

The influence of a new organic fertilizer based on sapropel on the results of germination of seeds of wheat, oats and mung bean

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Abstract. The article describes experience in studying the effect of a new complex biofertilizer based on natural raw materials - extracts of bird droppings and sapropel, namely: humic and fulvic substances from it, nitrogen-fixing microorganism *Azotobacter chroococcum*, fungus-ascmycete *Trichoderma viride* and a source of zinc sulfur - zinc sulfate. on germination and germination energy, seeds of winter wheat (*Triticum aestivum*) of Tanya variety, oats (*Avena sativa* L.) of Valdin 765 variety and legume mash (*Vigna radiata*) of Tajik 1 variety. The purpose of this study was to establish a sustainable positive effect by germinating seeds of winter wheat, oats and mung bean in Petri dishes when treated with a new complex biofertilizer based on sapropel and without treatment, to track the intensity of the germination energy of seeds of these plants on the third day and germination - on the seventh day. On the seventh day of germination of winter wheat in the experimental version, the length of seedlings exceeded the control version by 9.2%. In oats, the length of sprouts in the experimental version is 13.6% longer than in the control version.

1 Introduction

With the constant intensification of agriculture, and in particular crop production, there is always an acute question of how to increase the productivity (yield and quality) of certain crops, and at the same time improve the condition of soils on farmland, without resorting to a large increase in costs. In connection with the introduction of economic sanctions against Russia by the United States and the EU countries, ensuring the food security of the Russian Federation is a priority strategic problem for the development of the country [6].

A new biofertilizer based on sapropel has been developed [4], which is based on extracts of sapropel and chicken manure, the microorganism *Azotobacter chroococcum*, the ascomycete fungus *Trichoderma viride*, and zinc sulfate. A number of experiments prove that the use of organic fertilizers can increase the yield of both fodder and industrial crops.

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Field experiments were carried out with the use of biofertilizer based on bird droppings on crops of fodder vetch-wheat grass mixture. The developed new complex biofertilizer is a dark opaque brown colloidal liquid with a specific odor. The drug externally and in the main content resembles humate. [1, 2, 9, 10].

Winter wheat (*Triticum aestivum*) of the Tanya variety is one of the most common hard semi-dwarf varieties in the Kuban region, highly resistant to lodging, early ripening, earing and ripening at the same time. The originator is the Krasnodar Research Institute of Agriculture named after P.P. Lukyanenko. The variety was submitted for testing in 2001. The shape of the ear is from cylindrical to pyramidal, of medium length and density [5].

Spring oats (*Avena sativa* L.) Valdín 765 variety - bred at the Kuban experimental station of N. I. Vavilov All-Russian Institute of Plant Genetic Resources (VIR) (author D.F. Tantsyura). The variety is early ripe (from germination to economic ripeness 83-97 days). The grain is large, semi-long, bright yellow, valuable for cereal qualities. The weight of 1000 grains is 27-38 g, the grain size is 434-524 g/l, which ensures consistently high grain yields [3].

Mung bean (golden bean) (*Vigna radiata*) of Tajiksky 1 variety, is an annual herbaceous plant; species of the genus *Vigna* of the Legume family; leguminous crop originating from India. Mung bean seeds are actively used for food in many countries. [8].

The purpose of this study was to establish a sustainable positive effect by germinating seeds of winter wheat, oats and mung bean in Petri dishes when treated with a new complex biofertilizer based on sapropel and without treatment, to track the intensity of seed germination energy of these plants on the third day and germination on the seventh day.

2 Material and methods

The object of this research is the seeds of three agricultural crops often grown both in Russia and around the world (wheat, oats, mung bean) and their responsiveness to a new complex biofertilizer for subsequent recommendations for its use.

Studies on the effectiveness of the application of the studied biofertilizer were carried out in laboratory conditions at the Krasnodar Research Centre for Animal Husbandry and Veterinary Medicine, Krasnodar, Znamensky settlement. Germination was carried out in Petri dishes at an ambient temperature of 20-22°C, by uniformly treating 100 plant seeds with a certain amount (50 ml) of a solution of the desired concentration (1 ml of biofertilizer per 1 liter of water) and, as the solution was absorbed (and distilled water in the control variant) processing was repeated. The dishes were removed to a dark place with t° 20-22°C, and every day 1 ml of the solution and water in the control variant were added, respectively. The experiment was carried out according to the requirements of the State Standard (GOST) 12038-84 [7] in triplicate. On the third day of the study, the germination energy and the length of the appeared seedlings were determined. On the seventh day, germination was determined, at which sprouts and roots appeared in cereal crops (oats, wheat), and only roots appeared in mung bean. Each sprout and root was measured, and the data entered into the calculation tables.

Table 1. Germination of seeds in Petri dishes according to the State Standard (GOST) 12038-84.

Name of solutions	Stage	
Water (control)	Determination of germination energy (on the 3rd day) according to GOST 12038-84	Determination of seed germination (on the 7th day) GOST 12038-84
Experiment (new complex biofertilizer based on sapropel 1 ml/l)		

All data were statistically processed. The scheme of studies on the germination of seeds of the studied crops in Petri dishes is presented in Table 1.

3 Material and methods

According to Table 2, one can judge a significant increase in the energy of seed germination when they are treated with an aqueous solution of a new organic growth substance.

Table 2. Length of sprouts, % (on the 3rd day) according to GOST 12038-84

Name of solutions (0.01/1 l)	Types of crop seeds		
	Length of seedlings (average per 100 pcs.), mm		
	Winter wheat	Spring oats	Mung bean
Control (water)	8.15±0.3	1.6±0.15	20.64±0.33
Experiment (new complex biofertilizer based on sapropel 1 ml/l)	9.16±0.36**	3.1±0.17**	23.91±0.39***

Note: ** - p<0.01; *** - p<0.001

The data obtained in the variant with mung beans have a high degree of reliability (p<0.001). Germination energy is the ability of seeds to germinate quickly and evenly. Since on the third day all the studied cultures began to produce seedlings, they were measured and the result was compared. For 100 germinating seeds of winter wheat, the length of seedlings in the experimental variant is 12.4% longer (9.16 mm) than in the control (8.15 mm). Seeds of spring oats in the experimental variant (3.1 mm) had a sprout length of 51.6% more than the control (1.6 mm). Mung bean seeds in the experiment had an average length of 23.91 mm and exceeded the length of sprouts in the control variant (20.64 mm) by 15.8%.

Further, all variants of seeds were weighed. The data on the weight of the seeds under study on the third day of germination are shown in Table 3. The data presented indicate that the weight of germinated seeds is always much higher due to the absorbed moisture and the germination rate. However, the weight of 100 germinated seeds in the experimental variant slightly exceeds the control - seeds germinated in distilled water. In particular, wheat seeds germinated with a new biofertilizer exceed by 57.7% (6.15 g) dry control by weight (non-germinated seeds 3.90 g), and seeds germinated on water (control) - only by 48.7 % (5.80 g). Accordingly, the weight of seeds germinated with biofertilizer was 9% higher than the weight of seeds germinated with water.

Table 3. Weight of 100 seeds on the third day of germination, g

Variant	Types of crop seeds		
	Weight of 100 seeds, g		
	Winter wheat	Spring oat	Mung bean
Control (dry control)	3.90	2.80	5.75
Control (water)	5.80	3.10	15.70
Experiment (new complex biofertilizer based on sapropel 1 ml/l)	6.15	3.35	15.90

In studies of oats, the following results were obtained: grains germinated in the experimental variant exceeded dry control (2.8 g) by 19.7% (3.35 g), grains germinated in distilled water - by 10.7% (3.1 g), and if we compare both germinated options, then the experimental one is 9% more by weight than the control one. The mass of 100 mung bean

seeds germinated in a biofertilizer solution exceeded the dry control (5.75 g) by 276.5% (15.9 g), and those germinated with water (control) by 273% (15.70 g). Sprouted mung bean in the experimental variant has a mass greater than sprouted in water by 1.3%. les.

Laboratory seed germination is determined on the seventh day of germination. During this period, cereal crops (wheat, oats) already have roots and a sprout of a stem, in mung bean, only a sprout increases, separation into a root and a stem does not yet occur. The results of determining the length of sprouts on the seventh day of the study of cultures are presented in table 4.

Table 4. Length of sprouts, % (on the 7th day) according to the State Standard (GOST) 12038-84

Name of solutions	Crop seeds		
	Length of seedlings (average per 100 pcs.), mm		
	Winter wheat	Spring oat	Mung bean
Control (water)	9.42±0.25	18.7±0.23	26.77±0.2
Experiment (new complex biofertilizer based on sapropel 1 ml/l)	10.30 ±0.29***	20.73±0.24***	27.15±0.25***

Note: *** - p<0.001

All studies showed the highest degree of reliability. Table 4 shows the length of the sprouts that appeared on the seventh day of research. In winter wheat in the experimental variant, the average length of seedlings (10.3 mm) exceeded the control (9.42 mm) variant by 9.3%. In oats, the length of sprouts on the seventh day in the experimental variant was 20.73 mm, which is 12.2% longer than in the control variant (18.47 mm). Mung bean in the experimental group had an average sprout length of 27.15 mm, which is 1.4% more than the average length of the control - 26.77 mm.

On the seventh day of the experiment, the appeared roots of winter wheat and spring oat were measured (table 5).

The data presented in table 5 have a high degree of reliability. The average length of wheat roots on the seventh day of germination in the experimental variant exceeded the control one by 30.6% and amounted to 7.39 mm.

Table 5. Root length, % (on the 7th day) according to the State Standard (GOST) 12038-84

Name of solutions (0.01/1 l)	Crop seeds		
	Length of seedlings (average per 100 pcs.), mm		
	Winter wheat	Spring oat	
Control (water)	5.65±0.1	8.25±0.25	Control (water)
Experiment (new complex biofertilizer based on sapropel 1 ml/l)	7.39±0.2***	9.78±0.25***	Experiment (new complex biofertilizer based on sapropel 1 ml/l)

Note: *** - p<0.001

The length of the roots in the control variant was 5.65 mm. In the seeds of spring oats, the average root length in the experimental variant exceeded the control one by 18.5% and amounted to 9.78 mm. In the control variant, the average length of the oat root was 8.25 mm.

4. Conclusion

1. For 100 germinating seeds of winter wheat, the length of seedlings in the experimental variant is 12.4% longer (9.16 mm) than in the control (8.15 mm). Seeds of

spring oats in the experimental variant (3.1 mm) had a sprout length by 51.6% more than the control (1.6 mm). Mung bean seeds in the experiment had an average length of 23.91 mm and exceeded the length of sprouts in the control variant (20.64 mm) by 15.8%.

2. Wheat seeds germinated with the new bio-fertilizer exceed the weight of seeds germinated with water by 9%. Also, the mass of oat seeds germinated with biofertilizer exceeds the mass of germinated seeds in water by 9% (control). Sprouted mung bean in the experimental variant has a mass greater than sprouted in water by 1.3%.

3. In winter wheat on the seventh day of germination in the experimental variant, the average length of seedlings) exceeded the control variant by 9.3%. In oats, the length of sprouts on the seventh day in the experimental variant was 12.2% longer than in the control. Mung bean in the experimental group had an average sprout length of 1.4% more than the average length of the control.

4. The average length of wheat roots on the seventh day of germination in the experimental variant exceeded the control one by 30.6%; in the seeds of spring oats, the average length of the roots in the experimental variant exceeded the control one by 18.5%.

5. Since, for all the studied indicators, a positive effect was established from the use of a new complex biological product based on sapropel during the germination of wheat seeds, oats and mung bean, it can be concluded that this fertilizer is able to increase the germination energy, germination and productivity of agricultural crops, not only in the laboratory but also in the field.

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