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Impact of Vermicompost on the Productivity of Agricultural Crops.

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ABSTRACT

The impact of vermicompost which was obtained on the basis of camel manure, yield and quality of potatoes and beets was investigated. The increase of root crops yield 1.2-1.5 times in making 8 t / ha vermicompost in gray soils was established. It was shown that the use vermicompost as a fertilizer was more expedient, as it contains more nutrients (N,P,K) and organic humic acids compared to conventional compost. Vermicompost has a direct physiological effect on plants; it stimulates the development of root systems and reduces the harmful effects of pollutants.

Keywords*:* vermicompost, camel dun, yield, root crops, humic acid.

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INTRODUCTION

In the last century, with increasing amounts of pollutants emitted from anthropogenic sources, there has been a violation of the ecological balance in ecosystems. In this regard, the problem of the protection and rational use of natural resources was put forward to the forefront. Especially, the loss of soil fertility and accordingly deterioration of the quality of plant growing and livestock production is of great concern all of humanity, since it is of paramount importance for economic and social development of any country [1-3].

As it is known, in comparison with other objects of the biosphere, the soil cover is the medium receiving the pressure of the flow of industrial, agricultural, municipal emissions of different waste [4]. Under the intense pressure of increasing anthropogenic media, a soil system begins to lose the ability to perform its essential role of buffer and detoxicant. One of the main reasons of the observed phenomenon is the prevalence of degradation processes in the soil system on its biological productivity. On a global scale as a result of soil degradation, crop yields are reduced every year and consequently, the stocks of humic substances, which are the main source of nutrients, are reduced [5-6].

Rational use of fertilizers, ameliorants is one of the most important measures for improving soil fertility and increase of agricultural crops productivity. Special prospects were presented by the innovative eco-friendly bio-organic fertilizer, enabling alternatively to implement the replacement of traditional fertilizers, including a certain amount of pollutants of various natures in its structure a certain.

For example, the uncontrolled use of nitrogen fertilizers in large quantities (60 kg of active ingredient per 1 ha) suppresses the natural biological process of nitrogen fixation in the soil, causing the accumulation of nitrates and nitrites in the plants [7].

In maintaining and enhancing soil fertility, the special role among organic fertilizers is given to manure or its decomposed form, i.e., compost [8,9]. This type of fertilizer has a positive impact on the nutrition of plants, the soil properties and is an important reserve of soil replenishment by organic substance and increase of crop yields productivity [10].

Manure or compost in the soil forms agronomically valuable structure, improving its ability to retain water and contain air. On their surface, they retain ions of soluble salts, provide ion exchange equilibrium with soil solution and thus affect the conditions of the plant nutrition.

But, however, as manure or compost is not always environmentally safe fertilizer. They contain seeds of weeds, viable helminth eggs and pathogens. In order to prevent these drawbacks, most feasible and promising way is the use of a valuable fertilizer – vermicompost which is enriched by humus and sufficient nutrients [11]. In this regard, the development of rational methods of disposal of animal waste and crop farms aimed at generating vermicompost of vital importance in maintaining and improving soil fertility, is one of the most urgent tasks.

The aim of this work is to study dependence of productivity, quality, structural composition of root crops (beets, potatoes) on the nature of the vermicompost produced on the basis of manure use of various farm animals.

MATERIALS AND METHODS

In this paper, the choice as a study of composition and properties of vermicompost is associated with the absence of established scientific views on the reasons of such its high physiological activity. To carry out skilled researches, gray soils with humus content in the layer (0-40 cm) - 1.0-1.2% of total nitrogen - 0.09-0.18% of available phosphorus - 9,1-26,0 mg / kg and the amount of exchangeable bases - 23,6-26,9 mEq / 100 g soil were used. Soils had unfavorable physical properties, mainly the form not only of the surface crust in drying, but also lower structure of arable layer.

Field and laboratory analytical studies, analyses of soils and plants were made by conventional methods in soil science, agricultural chemistry and ecology [12-14]. Determination of soil fertility was defined by bioassays methods; selection of soil sampling for chemical analysis was conducted in accordance with SES

17.4.4.02-84; the content of organic substances was identified by the method of Turin; pH_{KCl} was conducted by Kappen, total nitrogen by Cornfield, mobile phosphorus and exchange potassium was defined by Kirsanov, condition of sowings and productivity of crops by phenological phases of development (SES 12014-80).

Productivity of potatoes and beet were determined by weighing the mass of the tubers. The storability of tubers were analyzed after 6 months of storage at a temperature of 5 ± 1 0C. The repeatitiveness of experience is three times. Statistical data processing was conducted by using the software called Statistica. 6.0 [15]. Vermicompost was locally introduced in the form of sockets as well as random with following stirring with a layer of 0-20 cm of soil.

RESULTS AND DISCUSSION

For vermicomposting, manures of large, small cattle, pork, horse, camel manures were selected and the basic nutrients in them were defined. The obtained data are presented in Table 1.

Table 1: The content of nutrient elements in different manure (%)

Nutrient elements	Types of manures				
	horse	cow	pork	sheep	camel
Nitrogen	0,3-0,8	0,1-0,7	0,4-0,9	0,7-0,9	0,4-1,0
Phosphorus	0,2-0,7	0,1-0,6	0,2-0,6	0,2-0,4	0,4-0,9
Potassium	0,2-0,8	0,2-0,7	0,4-0,7	0,3-0,8	0,5-0,9
Calcium	0,2-0,3	0,3-0,5	0,2-0,3	0,3-0,4	0,4-0,5
Magnesium	0,1-0,2	0,1-0,2	0,1-0,2	0,1-0,3	0,2-0,4
Humidity	67,0-71,1	74,5-77,3	69,9-72,4	61,2-64,5	5,3-8,4
Organic substance	24,6-25,9	19,9-20,2	23,7-24,9	30,8-31,5	29,0-32,7
pH	7,6-8,0	7,7-8,1	7,8-8,0	6,8-6,9	6,7-6,8

Of all types of manure on their nutritional value and chemical composition, the most valuable organic fertilizer is camel manure. A camel manure which is practically odorless has a high lightness and is more friable, less humid (from 5 to 8%) and contains more organic substances (29,0-32,7%) compared to the manure of other animals.

All types of manure separately and in mixture were used as the main component in the substrate intended for vermicomposting. Table 2 shows the average composition of vermicomposts obtained after 4 months of vermicomposting with red californian worms.

Table 2: Chemical composition of vermicompost (biohumus), obtained on the basis of manure of cattle, horses and camels

№	Name of the composition indicator	Contents, %	
		The mixture of manures of horse and cattle (1:1)	Camel manure
1	Dry remains	50,3-65,2	64,7-67,6
2	Humus substances	25,7-37,8	27,2-38,9
3	Humidity	35,0-40,1	28,8-32,4
4	pH	6,5-7,1	6,8-6,9
5	Total nitrogen	1,0-3,0	1,2-4,0
6	Total phosphorus (P_2O_5)	1,3-2,8	1,7-3,9
7	Total potassium (K_2O)	1,2-4,4	2,0-5,2
8	Calcium	4,0-6,0	4,8-7,2
9	Magnesium	0,5—2,3	0,3-0,9
10	Iron	0,5—2,5	0,4-1,8
11	Manganese	60,1-80,3 mg/kg	48,0-69,8мг/кг
12	Heavy metals	< MPC for soil	Not discovered
13	Pathogenic microflora	missing	missing
14	Helminth eggs	missing	missing

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The experimental data suggest that vermicompost greatly differs from the composition of the compost on its microbiological, chemical and other properties. The seeds of weeds are stored, helminths and other pathological microorganisms are not contained in the vermicompost,.

The results of experimental studies to determine the level of vermicompost influence (with camel manure) on the yield and quality of root crops are presented in Tables 3-4.

Table 3: Productivity and seed quality of potato of Scottish varieties grown in gray soils

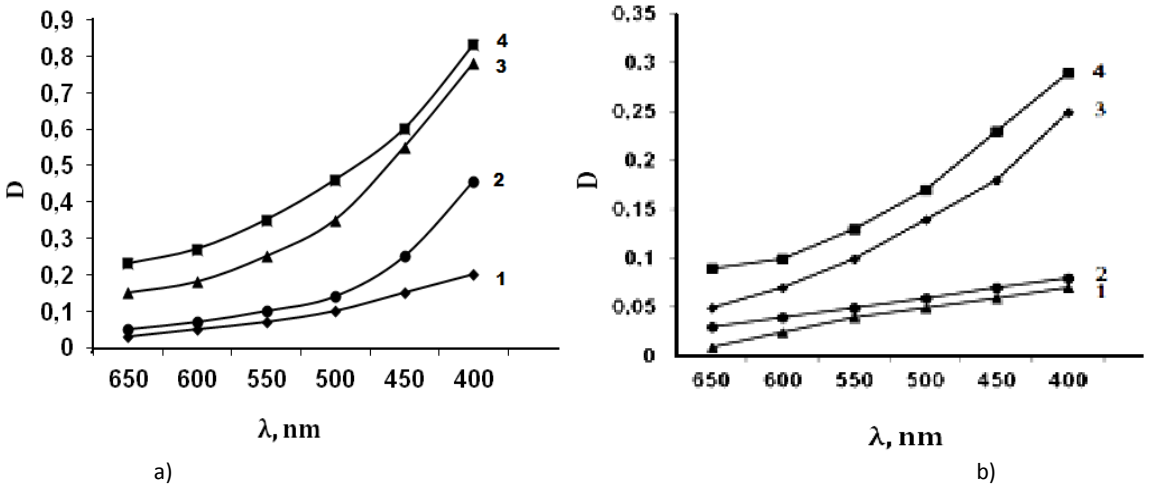
Variant	Productivity of potato, t/ha	Increase of productivity		Fractional composition of the harvest, t / ha		
		t/ha	%	trading	seminal	Non trading
Control (without vermicompost)	20,9	-	-	12,6	6,8	1,5
Vermicompost, 4 t / ha	26,5	+5,6	26,8	14,5	10,8	1,2
Vermicompost, 8 t / ha	32,0	+11,1	53,1	16,5	14,7	0,8
Camel manure, 4 t/ ha	24,8	+3,9	18,6	13,3	8,9	2,6
Camel manure, 8 t / ha	30,1	+9,2	44,0	14,4	14,3	1,4

Trading productivity of root crops depends on the nature and quantities of organic fertilizers. More positive results are achieved in making vermicompost than manure. When using 8 t / ha vermicompost, the indicator of potato (32.0 t / ha or 53.1% of control) and beet productivity (36.7 t / ha or 21.5% of control) is higher compared to the same amount of the introduced manure. The sharp change in sugar content in beet roots when introducing vermicompost or manure is not observed, that indicates the preservation of the qualitative composition (Table 4).

Table 4: Results of comparative analysis on the impact of vermicompost and manure on productivity and quality of beet roots.

Variant	Beet productivity, t/ha	Increase of productivity, t/ha	Collection of sugar, t/ha	Sugar content, %
Control (without vermicompost)	30,2 ± 0,7	_	4,02 ± 0,05	15,9 ± 0,2
Vermicompost, 4 t / ha	34,9 ± 0,5	4,7 ± 0,3	5,17 ± 0,03	16,4 ± 0,2
Vermicompost, 8 t / ha	36,7 ± 0,4	6,5 ± 0,3	5.58 ± 0,05	16,3 ± 0,1
Camel manure, 4 t/ ha	32,5 ± 0,6	2,3 ± 0,2	4,34 ± 0,04	15,8 ± 0,2
Camel manure, 8 t / ha	34,0 ± 0,5	3,8 ± 0,4	5,01 ± 0,04	16,0 ± 0,2

As the accumulated scientific basis and the results of our experiments show, unlike composts vermicompost has high growth stimulating (Figure 1), a fertilizer-ameliorating and other properties.



Substratum - manures: 1,3 – large cattle manure; 2,4 – camel manure

Figure 1: Optical density humic (a) and fulvic acid (b) allocated, respectively, from manure (1,2) and the vermicompost (3,4).

The established single scientific views on the reasons of such a high activity of vermicompost still do not exist. It requires conducting fundamental researches as the chemical composition and structure of organic substances as bacterial communities contained in vermicompost.

CONCLUSIONS

Thus, vermicompost increases the quantity, quality and presentation of products, which is important for the production of food root crops - potatoes and beets. A significant effect of the using vermicompost as compared to humus manure is shown. Potatoes and beets grown in introducing into unproductive gray soils of about 8 t / ha vermicompost, gave a yield increase respectively of 1.5 and 1.2-times compared to the control. By visual observation, the acceleration of flowering and ripening of crops, development encouragement of the root systems were observed. The absence of pathogenic microflora, eggs and larvae of helminthes introduced into the soil vermicompost can increase the environmental safety of the harvest of potatoes and beets.

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REFERENCES

[1] Novoselov S.I. (2011) Ways to preserve soil fertility and productivity increase of agro cenosis in the agriculture Nechernozemie. In: International scientific-practical conference "Innovative development of crop in the Republic of Mari El.", Russian Federation, Yoshkar Ola, May 2011, 21-31.

[2] Nikitishen V.I. and Kurganova E.V. (2007): Fertility and fertilizer of gray forest soils of the Central Russia. Moscow, Russian Federation, 367.

[3] Kozhemyakov A.P. and Dorosinsky L.M. (1989): The effectiveness of the use of nitrogen-fixing microorganisms preparations in agriculture. Proceedings of the All-Russian Research Institute for Agricultural Microbiology, Vol.59, P. 5-13.

[4] Zinyakova N.B., Khodjaeva A.K., Tulin A.S. and Semenov V.M. (2013): Active organic substances in the gray forest soil of arable and fallow lands. Agrochemistry, Vol.9, P. 3-14.

[5] Alvarez R. (2005): A review of nitrogen fertilizer and conservation tillageeffects on soil organic carbon storage. Soil Use Managment, Vol.21 (1), P. 38-52.

[6] Christopher S.F. and Lal R. (2007): Nitrogen management affects carbon seguestration in North American cropland soils. Critical Review Plant Science, Vol. 26(1), P. 45-64.

[7] Zavalin A.A. (2005): Biological products, fertilizers and crop. Moscow, Russian Federation, 302.

[8] Yadav K.D., Tare V. and Ahammed M.M. (2011): Vermicomposting of source-separated human faeces by Eisenia fetida: Effect of stocking density on feed consumption rate, growth characteristics and vermicompost production. Waste Management, Vol. 31 (6), P. 1162-1168.

[9] Amossé J., Bettarel Y., Bouvier C., Bouvier Th., Tran Duc T., Doan Thu Th. and Jouque P. (2013): The flows of nitrogen, bacteria and viruses from the soil to water compartments are influenced by earthworm activity and organic fertilization (compost vs. vermicompost). Soil Biology and Biochemistry, Vol. 66, P. 197-203.

[10] Tejada M. and Benítez C. (2011): Organic amendment based on vermicompost and compost: differences on soil properties and maize yield. Waste Managment Research, Vol. 29(11), P. 1185-1196.

[11] Abdimutalip N., Toychibekova G., Ozler M.A. and Oshakbayev M. (2014): Management Of Agricultural Wastes And Soil Neutralization By Vermicomposting With Californian Red Worms, Fresenius Environmental Bulletin, Vol.23 (2a). P. 640-644.

[12] Novitsky M.N., Don I.N. and Chernov D.V. (2009): Laboratory and practical training in soil science. St. Petersburg, Russian Federation, 23-25.

[13] Sychev V.G. (2008): The program and research methods of soil humus status of long experience GeoNetwork, benchmark sites and landfills of agroecological monitoring. Moscow, Russian Federation, 9-16.

[14] Sava C. and Stanciu G. (2011): New Analytical Method For Organic Matter Determination. Journal of Environmental Protection and Ecology, Vol.12 (4A), P. 2038-2045.

[15] Khalafyan A. (2008): Statistica. 6. Statistical analysis of the data. Moscow, Russian Federation, 4-9.