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INFLUENCE OF FERTILIZER MEGAMIX ON VARIETY CHARACTERS INHERITANCE OF UTERINE ROOT BEETS BORDEAUX 237

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Abstract

The influence of liquid mineral fertilizer from the series of preparations "Megamix" ("Megamix-seeds" and "Megamix-profi") on the inheritance of varietal traits of uterine roots of table beet variety 'Bordeaux 237' was studied. contributed to the reduction of interphase periods and, in general, the growing season according to the variants of the experiment by 4-9 days. In the population of 'Bordeaux 237' variety, the rounded shape of the root crop prevailed. The maximum amount of such root crops was obtained by joint treatment of seeds "Megamix-seeds" and seedlings "Megamix-profi" - 84.0%, with 72% in the control. Root shape index was 0.9 - 1.1. The use of "Megamix" in the technology of growing table beets in vegetable crop rotation had a positive effect on the growth and development of plants. Biometric measurements showed that, on average, the weight of the root crop varied from 234.0 to 248.4 g. the formation of the economic part of the crop was higher than in the control by 0.01-0.04 g/cm^2. The maximum yield of table beet 28.4 t/ha was obtained by joint treatment of seeds and seedlings with Megamix-seeds and Megamix-profi, which is 6.2 t/ha higher than in the control. Evaluating the effect of the use of "Megamix" fertilizer, its influence on quality indicators, namely the marketability of 96-99%, was established.

Key words: *beet, cultivar, uterine roots, varietal characteristics, fertilizers.*

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) is a widespread vegetable crop. It is rich in carbohydrates, mineral salts, organic acids and vitamins (C, B1, B2, B6, PP, P), biotin, folic and pantothenic acids and physiologically active substances - betaine and betanin. Beetroot is one of the early ripening, productive plants, its roots lie well during long-term storage (Burenin et al., 1998; Fedorova et al., 2017).

In the conditions of fierce competition in the market for selection achievements, high demands are currently made on the quality of new varieties and hybrids of vegetable crops. For dining beets, this is a high and stable yield, marketability, an attractive appearance of the root crop and, of course, resistance to diseases and pests. For mechanized cultivation, an important feature is an erect, compact leaf rosette, with thin petioles, which persists until the end of the growing season of plants, which makes it possible to use top-lifting combines during harvesting (Kozar, 2019).

To obtain high yields of table beet, vegetable growers use intensive cultivation technology that requires a large number of nutrients for plants. Some of them enter the plant from those available in the soil, the other from the fertilizers applied to the soil, and the third with foliar dressing. Each of these sources is only partially used. The amount of assimilated fertilizers is 30-60% of the applied fertilizers. The rest pass into hard-to-reach forms, being bound by the soil, washed out into groundwater or evaporated (in the form of ammonia), and the vegetable grower loses money (Romanyuk, 2000).

In this regard, it is possible to realize the high genetic productivity of plants without significant additional costs for their functioning, by optimizing the production process, by using new forms of micronutrient fertilizers in a chelated form in the cultivation technology. One of these forms is a complex highly effective liquid mineral fertilizer from a series of drugs "Megamix" (Kshnikatkina et al., 2010).

Presowing treatment with liquid mineral fertilizer from the Megamix series of preparations allows for strictly differentiated nutrition for each plant, enhance the starting

acceleration in the development of seedlings and their resistance to unfavorable environmental factors, optimize mineral nutrition (http // megamix52.ru)

In recent years, the range of beets cultivated in the Middle Volga region has significantly expanded. Modern varieties of this culture differ in yield, quality, economically valuable traits, as well as in the ability to effectively use modification and genotypic variability in various environmental conditions. But the Bordeaux 237 variety is still unsurpassed (Gryazeva, 2007).

Beet varieties are complex population systems, that is, they consist of different biotypes. They are characterized by a complex splitting of characters in the offspring. Therefore, when growing uterine root crops, it is necessary to ensure the preservation of the initial level of economically valuable traits of the variety (Pivovarov, 1999).

In this regard, the optimization of the combination of methods for growing table beets, contributing to better growth and development of plants and ensuring high yields with good commercial and economic qualities of root crops in various environmental conditions, with the preservation of all varietal characteristics, determine not only the fundamental nature, but also the practical orientation , the relevance of research in this area.

Research goal is to study the effect of liquid mineral fertilizer from a series of drugs "Megamix" ("Megamix-seeds" and "Megamix-pro") on the inheritance of varietal and economically valuable traits, increasing the productivity of uterine beetroot varieties Bordeaux 237 in the Penza region.

MATERIALS AND METHODS

The research was carried out at the collection site of the Penza State Agrarian University in 2019-2020.

Experiment scheme: 1. Control - no treatment. 2. Treatment of seeds with Megamix-seeds. 3. Treatment of seedlings with Megamix-profi. 4. Treatment of seeds with Megamix-seeds and seedlings with Megamix-profi.

The counting area of the plot was 3 m^2, the repetition was six times, the arrangement of the plots was systematic, the sowing scheme was three-line, belt 20 + 20 + 50 cm. The seeding rate of seeds was 10 kg per 1 ha.

When laying the field experiments, we were guided by the main provisions of the Methodology for state variety testing of agricultural crops (potatoes, vegetables, melons) (1975).

Phenological observations and biometrics were carried out at the beginning of the emergence of shoots, the formation of 4-5 and 10-12 leaves, the mass setting of root crops, the onset of technical and commercial ripeness according to the Methodology of field experience in vegetable growing and melon growing (1992).

The assimilation surface of the leaves was determined by the gravimetric method.

Harvesting and accounting of the harvest was carried out manually, on a plot basis, taking into account standard root crops (GOST R 51811-72001, 2010) and non-standard root crops by fractions.

The description of morphological characters was carried out in accordance with the method of I.A. Prokhorov, S.P. Potapova (1975), Guidelines for the approbation of vegetable crops and fodder root crops (1982), Methodological guidelines for the study and maintenance of the world collection of root crops (1977).

The object of the research was the ‘Bordeaux 237’ beet variety, which is the most widespread in the vegetable growing practice of our country.

Variety ‘Bordeaux 237’ was bred at the Gribovskaya vegetable selection and experimental station - authors V.V. Ordynsky and S.P. Agapov - by individual and family selection from a hybrid population from free cross-pollination of a number of table varieties with the ‘Detroit’ variety. Root crops are round and oval-round with a small head, slight roughness and uneven surface. The pulp is intensely dark red, dense, with a slightly increased sugar content. The variety is quite fruitful, mid-season, few flowers. Keeping quality of root crops is good. The variety is suitable for long-term storage, fresh consumption and canning. Polyspermous (Agapov, 1975).

The research material was a complex highly effective liquid mineral fertilizer from a series

of drugs "Megamix" ("Megamix-seeds" and "Megamix-profi"), which is based on a rich composition of micro- and macroelements. Most of the microelements are in a chelated form that is easily absorbed by plants. The drug has a significant effect on the life processes of the plant with a small application rate.

"Megamix-seeds" is a liquid mineral fertilizer for pre-sowing seed treatment based on micro- and macroelements (contains five macro- and 10 microelements), which ensures the best realization of the seedling development potential.

Purpose of "Megamix-seeds":

- full nutrition of seedlings in the initial phases of development, due to the content of macro- and microelements;
- the formation of a powerful root system, as the basis for the full development of culture;
- increasing the survival rate of culture, especially in the initial phases of development;
- an increase in the microbiological activity of the soil, and, as a result, an increase in immunity and the availability of nutrients;
- increased yield due to increased development of the root system and reduced risks in the initial, critical phases of plant development.

The consumption rate of the Megamix-seeds preparation is 2 l/t.

Megamix-profi is a liquid mineral fertilizer for foliar feeding with a rich content of microelements, aimed at complex stimulation of all plant processes. Synergy and antagonism of individual nutrients is also taken into account.

Appointment of "Megamix-pro":

- stimulation of root nutrition, activation of enzymes and replenishment of missing nutrients;
- elimination of the lack of trace elements in key phases and during the formation of the crop;
- increased productivity due to the stimulation of enzymatic processes and prolongation of the growing season;
- improving the quality of the crop, according to the indicators to which the variety is predisposed and to which the main fertilizers are oriented.

The consumption rate of the Megamix-profi preparation is 1 l/ha. Fork processing (http // megamix52.ru.)

RESULTS AND DISCUSSIONS

The accumulation of organic matter and the formation of the yield occurs during the growth of plants. The main criterion in the formation of a good harvest of beet root crops is the duration of the growing season.

Weather conditions have a significant impact on the transit times and the duration of interphase periods. The timing of the stages of development of table beet in different years is not the same.

Sowing of table beet was carried out on May 12 in 2019 and on May 18 in 2020. As a result of observations of the growth and development of plants, it was found that liquid mineral fertilizer from the Megamix series of preparations contributed to the faster growth and development of table beet plants, but this influence was ambiguous.

The duration of the "sowing-germination" period in the variants of treatment with liquid mineral fertilizer from the series of "Megamix" preparations ranged from 17 to 20 days, with 17 in the control (Table 1).

Table 1. Duration of interphase periods (average, 2019-2020)

Option	Sowing-seedlings	From germination to, days:			The length of the growing season
		phase forks	bunch ripeness	technical ripeness	
Control (no processing)	17	8	36	97	114
Seed treatment - "Megamix-seeds"	17	8	34	93	110
Treatment by seedlings - "Megamix-profi"	17	7	thirty	89	108
Seed treatment - "Megamix-seeds" + processing by seedlings - "Megamix-profi"	17	7	29	88	105

The longest period was 20 days in the treatment of seedlings with Megamix-Profi. The period of "sprouting, fork phase" was the shortest in the treatment options for seedlings and together of seeds and seedlings, which is one day shorter than in the control.

The duration of the period "shoots-bunch ripeness" ranged from 36 days in the control and up to 29-34 days in the treatment options. Small root crops with a diameter of 3-4 cm for beam ripeness are formed faster in the variant with joint treatment of seeds with Megamix-seeds and seedlings with Megamix-profi.

In general, the length of the growing season was shorter in the studied variants by 4-9 days compared to the control.

Thus, as a result of the research, it can be concluded that liquid mineral fertilizer from the Megamix series of preparations promotes the activation of seed germination processes and the reduction of interphase periods and, in general, the growing season of table beet.

The quality of canteen beetroot is determined by a set of features and properties. Modern varieties of table beet are mainly heterozygous populations subject to strong variability under the influence of environmental conditions (Burenin et al., 2016).

As a result of studying the forms of the root crop in the table beet variety 'Bordeaux 237', 3 biotypes were identified: round, round-flat and conical (Table 2).

In the population of 'Bordeaux 237' cultivar, the rounded shape of the root crop, characteristic of the cultivar, prevailed. The largest number of such root crops was obtained by joint treatment of seeds with Megamix-seeds and seedlings with Megamix-profi and amounted to 84.0%, with 72.0% in control.

An important feature that determines the technological qualities of varieties and hybrids of table beet is an erect, compact leaf rosette, which persists until the end of the growing season of plants and the shape of the root crop (Kozar, 2019).

Table 2. Influence of fertilizers from the Megamix series of preparations for varietal characteristics of uterine root crops of beet

Option	Root shape, %			Rosette of leaves, %			Color of the pulp
	rounded	rounded flat	conical	erect	sprawling	pressed	
The control	72.0	20.8	7.2	86.6	12.6	0.7	Maroon
Megamix seeds - seed treatment	79.6	14.2	5.8	89.3	10.6	-	Maroon
Megamix-pro treatment by seedlings	80.3	13,7	6.2	89.7	8.6	1.7	Maroon
Megamix-seeds - seed treatment + Megamix-pro treatment by seedlings	84.0	12.0	4.0	92.6	7.3	-	Maroon

The analysis of experimental data showed that in all variants the erect rosette of leaves prevailed, but in the variants of treatment with Megamix fertilizer, there were 2.7-6.0% more such plants than in the control.

In all variants, the roots had a maroon color of the pulp. Red-colored beet varieties have a higher content of vitamin C, betaine, betanin and ash elements, increased palatability and, often, more delicate pulp. Therefore, for the consumer and for canning, the intensity of the color of the pulp is an important feature, especially given the current market requirements (Burenin et al., 2016).

The shape of the root crop has a significant impact on the biometric indicators of beetroot (Table 3).

Table 3. Analysis of the morphological features of beetroot when processing Megamix (average 2019-2020)

Option	Root weight, cm	Root diameter, cm	Root length, cm	Leaves weight, g	Sheet length, cm	Number of leaves, pcs	Petiole length, cm	Root shape index
The control	234.0	8.6	8.4	90.0	15.0	13.0	13.2	0.9
Megamix-seeds - seed treatment	242.7	8.4	8.4	90.0	15.6	12.0	12.7	1.0
Megamix-pro - Processing by seedlings	246.0	8.0	8.5	88.1	16.0	14.0	12.7	1.1
Megamix-seeds - seed treatment + Megamix-pro treatment by seedlings	248.4	7.6	8.0	82.8	15.8	15.0	14.2	1.0

The combination of seed treatment and foliar treatments of beet plants in the forks phase had a significant impact on the growth and development of beet plants. "Megamix" stimulated the formation of leaves and the development of their assimilation surface, and also contributed to the thickening of root crops and an increase in their mass. Biometric measurements showed that, on average, the weight of the root crop varied from 234.0 to 248.4 g. In the variant, with the joint treatment of seeds and seedlings of beets, there was a tendency to decrease the weight of leaves by 7.2 g. The number of leaves varied from 12 to 15 pieces. on one plant.

Under the influence of Megamix, an increase in leaf length within the range of 15.8 - 16.0 cm was noted, with 15.0 cm in the control variant. The length of the petiole was in the range of 12.7 - 14.2 cm, in the control variant - 13.2 cm. These two indicators determine the plant height of the table beet, which is taken into account when mechanized harvesting of this crop.

Phenological and biometric studies have established that the most significant effect on the growth, development, dynamics of the formation of uterine root crops and the productivity of table beet was exerted by the complex treatment of seeds and vegetative plants in the fork phase with the fertilizer "Megamix".

Thus, the use of "Megamix" fertilizer in the technology of growing table beets in vegetable crop rotation had a positive effect on the growth and development of plants.

In our studies, we studied the relationship between the weight of the root crop and the weight of the leaves.

It has been established that the mass of the tops in the total mass of the plant ranges from 25.0 to 27.7%. The productivity of the work of the leaves - the number of grams of root crop mass created by the gram of the leaf ranged from 2.7 to 3 g in variants with the use of Megamix. The leaves worked most productively in the variant with joint treatment of seeds and seedlings with Megamix. In this variant, 3.0 grams of root crop mass was created with one gram of a leaf, with 2.6 grams in the control (Table 4).

Table 4. Relationship between root crops and beet leaf apparatus (average 2019-2020)

Option	Root mass		Leaf mass		The ratio of the mass of tops to the mass of the plant, %	Leaf productivity, g/g
	r	%	r	%		
The control	234.0	100.0	90.0	100.0	27,7	2.6
Megamix-seeds - seed treatment	242.7	103,7	90.0	100.0	27.0	2.7
Megamix-pro - seedling treatment	246.0	105.1	88.1	97.9	26.4	2.8
Megamix-seeds - seed treatment + Megamix-pro - treatment by seedlings	248.4	106.2	82.8	92.0	25.0	3.0

The degree of development of the leaf surface has a great influence on the productivity of agricultural plants. The leaf is not only a supplier of food and energy for the plant, it is the center of active and diverse regulation of the vital processes of the plant organism as a whole (Kshnikatkina et al., 2011).

It is believed that when applying new technologies, it is important to take into account the coefficient of economic efficiency (Khoz), which characterizes the level of use of assimilation products for the formation of the economic part of the crop (Timakova, 2011).

As a result of research, a close relationship has been established between the density of standing of plants and the coefficient of economic efficiency. So in the control it is equal to 0.35 g/cm^2 (Table 5). Treatment of seeds with "Megamix-seeds" and seedlings "Megamix-profi" contributed to an increase in the mass of the root crop and the area of the assimilation surface of leaves, and, accordingly, in these variants the Khoz was higher than in the control by 0.01-0.04 g/cm^2. The highest indicator of Khoz was in the variant with joint treatment of seeds and vegetative plants and amounted to 0.39 g/cm^2, which is 0.04 g/cm^2 higher than in the control. This indicates the formation of a more active photosynthetic apparatus in this variant.

Table 5. Coefficient of economic efficiency

Option	Density plants, thousand pcs/ha	Weight root vegetable, g	Square leaves, cm^2	Khoz., g/cm^2
The control	142.5	234.0	668.6	0.35
Megamix-seeds - seed treatment	151.9	242.7	674.2	0.36
Megamix-pro - Processing by seedlings	149.2	246.0	647.4	0.38
Megamix-seeds - seed treatment + Megamix-pro - treatment by seedlings	153.2	248.4	637.0	0.39

The main direction of increasing the coefficient of economic efficiency is the use of technologies that promote higher ratios of the mass of root crops and vegetative organs. One of these technologies is the use of liquid mineral fertilizer from the Megamix series of preparations.

The variety is able to realize its genetic potential for productivity when certain conditions are created by improving the elements of cultivation technology. Fertilizers play an important role among the factors influencing the yield of table root crops. According to I.I. Leunov, the share of the influence of fertilizers on the formation of the crop is from 30 to 45%, second only to the influence of meteorological conditions (Leunov, 1998).

The existence of any genotype is unthinkable outside a certain environment, therefore it is important to combine high productivity and ecological stability in one genotype under the influence of unfavorable environmental factors.

To determine the most optimal variant of the experiment that provides the maximum average yield in the entire set of environments, the selection criterion would be the value of OACi (general adaptive capacity). This is an indicator of the deviation of the average value of the characteristic for the options of experiencethe mean value of a trait in various environmental conditions (Kilchevsky et al.,1989).

Various years of cultivation were used as a set of media (Table 6).

The studies have shown that the yield of uterine beetroot crops significantly depended on the meteorological conditions of the growing season and on the treatment with preparations from the Megamix series.

So in the conditions of 2020, the yield was lower than in 2019, due to the unfavorable growing conditions of this year. The amount of precipitation during the period of root crop formation was 46% lower than the average long-term data. On average, for two years, the yield varied according to the variants of the experiment from 22.2 to 28.4 tons per hectare.

The maximum yield of table beet 28.4 t/ha was obtained by joint treatment of seeds and seedlings with Megamix-seeds and Megamix-profi, which is 6.2 t/ha higher than in the control.

Table 6. Productivity and quality of uterine root crops beetroot

Option	Productivity, t/ha		Average yield by options (Vi), t/ha	Deviation from the overall average (OACi), t/ha	Marketability, %
	2019	2020			
Control - seed treatment with water	23.8	20.6	22.2	- 3.4	90
Seed treatment with Megamix-seeds.	27.2	24.8	26.0	0,4	96
Seedling treatment with the drug Megamix-profi	26.0	25.8	25.8	0.3	95
Treatment of seeds with Megamix-seeds and seedlings with Megamix-profi	29.3	27.5	28.4	2.8	98
Average over the years	26.6	24.7	V Wed 25.6		

The positive value of the general adaptive ability was characteristic for all variants of the experiment with the Megamix preparation. Highest value OACi was in the variant with joint treatment of seeds and seedlings with Megamix-seeds and Megamix-profi preparations and amounted to 2.8 t/ha.

This allows us to conclude that there is a positive interaction between the studied options: the increase in yield from their combined action is much higher than when applied separately.

The quality of root crops as an economic feature is characterized by marketability, that is, the proportion of root crops suitable for sale and storage. The marketability of products is becoming increasingly important in connection with the increasing market requirements.

Evaluating the effect of the use of fertilizers from the Megamix series, one cannot fail to note their influence on quality indicators. Studies have shown that the studied drugs contribute to the improvement of the commodity structure of the crop. Marketability was in the range of 96-98%. When treating seeds and seedlings with Megamix, no root crops with ringing and lignification were observed in the harvest.

The marketability of beet roots is closely related to their shape. Varieties with a rounded shape of root crops have a higher marketable output than those with flat ones. They are characterized by good transportability and keeping quality during long-term storage. Root crops of this type are more convenient for processing in canneries. It is equally important that such root crops are better adapted when planted with special machines for growing seeds in the second year of life.

Thus, the research results show that the use of liquid mineral fertilizer from the Megamix series of preparations is effective, since it helps to increase the productivity and improve the marketability of beet root crops.

CONCLUSIONS

Presowing treatment of table beet seeds with Megamix-seeds contributed to the faster emergence of seedlings. The phase of mass emergence began 3 days earlier than in the control and in the variants where the seedlings were treated with Megamix-pro. In general, the growing season was shorter in the variants with the drug by 4-9 days compared to the control.

In the population of ‘Bordeaux 237’ cultivar, the rounded shape of the root crop, characteristic of the cultivar, prevailed. The largest number of such root crops was in the joint treatment of seeds with the drug Megamix-seeds and seedlings with the drug Megamix-profi and amounted to 84.0%, with 72.0% in the control.

In all variants, an erect rosette of leaves prevailed, but in the variants of treatment with Megamix fertilizer, there were 2.7-6.0% more such plants than in the control.

Average the weight of the root crop varied from 234.0 to 248.4 g. In the variant, with the joint treatment of seeds and seedlings of beets, a tendency was observed to decrease the weight of leaves by 7.2 g. The number of leaves varied from 12 to 15 pieces per plant. Under the influence of Megamix, an increase in leaf length within the range of 15.8-16.0 cm was

noted, with 15.0 cm in the control variant. The length of the petiole was in the range of 12.7-14.2 cm, in the control variant - 13.2 cm.

The leaves worked most productively in the variant with joint treatment of seeds and seedlings with Megamix. In this variant, 3.0 grams of the root crop mass was created with one gram of the leaf, with 2.6 grams in the control.

As a result of research, a close relationship has been established between the density of standing of plants and the coefficient of economic efficiency. The highest indicator of Khoz was in the variant with joint treatment of seeds and vegetative plants and amounted to 0.39 g/cm^2, which is 0.04 g/cm^2 higher than in the control. This indicates the formation of a more active photosynthetic apparatus in this variant.

The maximum yield of table beet 28.4 t/ha was obtained by joint treatment of seeds and seedlings with Megamix-seeds and Megamix-profi, which is 6.2 t/ha higher than in the control. Highest value OACi was in the variant with joint treatment of seeds and seedlings with Megamix-seeds and Megamix-profi preparations and amounted to 2.8 t/ha.

The use of liquid mineral fertilizer from the Megamix series of preparations is effective, as it helps to increase productivity and improve the commercial quality of the crop. There is a positive interaction between the studied options: the increase in yield from their combined action is much higher than when applied separately.

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