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The effect of organic and mineral fertilizers on the fruit yield *Cucurbita pepo* L.

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Abstract

The experiment was carried out in the vegetable field of the Department of Horticulture and Landscape Engineering, College of Agriculture, University of Karbala - Al-Husseiniyah District during the fall semester 2023-2024 in sandy soil according to a randomized completely block design (RCBD). The experiment included 19 treatments and three repetitions. Vermicompost tea was added to the soil at three levels (4, 8 and 12) liter ha-1, and humic extract was added at three levels as well (6, 12 and 18) liter ha-1. It was added to the soil in three batches, and three levels of NPK mineral fertilizer (25%, 50%, and75%) of the fertilizer recommendation with compared to a treatment to which the full fertilizer recommendation(100%) NPK(Comparison) ,was applied in three stages to investigate the impact of vermicompost tea humic acid and mineral fertilizer (NPK) on the quality of zucchini squash The results showed a significant effect of the highest concentration of vermicompost tea and mineral fertilizer 75% on the characteristics of fruit length and fruit weight, as treatment F12 excelled by giving it the highest rate of the mentioned characteristics, amounting to 18.90 cm and 210.90 g fruit $^{-1}$, and treatment F10 recorded the highest rate of fruit number characteristic of 5.63 fruit-1. The results also showed that the F3 treatment was superior in terms of fruit diameter, reaching 4.132 cm. We conclude from this that it is preferable to divide the organic and mineral fertilizers into batches, and it is possible to use quality organic fertilizer with a third of the amount of mineral fertilizer, that is, reducing mineral fertilizers and replacing them with organic fertilizers.

Keywords: chemical fertilizers, organic fertilizers, zucchini.

Introduction

The unconsidered use of chemical fertilizers has negative effects, the most important of which are soil pollution and increased salinity of cultivated lands. Therefore, it requires thinking and working on using modern fertilizers instead of traditional fertilizers to provide the necessary nutrients for plant growth and increase production while maintaining the soil in good condition and a clean environment [1].

increasing agricultural production and quality, preparing the soil with various elements, improving its physical, chemical, and biological characteristics, and reducing the effect of heavy elements [2].

Zucchini squash is of great nutritional importance, whether for the ripe fruits or the seeds of these fruits, because they contain vitamins and minerals [3] and are found in the markets in yellow and green colors [4]. It is grown in all Iraqi regions in the fields. The open tree has two periods: the first is spring, starting in mid-March, to produce its production at the end of April, and the second is autumn, during the second half of August, to produce its production in the months of October and the second [5].

Materials and Methods

A field experiment was carried out in the field of the Department of Horticulture and Landscape Engineering - College of Agricultural Engineering Sciences / University of Kerbela for the fall season 2023-2024. The land designated for conducting the research was prepared by plowing it in two perpendicular plows with a disc plow, and it was leveled and smoothed well. Then (9) drip tubes were extended from the main tube. Each replicate contained (3) drip tubes that were extended along the field. The number of treatments was 19 treatment in one replicate, with a ratio of 3. Replicates and 57 experimental units .

The area of the experimental unit was 3 m^2 (3 m x 1 m) Length x width and the distance between the sectors was 0.5 m for fertilizer treatments. After that, drip tubes were extended along the length of the field. Samples of the field soil were taken from different locations and at a depth of (0 -30 cm) and was mixed for the purpose of homogenization [6] for the purpose of studying some of the physical and chemical characteristics of the field soil. Samples were also taken from the well water used for irrigation and analyzed in the Kerbala Agriculture Directorate, Laboratory Division.

The seeds were planted on Oct/5/2023 with one of the hybrid squash varieties (Rahaf F1, American origin), at a rate of two seeds in each hole, and the distance between holes was 35 cm, alternating on both sides of the area, with 9 plants in the experimental unit. Chemical fertilizer was added to the soil in the form of 300 kg N ha^{-1} of ammonium sulphate (21% N), 150 kg P ha^{-1} of triple superphosphate (22% P), and 100 kg K ha^{-1} of potassium sulphate (41.5% K). The additions are considered a complete chemical fertilizer (100% NPK). NPK fertilizer was added to the soil in three batches. The first during planting, add a third of the amount of N with half the amount of P. The second batch, after individualization, a third of the amount of fertilizer N was added with the other half of the fertilizer P and half the amount of fertilizer K, the batch in the third, a third of the N fertilizer and the other half of the K fertilizer was added.

The rates of adding chemical fertilizers (NPK) were 100%, 75%, 50%, and 25%. Liquid organic fertilizers were added to the soil. Liquid vermicompost tea fertilizer was added at three levels, at 4, 8, and 12 liters per hour. Liquid humic acid was also added to the soil at three levels, at 6, 12, and 18 liters ha^{-1}. The additions were according to the recommendation of the producing company.

The measured indicators were the length of the fruit, the diameter of the fruit, the calculation of the average fresh weight of the fruit, and the average number of fruits according to the method [7].

Fruit length (cm): Fruit length was measured as an average of five randomly selected fruits from each experimental unit from the beginning of the floral end of the fruit to the point where it connects to the fruit bearing using a tape measure, then its average was recorded.

Fruit diameter (cm): Diameter was measured using Vernier from the center of the fruit as an average of five fruits.

Average fruit weight (g fruit^{-1}): The weight of the fruit was calculated from the following equation,

$$Fruit\ weight\ (gm\ fruit^{-1}) = \frac{Total\ color\ of\ fruits\ of\ experimental\ unit\ plants\ (g)}{Number\ of\ fruits\ in\ the\ experimental\ unit}$$

Number of fruits (plant fruit $^{-1}$): The number of fruits was calculated from the following equation,

$$No\ of\ Fruit\ (plant\ fruit^{-1}) = \frac{Number\ of\ fruits\ in\ the\ experimental\ unit}{Number\ of\ plants\ in\ the\ experimental\ unit}$$

Statistical analysis

The means were analyzed using the GenStat program according to a randomized completely block design (RCBD) with three replications, and the means were compared according to the least significant difference (L.S.D.) test at the 0.05 probability level [8].

Results and Discussion

Average length and diameter of the fruit (cm)

It was noted from the data presented in (Table 1) that there was a significant difference between the fertilizer treatments in the average length of the zucchini squash fruit, as most of the vermicompost tea + chemical fertilizer treatments gave a significant increase in the average length of the fruit and it was directly proportional to the increase in the concentration of the vermicompost tea, as the highest average length of the fruit was reached at Treatment F12, which recorded an average of 18.90 cm, with an increase rate of 15.95%, which did not differ significantly from other treatments compared to the average of the same trait due to the effect of other treatments, including treatment F0, which recorded the lowest average fruit length of 16.30 cm.

The statistical results presented in the same (table 1) indicate that the average diameter of the fruit increased significantly, which did not differ significantly from the rest of the treatments in treatment F3, and recorded an average of 4.132 cm, with an increase rate of 2.876%, which was significantly superior to treatment F0, which recorded the lowest value of 3.209 cm.

Table (1): Effect of adding NPK organic and chemical fertilizers on average fruit length (cm) and fruit diameter (cm).

Treatments	Treatment Symbol	Attribute	
		Fruit Length (cm)	Fruit diameter (cm)
NPK % 100	F0	16.30	3.209
NPK %75+ Humic acid 6 liters	F1	17.83	3.959
NPK %75 + Humic acid 12 liters	F2	17.83	4.074
NPK %75+ Humic acid 18 liters	F3	18.43	4.132
NPK %50 + Humic acid 6 liters	F4	17.10	3.633
NPK %50 + Humic acid 12 liters	F5	17.30	3.770
NPK %50 + Humic acid 18 liters	F6	17.73	3.852
NPK %25+ Humic acid 6 liters	F7	17.00	3.412
NPK %25+ Humic acid 12 liters	F8	17.10	3.461
NPK %25+ Humic acid 18 liters	F9	17.10	3.572
NPK %75+ Vermicompost tea 4 liters	F10	18.40	3.951
NPK %75+ Vermicompost tea 8 liters	F11	18.50	4.022
NPK %75+ Vermicompost tea 16 liters	F12	18.90	4.086
NPK %50 + Vermicompost tea 4 liters	F13	18.10	3.813
NPK %50 + Vermicompost tea 8 liters	F14	18.20	3.834
NPK %50 + Vermicompost tea 16 liters	F15	18.40	3.845
NPK %25 + Vermicompost tea 4 liters	F16	17.00	3.696
NPK %25 + Vermicompost tea 8 liters	F17	17.10	3.760
NPK %25 + Vermicompost tea 16 liters	F18	17.60	3.770
L.S.D 0.05		0.39	0.051

Average fruit weight (g fruit $^{-1}$) and number of fruits(fruit Plant^{-1})

The results of the statistical analysis of (Table 2) showed a significant significance for study factors on the average fresh weight of the fruit of the zucchini squash plant, as it increased significantly with the effect of the characteristic F12 plant compared to the characteristic plants F0, reaching 210.90 and 153.73 gm plant-1, respectively, an increase rate of 37.18%, which did not It differs significantly from F3, which was recorded as a fresh weight characteristic of Bulgarian fruit, 201.63 gm plant^{-1}.

The results presented in the same table also showed that the average number of zucchini squash fruits increased significantly with treatment F10 compared to treatment F0, where they recorded an average of 5.63 and 4.40 fruits per plant, respectively, with an increase rate of 27.95%, which did not differ significantly from treatment F3, which recorded an average Number of fruits: 5.33 fruits of the plant $^{-1}$.

Table (2):The effect of adding NPK organic and chemical fertilizers on the average fruit weight and average number of fruits of zucchini squash plants

Treatments	Treatment symbol	Attributes	
		Fruit weight (g fruit $^{-1}$)	Fruit No. (fruit Plant^{-1})
NPK % 100	F0	153.73	4.40
NPK %75+ Humic acid 6 liters	F1	191.43	5.13
NPK %75 + Humic acid 12 liters	F2	195.60	5.23
NPK %75+ Humic acid 18 liters	F3	201.63	5.33
NPK %50 + Humic acid 6 liters	F4	182.50	5.23
NPK %50 + Humic acid 12 liters	F5	186.23	5.03
NPK %50 + Humic acid 18 liters	F6	190.40	5.06
NPK %25+ Humic acid 6 liters	F7	171.43	4.73
NPK %25+ Humic acid 12 liters	F8	173.23	4.43
NPK %25+ Humic acid 18 liters	F9	175.43	4.70
NPK %75+ Vermicompost tea 4 liters	F10	190.10	5.63
NPK %75+ Vermicompost tea 8 liters	F11	197.70	5.23
NPK %75+ Vermicompost tea 16 liters	F12	210.90	5.30
NPK %50 + Vermicompost tea 4 liters	F13	177.40	4.50
NPK %50 + Vermicompost tea 8 liters	F14	183.60	4.70
NPK %50 + Vermicompost tea 16 liters	F15	184.43	5.10
NPK %25 + Vermicompost tea 4 liters	F16	173.63	4.73
NPK %25 + Vermicompost tea 8 liters	F17	174.30	4.73
NPK %25 + Vermicompost tea 16 liters	F18	175.10	4.60
L.S.D $_{0.05}$		4.68	0.26

It is noted from Table (1 and 2) that adding vermicompost tea had a significant effect on the length of the fruit, the fresh weight of the fruit, and the number of fruits per plant. The reason may be attributed to the fact that adding vermicompost tea to the soil provided the plant with nutrients (nitrogen, phosphorus, and potassium) and some micronutrients . Which is involved in the process of photosynthesis, the process of protoplasmic construction, respiration, and plant hormones, which contributed mainly to improving the nutritional and physiological condition of the plant, which was reflected positively on the length of the fruit [9] and these results are consistent with what was obtained [10,11]. Vermicompost tea added to the soil also provides the plant with the necessary nutrients, especially nitrogen and potassium, which help increase the strength and activity of vegetative growth, which increases the effectiveness of photosynthesis and the manufacture of carbohydrates, and increases the metabolic materials manufactured in the plant, thus increasing the weight of the fruit. The results are consistent with [12,11].

The increase in the number of fruits using vermicompost tea may be due to the fact that vermicompost tea has provided the plant with nutrients that are involved in the process of photosynthesis, the process of protoplasmic synthesis, respiration, and plant hormones, which contributed to improving the nutritional and physiological condition of the plant, which was reflected positively on yield indicators [13] The increase in the number of fruits may also be attributed to the fact that repeated additions of vermicompost tea during the plant's growth stages stimulated the formation of flowers as it regulated the level of hormones in the plant and thus increased the number of female flowers and increased fruit set, which had a positive impact on yield indicators [14]. These results are consistent with [15,16]. It is also believed that the abundance of organic matter resulting from the addition of vermicompost tea had a positive effect in enriching the root area with major elements, improving fruit set, and increasing the number of fruits, and this is consistent with [17]. The reason is also attributed to increasing levels of plant hormones, and this is consistent with what was mentioned by [18] as proven by the researchers [19].

The regularity of the process of pumping nutrients to the surroundings of the roots as a result of adding vermicompost tea led to faster division and elongation and increased efficiency of the photosynthesis process, which had a positive impact on the increase of branches and the increase in flower growth and thus the increase in the number of fruits. It is possible to explain the increase in the diameter of the fruit when treated with humic acid because it contains nitrogen and potassium, which play an important role in increasing the products of photosynthesis and their transfer to the fruits. Organic fertilizer also activates many microscopic organisms in the soil that release plant hormones that can stimulate growth of plant and nutrient absorption. These results are consistent with what was obtained [20].

High additions of mineral fertilizer also had a positive effect in increasing yield quality indicators. The increase may be attributed to increasing the availability of macronutrients in an abundant and ready form for absorption by the plant, thus prolonging the duration of fruit filling by delaying aging and increasing the size of the plant tissue (fruit), in addition to the role of these nutrients in Transporting manufactured materials to their storage locations in fruits [21] and these results are consistent with [22].

Phosphorus also plays an important role in the formation and transport of energy compounds such as ATP and others, which positively affects the vital processes taking place within the plant, including the process of photosynthesis, which includes the manufacture of carbohydrates and then increases the weight of the fruit [23]. In addition to its role in accelerating the ripening of fruits, these multiple physiological functions of phosphorus, along with the abundance of other nutrients within the plant, lead to the transfer of plant metabolites to the fruits, thus increasing the weight of the fruits [24].

The increase in yield quality indicators can be attributed to the role of potassium in activating various enzymatic systems, regulating the osmotic pressure of cells, and the process of opening and closing stomata. The cells formed with its presence have thicker walls, and the role of these factors is important in increasing the weight of fruits [25].

When vermicompost tea was added injectively into the soil with 75% of the fertilizer recommendation, it was observed that there was a gradual increase in most of the studied traits with increasing concentrations of vermicompost tea.

We recommend that mineral and organic fertilizers be divided into more than one batch, using one-third of the fertilizer recommendation for mineral fertilizer with the full fertilizer recommendation for vermicompost tea and humic acid.

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