Scientific Papers. Series B, Horticulture. Vol. LXIII, No. 1, 2019
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

THE EFFECT OF VERMICOMPOST WITH DIFFERENT ORIGINS ON THE DEVELOPMENT OF CUCUMBER SEEDLINGS

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Abstract

The aim of this study was to determine the influence of vermicompost with different origins on the development of cucumber seedlings. Three types of vermicompost produced by plant wast (PW), cow manure (CM) and a mixture from PW+CM were tested. In the mixture of peat and perlite in ration 3: 1 were added three quantities (5%, 10%, 15%) of each of investigated compost. The control was grown in the same mixture of peat and perlite. Some chemical properties: pH, contend of N, P, K of the vermicomposted were determined. In the end of seedling period was established that the vermicomposts has positive influence on the morphological signs and physiological indicators of the seedling plants. In most cases, the stimulation effect on the plants is enhanced by increasing the percentage of composts in the mixture. The plant height, leave number and area, chlorophyll content, fresh and dry weight on the plants, grown in peat and perlite mixture with 15% PW+CM of vermicompost there were the highest influence increased mostly in comparison with control.

***Key words**: cucumber, seedling, vermicompost, different origin.*

INTRODUCTION

Choosing the right mixture that meets the requirements of the growing crop is an essential part of the nursery. In recent years, a compost of California worms, called a vermicompost, has been widely used. Many authors report the positive effect of vermicompost on a number of crops (Vasudevan, 1997; Hidalgo, 1999; Pashanasi et al., 1996, Angelova et al. 2013; Vlahova, 2015). Its use as a supplement to the peat improves the growth and development of the plants (Atiyeh et al., 2000, Arancon et al., 2004, Sallaku et al., Manha and Wang, 2014). Since it is an organic product, the vermicompost is also widely used in organic vegetable production (Theunissen et al., 2010). In addition to the direct effect on plant development, the vermicompost has an indirect effect, protecting them from diseases and pests (Orlikowski, 1999; Nakasone et al., 1999; Szczech, 1999).

Cucumber is a rapid growth culture with high nutrition requirements. In addition, the cucumber plant is highly sensitive to the salt concentration of the nutrient solution (Cholakov, 2009). These specific requirements require that the selection of the components of the mixtures and the proportions between them to be dome very carefully.

What is the impact of vermicompost development of seedlings of cucumbers and does it matter its origin and its quantity in the mixture lies in the nature of this studies.

MATERIALS AND METHODS

The experiments were conducted in the period 2017-2018 at the Agricultural University of Plovdiv. Seeds of the direct Gergana variety were used to produce seedlings. The sowing of seeds was carried out at the end of March in plastic pots with a diameter of 10 cm.

The main components of the seedlings were peat, pearlite and vermicompost. Peat substrate is pre-enriched by 250 mg / l nitrogen, 250 mg / l phosphorus, 270 mg / l potassium and 1,2 mg / l of trace elements Fe, Cu, Mn, Mo, B and Zn. The salt concentration of the mixture is 1.2 ms, and pH 6.5-7.

Three types of vermicompost produced by plant waste (PW), cow manure (CM) and a mixture from PW+CM were tested. In the mixture of peat and perlite in ration 3: 1 were added three quantities (5%, 10%, 15%) of each of investigated compost. The control was grown in the same mixture of peat and perlite.

Some chemical properties: pH, contend of N, P, K of the vermicompost was determined (table 1).
The seedlings were grown for 35 days. At the end of the seedling period biometric measurements were performed on 10 plants of each variant. The subject of the study was the indicators: stem height (cm), the thickness of the stem (mm), number of leaves, leaf area (cm^2), the fresh vegetative mass (g), root system mass (g), root system volume (cm^3).The leaf area was determined by the Digimizer program. The volume of the root system was determined by measuring the amount of displaced liquid after immersing it in a cylinder with water. The total chlorophyll content was determined with the Chlorophyll Meter SPAD-502 apparatus. Determination of the quantity of dry mass and dry matter content of a plant with components above ground (stem+leaves) by Manuelyan, 1966.
The mathematical processing of the data was done by statistic program BIOSTAT.

Table 1.Chemical properties of vermicompost

Vermicompost	pH	NH_4 mg/100g	NO_3 mg/100g	P mg/100g	K mg/100g
Plant waste (PW)	6.98	20.92	44.73	110	87
Mixture from PW+CM	7.02	26.42	62.78	146	47
Cow manure (CM)	7.72	26.94	134.98	136	72

RESULTS AND DISCUSSIONS

A biometric indicator (table 2) of cucumber seedlings varies depending on the origin of the vermicompost and the quantity in which it is applied. For plants grown in a vermicompost from PW and PW+CM, the values of the main biometric indices increase with increasing content in the mixture. Increase compared to the control in the variants with 15% application is from 1,9 cm to 2,3 cm the height of the stem, from 20.9% to 23.4% of the leaf area, from 11,2% to 17,6 % for the weight fresh vegetative mass and from 30.8% to 35.0% for the root system mass. The volume of the root system is larger by 1.0 to 1.3 cm^3. The higher values of these indicators are applied to PW+CM. The differences compared to the control are statistically proven. The seedlings grown in 15% cow manure originating are the smallest. The plants of those variant have lowest stem and number of leaves. The leaf area and the fresh mass are very close to the control, but the volume and mass of the root system are larger. According to Tringovska and Dintcheva (2012), the differences in plant growth are mainly due to the difference in nutrient content of the mixture, but that may also be due to the change in some physical and biological properties of the substrate.
The effect of the application of vermicompost cow manure origin may be positive when administered at lower doses - 5% or 10% of the volume of the mixture. Comparing variants with 5 and 10 percent vermicomponent application shows that plants of cow manure variants grow most intensively. In that case the values of the ground part and root system are highest. According to some authors (Subler et al., 1998) the provision of seedlings with all the necessary nutrients is achieved when the vermicompost represents between 10% and 20% of the total volume of the mixture used.
Higher percentages of the vermicompost in most cases lead to suppression of the growth and development of young plants.
The ratio between the above-ground and root masses shows the degree of harmonious development of the seedling plants. All variants have lower values compared to the control, which means that the differences between the biometric counterparts are smaller and the plants are with better harmoniously developed. That is a prerequisite for better adaptation and restoration of plants after planting in a permanent place. In this connection, the most suitable from a biological aspect are variants 4

(4,64) and variant 10 (4,74), where the coefficient is the lowest.

The dry mass (table 4) of the plants increase with increased the content of the vermicompost. In the variants with cow manure origin, the highest values were obtained at 10% (2,20g), and then decreased. The synthesized dry mass has the highest values (2.29g) in plants of variant 10 (15% PW+CM). The lowest values were recorded in the control. The dry matter is from 10.06% (control) to 12.38 (15% PW+CM).

Table 2. Biometric indicators average for the period

Variant №	Content of vermicompost	Stem height, (cm)	Thickness of the stem (mm)	Leaves number	Leaf area	
					(cm^2)	% to the control
1	Control	17,1	64,5	3,3	288,0	100,0
Vermicompost produced by plant waste (PW)						
2	5%	17,4	65,0	3,5	301,6	104,8
3	10%	18,1	69,0	3,7	318,6	110,6
4	15%	19,0	72,5	4,0	348,4	120,9
Vermicompost produced by cow manure (CM)						
5	5%	18,6	69,0	4,0	318,1	110,6
6	10%	18,7	71,5	4,0	339,6	117,8
7	15%	16,9	66,5	3,2	296,7	103,1
Vermicompost produced by mixture from PW+CM						
8	5%	18,2	66,5	3,8	305,1	106,0
9	10%	18,5	67,5	3,9	326,9	113,5
10	15%	19,4	75,5	4,1	355,5	123,4
	GD 5%	0,75		0,82	30,21	
	GD 1%	1,02		1,12	37,31	
	GD 0,1%	1,36		1,49	46,4	

Table 3. Biometric indicators average for the period

Variant №	Content of vermicompost	Fresh vegetative mass (stem and leaves)		Root system volume (cm^3)	Root system mass (g)		Ratio above-ground / root masses
		(g)	% to the control		(g)	% to the control	
1	Control	15,70	100,0	4,40	2,88	100,0	5,45
Vermicompost produced by plant waste (PW)							
2	5%	16,30	103,7	4,70	3,25	112,7	5,02
3	10%	16,96	107,8	4,80	3,43	119,6	4,95
4	15%	17,48	111,2	5,40	3,77	130,8	4,64
Vermicompost produced by cow manure (CM)							
5	5%	17,04	108,4	5,10	3,50	121,3	4,88
6	10%	17,85	113,4	5,30	3,64	126,5	4,91
7	15%	15,77	100,4	4,70	3,04	105,2	5,19
Vermicompost produced by mixture from PW+CM							
8	5%	16,87	107,3	4,85	3,26	114,0	5,18
9	10%	17,69	112,4	5,25	3,55	123,5	4,99
10	15%	18,50	117,6	5,70	3,90	135,0	4,74
	GD 5%	2,18		0,72	0,87		
	GD 1%	2,94		0,98	1,18		
	GD 0,1%	3,92		1,30	1,58		

Comparing the variants with 5 % and 10 % administration of vermicompost shows that plants of CM are characterized by the highest dry matter content. The amount of dry matter is an important indicator reflecting the productive potential of young plants and its higher content in the vegetative organs is important for their faster adaptation to the environment. In connection with the above, it can be considered that the higher dry matter content in the above-ground part of plants outlines their advantage in physiological aspect (Shopova et al.,2014).

The results for the total chlorophyll content in the leaves (Table 4) supplement the physiological characteristics of the seedling plants. The inclusion in the peat-pearlite mixture of the tested additives increases the content of the total chlorophyll to varying degrees. The increase in the quantity of vermicompost in the cultivation mixture resulting in increased content of total chlorophyll. The total chlorophyll values are highest in plants grown in PW+CM vermicompost. Lower values relative to the control were recorded only for plants in the vermicompost produced by plant waste with 5 and 10% administration.

Table 4. Photosynthetic indicators of the plants

Variant №	Content of vermicompost	Stem and leaves		Content of total chlorophyll	
		dry weigh (g)	dry matter (%)	SPAD units	% to the control
1	Control	1,58	10,06	37,8	100,0
Vermicompost produced by plant waste (PW)					
2	5%	1,83	11,23	35,6	94,2
3	10%	1,99	11,73	36,1	95,5
4	15%	2,16	12,36	38,9	102,9
Vermicompost produced by cow manure (CM)					
5	5%	2,05	12,03	38,2	101,1
6	10%	2,20	12,33	40,8	107,9
7	15%	1,91	12,12	42,2	111,6
Vermicompost produced by mixture from PW+CM					
8	5%	1,99	11,80	40,1	106,1
9	10%	2,17	12,27	41,2	109,0
10	15%	2,29	12,38	43,6	115,3

CONCLUSIONS

Irrespective of origin, the vermicompost can has a positive influence on the morphological features and physiological characteristics of the seedling plants.

The stimulation effect on the application of vermicompost from plant waste and combination of plant waste and cow manure increase with increases of their application in a peat-pearlite mixture.

The cow manure vermicompost produces the best result when its amount in the peat-pearlite mixture is 10%.

The addition of 15% of this fertilizer can has a negative effect as the growth of the above-ground vegetative organs is slowed.

The use of a peat-pearlitic mixture with the addition of 15% vermicompost mixture of plant waste and cow manure increases the leaf area of the seedlings with 23.4%, the fresh vegetative mass and root system mass with 17.6% and 35.0%. Their physiological status is also improved. The total chlorophyll content in a leaves increased by 15.3%. The amount of dry mass and dry matter increased by 44% and by 16.8%.

ACKNOWLEDGEMENTS

This research work was carried out with the support of Agriculture university-Plovdiv, Department of Horticulture.

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