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STIMULATION OF SWEET SORGHUM SEED

Presented are research results on the efficiency of different ways of stimulating Sweet sorghum seeds using microelements and microfertilizers for pre-sowing treatment. We established that they improve seed germination power both in laboratory and field conditions, promote intensive growth and development of plants during the growing season as well as better preservation of plants and increase in their productivity. The most effective options to stimulate sorghum seeds appeared microfertilizer Avatar and Rost-concentrat that provided the highest crop productivity of 42.5 to 47.3 t of dry matter per 1 ha with dry matter content of 18.2 to 18.8% and sugar content of 12.8 to 13.2%, respectively.

Keywords: *seeds; methods of stimulation; microelements; microfertilizers; seed sowing quality; productivity.*

Introduction. At present, the ever-growing deficit of petroleum products, their high cost and the deterioration of ecological environment factors is forced to find the alternative clean energy sources. In this connection, relevant is the use of energy, which is stored by plants through their photosynthetic activity. In Ukraine, one of the alternative sources for biofuels production could be sugar sorghum, which is now grown in clean, compacted or mixed with other crops (corn, soy) [1].

Sweet sorghum has a high yield potential of green mass, in terms of 1 ha can get up to 1.4–1.5 tons of biofuels on unirrigated land and up to 2,2–2,5 tons – on irrigated. However, calculations show that available varieties of this crop can provide sugar at 2.8-3 t/ha in rainfed conditions and 4.5–5.0 t/ha – when irrigation applying (content of stems juice from 17 to 24%) [2].

It is known that sorghum seed are particularly sensitive to stress factors during germination. In addition, the biological feature of this culture is slow initial growth. Seed of sugar sorghum is germinating slowly – in the period "sowing-ladder" continues 25–30 days. As a result, its field germination is reduced, seedlings appear not simultaneously and liquefied [3]. Therefore for sorghum the particular significance is the development an effective technology of seed pre-treatment that will stimulate the initial growth and development of plants.

There are various methods of agricultural cultures seed stimulate that contribute to accelerated seeding emergence, increase field germination of seed, reduce the incidence of plants and, ultimately, increase the yield of this crop.

It is established that additional physical methods and methods of seed stimulate of sugar and fodder beet in most cases gave positive results [4]. Thus, according to G.V. Dronova [5] sugar beet seed processing by the concentrated solution of potassium chloride (2–5%) provided a receipt 28% and more stairs on the 14^{th} days, cut their to the stairs period and increased the resistance to disease and pests. In the

experiments of Ukrainian Institute of Agriculture the presowing treatment of fodder beet (Kyivskyy sort) by microelements is contributed an increase of field germination of seed: boron (0.01%) – 20%, cobalt (0.05%) – on 18% zinc (0.05%) – on 10–13% [6].

The aim of our research was to establish the features of seed germination, plant growth and development and sugar sorghum productivity formation depending on pre-treatment of seed and microelements fertilizers.

Materials and methods. The experiments were conducted during the 2011-2014 in Institute of bioenergy crops and sugar beet NAAS.

The scheme of the experiment: 1) without pre-treatment of seed (control); 2) seed soaking in ordinary water; 3) soaking in solutions of salts of microelements zinc (0.05%); 4) cobalt (0.05%); 5) manganese (0.05%); 6) Avatar fertilizers (0.7 l/kg) and 7) Rost-concentrate (1.0 l/kg).

Sugar sorghum hybrid is Dovista. The samples of seed in 4-fold repetition (up to 100 pc. in each) soaked during 24 hours and dried to a loose condition in accordance with the scheme of the experiment. After drying seed of the each variant are separated into two samples: the first – to determine the dynamics of germination and laboratory similarities, the second – to determine field similarities and plants growth and development.

Results and discussion. Sugar sorghum seed after stimulation was higher indexes of germination intensity for all variants of the experiment is established (*Table 1*).

Table 1

Intensity of seed germination, depending on methods of its stimulation (average of 2011–2014).

Variants	Number of germinated seed (%) on ... day after experiment laying				
	2	4 – energy of germination	6	8	10 – germination
1 (c)	8	76	78	81	81
2	9	79	83	83	83
3	16	86	88	89	89
4	12	83	85	85	85
5	12	84	86	87	87
6	18	87	89	89	89
7	16	87	89	90	90
$SSD_{0,05}$	-	1,6	-	-	1,6

So, on the second day after the laying of the experiment the number of the sprouted seed in variants 3–7 was in 1.5–2.2 times higher compared with the control in the average of research years.

The highest values of germination energy (86–87%) and seed similarity (89–90%) obtained by its pre-treatment of zinc and Avatar and Rost-concentrat microelement fertilizers.

While soaking in ordinary water the amount of sprouted seed is increased on the second day on 1%, the fourth – 3, sixth – 5 and tenth – 2% compared to control (*Table 1*).

Table 2

Density of stairs and field germination of seed depending on methods of its stimulation

Variants	Density of stairs, pcs/m					Field germination, %				
	Year/GTC					Year/GTC				
	2011 1,3	2012 1,2	2013 0,7	2014 1,6	average	2011 1,3	2012 1,2	2013 0,7	2014 1,6	average
1 (c)	9,5	9,8	9,2	10,2	9,7	76	78	73	81	77
2	9,8	10,0	9,4	10,4	9,9	78	80	75	83	79
3	10,2	10,6	10,0	10,7	10,4	81	84	79	85	82
4	10,0	10,2	9,3	10,6	10,0	79	81	74	84	80
5	10,0	10,4	9,5	10,7	10,2	79	82	75	85	80
6	10,5	10,6	9,5	11,0	10,4	83	84	79	87	83
7	10,6	10,9	10,1	11,3	10,7	84	86	80	89	85
$SSD_{0,05}$	0,4	0,3	0,5	0,5	0,4	3,2	3,0	2,5	3,1	3,0

Productivity of sugar sorghum agrophytocenoses is determined by factors that directly influence on its main indicators - is the appearance and number of stairs, field germination of seed, architectonic plant, stand density, yield of green mass, dry matter content and sugar. On average of research years the longest period of shoots occurrence is marked on the control – 18 days, the lowest – 13 days on the 7th variant where the seed are soaked in a Rost-concentrat fertilizers solution (*Table. 2*). In other variants, the number of stairs on the 18th day of their appearance was 110–115% from control.

The density of stairs in average of years is ranged from 9.7 pcs./m on the control to 10.7 pcs./m on the 7th variant 7 depending on variants of the experiment Regarding to field germination of seed, its values were high in almost all variants of experiment. The significant increase in field similarities is noted in variant 3, 6 and 7 – 82, 83 and 85% respectively. The tendency to field germination increasing is observed in variants of where the seed soaked in ordinary water and solutions of cobalt and manganese microelements. Furthermore, it should be noted that the value of this indicator is also largely dependent on the hydrothermal conditions during the "sowing-shoots" period. Thus, by the value of GTC in 2011 at 1.3, field germination of seed of sorghum was 76–84% in average of all experiment variants, in 2012 (GTC 1.2) – 78–86%, in 2013 (GTC 0.7) – 73–80 and in 2014 at 1.6 GTC – 81–89%.

More intense growth and development in the start of vegetation on the variants with sugar sorghum seed stimulation is contributed to a better preservation of plants during the growing season and contributed to productivity increased (*Table 3*).

Table 3

Sugar sorghum productivity depending on methods of its stimulation (average of 2011–2014)

Variants	The density of plant standing before harvesting, ths. pcs./ha	Plant height, cm	Yield of green mass, t/ha	Content of, %	
				dry matter	sugar
1 (c)	134,0	234,3	39,5	17,0	11,9
2	136,8	236,0	40,3	17,3	12,1
3	144,0	239,8	42,5	18,2	12,8
4	138,2	237,5	40,8	17,5	12,3
5	141,1	238,0	41,6	17,9	12,5
6	144,0	238,0	42,5	18,2	12,8
7	148,3	239,4	43,7	18,8	13,2
$SSD_{0,05}$	7,2	5,4	2,5	0,24	0,23

In average of research years the density of plants before harvesting on variants 3–7 on 4.2–14.3 thousand. pcs./ha, plant height – on 3,2–5,5 cm, the yield of green mass – 1,3–4,2 t/ha, dry matter content – on 0,5–1,8 t/ha, sugar – on 0,4–1,3% were greater than on the control.

Conclusions. 1. The conducted research showed that growth and development of sweet sorghum plants, forming its productivity is largely depends on the methods of seed stimulation.

2. The main effect of sugar sorghum seed stimulating is to increase the intensity of its germination in both laboratory and field conditions, contributing to a more intensive growth and development of plants during the growing season, and ultimately the better preservation of plants and increase of their productivity.

3. The highest values of germination energy (86–87%) and laboratory germination of seed (89–90%), density of stairs (10,4–10,7 pcs./m) and field germination (83–85%) are received by its pre-treatment of zinc and Avatar and Rost-concentrate microelement fertilizers. As a result, in the same variants is received the superior productivity of culture – 42,5–47,3 t/ha with the dry matter content at 18,2–18,8% and sugar 12,8–13,2% respectively.

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Анотація

Сторожик Л.І.

Стимулювання насіння сорго цукрового

Наведено результати дослідження ефективності різних способів стимулювання насіння сорго цукрового шляхом використання для його передпосівної обробки мікроелементів і мікродобрив. Встановлено, що використання цих препаратів покращує інтенсивність проростання насіння як у лабораторних, так і польових умовах, сприяє більш інтенсивному росту і розвитку рослин протягом вегетації, а в кінцевому результаті кращому збереженню рослин і підвищенню їхньої продуктивності. Найефективнішим виявилися варіанти з використанням для стимулювання насіння сорго мікродобрив Аватар та Рост-концентрат, на варіантах з якими отримано найвищий рівень продуктивності культури – 42,5–47,3 т/га з вмістом сухої речовини на рівні 18,2–18,8% та цукру 12,8–13,2% відповідно.

Ключові слова: *насіння, способи стимулювання, мікроелементи, мікродобрива, посівні якості насіння, продуктивність.*

Аннотация

Сторожик Л. А.

Стимулирование семян сорго сахарного

Приведены результаты исследования эффективности различных способов стимулирования семян сорго сахарного путем использования для его

предпосевной обработки микроэлементов и микроудобрений. Установлено, что использование этих препаратов улучшает интенсивность прорастания семян, как в лабораторных, так и полевых условиях, способствует более интенсивному росту и развитию растений в течение вегетации, а в конечном итоге лучшей сохранности растений и повышению их продуктивности. Наиболее эффективными оказались варианты с использованием для стимулирования семян сорго микроудобрений Аватар и Рост-концентрат, на вариантах с которыми получена самая высокая продуктивность культуры – 42,5–47,3 т/га с содержанием сухого вещества на уровне 18,2–18,8% и сахара 12,8–13,2% соответственно.

Ключевые слова: *семена, способы стимулирования, микроэлементы, микроудобрения, посевные качества семян, продуктивность.*