

EFFECT OF THE ORGANIC AND BIODYNAMIC FERTILIZATION ON THE PRODUCTIVITY OF SUGAR, FODDER AND TABLE BEETS

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Abstract

The use of organic fertilizers in the ecological production of sugar, fodder and table beets increases significantly the volumes of organic raw material for production of forages and food. The influence of variants of treatment with the organic fertilizers Free N 100, Raim Zolfo, Heliosulfure, and the biodynamic preparations 500 and Fladen, on the productivity and dry matter content of the sugar beet variety Diex, fodder beet variety Sasha and Radost table beet variety has been tested on the Experimental ecology field (carbonate black earth) of Al-Shumen during the period 2019-2020. The test was conducted using the long plots method in 4 repetitions with 8.2 sq. meters area of the experimental plot, in crop rotation of wheat-beet-sorghum, without any use of conventional pesticides and fertilizers. The productivities of the treated with biological preparations variants exceed that of the control in the more favorable for the development of the crops 2019, as well as in the extremely dry for the vegetation 2020.

Key words: organic fertilizers, biodynamic preparations, sugar, fodder, table, beet.

INTRODUCTION

The organic farming as a form of sustainable production is an important priority in the agricultural development policy of Bulgaria. There is a significant increase in organic production on world markets (Lukyanova, 2003; Bozhanska, 2019). Organic farming strengthens agro-ecosystems, preserves biodiversity, promotes healthy food production and creates more employment in rural areas. The production of clean food from chemically contaminated food becomes fundamental for the health status of the population (Kulaeva and Kuznetsov, 2004; Balezentiene and Sampietro, 2009; Georgiev et al., 2019; Bozhanska et al., 2020).

To achieve this goal, the regulation of crop life processes without the use of chemicals is studied (Kerin and Berova, 2001; Mihova et al., 2015). A number of companies have appeared offering various ecological fertilizers and biostimulants. The experimental study of the complex use of organic preparations provides valuable

information to farmers - producers of organic products (Enchev and Kikindonov, 2016; Dochev et al., 2019).

The main indicator of soil fertility is the humus content. Excessive use of pesticides in Bulgaria threatens the deterioration of natural fertility, pollutes groundwater and the environment, increases the acidification of usable areas (Yakimov, 2013). Biodynamic agriculture, as a form of organic farming, aims to revive soil fertility. Based on many years of experience, the effect of biodynamic preparations on soil and plants by stimulating humus content and biological activity has been reported (Schauman, 1987; Raupp, 2001). According to agrochemical studies, the activity of biodynamic preparations is significantly higher compared to fertilizer material. This shows that in biodynamic agricultural practices, the stimulation is towards achieving the right natural values and balance of soil agrochemical components, which leads to more intensive carbonate cycle and efficient biological turnover,

ensuring sustainable fertility with respect to the nitrogen cycle (Naydenova et al., 2015). The sugar, fodder and table beets are crops with high potential to expand the raw material base for production of forages, food and biofuels. The increased demand for organic products is reviving interest in sugar beet for the production of sweet syrups. The Shumen Agricultural Institute conducts researches on the use of organic preparations in beet production (Enchev et al., 2017, 2018). The aim of the present study is to study the productive potential of different forms of beets in the conditions of organic agriculture in the region of Northeastern Bulgaria.

MATERIALS AND METHODS

The experimental study was conducted in 2019-2020 at the Agricultural Institute - Shumen, Northeastern Bulgaria. The experimental ecological field has a five-year period without use of any chemical pesticides and mineral fertilizers, on carbonate black earth, with a scheme of crop rotation of wheat - sorghum - beet. The field experiment is based on the method of fractional plots with quadruple repeatability of the variants, with an area of the harvest plot of 8.2 sq.m. The sowing was carried out at the end of April, at a distance of 70 cm between rows and with in-row density of 12 plants per square meter.

The variants include 3 varieties: Diex - sugar beet, Sasha - fodder beet, Radost - table beet, all from the selection of Agricultural institute, listed in the State Variety List of the Republic of Bulgaria, with 3 treatment options: controls without treatment, fertilization with biodynamic and biological preparations.

The biodynamic treatment is with the simultaneous use of the preparations 500 and Fladen, applied in a formed rosette phase with 1.5% solution. Free N 100 and Reim Zolfo were imported as biological complex treatment. The first, applied in a

dose of 0.05 l/da, enriches the soil and helps the absorption of atmospheric nitrogen, and the second preparation, in addition to being a fungicide, also acts as a stimulant for plant growth applied in a dose of 250 ml/100 l water. Later, the biological fungicide Heliosulfur was applied at a dose of 500 ml/da.

The roots were harvested at the end of October. The weight of each harvest plot of each variant was measured by the root yield indicator, the dry matter content was determined refractometrically. The results were statistically processed with the XLSTAT program for proof and accuracy of the experiments.

RESULTS AND DISCUSSIONS

The agrometeorological conditions at the beginning of the vegetation in 2019 are characterized as favorable, with good soil moisture and high enough temperature for the normal germination and formation of garnished crops. The rainfalls in July allowed for intensive crop development. From mid-August to the end of October, there was a drought, which reduced the accumulation of biomass. 2020 is characterized as extremely unfavorable, with record water deficit. Winter rainfalls are half the norm. March and April were practically without any rainfalls, and the whole of May is one third of the normal precipitation. The prolonged extreme drought in July and August had an irreversible impact on record low productivity levels (Table 1).

The results of 2019 test of organic preparations effect on the productivity of three varieties of beet are shown on Table 2. In the more favorable 2019 the productivity of the three varieties in their control variant has relatively high for organic farming levels of 2 tons - from the table beet, 3.4 tons - from sugar beet, and up to 4.5 tons from the fodder beet.

Table 1. Agrometeorological conditions for the vegetation period, 2019-2020

Year Month	Rainfalls - mm					Temperature Mean for the month
	Decades			Sum	Norm	
	I.	II.	III.			
IV 2019	7.7	45.9	-	53.6	41.0	10.1
V	24.8	16.0	8.4	49.2	64.0	16.7
VI	28.8	10.6	31.2	70.6	75.0	22.2
VII	8.0	24.5	9.1	41.6	60.0	21.9
VIII	22.1	3.7	1.6	27.4	42.0	22.9
IX	-	4.2	11.9	16.1	28.0	18.7
X	16.2	-	7.1	23.3	53.0	13.3
IV.2020	0.0	0.6	1.0	1.6	41.0	12.0
V	12.3	0.0	14.1	26.4	64.0	16.8
VI	4.9	71.1	2.4	78.4	75.0	21.4
VII	0.5	1.1	13.2	14.8	60.0	24.7
VIII	0.0	21.1	0.3	21.4	42.0	24.4
IX	21.7	0.0	9.4	31.1	28.0	21.1
X	17.7	18.9	11.3	47.9	53.0	15.6

The treatment with organic preparations dramatically increases the root yield by 20 to 30% compared to the control. The effect on fodder beet is weaker. The increase in root yield is associated with a slight decrease of the dry matter content, which is expected having in mind the inverse correlation of these traits. The resulting dry matter yield is a demonstration for the ability of organic treatments to largely compensate for intensive factors such as pesticides and mineral fertilization in the

conventional sugar and table beet production.

The extreme water deficit conditions in 2020 have a strong impact on productivity. The reduction in root yield is half of the results obtained in 2019 for all three forms of beets. The processes of accumulation of nutrients in the beet root are sensitive to water deficiency, in which nutrients are redirected to maintain the physiological balance of the leaf apparatus.

Table 2. Effect of the treatment with organic preparations on the productivity and the dry matter content of varieties of sugar beet - Diex, fodder beet – Sasha, table beet - Radost 2019

Variants	Root Yield		Dry matter content		Dry matter Yield	
	t/ha	Rel. to control (%)	%	Rel. to control (%)	t/ha	Rel. to control (%)
Sugar beet - Diex						
Control	33.9	100.0	14.8	100.0	5.02	100.0
Biodynamic fertilization	41.9	123.3	14.2	95.9	5.94	118.3
Biological fertilization	44.4	130.8	14.0	94.6	6.22	123.9
Fodder beet Sasha						
Control	45.3	100.0	15.8	100.0	7.15	100.0
Biodynamic fertilization	47.9	105.7	15.7	99.4	7.52	105.3
Biological fertilization	49.9	110.2	15.2	96.2	7.59	106.1
Table beet Radost						
Control	21.1	100.0	12.3	100.0	2.60	100.0
Biodynamic fertilization	25.4	120.4	12.4	100.8	3.15	121.1
Biological fertilization	26.8	127.0	12.3	100.0	3.30	126.8
GD 1%	3.56	6.72	1.72	3.52	1.89	5.08
P %	3.52		4.08		3.84	

The effect of treatment with biodynamic and biological preparations in these extreme conditions is also decreasing compared to that in 2019 (Table 3). The trend of stronger impact of treatment on the productivity of sugar and table beets compared to fodder beet productivity is repeated. The effect of biological preparations is stronger, as the influence of biodynamic stimulants on the

humus content is suppressed in conditions of severe water deficiency. The significant increase of the dry matter content is normal, making it impressive to keep the lower dry matter levels in the table beet. As a result, the increase in dry matter yield when treated with biostimulants is statistically proven only for sugar beet.

Table 3. Effect of the treatment with organic preparations on the productivity and dry matter content of varieties of sugar beet - Diex, fodder beet - Sasha and table beet - Radost, 2020

Variants	Root yield		Dry matter content		Dry matter yield	
	t/ha	Rel. to control %	%	Rel. to control %	t/ha	Rel. to control %
Sugar beet - Diex						
Control	12.4	100.0	20.0	100.0	2.48	100.0
Biodynamic fertilization	13.2	106.5	21.0	105.0	2.77	111.8
Biological fertilization	13.8	111.3	21.5	107.5	2.97	119.6
Fodder beet - Sasha						
Control	19.6	100.0	20.5	100.0	4.02	100.0
Biodynamic fertilization	20.2	103.1	20.5	100.0	4.14	103.0
Biological fertilization	20.4	104.1	21.0	102.4	4.28	106.6
Table beet - Radost						
Control	12.5	100.0	13.8	100.0	1.73	100.0
Biodynamic fertilization	13.7	109.6	13.0	94.2	1.78	102.9
Biological fertilization	14.6	116.8	12.5	90.6	1.83	105.5
GD 1%	4.81	5.21	3.20	4.41	1.58	5.52
P %	5.72		5.43		4.78	

CONCLUSIONS

The results of the test in conditions of organic farming without use of pesticides and mineral fertilizers show a significant variation in yields depending on the agro-climatic conditions.

The extreme deviations from the norm sharply reduce the yield and the effect of treatment with organic preparations. Ensuring optimal water balance is crucial for efficient ecological beet production.

For the application of organic production, tests of a larger range of preparations are needed, as well as selection of more adapted varieties. The sugar beet has a greater potential for organic production than fodder and table beet. The effect of biological preparations is stronger, as the influence of the biodynamic stimulants on the humus content is suppressed in severe water deficiency conditions.

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