Federal State Budgetary Scientific Institution

"I. V. Michurin Federal Scientific Center"

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Director of FSBSU

"I. V. Michurin Federal Scientific Center"

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REPORT

on agrochemical test of EKO-SP + Fertilizer, based on humic substances, brand: A on potatoes

Executor:

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Name of the agrochemical.

EKO-SP + fertilizer, based on humic substances, brand: A

The purpose of the tests.

Determining of the biological effectiveness of an agrochemical EKO-SP + Fertilizer, based on humic substances, grade: A on potatoes.

Characteristics of the agrochemical.

Fertilizer, based on humic acids

Nutrient content (quality indicators).

Indicator name	Content
	Brand A
Content of humic acids, g/l	13 -17
Dry solids weight ratio, %	2,0 - 3,5
Organic matter content, %	65 - 75
Hydrogen ion activity indicator, pH	7 - 8,5
Density, g/cm^3	1,0 - 1,05

Preparative form (appearance).

Brand A - liquid from dark brown to black.

Brief characteristic of the variety

The study was carried out in a field experiment on potatoes of the Sante variety.

Mid-season Dutch table variety with high productivity. Suitable for mechanical harvesting and treatment. Has good and excellent taste. Suitable for frying. Requires a wide row spacing. Adapted for the climatic conditions of central and southern Russia. Ripening stage is 85-90 days. Starch content is 15-16%. The average weight of tubers (grams) is 90-120. The number of tubers on a bush is up to 20. Productivity is up to 570 kg/ha. Consumer qualities: good taste, ideal for cooking fried potatoes and French fries, the flesh does not darken when cut. Keeping quality (storageability) is 92%. The skin color is yellow, the flesh color is light yellow. Disease resistance: liable to late blight on the tops (tubers are resistant), susceptible to common scab.

Potatoes were planted on May 7, 2020. Planting rate of seeds 43000 pcs/ha. Harvesting was on September 1, 2020.

Agricultural technology, records and observation in experiment.

In the experiment, the following agrotechnical measures, records and observations were carried out:

1. Spring soil cultivation;
2. Ridge tillage;
3. Planting potatoes;
4. Phenological observations of plant development - during the growth;
5. Agrochemical treatment according to the experiment scheme;
6. Spraying potato plants with herbicides, fungicides and insecticides;
7. Manual harvesting of potatoes from each plot with sampling for determination of biochemical indicators;
8. Determination of biochemical indicators in potato tubers;
9. Processing experimental data and writing a report.

Brief description of the testing zone

The Tambov Region occupies the central part of the Oka-Don plain. The relief is gently undulating, dissected by draws and ravines. Forests (pine, oak, maple, linden, ash, birch, aspen) occupy about 10% of the territory. The region is located in the forest-steppe zone. The soils are typical deep chernozems, in the south - leached, in the north - gray forest soils. Along valleys and graws, there are meadow chernozem and peat-bog. The climate of the Tambov region is moderately continental. The average temperature in January is -8...-9 ° C, in July + 19...+ 20 °C. The average annual precipitation is from 450 to 550 mm. The city of Michurinsk-Science City of the Russian Federation is located in the western part of the Oks-Don Plain, on the right bank of the Lesnoy Voronezh River (basin of the Don River).

Agrochemical soil characteristics

The soil of the experimental plot is heavy clayloam medium-leached chernozem of medium thickness on loess loam. The soil contains 4-6% of humus, is highly saturated with footings (70-90%). The depth of the humus layer is on

average 50-60 cm. The reaction of the upper soil layers is slightly acidic (pH = 5.7). The structure of the soil is granular-pulverescent and lumpy-granular. The presence of pores in the upper layers reaches 65%. The normal field capacity of the tilth top soil is about 30%.

The content of easily hydrolyzable nitrogen is 186.7 mg/kg according to Tyurin and Kononova, mobile phosphorus is 178.7 mg/kg of soil and exchangeable potassium is 171.0 mg/kg according to Chirikov in the modification of CRIAS.

Weather conditions for the growth

Table 1. Meteorological conditions for the growth of 2020 (according to the data of the Tambov CHEM - a branch of the Federal State Budgetary Institution "Central Chernozem DHEM")

Indicator	Decade	Month				
		april	may	june	july	august
Average month air temperature, °C		6.0	12.7	19.9	20.8	19.0
Maximum air temperature, °C		21.4	27.4	31.0	35.3	32.6
Minimum air temperature, °C		-7.4	2.1	9.5	8.6	14.3
Average long-term average month air temperature, °C		6.8	14.5	18	19.4	18.1
Precipitation by decade, mm	I	2	38.5	61.8	33.2	3.1
	II	21	17.2	0.6	2.3	8.6
	III	4.5	16.5	43.0	10.5	4.0
	∑	27.5	72.2	105.4	46.0	15.7
	Average long-term	37	52	56	70	60
Relative air humidity, %	I	43	62	71	63	57
	II	61	60	54	63	61
	III	51.8	65	63	54	55
	Average	52	62	63	60	57
	Average long-term	74	62	63	68	69

In general, the weather conditions during the growth of 2020 differed from the average long-term values.

Weather conditions in April 2020 did not differ significantly from the average long-term values.

The average decade temperature In the first decade was 4.9 °C (1.7 °C above the norm), while the maximum reached 18.3 °C (April 8), and the minimum -7.6 °C (April 1). The amount of precipitation over the decade was 2.0 mm (17% of the

norm for the decade). Average relative air humidity 43%: 8 days per decade with a relative air humidity of less than 30%. During the daytime the temperature on the soil surface ranged from 22 °C to 39 °C, and at night was from -7 °C to 3 °C. Second decade of April was characterized by a drop in temperature and frequent precipitation. So the average decade air temperature was 4.8 °C (2.0 °C below the norm). In total, there were 21 mm of precipitation over a decade (175% of the norm for a decade). The wind speed was 10 - 12 m/s. The temperature on the soil surface ranged from -3 °C to 31 °C. Average relative air humidity was 61%: 3 days per decade with relative air humidity less than 30%. In the third decade of April, the weather was relatively cool. The average air temperature for a decade is 8.4 °C, which is 2.0 °C below the norm. Wind gusts up to 16 m/s were recorded everywhere. The total amount of precipitation over the decade was 4.5 mm (3.5% of the norm). The average relative air humidity was 52%, values of 30% and below were recorded for six days. The temperature on the soil surface ranged from -3 °C to 44 °C.

The average month air temperature in April was 6.0 °C, which is 0.8 °C higher than the norm. The amount of precipitation for the month was 27 mm, which corresponds to 74% of the norm.

During the first decade of May, the average air temperature was 13.9 °C, which is 1.1 °C higher than the norm. The maximum temperature ranged from 15.1 °C to 26.5 °C, and the minimum ranged 4.1-14.7 °C. The total amount of precipitation for a decade was 38.5 mm (226% of the norm for a decade): three days in a decade with precipitation of more than 5 mm (May 6, 8, 10). The average relative air humidity was 62%. The temperature on the soil surface ranged from 2 °C to 47 °C. The second decade of May was characterized by a decrease in air temperature (from 2.2 to 24.6 °C): the average temperature for a decade was 11.0 °C, which is 3.5 °C colder than the norm. In total, there were 17.2 mm of precipitation over the decade (101% of the norm). The average relative air humidity was 60%. The temperature on the soil surface ranged from 2 °C to 34 °C. The third decade of May was also characterized by lower (relative to average long-

term) values of air temperature: the average decade values of the indicator were 13.2 °C, which was 3.0 °C colder than the norm. At the same time, at the beginning of the decade, the minimum air temperature reached 2.1 °C. The total amount of precipitation over the decade was 16.5 mm (92% of the norm for the decade). The average relative air humidity was 65%. Moreover, its minimum values reached 30% and below for two days. The temperature on the soil surface ranged from 2 °C to 47 °C.

The average air temperature for the month was 12.7 °C (deviation from the norm was 1.8 °C). The maximum temperature for the month was 27.4 °C, the minimum - 2.1 °C. The amount of precipitation for the month was 72.2 mm (134% of the norm).

In the first decade of June, the average air temperature was 18.5 °C, which was 1.2 °C higher than the norm. At the same time, the maximum air temperature reached 28.3 °C, and the minimum 9.5 °C. For June 2-3, there were 54.2 mm of precipitation, and the average for a decade was 61.8 mm (343% of the norm). The average relative air humidity values were 55%. The temperature on the soil surface ranged from 10 °C to 50 °C. During the second decade of June, the weather was hot, without precipitation. In the daytime, the air warmed up to 31.0 °C, and the average decade temperature was 22.2 °C (4.1 °C above the norm). The maximum temperature on the soil surface reached 50 °C. The amount of precipitation was 0.6 mm (3% of the norm). The relative air humidity was 54%, while during two days they reached 30% and below. Also during the decade, 8 days with downy mildew were recorded (the total duration was 65 hours). The third decade of June was characterized by hot and rainy weather. The average air temperature was 19.1 °C (0.5 °C above the norm); 43.0 mm of precipitation in 5 days were 226% of the norm for a decade. The average relative air humidity values were 63%. The temperature on the soil surface ranged from 10 °C to 50 °C.

The average air temperature in June was within 19.9 °C (deviation from the norm was 1.9). The absolute maximum temperature for the month was 31 °C, the absolute minimum air temperature was 9.5 °C. The amount of precipitation for the

month was 105.4 mm (188% of the month norm).

In the first decade of July, frequent precipitation with thunderstorms was noted; wind gusts of 16-20 m/s are fixed. The maximum air temperature was recorded on July 7-8 (34.9 °C and 35.3 °C, respectively); the soil surface was warmed up to 50 °C. There were 33.2 mm of precipitation, which was 144% of the decade, and 47% of the month. The average relative air humidity was 63%. The average air temperature in the second decade of July was 19.4 °C, which is 0.1 °C colder than the norm. There were 2.3 mm of precipitation, which was 10% of the decade. The soil surface was warmed up to 50 °C. The third decade of July was characterized by hot weather: the average air temperature over the decade was 20.0 °C, which is 0.5 °C warmer than the norm; there were 10.5 mm of precipitation, which was 44% of the decade; the maximum wind speed reached 10-12 m/s in the first days of the decade.

The average month air temperature in July was 20.8 °C, which was 1.4 °C higher than the norm, the absolute minimum was 8.6 °C, the absolute maximum reached 35.3 °C. The amount of precipitation for the month is 46.0 mm (65.7% of the norm).

The average air temperature in the first decade of August was 19.9 °C, which was 1 °C warmer than the norm. In total for the decade, the amount of precipitation was 3.1 mm (16% of the decade and 5% of the month norm), the average relative air humidity over the decade was 57%. The average temperature values in the second decade of August was 17.2 °C, which was 1.2 °C below the norm. There were 43% of precipitation from the decade, 29% of the month and amounted to 8.6 mm. Average decade relative air humidity is 61%. In the third decade of August, the average air temperature was 19.0 °C, which was 2.2 °C warmer than the norm. In total, there were 4 mm of precipitation over the decade (20% of the decade norm and 26% of the month norm), the relative air humidity was 55%.

Thus, the average temperature in August 2020 turned out to be 0.9 °C above the norm and amounted to 19.0 °C. The maximum air temperature was 32.6 °C, the

minimum was 14.3 °C. The amount of precipitation per month was 15.7 mm (26.2% of the norm).

Table 2. Meteorological data on the day of treatment

Treatment date	May 25	June 16
Temperature	11,2^{0}C	21,8 ^{0}C
Atmosphere pressure	755 mm Hg	751 mm Hg
Air humidity	67%	44%
Wind speed	2 m/s	2 m/s
Wind direction	S	SE

Experimental design

1. Control. Background NPK
2. Background NPK + EKO-SP + Fertilizer, based on humic substances. Spray application of plants - 1st in the phase of full seedlings, 2nd in the budding phase, consumption of agrochemical - 1.0 l/ha, consumption of working solution - 300 l/ha.
3. Background NPK + EKO-SP + Fertilizer, based on humic substances. Spray application of plants - 1st in the phase of full seedlings, 2nd in the budding phase, consumption of agrochemical - 1.5 l/ha, consumption of working solution - 300 l/ha.
4. Background NPK + EKO-SP + Fertilizer, based on humic substances. Spray application of plants - 1st in the phase of full seedlings, 2nd in the budding phase, consumption of agrochemical - 2.0 l/ha, consumption of working solution - 300 l/ha.

The area of the experimental plots is 100 m^2, the area of the registration plots is 50 m^2. The experiment was repeated four times.

Study procedure.

Field plot studies of the studied agrochemical for the productivity and quality of potatoes were carried out in full accordance with the standard methods, set forth in the following editions "Study Methods for Potato Culture", M., 1967; "Methodology of physiological and biochemical studies on potato culture", M., 1989; "Study procedure for the protection of potatoes from diseases, blasts, weeds and immunity", M., 1995.

Phenological observations of the onset of development and growth phases of potato plants were carried out (according to the method of SRIPF, 1967).

The onset of the following phases of plant development was noted:

- Seedlings (Figure 1);
- Budding;
- Flowering (Figure 2);
- Top necrosis (Figure 3).

Figure 1 - Phase of full seedlings of potatoes in the experimental plot (25/05/2020)

Figure 2 - Flowering phase (full) of potatoes in the experimental plot (10/07/2020)

Figure 3 - Phase of potato top necrosis in the experimental plot (26/08/2020)

The accounting and structure of the harvest of potato tubers was carried out from each plot, weighing the fractions separately: small fraction - tubers with a transverse diameter less than 30 mm; seed - from 30 to 60 mm in transverse diameter; food - tubers with a transverse diameter of more than 60 mm.

In the harvested potatoes, the following was determined:

- Starch content (GOST 26176 - 87)
- Nitrate content (GOST 29270-95)

Dispersion and correlation analyzes of the experimental data were carried out according to B.A. Dospehov, 1985.

Study results

In our experiment, the duration of the growth of potato of Sante variety - from seedlings (25/06/2020) to harvesting (01/09/2020) was 98 days (Table 3).

Table 3. Phenological observations of the development of potato plants.

Variant	Planting	Seedlings		Budding		Flowering		Top necrosis		Harvesting
		start.	full	start.	full	start.	full	start.	full	
Control	7.05	20.05.	25.05.	12.06.	16.06.	25.06.	10.07.	19.08.	no	1.09.
EKO-SP + 1,0 l/ha	7.05	20.05.	25.05.	12.06.	16.06.	25.06.	10.07.	no	no	1.09.
EKO-SP + 1,5 l/ha	7.05	20.05.	25.05.	12.06.	16.06.	25.06.	10.07.	no	no	1.09.
EKO-SP + 2,0 l/ha	7.05	20.05.	25.05.	12.06.	16.06.	25.06.	10.07.	no	no	1.09.

The time of passage of the main phenophases on potato plants was not changed for the variants of the experiment. The complete top necrosis was not observed in any of the variants. On August 24, the desiccant Sukhovey, WS (2 l/ha) was applied.

Table 4. The height of potato plants of the Sante variety on the doses of the EKO-SP + agrochemical.

Variant	Development phases		
	Full seedlings, cm 25/05/2020.	Budding, cm 16/06/2020	After flowering, see 17/07/2020.
Control	9.9	22.7	48.2
EKO-SP + 1.0 l \ ha	10.0	24.5	50.4
EKO-SP + 1.5 l/ha	10.3	24.9	55.0
EKO-SP + 2.0 l/ha	10.5	26.1	54.2
LSD $_{0,5}$	0.1	1.3	1.1

Analysis of developmental data reveals a positive effect on the height of the potato plant (Table 4). However, the maximum excess of the values of the control variant ranges from 10 to 14% (depending on the phase of development and the agrochemical consumption).

One of the main indicators, reflecting the effectiveness of the studied agrochemical, is the productivity of potatoes. There is a clear tendency of an increase in the productivity and marketability of potatoes with an increase in the doses of the EKO-SP + agrochemical (Table 5).

Table 5. The productivity of potatoes of the Sante variety, depending on the doses of the EKO-SP + agrochemical.

Variant	Gross yield, t/ha	Yield increase		Marketability, %
		t/ha	%	
Control	47.6	-	-	92
EKO-SP + 1.0 l \ ha	49.8	2.2	4.6	92
EKO-SP + 1.5 l/ha	52.3	4.7	9.9	93
EKO-SP + 2.0 l/ha	53.7	6.1	12.8	93
$LSD_{0,5}$	1.3			

So in the control variant, the productivity was 47.6 t/ha. When applying the EKO-SP + agrochemical, the increase in productivity (relative to control) ranged from 4.6% to 12.8%.

The maximum productivity of 53.7 t/ha was obtained in the variant of the experiment with an agrochemical consumption of 2.0 l/ha, which amounted to an increase of 6.1 t/ha to the control. The lowest productivity indicator in the experiment was showed by the agrochemical consumption of 1.0 l/ha - 49.8 t/ha.

Analysis of the indicator of marketability of potatoes showed 92-93% in all variants of the experiment.

The application of the EKO-SP + agrochemical (regardless of the consumption of the agrochemical) had a positive effect on the structure of the harvest, contributing to the accumulation of tubers with a fraction of more than 60 mm and a fraction of 30-60 mm (Table 6).

Table 6. The effect of the agrochemical EKO-SP + on the structure of the harvest of potatoes of the Sante variety.

Variant	Tuber weight (kg) from 1 m^2				Fraction composition by weight, %			
	total	> 60 mm	30-60 mm	< 30 mm	total	> 60 mm	30-60 mm	< 30 mm
Control	4.76	3.05	1.07	0.64	100	64.1	22.5	13.4
EKO-SP + 1,0 l/ha	4.98	3.3	1.29	0.39	100	66.3	25.9	7.8
EKO-SP + 1,5 l/ha	5.23	3.35	1.42	0.46	100	64.1	27.1	8.8
EKO-SP + 2,0 l/ha	5.37	3.5	1.67	0.20	100	65.2	31.1	3.7

It was also noted that with an increase in the dose of agrochemical consumption per hectare, there is a decrease in tubers of fraction less than 30 mm from 7.8% to 3.7% (with values of 13.4% in the control).

According to the results of the study of the tops, it is also clearly noticeable that with the application of an agrochemical and with an increase in its rate, the

weight of the tops increases: the increase in relation to the control was 144 g (35%), 210 g (51%) and 260 g (63%), respectively (Table 7).

Table 7. The influence of the EKO-SP + agrochemical on the growth of potato vine of the Sante variety.

Variant	Tops weight from 1 bush, g	Increase to control	
		g	%
Control	410	-	-
EKO-SP + 1.0 l \ ha	554	144	35
EKO-SP + 1.5 l/ha	620	210	51
EKO-SP + 2.0 l/ha	670	260	63

From the data in Table 8 it can be seen that the application of the EKO-SP + agrochemical gives an increase in the number of tubers in all variants of the experiment in comparison with the control: there is an increase in the fraction of more than 60 mm and a fraction of 30-60 mm. The average weight of tubers with fractions of more than 60 mm and 30-60 mm was observed in the variant of the experiment with an agrochemical consumption of 2.0 l/ha and amounted to 143 g and 93 g, respectively.

Table 8. Number and weight of tubers per 1 bush.

Variant	Number of tubers, pcs/bush				Average tuber weight, > 60 mm, g	Average tuber weight, 30-60 mm, g
	total	> 60 mm	30-60 mm	< 30 mm		
Control	9	4	2	3	125	83
EKO-SP + 1,0 l/ha	11	6	3	2	137	89
EKO-SP + 1,5 l/ha	14	8	5	1	140	93
EKO-SP + 2,0 l/ha	17	11	5	1	143	93

The use of spray application with an agrochemical on full seedlings and at the budding phase under the conditions of the 2020 growth showed a change in starch content as a percentage of control: the highest indicator was observed in the variant with an agrochemical consumption of 2.0 l/ha and amounted to 13.0% (the excess of control was 0.7%) (Table 9).

Table 9. Biochemical indicators of the quality of potato tubers of the Sante variety.

Variant	Raw starch, %	Nitrates, mg/kg
Control	12.3	192

EKO-SP + 1.0 l \ ha	12.2	205
EKO-SP + 1.5 l/ha	12.9	212
EKO-SP + 2.0 l/ha	13.0	223
$LSD_{0,5}$	0.1	11

The content of nitrates in products in none of the variants exceeded the norm of 250 mg/kg and amounted to 205-223 mg/kg.

Conclusions

Thus, the application of the EKO-SP + agrochemical during the growth of 2020 had a positive effect on the growth and development of potato plants of the Sante variety.

The maximum productivity was obtained in the variant with an agrochemical consumption of 2.0 l/ha and amounted to 53.7 t/ha. The increase to the control was 12.8% (6.1 t/ha). The number and weight of tubers of the fraction more than 60 mm and 30-60 mm (relative to the control variant) increased.

To find out the maximum potential from the application of an agrochemical, it is recommended to continue study with other consumption rates. However, according to the results of positive tests of the agrochemical EKO-SP + fertilizer, based on humic substances, brand: And on potatoes, it can be concluded, that the application of this product in the conditions of crop production will be economically feasible and profitable. The low cost of an agrochemical and a tangible increase in qualitative and an increase in quantitative indicators of productivity, in particular when used on potatoes, when using EKO-SP + fertilizers, based on humic substances, brand: A, in the technology of cultivation of agricultural crops, will be economically profitable for agricultural producers.