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Effect of Mineral and Organic Nitrogen and some Natural Substances on Productivity and Fruit Quality of Sweet Pepper

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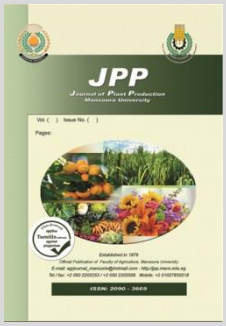

ABSTRACT

A field experiment was carried out during the summer seasons of 2018 and 2019 at Gemmeiza Agric. Res. Station, Gharbeya Governorate, Egypt to evaluate effects of mineral and organic nitrogen as well as using vitamin C and chitosan as foliar spray on growth , yield and fruit quality of sweet pepper cv. California Wonder grown in clay soil. The interaction between fertilizing sweet pepper plant with MN at 25 % RR+ON at 75 % RR and spraying with Vit.C at 300 ppm increased plant height, number of leaves / plant, number of branches/ plant and shoot dry weight at 90 days after transplanting in both growing seasons. However, fertilizing plants with MN at 25 % RR +ON at 75 % RR and spraying with chitosan at 2ml/l or Vit.C at300 ppm increased N,P and K contents and their uptake by shoot. In addition, the interaction between fertilizing with MN at 25 % RR+ON at 75 % RR and spraying with chitosan at 2ml/l increased average fruit weight, yield / plant and total yield /fed. as well as nitrogen use efficiency and lowest values of nitrate content in fruits. Nevertheless, the interaction between fertilization with MN at 50 %RR+ ON at 50 % RR and spraying with chitosan at 2 ml/l increased DM% in fruit, whereas the interaction between fertilizing with MN at 50 %RR+ON at 50 %RR and spraying with Vit. C at 300 ppm increased TSS and Vit.C in fruits in both seasons.

Keywords: Sweet pepper, mineral nitrogen , organic nitrogen , Vit. C. chitosan, yield .

INTRODUCTION

Pepper *(Capsicum annuum L.)* is one of the most important vegetable plants in the world, on this case should be increasing its quantity and quality by researchers.

Fertilizers are extremely important to the growth and development of plants. Most of the fertilizers used are made unavailable to plants because of numerous factors such as leaching, photolysis degradation, hydrolysis and decomposition. The harmful effects of using huge amounts of nitrogen as mineral fertilizers in agricultural production have been recognized during the last decades. It has also been noted that most of the nitrate and nitrite used accumulate in the food chain which causes hazardous effects. Part of this chemical fertilizer also escapes water and causes biological balance disturbances and contaminates under groundwater. (Waksman, 1952). For these purposes, the use of organic fertilizers in the development of vegetable crops to minimize contamination of plants and soils with different elements and also to reduce the use of mineral fertilizers was of great importance. It needs high fertility soil for growing pepper, particularly N- fertilizer. In addition, there is a close relationship between the growth and development of pepper plants and the amount of nitrogen compound, which is why nitrogen was considered a decisive factor in the growth of pepper. A proper ratio of faster-acting fertilizers (minerals) and slower-acting ones (organic manures) will make nutrient uptake easier. This relationship requires attention, especially in the choice of source of N-fertilizers(Somos, 1984). Many authors showed that, fertilizing pepper plants with organic manures along with N-mineral fertilizer increased plant growth, productivity and fruit quality (Younes , 2003; Shehata *et al*., 2004; Ghoname, and Shafeek, 2005; Amor, 2007; Abu-Zahra, 2012; Fawzy *et al*., 2012; Koshale *et al*. ,2018 ; Omar, *et al*., 2018 and Çerçioğlu,2019).

Ascorbic acid (vitamin C): Ascorbic acid is an important antioxidant in the Glutathione ascorbate pathway. It is a cofactor for many enzymes, including those involved in cell wall synthesis, especially in proline residue hydroxylation (Abo-Hinna and Merza, 2012).

Many researchers reported that using ascorbic acid as foliar spraying improved the vegetative growth, yield and quality of some vegetable crops (Shehata *et al*., 2002; El-Tohamy *et al*., 2008 on eggplant, Masahumi *et al*., 2008; Khafagy *et al*., 2009 , El-Hifny and El-Sayed, 2011 and Shabana *et al*. ,2015 on sweet pepper).

Chitosan has specific biological and commercial properties: (a) a given chemical structure; (b) the potential to be chemically and enzymatically modified; (c) physical and biological functionality; (d) biodegradability and biocompatibility with many organs, tissues, and cells; and (e) the potential to be transformed into multiple products to facilitate applications (Harish and Tharanathan 2007). Spraying plants with chitosan gave the highest values of plant growth , yield and quality than unsprayed plants (El-Tantawy, 2009 on tomato , Ghoname, *et al*. ,2010 Mahmood *et al., 2017* on sweet pepper , Sultana *et al*. 2017 on tomato and eggplant, and Esyanti *et al*. 2019 on sweet pepper) .

Therefore the objective of the present work was to study the effect of combinations between mineral and organic nitrogen and some natural substances on growth, yield and fruit quality of sweet pepper grown in clay soil.

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MATERIALS AND METHODS

A field experiment was carried out during the summer seasons of 2018 and 2019 at Gemmeiza Agric. Res. Station, Gharbeya Governorate, Egypt to evaluate effects of mineral and organic nitrogen as well as using some natural substances on growth , yield and fruit quality of sweet pepper cv. California Wonder grown in clay soil.The physical and chemical properties of the experimental soil are presented in Table 1

Table 1. The physical and chemical properties of the experimental soil in 2018 and 2019 seasons

Soil property	1st season	2nd season
Physical properties		
Clay (%)	56.92	59.04
Silt (%)	23.67	22.96
Sand (%)	19.41	18.00
Texture	Clay	Clay
Chemical properties		
E.C. (mmhos/cm)*	1.36	1.37
pH**	7.79	7.82
Organic matter (%)	1.54	1.55
Available N (ppm)	8.79	9.14
Available P_2O_5 (%)	0.028	0.027
Available K_2O (%)	0.53	0.52

Samples of the soil were obtained from 25 cm soil surface.
***E.C: Electric conductivity, ** pH (1: 2.5 suspension)**

This experiment included 15 treatments, which were the combinations between five treatments of mineral and organic nitrogen and two natural substances .i.e., Vit. C at 300 ppm , chitosan at 2 ml /l, beside unsprayed plants.

The treatments of mineral and organic nitrogen are shown in Schedule 1

Treatments	Mineral N (ammonium sulphate kg/fed.)	Organic N (chicken manure ton/fed.)
Mineral nitrogen (MN) at 100 % recommended rate (RR)	682.93 (140 Kg N)	0.00 (0 kg N)
MN at 75 % RR (MN) + organic nitrogen (ON at 25 %RR	512.18 (105 Kg N)	1.198 (35 Kg N)
MN at 50 %RR +ON at 50 % RR	341.46 (70 Kg N)	2.397 (70 Kg N)
MN at 25 %RR +ON at 75 % RR	170.73 (35 Kg N)	3.595 (105 Kg N)
ON at 100% RR	0.00 (0 Kg N)	4.794 (140 Kg N)

The recommended rate of nitrogen was 140 kg /fed., and added in the form of ammonium sulphate , while organic manure was added in the form of chicken manure and obtained from El-Gemmeiza Poultry Station.

The used chicken manure analysis were 2.91 and 2.93 % N, 0.98 and 1.02 % P, 1.18 and 1.16 % K , 1059 and 1061 ppm Fe, 208 and 206 ppm Mn , 224 and 221 ppm Zn and 34.64 and 33.79 % organic matter during the 1st and 2nd seasons, respectively.

These treatments were arranged in a split plot design with three replications. The combination of mineral and organic nitrogen were randomly distributed in the main plots , while some natural substances were arranged in the sub plots. Plot area was 11.2 m^2, which consisted of four ridges of 4m long and 70 cm width. Sweet Pepper seeds were sown in the nursery under low plastic tunnels on 15th and 14th January 2018 and 2019 seasons, respectively, and transplanted in the open field on 15th and 16th of March in the two growing seasons, respectively at 30 cm apart in one side of the ridges.

One third of the different rates of mineral N were added during soil preparation with all different rates of chicken manure (organic nitrogen) prior to transplanted, and the rest amounts of N were added at three portions as soil application at 30, 60 and 90 days after transplanting .

Chitosan compound was obtained from Technogene Company, Dokki, Giza, Egypt. Chitosan solution was prepared by dissolving a proper amount of chitosan powder (Poly-(1.4-B-D-glucopyranosamine); 2-Amino-2-deoxy-(1-<4)-B-D-glucopyranan) in 5 % acetic acid.

The Plants sprayed four times with ascorbic acid and chitosan treatments, at 30, 45, 60 and 75 days after transplanting.

The other cultural practices for sweet pepper commercial production were used according to the instruction laid down by the Ministry of Agriculture, Egypt.

Data recorded: Three plants from plot were randomly taken at 90 days after transplanting and the following data were recorded : Plant height , both number of leaves and branches / plant and shoot dry weight/ plant (g) .

Plant Chemical Composition: Nitrogen, phosphorus and potassium contents season in shoots at 90 days after transplanting in both growing seasons were determined according to according to the methods described by Bremner and Mulvaney (1982), Olsen and Sommers (1982), and Jackson (1970), respectively. Their uptakes of N, P and K per shoot were computed.

Total yield: Eight harvesting were picked all over the season for all plots and the following data were calculated, average fruit weight (gm), average number of fruits/ plant, total yield / plant (kg) and total yield/ feddan (ton).

Nitrogen Use Efficiency (NUE): It was determined by dividing the fruit yield/ fed., by the nitrogen quantity/ fed., and expressed as kg fruits /kg N according to Clark, (1982).

Fruit quality: Dry matter contents (%), total soluble solids (T.S.S) were measured by hand Refractometer and ascorbic acid (Vitamin C) were assayed according to A.O.A.C (1995). Nitrate content, it was determined according to the methods described by Cafado et al. (1975).

Statistical analysis: Recorded data were subjected to the statistical analysis of variance according to Snedecor and Cochran (1967), and means separation were done according to Duncan (1955).

RESULTS AND DISCUSSION

1.Plant growth

Data in Table 2 show that fertilizing sweet pepper plant cv. California Wonder grown in clay soil with mineral nitrogen (MN) in combinations with organic nitrogen (ON) at different rates were the best treatments for increasing plant height, number of leaves / plant, number of branches/ plant and shoot dry weight at 90 days after transplanting compared with fertilizing MN or ON at 100 % of recommended rate (RR). Fertilizing with MN at 25 % RR+ON at 75 % RR gave the tallest plants and recorded maximum values of number of branches/ plant and shoot dry weight/ plant, whereas MN at 50 % RR+ON at 50% RR recorded maximum values of number of leaves / plant in both

seasons. The increases in shoots dry weight / plant were about 24.8 and 27.4 % for fertilizing with MN at 25 % RR+ON at 75 % RR over the MN at 100% RR in the 1st and 2nd seasons, respectively.

The increases in the vegetative growth of pepper plants by applying organic manure might be referred to its role in enhancing soil physical properties as soil texture, water holding capacity and it creates a good aeration in soils and decreased the pH value and consequently nutrients in the soil became more available for enhancing plant growth (Khandaker *et al.,* 2017). However, the balance among the combined items which led to the highest average values of vegetative growth traits could be taken place due to the presence of N mineral fertilization; brought about improvement in the given vegetative growth characteristics and increase uptake of nitrogen and its associated role in chlorophyll synthesis and subsequent by the process of photosynthesis and carbon dioxide assimilation (Jasso-Chaverria *et al.,* 2005) resulting in enhancement the growth of sweet pepper. These findings are in agreement with the results of Younes , (2003), Shehata *et al.* (2004), Ghoname, and Shafeek (2005) on sweet pepper.

Table 2. Effect of fertilizing with mineral and organic nitrogen on plant growth of sweet pepper at 90 days after transplanting during 2018 and 2019 seasons

Treatments	Plant height (cm)	Number of leaves/ plant	Number of branches / plant	Shoot dry weight (g)	Relative increases in shoot dry weight (%)
			2018 season		
100% RR (MN)	62.36 d	110.61 d	13.26 d	37.68 d	00.0
75 %RR(MN)+ 25 %RR(ON)	65.51 c	125.18 c	13.99 c	40.80 c	08.3
50 %RR(MN)+ 50 %RR(ON)	69.54 b	140.92 a	15.80 b	45.27 b	20.1
25 %RR(MN)+ 75 %RR(ON)	72.48 a	132.46 b	16.53 a	47.01 a	24.8
100% RR (ON)	64.66 c	114.92 d	13.36 cd	37.75 d	0.20
			2019 season		
100% RR (MN)	63.65 c	114.00 d	13.61 c	38.44 c	00.0
75 %RR(MN)+ 25 %RR(ON)	66.97 b	141.01 b	16.11 b	43.45 b	13.0
50 %RR(MN)+ 50 %RR(ON)	69.00 b	150.00 a	16.46 b	43.13 b	12.2
25 %RR(MN)+ 75 %RR(ON)	75.14 a	148.29 a	19.91 a	48.97 a	27.4
100% RR (ON)	68.81 b	123.60 c	14.53 c	38.90 c	01.2

RR = Recommended rate , MN = mineral nitrogen and ON= organic nitrogen
Means followed by the same letter(s) within each column do not significantly differ using Duncan's Multiple Range Test.

Spraying sweet pepper plants four times at 30, 45 , 60 and 75 days after transplanting with vitamin C (Vit.C) at 300 ppm increased plant height, number of leaves / plant, number of branches/ plant and shoot dry weight at 90 days after transplanting, followed by spraying with chitosan at 2 ml/l (Table 3). Ascorbic acid has been shown to protect plants from oxidation and it is known to control cell differentiation and to promote plant growth (Talaat, 2003). These results are harmony with those reported with El-Hifny and El-Sayed (2011) and Shabana *et al*. (2015) on sweet pepper.

The interaction between fertilizing sweet pepper plant with MN at 25 % RR+ON at 75 % RR and spraying with Vit.C at 300 ppm increased plant height, number of leaves / plant, number of branches/ plant and shoot dry weight at 90 days after transplanting in both growing seasons compared to other interactions treatments (Table 4).

The increases in shoots dry weight / plant were about 56.1 and 30.9 % for the interaction between fertilizing with MN at 25 % RR+ON at 75 % RR and spraying with Vit.C at 300 ppm over the control (MN at 100% RR and unsprayed) in the 1st and 2nd seasons, respectively.

2. N,P and K contents and uptake of shoots

Fertilizing with MN at 25 % RR+ON at 75 % RR gave the highest values of N,P and K contents and uptake of shoots at 90 days after transplanting , except K content in the 1st season, whereas MN at 100 % RR or ON at 100 % RR gave the lowest values of N,P and K contents and uptake (Table 5). These results may be due to that MN at 25 % RR + ON at 75 % RR gave the highest shoot dry weight, whereas MN at 100 % RR or ON at 100 % RR gave the lowest values of shoot dry weight (Table 2).

The superiority N,P and K concentration of pepper leaf tissues may be attributed to increase the availability of N, P and K in the soil solution becomes available to the plant and improves root growth, hence increase the root absorption area. Consequently, absorption would be higher and nutrient accumulation in leaves tissue increased. These results corroborate with Ayodele *et al*. (2015) and Omar, *et al*. (2018) on sweet pepper.

Table 3. Effect of spraying with vitamin C and chitosan on plant growth of sweet pepper at 90 days after transplanting during 2018 and 2019 seasons

Treatments	Plant height (cm)	Number of leaves/ plant	Number of branches / plant	Shoot dry weight (g)	Relative increases in shoot dry weight (%)
			2018 season		
Unsprayed (control)	63.75 b	98.40 b	11.91 c	35.33c	00.0
Vit C at 300 ppm	72.54 a	138.05 a	17.27 a	45.90a	29.9
Chitosan at 2 ml /l	64.44 b	138.00 a	14.59 b	43.87b	24.2
			2019 season		
Unsprayed (control)	62.30 b	136.61 a	13.98 c	42.01b	00.0
Vit C at 300 ppm	72.50 a	137.05 a	17.89 a	42.77a	01.8
Chitosan at 2 ml /l	71.34 a	132.49 b	16.51 b	42.96a	02.3

Means followed by the same letter(s) within each column do not significantly differ using Duncan's Multiple Range Test

Table 4. Effect of interaction between fertilizing with mineral , organic nitrogen and spraying with Vit. C and chitosan on plant growth of sweet pepper at 90 days after during 2018 and 2019 seasons

Treatments		Plant height (cm)	Number of leaves / plant	Number of branches / plant	Shoot dry weight (g)	Relative ±in shoot dry weight (%)
Fertilization	**Substances**		**2018 season**			
100% RR (MN)	Unsprayed	62.06 fg	95.00 i	11.97 gh	32.87h	000
	Vit C at 300 ppm	65.17 ef	115.90 h	14.25 e	41.42d	26.0
	Chitosan at 2 ml /l	59.85 g	120.94 fg	13.58 ef	38.76fg	17.9
75 %RR(MN)+ 25 % RR (ON)	Unsprayed	64.88 ef	95.28 i	11.97 gh	33.30h	1.3
	Vit C at 300 ppm	71.82 c	136.13 de	15.48 cd	46.79bc	42.3
	Chitosan at 2 ml /l	59.85 g	144.12 c	14.53 de	42.32d	28.7
50 %RR(MN)+ 50 % RR (ON)	Unsprayed	66.78 de	116.19 gh	12.92 fg	41.14de	25.2
	Vit C at 300 ppm	76.95 b	153.90 b	19.00 b	48.36b	47.1
	Chitosan at 2 ml /l	64.88 ef	152.67 b	15.48 cd	46.31c	40.9
25 %RR(MN)+ 75 % RR (ON)	Unsprayed	65.83 e	96.62 i	11.68 h	37.10g	12.9
	Vit C at 300 ppm	81.70 a	160.83 a	22.13 a	51.30a	56.1
	Chitosan at 2 ml /l	69.92 cd	139.94 cd	15.77 c	52.63a	60.1
100% RR (ON)	Unsprayed	59.18 g	88.92 j	11.02 h	32.26h	-1.9
	Vit C at 300 ppm	67.07 de	123.50 f	15.48 cd	41.66d	26.7
	Chitosan at 2 ml /l	67.73 de	132.33 e	13.58 ef	39.33ef	19.7
			2019 season			
100% RR (MN)	Unsprayed	57.95 g	114.67 gh	13.30 h	38.10 ij	000
	Vit C at 300 ppm	66.50 f	114.95 gh	14.25 fgh	38.29ij	0.50
	Chitosan at 2 ml /l	66.50 f	112.38 h	13.30 h	38.95hi	2.2
75 %RR(MN)+ 25 % RR(ON)	Unsprayed	58.52 g	145.63 c	13.58 gh	40.19g	5.5
	Vit C at 300 ppm	71.53 c-e	145.35 c	19.57 bc	46.41c	21.8
	Chitosan at 2 ml /l	70.87 c-f	132.05 e	15.20 fg	43.75de	14.8
50 %RR(MN)+ 50 % RR(ON)	Unsprayed	59.18 g	152.67 b	14.25 f-h	42.80ef	12.3
	Vit C at 300 ppm	74.38 bc	148.87 c	18.05 cd	41.90f	10.0
	Chitosan at 2 ml /l	73.43 b-d	148.49 c	17.10 de	44.70d	17.3
25 %RR(MN)+ 75 % RR(ON)	Unsprayed	66.50 f	138.04 d	15.20 fg	49.16a	29.0
	Vit C at 300 ppm	80.75 a	159.89 a	23.37 a	49.88a	30.9
	Chitosan at 2 ml /l	78.18 ab	146.96 c	21.18 b	47.88b	25.7
100% RR (ON)	Unsprayed	69.35 d-f	132.05 e	13.58 gh	39.81gh	04.5
	Vit C at 300 ppm	69.35 d-f	116.19 g	14.25 f-h	37.38j	-1.9
	Chitosan at 2 ml /l	67.73 ef	122.55 f	15.77 ef	39.52gh	03.7

RR = Recommended rate , MN = mineral nitrogen and ON= organic nitrogen
Means followed by the same letter(s) within each column do not significantly differ using Duncan's Multiple Range Test.

Table 5. Effect of fertilizing with mineral and organic nitrogen on N,P and K contents and its uptake by shoots of sweet pepper at 90 days after transplanting during 2018 and 2019 seasons

Treatments	Contents (%)			Uptake (mg/ shoot)		
	N	P	K	N	P	K
			2018 season			
100% RR (MN)	2.83 c	0.513 d	2.50 a	1073.0 c	195.10 e	949.7 d
75 %RR(MN)+ 25 % RR (ON)	3.53 ab	0.555 c	2.53 a	1457.2 b	230.33 c	1047.7 c
50 %RR(MN)+ 50 % RR (ON)	3.15 bc	0.618 b	2.46 a	1429.2 b	280.67 b	1116.3 b
25 %RR(MN)+ 75 % RR (ON)	3.75 a	0.637 a	2.56 a	1769.8 a	298.83 a	1185.3 a
100% RR (ON)	2.86 c	0.554 c	2.60 a	1090.2 c	211.83 d	989.2 d
			2019 season			
100% RR (MN)	3.40 b	0.497 c	2.33 c	1308.0 d	191.50 c	897.4 e
75 %RR(MN)+ 25 % RR (ON)	3.60 ab	0.540 b	2.76 b	1571.7 b	236.00 b	1198.9 d
50 %RR(MN)+ 50 % RR (ON)	3.51 b	0.598 a	3.46 a	1516.2 c	258.33 b	1494.7 b
25 %RR(MN)+ 75 % RR (ON)	3.66 ab	0.625 a	3.36 a	1796.0 a	306.00 a	1647.5 a
100% RR (ON)	3.86 a	0.529 b	3.40 a	1500.8 c	205.83 c	1318.7 c

RR = Recommended rate , MN = mineral nitrogen and ON= organic nitrogen
Means followed by the same letter(s) within each column do not significantly differ using Duncan's Multiple Range Test.

Spraying with Vit.C at 300 ppm or chitosan at 2ml/l increased N,P and K contents and uptake of shoots compared to control (unsprayed) plants (Table 6). Plants which sprayed with Vit.C at 300 ppm recorded maximum values of N,P and K contents and uptake of shoots at 90 days after transplanting with no significant differences with plants which sprayed with chitosan at 2 ml/l in the 2nd season only. In the same respect, El-Hifny and El-Sayed (2011) and Shabana, *et al.* (2015) detected that foliar application of ascorbic acid increased the content of macronutrients N P K of sweet pepper tissues.

Respecting the interaction between fertilizing with MN+ON and spraying with chitosan and Vit. C, in general, the interaction between fertilizing with MN+ON at different rates and spraying with chitosan at 2ml/l and Vit.C at300 ppm increased N,P and K contents and uptake of shoots compared to the interaction between MN at 100% RR and unsprayed (Table 7).

Table 6. Effect of spraying with vitamin C and chitosan on N,P and K contents and its uptake by shoots of sweet pepper at 90 days after transplanting during 2018 and 2019 seasons

Treatments	Contents (%)			Uptake (mg/ shoot)		
	N	P	K	N	P	K
			2018 season			
Unsprayed (control)	3.02 c	0.524 c	2.46 b	1072.9 c	187.46 c	875.4 c
Vit C at 300 ppm	3.43 a	0.608 a	2.64 a	1586.1 a	279.80 a	204.4 a
Chitosan at 2 ml /l	3.23 b	0.593 b	2.50 b	1432.6 b	262.80 b	093.1 b
			2019 season			
Unsprayed (control)	3.22 b	0.526 c	2.92 b	1355.9 c	222.90 b	1238.5 b
Vit C at 300 ppm	3.87 a	0.563 b	3.18 a	1653.8 a	243.10 a	1354.5 a
Chitosan at 2 ml /l	3.74 a	0.584 a	3.10 a	1605.9 b	252.60 a	1341.4 a

Means followed by the same letter(s) within each column do not significantly differ using Duncan's Multiple Range Test.

Table 7. Effect of interaction between fertilizing with mineral, organic nitrogen and spraying with Vit. C and chitosan on N,P and K contents and its uptake by shoots of sweet pepper at 90 days after transplanting during 2018 and 2019 seasons

Treatments		Contents (%)			Uptake (mg/ shoot)		
		N	P	K	N	P	K
Fertilization	Substances			2018 season			
100% RR (MN)	Unsprayed (control)	2.70 gh	0.460 fg	2.20 e	891.1 i	152.80 h	729.0 h
	Vit C at 300 ppm	3.00 e-h	0.526 e	2.60 b-d	1242.5 f	218.00 fg	1073.7 ef
	Chitosan at 2 ml /l	2.80 f-h	0.553 d	2.70 a-c	1085.3 h	214.50 fg	1046.5 ef
75 %RR(MN)+ 25 % RR (ON)	Unsprayed (control)	3.20 d-g	0.453 g	2.20 e	1065.5 h	151.00 h	732.5 h
	Vit C at 300 ppm	3.90 a	0.606 c	2.80 ab	1824.5 b	283.50 c	1310.0 a
	Chitosan at 2 ml /l	3.50 b-e	0.606 c	2.60 b-d	1481.5 d	256.50 de	1100.5 ef
50 %RR(MN)+ 50 % RR (ON)	Unsprayed (control)	3.00 e-h	0.573 d	2.50 b-e	1234.0 f	235.50 ef	1028.5 f
	Vit C at 300 ppm	3.25 c-f	0.636 b	2.50 b-e	1571.5 c	307.50 b	1209.0 bc
	Chitosan at 2 ml /l	3.20 d-g	0.646 ab	2.40 cde	1482.0 d	299.00 bc	1111.5 de
25 %RR(MN)+ 75 % RR (ON)	Unsprayed (control)	3.60 a-d	0.653 ab	3.00 a	1335.5 e	242.00 e	1113.0 de
	Vit C at 300 ppm	3.90 ab	0.606 c	2.30 de	2000.5 a	311.00 b	1180.0 cd
	Chitosan at 2 ml /l	3.75 a-c	0.653 ab	2.40 c-e	1973.5 a	343.50 a	1263.0 ab
100% RR (ON)	Unsprayed (control)	2.60 h	0.483 f	2.40 c-e	838.5 j	156.00 h	774.0 h
	Vit C at 300 ppm	3.10d-g	0.670 a	3.00 a	1291.5 e	279.00 cd	1249.5 a-c
	Chitosan at 2 ml /l	2.90 f-h	0.510 e	2.40 c-e	1140.5 g	200.50 g	944.0 g
				2019 season			
100% RR (MN)	Unsprayed (control)	3.00 e	0.500 f	2.00 i	1143.0 k	190.50 h-j	762.0 k
	Vit C at 300 ppm	3.50 b-d	0.426 g	2.60 gh	1340.0 hi	163.00 j	995.3 i
	Chitosan at 2 ml /l	3.70 bc	0.567 de	2.40 h	1441.0 fg	221.00 e-h	935.0 j
75 %RR(MN)+ 25 % RR (ON)	Unsprayed (control)	3.10 de	0.448 g	2.90 f	1245.7 j	180.00 ij	1165.3 h
	Vit C at 300 ppm	3.80 bc	0.581 b-e	2.60 gh	1763.5 bc	269.50 b-d	1206.5 gh
	Chitosan at 2 ml /l	3.90 ab	0.591 a-e	2.80 fg	1706.0 cd	258.50 c-e	1225.0 g
50 %RR(MN)+ 50 % RR (ON)	Unsprayed (control)	3.10 de	0.560 e	3.50 bc	1326.5 i	239.50 d-g	1498.0 de
	Vit C at 300 ppm	3.85 a-c	0.606 a-d	3.50 bc	1613.0 e	254.00 c-f	1466.5 de
	Chitosan at 2 ml /l	3.60 bc	0.630 a	3.40 b-d	1609.0 e	281.50 a-c	1519.5 cd
25 %RR(MN)+ 75 % RR (ON)	Unsprayed (control)	3.40 c-e	0.616 abc	3.20 de	1671.5 de	303.00 ab	1573.0 c
	Vit C at 300 ppm	3.90 ab	0.626 ab	3.30 cd	1945.0 a	312.00 a	1646.0 b
	Chitosan at 2 ml /l	3.70 bc	0.633 a	3.60 b	1771.5 b	303.00 ab	1723.5 a
100% RR (ON)	Unsprayed (control)	3.50 b-d	0.506 f	3.00 ef	1393.0 gh	201.50 g-j	1194.0 gh
	Vit C at 300 ppm	4.30 a	0.580 c-e	3.90 a	1607.5 e	217.00 f-i	1458.0 e
	Chitosan at 2 ml /l	3.80 bc	0.503 f	3.30 cd	1502.0 f	199.00 g-j	1304.0 f

RR = Recommended rate , MN = mineral nitrogen and ON= organic nitrogen

Means followed by the same letter(s) within each column do not significantly differ using Duncan's Multiple Range Test.

3. Yield and its components

Mineral nitrogen at 75, 50 and 25 % RR+ organic nitrogen at 25, 50 and 75 % RR increased average number of fruits/ plant , average fruit weight, yield / plant and total yield /fed. compared to mineral nitrogen at 100 %RR or organic nitrogen at 100% RR in both seasons (Table 8). Fertilizing sweet pepper plant with MN at 25 % RR+ON at 75 % RR significantly increased average number of fruits/ plant, average fruit weight, yield / plant and total yield /fed. The increases in total yield/fed. were about 29.4 and 28.7 % for fertilizing with MN at 25 % RR+ON at 75 % RR over the MN at 100% RR in the 1st and 2nd seasons, respectively.

The impact of organic fertilizer as a source of slow releasing nutritive elements and rapid dissolved N element as a mineral (inorganic) fertilizer represent a synergism of combination components that to be available for plants to improve the plants quantitative vegetative growth [plant height, leaf number /plant ,branches number/ plant, and dry weight of plant, which reflected on the production of higher number of flowers, number of fruits/plant and highest average fruit weight which were positively contributes towards fruit's yield. The trend of these results is supported by Ghoname, and Shafeek (2005), Amor (2007), Abu-Zahra (2012), Fawzy *et al*. (2012), Koshale

et al. (2018) , Omar *et al*. (2018) and Çerçioğlu (2019) on sweet pepper.

Spraying with Vit.C at 300 ppm or chitosan at 2ml/l increased yield and its components compared to control (unsprayed) plants (Table 9). Sweet pepper which sprayed with chitosan at 2ml/l recorded maximum values of average number of fruits/ plant, average fruit weight, yield / plant and total yield /fed. in both seasons, followed by spraying with Vit. C at 300 ppm. The increases in total yield/fed. were about 26.7 and 39.1 % for chitosan at 2ml/l and 21.0 and 33.3 % for Vit.C at 300 ppm over the control (unsprayed) in the 1st and 2nd seasons, respectively. El-Tantawy (2009) on tomato, Ghoname, et al. (2010) on sweet pepper and Sultana et al. (2017) on tomato and eggplant.

The interaction between fertilizing with MN at 25 % RR+ON at 75 % RR and spraying with chitosan at 2ml/l increased average fruit weight, yield / plant and total yield /fed. with no significant differences with the interaction between MN at 25 % RR+ON at 75 % RR and spraying with Vit. C at 300 ppm in the 2nd season (Table 10). As for average number of fruits / plant , the interaction between MN at 50 % RR+ON at 50 % RR and spraying with chitosan at 2ml/l increased average number of fruits/ plant. The increases in total yield/fed. were about 73.8 and 66.2 % for the interaction between fertilizing with MN at 25 % RR+ON at 75 % RR over the MN at 100 RR and spraying with chitosan at 2 ml/l over the control (MN at 100% RR without sprayed) in the 1st and 2nd seasons, respectively.

4. Nitrogen use efficiency (NUE)

Plants which fertilized with MN at 25 % RR+ON at 75 % RR were the highest NUE (91.93 and 82.50 kg fruits/ 1 kg nitrogen) compared to the plants which fertilized with MN at 100 %RR (71.05 and 64.93 kg fruits/1 kg N) and plants which fertilized with ON at 100 % (67.93 and 69.37 kg fruits/ 1 kg N) in the 1st and 2nd seasons, respectively ((Table 8). These results are in agreement with those found Abdallah (2018) on snap bean.

Table 8. Effect of fertilizing with mineral and organic nitrogen on yield and its components as well as nitrogen use efficiency (NUE) of sweet pepper during 2018 and 2019 seasons

Treatments	Fruit No./ plant	Average fruit weight (g)	Yield / plant (kg)	Total yield (ton/fed.)	NUE (kg fruit / 1 kg N)	Relative ±in in total yield (%)
			2018 season			
100% RR (MN)	10.53 c	52.19 b	0.552 cd	9.947 d	71.05 d	00.0
75 %RR(MN)+ 25 % RR (ON)	10.86 c	52.43 b	0.571 c	10.284 c	73.45 c	03.4
50 %RR(MN)+ 50 % RR (ON)	12.96 ab	51.83 b	0.673 b	12.114 b	86.53 b	21.8
25 %RR(MN)+ 75 % RR (ON)	13.20 a	54.29 a	0.715 a	12.870 a	91.93 a	29.4
100% RR (ON)	12.73 b	41.43 c	0.528 d	9.510 e	67.93 e	-4.40
			2019 season			
100% RR (MN)	10.63 c	46.21 b	0.493 d	8.973 e	64.09 e	00.0
75 %RR(MN)+ 25 % RR (ON)	11.30 b	44.96 c	0.509 cd	9.264 d	66.17 d	03.2
50 %RR(MN)+ 50 % RR (ON)	11.63 b	50.75 a	0.595 b	10.841 b	77.43 b	20.8
25 %RR(MN)+ 75 % RR (ON)	12.20 a	51.95 a	0.634 a	11.551 a	82.50 a	28.7
100% RR (ON)	12.06 a	44.07 c	0.533 c	9.713 c	69.37 c	08.2

RR = Recommended rate , MN = mineral nitrogen and ON= organic nitrogen

Means followed by the same letter(s) within each column do not significantly differ using Duncan's Multiple Range Test.

Nitrogen use efficiency were about 85.44 and 80.60 kg fruits/ 1 kg N for the plants which sprayed with chitosan at 2 ml/l, 81.64 and 77.22 kg fruits/ 1 kg N for the plants which sprayed with Vit. C at 300 ppm and 67.45 and 57.92 kg fruits/1 kg N for the plants which unsprayed in the 1st and 2nd seasons, respectively (Table 9).

Table 9. Effect of spraying with vitamin C and chitosan on yield and its components as well as nitrogen use efficiency (NUE) of sweet pepper during 2018 and 2019 seasons

Treatments	Fruit No/ plant	Average fruit weight (g)	Yield / plant (kg)	Total yield (ton/fed.)	NUE (kg fruit / 1 kg N)	Relative increases in total yield (%)
			2018 season			
Unsprayed (control)	11.62 c	45.31 c	0.524 c	9.443 c	67.45 c	00.0
Vit C at 300 ppm	12.12 b	52.43 b	0.635 b	11.429 b	81.64 b	21.0
Chitosan at 2 ml /l	12.44 a	53.57 a	0.664 a	11.963 a	85.44 a	26.7
			2019 season			
Unsprayed (control)	10.98 b	40.65 c	0.445 c	8.110 c	57.92 c	00.0
Vit C at 300 ppm	11.76 a	50.35 b	0.594 b	10.811 b	77.22 b	33.3
Chitosan at 2 ml /l	11.96 a	51.75 a	0.620 a	11.284 a	80.60 a	39.1

Means followed by the same letter(s) within each column do not significantly differ using Duncan's Multiple Range Test.

Sweet pepper plants which fertilized with MN at 25 % RR+ON at 75 % RR and sprayed with chitosan at 2 ml/l were the highest NUE (99.0 and 90.74 kg fruits /1 kg N), followed by the plants which fertilized with MN at 25 % RR+ON at 75 % RR and sprayed with Vit. C at 300 ppm (96.30 and 89.44 kg fruits/ 1 kg N) in the 1st and 2nd seasons, respectively (Table 10).

5. Fruit quality

Fertilizing with MN at 25 % RR+ON at 75 % RR increased DM% and total soluble solids (TSS) and gave the lower values of nitrate contents in fruits, whereas MN at 50% RR+ON at 50 % RR increased Vit. C in fruits (Table 11). The results are in accordance with those obtained by Fawzy *et al*. (2012) on sweet pepper.

Spraying plants with chitosan at 2 ml/l increased DM% and TSS % in fruits and gave the lowest values of nitrate contents in fruits, whereas, spraying with Vit. C at 300 ppm increased Vit. C in fruits (Table 12). These are in agreement with reported by Mahmood *et al. (*2017*)* and Esyanti *et al*. (2019) on sweet pepper.

The interaction between fertilization with MN at 50 %RR+ ON at 50 % RR and spraying with chitosan at 2 ml/l increased DM%, whereas the interaction between fertilizing with MN at 50 %RR+ON at 50 %RR and spraying with Vit. C at 300 ppm increased TSS and Vit.C in fruits in both seasons (Table 13). As for nitrate content, the interaction between fertilizing with MN at 25 % RR+ON at 75 %RR and spraying with chitosan at 2 ml/l gave the lowest values of nitrate content in fruits, followed by the interaction between MN at 25 %RR+ON at 75 %RR and spraying with Vit.C at 300 ppm in both seasons (Table 13).

It could be concluded that, the interaction between fertilizing sweet pepper plants grown in clay soil with MN at 25 % RR+ON at 75 % RR and spraying with chitosan at 2 ml/l or with Vit. C at 300 ppm were the best interaction treatments for increasing plant growth , mineral uptake by shoot, yield and its components, NUE and gave the lowest nitrate content in fruits.

Table 10. Effect of interaction between fertilizing with mineral , organic nitrogen and both Vit. C and chitosan on yield and its components as well as nitrogen use efficiency (NUE) of sweet pepper during 2018 and 2019 seasons

Treatments		Fruit No/ plant	Average fruit weight (g)	Yield / plant (kg)	Total yield (ton/fed.)	NUE (kg fruit / 1 kg N)	Relative ±in total yield (%)
Fertilization	**Substances**			**2018 season**			
100% RR (MN)	Unsprayed (control)	9.30 g	47.63 e	0.443 f	7.974 h	56.96 h	00.0
	Vit C at 300 ppm	11.00 e	54.09 cd	0.595 cd	10.707 e	76.48 e	34.3
	Chitosan at 2 ml /l	11.30 e	54.87 cd	0.620 cd	11.160 d	79.71 d	40.0
75 %RR(MN)+ 25 % RR (ON)	Unsprayed (control)	10.30 f	47.28 e	0.487 ef	8.766 g	62.61 g	09.9
	Vit C at 300 ppm	11.00 e	54.09 d	0.595 cd	10.710 e	76.50 e	34.3
	Chitosan at 2 ml /l	11.30 e	55.93 bc	0.632 c	11.376 d	81.26 d	42.7
50 %RR(MN)+ 50 % RR (ON)	Unsprayed (control)	12.60 cd	46.35 e	0.584 d	10.512 e	75.09 e	31.8
	Vit C at 300 ppm	13.00 bc	55.00 cd	0.715 b	12.870 c	91.93 c	61.4
	Chitosan at 2 ml /l	13.30 ab	54.14 cd	0.720 b	12.960 c	92.57 c	62.5
25 %RR(MN)+ 75 % RR (ON)	Unsprayed (control)	13.60 a	46.03 e	0.626cd	11.268 d	80.49 d	41.3
	Vit C at 300 ppm	13.00 bc	57.62 ab	0.749 ab	13.482 b	96.30 b	69.1
	Chitosan at 2 ml /l	13.00 bc	59.23 a	0.770 a	13.860 a	99.00 a	73.8
100% RR (ON)	Unsprayed (control)	12.30 d	39.27 h	0.483 ef	8.694 g	62.10 g	09.0
	Vit C at 300 ppm	12.60 cd	41.35 g	0.521 e	9.378 f	66.99 f	17.6
	Chitosan at 2 ml /l	13.30 ab	43.68 f	0.581 d	10.458 e	74.70 e	31.2
				Unsprayed (control)			
100% RR (MN)	Vit C at 300 ppm	10.30 f	40.78 g	0.420 g	7.644 k	54.60 j	00.0
	Chitosan at 2 ml /l	10.30 f	46.70 e	0.481 ef	8.754 i	62.53 h	14.5
	Unsprayed (control)	11.30 de	51.15 d	0.578 bc	10.520 e	75.14 d	37.6
75 %RR(MN)+ 25 % RR (ON)	Vit C at 300 ppm	11.00 e	39.00 g	0.429 g	7.808 k	55.77 ij	02.1
	Chitosan at 2 ml /l	11.60 cd	48.02 e	0.557 b-d	10.137 f	72.41 e	32.6
	Unsprayed (control)	11.30 de	47.88 e	0.541 cd	9.846 g	70.33 f	28.8
50 %RR(MN)+ 50 % RR (ON)	Vit C at 300 ppm	10.00 f	44.30 f	0.443 fg	8.063 j	57.59 i	05.5
	Chitosan at 2 ml /l	12.30 ab	53.58 c	0.659 a	11.994 c	85.67 b	56.9
	Unsprayed (control)	12.60 a	54.37 bc	0.685 a	12.467 b	89.05 a	63.1
25 %RR(MN)+ 75 % RR (ON)	Vit C at 300 ppm	12.00 bc	43.17 f	0.518 de	9.428 h	67.34 g	23.3
	Chitosan at 2 ml /l	12.30 ab	55.93 ab	0.688 a	12.522 ab	89.44 a	63.8
	Unsprayed (control)	12.30 ab	56.75 a	0.698 a	12.704 a	90.74 a	66.2
100% RR (ON)	Vit C at 300 ppm	11.60 cd	36.03 h	0.418 g	7.608 k	54.34 j	-0.5
	Chitosan at 2 ml /l	12.30 ab	47.56 e	0.585 bc	10.647 e	76.05 cd	39.3
	Unsprayed (control)	12.30 ab	48.62 e	0.598 b	10.884 d	77.74 c	42.4

RR = Recommended rate , MN = Mineral nitrogen and ON= Organic nitrogen

Means followed by the same letter(s) within each column do not significantly differ using Duncan's Multiple Range Test.

Table 11. Effect of fertilizing with mineral and organic nitrogen on fruit quality of sweet pepper during 2018 and 2019 seasons

Treatments	Dry matter (%)	TSS %(Brix)	Vit C mg/100 g FW)	Nitrite contents (mg/kg FW)
			2018 season	
100% RR (MN)	6.51 d	4.28 d	118.23 d	8.78 a
75 %RR(MN)+ 25 % RR (ON)	6.91 c	4.37 c	121.40 c	7.47 b
50 %RR(MN)+ 50 % RR (ON)	7.42 b	4.63 b	134.10 a	6.96 c
25 %RR(MN)+ 75 % RR (ON)	7.79 a	4.76 a	127.77 b	5.96 d
100% RR (ON)	7.59 ab	4.04 e	117.60 d	5.37 e
			2019 season	
100% RR (MN)	6.48 d	4.66 bc	112.36 c	10.23 a
75 %RR(MN)+ 25 % RR (ON)	7.09 c	4.72 b	115.67 b	8.67 b
50 %RR(MN)+ 50 % RR (ON)	7.30 b	5.15 a	123.75 a	6.32 c
25 %RR(MN)+ 75 % RR (ON)	7.73 a	5.07 a	124.75 a	5.26 d
100% RR (ON)	7.41 b	4.54 c	113.58 c	4.82 e

RR = Recommended rate , MN = Mineral nitrogen and ON= Organic nitrogen

Means followed by the same letter(s) within each column do not significantly differ using Duncan's Multiple Range Test.

Table 12. Effect of spraying with vitamin C and chitosan on fruit quality of sweet pepper during 2018 and 2019 seasons

Treatments	Dry matter (%)	TSS %(Brix)	Vit C mg/100 g FW)	Nitrite contents (mg/kg FW)
		2018 season		
Unsprayed (control)	6.49 c	4.04 b	108.50 c	7.20 a
Vit C at 300 ppm	7.25 b	4.61 a	136.20 a	6.91 b
Chitosan at 2 ml /l	7.99 a	4.59 a	126.76 b	6.61 c
		2019 season		
Unsprayed (control)	6.27 c	4.47 c	103.40 c	7.62 a
Vit C at 300 ppm	7.60 b	4.92 b	129.10 a	7.45 b
Chitosan at 2 ml /l	7.74 a	5.09 a	121.57 b	6.10 c

RR = Recommended rate , MN = Mineral nitrogen and ON= Organic nitrogen
Means followed by the same letter(s) within each column do not significantly differ using Duncan's Multiple Range Test.

Table 13. Effect of interaction between fertilizing with mineral, organic nitrogen and spraying with Vit. C and chitosan on fruit quality of sweet pepper during 2018 and 2019 seasons

Treatments		Dry matter (%)	TSS % (Brix)	Vit. C (mg/100 g FW)	Nitrite contents (mg/kg FW)
Fertilization	Substances		2018 season		
100% RR (MN)	Unsprayed (control)	5.95 h	4.10 h	105.10 g	9.10 a
	Vit C at 300 ppm	6.29 gh	4.33 ef	127.40 d	8.83 ab
	Chitosan at 2 ml /l	7.31 ef	4.42 d-f	122.20 e	8.42 b
75 %RR(MN)+ 25 % RR (ON)	Unsprayed (control)	6.12 gh	4.10 h	106.20 g	7.90 c
	Vit C at 300 ppm	6.46 g	4.47 de	130.20 c	7.47 cd
	Chitosan at 2 ml /l	8.16 ab	4.56 cd	127.80 d	7.06 de
50 %RR(MN)+ 50 % RR (ON)	Unsprayed (control)	5.95 h	4.10 h	120.30 e	7.10 de
	Vit C at 300 ppm	7.82 b-d	5.15 a	146.40 a	7.15 d
	Chitosan at 2 ml /l	8.50 a	4.65 c	135.60 b	6.65 ef
25 %RR(MN)+ 75 % RR (ON)	Unsprayed (control)	6.97 f	4.29 fg	105.30 g	6.29 fg
	Vit C at 300 ppm	8.07 abc	4.97 b	147.40 a	5.97 gh
	Chitosan at 2 ml /l	8.33 a	5.02 ab	130.60 c	5.62 hij
100% RR (ON)	Unsprayed (control)	7.48 de	3.65 i	105.60 g	5.65 hi
	Vit C at 300 ppm	7.65 c-e	4.15 gh	129.60 cd	5.15 j
	Chitosan at 2 ml /l	7.65 c-e	4.33 ef	117.60 f	5.33 ij
			2019 season		
100% RR (MN)	Unsprayed (control)	5.60 h	4.51 f-h	100.25 i	10.62 a
	Vit C at 300 ppm	6.80 f	4.65 e-g	120.25 d	10.32 b
	Chitosan at 2 ml /l	7.04 e	4.83 c-e	116.58 e	9.75 c
75 %RR(MN)+ 25 % RR (ON)	Unsprayed (control)	5.92 g	4.38 gh	102.00 hi	9.52 c
	Vit C at 300 ppm	7.44 cd	4.83 c-e	124.75 c	9.24 d
	Chitosan at 2 ml /l	7.92 b	4.97 b-d	120.25 d	7.25 e
50 %RR(MN)+ 50 % RR (ON)	Unsprayed (control)	5.76 gh	4.74 d-f	103.50 gh	6.95 f
	Vit C at 300 ppm	7.84 b	5.56 a	139.00 a	6.85 f
	Chitosan at 2 ml /l	8.32 a	5.15 b	128.75 b	5.18 h
25 %RR(MN)+ 75 % RR (ON)	Unsprayed (control)	6.80 f	4.51 f-h	105.25 g	5.79 g
	Vit C at 300 ppm	8.40 a	5.11 bc	137.75 a	5.72 g
	Chitosan at 2 ml /l	8.00 b	5.61 a	131.25 b	4.27 i
100% RR (ON)	Unsprayed (control)	7.28 d	4.24 h	106.00 g	5.26 h
	Vit C at 300 ppm	7.52 c	4.47 f-h	123.75 c	5.14 h
	Chitosan at 2 ml /l	7.44 cd	4.92 b-e	111.00 f	4.06 i

RR = Recommended rate , MN = Mineral nitrogen and ON= Organic nitrogen
Means followed by the same letter(s) within each column do not significantly differ using Duncan's Multiple Range Test.

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تأثير النيتروجين المعدنى والعضوى وبعض المواد الطبيعيه على الإنتاجية وجودة ثمار الفلفل الحلو

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أجريت تجربتان حقليتان خلال موسمى صيف ٢٠١٨ ، ٢٠١٩ وذلك بمزرعة التجارب الزراعية – محطة بحوث الجميزة – محافظة الغربية – مصر وذلك بهدف دراسة تأثير النيتروجين المعدنى والعضوى والرش الورقى بفيتامين ج والشيتوسان على النمو ، المحصول وجوده ثمار الفلفل الحلوصنف كالفورنيا وندر النامى فى الارض الطينيه. سجلت معامله التفاعل بين تسميد نبات الفلفل الحلو بالسماد المعدنى النيتروجينى بمعدل ٢٥ % من المعدل الموصى به + السماد العضوى النيتروجينى بمعدل ٧٥ % من المعدل الموصى به والرش بفيتامين ج بمعدل ٣٠٠ جزء فى المليون الى زياده كل من إرتفاع النبات ، عدد الأوراق/ نبات ، عدد الأفرع للنبات ، الوزن الجاف للعرش وذلك بعد ٩٠ يوم من الشتل فى كلا موسمى النمو. ومع ذلك فقد سجل تسميد نبات الفلفل الحلو بالسماد المعدنى النيتروجينى بمعدل ٢٥ % من المعدل الموصى به + السماد العضوى النيتروجينى بمعدل ٧٥ % من المعدل الموصى به والرش بالشيوسان بمعدل ٢ مل/لتر أو فيتامين ج بمعدل ٣٠٠ جزء فى المليون الى زياده محتوى العرش من النيتروجين والفوسفور والبوتاسيوم وكذلك الممتص منهم بواسطه العرش ، بالإضافه الى ذلك فقد سجل التفاعل بين تسميد نبات الفلفل الحلو بالسماد المعدنى النيتروجينى بمعدل ٢٥ % من المعدل الموصى به + السماد العضوى النيتروجينى بمعدل ٧٥ % من المعدل الموصى به والرش بالشيتوسان بمعدل ٢ مل/لتر الى زيادة متوسط وزن الثمرة / محصول النبات، المحصول الكلى للفدان وكذلك كفاءة استخدام النيتروجين وأقل القيم لمحتوى النترات فى الثمار. وعلى الرغم من ذلك فقد سجل التفاعل بين التسميد بالسماد المعدنى النيتروجينى بمعدل ٥٠ % من المعدل الموصى به + السماد العضوى النيتروجينى بمعدل ٥٠ % من المعدل الموصى به والرش بالشيتوسان بمعدل ٢ مل/لتر الى زياده النسبة المئوية للمادة الجافة فى الثمار، بينما أدى التسميد بالسماد المعدنى النيتروجينى بمعدل ٥٠ % من المعدل الموصى به + السماد العضوى النيتروجينى بمعدل ٥٠ % من المعدل الموصى به والرش بفيتامين ج بمعدل ٣٠٠ جزء فى المليون الى زيادة محتوى المواد الصلبه الذائبه وفيتامين ج فى الثمار فى كلا الموسمين.