphorus pentoxide in soil. Experimental conditions: The test samples were introduced into the soil with a moisture content of 16.8%, mixed and placed in a thermostat, kept for 30 days at a temperature of 25°C; to maintain stable soil moisture, water was added to a moisture content of 16.8%; every 10 days, the content in the soil of easily hydrated nitrogen and mobile forms of phosphorus pentoxide was determined; at the end of the growing season, the number of microorganisms in the soil was determined, the number of soil microorganisms providing nitrogen and phosphorus nutrition, mineralizing humus and decomposing the nitrate-nitrogen of the soil.

Tables 1 show the obtained results of changes in the content of easily hydrolyzable nitrogen and the mobile form of phosphorus pentoxide in model soil samples. It was found that at the end of the experiment in the samples using a

mixture of mono-, dicalcium phosphates and ammonium nitrate, a decrease in the content of easily hydrolyzable nitrogen by 1.5-3.9% and a mobile form of phosphorus pentoxide by 6.9-8.3%, and in the case of mono- and dicalcium phosphates of zinc phytocompounds there is an increase in the content of easily hydrolyzable nitrogen by 11.5-12.7% and mobile forms of phosphorus pentoxide – 6.9-8.1%.

Table 1 – Changes in the content of easily hydrolyzable nitrogen and mobile form of phosphorus pentoxide in model soil samples

№	Etalons	Times of Day							
		0		10		20		30	
		N	P_2O_5	N	P_2O_5	N	P_2O_5	N	P_2O_5
1	Etalon-1 soil + MPP + AC N: P_2O_5 = 1:0.5	25,2	17,2	24,8	16,6	24,5	16,0	24,2	15,8
2	Etalon-2 soil + DPP + AS N: P_2O_5 = 1:0.5	25,2	17,2	25,3	16,8	25,0	16,4	24,8	16,0
3	Soil + MPP FSC + AS N: P_2O_5 = 1: 0.5	25,2	17,2	27,1	17,9	27,8	18,3	28,1	18,6
4	Soil + DPP FSTS + AS N: P_2O_5 = 1:0.5	25,2	17,2	27,3	17,8	27,9	18,0	28,4	18,4

The fact of a decrease in the content of easily hydrolyzable nitrogen and phosphorus pentoxide (table 2) in the case of standard fertilizers and an increase in the use of a composition based on mono-, dicalcium phosphates with Phyto-zinc microorganisms, an increase in the number of oligratrophs and denitrifiers that decompose humus and nitrate nitrogen of the soil, then when using compassion-based on mono-, dicalcium phosphates with a phytocompound of zinc (options 3 and 4), an increase in the number of reducing and phosphate-mobilizing micro-organisms occurs, a decrease in the number of oligotrophs and nitrate soil nitrogen.

Table 2 – The effect of mono-, dicalcium phosphates with a phytocompound of zinc on the number of soil microorganisms

Options	The number of soil microorganisms, million CFU in 1.0 g of soil			
	freeliving	phosphate-mobilizing	oligotrophs	denitrifiers
Control-soil	0,46	0,58	8,4	6,8
Etalon-1 Soil + MPP + AS N: P_2O_5 = 1:0.5	0,48	0,60	12,7	16,3
Etalon-2 Soil + DPP + AS N:P_2O_5 =1:0.5	0,47	0,61	12,3	16,4
Soil + MPP FSC + AS N: P_2O_5 = 1: 0.5	1,51	2,08	5,8	6,4
Soil + DPP FSC + AS N: P_2O_5= 1: 0.5	1,52	2,09	5,7	6,2

The data obtained are of great theoretical and practical importance for the creation of a new class of phosphorus-containing fertilizers that ensure the presser-vation of soil fertility, increase the efficiency of phosphorus pentoxide fertilizers and obtain high-quality crop yields.

2. Study of the microbiological and agrochemical characteristics of the compositions on a micro-plot experiment on cotton crops. A micro-plot experiment with three replicates was laid in 2019. The experiment is placed in one tier, the size of the plots is 8 m^2, the area for the experiment is 96 m^2. mono-, dicalcium phosphates and their compositions with a phyto-zinc compound were introduced before sowing on April 28, 2019, in combination with harrowing, ammonium nitrate - on June 24, 2019, at the beginning of the budding phase. The agrotechnical of the experiment is generally accepted for the Maktaaral cotton-growing zone. The sowing of seeds was carried out on April 29, 2019. cotton seeds Maktaaral-4005, first reproduction. The micro plot experiment scheme is shown in table 3.

Table 3 – Scheme of micro-plot experiment on light gray soil during cotton cultivation

№	Options	The introduction of the AU in terms of the N phase of budding, g / 8 m^2	Application of MPP, DPP and their composition in terms of P2O5 before sowing, g / 8 m^2
1	Etalon-1. MPP + AS N: P_2O_5 = 1: 0.5	160	80
2	Etalon-2. DPP + AS N: P_2O_5= 1: 0.5	160	80
3	MPP FSC + AS N: P_2O_5 = 1: 0.5	160	80
4	DPP FSTS + AS N: P_2O_5 = 1: 0.5	160	80

Table 4 presents the results of phenological observations, plant growth and development, and the yield of raw cotton. From the data obtained, it follows that the development of plants is ahead in growth in the case of variants where compositions containing a phyto compound of zinc were used, characterized by the height of the main stem, the number of buds, fruit branches, and bolls [5]. If the average yield in the reference variants has a value of 25.7 c/ha, then the compositions containing a phytocompound of zinc provided a yield of raw cotton of 29.6 and 30.0 c/ha, which provides an increase in yield of 3.9 and 4.3 c/ha or 15.1 and 16.7%.

Table 4 – Plant growth and development and the yield of raw cotton

Options	Height of the main stem according to the growing season, cm		The number of buds, pcs.	The number of fruit branches, pcs.	The number of boxes, pcs.	Productivity, c/ha	Average yield increase to benchmarks	
Date	1.06.19	1.09.19	1.07.19	1.08.19	1.09.19	20.10.19	c/ha	%
1	12,0	64,5	5,9	5,3	5,9	25,6	–	–
2	12,1	64,8	6,0	5,3	5,9	25,8		
3	13,6	68,4	7,1	6,2	6,2	29,6	3,9	15,1
4	13,8	68,5	7,1	6,3	6,2	30,0	4,3	16,7

Analysis of soil and plants for the content of nutrients and the number of soil microorganisms in the middle of the growing season according to options (tables 5 and 6) is in good agreement with the data in table 5.

Table 5 – The content of nutrients in the soil (0.0-30.0 cm) and plants in the flowering phase of cotton (light gray soil) (mid-growing season)

Options	Indicators					
	soil, mg / kg			Plant,%		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
1	25,6	15,4	114,0	0,91	0,72	1,0
2	25,9	15,8	114,0	0,91	0,72	1,01
3	28,4	19,1	138,0	0,94	0,74	1,21
4	25,7	19,4	138,0	0,94	0,75	1,20

Table 6 – The effect of mono-, dicalcium phosphates with a phytocompound of zinc on the number of soil microorganisms

Options	The number of soil microorganisms, million CFU in 1.0 g of soil			
	freeliving	phosphatemobilizing	oligotrophs	denitrifiers
1	0,43	0,59	11,4	15,4
2	0,43	0,60	11,3	15,3
3	1,4	1,86	6,6	7,2
4	1,43	1,9	6,5	7,2

It has been shown that compositions containing zinc Phyto compounds (options 3 and 4) contribute to a greater accumulation of nutrients both in the soil and in plants, as well as the number of microorganisms that ensure the preservation of humus and nitrate-nitrogen in the soil [6-7].

Conclusions.

1. On model soil samples, the positive effect of a composition based on mono-, dicalcium phosphates with a phytocompound of zinc on an increase in the number of soil microorganisms affecting the nitrogen and phosphorus nutrition of a plant and a decrease in the number of oligotrophs and denitrifiers decomposing humus and nitrate nitrogen of the soil is shown. Accumulation of nitrogen and phosphorus pentoxide in the soil has been achieved.

2. Under the conditions of a micro-plot experiment, it was determined that the compositions containing a phytocompound of zinc provide an increase in the yield of raw cotton in comparison with the standards - mono-, dicalcium phosphates 3.9 and 4.3 c/ha. The data obtained are in good agreement with phenological observations, the content of nutrients in the middle of the growing season, and the results of microbiological studies.

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Резюме

М. А. Жолмаганбетова, С. Усманов, Ш. Байбащаева,
К. У. Махмудов, Р. У. Махмудов, Х. Усманов

МОНО-, ДИКАЛЬЦИЙФОСФАТ, МЫРЫШ НЕГІЗІНДЕГІ ФИТОТЫҢАЙТҚЫШТАРДЫҢ АЛУ ТЕХНОЛОГИЯСЫН ЖӘНЕ МИКРОБИОЛОГИЯЛЫҚ, АГРОХИМИЯЛЫҚ СИПАТТАМАЛАРЫН ЗЕРТТЕУ

Модельдік топырақ үлгілерінде жеңіл гидролизденетін азотқа және фосфор пентаоксидінің жылжымалы формаларына әсер ететін топырақ микроорганизмдерінің санына мырыш фитоқосылысы бар моно-, дикальций фосфаттары негізіндегі композицияның оң әсері анықталды.

Нәтижеде азотты бекітетін микроорганизмдер санын эталондармен салыстырғанда 3,14-3,2 есеге және фосфатмобилдеуші – 3,4-3,42 есеге арттыруға; топырақтың 11-11,5% жеңіл гидролизденетін азоттың және 7,98-8,14% фосфор пентаоксидінің жылжымалы нысандарының жинақталуына. Сонымен бірге топырақтың қарашірігі мен нитратты азотын ыдырататын олиготрофтар мен денитрификаторлар санының 2,18-2,15 есе және 2,5-2,56 есе төмендеуі топырақ құнарлылығын сақтаудың негізі болып табылады.

Эталондық нұсқаларда, фосфор пентаоксидінің ретоградациясымен байланысты оныңжылжымалы нысандарының мөлшері 6,97-8,12%-ға төмендегені байқалады.

Микробөлшектік тәжірибе жағдайында құрамында мырыштың фитоқосылысы бар композициялар эталондар – моно-, дикальцийфосфаттар мен салыстырғанда-шитті мақта дақылының өнінің артуын 3,9 ц/га және 4,3 ц/га анықталды. Алынған деректер фенологиялық бақылауларға, вегетациялық кезеңнің ортасында қоректік заттардың құрамына және микробиологиялық зерттеулердің нәтижелеріне сәйкес келеді.

Түйін сөздер: құрамында фосфор бар тыңайтқыштар, мырыш, моно-, дикальций фосфаты, фитоқосылыс, фитопрепараттар.

Резюме

М. А. Жолмаганбетова, С. Усманов, Ш. Байбащаева,
К. У. Махмудов, Р. У. Махмудов, Х. Усманов

ИССЛЕДОВАНИЕ ТЕХНОЛОГИЙ ПОЛУЧЕНИЯ МИКРОБИОЛОГИЧЕСКИХ И АГРОХИМИЧЕСКИХ ХАРАКТЕРИСТИК ФИТОУДОБРЕНИЙ НА ОСНОВЕ МОНО-, ДИКАЛЬЦИЙФОСФАТА С ФИТОСОЕДИНЕНИЕМ ЦИНКА

На модельных почвенных образцах установлено положительное влияние композиции на основе моно-, дикальцийфосфатов с фитосоединением цинка на численность почвенных микроорганизмов, влияющих на азотное и фосфорное питание растений и накопление в почве легкогидролизуемого азота и подвижных форм пентаоксида фосфора. Достигнуто: повышение численности азотфиксирующих микроорганизмов в сравнение с эталонами в 3,14-3,2 раза и фосфатмобилирующих – 3,4-3,42 раза; накопление в почве 11-11,5 % легкогидролизуемого азота и 7,98-8,14 % подвижных форм пентаоксида фосфора. При этом снижение численности олиготрофов и денитрификаторов, разлагающих гумус и нитратный азот почвы в 2,18-2,15 раза и 2,5-2,56 раза – основа сохранения почвенного плодородия.

В эталонных вариантах наблюдается снижение содержания подвижных форм пентаоксида фосфора на 6,97-8,12 %, что связано с ретоградацией пентаоксида фосфора. В условиях микроделяночного опыта определено, что композиции содержащие фитосоединение цинка обеспечивают прибавку урожая хлопка-сырца в сравнении с эталонами – моно-, дикальцийфосфатами 3,9 и 4,3 ц/га. Полученные данные хорошо согласуются с фенологическими наблюдениями, содержанием в середине вегетации питательных элементов и результатами микробиологических исследований.

Ключевые слова: фосфорсодержающие удобрения, цинк, моно-, дикальцийфосфат, фитосоединения, фитопрепараты.

Information about authors:

Zholmaganbetova Marzhan Amanbaevna	PhD student, Kazakh National Women's Pedagogical University, Almaty, the Republic of Kazakhstan; marzhan.zholmaganbetova.75@mail.ru; https://orcid.org/0000-0002-7057-3969.
Usmanov Sultan	Doctor of technical science, professor, “A.B. Bekturov Institute of Chemical Sciences” JSC,Almaty, the Republic of Kazakhstan; usmanov_su@mail.ru; https://orcid.org/0000-0002-9747-3589.
Baybashchaeva Shinar	Research associate, “A.B. Bekturov Institute of Chemical Sciences” JSC, Almaty, the Republic of Kazakhstan; 78 bs.shinar@mail.ru; https://orcid.org/0000-0002-6071-9362.
Makhmudov Kamal	Senior researcher, LLP "Scientific and Production Association" Ana-Zher ", Almaty, Republic of Kazakhstan; k.mahmudov@mail.ru; https://orcid.org/0000-0002-9963-6732
Makhmudov Ravshan	Senior researcher, LLP "Scientific and Production Association" Ana-Zher ", Almaty, Republic of Kazakhstan; ravshan.m@mail.ru; https://orcid.org/0000-0002-6076-3574.
Usmanov Hozra tSultanovish	Candidate of technical science, Senior researcher, LLP "Scientific and Production Association" Ana-Zher ", Almaty, Republic of Kazakhstan; h.usmanov@mail.ru; https://orcid.org/0000-0003-1669-357X.