Effect of organic fertilizers on cucumber (Cucumis sativus) yield

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ABSTRACT: In order to study the effect of organic fertilizer on cucumber yield an experiment was conducted during 2013 growing season in Shirvan region of Iran. The experiment was randomized complete block design with 3 replications. The treatments included, 50 t/h cow manure, 14 and 7 t/h vermicompost, 7 t/h urban waste compost, 4 kg/h spray of NPK (20-20-20), Marian algae spray and check (no fertilizer). The results showed that in spite of no significant different among 50 t/h cow manure, 14 t/h vermicompost and chemical fertilizer, using 14 t/h vermicompost produced higher cucumber yield compared with all other treatments and this treatment showed 24% more yield than chemical fertilizer. The root dry weight increment in this treatment was also 33.9% more than chemical fertilizer. Both of 50 t/h cow, manure and 14 t/h vermicompost produced the highest plant dry weight compared with other treatments. Using 14 t/h vermicompost showed the highest cucumber weight. 50 t/h cow manure produced the highest number of cucumber per plant. Generally according to results of this experiment using 14 t/h vermicompost or 50 t/h cow manure are advisable to produce more cucumber yield compared with chemical fertilizer and other treatments.

Key words: vermicompost, manure, chemical fertilizer, cucumber

INTRODUCTION

Soils in arid and semi-arid regions of Iran which includes more than 80% of agricultural land, in terms of organic materials are poor. To improve agricultural productivity and soil fertility it is necessary to add organic matter to the soil. However, because of limited resources of traditional organic materials such as animal manure (Biboard et al 2000) the use of various wastes such as organic waste, sewage sludge, agricultural waste and industrial solid waste as organic materials is growing. Among the organic manures, compost is the most important economical source of nitrogen. Widespread use of chemical fertilizer in vegetable production and greenhouses and according to chemical fertilizer destructive side effect, reveals the importance of organic fertilizer for sustainable agriculture (Gaskell, 1999).

Application of organic waste including manure, sewage sludge, municipal compost in soil is a suitable method for the maintenance of soil organic matter, improve soil quality and supply nutrients needed by plants (Davarinezhad et al 2004). Excessive use of chemical fertilizers and pesticides in agricultural ecosystems make some problems such as environmental pollution, soil erosion, food chain restriction, pest resistance to pesticides. In addition, human and environmental problems, arise the necessitates of non-chemical methods of soil fertilization. Unprincipled use of agricultural pesticides and nitrogen fertilizer and harmful effects on humans and environment, are the critical issues of today's world. Use of organic fertilizers and biological control, plays an important role in this context (Greer and Dayvr, 2000).

The use of compost in the soil, generally in order to maintain and increase aggregate stability, and fertility of soils for farming and gardening in the past decade has been of particular importance. In this way, in addition of cost reduction and waste disposal, it will lead to more efficiency and usefulness (Lalandh et al, 2000). Vollmer (1999) reported the use of compost as mulch in cucumber and strawberry, increased farm production. Haug (1993) and Dany (2000) examined the impact of vermicompost compared with the industrial compost and NPK fertilizer on growth and yield of cucumber and reported that vermicompost increased plant efficiency. They also declared that the application of vermicompost mixed with topsoil has a positive effect on growth of cucumber plants. Ahmadi et al (2003) studied The effects of 50, 100 and 150 t/h manure on cucumbers and reported that 100 t/h manure compared with the other treatments had a greater impact on cucumber yield. They reported that cucumber yield in the treatments of, 50, 100 and 150 t/h manure lead to 89, 100 and 90 t/h respectively.

Cook and colleagues (1998) tested the effect of compost on yield of cucumber and spring barley and reported increasing of cucumber yield and 25 percent increment of dry matter and number of sprouts per
plants in barley. Shafiee Zargar (1996) tested the effect of different amounts of manure on yield and quality of cucumber cultivars and explained that application of 30 t/h manure and 150 kg/h nitrogen produced maximum number of nodes per plant. Ferguson (2001) reported that consumption of 20 t/h of urban waste compost increased cucumber yield up to 15 t/h. Fybrt and colleagues (1995) tested the impact of the compost on yield of cucumber and onion and reported that consumption of 15 t/h compost increased yield of onion and cucumber by 15 percent. Razavi Toosi (2001) reported that application of 15 t/h compost produced the highest yield in spinach and rice. Other scientists also reported the positive effect of organic fertilizer on medical plants and crop plants. Azimzadeh(2013) reported that Safflower showed better reaction to organic fertilizer in both dry land and irrigated condition. Zariri et al (2013) reported that peppermint medical plant showed better reaction to using 10 t/h vermicompost, 10 t/h urban waste compost and 50 t/h farmyard manure. Azimzadeh et al (2014) reported that canola shows a better reaction to manure and vermicompost in limited condition of moisture and their replacement possibility in such as these condition with chemical fertilizer is considerable. The aim of this study was also to investigate the effect of organic fertilizer on cucumber yield.

MATERIALS AND METHODS

In order to study the effect of organic fertilizers on cucumber yield an experiment was conducted during 2013 growing season in Shirvan region (1120 m higher than sea level) in Iran. The experiment was randomized complete block design with 3 replications. The treatments included, 50 t/h cow manure (C.M), 14 t/h vermicompost, 7 t/h vermicompost, 7 t/h urban waste compost (U. W. C), 4 kg/h NPK (20-20-20) spray, Marian algae spray (MAS) (3 l/h), and check (no fertilizer). The distance between replications was 2 m. The depth and width of each plot in order were 3 and 2 m. The distance of plant on row was 25 cm. The seed was Super star. Land preparation was by moldboard and two disking. After disking land leveling was done and finally the plot were designed. Surface irrigation was done every 3 days. cow manure, vermicompost and urban waste compost according to mentioned amount broadcasted on plot surface and mixed with soil at the depth of 30cm by labor. Chemical fertilizers of NPK sprayed on plant during growing season every 15 days. Marian algae (Stimplex) sprayed on plant after 4 leaves stage every 10 days. At the end of growing season (Fig 1) the samples were collected from each plot. Analysis of variance of recorded traits in each plot and mean comparison was done by Dancan multiple test range. The data collected from each plot during growing season considered as total yield. The data analyzed with MSTAT-C software and mean comparison was done by Dancan multiple test range.

RESULTS AND DISCUSSION

As shown in table 1, effect of fertilizer treatments an all recorded traits were significant (P≤1%).

<table>
<thead>
<tr>
<th>S. O. V</th>
<th>D.F</th>
<th>Cucumber plant diameter</th>
<th>Cucumber weight</th>
<th>Cucumber length</th>
<th>Cucumber yield</th>
<th>Plant dry weight</th>
<th>Plant length</th>
<th>Root dry weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rep</td>
<td>2</td>
<td>0.470</td>
<td>0.101</td>
<td>28.4</td>
<td>0.604</td>
<td>214740.4</td>
<td>32.02</td>
<td>354.36</td>
</tr>
<tr>
<td>Treatments</td>
<td>6</td>
<td>78.166**</td>
<td>0.061**</td>
<td>609.48**</td>
<td>0.797**</td>
<td>2662358.4**</td>
<td>205.38**</td>
<td>399.97**</td>
</tr>
<tr>
<td>Error</td>
<td>12</td>
<td>4.094</td>
<td>0.002</td>
<td>4.99</td>
<td>0.065</td>
<td>63702</td>
<td>3.72</td>
<td>40.37</td>
</tr>
<tr>
<td>C.V %</td>
<td>2.8</td>
<td>1.8</td>
<td>3.19</td>
<td>1.66</td>
<td>4.65</td>
<td>4.59</td>
<td>4.61</td>
<td>12.16</td>
</tr>
</tbody>
</table>

** Significant at 1% levels of probability

Effect of fertilizer treatments on number of cucumber per plant

Mean comparison showed that using 50 t/h cow manure produced the highest number of cucumber per plant Fig 1). After cow manure the treatment of 14 t/h vermicompost showed significantly higher number of cucumber per plant compared with other treatments. 50 t/h cow manure produced 5.5% higher cucumber per plant compared with 14 t/h vermicompost, 10% more than 7 t/h vermicompost and chemical fertilizer, 14% more than urban waste compost, 12.5% more than Marian algae spray and 18.5% more than check. Plant dry weight in cow manure and 14 t/h vermicompost were also more than other treatments (Fig 4) that indicated better aboveground development and branching that contain more fruiting sprouts that led to more cucumber per plant. Shafiee Zargar (1996) also reported that 30 t/h cow manure produced the highest number of cucumber per plant.
Effect of fertilizer treatments on cucumber diameter

Mean comparison of cucumber diameter indicated that chemical fertilizer and 14 t/h vermicompost showed the highest diameter compared with other treatments. The lowest cucumber diameter belonged to 3 L/h Marian algae spray and check that were 2.55 and 2.45 cm respectively (Fig 2). Higher accessibility of nitrogen in chemical fertilizer and 14 t/h vermicompost can induced protein production that causes more meristem cells and cell division that finally led to higher cucumber diameter and cucumber length (Tisda and Nelson., 1975, Salardini and Mojtahedi., 1988, Salardini., 1995).

Effect of fertilizer treatments on cucumber weight

As shown in fig 3, 14 t/h vermicompost and chemical fertilizer treatments produced significantly higher cucumber weight compared with other treatments. In spite of no significant different between 14 t/h vermicompost and chemical fertilizer, the treatment of 14 t/h vermicompost showed 4% more cucumber weight than chemical fertilizer treatment. Cucumber weight increment in 14 t/h vermicompost compared with cow manure, 7 t/h vermicompost, 7 t/h urban waste compost, Marian algae and check were, 15.2%, 18.6%, 29.6, 36% and 43% respectively. Weight increment in 14 t/h vermicompost and chemical fertilizer treatments attributed to higher cucumber diameter in these treatments.
Effect of fertilizer treatments on cucumber weight

There were no significant different among 50 t/h cow manure, 14 t/h vermicompost, 7 t/h vermicompost and chemical fertilizer treatments in case of cucumber length (Fig 4). The length of cucumber in other treatments incldes, 7 t/h urban waste compost, marian algae and check were significantly low and the lowest cucumber length belonged to check treatment (14.56 cm). As mentioned cucumber length, cucumber weight and number of cucumber per plant in urban waste compost compared with vermicompost, cow manure and chemical fertilizer were lower. Higher electrical conductivity of urban waste compost can be a reason for this restricted growth and development of cucumber. The optimum electrical conductivity for cucumber growth is 3 ds/m (Nasohi 204) while electrical conductivity in applied urban waste compost was more than 3 ds/m (the fertilizer test result).

Effect of fertilizer treatments on plant dry weight

There were no significant different between using 50 t/h cow manure and 14 t/h vermicompost and both of them produced the hgiest plant dry weight compared with other treatments (Fig 5). Cow manure and 14 t/h vermicompost treatments showed 22.7 and 19.5% higher dry weight compared with chemical fertilizer treatment espectively. Dry weight increment of cow manure compared with 7 t/h vermicompost, urban waste compost, marian algae and check were, 21, 32.4, 34.4 and 40.4% respectively. The dry weight increment of 14 t/h vermicompost comared with 7 t/h vermicompost, urban waste compost, marian algae and check were, 17.7, 29.5, 31.6 and 37.9% respectively. Vermicopost because of producing growth promoting hormone can improve plant growth and development. In addition, organic fertilizer like as vermicompost and cow manure can increas soil proosity that led to lower soil bulk density that permit better root growth. Good root sestem enhances above ground growth and development that finally causes higher yield production and higher dry weight (Baybordi et al., 2000, Ghosh et al., 2004, Behnam Kamkar and Mahdavi Damghan., 2008).
Figure 5. Effect of fertilizer treatments on plant dry weight

**Effect of fertilizer treatments on root dry weight**

As shown in fig 6, the highest root dry weight belonged to using 14 t/h vermicompost. The root dry weight increment in this treatment compared with 50 t/h cow manure, 7 t/h vermicompost, 7 t/h urban waste compost, chemical fertilizer, Marian algae and check treatments were, 26.9, 30.4, 33.9, 30.4, 38.8 and 51.3% respectively. Vermicompost compared with cow manure in addition of decreasing soil bulk density produced growth promoting hormone that causes better root network of plant (Dynes 2003). Edward (1996) reported that vermicompost can improve plant growth and development by providing better soil physical condition for root growth and development that causes higher root dry weight.

Figure 6. Effect of fertilizer treatments on root dry weight

**Effect of fertilizer treatments on plant length**

The highest plant length observed in 50 t/h cow manure treatment that was significantly more than other treatments (Fig 7). Using 50 t/h cow manure compared with 14 t/h vermicompost, 7 t/h vermicompost, 7 t/h urban waste compost, chemical fertilizer, 3 l/h Marian algae spray and check produced 9.2%, 9.9%, 9.5%, 14.6%, 22.9% and 22.6% respectively. Cow manure will improve soil porosity, soil water capacity, soil fertility that finally led to better plant growth (Karlen and Camp 1985). ShafieeZargar (1996) also reported that using 30 t/h cow manure produced plants with 130 cm length. Ebrahim et al (2010) reported positive effect of cow manure and urban waste compost on length of wheat plant as well.
Effect of fertilizer treatments on cucumber total yield

Mean comparison of cucumber total yield showed that in spite of no significant different among 50 t/h cow manure, 14 t/h vermicompost and chemical fertilizer, the treatment of 14 t/h vermicompost produced the highest total yield (6461 kg/h) (Fig 8). The lowest total yield belonged to check treatment (3960 kg/h). Total yield of cucumber in treatment of 14 t/h vermicompost 3.6% was more than 50 t/h cow manure and 5.9% was more than chemical fertilizer treatments. Total yield of cucumber in treatment of 14 t/h vermicompost was also 10.6% more than 7 t/h vermicompost and 24% more than 7 t/h urban waste compost. Total yield increment of 14 t/h vermicompost compared with Marian algae spray and check were 28.4 and 38.7% respectively. The most important result in this experiment is no significant difference among chemical fertilizer and 14 t/h vermicompost and 50 t/h cow manure. Using 14 t/h vermicompost and 50 t/h cow manure not only produced lower total yield but also produced 5.9% and 2.4% more than chemical fertilizer respectively. Cucumber weight in 14 t/h vermicompost was also more than chemical fertilizer but cucumber diameter in this treatment was lower than chemical fertilizer that can attributed to compensatory effect of yield components. Dynes (2003) also reported positive effect of vermicompost on cucumber properties. Ahmadi et al (2003) indicated the highest cucumber yield with using 100 t/h cow manure. Shafiee zargar (1996) reported improvement of qualitative and quantitative properties of cucumber with using cow manure at the rate of 30 t/h.

Scientists in last year’s tried to study on replacement probability of organic manure with chemical fertilizer. Azimzadeh (2013) reported better reaction of Safflower to organic fertilizer in both dry land and irrigated condition. Zariri et al (2013) reported that peppermint medical plant showed better reaction to using 10 t/h vermicompost, 10 t/h urban waste compost and 50 t/h farmyard manure. Azimzadeh et al (2014) reported that canola shows a better reaction to manure and vermicompost in limited condition of moisture and their replacement possibility in such as these condition with chemical fertilizer is considerable.
Generally according to result of this experiment using 14 t/h vermicompost, 50 t/h cow manure and chemical fertilizer produced almost the same yield but because of nutrient supplying and soil physical improvement in organic fertilizer, using 50 t/h cow manure or 14 t/h vermicompost prefer to chemical fertilizer in cucumber production.

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