INFLUENCE OF MANURE AND CACO3 ON GROWTH, PHOTOSYNTHESIS AND PRODUCTIVITY OF TOMATO VARIETIES

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Abstract

The present work was carried out to determine the effects of manure and $CaCO_3$ on growth, content of photosynthetic pigments, activity photosystem 2 (PS 2) and yield parameters six varieties of tomatoes. The plants were grown under conditions of closed (greenhouse) and open ground, with manure applied in the calculation of 500 g and $CaCO_3$ (chopped eggshell) 50 g per 1 m^2 of soil. It was revealed that the high grades of the photosynthetic apparatus and productivity were characterized by the varieties Tolstoy and Volgograd, which can be used in breeding work.

Key words: tomato varieties, manure, chlorophyll, carotenoids, PS 2, yield

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Introduction

Tomatoes are one of the valuable vegetable crops grown all over the world to provide the needs of the population with valuable natural compounds, as well as for processing in canneries. Growing tomatoes in winter greenhouses is of enormous economic importance for providing the population with vitamins C, B1, B2, B3, PP, as well as elements of potassium, sodium, magnesium, phosphorus, iron, sugars, apple and citric acids and proteins. Tomatoes are demanding for soil fertility, especially phosphorus, nitrogen and potassium. In the seedling period, tomato intensively consumes potassium and phosphorus, later nitrogen. Plants use nitrogen to form vegetative organs, especially in the period from sprouting to flowering. The consumption of phosphorus is mainly associated with the growth of the root system, fruits and seeds. Potassium is especially needed during the period of growth and maturation of fruits. Tomatoes also need other microelements: sulfur, iron, boron, manganese and others. To obtain a high yield, it is necessary to increase the concentration of carbon dioxide, which can be increased by adding manure to the soil where tomatoes will grow. It is considered that first of all it is important to select organic materials instead of using synthetic fertilizers in organic vegetable growing in order to increase soil productivity. That is why green manure, composts and other organic fertilizers should be used in cultivation of organic vegetables [1]. Manure is an environmentally friendly and economically beneficial organic fertilizer. In experiments carried out using sandy soil, with the addition of organic fertilizers, plant growth was markedly accelerated in comparison with control plants [2,3]. Organic fertilizers also neutralized the

acidity of the soil, (3) and increased the activity of catalase [5]. The addition of various stimulants improves the quality of the crop [6], stress tolerance [7]. It is known that calcium is one of the necessary elements for the growth and development of plants, and it also removes the toxic effect of harmful ions for plants, such as sodium ions. In earlier studies it was shown that providing additional Ca has reduced some of the detrimental effects of Na on tomato and other crops. [8,9].

Based on this, the purpose of our studies was to study the effect of manure and $CaCO_3$on the growth, photosynthesis and productivity of different varieties of tomatoes.

Material and methods

The object of study was six varieties of tomatoes, grown under the conditions of a greenhouse and open ground. The manure was applied with the calculation of 500 g and $CaCO_3$ (chopped eggshell) 50 g per 1 m^2 of soil. In the phases of plant development, leaf samples were taken to determine the content of chlorophyll and carotenoids. he efficiency of the photosystem (Fv / Fm) was determined using a photosynthesis analyzer (PAM, Germany). The activity of photosystem 2 (PS 2) was determined on the polarograph (OH103) by releasing oxygen with application of the Clark electrode [10]. The content of chlorophylls and carotenoids was determined on the spectrophotometer (Multiscan GO, Germany) by trituration the leaves in 80% acetone, measuring the absorption at 645, 663, and 440, using the Wettstein and Arnon coefficients [11]. Data analysis and statistical analysis was conducted using Microsoft Excel. Statistical analysis was performed with the aid of the Statgraphics Plus 5.1 statistical package. The means of values were compared by Duncan's multiple range test (p = 0.05).

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Results and discussion

The results of experiments on the effect of manure on the content of photosynthetic pigments and on fluorescence parameters are shown in Table 1.

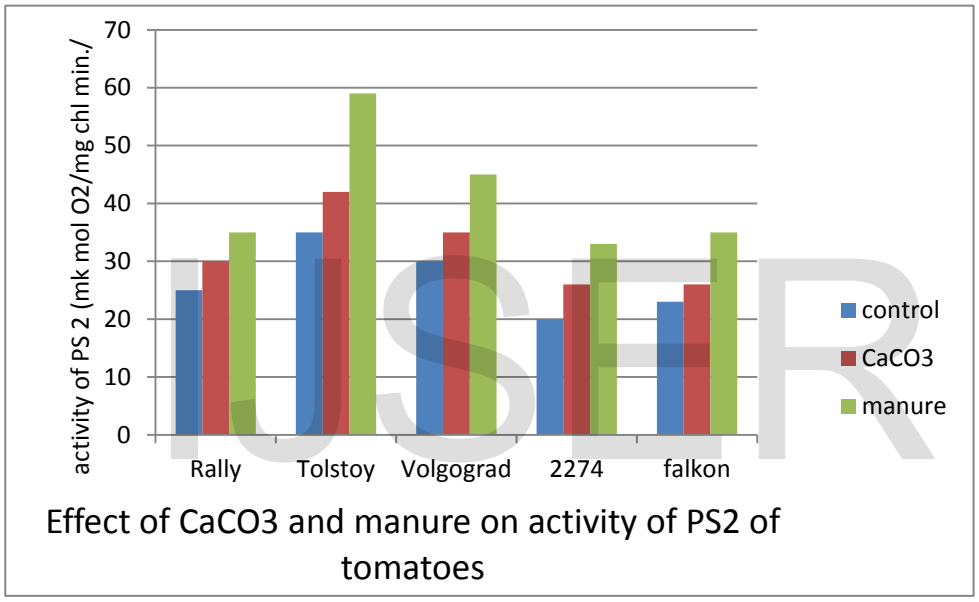
Table 1. Effect of manure on content of chlorophyll, carotenoids and the efficiency of the photosystem 2

Variety	Chlorophyll(a+b)mg/g		Carotenoids mg/g		F_v / F_m	
	Control	experience	Control	experience	Control	experience
Rally	0,97*	1,5	15,2	16,8	0,7	0,8
Tolstoy	0,97	1,8	15,2	16,9	0,7	0,8
Volgograd spring	0,79	1,7	10,9	13,2	0,8	0,8
Volgograd autumn	0,81	2,0	12,3	14,5	0,7	0,8
22-74	0,50	1,1	21,1	23,2	0,5	0,6
Falkon	1,10	1,4	20,8	22,4	0,5	0,6

* Each value represents the mean ± SD (standard deviation) for the mean n = 3 independent experiments p = 0.05.

As can be seen from Table 1, manure positively affects the content of chlorophyll a + b and carotenoids. The ratio a / b is increased, which indicates an accelerated synthesis of chlorophyll a. The manure also contributed to an increase in the activity of the photosynthetic apparatus of tomatoes (Figure). Activity photosystem 2 increased by 65% in Tolstoy, which markedly exceeded the activity of plants of other varieties. To measure the physiological state of plants on whole leaves, the values of the ratio Fv / Fm were measured. As can be seen from the table, the values of Fv / Fm in control and experimental plants are significantly different. Inter variety differences are also observed. Our data are consistent with generally accepted opinions that the values of the parameter Fv / Fm above 0.74 reflect the favorable state of the plants.

To study the effect of calcium on the growth and development of tomatoes, we used a chopped eggshell as the organic calcium. The results of experiments obtained using organic calcium are given in figure.



Effect of CaCO3 and manure on activity of PS2 of tomatoes

* Each value represents the mean ± SD (standard deviation) for the mean n = 3 independent experiments p = 0.05.

According to several authors (Mahmoud B.Ali et al., 2014; Saidu et al., 2011; Tiamiyu et al., 2013; Ayoub and Afrah, 2014) manure when decomposed increases both macro and micro nutrients as well as enhances the physical and chemical properties of the soil; this led to its high vegetative growth. The nonsignificant difference observed in the treatments supplied with goat and cow dung with control treatment could be either there were some nutrients already present in the soil or the plants need were satisfied with the quantity of nutrients present in the soil. Tomato grown on poultry manure and sown at the right time performed better in terms of the height of the plant than the other sources of organic manure and sowing date. This shows that poultry manure was readily available and in the best form for easy absorption by the plant roots, hence there was a boost in the morphological growth of the plant. The obtained results corroborated the finding of in okra production in which they reported that organic manure, especially poultry manure could increase length of crops when compared with other sources of manures and sowing dates The increase in number of leaves plant-1 with organic fertilizer application and sowing date stressed its importance during the vegetative growth of crop plants The non-significant effect of manure

sources on fruit length could be due to the effect of these sources of organic manure on enhancing vegetative growth. All the nutrients supplied by the different manure sources might have been diverted to vegetative growth. This could be due to their bulkiness and higher amount of nutrients already present in the soil could contribute to this phenomenon.

Organic fertilizer affected the morphometric parameters of plants stem diameter, wet weight of the aboveground part of plants (Table 2).

Table 2. Effect of manure on height and yield of tomato plants

Variety	Height, sm	Harvest of a single plant, g	Harvest, m^2 / kg	average fruit weight, g
control	51	750 ± 61	15	40
Rally manure	60	840 ± 68	17	45
control	65	1200 ± 72	19	46
Tolstoy manure	74	1370 ± 75	23	50
control	62	1300 ± 68	21	48
Volgograd spring manure	66	1450 ± 71	25	52
control	55	1060 ± 65	19	44
Volgograd autumn manure	60	1270 ± 68	22	49
control	45	550 ± 34	15	42
22-74 manure	52	670 ± 45	18	45
control	48	630 ± 46	16	43
Falkon manure	64	750 ± 55	19	46

As can be seen From the table, there are differences between the varieties. The tomato variety Tolstoy has the highest morphometric parameters. Our studies have shown that the application of organic fertilizer has unequivocally increased the growth, the diameter of the stem, the wet weight of the aboveground and underground parts, as well as the productivity of tomatoes. According to the literature data, organic fertilizer improves the water potential of the soil, facilitates the entry of elements of mineral nutrition into the roots of plants (5). During drought, manure prevents evaporation of water and promotes moisture retention in soil capillaries around the root system of plants. In drought conditions, varietal characteristics are also revealed: some varieties use mineral elements more intensively, others more slowly. In our experiments the

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Volgograd and Tolstoy varieties were the most intense, which, under identical conditions of supply with organic fertilizer, yielded a higher yield of tomatoes.

Conclusion

When growing 6 different varieties of tomatoes with the introduction of organic fertilizer the most productive were the varieties Tolstoy and Volgograd, which can be used in breeding for obtaining more highly productive varieties.

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