

PHOSAGRO IN BRAZIL:

EXPERIMENTAL RESULTS ON SOYBEAN AND CORN SHOW THE ADVANTAGES OF PHOSAGRO FERTILIZERS

PhosAgro launched agronomic operations in Brazil in September 2018. The main brands for promotion in the Brazilian market include ammonium-phosphate-sulphate NP(S) 14:40(7), as well as complex NPK(S) 15:15:15(10), 12:32:16(1), and 10:26:26(2). These fertilizers were used to deploy 6 tests in different regions of Brazil with soybean, wheat, corn, sugarcane and cotton.

TEST ON SOYBEAN IN BRAZIL

The PhosAgro Agricultural Service remains active in Brazil. Tests have been deployed on the leading crops cultivated in the country's fields: soybean, corn, wheat, sugarcane. By the end of the year a test on cotton plant is planned to be deployed. The geographical extent of the research is impressive, from the Mato Grosso region in the west-central part of the country to the Rio Grande do Sul in southern Brazil. Two PhosAgro brands have been tested: ammophos NP (S) 12:52(1,5) and NPK(S) 1:20:20 (5). For testing, we have chosen soybean, which, according to the Food and Agriculture Organization of the United Nations (FAO), ranks first in the region in terms of crop area. To date, we have obtained our first field test results for our products on the South American continent. The Fundação MT Institute, one of Brazil's most respected agricultural research institutions, was the test operator. Both fertilizers produced good results and, most interestingly, proved to be top performers in terms of yields.



WORLD'S MOST POPULAR PHOSPHATE FERTILIZER

PhosAgro has been producing ammophos, the world's most popular phosphate fertilizer for more than 20 years. In the Latin American market, it has to compete with similar Moroccan and Chinese brands. When choosing soybean fertilizers, the efficiency of Russian ammophos is naturally questioned by consumers—Brazilian farmers, who are not well familiar with our product. This is particularly relevant in the Cerrado region, where soils are characterized by low natural fertility and phosphorus content in the arable soil. Besides, both our and foreign fertilizers of this brand face complex conditions, where plants have to compete with aluminum and ferrous ions absorbing phosphorus, otherwise available to the plant root system, due to their significant amount in local soils, which often causes ochre-red coloration of the latter.

On the red soils of equatorial Brazil, there is the practice of fertilizing soils under soybeans with phosphogypsum, ammophos and potassium chloride. Our product, despite the abundant tropical rainfall accompanying the growing soybean plantations, showed results above the regional average (compared

to data published in CONAB's June 9th review).

The yields from the applied fertilizer systems exceed the reference yields by more than a third when no fertilizers have

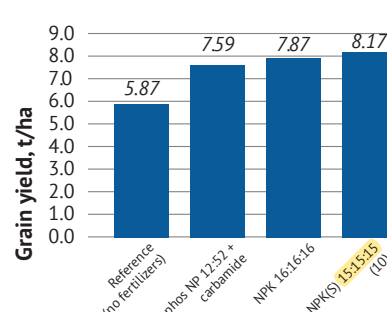
	Yield, t/ha
No fertilizers	3.07
PhosAgro Ammophos	4.11
Ammophos made in China	4.04
Ammophos made in Morocco	4.02

been applied at all, i.e. they show stable results. The highest yield in 2019, 4.11 t/ha, was obtained by applying ammophos produced by PhosAgro.

RESULTS OF FIELD TEST FOR CORN WITH DIFFERENT FERTILIZER BRANDS

The efforts of our manufacturers and chemists resulted in the high efficiency of our products in various soil-climatic areas both in Russia and around the globe. Agricultural marketing experts in Brazil obtained the results of NPK(S) 15:15:15 (10) field test. The test conducted in 2019 on corn clearly demonstrated the need to use sulfur-containing complex fertilizers to increase the grain yield of this crop. The maximum grain yield, 8.17 t/ha, was achieved with NPK(S) 15:15:15 (10). Grain yield was 4% higher than the test option with only nitrogen, phosphorus and potassium introduced.

The effect of sulfur-containing complex fertilizer produced by PhosAgro on Brazil's Corn productivity (2019)

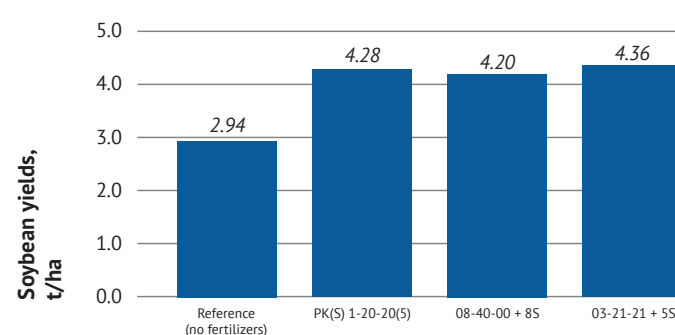


DEMAND FOR PK (S)

The main requirement of Brazilian market customers is that nitrogen in the fertilizer brand for the most popular crop, the soybean, should be below 10%. PhosAgro's manufacturers successfully address this task by producing and delivering PK(S) 0:20:20(5) to the South American continent. The brand does not only meet the marketing needs of soybean producers but

also provides high agronomic efficiency. In the test organized by PhosAgro's Agricultural Service, the selected brand demonstrated high yield results and was just as good as the competitive brands and products that have long been established in the Brazilian market.

Results of soybean test with PK(S) 1-20-20(5)



STRONG MARKET PRESENCE

Conducting workshops for customers of PhosAgro Americas (trading company of PhosAgro Group in Brazil)

Brazil's agricultural market is booming. Here, manufacturers from around the globe present their agrochemicals. PhosAgro has long established itself as a reliable supplier of quality products in its priority Russian market, and Brazil is also a premium market for us. Since the beginning of the year, we have been conducting workshops and training to familiarize the local market with the PhosAgro product line, including environmentally friendly phosphorus fertilizers. During workshops in Sao Paulo, in the states of Parana and the Rio Grande do Sul, the PhosAgro Agricultural Service held a number of meetings and training sessions for the major distributors, OUROFERTIL, BRFertiL, LDC, COONAGRO, which sell fertilizers to farmers in Brazil. The events also featured presentations on PhosAgro's history, product portfolio, specifics of production and competitive advantages of the company's products, as well as the first results of tests on soybeans and corn in 2019. The Brazilian partners showed particular interest in sulfur-containing brands NPK(S) 15:15:15(10), NP(S) 14:40(7) and PK(S) 20:20(5).



PHOSAGRO HELD A FIELD DAY IN THE KRASNODAR KRAI

PhoSagro held a Field Day at its agricultural test site arranged in the fields of the Kuban branch of AgroGard JSC in Vyselkovsky district of Krasnodar Krai.



The event was attended by several dozens of agricultural companies of the Krasnodar Krai, teachers and students of leading agricultural universities in Russia, the Kuban State Agrarian University and the Russian State Agrarian University – Moscow Timiryazev Agricultural Academy.

At the opening of the event, PhosAgro Deputy General Director for Sales and Marketing Sergei Pronin said, "This is the fourth and

and regional administrations. We have something to show at each and every site of ours in the Oryol, Moscow, Saratov regions, in the Krasnodar Krai: PhosAgro solutions really work. This is part of PhosAgro's commitment to improving the fertility of Russian soils.

The agricultural test site's soils were initially marked by imbalanced nutrient levels: sulfur deficiency, moderate phosphorus and high potassium levels. In this respect, a formula based on complex and phosphorus fertilizers with sulfur and micronutrients NP-K(S) 15:15:15(10) + 0.3B, NP(S) 20:20(14) + 0.4Zn was applied for sunflower and corn. NP 11:37 liquid complex fertilizer (LCF) containing dissolved phosphorus was used as a pre-sowing fertilizer and foliar fertilizer.

The observations of crops revealed the maximum accumulation of vegetative mass



final Field Day, which we are holding at our four own agricultural sites in Russia this season. We're conducting it in the Kuban, the most fertile land. I want to thank the owners of these lands, the Agro-Gard company, one of the leading Russian agricultural holdings with which we have been cooperating for many years, we have been trying various methods of applying mineral fertilizers on their fields, and achieving excellent results. We are grateful to our partners in the agricultural technology sector, our advisors from agricultural universities



On a test field of 15 hectares, mineral nutrition systems were presented for the main agricultural crops of the region: winter wheat, soybeans, sugar beets, sunflowers and corn. Sunflower and corn hybrids were provided by Limagrain and Bayer, equipment for spring field work was provided by Eurotehnika AMAZONE; plant protection agents – by BASF, Bayer, Shchelkovo Agrochem and August Firm. PhosAgro, in turn, provided the agricultural test site with highly efficient environmentally friendly mineral fertilizers.



Exposition of the main brands of PhosAgro mineral fertilizers

in the corn crops in the version with urea and NP(S) + Zn 20:20(14)+0.4Zn, and sunflower in the version with pre-sowing application of LCF in a dose of 100 kg/ha.

For the sugar beet, demanding the presence of potassium and calcium in the soil, fertilizers

with calcium NPK(S) + CaO 5:15:30(5) were used, which ensured a crop yield of 418 c/ha and 16.45% sugar content, even amidst the heat and almost no rain in the region this summer."

— 80% of the specialists currently employed in the agricultural industry of the Krasnodar Krai have graduated from the Kuban State Agrarian University. This Field Day is a unique opportunity for teachers and students of our university to learn and discuss the agronomic practices of the two largest companies in their fields, PhosAgro and AgroGard. Last year, the PhosAgro-Region network opened its own training center at the university, and today, students have the opportunity to see how fertilizers work in the fields, and make direct contacts with company specialists. We are grateful to



Gathering of participants before the opening of the agricultural test site

PhosAgro for their contribution to the agricultural education of the Kuban, said Alexander Trubilin, Rector of the Kuban State Agrarian University, on the Field Day.

— In the Kuban, PhosAgro and AgroGard are holding the second Field Day, where we show tests that have already produced impressive practical results. Two of the four AgroGard enterprises operating in the Krasnodar Krai, in the Vyselkovsky and Korenovsky districts, exceeded the threshold of 70 metric centners per hectare for wheat and barley. Having

unique expertise, we will continue to share our practices on the proper use of high-performance PhosAgro fertilizers in other regions where there are AgroGard branches and where PhosAgro tests are especially in demand, said Pavel Tsaryov, General Director of AgroGard JSC.

PhosAgro agricultural test sites—four scientific and technological sites in the Oryol, Moscow, Saratov regions and the Krasnodar Krai, designed to test, demonstrate and train agricultural producers in the effective use of plant mineral nutrition systems and technologies. Agronomic solutions based on a wide range of PhosAgro mineral fertilizers, the best examples of domestic breeding and modern plant protection agents are used at the agricultural test sites to preserve soil fertility and obtain quality yields. Major federal and regional research organizations, Russian and world leaders in the field of breeding, agricultural machinery and plant protection agents, developers of precision agriculture technologies engage in organizing the work of agricultural test sites.

COMPARATIVE EFFICIENCY OF APPLICATION OF LCF AND SOLID PHOSPHORUS FERTILIZERS IN LITHUANIA

FIELD TEST AT THE RUMOKAI EXPERIMENTAL STATION OF THE LITHUANIAN
RESEARCH CENTER FOR AGRICULTURE
AND FORESTRY ON SPRING WHEAT (2019)

Liquid phosphorous fertilizers in a range of soil and climatic conditions contribute to higher crop yields compared to solid phosphorous fertilizers. This is due to a decrease in the fixation of phosphorus by the soil when using liquid phosphorus fertilizers. This consequently increases the availability of phosphorus for plant root systems from fertilizers introduced into the soil.

A field experiment to study the effect of LCF NP 11:37 and different brands of granular complex fertilizers (amorphous NP 12:52, NPK 10:26:26, NPK 15:15:15) on the yield and quality of spring wheat grain was carried out in 2019 at Rumokai experimental station of the Lithuanian Research Center for Agriculture and Forestry. Spring wheat variety Quintus was grown in the experiment. The loamy soil had a good supply of mobile phosphorus and potassium before the test was deployed.

The field experiment scheme included seven options (Table 1). LCF NP 11:37 was introduced in spring before sowing spring wheat using a sprayer. Granular complex fertilizers and potassium chloride were also introduced in the spring before sowing using a spreader. During the vegetation period, spring wheat was fertilized twice with ammonium nitrate by scattering.

TABLE 1. SPRING WHEAT FIELD TEST SCHEME

No.	Test option (fertilizers)	Dose, kg/ha		Dates and ways of application
		physical weight	equiv. to primary nutrients	
1	LCF NP 11:37	80	N ₉ P ₃₀	With a sprayer pre-sowing
	Ammonium nitrate	165	N ₅₆	1st fertilization by scattering
		100	N ₃₄	2nd fertilization by scattering
2	Ammophos NP 12:52	115	N ₁₄ P ₆₀	By scattering pre-sowing
	Ammonium nitrate	150	N ₅₁	1st fertilization by scattering
		100	N ₃₄	2nd fertilization by scattering
3	LCF NP 11:37	160	N ₁₈ P ₆₀	With a sprayer pre-sowing
	Ammonium nitrate	197	N ₆₇	1st fertilization by scattering
		59	N ₂₀	2nd fertilization by scattering
4	Ammophos NP 12:52	175	N ₂₁ P ₉₁	By scattering pre-sowing
	Ammonium nitrate	147	N ₅₀	1st fertilization by scattering
		88	N ₅₀	2nd fertilization by scattering
5	NPK 10:26:26	230	N ₂₃ P ₆₀ K ₆₀	By scattering pre-sowing
	Ammonium nitrate	147	N ₅₀	1st fertilization by scattering
		79	N ₂₇	2nd fertilization by scattering
6	LCF NP 11:37	80	N ₉ P ₃₀	With a sprayer pre-sowing
	Potassium chloride	100	K ₆₀	By scattering pre-sowing
	Ammonium nitrate	162	N ₅₅	1st fertilization by scattering
		59	N ₂₀	2nd fertilization by scattering
7	NPK 15:15:15	400	N ₆₀ P ₆₀ K ₆₀	By scattering pre-sowing
	Ammonium nitrate	59	N ₂₀	1st fertilization by scattering
		59	N ₂₀	2nd fertilization by scattering

Table 2 presents the spring wheat yield structure when using different forms of phosphorus fertilizers. The significantly better productive tillering capacity of spring wheat was observed in test option No. 3 with the application of LCF NP 11:37 at a phosphorus dose of 60 kg of P2O5/ha. And the maximum length of the stalk, as well as the ear length, were obtained in test No. 2 with the application of amorphous NP 12:52 in the same phosphorus

dose. The maximum grain yield of spring wheat 4.28 t/ha was obtained in the test option No. 1, where LCF NP 11:37 was applied in the minimum phosphorus dose equal to 30 kg P2O5/ha. The application of higher phosphorus doses (60–90 kg P₂O₅/ha) in the form of granular complex fertilizers did not lead to an increase in grain yield. The inclusion of potassium in the spring wheat nutrition program also did not produce a positive

TABLE 2. SPRING WHEAT YIELD STRUCTURE

Test option No.	Number of productive stalks, pcs/m ²	Stalk length, cm	Ear length, cm
1	278	39.9	9.0
2	307	41.9	9.5
3	325	39.7	8.8
4	246	39.6	9.2
5	266	31.9	9.1
6	293	41.1	8.9
7	266	40.9	9.0



Field Day, Scandagra

result. The crop productivity results are explained by the high soil levels of phosphorus and potassium. These conditions justify the application of a low dose of phosphorous fertilizers.

In terms of Russian standards for the quality of the soft wheat grain, all test options produced the grain of at least grade 3 according to RF GOST (Table 3). Judging by the grain unit indicator (<745 g/l), all test options demonstrated low grain plumpness with insufficient atmospheric

moistening. Sedimentation analysis showed that all test options had yielded high-quality wheat in terms of the flour baking strength index, which can be obtained from this grain (sedimentation index > 60 ml).

Fig. 1 Spring wheat grain yield

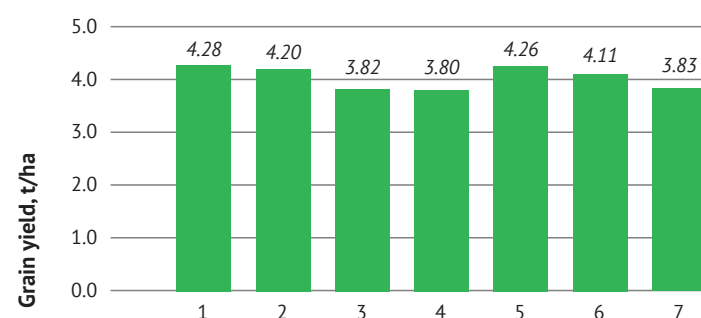


TABLE 3. SPRING WHEAT GRAIN QUALITATIVE INDICATORS

Test option No.	Protein	Starch	Gluten	Sedimentation index, ml	Grain unit	
	%				kg/hL	g/L
1	16.7	61.0	32.6	69.4	74.0	740
2	16.7	60.8	32.3	68.7	74.0	740
3	17.1	60.4	33.1	70.0	73.4	734
4	17.1	60.3	33.4	70.1	73.4	734
5	16.8	61.0	32.6	68.8	74.2	742
6	17.0	60.7	33.1	70.1	74.2	742
7	17.0	60.5	33.3	70.0	73.9	739

FIELD EXPERIMENT AT THE VOKEISK EXPERIMENTAL STATION OF THE LITHUANIAN
RESEARCH CENTER FOR AGRICULTURE AND FORESTRY
ON SPRING WHEAT (2019)

A field experiment to study the effect of liquid complex fertilizer LCF NP 11:37 and different brands of granular complex fertilizers on the yield of spring wheat grain was carried out in 2019 at the Vokeisk experimental station of the Lithuanian Research Center for Agriculture and Forestry. Light soils are widespread in this region.

The field test scheme included 8 options. LCF NP 11:37 was introduced in spring before sowing spring wheat using a sprayer. Granular complex fertilizers and potassium chloride were also introduced in the spring before sowing using a spreader. During the vegetation period, spring wheat was fertilized twice with ammonium nitrate by scattering.

The vegetation period of 2019 was marked by arid weather conditions. In these spring wheat cultivation conditions, the application of **LCF NP 1137** had obvious advantages over solid phosphorus fertilizers (Fig. 2). With the same doses of nitrogen, phosphorus, and potassium, the use of **LCF NP 1137** increased the yield of spring wheat by 7–14% compared to granular phosphorus complex fertilizer options.

The use of LCF NP 11:37 reduced the amount of phosphorus immobilized by the soil and increased its availability for plants. These soils immobilize phosphorus by employing sesquioxides of iron and aluminum, as well as calcium carbonate.

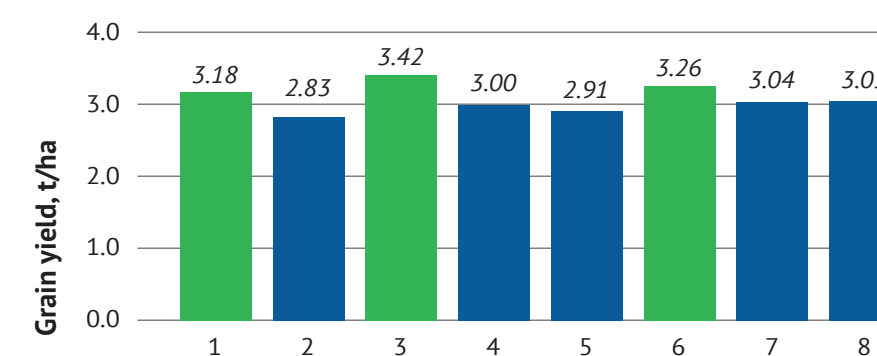
Test options

- 1) $N_{103}P_{59}$: **LCF NP 11:37** (160 kg/ha) + ammonium nitrate (150+100 kg/ha)
- 2) $N_{99}P_{60}$: **ammophos NP 12:52** (115 kg/ha) + ammonium nitrate (150+100 kg/ha)
- 3) $N_{97}P_{91}$: **LCF NP 11-37** (245 kg/ha) + ammonium nitrate (147+59 kg/ha)
- 4) $N_{101}P_{91}$: **ammophos NP 12:52** (175 kg/ha) + ammonium nitrate (147+88 kg/ha)
- 5) $N_{100}P_{60}K_{60}$: **NPK 10:26:26** (230 kg/ha) + ammonium nitrate (147+79 kg/ha)
- 6) $N_{88}P_{59}K_{60}$: **LCF NP 11:37** (160 kg/ha) + potassium chloride (100 kg/ha) + ammonium nitrate (147+59 kg/ha)
- 7) $N_{100}P_{60}K_{60}$: **NPK 15:15:15** (400 kg/ha) + ammonium nitrate (59 + 59 kg/ha)
- 8) $N_{100}P_{60}K_{60}$: **S42 Zn1,2: NP(S) + Zn 20:20** (14) + 0.4Zn (300 kg/ha) + potassium chloride (100 kg/ha) + ammonium nitrate (59 + 59 kg/ha)

CONCLUSIONS

1. The maximum spring wheat grain yield (4.28 t/ha) cultivated on loamy soil with a good supply of mobile forms of phosphorus and potassium was obtained in the test version with pre-sowing application of LCF NP 11:37 at a dose of 80 kg/ha (30 kg R_2O_5 /ha).
2. The application of granular complex fertilizers in higher phosphorus doses (60–90 kg of P_2O_5 /ha) did not lead to an increase in the spring wheat yield.
3. All test options yielded high-quality grain with high baking quality of flour, which can be obtained from this grain.

Fig. 2 The effect of PhosAgro liquid and solid phosphorus fertilizers on spring wheat grain yield (Vokeisk experimental station of the Lithuanian Research Center for Agriculture and Forestry, 2019)



Workshop for Kauno Grūdai managers during the exhibition
AGROVIZIJA

The use of LCF NP 11:37 for spring wheat in Lithuania increased grain yield by 7–14% compared to the granular complex phosphorus fertilizers.



Spring wheat plants in field test options with the application of PhosAgro liquid and solid complex phosphorus fertilizers (Vokeisk experimental station of the Lithuanian Research Center for Agriculture and Forestry, 2019)



Evaluation of the test results