Original Research Article

THE EFFECTS OF ORGANIC AND CHEMICAL FERTILIZER APPLICATIONS ON YIELD AND PlANT VEGETATIVE GROWTH OF EGGPLANT (*Solanum melongena L.*)

Abstract

A field experiment was conducted to evaluate the effects of organic and chemical fertilizers on yield and plant vegetative growth of eggplant (*Solanum melongena L.*) between 22.05.2018 and 12.09. 2018 under field conditions in Bandırma, Turkey. Treatments were control with no fertilizer (CONT), developed organic fertilizer (DOF), organic fertilizer (OF) chemical fertilizer (CHF), each treatment has 3 replicates. Developed Organic fertilizer and Organic fertilizer were applied in (2) ton/da, chemical fertilizer (15N, 15P, 15K, 20 SO_3) was applied in 40 kg/da. Yield and plant vegetative growth weight were determined. Organic and chemical fertilizer applications had significant effect ($P<0.05$) on yield and plant vegetative growth. The eggplant yield at CONT, DOF, OF, CHF were 3922, 4593, 4375, 4579 $kg.da^{-1}$ respectively. The plant vegetative growth at CONT, DOF, OF, CHF were 3548, 4018, 3818, 3882 $kg.da^{-1}$ respectively. The difference between fertilizers (DOF, OF, and CHF) was not very high so that organic fertilizers are competitive and may be a suitable replacement for chemical fertilizer.

KEYWORDS: Organic fertilizer, vegetative growth, fruit yield, eggplant

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 (Kantharajah et al., 2004). 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 (Sihachkr et al., 1993). 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 (Zenia and Halina, 2008). According to the reports released in 2013, in 162 countries, 1.8 million organic certified producers, 37.2 million ha in the field of organic farming (Willer et al., 2013). According to the data obtained from TURKSTAT (2014) as of 2013 (213) kinds of products in Turkey, at 769014 hectares, 60797 Manufacture, 1.620.466 tons of organic herbal production. The amount of organic vegetable production in Turkey around 30,000 tons. The major share respectively tomatoes, cucumber, beans, pepper, lettuce and eggplant (Hekimoğlu and Altındeğer, 2010). Fertilizers are used to improve soil fertility but intensive inorganic fertilizer usage in agriculture causes so many health problems and unrecoverable environmental pollution. Thus, to reduce and eliminate the adverse effects of Synthetic fertilizers on human health and environment, now-a-days a new agricultural practice have been developed called as organic agriculture, sustainable agriculture or ecological agriculture (Aksoy, 2001; Chowdhury, 2004). Inorganic fertilizers are known for their high cost and their negative environmental effects if managed poorly (Morris *et al.,* 2007). Direct effect are due to readily available nutrients from applied compost while indirect effects are through improvement of soil structure and nutrient and water retention favorable to plant growth. In a particular experiment, the authors found that application of organic

amendments have potential to increase the growth and chemical composition of two cultivars of safflower and therefore, might be a good alternative to chemical fertilizers (Naderi and Bijanzadeh, 2014). There is effect of different organic manures and inorganic fertilizer levels in soil were observed on growth performances and yield of eggplant (Vijaya, 2011). Louisa and Taguiling, 2016 reported that compost stimulates plant growth in terms of total height, number of leaves, fresh weight of plant biomass, and initial yield of green pepper (*Capsicum annuum*), eggplant (*Solanum melongena*), and Okra (*Abelmoscus esculentus*).

This study aims to determine the effect of organic and developed organic fertilizers as compared to chemical fertilizers on growth and yield of eggplant.

2. MATERIALS AND METHODS

2.1. MATERIALS

Research Area: The experiment carried out in a field near Akçapınar village which located at 40 ° 16 '44.4252' 'North and 28 ° 4' 18.9552 " Eastern latitudes and longitudes. The height from the sea is 41 m). Akçapınar is bound to the of Bandırma district, Balıkesir governorate, Bandırma is located to the south of the Marmara Sea. Karacabey (Bursa) to the east, Gönen to the west, Erdek and Kapıdağ to the north, Manyas and Kuşgölü to the south.

Climate: Bandırma is under the climate of Mediterranean Sea and the Black Sea. In addition, due to the fact that the terrestrial climate from the Balkans is located on the transition area, various climate features are observed in the district, the lowest temperature according to 52-year climate data is -14.6 ºC (January 15, 1954), while the high temperature was recorded as 42.4 ºC (July 9, 2000). The average annual temperature is 14 ºC. The dominant wind direction is North-Northeast. The average wind speed is 15 km/h. The average annual rainfall in the district is 703.3 mm. The annual relative humidity average is 73%.

Properties of the Experiment Soil: From the soil profile opened in the experiment area, disturbed and undisturbed soil samples were taken from 0-30, 30-60 and 60-90 cm soil layers and physical and chemical analyzes were performed on these samples. The pH of the test soil was pH 8-8.1, salt content 0.76-0.84 ds/m, organic matter % 0.68-1.2, total nitrogen 9.4-9.7 kg.da^{-1}, phosphorus 1.44 -1.69 kg.da^{-1}, potassium 59.8-83.8 kg.da^{-1}, calcium varied from 1971 to 2230 kg.da^{-1}, and volume weight (As) ranged from 1.28 to 1.31 g.cm-3. In addition, a 0-30 cm layer of soil profile; 30-60 cm sandy clay Tin, 60-90 cm layer has clayey texture.

Properties of Irrigation Water: Irrigation water was taken from a deep well near the experiment field. The water from the deep well is pumped into a pool. A sample was taken from irrigation water and analyzed. Irrigation water is in C3S1 class. The water is 3 in salinity and 1 in sodium.

Class A pan Evaporation: Class A pan evaporation used in the experiment is 121 cm in diameter and 25 cm in height was made of 2 mm thick galvanized steel plate. Wooden base was put at the bottom of the pan allowing air flow 10 cm height. Changes in the water level at the surface are measured. It was covered on a wire mesh to prevent the water intake by the insects and animals.

Fertilizers: Three different fertilizers were used in the study. 1-Chemical fertilizer (CHF), 2-Organic fertilizer (OF), and 3- developed organic fertilizer (DOF). CHF; N, P, K, SO3 (15-15-15 + 20), OF; DOF; 75% cow manure and 25% poultry manure (The difference between OF and DOF is that develoed organic fertilizer is mixed with small partical from the organic fertilizer it's about 50 microns in volume). In both organic fertilizers, the organic matter content is 33%, the humic + volvic content is 18.4% and the pH is 7.4.The organic fertilizers both were prepared in an aerobic fermentation method (windrow), whereas the

level of humidity, oxygen and temperature were monitored. The humidity at the beginning of fermentation was 60% and the process of flipping and aeration were performed when the temperature reached at about 60 degrees Celsius and when the oxygen rate reduced above 5% for 45 day. This process called composting which is a naturally occurring process in which bacteria, fungi, and other microorganisms convert organic material into a stabilized product termed as compost. This means that microorganisms do the composting work for you. Your role in managing the composting process is to make sure that the microorganisms have the environment they need in order to do their work quickly and effectively.

2.2. Method

Fertilizer Treatment : Three fertilizer treatments were applied the first treatment is organic fertilizer (OF) applied at 2 Ton/da, the second fertilizer is development organic fertilizer (DOF) applied at 2 Ton/da and the third treatment is chemical fertilizer (CHF) applied at 40 kg/da. Each treatment has 3 replicates.

Soil Preparation and Planting First the experiment area was tilled and then parcels were created. Then the fertilizers applied According to the experiment plan. After that the drip irrigation system has been applied. The eggplant sapling were planted according to the experiment plan on 02/06/2017, the spacing between the lines as planting lines is 70 cm, the spacing between the plant and the other is 40 cm, each parcel contains 6 lines, in each line (20) plant and each experiment piece contains (120) plants, the dimensions are: 8m*4.2 m=33.6 m^2. There are 9 parcels, with an area of 33.6 m2 for each parcel and the total area of the experiment pieces is 302.4 m2, the space between the parcel and the other is 2 m, the total area of the experiment is 659.2 m^2, the total number of Eggplant (*Solanum Melongena*) saplings is (1080).

Calculation of Irrigation Water Amount The amount of irrigation water was calculated according to the method given by Gençoğlan and Ark., (2006), taking Evaporation quantities were measured at 09:00 am in class A pan evaporation. These measured values are used to calculate the amount of irrigation water. The amount of irrigation water is calculated by the equation given below.

V= E (pan) * A *P * IR

V: water volume / L

E: A Pan-Evaporation / mm

A: parcel area / m2

P: percentage of coverage

IR: Irrigation Applied rate (100%). Drip irrigation method was used, irrigation was applied as 100% of evaporation from Class A pan evaporating, and the calculated irrigation water amounts were applied to the parcels by using water meters. Experiment was irrigated 12 times. The total amount of irrigation water applied to the experimental pieces was 305 mm/da, in addition to 143 mm rainfall.

Evaluation of Data: Statistical analyzes were performed on the parcels (randomized blocks) of the obtained data according to the experimental design. ANOVA one way Statistical analyzes were performed by using SPSS (24.0v) Program.

Result and Discussion

Eggplant plant began to fruiting one month after planting (22.06.2018). It was harvested 5 times, the first harvest was in (19.07.2018), and the last harvest was in (12.09.2018). According to the results of variance analysis conducted in order to determine the effects of the kind of fertilizer on the yield, it was found significant at 5% level ($p<0.05$) (Urkurkar, 2010 and Yolcu, 2011) also reported significant differences in

yield with the application of different fertilizer sources. According to the LSD test there are 2 groups, DOF, OF and CHF treatment, in A group, the control in B group. The heights yield at DOF (4593 kg.da^{-1}) and the lowest yield was at control (3922 kg.da^{-1}). There were no significant differences between the three fertilizers treatments (DOF, OF, CHF) (table 1). These results can be explained that adding organic fertilizer to the soil make mineral more available in the soil in addition to what organic fertilizer contain from mineral.

*Table 1. Total Yeild Results (*kg.da^{-1}*)*

Replicates	Tratments			
	DOF	OF	CHF	Control
R1	4630	4827	4539	3886
R2	4713	3987	4561	3828
R3	4437	4311	4638	4051
Average	4593^{a}	4375^{a}	4579^{a}	3922^{b}

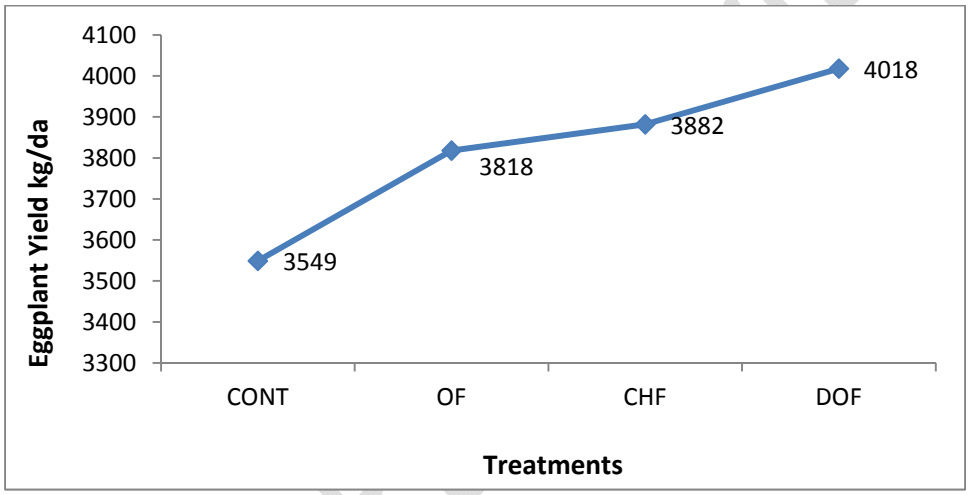

Figure 1. *Effect of three different fertilizers on yield*

Plant Vegetative Growth: According to the results of variance analysis conducted in order to determine the effects of the kind of fertilizer on the plant vegetative growth of eggplant it was found significant at 5% level ($p<0.05$). (Lanyasunya; 2007, Efthimiadou; 2009, Fateh, et al, 2009 and Urkurkar et al., 2010) also reported significant differences in vegetative growth with the application of different fertilizer sources. According to the LSD test there are 2 groups, DOF, OF, CHF treatment, in A group and the control in B group. The heights plant vegetative growth at DOF (4018 kg.da^{-1}), the lowest plant vegetative growth was at control (3548 kg.da^{-1}). There were no significant differences between the three fertilizers treatments (DOF, OF, CHF). (table2).These result can be explained that organic fertilizer contains Azote which is important to vegetative growth.

*Table 2. Total vegetative growth Results (*kg.da^{-1}*)*

Replicates	Tratments			
	DOF	OF	CHF	Control
R1	3991	3869	3957	3592
R2	3987	3895	4083	3571
R3	4077	3690	3606	3483
Average	4018^{a}	3818^{a}	3882^{a}	3548^{b}

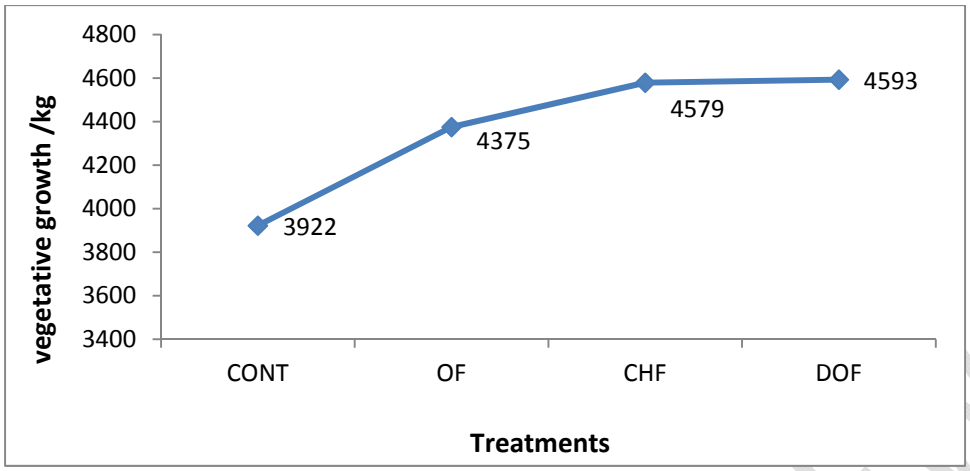

Figure 2. *Effect of three different fertilizers on Plant Vegetative Growth*

4. CONCLUSIONS

Acording to Bandırma Akçapınar conditions, during the growing period of the eggplant it was founed as fertilizers application there were significant differences between the control treatment and the other treatments ($P<0.05$)., in yield and plant vegetative growth. No significant differences were found between the three fertilizers treatments (DOF, OF, CHF) in yield and plant vegetative growth ($P>0.05$). The highest fruit yield of the experiment (4593 kg.da-1) was obtained at DOF tratment; the lowest yield in the experiment (3562 kg.da-1) was obtained at control. The heights plant vegetative growth at DOF treatment (4018 kg.da-1), and the lowest vegetative growth was at control (3548 kg.da-1).

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