The Effects of Vermicompost Application on the Yield of Lettuce Plant (*Lactuca sativa* L. var. *crispa*)

ABSTRACT: This research was done to find out the effect of increasing vermicompost application on yield of lettuce (*Lactuca sativa* L. var. *crispa*) plant. For this purpose *Lactuca sativa* L. var. *crispa cv. Bellafiesta* lettuce kind and Riverm Company Vermicompost were used in this research. Four vermicompost doses; 0 kg/ha, 4000 kg/ha, 8000 kg/ha and 12000 kg/ha were applied to lettuce plant. According to the results, important increases of fresh weight, plant size, number of leaf, length and width of leaf for each plant and dry matter yield of plants were determined with increasing Vermicopmost applications. But the effects of Vermicopmost applications on some macro element (N, P, K, Ca and Mg) contents of plant were not found significant statistically.

Key words: biological property, lettuce, macro nutrient element, vermicompost,

1. INTRODUCTION

Today an increase in the products gained from per unit area has become a necessity to satisfy mankind's need for food. On the other hand, the necessity of increase in the products brings another necessity to use more inorganic fertilizers per unit area. As a result of the excessive application of inorganic fertilizers, natural sources such as soil and water are being polluted and serious health problems are occurring.

Mostly in vegetable farming, in order to reach a high degree of productivity and maximum growth, the amount of inorganic fertilizer as the main source of nutrient is emphasized, however, usually exceeded [1,2].

It has been a well-known fact that green plants respond positively to inorganic fertilizer with nitrogen content however, nitrogen application has a limited positive effect on the crop yield. Increasing nitrogen fertilization can affect plant's agronomy, macro and micro nutrient element contents, and the quality of the product negatively. Nitrogen has an important role in the plant's vegetative development and crop yield. However, the excessive use of nitrogen fertilizer in order to increase productivity might cause the risk of nitrate accumulation [3,4].

While excessive inorganic nitrogen fertilizer causes soil pollution [5- 7], it also causes the accumulation of harmful compounds for human health in vegetables [8]. Nevertheless, according to FAO/WHO [9] nitrate generates toxic effect if it exceeds 5 mg for each kg of human body. For this reason, in vegetable farming the management of nitrogen fertilization should carefully be programmed.

The scientists who are seeking a solution for this problem put forward that organic fertilizer applications should be increased in following years. Because while organic fertilizers are manure materials and nutrient sources, they can reform the degenerations in soil and water caused by inorganic fertilizers. In recent years, the use of organic fertilizers is increasing especially in vegetable farming.

The aim of this research, the effects of increasing doses vermicompost application on some nutrient element content and some agronomic properties of lettuce (*Lactuca sativa* L. var. *crispa*) plant was investigated.

2. MATERIALS AND METHODS

In the research, *Lactuca sativa* L. var. *crispa cv. Bellafiesta* was used, which is a type of lettuce plant. Two seeds for each pot were planted and peat was used as the production ground (Klasmann-Deilmann, potground H, Germany). When they gained 3-4 leaves 30 days after the plantation and they were transmitted to their permanent pots. Randomized blocks were designed as 3 replications on the experimental design, and there were 108 plants in total, 9 in each parcel. Total experimental area was 75 m^2. The vermicompost was applied to the plants (1st dose: 0 g/m^2, 2nd dose: 400 g/m^2, 3rd dose: 800 g/m^2, 4th dose: 1200 g/m^2) right after the plantation. Some chemical properties of the vermicompost used in the experiment were presented in Table 1 below.

Table 1. Some chemical properties of vermicompost

pH	7.60
Org. Matter, %	51.80
Total hümic+ fulvic acid, %	46.10
Org. C %	27.80
Total N, %	1.50
Soluble P_2O_5, %	0.20
Soluble K_2O, %	1.10
Soluble CaO, %	0.26
Soluble MgO, %	0.13

Thirty days after the plantation the plants were harvested and plant height (cm), plant diameter (cm), leaf size (cm), leaf width (cm), root height (cm), plant weight (gr), and number of leaves were measured. Dry material content of the plants was obtained by washing them with pure water and drying them in 65 ^{0}C for 48 hours. After the dry weight was determined necessary elemental analyses were conducted on grained samples by using ICP-OES device [15]. The collected data were analyzed by using MSTAT program.

3. RESULTS AND DISCUSSION

3.1. The Effects of Vermicompost Application on Some Biological Properties of Lettuce Plant

The effects of increasing doses of vermicompost application on the height, diameter, number of leaves, leaf size, leaf width and the weight of lettuce plant (*Lactuca sativa* L. var. *crispa cv. Bellafiesta*) were presented on Table 2. The effects on the biological properties of the lettuce plant vary depending on the amount of doses (Table 2).

Table 2. The effect of vermicompost on some biological properties of lettuce plant, *, **, *

Dose	Plant height (cm)	Diameter (cm)	Root length (cm)	Num. of leaves	Length of leaf (cm)			Leaf width (cm)			Plant fresh weight (gr)
					Int.	Med	Ext.	Int.	Med	Ext.	
0	24.2ns	32.2b	18.7ns	20.6b	11.2ns	16.2b	16.9b	8.1ns	13.7b	15.0ns	126.4b
4000	26.6ns	34.8a	17.5ns	22.0a	11.0ns	16.7a	16.5b	8.1ns	14.7a	15.0ns	138.6a
8000	25.2ns	34.3a	19.3ns	21.8a	11.2ns	17.0a	17.4ab	8.9ns	15.4a	15.2ns	142.8a
12000	24.2ns	34.6a	18.0ns	22.2a	11.2ns	16.7a	17.0b	8.4ns	15.2a	15.4ns	122.7b

*: values average of three replications, **: each parameter was evaluated individually, ***: significant at the level of 5 %.

Significant rise in the plant width, the number of leaves, leaf size, leaf width, and the plant fresh weight was observed upon the increasing doses of vermicompost application. On the other hand, with the vermicompost application decrease in the height and root size of the lettuce plant was determined comparing to the control group. These results are concordant to the research indications by Yourtchi et al. [11]. In the statistical evaluation, the increases were statistically significant at the level of 5 %.

Organic fertilizers are quite popular in farming recently. The use of these fertilizers provides significant rise in the crop yield and quality of the plant. In a research [10], 50, 100, 200, 400 and 600 mg/kg humic acid were applied to corn and the effects of this application on fresh and dry weight of the plant and on the amount of protein were examined. A significant increase in biological characteristics of corn was observed upon the application of humic acid doses above 200 mg/kg.

In a research conducted to identify the effects of increasing doses of vermicompost application to potato plant on the crop yield of the plant, 0, 4.5, 9 and 12 tones/da of vermicompost were applied. As a result, it was concluded that maximum plant height, dry weight of leaf and plant stem, dry and fresh weight of tuber, total tuber weight, the number of tubers, tuber diameter and such biological parameters were obtained from the application of 12 tones/da of vermicompost [11].

A research by Alam et al., [12] examines the crop yield of potato plant and its characteristics upon the application of increasing doses of vermicompost. Certain increases in some agronomic features such as potato's tuber diameter, tuber weight, the crop yield gained from per area, and leaf width index were observed once vermicompost was applied.

In a study held in Azerbaijan the effects of the application of 2, 4, 6 tones/da of vermicompost on red onion plant (*Allium cepa* L.) were analyzed. The highest crop yield of the onion plant in terms of protein and ascorbic acid content was determined

from the fields on which 6 tones/ha of vermicompost were applied [13].

In Bangladesh the effects of various doses of vermicompost on cauliflower farming have been investigated. 0, 1.5, 3 and 6 tones/ha doses of vermicompost were applied to the plants, and certain biological features were measured such as maximum plant height, the number of leaves, fruit width, fruit height, total weight, commercial weight, and crop yield of stem. According to the results, the maximum yield was obtained from the field on which 6 tones/ha of vermicompost was applied [14].

3.2. The Effects of Vermicompost Application on Some Macro Nutrient Element (N, P, K, Ca, Mg) Contents of The Lettuce Plant

The effects of vermicompost application on the some macro nutrient element contents of the lettuce plant were presented in average of three replications in Table 3.

Table 3. The effect of vermicompost application on some macro nutrient element (N, P, K, Ca, Mg) contents of lettuce plant, %.

Doses	N	P	K	Ca	Mg
0	5.43	0.92	10.95	1.42	0.21
4000	5.30	0.81	9.24	1.25	0.18
8000	5.09	0.71	9.86	1.24	0.18
12000	5.11	0.67	9.61	1.42	0.20

As it can be seen on Table 3, no significant mutation was discovered in N, P, K, Ca and Mg contents of the plant upon the increasing doses of vermicompost application. These effects were not considered as significant. The short probation period which is 30 days and plants' inability to obtain enough nutrient elements from soil could be demonstrated as the reason.

In as research held in agricultural fields, a relationship was determined between protein and ascorbic acid content of red onion plant (*Allium cepa* L.) and increasing doses of vermicompost [13].

A study by Yourtchi et al. [11] reveals that a significant increase in nitrogen, phosphorus, and potassium contents of the potato plant were determined with the application of increasing doses of vermicompost.

4. CONCLUSION

This study exposes that the increasing doses of vermicompost application multiply the crop yield, fresh weight and diameter, number of leaves, size and width of leaves of the lettuce plant. However, the plant's nitrogen, phosphorus, potassium, calcium, and magnesium contents do not receive an important fluctuation.

This study proves that vermicompost can be used in agricultural production by exhibiting the example of lettuce farming. It has been a well-known fact that there is

an inadequacy of organic matter amount in most of the agricultural fields of Turkey. With this study, it has been revealed that vermicompost application could be an alternative source of organic matter in eliminating the inadequacy of organic matter in agricultural fields.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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