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Effects of Vermicompost Application and Nitrogen Fertilizer Rates on Fruit Yield and Several Attributes of Eggplant (*Solanum melongena* L.) in Iran

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Abstract: For study effects of vermicompost application and nitrogen fertilizer rates on fruit yield and several attributes of eggplant, an experiment in factorial format based on randomized complete block design with three replications in Astaneh Ashrafiyeh Township (north of Iran) in 2011 farming year was conducted. Factors of experiment was consisted of vermicompost application in three levels of (V_1. control (without vermicompost application), V_2. 3 t/ha and V_3. 6 t/ha vermicompost application) and nitrogen fertilizer rates with four levels of (N_1. control (no nitrogen fertilizer), N_2. 25 kg/ha, N_3. 50 kg/ha and N_4. 75 kg/ha pure nitrogen from source of urea (46% pure nitrogen)). In maturity time, fruit yield, number of fruits per plant, fruit length and plant height were measured. Results showed that, the effects of vermicompost application and nitrogen usage on all studied traits were significant at 1% probability level. Also, interaction effect of vermicompost and nitrogen on plant height at 1% and on fruit yield and number of fruits per plant at 5% was significant, but on fruit length was non significant. Between vermicompost levels the highest fruit yield was recorded from V_3 treatment with 33.43 t/ha. The maximum fruit yield between nitrogen fertilizer levels was found from N_4 treatment with 35.03 t/ha. Between interaction effect levels, the V_3N_4 treatment with 41.44 t/ha was recorded as highest fruit yield.

Key words: Eggplant · Vermicompost Application · Nitrogen Fertilizer · Fruit Yield · Astaneh Ashrafiyeh

INTRODUCTION

Eggplant (*Solanum melongena* L.), also known as Aubergine, Brinjal or Guinea squash is one of the non-tuberous species of the night shade family Solananceae [1]. The varieties of *Solanum melongena* L. show a wide range of fruit shapes and colors, ranging from oval or egg-shaped to long club-shaped; and from white, yellow, green through degrees of purple pigmentation to almost black. It is an economically important crop in Asia, Africa and the sub-tropics (India, Central America) and it is also cultivated in some warm temperate regions of the Mediterranean and South America [2]. Eggplant fruits are known for being low in calories and having a mineral composition beneficial for human health. They are also a rich source of potassium, magnesium, calcium and iron [3]. The yield depends upon several production factors. Among these proper, balanced nutrition plays a significant role. Nitrogen is considered as one of the essential macronutrients required by the plants for their growth, development and yield [4]. Nitrogen deficiency generally results in stunted growth and chlorotic leaves caused by poor assimilate formation that leads to premature flowering and shortening of the growth cycle. The presence of N in excess promotes development of the above ground organs with abundant dark green (high chlorophyll) tissues of soft consistency and relatively poor root growth. This increases the risk of lodging and reduces the plants resistance to harsh climatic conditions and to foliar diseases [5]. Nitrogen (N) fertilizer use has played a significant role in increase of crop yield [6]. Aminifard *et al*. [7], with study responses of eggplant to different rates of nitrogen under field conditions reported that fertilization with 100 Kg/ha nitrogen resulted in the highest average fruit weight and fruit yield. Pal *et al*. [8], reported that eggplant fruit yield increased with increase in nitrogen up to187.5 kg/ha. Sat and Saimbhi [9], observed that increasing the nitrogen significantly delayed flowering of eggplant and increased the number of days taken to fruit setting of eggplant. Organic fertilizers were common before of 1940°s in Iran and many farmers using of chemical fertilizers know as unlawful and refrain its using. But many advertisements caused to use of chemical fertilizer by some farmers was extremist and forgot its effect on bioenvironmental pollution and in other words forgot organic and biological fertilizers [10].

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Table 1: The results of soil analysis at the experimental sites

Depth	0-30 cm	Soil texture	Loam clay
Clay (%)	46.58	E.C. (mmhos/cm)	1.320
Silt (%)	29.97	Total nitrogen (%)	0.194
Sand (%)	23.45	P (ppm)	9.100
pH	7.2	K (ppm)	197.000

Table 2: Some chemical properties of used vermicompost

Nitrogen (%)	Phosphorus (%)	Potassium (%)	Organic Carbon (%)	pH	Fe (mg/kg)	Zn (mg/kg)	Mn (mg/kg)	Cu (mg/kg)
1.5	1.8	1	20	7.2	800	400	120	180

But in recent years due to unsuitable effect of chemical fertilizers on the soil, using of organic materials serves as a good and suitable source to supply soil food elements [11]. One of the best organic materials for increasing crops yield is vermicompost. Vermicomposting involves the bio-oxidation and stabilization of organic material by the joint action of earthworms and microorganisms. Although it is the microorganisms that biochemically degrade the organic matter, earthworms are the crucial drivers of the process, as they aerate and fragment the substrate, thereby drastically altering the microbial activity. Earthworms act as mechanical blenders and by comminuting the organic matter they modify its physical and chemical status by gradually reducing the ratio of C:N and increasing the surface area exposed to microorganisms - thus making it much more favourable for microbial activity and further decomposition [12]. Vermicompost being a stable fine granular organic matter, when added to clay soil loosens the soil and improves the passage for the entry of air. The mucus associated with the cast being hydroscopic absorbs water and prevents water logging and improves water-holding capacity. The organic carbon in vermicompost releases the nutrients slowly and steadily into the system and enables the plant to absorb these nutrients. The soil enriched with vermincompost provides additional substances that are not found in chemical fertilizers [13]. The objectives of the present research are to determine the effect of vermicompost application and also nitrogen fertilizer rates on eggplant yield and several attributes.

MATERIALS AND METHODS

In order to study the effects of vermicompost application and nitrogen fertilizer rates on fruit yield and several attributes of eggplant, an experiment in factorial format based on randomized complete block design with three replications in Astaneh Ashrafiyeh Township located in 37° 16' latitude and 49° 56' longitude (north of Iran) in 2011 was conducted. Soil analysis results show that (Table 1), the soil texture was loam clay and pH, 7.2. Factors of experiment was consist of vermicompost application in three levels of (V_1. control (without vermicompost application), V_2. 3 t/ha and V_3. 6 t/ha vermicompost application) and nitrogen fertilizer rates with four levels of (N_1. control (no nitrogen fertilizer), N_2. 25 kg/ha, N_3. 50 kg/ha and N_4. 75 kg/ha pure nitrogen from source of urea (46% pure nitrogen)). Some chemical properties of used vermicompost in experiment showed in Table 2. The experimental field was cleared, ploughed, harrowed and divided into plots, with 10 m^2 areas. Six-week-old eggplant plants were hand-transplanted into well-prepared beds in the field. The spacing between rows was 80 cm and plants were 50 cm. All practical managements included; mulching, weeding and other agronomic treatments were done mechanically. Irrigation was done based on plant requirements once a week. In maturity time, fruit yield, number of fruits per plant, fruit length and plant height were measured. The data was analyzed using MSTATC software. Also, the figures were drawn by EXCEL software. The Duncan's multiple range test (DMRT) was used to compare the means at 5% of significant.

RESULTS AND DISCUSSION

Effect of Vermicompost Application: Results of variance analysis showed that, the effect of vermicompost application on fruit yield, number of fruits per plant, fruit length and plant height was significant at 1% probability level (Table 3). Comparison of mean between vermicompost application levels showed that, the highest fruit yield with 33.43 t/ha, number of fruits per plant with 6.36 fruits, fruit length with 29.32 cm and plant height with 121.1 cm were obtained from V_1 (6 t/ha vermicompost application) treatment. The V_2 (3 t/ha vermicompost application) treatment with 117.5 cm plant height statistically was placed on same level with V_3 treatment.

Table 3: Analysis of variance related to the traits of eggplant under vermicompost application and nitrogen fertilizer rates

Source of variance	df	Fruit yield (t/ha)	Number of fruits per plant	Fruit length (cm)	Plant height (cm)
		----------MS----------			
Vermicompost (V)	2	577.535**	9.421**	294.944**	4487.577**
Nitrogen fertilizer (N)	3	451.056**	7.003**	47.554**	657.326**
V×N	6	9.605*	0.455*	4.488ns	109.374**
Error	22	3.437	0.176	5.206	22.264

Ns, ** and * respectively: non significant, significant in 1% and 5% area

Table 4: comparison of mean about the effects of vermicompost application and nitrogen fertilizer rates

Treatments	Fruit yield (t/ha)	Number of fruits per plant	Fruit length (cm)	Plant height (cm)
Vermicompost				
V1	19.60C	4.59C	19.43C	85.95B
V2	25.58B	5.63B	23.70B	117.5A
V3	33.43A	6.36A	29.32A	121.1A
Nitrogen				
N1	19.52D	4.34C	21.12C	98.1D
N2	21.56C	5.39B	23.96B	105.2C
N3	28.71B	6.03A	24.90AB	111.2B
N4	35.03A	6.34A	26.61A	118.2A

Within each column, means followed by the same letter do not differ significantly at P<0.05

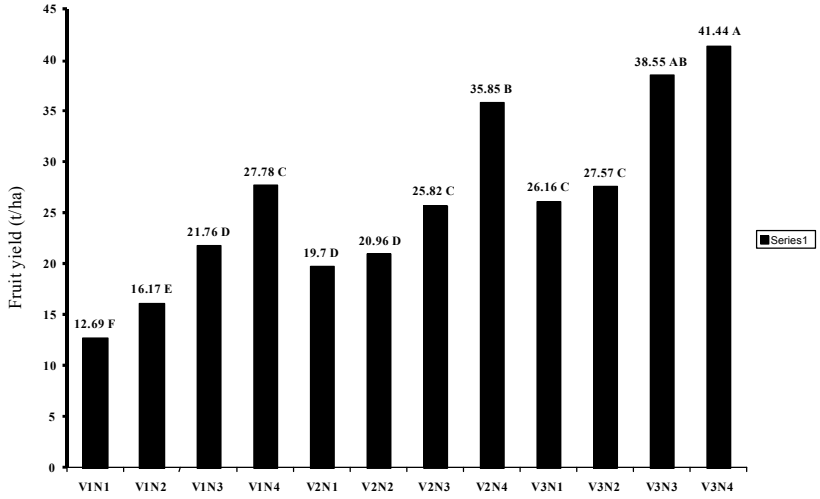

Fig. 1: Interaction effect of vermicompost and nitrogen fertilizer application on fruit yield

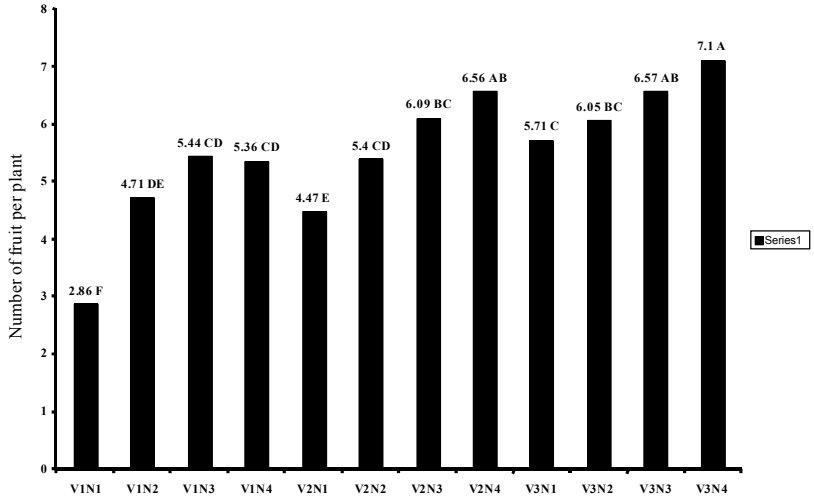

Fig. 2: Interaction effect of vermicompost and nitrogen fertilizer application on number of fruit per plant

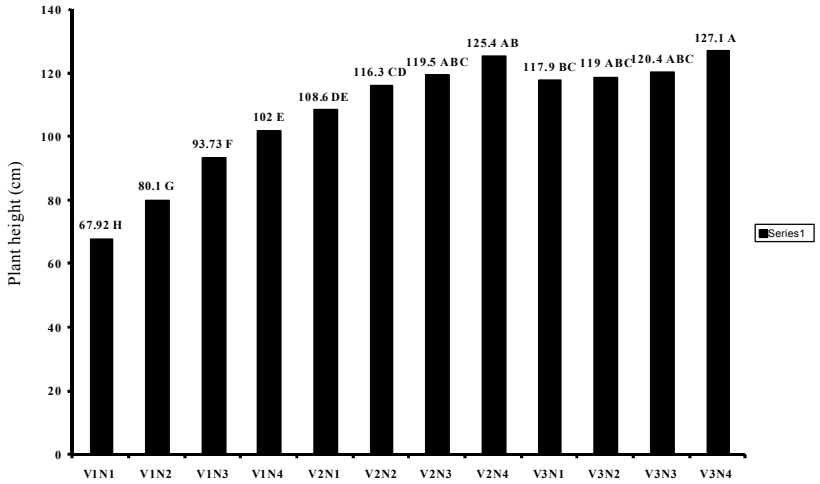

Fig. 3: Interaction effect of vermicompost and nitrogen fertilizer application on plant height

On the other hand, the lowest fruit yield, number of fruits per plant, fruit length and plant height were found from V_1 (without vermicompost application) treatment respectively with 19.6 t/ha, 4.59 fruits per plant, 19.43 cm and 85.95 cm was recorded (Table 4). Many researchers were reported that application of vermicompost because of supplying optimum nourishment condition caused to improve growth, yield and yield components in crops [14-17].

Effect of Nitrogen Fertilizer Rates: With attention to results of variance analysis (Table 3), the effect of nitrogen fertilizer on fruit yield, number of fruits per plant, fruit length and plant height showed significant differences at 1% probability level. Comparison of mean between nitrogen fertilizer rates showed that (Table 4), the highest amounts of fruit yield, number of fruits per plant, fruit length and plant height respectively with 35.03 t/ha, 6.34 fruits per plant, 26.61 cm and 118.2 cm were recorded from N_4 (75 kg/ha nitrogen) treatment. The N_3 (50 kg/ha nitrogen) treatment with 6.03 fruits per plant statistically was placed in same level with N_4 treatment. Also, the minimum amounts of fruit yield with 19.52 t/ha, number of fruits per plant with 4.34 fruits, fruit length with 21.12 cm and plant height with 98.1 cm were recorded from N1 (no nitrogen fertilizer) treatment. Similar results were reported by Pal *et al*. [8], Sat and Saimbhi [9], Akanbi *et al*. [18] and Aujla *et al.* [19].

Interaction Effect of Vermicompost and Nitrogen Application: the results of the study showed that the interaction effect of vermicompost application and nitrogen fertilizer rates on plant height at 1% and on fruit yield and number of fruits per plant at 5% was significant. But, interaction effect levels don't showed significant differences on fruit length. The highest fruit yield with 41.44 t/ha, number of fruits per plant with 7.1 fruits and plant height with 127.1 cm were recorded from V_3N_4 (6 t/ha vermicompost application and 75 kg/ha nitrogen fertilizer) treatment. On the other hand the lowest fruit yield with 12.69 t/ha, number of fruits per plant with 2.86 fruits and plant height with 67.92 cm were found from V_1N_1 (without vermicompost application and no nitrogen fertilizer) treatment (Figure 1, 2 and 3). Similar results were reported by Jose *et al*. [20], Roe *et al.* [21], Devi *et al*. [22] and De Grazia [23].

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