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Growth and Yield Responses of Sweet Pepper (*Capsicum annum* L.) to Organic and NPK Mineral Fertilization under Plastic Houses Conditions at Arid Regions

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ABSTRACT

Two greenhouse experiments were conducted during 2014/ 2015 and 2015/2016 seasons in the Experimental Station Farm, Faculty of Agriculture and Natural Resources, Aswan University, Egypt on a sandy textured soil under unheated plastic houses. The target fertilization program seeks to achieve the best combination of various organic and NPK mineral fertilization that lead to the highest yield and quality of produced sweet pepper plant "Lama Star F_1 hybrid" especially during the winter season. Therefore, 12 treatments were arranged in a Split plot layout in complete randomize block design with three replicates. Chicken manure at the rates of (10, 15 and 20m^3/fed.) were randomly arranged in the main plots, while NPK mineral fertilization at rates of (0:0:0, 50:30:50, 100:40:80, and 150:50:110 Kg N:P_2O_5:K_2O/fed., respectively, were randomly distributed in the sub-plots. The obtained results demonstrated that the treatment combination of chicken manure at 20 m^3/ fed. Plus either 150:50:110 or 100:40:80 Kg. NPK/fed. brought about the highest significant mean values of most studied characters as vegetative growth characters (i.e. plant height, number of leaves/plant, the number of branches /plant and plant fresh weight); yield characters {i.e. No. fruits /plant, average fruit weight (g), early yield/m^2 (kg) and total yield/m^2 (kg)}; fruit quality (i.e. TSS %,vitamin C, and non-reducing fruit sugars); chemical analysis characters (*viz*,a, b and total chlorophyll and N, P, K contents in leaves and fruits) during both seasons of the study as compared to the other treatments. Based upon, the reported results, it is possible to conclude that, the combination among 20 m^3/fed. of chicken manure plus either 150:50:110 or 100:40:80 Kg. NPK/fed. considered as the optimal combination treatment whereas it gave the highest mean values of vegetative growth characters, yield and its components and fruit quality of pepper plants grown under plastic houses conditions at Aswan governorate.

Keywords: Pepper, NPK mineral fertilization, NPK inorganic fertilization, organic fertilization, chicken manure, vegetative growth, yield parameters, fruit quality.

INTRODUCTION

Sweet pepper (*Capsicum annum* L.) is a member of family Solanaceae and genus *Capsicum*. Tropical South America, especially Brazil is thought to be the original home of pepper. It is one of the most popular and favorite vegetable crops cultivated under plastic houses in Egypt for both export and local consumption. It occupies the second rank among vegetable crops areas grown under plastic houses. Pepper is recognized as one of the best vegetable source for human health beneficial components (Block *et al*., 1992).

The increase in soil productivity is one of the major key factors, attributing to substantial increase in agricultural production to fulfill the increase in the human population. In order to achieve higher yields and quality, soil health is a critical factor. Therefore, chemical fertilizers must be integrated with organic manures. The yield per unit area can be increased along with the improvement of its quality through the balanced application of organic and inorganic in proper combination. Mineral fertilizers considered a major source of plant nutrition, but the excessive use of mineral fertilizers represent the major cost in plant production and creates pollution of agro-eco system as well as deterioration of soil fertility (Singh and Ryan, 2015).

The mineral nutrients, N, P and K are known to affect growth and yield of the capsicums. Applications of N fertilizer levels showed significant effect on all growth and yield parameters. For instance, yield in pepper; increased with increase in nitrogen (N) level, but excessive N application may, also, decrease the yield (Khan *et al.,* 2014). It was reported that N fertilizer increased fruit weight, yield and fruit number of pepper (Tumbare and Niikam, 2004). Improved nitrogen management can be achieved by matching nitrogen supply with crop need and selecting appropriate nitrogen level to minimize nitrate nitrogen accumulation in soil at times, when the leaching potential is high (Papendick, 1987). Under severe conditions of excess nitrogen, leaves developed necrotic lesions followed by dropping.

It is evident from literature, that potash affects mostly the quality of fruits and vegetables. Potassium is one of the three major nutrients needed for plant growth (Russo, 1991; Hartz *et al*., 1993). Potassium plays a part in many important regulatory roles in the plant, i.e. osmo-regulation process, regulation of plant stomata and water use, translocation of sugars and formation of carbohydrates, energy status of the plant, the regulation of enzyme activities, protein synthesis and many other processes needed to sustain plant growth and reproduction (Hsiao and Lauchli, 1986). It is, also, a highly mobile element in the plant and has a specific phenomenon, it is called luxury consumption. Potassium is, also, known as the quality nutrient because of its important effects on quality factors (Lester, 2006). Further, phosphour plays a central, pivotal metabolic and regulatory role on the many of several physiological and biochemical processes in plants, including photosynthesis, energy conservation, inter- and intracellular co-ordination of carbohydrate metabolism and in energy transfers (Abel *et al*., 2002).

Organic matter has beneficial effects on soil chemical and physical characteristics, biological activity and soil structure including pH stabilization and faster water infiltration rate due to enhancing soil aggregation, increasing soil organic matter content. In addition, organic matter protects crops against pathogens and saprophytic through increasing parasitism and antibiosis (Jamir *et al*., 2017).

Nowadays, the best integrated fertilization management which includes organic and inorganic; plays crucial roles in this respect. Therefore, the absence of fertilization program for pepper production under greenhouses conditions at Aswan region remains limiting factor, needs more research to develop an appropriate

fertilization program satisfies the requirements to achieve the highest yield with best quality of pepper plants grown under plastic houses environments. So, the objectives of these experiments were to examine the beneficial roles of organic and mineral (NPK)fertilization on sweet pepper (*Capsicum annum* L.) growth performance under plastic houses conditions to determinate the suitable fertilization program to pepper plants "Lama Star F_1 hybrid" during its scarcity period of the year (from September to May).

MATERIALS AND METHODS

Two field experiments were carried out during the winter seasons of 2014-2015 and 2015-2016, at the Experimental Station Farm, Faculty of Agriculture and Natural Resources, Aswan University, Egypt, under unheated plastic houses. Before transplanting, random soil sample of 30 cm depth from different places of the greenhouse were collected and analyzed for some important chemical and physical properties as described by Jackson (1967) and Page *et al*. (1982). The experimental soil physical and chemical properties data are given in Table (1).

Table 1. Physical and chemical properties of the experimental site during both seasons 2014/2015 and 2015/2016.

Soil properties	Season	
	2014/2015	2015/2016
Physical analysis:		
Clay (%)	3.00	3.50
Silt (%)	0.00	0.00
Sand (%)	97.00	96.50
Textural class	Sandy	Sandy
Chemical analysis: Soluble cations in (1:1) soil: water extract (mmol/l)		
Ca^{++}	3.06	3.10
Mg^{++}	1.02	1.05
K^{+}	0.83	0.85
Na^{+}	0.76	0.80
Soluble anions in (1:1) soil: water extract (mmol/l)		
CO_3^{--}	0.00	0.00
HCO_3^{-}	7.10	7.06
Cl^{-}	3.60	3.57
SO_4^{--}	0.40	0.44
pH (1:1 soil suspension)	8.10	8.20
EC at 25° C (ds/m)	0.25	0.28
Available N (mg/kg soil)	10	15
Available P (mg/kg soil)	31	37
Available K (mg/kg soil)	175	180

Pepper seeds were sown in seedling foam trays (84 eyes) filled with a mixture of peat moss: vermiculite (1:1 v/v), supplemented with 300 g ammonium sulphate (20.5% N), 400 g calcium superphosphate (15% P_2O_5), 150 g potassium sulphate (48% K_2O), 50 ml micronutrient solution and 50 g of a fungicide (thiophenatemethyle) for each 50 kg of the mixture under plastic house on October 26th, during both seasons of the study. Seedlings of 22 days old were transplanted in the plastic houses on November 20th during both seasons at 30 cm apart and 1 m width of ridge. The experimental plot consisted of one ridge with 3 m long and 1meter width making an area of 3 m^2 using drip irrigation system. All missing transplants were replaced by another ones of the same age, one week later after transplanting.

The plastic house was 24 m long and 6 m width making a total area 144 m^2, during both seasons, 50 cm from both sides of the plastic house's arch near from plastic and 30 cm from beginning (entrance) and end (exit or out) of the plastic house were left without planting. So, the total number of plants/ plastic house were 390 plants (2.71 plants/m^2).

Pepper cultivar seeds coined as "Lama Star F_1 hybrid" was used for the experimentation. It was purchased from Newstar for Modern Agriculture Co., Egypt

The analyses were carried out at Nubariya Research Station, Agricultural Research Center, Nubariya, El-Behiera Governorate, Egypt.

Table 2. Chemical analysis of the chicken manure of both seasons 2014/2015 and 2015/2016.

Properties	Season	
	2014/2015	2015/2016
pH (1:10 manure suspension)	7.57	7.52
EC (1 :10) water extract, dS/m	3.96	3.86
O. M. %	59.31	59.25
Soluble cations (meq/L)		
Ca^{++}	3.06	3.00
Mg^{++}	2.72	2.70
Available nutrients (%)		
Nitrogen (N)	2.27	2.25
Phosphours (P)	1.02	1.04
Potassium (K)	1.70	1.60
C/N ratio	13:1	13:1

Organic fertilization was done using matured chicken manure which obtained from the local area and its chemical analysis is presented in Table (2). Chicken manure treatments were randomly assigned in the main plots as 10, 15 and 20 m^3/fed. before planting. Mineral fertilization treatments were randomly distributed in the sub plots as (0-0-0, 50-30-50, 100-40-80, and 150-50-110 Kg N-P_2O_5-K_2O/fed., respectively. Ammonium nitrate (33.5% N) and nitric acid (15% N) as a source of nitrogen were added. Phosphoric acid (55% P_2O_5) as a source of phosphorus was used. In addition, soluble potassium sulphate (50% K_2O) as a source of potassium was added and calcium nitrate (15.5%N +19% Ca_2O) as a source of nitrogen and calcium was applied. A drip irrigation network was designed for this study and consisted of lateral's GR of 16 mm in diameter, with emitters at 0.3 m distance, with allocating a lateral for each row. The emitters had a discharge rate of 4 $l.h^{-1}$. Both conducted experiments were split plot layout in a randomized complete blocks design, with three replications. Each replicate included 12 treatments. Each experimental plot area was 3 m^2 (1 m x 3 m) during both seasons and 0.30 m between plants and 1.0 m pathway. The planting distance adopted at both sites was 0.30 m × 1.0 m, and the plant population per plot was ten plants. Harvesting of the fruits was done for early yield after 70 days, then for the rest of

harvesting, each 5 days in summer seasons and each 10 days in winter seasons.

Recorded data:

Four plants form each treatment in each replication were randomly selected and tagged for records of growth, early yield and total yield as well fruit quality parameters.

1. Vegetative growth – related characters, all the following characters were determined after 120 days of transplant; plant height (cm) was recorded in centimeters from the base of the plant to the terminal growing point of tagged plants using a meter scale. Numbers of leaves and branches per plant were counted. Plant fresh weights were determined as the average fresh weight of plant foliage.
2. Fruit number and yield parameters were determined *via* mean fruits' number/plant which was determined from the total number of fruits harvested over the entire harvest period (110 days).Fruit weight/plant was calculated from the fruit harvested over the all picking times. Total fruit weight from the tagged plants was recorded and fruit yield/square meter compared as fruit yield per square meter =Average fruit yield/plant x number of plants/square meter. Average fruit weight (g) was calculated as total fruit yield (kg)/ total number of fruits per plant. Early yield was considered as the weight of all harvested fruits during the first 30 days of harvesting per square meter expressed in Kg.
3. Fruit quality, four fruits were randomly taken from each plot of all pickings to measure the chemical characteristics as follows:(1) Total soluble solids content (TSS %)or degrees Brix (Bx°) which is numerically equal to the percentage of sugar and other dissolved in a solution (Caralcantio*et al*., 2010; Majiid *et al*., 2011).It was estimated in the juice of the fresh fruits using a hand refractometer according to (A.O.A.C., 1992). (2) Total, reducing and non-reducing sugars, which were determined for each fruit sample according to the method described by Malik and Singh (1980) and(3) Vitamin C (Ascorbic acid) was measured by titration with iodide potassium according to method of Ranganna (1986) and calculated as mg vitamin C/ 100 cm^3 juice.
4. Chemical analysis, N P K contents were determined as follows (1) N, P and K contents of fruits, the kjeldahe digestion procedure was conducted as described by Okalebo *et al.* (2002). The total nitrogen in plant samples was determined using the microkjedal method of distillation and titration as described by Pregel (1945). Total P was determined following color development using the Bray P1 extractant, measured by the Murphy blue coloration (Murphy and Riely, 1962) and determined on a Spectrophotometer (model Perkin Elmer Lamda 45). Total K in samples was read by aspirating directly into Jenway flame photometer (PFP7). (2)The leaf pigments chlorophyll a, b and total chlorophyll of the fifth leaf from the growing tip of plant were estimated by spectrocolorimeter as described by Moran and Porath (1980) after 60 days from transplanting in both seasons.

All obtained data of the present study were, statistically, analyzed according to the design used bythe MSTAT-C computer software program (Bricker,1991) and were tested by analysis of variance.The comparisons among the means of different treatments were carried out, using the revised least significant difference test at 0.05 level of probability was used to compare the differences among the means of the various treatment combinations asillustrated by (El-Rawy and Khalf-Allah, 1980; Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

1. Vegetative growth characters: results listed in Tables (3) indicated that the highest significant average values of all studied vegetative growth characters {i.e. plant height (cm), number of leaves/plant, the number of branches /plant and plant fresh weight(g)}were obtained from the treatment combination of chicken manure at 20 m^3/ fed. plus either 150:50:110 or 100:40:80 Kg. NPK/fed. compared to the other treatments during both seasons. The obtained results, in this context, show that the integrated role of the tested combinations on the given traits, i. e. the balanced and better nutrition absorbed and metabolize of more carbohydrate by plants due to providing them with the best combination of nutrition's, which could provide quick release of mineral NPK elements plus those being slowly released *via* organic fertilization which could enhance vegetative growth (Adhikari*et al*., 2016).The result of physical and chemical properties of the soil(Table 2) indicated that the soil textural class was a sandy, containing 3% clay and97% sand. Therefore, increases in the vegetative growth of pepper plants by applying chicken manure might be referred to its role in enhancing soil physical prosperities 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. It, also, includes some plant growth promoters such as auxins and gibberellic acid. This result is in agreement with Baiyeri*et al.* (2016); Khandaker*et al.*(2017). This finding may be, also, attributed to the critical part of N in plants, which found in nucleic acids, co-enzymes, and proteins-phosphorus, likewise has a part in N_2 fixation, and increment photosynthesis of plant, although phosphorus has a fundamental part in energy metabolism the high energy of hydrolysis of phosphate and different organic phosphate bonds being used to induce chemical reaction, while potassium activates some enzymes and K^+ ions play an vital part in control leaves stomatal guard cells and as well increment photosynthesis.

Dubey *et al*. (2017) reported that the treatment combination of NPK. (175:55:45 kg/ha) affected significantly vegetative growth characters of pepper plants, NPK(155:55:45 kg./ha) found superior in terms of yield and NPK (155:55:55 kg/ha) was superior in relation to fruit quality. The stimulating effect of NPK combination on the above-mentioned characteristics were confirmed by Ademola and Agele (2015); Lego *et al.* (2016).

Table 3. Averages of some vegetative growth characters of pepper plants "Lama Star F1" as affected by organic and NPK mineral fertilizers during 2014/2015 and 2015/2016 growing seasons.

Treatments (Fertilizers)		Plant height (cm)		No. of leaves/ plant		No. branches/plant		Plant fresh weight (g)	
Organic m^3/fed.	N: P_2O_5:K_2O	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016
10	0:0:0	52.33 i	49.00 h	128.0 h	119.2 h	7.47 j	6.40 k	775.0 j	760.0 e
	50:30:50	55.33 g	50.00 h	129.2 g	121.2 fg	7.70 i	7.30 i	790.0 i	780.0 de
	100:40:80	58.33 e	53.67 e	135.2 c	126.2 cd	9.70 f	8.70 f	830.0 e	820.0 b-e
	150:50:110	59.33 d	55.33 d	136.2 c	127.2 c	10.30 e	9.30 e	845.0 d	840.0 a-d
15	0:0:0	53.67 h	50.00 h	129.0 gh	120.2 gh	7.20 k	6.70 j	781.7 j	770.0 e
	50:30:50	56.33 f	52.67 ef	132.2 e	122.5 e	8.70 g	8.43 g	810.0 g	800.0 c-e
	100:40:80	62.33 c	56.67 c	138.2 b	130.2 b	11.30 d	10.27 d	850.0 d	850.0 a-c
	150:50:110	62.33 c	58.33 b	141.5 a	131.2 b	11.73 c	10.70 c	880.0 b	870.0 ab
20	0:0:0	56.17 f	51.33 g	131.0 f	122.2 ef	8.40 h	7.70 h	800.0 h	856.7 a-c
	50:30:50	58.33 e	52.33 fg	134.0 d	125.2 d	9.53 f	8.53 g	820.0 f	810.0 b-e
	100:40:80	64.33 b	60.33 a	141.2 a	134.0 a	12.30 b	11.33 b	870.0 c	870.0 ab
	150:50:110	65.33 a	61.33 a	142.2 a	134.5 a	12.70 a	11.73 a	900.0 a	890.0 a

Values having the same alphabetical letter (s) in common, within each column, do not significantly differ, using the revised L.S.D. test at 0.05 level of probability.

2. Yield and its components: results presented in Table (4) disclose that the combination of organic manure (chicken) at 20 m^3 /fed. plus either 150:50:110 or 100:40:80 Kg. NPK/fed.; recorded the highest average values of No. fruits /plant, early yield/m^2 (kg)and total yield/m^2 (kg) during both seasons of the study, compare to the other treatments. The same trend was observed for average fruit weight (g) during the second season only but during the first season non-significant effect for this character was recorded. The results obtained could be attributed to the great vegetative growth which taken place initially due to the enrich nutrient status of the plants which reflected on the production of higher number of fruits/plant and highest average fruit weight which were positively contributes towards fruit's yield. Increased yield was correlated to balanced nutrition, better uptake of nutrients by plants which exerted such good yield. Chicken manure contains 2.27% N, 1.02% P and 1.7 K (Table 2), in addition to these, it is, also, contains micro nutrients. It is a good source of organic matter (59.31%) which acts as a store house of all plant nutrients including trace elements might have released them gradually and steadily and this contributed towards the balanced nutrition of crop which resulted in maximum fruit yield.

Table 4. Averages of some yield characters of pepper plants "Lama Star F1" as affected by organic and NPK mineral fertilizers during 2014/2015 and 2015/2016 growing seasons.

Treatments (Fertilizers)		No. of fruits per plant		Average fruit fresh weight (g)		Early yield/m^2 (kg)		Total fruit yield/m^2 (kg)	
Organic m^3/fed.	N: P_2O_5:K_2O	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016
10	0:0:0	18.00 i	15.00 de	36.67 a	34.93 c	1.20 h	1.00 f	1.78 e	1.42 e
	50:30:50	18.67 h	15.00 de	37.67 a	35.87 bc	1.40 f	1.10 ef	1.91 de	1.48 de
	100:40:80	21.70 e	16.30 c-e	39.17 a	37.17 a-c	1.70 c	1.15 ef	2.30 b-d	1.65 c-e
	150:50:110	22.30 d	16.57 c-e	40.00 a	38.00 a-c	1.75 c	1.30 c-e	2.42 bc	1.71 c-e
15	0:0:0	18.50 h	14.30 e	37.50 a	35.37 bc	1.30 g	1.10 ef	1.88 de	1.37 e
	50:30:50	20.30 f	15.63 de	38.83 a	36.63 a-c	1.50 e	1.20 d-f	2.14 c-e	1.56 de
	100:40:80	24.30 c	17.67 b-d	40.67 a	39.33 a-c	1.90 b	1.40 b-d	2.68 ab	1.88 b-d
	150:50:110	25.30 b	19.00 bc	42.17 a	39.50 a-c	1.93 b	1.50 a-c	2.89 a	2.03 bc
20	0:0:0	19.30 g	15.30 de	38.17 a	36.40 a-c	1.40 f	1.20 d-f	2.00 c-e	1.51 de
	50:30:50	21.30 e	16.00 de	39.33 a	37.37 a-c	1.60 d	1.25 de	2.27 b-d	1.62 c-e
	100:40:80	25.70 b	20.30 ab	40.93 a	41.67 ab	1.95 ab	1.60 ab	2.88 a	2.29 ab
	150:50:110	26.30 a	22.00 a	42.43 a	42.83 a	2.02 a	1.70 a	3.02 a	2.56 a

Values having the same alphabetical letter (s) in common, within each column, do not significantly differ, using the revised L.S.D. test at 0.05 level of probability.

The profound effect of both organic and inorganic fertilizers on yield of pepper's outcomes may be attribute to impact of organic fertilizer as a source of slow releasing nutritive elements and rapid dissolved NPK elements 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, fresh and dry weight of plants]. The obtained results are in agreement, more or less, with many studies found that the combination of mineral fertilization with NPK + chicken manure led to increase yield and yield components of pepper plants such as those reported by EL-Shimi *et al.* (2015); Alhrout (2017).

3. Fruit quality characters, results in Table (5) reflected that the mixture 20 m^3/fed. chicken manure with either

150:50:110 or 100:40:80 Kg NPK/fed.; gave the highest, significant ($p \leq 0.05$), values for TSS % (Brix) and Vitamin C (Ascorbic acid) during both seasons, compared to the other treatments. The obtained results showed that pepper plants treated with 20 m^3/fed. chicken manure plus 150:50:110 Kg NPK/fed.; gave the highest, significant ($p \leq 0.05$), values for reducing, non-reducing and total fruit sugars during both seasons, except for reducing sugars during the second season, compared to the other treatments. The finding of TSS could be explained on the basis that the nutritional integration in the defined combination which its contents, rapidly, released nutritive elements (NPK) and slow release nutritive elements of organic fertilizer too, enhanced vegetative growth to photosynthize more photosynthates *viz* carbohydrates and starch which convert into sugars. Similar results, more or less, were, also, reported by Voth *et al.* (1967); El-Gizy (1978).Improvement in ascorbic acid content in pepper fruits with chicken manure may be because of slow but continuous supply of all major and micro-nutrients, which might have helped in the assimilation of carbohydrates and in turn synthesis of ascorbic acid (Bade*et al*., 2017).

Table 5. Percentages of some chemical fruit quality characteristics of pepper plants "Lama Star F1" as affected by organic and NPK mineral fertilizers during 2014/2015 and 2015/2016 growing seasons.

Treatments (Fertilizers)		TSS % (Brix)		Vitamin C (Ascorbic acid) mg/100 g		Fruit sugars (%D. W.)					
						Reducing sugars		Non-reducing sugars		Fruit total sugars	
Organic m^3/fed.	N: P_2O_5:K_2O	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2015/ 2016	2015/ 2016
10	0:0:0	6.10 e	5.90ef	125.0 f	120.0 f	2.80 j	2.50i	1.50i	1.30i	4.30 j	3.80 h
	50:30:50	6.20 de	5.90ef	130.0 e	128.0 de	3.20 h	2.80gh	1.60 hi	1.50gh	4.80i	4.30fg
	100:40:80	6.40 cd	6.20 cd	135.0 cd	132.0bc	4.10 e	3.50 d	1.90ef	1.80 de	6.00 f	5.30 d
	150:50:110	6.50bc	6.30bc	136.7 c	133.0bc	4.30 d	4.60 a	2.00 de	1.90 cd	6.30 e	6.50 a
15	0:0:0	6.10 e	5.80 f	125.0 f	125.0 e	3.10 hi	2.70 hi	1.60 hi	1.40 hi	4.70i	4.10 g
	50:30:50	6.30 c-e	6.10 c-e	132.3 de	130.0 cd	3.40 g	3.20ef	1.80fg	1.60fg	5.20 h	4.80 e
	100:40:80	6.50bc	6.50 ab	140.0 b	134.0 ab	4.40 cd	3.90 c	2.10 cd	2.00bc	6.50 d	5.90 c
	150:50:110	6.70 ab	6.53 ab	142.0 ab	135.0 ab	4.50 c	4.10bc	2.20bc	2.10 b	6.70 c	6.20 b
20	0:0:0	6.20 de	6.00 d-f	130.0 e	128.0 de	2.98i	3.00fg	1.70gh	1.50gh	4.68i	4.50 f
	50:30:50	6.40 cd	6.20 cd	134.0 cd	130.0 cd	3.60 f	3.30 de	1.80fg	1.70ef	5.40 g	5.00 e
	100:40:80	6.70 ab	6.60 a	143.0 a	135.0 ab	4.70 b	4.10bc	2.30 ab	2.10 b	7.00 b	6.20 b
	150:50:110	6.80 a	6.70 a	144.7 a	137.0 a	4.90 a	4.25 b	2.43 a	2.30 a	7.33 a	6.55 a

Values having the same alphabetical letter (s) in common, within each column, do not significantly differ, using the revised L.S.D. test at 0.05 level of probability.

The findings of increases in chemical characters quality of pepper fruits with NPK mineral application are in agreement with those reported by El-Bassiony *et al.* (2010). Also, many investigators found increases in chemical characters quality of pepper fruits by application with chicken manure such as those reported by Aminifard *et al.* (2013); Khandaker *et al.* (2017). This result may be attributed to the synchronization of availability of the proper forms of nutritive elements *via* organic or inorganic fertilization. In other words, organic manure mineralizes and uptake slowly, compare to the inorganic fertilization NPK which release readily to the plants. These findings could be accounted to the presence of nitrogen either in mineral or in combination with organic fertilization which could activate many enzymes having a direct effect on photosynthesis and might increase the dry matter and subsequently enhanced fruit sugars content or many enzymes involved in metabolism of sugars contents (Mottaghian *et al*., 2008). These findings are in line with those reported by Ahmed *et al*. (2013); EL-Shimi*et al*. (2015).

4. Plant chemical analysis:

According to the results illustrated in Table (6), it is evident that using the combination of 20 m^3/fed. chicken manure with either 150:50:110 or 100:40:80 Kg NPK/fed.; gave rise to the highest significant average values of the chlorophyll (a, b and total a+b) and nutritional elements (N, P and K) in pepper fruits compared to the other treatments. The findings of chlorophyll could be giving rise to the beneficial effects of each component of the give combination. Chicken manure contains major nutrient elements associated of photosynthetic activities as Mg^{+2}, N, P, K and thus cooperate with the other variables in promoting roots and vegetative growth, and the very close relationship between chlorophyll and nitrogen content especially in mineral (inorganic) forms (Field and Mooney, 1986; Amalitois *et al*., 2004). It is an acceptable finding owing to considering nitrogen as a structural element of chlorophyll and protein molecules, thereby affects the formation of chloroplasts and accumulation within or inside them (Tucker, 2004; Daughtry *et al*., 2000). These findings may be taken place owing to the availability of various sources for nitrogen (mineral and organic) containing N which is involved in biosynthesis of various amino acids, hence proteins function as a structural of chloroplast (Marschner, 1995), subsequently its favorable impact on chlorophyll content is quite expected. The promotive impact of organic and inorganic fertilizer on chlorophyll content may give rise to the fact that N is a component of chlorophyll molecule. The findings of nutritional elements (N, P and K) in pepper fruits are matching with those reported by Maya *et al*. (1999). These results may be owned to the quick availability of N, P and K elements of mineral fertilizer and the slow release of organic manure of nutrient constituents during the crop growth cycle which reflect on vegetative and reproductive

organs (fruits).Similar results were reported by Shahein *et al.* (2015); Khandaker *et al.*(2017).

In conclusion: under the same conditions of this investigation, it could be recommended that application of 20 m^3/fed. chicken manure with either 150:50:110 or 100:40:80 Kg NPK/fed to sweet pepper plants "Lama Star F1" are preferable and considered as the most suitable treatment for realizing the highest economic and safe yield of sweet pepper.

Table 6. Averages of leaves chlorophyll and nutrient content of pepper fruits "Lama Star F1" as affected by organic and NPK mineral fertilizers during 2014/2015 and 2015/2016 growing seasons.

Treatments (Fertilizers)		Leaves chlorophyll content (mg/g f.w.)						Nutrient contents of fruits (% d.w.)					
		Chlorophyll a		Chlorophyll b		Total chlorophyll		N		P		K	
Organic m^3/fed.	N: P_2O_5:K_2O	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2014/ 2015	2015/ 2016	2015/ 2016	2015/ 2016	2015/ 2016	2015/ 2016
10	0:0:0	0.72 f	0.70 f	0.50 d	0.50 e	1.22 f	1.20 g	1.80 g	1.60 j	0.18 d	0.19 f	1.93 h	2.10i
	50:30:50	0.75ef	0.72ef	0.52 cd	0.51 de	1.27ef	1.23 e-g	1.90fg	1.80 hi	0.20 cd	0.21 d-f	2.15gh	2.30gh
	100:40:80	0.80 b-e	0.76 b-f	0.55 b-d	0.53 b-e	1.35 cd	1.29 d	2.30 d	2.20 de	0.23 b-d	0.25 a-f	2.47 e	2.70 d
	150:50:110	0.82 b-d	0.77 b-e	0.57 a-c	0.54 b-e	1.39bc	1.31 cd	2.40 d	2.30 d	0.24 b-d	0.26 a-e	2.60 de	2.76 cd
15	0:0:0	0.73 f	0.71ef	0.50 d	0.50 e	1.23 f	1.21fg	1.85fg	1.70ij	0.19 d	0.20ef	2.10gh	2.18 hi
	50:30:50	0.77 d-f	0.74 c-f	0.54 b-d	0.52 c-e	1.31 de	1.26 d-f	2.10 e	2.03fg	0.22 b-d	0.23 b-f	2.40ef	2.50ef
	100:40:80	0.85 ab	0.79 a-d	0.56 b-d	0.56 a-d	1.41 b	1.35bc	2.60 c	2.50 c	0.26 a-c	0.27 a-d	2.80 cd	2.90 c
	150:50:110	0.85 ab	0.81 ab	0.59 ab	0.57 a-c	1.44 b	1.38 b	2.70bc	2.60bc	0.27 ab	0.28 a-c	2.90bc	3.10 b
20	0:0:0	0.75ef	0.73 d-f	0.52 cd	0.52 b-e	1.27ef	1.25 d-g	2.00ef	1.90gh	0.20 cd	0.22 c-f	2.20fg	2.40fg
	50:30:50	0.78 c-f	0.75 b-f	0.54 b-d	0.53 b-e	1.32 de	1.28 de	2.30 d	2.10ef	0.23 b-d	0.23 b-f	2.40ef	2.60 de
	100:40:80	0.84 a-c	0.80 a-c	0.60 ab	0.58 ab	1.44 b	1.38 b	2.80 ab	2.70 ab	0.28 ab	0.29 ab	3.03 ab	3.20 ab
	150:50:110	0.89 a	0.83 a	0.62 a	0.61 a	1.51 a	1.44 a	2.88 a	2.80 a	0.30 a	0.31 a	3.17 a	3.30 a

Values having the same alphabetical letter (s) in common, within each column, do not significantly differ, using the revised L.S.D. test at 0.05 level of probability.

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استجابات نمو وإنتاج الفلفل الحلو للتسميد العضوي والمعدني NPK تحت ظروف الصوب البلاستيكية في المناطق الجافة

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أجريت تجربتان حقليتان في البيوت البلاستيكية خلال موسمي النمو ٢٠١٥/٢٠١٤ و٢٠١٦/٢٠١٥ في محطة التجارب الزراعية، كلية الزراعة والموارد الطبيعية، جامعة أسوان، مصر، في تربة رملية القوام تحت ظروف الصوب البلاستيكية غير المدفأة. وأجريت هذه الدراسة بغرض إعداد برنامج تسميدي شامل يؤدي إلى زيادة إنتاجية وجودة محصول الفلفل الحلو النامي تحت ظروف البيوت البلاستيكية في المناطق الجافة. وكان الهدف من برنامج التسميد هو تحقيق أفضل توليفة من الأسمدة العضوية والمعدنية NPK التي تؤدي للحصول على أعلى محصول وجودة من نباتات الفلفل الحلو هجين لاما ستار وخاصة خلال الموسم الشتوي. لذلك تم تخطيط ١٢ معاملة في تجربة قطع منشقة في تصميم القطاعات العشوائية الكاملة بثلاث مكررات. تم توزيع ثلاث معدلات من السماد الداجني وهي (١٠ و ١٥ و ٢٠ م^3/فدان) عشوائيا في القطع الرئيسية ووزع أربعة معاملات من التسميد المعدني NPK وهي (بدون تسميد معدني) و(٥٠:٣٠:٥٠) و (١٠٠:٤٠:٨٠) و (١٥٠:٥٠:١١٠) كجم/فدان K_2O- P_2O_5–N على التوالي في القطع تحت الرئيسية. وأظهرت النتائج المتحصل عليها أن المعاملة المكونة من التوليف بين السماد العضوي بمعدل٢٠م^3 / فدان سماد داجني مع أياً من (١٠٠:٤٠:٨٠) أو (١٥٠:٥٠:١١٠) كجم/فدان K_2O - P_2O_5–N قد أدت للحصول على أعلى متوسطات القيم من صفات النمو الخضري (ارتفاع النبات وعدد الأوراق والأفرع للنبات والوزن الطازج للنبات)، كما أدت لزيادة صفات المحصول معنوياً (عدد الثمار ومتوسط وزن الثمرة و المحصول المبكر للمتر المربع و المحصول الكلي للمتر المربع)، وصفات الجودة للثمار (المواد الصلبة الذائبة الكلية و فيتامين سي والسكريات المختزلة والغير مختزلة و الكلية بالثمار)، كما أدت لزيادة معنوية في صفات كلوروفيل أ و ب والكلوروفيل الكلي أ+ب و محتوى الثمار من النيتروجين والفوسفور والبوتاسيوم، خلال موسمي الدراسة مقارنة بباقي المعاملات المستخدمة. وبناء على النتائج المتحصل عليها يمكننا أن نستنتج أن المعاملة بالسماد العضوي بمعدل ٢٠م^3 / فدان سماد داجني مع أياً من ١٠٠:٤٠:٨٠ أو ١٥٠:٥٠:١١٠كجم/فدان K_2O- P_2O_5 – N قد أدت للحصول على أعلى متوسطات القيم لصفات النمو الخضري ومحصول وجودة ثمار نباتات الفلفل الحلو هجين لاما ستار النامية تحت ظروف الصوب البلاستيكية بالمناطق الجافة مقارنة بالمعاملات الأخرى.