Journal of Horticultural Science & Ornamental Plants 11 (3): 204-213, 2019
ISSN 2079-2158

DOI: 10.5829/idosi.jhsop.2019.204.213

# Effect of Using Water Hyacinth Compost Comparing with Some Organic Fertilizers and Mineral Fertilizer Levels on Growth and Yield of Sweet Pepper

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**Abstract:** This study was designed to evaluate the effect of using water hyacinth compost as organic fertilizer on sweet pepper plants c.v California wonder. Due to the availability of water hyacinth weed which it grow in the Nile River in large quantities. The experiment was conducted at the Experimental Farm of Kaha Station, Qalubia Governorate, Egypt during two successive summer seasons of 2017 and 2018 in clay soil. The experiments contain two factors, which distributed in a split plot design system. The first factor was adding mineral fertilizer at three levels; i.e., 50%, 75% and 100% (control) from the recommended mineral fertilization of sweet pepper plants where it distributed in the main plots, the second factor was adding different types of organic fertilizers at the rate of 100% and 50% from the recommendation (farmyard manure at 7 or 3.5 ton/fed., commercial compost (El-Waha) at 10 or 5 ton/fed. and water hyacinth compost at 10 or 5 t/fed, respectively) which distributed in the sub-plot. The results showed that using water hyacinth compost at 100% (10 t/ fed.) and fertilized the plants by 75 % of the mineral recommended fertilization treatment increased all growth parameters, i.e plant length, leaf area, fresh and dry weight of foliage per plant, fruits number/plant, early yield as well as total yield in both growing season comparing to control (i.e., fertilizing by using 100 % of the mineral recommended fertilization + farmyard manure at the rate of 7 ton/fed.).Generally, the results indicated that, it could be recommended by using water hyacinth compost at 100% (10 ton/fed.) and fertilizing by using 75 % of the mineral recommended fertilization which gave the highest values of vegetative growth and total yield of sweet pepper plant, as well as enhancing the fruit quality at the same time saving 25% from mineral fertilization.

**Key words:** Sweet pepper · Compost · Farmyard manure · Water hyacinth compost · Growth · Yield

## INTRODUCTION

Pepper (*Capsicum annuum* L.) is one of the most popular and favorite vegetable crop cultivated for local market and exportation which it is considered as high cash crop as well as high values from vitamins and some elements. The fruits have been widely used as fresh vegetable or as different dishes in the meals. It has occupied an important rank in world agriculture and that is due to its high profit and nutritional values for human health [1]. Sweet pepper fruits are a rich source of vitamin C, polyphenols, chlorophylls, carotenoids, sugars, magnesium, calcium, potassium, phosphorus and iron [2, 3].

Mineral fertilizers application plays an important role in plant growth and yield productivity of sweet pepper plants. Chemical fertilizers and organic manure have positive effects on plant growth and the soil. Chemical fertilizers have high nutrient contents (i.e. major elements - nitrogen, phosphorus, potassium, macro nutrients and other micro nutrients) normally added in smaller amount and are rapidly taken up by plants. However, the use of excess fertilizer can result in some problems, such as nutrient loss, surface water and groundwater contamination, soil acidification or basification, reductions in useful microbial communities and increased sensitivity to harmful insects. In this regard, Devi *et al*. [4] obtained better fruit weight and fruit yield of eggplant with the application of 120 kg NPK per hectare. It also helps in increasing desirable acidic flavor. Excess potassium content on chemically over fertilized soil decreases Vitamin C, carotene content and antioxidant compounds in vegetables [5]. Moreover, many investigators reported that increasing the amount of

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NPK-fertilizer caused an increase in the vegetative growth of eggplant, fruit yield and fruit quality [6, 7]. Kehinde *et al*. [8] showed that eggplant growth, yield and other shoot's characteristics greatly increased by adding 200kg NPK/ha application. Also, Suge *et al*. [9] reported that, increasing NPK from 50% to 100% from the recommended rates encouraged the vegetative growth of eggplants and produced more fruit yield. Moreover, fertilizers, especially NPK, promote vegetative growth and impart deep green colour characteristics essentially that it is important for photosynthesis. Futuless *et al*. [10] and Larcheveque *et al*. [11] found that chemical fertilizers promote higher growth and root development compared to livestock organic manure in a poplar plantation in clay soil. In this regard, Toungous [12] reported that, using chemical fertilizer at high level (l50kgNPK) promoting the vegetative growth and increase the total yield of sweet pepper. Organic manure has a number of shortcomings, including low nutrient content, slow decomposition and different nutrient compositions depending on its organic materials, compared to chemical fertilizers. In the other side, organic manure has multiple benefits and that is due to its balanced supply of nutrients, including micronutrients, increased soil nutrient availability and this reflect on increasing soil microbial activity, the decomposition of harmful elements, soil structure improvements and root development, moreover increased soil water hold capacity. In addition, organic manure significantly increased the soil pH and the concentrations of nitrogen, available phosphorus, exchangeable potassium, calcium and magnesium. In contrast, the NPK chemical fertilizer decreased the soil pH and exchangeable calcium concentration, did not affect the soil concentrations of nitrogen and magnesium and increased the concentrations of available phosphorus and exchangeable potassium. In this regard, Han *et al*. [13] and Adhikari *et al*. [14] studied the effect of different treatments (Control, Chemical fertilizer, Vermi-compost, Poultry manure, Farmyard manure, Goat manure and Commercial organic fertilizer) and the results revealed better growth and yield performance by vermi-compost followed by poultry manure over the control and FYM.

Composting of organic waste offers solution to get rid of large amounts of waste worldwide. Composting is a natural process of recycling decomposed organic materials into a rich nutrient soil known as compost. Traditional composting of organic wastes has been known for several years. The use of compost has been used to increase crop productivity and yields and that is usually associated with improved soil structure and enhancing soil fertility, increased soil microbial populations, significantly increased tomato plant dry biomass, fruit quality and yield [15-19]. Moreover, Nguyen *et al*. [20] reported that, addition compost to tomato or pepper plants increased shoots and root growth as well as fruit yield. Recycling waste from the livestock industry prevents environmental contamination and reduces treatment costs. At the same time, it promotes soil improvements and agricultural productivity. However, the simultaneous use of chemical fertilizer and organic manure has revealed diverse results relative to the plant types and soil characteristics. A study on tomatoes (*Lycopersicon esculentum*) in acidic soil by Murmu *et al*. [21] found that organic manure increases crop productivity, nitrogen utilization efficiency and soil health compared to chemical fertilizer.

One largely overlooked resource available for soil fertility remediation is the use of non-traditional organic materials such as weeds (Water hyacinth) which belongs to the family Pontederiaceae. It is a floating biomass with long round spongy stems. Its leaves are deep green, large and erect. The plant is luxuriant in growth and multiplies very rapidly. The plant is characterized by formation of large floating mats that normally cover the water surface. When allowed to propagate, it is quickly colonizes vast areas of water masses causing many number of problems. Some examples of detrimental effects include loss of fishing ground, provision of habitats for mosquito and bilharzias breeding, occlusion of waterways for navigation, interference with hydroelectric power sources and suppression of other useful aquatic life [22]. It is considered as a valuable source of macronutrients such as phosphorus, nitrogen and potassium which consider very essential for plant nutrition [23-25]. Due to the availability of water hyacinth in Nile River in large quantities; it can be used as a material for production of organic fertilizer as a compost. The compost could then be applied to plants as a source of nitrogen, phosphorus and potassium (NPK) which are the macro nutrients that limit crop growth [26, 27]. The real challenge is not how to get rid of these weeds but how to benefit from it and turn it into a compost source. Thus the issue of water hyacinth should be looked from a different view. However, there is a continued emphasis from some researchers that there is consider significant benefit to be obtained from water hyacinth [28, 29].

In this regard, Lata and Veenapani [30] revealed that, the growth of *Brassica Juncea* was more pronounced with adding 50% water hyacinth manure from its recommendation and productivity with 100% water

hyacinth manure treatment. Moreover, Osoro *et al*. [31] on maiz, Osoro *et al*. [32] on common bean, Abu- Talkah [33] on taro showed that taro plants growth (plant height, number of leaves, leaf area) and production (weight of fresh taro) significantly increased with the dose of organic fertilizer water hyacinth 20 tons/ha, but not significantly different with treatment dose of organic fertilizer water hyacinth at 15 tones / ha.

Also, Mashavira *et al.* [34] on tomato reported that, water hyacinth which is locally available and in large quantities can be composted to prepare organic fertilizers and effectively used as an organic soil amendment to restore soil and increase growth and yield attributes without compromising the health of consumers by heavy metal toxicity build up. Which they found that, heavy metal concentrations increased with increase in the water hyacinth compost rate but at all application rates, the concentrations of Pb, Zn, Ni and Cu detected in tomato fruit were within the permissible ranges. On average Ni concentration in the tomato fruit was 90% lower than the maximum permissible levels, Pb was 85% lower, Cu was 93% and Zn was 86% lower than the Codex Alimentations Commission permissible levels of heavy metals in vegetables.

The aim of this study was designed to evaluate the effect of integrated use of water hyacinth weed as organic fertilizer for sweet pepper plants comparing with some sources of organic manure. Whereas the water hyacinth weed founded in Nile River in large quantities; it can be used as a material for production of organic fertilizer as well as minimizing the chemical fertilizer application. Which, organic production very important nowadays with a high yield and desirable quality as well as a minimizing adding mineral fertilizer rates.

## MATERIALS AND METHODS

The experiment was conducted at the Experimental Farm of Kaha Station, Qalubia Governorate. Egypt. The soil was clay in texture with 7.1 pH, 1.27% organic matter, 110ppm N, 56ppm P and 98ppm K. The present investigation was conducted during two successive seasons of 2017 and 2018 to study the effect of organic and mineral fertilizers on growth and yield of sweet pepper. Seeds of sweet pepper (*Capsicum annum* L) cv. California wonder were sown under plastic house in nursery at the first week of February during both seasons and received natural agricultural practices. After 50 day from sowing healthy seedlings were selected and transplanted in the field plots. The plot areas was 8.4 $m^2$ and include 3 ridges each of 0.7 m width and 4.0m length. A split - plot design system with three replicates was adopted. Eighteen treatments, i.e., the combination among three levels (50%, 75% and 100% control) from the recommended mineral fertilization of sweet pepper plants ;i.e.,130 kg N+45 kg $P_2O_5$+72 kg $K_2O$ / fed which were distributed in the main plots. In addition, adding different types from organic manure at the rate of 100% and 50% from the recommendation, i.e. 7 or 3.5/fed ton from farmyard manure, commercial compost (El- Waha) at 10 or 5 ton/fed and water hyacinth compost at 10 or 5 ton/fed., respectively which distributed in the sub-plots.

**Water Hyacinth Compost Preparation and Management:** Water hyacinth was collected manually from Nile River at flowering stage of it, sun-dried and chopped into small pieces of about 5 cm and a compost of pile 2 m × 2 m × 2 m was prepared by putting alternate layers of water hyacinth (450 mm), cow manure and soil (10 mm thick). The compost piles were turning and mixing weekly basis to aerate the compost, break compost clumps and to ensure that peripheral exposed materials were incorporated into the pile and homogeneously decomposed. After 9 weeks the temperature in the compost pile dropped to steady mesophilic levels of between 30°C - 40°C. The compost piles were transferred for curing and reach to mature stage became to ready for using after an additional 4 weeks. For curing the stable compost was taken into a garden shed with free air circulation. A water impermeable plastic sheet was spread on the ground before heaping the stable compost to avoid leaching. Water was periodically added to the curing compost to keep it barely moist [34]. All compost types and organic manure were added to the soil during soil preparing and ridging.

The other agricultural practices were followed according to the recommendation for sweet pepper plantation. The following data were recorded as follows:

**Recorded Data**

**Vegetative Growth Parameters:** Three plants were randomly chosen from each treatment in the three replicates at the beginning of flowering stage at 60 day after transplanting in order to determine the following data:

Plant length (the length of main stem cm), stem diameter (cm) and No. of brunches/ plant.

Table 1: Chemical properties of the organic fertilizers used in this study

| Organic fertilizer | Chemical properties |
|---|---|
| 1-Farmyard manure (control) | 2 % N, 0.26% P, 0.3% K,0.2% Ca<br>EC 1.9, pH 7.9<br>73% moisture |
| 2- Commercial compost<br>(El-wahha compost it is contain plant waste 70% and animal waste 30%) | 1.3% N, 0.8 P %,0.7 % K, EC 6.2, pH 6.8<br>37%Organic matter, C/N ratio 01:18, 25% moisture |
| 3- Water Hyacinth Compost<br>(Nile Water Hyacinth Compost it is contain water hyacinth weed 70% and animal waste 30%) | 0.74% N, 1.6 P %, 4,9 % K, EC 3.06, pH 6.6<br>22.5%Organic carbon,, 25% moisture<br>Some heavy metal such as (0.324 ppm Zn, 0.194 ppm Ni, 0.758 ppm Cu, 0.0001 ppm Pb, these concentration were within the permissible ranges) |

**Fresh Weight and Dry Weight (g/plant):** A random sample of other three plants from each plot were taken and dried at 70°C till constant weight and the dry weight of whole plant was determined using the standard methods as illustrated by A.O.A.C [35].

The leaf area was calculated at flowering stage (after 60 days from transplanting) from the fourth upper leaves according to the following formula of Wallace and Munger [36].

$$\text{Leaf area } (cm^2) = \text{Leaves dry weight (gm) x disk area / Disk dry weight (gm)}$$

**Total Fruit Yield and its Components:** Fruit number/plant, average fruit weight (g), early fruit yield (ton/fed) as the first and second pickings and total fruit yield (ton/fed) were recorded.

**The Physical Characters of Sweet Pepper Fruits:** Five sweet pepper fruits were randomly selected from each plot at the second picking 95 days after transplanting to determine the following data: Fruit length (cm), fruit diameter (cm) and flesh thickness cm (by using a caliper).

**The Chemical Characters of Sweet Pepper Fruits**

**Ascorbic acid:** (Vitamin C mg/100g fresh weight) content was determined by using the die 2, 6 dichlorophenol indophenols, method as described by Ranganna [37].

Phosphours and potassium were determined in dry fruit on the basis of dry weight according to the methods described by Olsen and Sommers [38] and Jackson [39], respectively.

**Statistical Analysis:** Data obtained were subjected to the proper analysis of variance (split- split plot design) as described by Snedecor and Cochran [40] using M. stat program. Averages between treatments were differentiated by using LSD at 5% level.

## RESULTS AND DISCUSSION

**Plant Growth**

**Effect of Mineral Fertilization Levels:** Data in Table (2) illustrate that, the plants showed best growth attributes, i.e., plant length, number of branches/plant with 100% of the recommended mineral rate whereas, stem diameter, leaf area as well as fresh and dry weight of foliage per plant with 75% of the recommended mineral fertilization, these results were true in both growing seasons. In this regard Meniutiu [6] on eggplant, Balliu *et al*. [7] on pepper, Kehinde *et al*. [8] on eggplant, Suge *et al*. [9] on eggplant and Toungous [12] on sweet pepper indicated that increasing the amount of NPK-fertilizer caused an increase in the vegetative growth.

**Effect of Organic Fertilizer Types:** As shown in Table (2), sweet pepper plants grown in the soil fertilized by water hyacinth compost at 100% (10 ton/ fed.) gave the highest values of vegetative growth parameters, stem diameter, leaf area as well as the fresh and dry weight of plant in both growing season on the contrary, hyacinth compost at 50% increased number of branches/plant whereas commercial compost at100% (10 ton/fed) increased plant length and number of branches/plant and this due to its contents from the main elements and the organic matter as shown in Table (1). These results are in agreements with those obtained by Lata and Veenapani [30] *on Brassica Juncea*, Osoro *et al*.[31] on maiz, Osoro *et al*.[32] on common bean, Mashavira et *al.*[34] on tomato and Abu- Talkah [33] on taro.

**Effect of the Interaction Between Mineral Fertilization Levels and Organic Fertilizer Types:** Data in Table (2) indicated that using water hyacinth compost at 100% (10 ton/ fed.) and fertilization by 75 % of the mineral recommended fertilization treatment increased plant length, leaf area, fresh and dry weight of foliage per plant in both growing season and stem diameter in the first

Table 2: Effect of mineral fertilizer levels, organic fertilizer types and their interactions on vegetative growth of sweet pepper plants at 60 days after transplanting during the two seasons of 2017 and 2018.

| | Plant length (cm) | | No. of. brunches/ plant | | Stem diameter (cm) | | Leaf area ($cm^2$) | | Fresh weightg / (plant) | | Dry weightg / (plant) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | 2017 | 2018 | 2017 | 20178 | 2017 | 2018 | 2017 | 2018 | 2017 | 2018 | 2017 | 2018 |
| fertilization (NPK) Mineral | | | | | | | | | | | | |
| 100% (control) | 40.47 | 40.47 | 20.17 | 19.30 | 1.15 | 1.17 | 374.47 | 363.84 | 212.33 | 218.94 | 41.08 | 38.77 |
| 75% | 39.88 | 39.18 | 18.78 | 19.60 | 1.22 | 1.18 | 398.31 | 413.85 | 236.55 | 248.31 | 47.62 | 47.48 |
| 50% | 36.54 | 37.62 | 14.81 | 15.05 | 0.99 | 0.99 | 239.35 | 249.83 | 162.58 | 162.37 | 28.04 | 27.57 |
| L.S.D at 5 % level | 0.67 | 0.44 | 0.43 | 0.95 | 0.12 | 0.04 | 7.56 | 6.44 | 6.33 | 1.96 | 0.24 | 0.44 |
| Organic manure types | | | | | | | | | | | | |
| Farmyard manure 100% (control) | 40.75 | 39.00 | 16.67 | 16.03 | 1.07 | 1.07 | 241.51 | 239.30 | 194.43 | 188.32 | 35.09 | 34.40 |
| Commercial compost 100% | 40.50 | 42.67 | 20.50 | 20.73 | 1.08 | 1.05 | 413.65 | 398.39 | 209.51 | 235.60 | 40.67 | 37.05 |
| Water hyacinth compost 100% | 41.17 | 41.57 | 18.17 | 19.33 | 1.24 | 1.23 | 427.85 | 460.18 | 228.00 | 231.77 | 45.43 | 42.53 |
| Farmyard manure 50% | 36.53 | 34.57 | 15.00 | 14.00 | 1.07 | 1.04 | 228.28 | 232.22 | 206.70 | 206.63 | 36.37 | 36.70 |
| Commercial compost 50% | 35.33 | 36.00 | 15.83 | 17.00 | 1.08 | 1.10 | 359.47 | 360.10 | 186.03 | 189.88 | 36.83 | 36.70 |
| Water hyacinth compost 50% | 39.49 | 40.73 | 21.34 | 20.80 | 1.18 | 1.20 | 353.49 | 364.84 | 198.25 | 207.04 | 39.10 | 40.25 |
| L.S.D at 5 % level | 0.74 | 0.45 | 1.02 | 0.71 | 0.07 | 0.09 | 7.32 | 4.44 | 8.42 | 3.87 | 0.72 | 0.64 |
| The interaction between them | | | | | | | | | | | | |
| 100% Farmyard manure 100% (control) | 42.50 | 41.00 | 19.00 | 17.30 | 1.05 | 1.10 | 270.70 | 254.10 | 189.70 | 177.90 | 31.60 | 30.00 |
| Commercial compost 100% | 43.50 | 46.00 | 23.50 | 23.20 | 1.25 | 1.20 | 435.89 | 400.10 | 228.73 | 236.10 | 45.90 | 41.10 |
| Water hyacinth compost 100% | 37.50 | 38.00 | 22.50 | 23.00 | 1.25 | 1.30 | 484.64 | 480.64 | 245.40 | 244.00 | 43.00 | 40.90 |
| Farmyard manure 50% | 38.80 | 36.00 | 18.50 | 13.00 | 1.20 | 1.10 | 251.50 | 249.50 | 224.90 | 225.10 | 38.60 | 39.30 |
| Commercial compost 50% | 38.00 | 38.00 | 15.00 | 17.00 | 1.05 | 1.10 | 416.53 | 407.17 | 154.83 | 190.66 | 43.20 | 40.10 |
| Water hyacinth compost 50% | 42.50 | 43.80 | 22.50 | 22.30 | 1.10 | 1.20 | 387.55 | 391.53 | 230.45 | 239.88 | 44.20 | 41.20 |
| 75% Farmyard manure 100% | 39.50 | 38.00 | 14.00 | 14.50 | 0.97 | 1.10 | 237.50 | 241.70 | 178.88 | 176.60 | 36.33 | 36.10 |
| Commercial compost 100% | 38.00 | 39.00 | 23.00 | 23.00 | 1.20 | 1.10 | 489.39 | 497.39 | 228.80 | 300.00 | 46.80 | 48.65 |
| Water hyacinth compost 100% | 45.00 | 47.70 | 16.50 | 18.00 | 1.37 | 1.30 | 552.69 | 620.97 | 306.60 | 308.00 | 63.70 | 61.00 |
| Farmyard manure 50% | 38.80 | 36.00 | 15.50 | 18.00 | 1.10 | 1.10 | 222.99 | 230.84 | 222.90 | 223.80 | 49.40 | 48.80 |
| Commercial compost 50% | 37.00 | 35.00 | 20.50 | 21.00 | 1.30 | 1.20 | 428.33 | 432.10 | 255.17 | 245.28 | 43.50 | 42.20 |
| Water hyacinth compost 50% | 40.99 | 39.40 | 23.20 | 23.10 | 1.40 | 1.30 | 458.94 | 460.10 | 226.93 | 236.20 | 46.00 | 48.15 |
| 50% Farmyard manure 100% | 40.25 | 38.00 | 17.00 | 16.30 | 1.20 | 1.00 | 216.32 | 222.10 | 214.72 | 210.45 | 37.35 | 37.10 |
| Commercial compost 100% | 40.00 | 43.00 | 15.00 | 16.00 | 0.80 | 0.85 | 315.67 | 297.67 | 171.00 | 170.70 | 29.30 | 21.40 |
| Water hyacinth compost 100% | 41.00 | 39.00 | 15.50 | 17.00 | 1.10 | 1.10 | 246.21 | 278.94 | 132.00 | 143.30 | 29.60 | 25.70 |
| Farmyard manure 50% | 32.00 | 31.70 | 11.00 | 11.00 | 0.90 | 0.91 | 210.35 | 216.32 | 172.30 | 171.00 | 21.10 | 22.00 |
| Commercial compost 50% | 31.00 | 35.00 | 12.00 | 13.00 | 0.90 | 1.00 | 233.56 | 241.02 | 148.10 | 133.70 | 23.80 | 27.80 |
| Water hyacinth compost 50% | 35.00 | 39.00 | 18.33 | 17.00 | 1.03 | 1.10 | 213.98 | 242.90 | 137.37 | 145.05 | 27.10 | 31.40 |
| L.S.D at 5 % level | 0.48 | 0.27 | 0.67 | 0.30 | 0.03 | N.S | 4.71 | 2.79 | 5.27 | 2.12 | 0.43 | 0.39 |

season. On the other hand according to number of branches/plant the best treatment was using the commercial compost (El-Waha) at 100% (10 ton/ fed.) and fertilization by 100 % of the mineral recommended fertilization treatment in both growing season.

## Yield and its Components

**Effect of Mineral Fertilization Levels:** Data in Table (3) revealed that fertilizing sweet pepper with75% of the recommended rate of NPK increased average of fruit weight and early yield, whereas fertilizing with 100% increased average of fruit number/plant and total yield, these results were true in both growing seasons. It can said that these treatments as shown in Table (2) showed obvious, increasing in plant growth which that reflect on yield and its components. The same trend was obtained by Meniutiu[6] on eggplant, Balliu *et al*.[7] on pepper, Kehinde *et al*.[8] on eggplant, Suge *et al*.[9] on eggplant and Toungous [12] on sweet pepper which indicated that increasing the amount of NPK-fertilizer caused an increase in the yield and its components.

**Effect of Organic Fertilizer Types:** Data in Table (3) noticed that, the highest values of fruits number/plant, average fresh fruit weight, early yield and total yield were recorded by adding water hyacinth compost or the commercial compost (El-Waha) at 100% (10 ton/ fed.). These results were true in the two seasons of the study. The positive effect of applying water hyacinth compost or the commercial compost (El-Waha) could be expected because its have favorable conditions for increasing sweet pepper vegetative growth as shown in Table (2) Moreover, its considered as a valuable source of highest concentration from N, K and the organic matter as shown in Table (1) macronutrients such as phosphorus, nitrogen and potassium that are essential for plant

Table 3: Effect of mineral fertilization levels, organic fertilization types and their interactions on the total yield and its components of sweet pepper fruits during the two seasons of 2017 and 2018

| | Average of fruit weight (g) | | Fruit number/plant | | Early yield (Ton/ fed) | | Total yield (Ton/ fed) | |
|---|---|---|---|---|---|---|---|---|
| Treatments | 2017 | 2018 | 2017 | 2018 | 2017 | 2018 | 2017 | 2018 |
| Mineral fertilization(NPK) | | | | | | | | |
| 100% (control) | 90.06 | 88.09 | 30.36 | 28.34 | 1.81 | 1.88 | 24.13 | 22.03 |
| 75% | 92.33 | 91.61 | 29.63 | 27.63 | 2.71 | 2.72 | 23.99 | 21.96 |
| 50% | 76.59 | 75.48 | 22.27 | 21.13 | 1.74 | 1.85 | 17.75 | 16.03 |
| L.S.D at 5 % level | 0.44 | 0.65 | 0.58 | 0.44 | 0.10 | 0.08 | 0.42 | 0.21 |
| Organic manure types | | | | | | | | |
| Farmyard manure 100% (control) | 88.67 | 86.22 | 25.80 | 23.35 | 2.73 | 2.76 | 21.03 | 19.09 |
| Commercial compost 100% | 80.44 | 78.08 | 30.44 | 28.29 | 2.24 | 2.39 | 23.95 | 22.46 |
| Water hyacinth compost 100% | 95.17 | 94.62 | 32.75 | 30.67 | 2.53 | 2.80 | 26.08 | 24.26 |
| Farmyard manure 50% | 87.41 | 83.84 | 21.63 | 20.77 | 2.06 | 1.77 | 17.88 | 15.78 |
| Commercial compost 50% | 85.35 | 85.88 | 27.13 | 25.60 | 1.49 | 1.55 | 21.02 | 20.05 |
| Water hyacinth compost 50% | 80.91 | 81.71 | 26.77 | 25.53 | 1.46 | 1.63 | 21.78 | 18.39 |
| L.S.D at 5 % level | 0.64 | 0.66 | 0.77 | 0.45 | 0.07 | 0.08 | 0.53 | 0.35 |
| The interaction between them | | | | | | | | |
| 100% Farmyard manure 100% (control) | 94.16 | 91.18 | 27.63 | 24.76 | 2.17 | 2.42 | 22.67 | 19.23 |
| Commercial compost 100% | 84.00 | 79.65 | 34.80 | 33.17 | 2.14 | 2.25 | 26.31 | 24.29 |
| Water hyacinth compost 100% | 104.13 | 103.53 | 35.35 | 33.30 | 2.02 | 2.44 | 30.50 | 27.56 |
| Farmyard manure 50% | 88.15 | 84.50 | 21.40 | 21.40 | 1.73 | 1.25 | 16.97 | 14.48 |
| Commercial compost 50% | 84.10 | 84.20 | 34.58 | 32.40 | 1.41 | 1.38 | 26.39 | 24.62 |
| Water hyacinth compost 50% | 85.80 | 85.50 | 28.40 | 25.00 | 1.37 | 1.54 | 21.93 | 22.00 |
| 75% Farmyard manure 100% | 90.55 | 86.50 | 25.87 | 24.00 | 3.03 | 3.00 | 21.06 | 18.06 |
| Commercial compost 100% | 91.85 | 94.30 | 32.42 | 29.70 | 3.44 | 3.52 | 26.36 | 23.96 |
| Water hyacinth compost 100% | 88.77 | 88.73 | 39.10 | 35.40 | 3.39 | 3.48 | 28.29 | 25.36 |
| Farmyard manure 50% | 93.30 | 91.60 | 25.60 | 25.50 | 2.66 | 2.33 | 21.85 | 21.62 |
| Commercial compost 50% | 86.02 | 87.20 | 26.00 | 23.00 | 1.52 | 1.69 | 20.13 | 21.00 |
| Water hyacinth compost 50% | 103.50 | 101.30 | 28.80 | 28.20 | 2.23 | 2.32 | 26.29 | 21.74 |
| 50% Farmyard manure 100% | 81.31 | 80.97 | 23.90 | 21.30 | 3.00 | 2.85 | 19.37 | 19.97 |
| Commercial compost 100% | 65.46 | 60.30 | 24.10 | 22.00 | 1.15 | 1.41 | 19.19 | 19.13 |
| Water hyacinth compost 100% | 92.61 | 91.60 | 23.80 | 23.30 | 2.18 | 2.50 | 19.45 | 19.87 |
| Farmyard manure 50% | 80.78 | 75.43 | 17.90 | 15.40 | 1.78 | 1.74 | 14.83 | 11.23 |
| Commercial compost 50% | 85.93 | 86.25 | 20.80 | 21.40 | 1.53 | 1.59 | 16.53 | 14.52 |
| Water hyacinth compost 50% | 53.42 | 58.33 | 23.10 | 23.40 | 0.78 | 1.02 | 17.12 | 11.45 |
| L.S.D at 5 % level | 0.39 | 0.43 | 0.54 | 0.27 | 0.05 | 0.04 | 0.30 | 0.22 |

nutrition. The same trend was noticed by several investigators, Lata and Veenapani [30] *on Brassica Juncea*, Osoro *et al*. [31] on maiz, Osoro *et al*.[32] on common bean, Mashavira *et al*. [34] on tomato and Abu- Talkah [33] on taro.

**Effect of the Interaction Between Mineral Fertilization Levels and Organic Fertilizer Types:** The obtained data in Table (3) revealed that, using water hyacinth compost at 100% (10 ton/ fed.) and fertilization by 100% of the mineral recommended fertilization treatment or using water hyacinth compost at 100% from the organic recommended fertilization (10 ton/ fed.) and fertilization by 75% of the mineral recommended fertilization treatment increased early yield, total yield and fruits number. Moreover, data indicated that the best treatment for fresh fruit weight was using water hyacinth compost at 100% (10 ton/ fed.) and fertilization by 100% of the mineral recommended fertilization in both growing season.

**Some Physical Characters of Sweet Pepper Fruits**

**Effect of Mineral Fertilization Levels:** The obtained results in Table (4) showed some physical characteristics of sweet pepper fruit i.e. fruit length, fruit diameter, flesh thickness and number of vacuoles. The data illustrated that, in general the plants fertilized by 75 % of the recommended mineral fertilization gave the highest values of all mentioned physical characteristics of sweet pepper in both growing season. Many investigators reported that increasing the amount of NPK-fertilizer caused an increase in fruit quality [4, 6-8].

**Effect of Organic Fertilizer Types:** As shown in Table (4), sweet pepper plants grown in the soil fertilized by the commercial (El-Waha) compost or water hyacinth compost at 100% (10 ton/ fed.), respectively gave the highest values of fruit length, fruit diameter and flesh thickness of pepper fruits in both growing season as mentioned by Arancon *et al*. [15] on sweet pepper and Ali [16] on tomato.

Table 4: Effect of mineral fertilizer levels, organic fertilizer types and their interactions on some physical characters of sweet pepper fruits during the two seasons of 2017 and 2018

| | | Fruit lengthcm | | Fruit diametercm | | Flesh thicknesscm | |
|---|---|---|---|---|---|---|---|
| Treatments | | 2017 | 2018 | 2017 | 2018 | 2017 | 2018 |
| fertilization (NPK) Mineral | | | | | | | |
| 100% (control) | | 6.74 | 6.93 | 6.39 | 6.46 | 0.48 | 0.45 |
| 75% | | 7.19 | 7.19 | 6.57 | 6.49 | 0.47 | 0.47 |
| 50% | | 6.53 | 6.57 | 6.17 | 6.18 | 0.42 | 0.43 |
| L.S.D at 5 % level | | 0.12 | 0.08 | 0.04 | 0.06 | 0.02 | 0.01 |
| Organic manure types | | | | | | | |
| Farmyard manure 100% (control) | | 6.84 | 6.68 | 6.53 | 6.38 | 0.46 | 0.43 |
| Commercial compost 100% | | 7.06 | 7.09 | 6.07 | 6.18 | 0.48 | 0.48 |
| Water hyacinth compost 100% | | 7.13 | 7.28 | 6.53 | 6.55 | 0.47 | 0.47 |
| Farmyard manure 50% | | 6.51 | 6.52 | 6.44 | 6.27 | 0.43 | 0.42 |
| Commercial compost 50% | | 6.97 | 7.12 | 6.27 | 6.35 | 0.45 | 0.44 |
| Water hyacinth compost 50% | | 6.40 | 6.68 | 6.42 | 6.54 | 0.44 | 0.44 |
| L.S.D at 5 % level | | 0.07 | 0.08 | 0.06 | 0.05 | 0.02 | 0.01 |
| The interaction between them | | | | | | | |
| 100% | Farmyard manure 100%(control) | 7.21 | 7.01 | 6.82 | 6.88 | 0.48 | 0.43 |
| | Commercial compost 100% | 7.24 | 7.25 | 5.93 | 6.20 | 0.51 | 0.50 |
| | Water hyacinth compost 100% | 7.01 | 7.32 | 6.69 | 6.75 | 0.49 | 0.46 |
| | Farmyard manure 50% | 6.40 | 6.60 | 6.35 | 6.40 | 0.48 | 0.45 |
| | Commercial compost 50% | 6.07 | 6.52 | 6.15 | 6.18 | 0.47 | 0.45 |
| | Water hyacinth compost 50% | 6.50 | 6.85 | 6.40 | 6.35 | 0.43 | 0.40 |
| 75% | Farmyard manure 100% | 6.96 | 6.86 | 6.34 | 6.37 | 0.52 | 0.50 |
| | Commercial compost 100% | 7.44 | 7.48 | 6.40 | 6.20 | 0.49 | 0.50 |
| | Water hyacinth compost 100% | 7.20 | 7.40 | 6.50 | 6.53 | 0.43 | 0.44 |
| | Farmyard manure 50% | 6.93 | 6.66 | 6.56 | 6.26 | 0.43 | 0.43 |
| | Commercial compost 50% | 7.36 | 7.33 | 6.61 | 6.66 | 0.45 | 0.43 |
| | Water hyacinth compost 50% | 7.23 | 7.40 | 7.01 | 6.97 | 0.49 | 0.49 |
| 50% | Farmyard manure 100% | 6.36 | 6.16 | 6.43 | 5.90 | 0.38 | 0.37 |
| | Commercial compost 100% | 6.50 | 6.55 | 5.87 | 6.15 | 0.45 | 0.45 |
| | Water hyacinth compost 100% | 7.17 | 7.13 | 6.41 | 6.36 | 0.49 | 0.50 |
| | Farmyard manure 50% | 6.21 | 6.30 | 6.41 | 6.16 | 0.39 | 0.37 |
| | Commercial compost 50% | 7.48 | 7.50 | 6.05 | 6.20 | 0.43 | 0.45 |
| | Water hyacinth compost 50% | 5.48 | 5.80 | 5.86 | 6.30 | 0.40 | 0.43 |
| L.S.D at 5 % level | | 0.04 | 0.05 | 0.03 | 0.02 | 0.02 | 0.01 |

Table 5: Effect of mineral fertilizer levels, organic fertilizer types and their interaction on some chemical characters of sweet pepper fruits during the two seasons of 2017 and 2018.

| | | Vit C (mg/100g) | | P(%) | | K(%) | |
|---|---|---|---|---|---|---|---|
| Treatments | | 2017 | 2018 | 2017 | 2018 | 2017 | 2018 |
| Mineral Fertilization(NPK) | | | | | | | |
| 100% (control) | | 165.59 | 161.47 | 0.74 | 0.72 | 3.96 | 3.85 |
| 75% | | 146.61 | 144.88 | 0.62 | 0.63 | 3.69 | 3.85 |
| 50% | | 139.72 | 137.88 | 0.64 | 0.67 | 3.57 | 3.61 |
| L.S.D at 5 % level | | 1.65 | 0.87 | 0.08 | 0.06 | 0.06 | N.S |
| Organic manure types | | | | | | | |
| Farmyard manure 100% (control) | | 152.93 | 148.48 | 0.58 | 0.59 | 3.56 | 3.39 |
| Commercial compost 100% | | 158.53 | 156.08 | 0.69 | 0.69 | 3.51 | 3.82 |
| Water hyacinth compost 100% | | 146.81 | 145.18 | 0.72 | 0.73 | 4.13 | 4.34 |
| Farmyard manure 50% | | 145.00 | 138.43 | 0.61 | 0.61 | 3.39 | 3.06 |
| Commercial compost 50% | | 153.38 | 152.82 | 0.69 | 0.71 | 3.88 | 3.99 |
| Water hyacinth compost 50% | | 147.19 | 147.49 | 0.71 | 0.71 | 3.97 | 4.01 |
| L.S.D at 5 % level | | 0.69 | 0.88 | 0.05 | 0.05 | 0.07 | 0.24 |
| The interaction between them | | | | | | | |
| 100% | Farmyard manure 100% (control) | 168.78 | 155.44 | 0.62 | 0.67 | 3.72 | 3.14 |
| | Commercial compost 100% | 162.40 | 160.08 | 0.67 | 0.69 | 3.68 | 3.71 |
| | Water hyacinth compost 100% | 177.48 | 172.45 | 0.84 | 0.88 | 4.67 | 4.86 |
| | Farmyard manure 50% | 155.44 | 150.80 | 0.68 | 0.53 | 3.58 | 3.08 |
| | Commercial compost 50% | 170.13 | 170.00 | 0.83 | 0.81 | 4.01 | 4.13 |
| | Water hyacinth compost 50% | 159.31 | 160.08 | 0.82 | 0.76 | 4.09 | 4.21 |
| 75% | Farmyard manure 100% | 154.67 | 150.80 | 0.53 | 0.55 | 3.21 | 3.27 |
| | Commercial compost 100% | 177.87 | 174.00 | 0.60 | 0.61 | 3.44 | 3.76 |
| | Water hyacinth compost 100% | 119.87 | 120.00 | 0.65 | 0.65 | 3.82 | 4.25 |
| | Farmyard manure 50% | 142.68 | 136.88 | 0.59 | 0.59 | 3.72 | 3.71 |
| | Commercial compost 50% | 141.52 | 144.61 | 0.67 | 0.68 | 3.81 | 4.00 |
| | Water hyacinth compost 50% | 143.07 | 143.00 | 0.69 | 0.69 | 4.14 | 4.10 |
| 50% | Farmyard manure 100% | 135.33 | 139.20 | 0.58 | 0.56 | 3.75 | 3.79 |
| | Commercial compost 100% | 135.33 | 134.16 | 0.80 | 0.79 | 3.39 | 3.99 |
| | Water hyacinth compost 100% | 143.07 | 143.10 | 0.67 | 0.66 | 3.90 | 3.91 |
| | Farmyard manure 50% | 136.88 | 127.60 | 0.56 | 0.69 | 2.85 | 2.39 |
| | Commercial compost 50% | 148.48 | 143.84 | 0.58 | 0.64 | 3.82 | 3.86 |
| | Water hyacinth compost 50% | 139.20 | 139.40 | 0.64 | 0.68 | 3.69 | 3.73 |
| L.S.D at 5 % level | | 0.43 | 0.54 | 0.03 | 0.02 | 0.04 | 0.16 |

**Effect of the Interaction Between Mineral Fertilization Levels and Organic Fertilizer Types:** The obtained results in Table (4) showed that, the highest value of fruit length was obtained from using commercial compost (El -Waha) at 50% and fertilization by 50% of the mineral recommended fertilization treatment. On the contrary, the highest values of fruit diameter were recorded when the plants fertilized by the water hyacinth compost at the level of 50% (5 ton/ fed.) and fertilization by 75 % of the mineral recommended fertilization treatment. According to flesh thickness the best treatments were using farmyard manure or compost at 100% and fertilization by 75 % of the mineral recommended fertilization levels. These results were true in the two seasons of the study.

**Some Chemical Characters of Sweet Pepper Fruits**

**Effect of Mineral Fertilization Levels:** Data in Table (5) noticed that, in general the highest fruit V.C concentration, P (%) and K (%) were obtained from fertilization by 100 % of the recommended fertilization but these increases did not reach to the significance level for K% in the second season. These results were true in the two seasons of the study. These results are in agreements with those obtained by Toor *et al*. [5].

**Effect of Organic Fertilizer Types:** As shown in Table (5), sweet pepper plants grown in the soil fertilized by water hyacinth compost at 100% (10 ton/ fed.) gave the highest values of K% and P% in both growing season.

While, the commercial compost (El-Waha) at 100% (10 ton/ fed.) gave the highest values of V.C, in both growing season. The superior results of using these two types of the mentioned compost due to its contents from N, $K_2O$, organic matter and C/N ratio as shown in Table (1).

**Effect of the Interaction Between Mineral Fertilization Levels and Organic Fertilizer Types:** Regarding to the influence of the interaction between mineral fertilization levels and organic fertilizer types on some chemical characters i.e. V.C, K% and P% of sweet pepper fruits are shown in Table (5) it is noticed that, the highest values of V.C, K (%) and P (%) were obtained from fertilizing the plants by water hyacinth compost at 100% treatment and the plants received 100 % of the mineral recommended fertilization treatment. These results were true in the two seasons of the study.

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