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Effect of Adding Fulzyme plus and Spraying with Green Tea Extract on Vegetative Growth and Yield of Pepper cv. California Wonder

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Abstract: A filed experiment was carried out at one of the private farms at Al-Suwaira District, Wasit Governorate during the spring season 2021, in order to evaluate the effect of adding Fulyzme plus (biofertilizer) and the foliar application of green tea extract (organic nutrient) on growth and yield of pepper plant cv. California wonder. A factorial experiment (43) was carried out using RCBD Design with three replicates. The Fulyzme plus treatment was applied with four concentrations (0, 10, 20. and 30 g. L^{-1}). The foliar application of green tea extract was applied with three concentrations which were 0, 2 and 4 ml. L^{-1}. Results revealed significant effects of Fulyzme plus at 30 g. L^{-1} and the foliar application of green tea extract at the 4 ml. L^{-1} in plant height (89.62 cm), number of branches (9.44 branch. $Plant^{-1}$), number of leaves (38.28 leaf. $Plant^{-1}$), leaves area (40.79 dcm^2. $Plant^{-1}$), number of flowers (35.77 flower. $Plant^{-1}$) and fruits set (62.45%), number of fruits (17.96 fruit. $Plant^{-1}$), plant yield (4.16 kg. $plant^{-1}$), productivity (137.93 t. ha^{-1}) and Vitamin. C in fruits (34.74 ml.$100g^{-1}$). Therefore adding bio-fertilizer and spraying with organic nutrient improved vegetative growth and increase yield of pepper plants.

Keywords: *Capsicum annuum* L., Fertilizer, Natural nutrients, Productivity.

Introduction

Sweet peppers (*Capsicum annuum* L.) belongs to the Solanaceae family. The nutritional importance of pepper is due to its high content of vitamin C and high amount of vitamin A which is necessary for human growth, as well as other types of vitamins and minerals such as calcium, iron and phosphorous (Rao & Rao, 2007). Pepper production in Iraq is low when compared to global production, and to increase production, attention must be paid to crop service operations by following modern agricultural methods due to their impact on plant growth and productivity. It also aims to reduce as much as possible from pollutants by using bio and organic fertilizers instead of chemical fertilizers (El-Akabawy, 2000).

Recent studies have confirmed the danger of continuing agriculture that depends on chemical fertilizers, which leads to negative effects on the environment and thus causes threat to human health. Therefore, interest in safer methods, such as organic and a biological agriculture, in which organic fertilizers and beneficial microorganisms are used in order to provide healthy food and

increase plant productivity with high quality moreover maintain a pure and clean environment (Estken &r Pirlak, 2002), therefore the trend began to pay attention to safer methods and to introduce modern agricultural techniques as an alternative to chemical fertilizers, such as bio-organic fertilizers, which are one of the components of sustainable agriculture (Goss *et. al*., 2013). It also works to provide a hormonal balance that stimulates growth through the activity of the beneficial microorganisms. Biofertilizers are added either directly to the soil or with irrigation water or foliar fertilization which is the fastest and best way to provide the plant with nutrients and avoid fixing nutrient elements in the soil (Stojanova *et al.*, 2016). Soil microorganisms contribute to increasing soil fertility and increasing plant growth and productivity, Ahmed *et al*. (2013) found that the addition of biofertilizers with organic waste and chemical fertilizers at a rate of 357.14 kg. ha^{-1} for pepper plants led to a reduction in the costs of adding chemical fertilizers alone and prevented the accumulation of nitrates in the crop, thus providing a yield of high nutritional value. Spraying green tea leaf extract on pepper plant led to an increase in yield byieie 21.9% in the first year and 16.3% in the second year due to the increase in the number of fruits and leaf area of the plant (Zaccardelli *et al.*, 2018).

Organic farming involves using organic materials without using chemicals to grow crops (Abu Rayan, 2010). The utilization of organic farming has been stimulated as the main farming method today (Scotti *et al.*, 2016) to improves soil fertility (Pane *et al.*, 2013a), and may be necessary for plant disease management by restoring soil suppressive properties (Pane *et al.*, 2013b). The extract of the green tea plant (*Camellia sinensis*) contains the highest percentage of phenolic compounds and flavonoids that act as antioxidants in addition to their inhibitory effects on pathogens (Armstronga *et al*., 2020). Green tea leaves contains total carbohydrate 11.0 g, total fats 0.4 g, flavonoids 0.3 g, tannins 2.9 g, flour 20.0 mg, N1.19 g ,P 1g, K 0.5 g, Magnesium 41 mg, Zinc 51 mg, Fe60 mg, Mn 0.7 g, Coneshin 110 mg, Thiamine 90 mg, Vitamin A 88 mg, Vitamin B 74.1mg, Vitamin C 120 mg, Coffeic acid 315mg for Kg dry weight of green leaves (Lee *et al*., 2015).

The main objective of this investigation is to study of the effect of adding Fulzyme plus (biofertilizer) and spraying with Green tea extract (natural organic nutrient) on sweet pepper plant to determine which of the combinations give the best vegetative growth and improve quantity and quality of production.

Materials & Methods

Field experiment was conducted in the open field at one of the private farms in Al-Suwaira, Wasit Governorate at (32.92°N, 44.77°E) which is about 55 Km south of Baghdad, Iraq during the spring season of 2021, in order to evaluate the role of adding Fulzyme plus as a biofertilizer which was resulting from a distinctive fermentation process and contains high concentrations of beneficial bacteria and complex enzymatic systems that all work to improve soil fertility and stimulating plant growth and contains *Bacillus subtilis*, Pseudomonas putida, Proteasa enzymes, Amylase, Chitinase, Lipase, Gibberellin hormones and Cytokinin (Shayal Alalam *et al*., 2020) and spraying with Green tea extract as a natural organic nutrient on the growth and yield of sweet pepper plant cv. California Wonder. The seeds were sown in seedling trays on 19

January 2021. The seedling with two true leaves were planted in open field on 4 March 2021. The field experiment was divided into three blocks, and each block was divided into 12 experimental units with an area of 3.0 m^2. The distance between planting line was 0.75 m and 0.4 m between each plant, with an average of 10 plants per experimental unit. All agricultural operations were performed for all experimental units. A factorial experiment within the Randomized complete Block Design with three replicates included two factors, the first was the addition of liquid fertilizer Fulzyme plus (produced by JH, Biotech, Inc., USA) as a solution to the soil with irrigation water twice, the first addition after planting and the second addition after twenty days from first, with symbol as F at four concentrations: F_0 control treatment, F_{10} a concentration of 10 $g.L^{-1}$, F_{20} a concentration of 20 $g.L^{-1}$, and F_{30} a concentration of 30 g. L^{-1}, The second factor was the foliar application of green tea leaf extract (as an organic liquid nutrient was produced by the Zojaj club company brought from the province of Lahijan in the north of Iran on the coast of the Caspian Sea,), with a symbol (GT) at three concentrations: GT_0 control treatment, GT_2 a concentration of 2 $ml.l^{-1}$ and GT_4 a concentration of 4 $ml.l^{-1}$. The foliar applications were applied after 10 days of cultivation and 15 day between each application for three times. The results were analyzed by using SPSS ver. 24. For the comparison between the means, the Revised Least Significant Difference (R.L.S.D. was used at the probability level of 0.05 (Al-Rawi & Khalaf Allah, 2000). The following parameters were measured: Plant height (cm), Number of branches (branches. $plant^{-1}$), Leaves number (leaf.$plant^{-1}$), leaves area (dcm^2 $plant^{-1}$) calculate by using the Digimizer program according to the method described according to (Sadik *et al.*, 2011) , fruits number (fruit. $plant^{-1}$), fruit's weight (g. $fruit^{-1}$). Plant's yield (kg. $plant^{-1}$), Productivity (t. ha^{-1}) and Vitamin C (ml. $100g^{-1}$ fresh weight) was estimated by smearing fruit juice with 2,6-dichlorophenol indophenols dye according to (A.O.A.C., 2016).

Results & Discussions

Vegetative Growth and Flowering Traits

Results in table (1) showed a significant response of pepper plants to Fulzyme plus application at the level F_{30} in plant height, number of branches, number of leaves and leaves area reached 85.33 cm, 9.12 branches. $Plant^{-1}$, 36.04 leaf. $Plant^{-1}$ and 38.44 dcm^2. $Plant^{-1}$ respectively compared to F_0 which had the lowest values (54.09 cm, 5.07 branch. $Plant^{-1}$, 20.14 leaf. $Plant^{-1}$ and 28.83dcm^2. $Plant^{-1}$ respectively). This can be attributed to the addition of Fulzyme plus as a bio-fertilizer contains bacteria that dissolve phosphorous in the soil and facilitate it for plants and effectively contribute to the process of decomposition of organic matter in the soil (Shayal Alalam *et al.*, 2020), On the other hand, biological factors play an important role in the supplying of nutrients, especially nitrogen and may have encouraged the activity of meristems and leads to an increase in the rates of photosynthesis which is positively reflected on the increase in plant height and no. of branches (Hassan *et al.*, 2012). Ahmed *et al*. (2013) recorded similar results on sweet pepper. Spraying green tea extract at 4 $ml.l^{-1}$ gave the highest value of the plant height, number of branches, number of leaves and leaves area (75.42 cm, 7.73 branch. $Plant^{-1}$, 29.60 leaf. $Plant^{-1}$ and 35.77dcm^2. $Plant^{-1}$ respectively). This probably due to the role of green tea extract which is rich in organic and inorganic bio

molecules (Brion, *et al.*, 2004) that could promote growth traits. Results of table (1) are shows significant superior in F_{30} or in GT_4 than the rest of the concentrations for each Fulyzme plus and green tea extract and gave the highest value of number of flowers (33.14 and 28.52 flower. Plant^{-1}) and fruit set (61.47 and 54.30%) respectively, while the lowest vales in control treatment (F_0 or GT0) reached 20.36 and 25.21 flower. Plant^{-1} and 45.44 and 51.13% respectively. This is due to the fact that bio fertilizer (Fulzyme plus) and natural organic nutrients (green tea extract) work to improve soil fertility, stimulate plant growth by facilitate nutrients for the plant and actively contribute to the process of decomposition of organic matter in the soil, and then release the fertilizer elements which was reflect on increase number of flowers in plant (Giovannoni, 2004). The improvement in vegetative growth traits of plants reflected on increase percentage of fruits set and the developmental stages of pollen grains which directly affect the processes of pollination and fertilization (De Jong *et al.*, 2009). The increases in vegetative growth characteristics as a result of the addition of these nutrients may be attributed to their role in providing the plant with nutrients that enter the process of carbon metabolism, respiration and protoplasmic construction, as well as its role in the formation of RNA and DNA that is necessary for cell division, and thus leads to an increase in the mass of protoplasm and cell division, which increases Vegetative growth of plants and reflex on yield and productivity (Taiz & Zeiger, 2010).

Table (1): Effect of Fulzyme plus and spraying with Green Tea extract on the vegetative growth and flowering traits of pepper plant.

Treatments	Plant height (cm)	No. of branches (branch. plant^{-1})	No. of Leaves (Leaf. plant^{-1})	Leaf area (dcm^2. plant^{-1})	No. of Flowers (flower. plant^{-1})	Fruit set %
Average of Fulzyme plus (g.l^{-1})						
F_0	54.09±8.10 ^{d}	5.07±1.31 ^{d}	20.14±1.33 ^{d}	28.83±1.94 ^{d}	20.36 ±1.93 ^{d}	45.44±1.24 ^{d}
F_{10}	69.45±2.05 ^{c}	6.67±0.36 ^{c}	24.37±0.91 ^{c}	33.12±0.67 ^{c}	25.56 ±1.08 ^{c}	49.29±0.65 ^{c}
F_{20}	74.95±2.34 ^{b}	8.05±0.30 ^{b}	29.50±3.10 ^{b}	36.12±1.21 ^{b}	28.34 ±0.89 ^{b}	55.10±2.92 ^{b}
F_{30}	85.33±3.88 ^{a}	9.12±0.35 ^{a}	36.04±1.86 ^{a}	38.44±2.21 ^{a}	33.14 ±2.09 ^{a}	61.47±1.01 ^{a}
Average of green tea extract (ml.l^{-1})						
GT_0	66.56±13.2^c	6.48±2.1^c	25.65±5.92^c	32.45±3.77^c	25.21±5.06^c	51.13±6.21^c
GT_2	70.88±12.31^b	7.47±1.36^b	27.295.92^b	34.16±3.83^b	26.81±4.44^b	53.05±6.49^b
GT_4	75.42±9.75^a	7.73±1.34^a	29.60±6.94^a	35.77 ±3.88^a	28.52±5.10^a	54.30±6.50^a

The results in table (2) shows significant effects in the interaction between Fulyzme and the foliar application of green tea extracts on pepper plant in all growth and flowers traits, where the treatment of $F_{30}GT_4$ gave the significant highest values of plant height, number of branches, number of leaves, leaves area, number of flowers and fruits set reached 89.62 cm and 9.44 branch. Plant^{-1}, 38.28 leaf. plant^{-1} 40.79 dcm^2. Plant^{-1} 35.77 flower. plant^{-1} and 62.45% respectively compared to control F_0GT_0 which had the lowest values (46.50 cm, 3.33 branch. Plant^{-1}, 18.53 leaf. Plant^{-1} and 26.60 dcm^2. plant^{-1} 18.02 flower.

Plant^{-1} and 44.06% respectively). The reason for the positive effect of interaction between the two factors in increasing the values of growth traits may be due to their combined role and effect in stimulating and increasing the hormone production including auxins and cytokinines which promote cell division and cell expansion which eventually contribute to plant growth and flowering (Taiz *et al*. 2018).

Yield and its components traits

The production of pepper plant is the final outcome of the effect of the phenotypic and physiological characteristics of the plant, and the results in table (3) shows that the addition of Fulzyme plus led to a significant increase in the yield traits and its components, where F_{30} increase number of fruits and its weight and this was reflected on the plant's yield and productivity (16.16 fruit. Plant^{-1}, 243.96 g, 3.95 kg. plant^{-1} and 130.42 t. ha^{-1} respectively). It also led to a significant increase in the fruit's content of Vitamin C reached 33.06 ml.100g^{-1} while the control treatment gave 7.89 fruit. Plant^{-1}, 139.48 g, 1.10 kg. Plant^{-1} and 36.30 t. ha^{-1} respectively and also decrease Vit. C in fruits (20.80 ml.100g^{-1}). Spraying green tea extract at concentration of 4 ml. l^{-1} (GT4) gave the highest results 12.96 fruit. Plant^{-1}, 194.28 g, 2.63 kg. plant^{-1} and 86.71 t. ha^{-1} respectively) and led to a significant increase in the fruit's content of Vit. C (28.12 ml.100g^{-1}) in comparison with the control treatment which gave 10.73 fruit. Plant^{-1}, 184.87 g, 2.10 kg. Plant^{-1} and 69.27 t. ha^{-1} respectively and also decrease Vit. C in fruits (25.00 ml.100g^{-1}). Increase in yield traits may be due to the fact that the increase in the characteristics of vegetative and flowering growth (table 1) after the addition of fulzyme plus as abiofertilizer and natural organic nutrients (green tea extract) which had a positive effect on increasing the number of fruits for the plant and may have encouraged the transfer of manufactured materials from the leaves to the fruits and this was reflected positively on the increase in the weight of the fruit and the yield of the plant and then an increase in productivity. The increases in vegetative growth characteristics as a result of the addition of these nutrients may be attributed to their role in providing the plant with nutrients that enter the process of carbon metabolism, respiration and protoplasmic construction, as well as its role in the formation of RNA and DNA that is necessary for cell division, and thus leads to an increase in the mass of protoplasm and cell division, which increases Vegetative growth of plants and reflex on yield and productivity (Taiz & Zeiger, 2010).

Table (2): Effect of the interaction between Fulzyme plus and spraying with green tea extract on the vegetative growth and flowering traits of pepper plant.

Interaction	Plant height (cm)	No. of branches (branch. plant^{-1})	No. of Leaves (Leaf. plant^{-1})	Leaf area (dcm^2. plant^{-1})	No. of Flowers (flower. plant^{-1})	Fruit set %
F_0 GT_0	46.50±1.05^{i}	3.33±0.07^{l}	18.53±0.46^{k}	26.60±0.13^{j}	18.02±0.21^{l}	44.06±0.66^{k}
F_0 GT_2	51.32±1.49 ^{h}	5.82±0.04^{k}	20.49±0.54^{j}	28.91±0.66^{i}	20.74±0.66^{k}	45.54±0.46^{j}
F_0 GT_4	64.44±0.65 ^{g}	6.07±0.03^{j}	21.40±0.36^{i}	30.97±0.53^{h}	22.33±0.32^{j}	46.71±0.50^{i}
$F_{10}GT_0$	66.81±0.26 ^{f}	6.23±0.11^{i}	23.41±0.52^{h}	32.53±0.52^{g}	24.23±0.27^{i}	48.70±0.10^{h}
$F_{10}GT_2$	70.72±0.65 ^{e}	6.74±0.05^{h}	24.41±0.60^{g}	33.01±0.49^{fg}	25.81±0.20^{h}	49.05±0.09^{h}
$F_{10}GT_4$	70.81±0.84 ^{e}	7.04±0.07^{g}	25.28±0.14^{f}	33.83±0.08^{f}	26.63±0.34^{g}	50.13±0.13^{g}
F_{20} GT_0	71.98±0.95 ^{e}	7.69±0.04^{f}	26.60±0.57^{e}	34.81±0.55^{e}	27.40±0.44^{f}	51.38±0.22^{f}
F_{20} GT_2	76.04±0.13 ^{d}	8.09±0.03^{e}	28.48±0.69^{d}	36.03±0.10^{d}	28.240.16^{e}	56.00±0.33^{e}
F_{20} GT_4	76.81±0.88 ^{d}	8.37±0.04^{d}	33.42±0.70^{c}	37.50±0.17^{c}	29.37±0.21^{d}	57.92±0.11^{d}
F_{30} GT_0	80.93±0.19 ^{c}	8.670.05^{c}	34.08±0.11^{c}	35.85±0.58^{d}	31.20±0.64^{c}	60.36±0.53^{c}
F_{30} GT_2	85.45±0.91^{b}	9.24±0.06^{b}	35.77±0.33^{b}	38.69±0.89^{b}	32.45±0.58^{b}	61.61±0.49^{b}
F_{30} GT_4	89.62±1.62^{a}	9.440.06^{a}	38.28±0.55^{a}	40.79±0.29^{a}	35.77±0.89^{a}	62.45±0.52^{a}

Table (3): Effect of Fulzyme plus and spraying with green tea extract on the yield and its components traits of pepper plant.

Treatments	No. fruit. Plant $^{-1}$	fruit weight (g)	Plant Yield (kg.plant$^{-1)}$	Productivity (t. ha^{-1})	Vitamin C (ml.100g^{-1})
Average of Fulzym plus (g.l^{-1})					
F_0	7.89±1.28 ^{d}	139.48±6.71 ^{d}	1.100±0.183 ^{d}	36.300±6.062 ^{d}	20.81±1.76 ^{d}
F_{10}	10.95±0.39 ^{c}	167.90±6.05 ^{c}	1.840±0.124 ^{c}	60.720±4.088 ^{c}	24.32±0.79 ^{c}
F_{20}	12.50±0.65 ^{b}	193.62±28.69 ^{b}	2.436±0.487 ^{b}	80.370±16.064 ^{b}	28.13±1.45 ^{b}
F_{30}	16.16±1.66 ^{a}	245.96±15.20 ^{a}	3.952±0.181 ^{a}	130.420±5.980 ^{a}	33.06±1.58 ^{a}
Average of Green Tea Extract (ml.l^{-1})					
GT_0	10.73±2.95^{c}	184.87±50.39^{b}	2.099±1.092^{c}	69.272±36.049^{c}	25.00±4.77^{c}
GT_2	11.92±3.13^{b}	181.07±39.04^{b}	2.269±1.084^{b}	74.882±35.777^{b}	26.62±4.71^{b}
GT_4	12.96±3.37^{a}	194.28±41.07^{a}	2.627±1.141^{a}	86.707±37.640^{a}	28.12±4.86^{a}

The increase in the number of branches and leaf area (table 1) led to an increase in the process of photosynthesis and an increase in the amount of processed carbohydrates and its transfer to the effective growth areas and flowers, thus increasing the percentage of fruit set and then increasing the yield of the plant as a result of reducing competition between vegetative growth and flowering (Abbas, *et al.*, 2014). These results are in agreement with Abou El-Nour & Ewais (2017) in terms of an increase in the yield of pepper plant under the foliar application of Moringa leaf extract and with Radin & Warman (2011) in terms of an increase in the yield of tomato and agreement with what was stated by Hussein *et al*. (2016) and Almohammedi & Kokaz (2021) and that they used Fulzyme Plus on potato.

The interaction between Fulyzme and the foliar application of green tea extracts on pepper plant (Table 4) had a significant effect on yield and its components traits. $F_{30}GT_4$ treatment caused significant superiority compared with other treatments and gave the highest value of number of fruits (17.96 fruit. Plant^{-1}), plant yield (4.16 kg. plant^{-1}), productivity (137.93 t. ha^{-1}) and Vit. C in fruits (34.74 ml.100g^{-1}), the highest weight of fruits were in $F_{30}GT_0$ treatment reached 265.23 g while the lowest values appeared in control treatment (F_0GT_0), which gave number of fruits (6.38 fruit. Plant^{-1}), plant yield (0.89 kg. plant^{-1}), productivity (29.26 t. ha^{-1}) and Vit. C in fruits (18.63 ml.100g^{-1}), while the lowest values of fruit weight appeared in treatments F_0GT_2, F_0GT_0 and F_0GT_4 without significant differences between them (136.67, 139.43 and 140.33 g).

Table (4): Effect of the interaction between Fulzyme plus and spraying with Green Tea Extract on the yield and its components traits of pepper plant.

Interaction	No. fruit. Plant $^{-1}$	fruit weight (g)	Plant Yield (kg.plant$^{-1)}$	productivity (t. ha^{-1})	Vitamin C (ml.100g^{-1})
F_0 GT_0	6.38±0.54^{l}	139.43±11.23^{f}	0.887±0.025^{l}	29.260±0.830^{l}	18.63±0.61^{l}
F_0 GT_2	8.04±0.23^{k}	138.67±6.36^{f}	1.116±0.080^{k}	36.850±2.646^{k}	21.27±0.41^{k}
F_0 GT_4	9.24±0.12^{j}	140.33±3.37^{f}	1.297±0.035^{j}	42.790±1.159^{j}	22.52±0.18^{j}
$F_{10}GT_0$	10.53±0.26^{i}	161.00±1.32^{e}	1.697±0.055^{i}	55.990±1.817^{i}	23.52±0.12^{i}
$F_{10}GT_2$	10.94±0.07^{h}	169.33±4.24^{d}	1.853±0.035^{h}	61.160±1.159^{h}	24.16±0.08^{h}
$F_{10}GT_4$	11.36±0.16^{g}	173.37±2.68^{d}	1.970±0.265^{g}	65.010±0.873^{g}	25.29±0.18^{g}
F_{20} GT_0	11.85±0.06^{f}	173.80±3.59^{d}	2.060±0.053^{f}	67.980±1.746^{f}	26.74±0.39^{f}
F_{20} GT_2	12.35±0.15^{e}	175.37±1.45^{d}	2.167±0.042^{e}	71.500±1.373^{e}	27.72±0.51^{e}
F_{20} GT_4	13.29±0.27^{d}	231.70±3.76^{c}	3.080±0.020^{d}	101.640±0.660^{d}	29.93±0.11^{d}
F_{30} GT_0	14.15±0.06^{c}	265.23±2.10^{a}	3.753±0.045^{c}	123.860±1.488^{c}	31.12±0.12^{c}
F_{30} GT_2	16.35±0.15^{b}	240.90±1.04^{b}	3.940±0.020^{b}	130.020±0.660^{b}	33.33±0.08^{b}
F_{30} GT_4	17.96±0.14^{a}	231.73±4.46^{c}	4.163±0.050^{a}	137.390±1.661^{a}	34.74±0.06^{a}

The results of the interaction between green tea and fulzyme may be due to the integration between them in creating a state of appropriate nutritional balance for plants and appropriate environmental conditions, which contributed to an increase in the transmission of the products of carbon metabolism and then increased plant productivity represented in the number and weight of fruits and vitamin C in fruits.

Conclusion

It could be concluded that it is possible to add Fulyzme plus at concentration 30 g.l^{-1} with the foliar application of green tea extracts at concentration 4 ml.l^{-1} can be used in sweet pepper plant cv. California Wonder to be the most efficient treatment which improved vegetative growth and flowering traits and trait components of yield, yield per plant and the productivity. Therefore, we could be recommend a bio-fertilization and spraying with organic nutrients to improve of pepper plant.

Contribution of Authors

I.J.A.: Write the manuscript, read and revised the manuscript.

Z R.J.A.: Data Collection; and statistical analysis.

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Conflict of interest

The authors declared that they have no conflict of interest.

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تأثيراضافة المغذيFulzyme plus والرش بمستخلص أوراق الشاي الاخضر في نمو وحاصل نبات الفلفل صنف California Wonder

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المستخلص: أُجريت تجربة حقلية في الحقل المكشوف لاحد المزارع الخاصة في قضاء الصويرة، محافظة واسط خلال الموسم الربيعي 2021 بهدف تقييم تاثير اضافة Fulzyme plus (السماد الحيوي) والرش بمستخلص اوراق الشاي الاخضر (مغذي عضوي) في نمو وحاصل نبات الفلفل صنف كاليفورنيا وندر. نفذت كتجربة عاملية (4×3) ضمن تصميم القطاعات الكاملة المعشاة و بثلاث مكررات , تم اضافة السماد الحيوي باربع مستويات (0, 10, 20 و 30 غم. لتر$^{-1}$) وتم رش مستخلص الشاي الاخضر بثلاثة تراكيز هي 0, 2 و 4 مل.لتر $^{-1}$. اظهرت النتائج تفوق معنوي لمعاملة اضافة السماد Fulzyme plus بالتركيز 30 غم.لتر$^{-1}$ طن.هكتار$^{-1}$ والرش بمستخلص الشاي الاخضر بتركيز 4 مل.لتر$^{-1}$ في طول النبات (89.62 سم) وعدد الافرع (9.44 فرع. نبات$^{-1}$) وعدد الاوراق (38.28 ورقة. نبات$^{-1}$) والمساحة الورقية (40.79 دسم^{2}. نبات$^{-1}$) وعدد لازهار (35.77 زهرة. نبات$^{-1}$) ونسبة العقد (62.45%) وعدد الثمار (17.96 ثمرة. نبات$^{-1}$) وحاصل النبات (4.16 كغم. نبات$^{-1}$) والانتاجية في وحدة المساحة (137.93 طن. هكتار$^{-1}$) وفيتامين C في الثمار (34.74 مل.100غم$^{-1}$وزن طري). لذلك فإن إضافة السماد الحيوي والرش بالمغذيات العضوية يمكن أن يحسن النمو الخضري وزيادة حاصل نباتات الفلفل.

الكلمات المفتاحية: السماد الحيوي، *Capsicum annuum* L.، مغذيات طبيعية، الانتاجية.