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EFFECTS OF ORGANIC MANURE AND CHEMICAL FERTILIZATION ON THE GROWTH, YIELD AND QUALITY CHARACTERISTICS OF STRAWBERRIES

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ABSTRACT

Two field experiments were conducted at the Experimental Farm of the Faculty of Agriculture, Suez Canal University during 1998/1999 and 1999/2000 seasons to study the effects of organic manuring in comparison with chemical fertilization on the growth, foliage nutrient content, yield and quality components of the strawberry cultivar 'Chandler'. Organic treatments included 1) composted chicken manure in pelleted form (PCM), 2) Fertile Desert (FD) as composted plant manure, 3) fresh chicken manure (CM), 4) animal manure (AM) and 5) a combination of AM+CM. Mineral NPK and a control treatments were also included for comparison.

The obtained results indicated that PCM significantly increased most growth parameters, including number of leaves and crowns/plant, shoot and root fresh and dry weights as well as root length and number of flower trusses/plant. FD was comparable to or ranked second after PCM on growth enhancement as compared with NPK or the control. Foliage N,K, Mn and Zn contents were significantly higher in PCM, FD and AM + CM-treated plants while plants treated with FD had the highest P content. Early (March) fruit yield was significantly the highest with the application of PCM or FD in 1998/1999 and AM+CM in 1999/2000. Both PCM and FD treatments also produced the highest yield during April and May. Thus, PCM followed by FD significantly produced the highest total yield and fruit weight. Fruit TSS was not significantly different among treatments. However, fruits from PCM-treated plants had higher total sugars. The ascorbic acid content was also increased with PCM and FD treatments.

INTRODUCTION

In Egypt, strawberry is becoming one of the most important vegetable crops for fresh consumption, processing and exportation. The crop is commonly grown in sandy soils to obtain early yields and good quality fruits, especially in Ismailia and the newly cultivated areas. In such soils, fertilizer requirement is high due to poor nutrients availability and organic matter contents. In addition to their high costs, chemical fertilizers might cause ground water contamination and environmental hazards (Lee, 1992). Thus, organic strawberry production may provide a good alternative to the problematic chemical fertilizers.

In general, the incorporation of composted manure in sandy soils can increase nutrient availability, cation exchange capacity and micronutrients. It contains high organic content, improves drought tolerance (Hotlink *et al*., 1991) and increases soil microbial activities (Meissner, 2000). Recently, results of Funt and Bierman (2000) on strawberry indicated that composted plant manure decreased soil bulk density and the percent water filled soil pore space in addition to increasing soil respiration and biological activity.

The intensive studies of Gliessman *et al*. (1996a) on organic strawberry showed that the organic system had resulted in significant increase in naturally occurring predators and beneficial soil organisms.

Research results on strawberry growth and productivity under organic system are conflicting. Results of Encke (1988) indicated that animal manure had no effect on growth and generative characters of the plants. In other report by Nonnecke and Christian (1997), the application of corn gluten as organic N source for strawberry resulted in decreasing in fruit yield and berry weight due to excess N levels and increasing vegetative growth. Gliessman *et al*. (1996b) applied organic compost plus dairy wast that contained 1.5% N, 2% P and 2% K into strawberry plant beds. They found lower growth and yield of organic as compared with synthetic fertilizers. However, better fruit quality and a greater return per hectare was recorded for organic fruits.

In contrast, the beneficial effects of organic manure on strawberry yield were early reported by Hitz (1951) and later by Albregts and Howard (1981). Chicken manure (CM) of 3.4% N and 0.86% P was evaluated in comparison with ammonium nitrate (AN) and unfertilized control (Rubeiz *et al*., 1998). Strawberry yield was highest with (CM) at 14t/ha compared to AN. In earlier report, Rubeiz *et al*. (1993) used CM from laying hens or broiler chickens in comparison with ammonium sulfate (AS). Again, total strawberry yield was high using CM than AS or the control. Rocker and Meesters (1995) reported that average yields were markedly increased by the addition of composted plant manure, while control plots had similar yield if N application rate increased by 165 units/ha. Treatment with farm yard manure (FYM) at 40t/ha plus N at 30kg/ha produced the highest strawberry yield, while N alone at 90 kg/ha depressed yield (Kopanski and Kawecki, 1994). Composted manure also increased strawberry plant fresh and dry weight as well as multiple crown formation (Funt and Biermam, 2000). In other plant species, organic fertilizers increased the growth and yield of tomato (Steffen *et al*. 1995 and El-Sheikh and Salama, 1997); cowpea (Abd-Elfattah and Saleh, 1999); cucumber (Abou-Hadid *et al*., 2001). In most of these studies, it was also reported that extensive compost amendment had resulted in increased nutrient composition in leaf tissues for a number of essential elements. Considering the quality of organically–grown plants, results of Cayuela *et al*. (1997) showed that strawberry (cv. Chandler) treated with organic manure had fruits with superior quality in terms of more intense color, higher sugar and dry matter content and better storage quality than fruits from traditional NPK fertilization. On tomato, chicken manure also increased fruit TSS, vitamin C, acidity and total sugars (El-Sheikh and Salama, 1997).

Since most of the strawberry soils in Ismailia and the newly cultivated areas in Sinai are sandy type, poor in organic matter, the addition of organic fertilizers is necessary. However, little information is available to guide growers on efficient utilization of organic materials. Therefore, this study was conducted to test the effects of different organic manure on the growth, yield and fruit quality of strawberries.

MATERIALS AND METHODS

This study was conducted at the Experimental Farm of the Faculty of Agriculture, Suez Canal University during the two successive seasons 1998-1999 and 1999-2000. The study utilized the strawberry (*Fragarra* x *ananassa* Duch.) cultivar 'Chandler', a short day genotype commonly cultivated in Egypt under frigo plantation system. However, for the purpose of organic plantation, frigo plants were not utilized since they are produced under heavy use of synthetic fertilizer and pesticides in the nursery field. Instead, we used plug-propagated transplants produced in the greenhouse in 5cm plastic pots amended with soilless medium composed of peat + vermiculite + perlite (1:1:1 by volume) as described by Mohamed (2000).

A representative soil samples were collected from the experimental field for the determination of soil properties (Table 1). The experimental field was plowed and disked then divided into plots in which organic manure treatments were applied four weeks before transplanting. The organic fertilizer treatments included pelleted chicken manure (PCM) in composted form (Green Vally Co., Ismailia), Fertile Desert (FD) composed of 90% plant residues + 10% blood and bonmeal (Amer. Egyptian Corp. for Desert Reclamation, Sadat City), well rotted animal manure (AM), dry chicken manure (CM) brought from laying hen station of the Animal Sci. Dept., Faculty of Agric., Ismailia; and a combination of AM + CM (2:1 w/w). The chemical analysis of the utilized manure is presented in Table (2). The sixth treatment included traditional NPK fertilizer where N supplied from ammonium sulfate (20.5% N) at 175 kg N/fed, K as potassium sulfate (48% K_2O) at 150 kg K_2O/fed while P was added during soil preparation for the NPK treatment as calcium superphosphate (15.5% P_2O_5) at 31kg P_2O_5/fed. A control plot without fertilizer amendment was also included. For the NPK treatment, nitrogen was split into three equal doses applied during November, December and January while potassium was applied during early flowering and fruiting stages in both seasons.

Table 1. Physical and chemical analysis of the experimental soil at depth 0-40cm in 1998/1999 and 1999/2000*.

Character / Season	Sand %	Silt %	Clay %	Text.	N %	P mg/100g soil	K mg/100g soil	Fe	Mn Ppm	Zn Ppm	Cu
1998/1999	92	4	4	Sandy	0.12	0.56	6.16	1.14	0.16	0.41	0.30
1999/2000	90	4	6	sandy	0.15	0.52	6.32	1.25	0.14	0.46	0.23

*** The soil has a pH value of 8.2, EC = 860ppm and 0.13% organic matter (average of two seasons).**

The amount of organic fertilizer was applied based on the level of N in each manure type as presented in Table (2) to provide 175kg N/fed, equivalent to the traditional N fertilizer treatment. The application of organic manure took place four weeks before transplanting in a band about 10cm deep and mixed with the soil during bed shaping. Rock phosphate (Abo-Tartour, 28.13% P_2O_5) as source of organic P was applied at 0.5 kg/m^2 in all plots treated with organic manure.

Table 2. Chemical analysis and the application rate of the organic manures used during the experiment.

Content	PCM	FD	AM	CM
N%	3.0	5.36	1.1	2.9
P%	2.0	3.14	0.41	1.14
K%	1.2	1.4	0.85	1.8
Fe (ppm)	2909	18.0	650	168
Mn (ppm)	209	2.0	135	214
Zn (ppm)	56.8	200	87.6	110
Cu (ppm)	7.3	10	11.0	92
Organic matter %	53.7	56.3	60.7	63.5
Organic carbon %	31.8	32.6	7.9	32
C/N ratio	1:11	1:6.1	1:19	1:11
Moisture %	10.6	14.5	71	55.0
PH	6.7	6.5	7.5	7.2
Application rate kg/fed	5833	3265	15909	6034

Plug-propagated plants of 8-week-old during 1998 and 6week-old during 1999 were transplanted into the field on 25 Sept., 1998 and 1999, spaced 25cm between plants. Each plot (about 29m^2) consisted of 6 rows each 8m long and 0.6m wide. An empty row was left between each adjacent plot. Plants were irrigated as needed via surface irrigation and weeds were controlled by hand throughout the growing season. No pesticides were applied during the study.

Data were collected on growth, folair nutrient contents, yield and fruit composition as follow:

1- Growth and reproductive development

By the end of March, in both seasons, representative samples of 6 plants were carefully lifted from the inner 3 rows of each experimental plot. Data were recorded on number of leaves/plant, number of crowns, petiole length (cm), root length (cm), shoot fresh weight (g), root fresh weight (g), and number of flower trusses/plant. After drying in an oven for 72hrs at 70°C and reaching constant weight, shoot and root dry weights (g/plant) were recorded.

2- Mineral nutrient analysis

Dried leaf samples were ground using 2mm sieves, wet digested using H_2SO_4 –H_2O_2 mixture as described by Parkinson and Allen (1975). Total N was determined using the macro Kjeldahl method (Black, 1965). Total phosphorous was determined spectro-photometrically (Jackson, 1958) and total potassium by flame photometer method (Jackson, 1958). The micronutrients Mn, Fe, Zn and Cu were determined using an atomic absorption spectro-photometer (Raw, 1973).

3- Fruit Yield

Strawberry fruits were harvested whenever reaching marketable fruit size, weighed and counted to calculate yield and average fruit weight (g). The accumulated yield of March, April and May was calculated to represent early,

mid, and late harvest yield, while the sum of all represent the total yield. All yield data were converted into per feddan basis.

4- Fruit quality measurements

Fruit total soluble solids (TSS%) were determined from a random sample of five fruits harvested during the first week of April using a hand refractometer. Titratable acidity was determined as g citric acid/100g juice in a random sample of 100g fresh fruits from each plot according to A.O.A.C (1990). Ascorbic acid content was determined as mg/100g fresh fruit using 2,6 dichlorophenol indol phenol for titration according to A.O.A.C (1990). Total sugars were determined in dry matter of a random fruit sample according to Nelson (1974).

The experimental design was a randomized complete blocks with three replications. Data were analyzed using the analysis of variance of SAS computer program (SAS Institute, 1986). Statistical differences were determined using the Least Significant Differences (LSD) test according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1- Growth and Reproductive Development

In general, organic manure treatments improved most of the growth characters of strawberry plants compared to NPK treatment, while plants of the control had significantly the least growth for all parameter tested (Table 3). In both seasons, composted chicken manure in pelleted form (PCM) significantly produced the highest growth in terms of number of leaves (NL) and crowns/plant, shoot (SDW) and root (RDW) dry weight, shoot (SFW) and root (RFW) fresh weight and root length (Table 3). In the first season, NL, SFW and SDW of PCM-treated plants were 1.6, 1.3 and 1.3 times of NPK-treated plants, and 2, 1.3, 1.5 times of the control plants, respectively. In the second season however, the differences in growth among treatments were much higher. In this respect, PCM plants had more than 3-fold increase in NL and crowns, SFW and SDW over NPK-treatment, and >5-fold increase in NL and crowns as well as SFW and SDW compared to the control. Fertile Desert (FD) was comparable to or ranked second after PCM on growth enhancement as compared with the other treatments, especially NPK or the control. Plants in all organic treatments had petiole length better than or equal to NPK, while plants of the control had significantly the least petiole length, in both season. No significant differences were detected among the three treatments AM, CM and AM+CM for most growth characters during the two seasons. However, plants treated with the combination of AM+CM had slightly better growth than either AM or CM alone, especially in the first season.

Table 3. Vegetative and reproductive growth characters of strawberry plants in response to organic and mineral fertilizer.

Character*	NL	PL cm	Crown No.	SFW g.	RFW g.	SDW g.	RDW g.	RL Cm	Trusses No.
Treatment				**(1998-1999)**					
PCM	57.7	16.6	8.0	125.3	20.0	35.6	7.0	20.0	9.0
FD	48.0	16.4	7.7	118.0	17.7	34.4	6.1	18.7	8.7
AM	38.7	14.3	5.3	102.3	13.6	27.7	4.3	17.6	7.7
CM	44.0	14.4	6.6	104.0	13.6	22.9	5.2	17.3	7.0
AM+CM	46.7	14.6	7.0	107.6	13.8	28.4	5.7	18.6	8.6
NPK	38.3	13.8	6.3	99.0	14.3	27.3	5.2	17.2	7.0
Control	28.3	11.2	4.0	82.0	13.0	22.8	3.4	15.2	3.2
$LSD_{5\%}$	**13.1**	**1.8**	**1.8**	**23.2**	**5.1**	**7.2**	**1.8**	**2.2**	**1.6**
				(1999-2000)					
PCM	49.3	14.7	6.7	108.7	22.0	35.7	4.5	17.0	4.8
FD	28.7	12.7	4.2	96.3	18.0	24.6	3.8	16.3	4.3
AM	16.6	11.6	2.3	55.3	14.6	15.4	3.1	14.6	2.6
CM	23.3	12.0	3.3	61.3	15.7	15.1	3.4	14.3	2.8
AM+CM	20.0	12.7	2.7	69.6	16.0	15.7	3.7	14.7	3.6
NPK	13.3	11.3	2.0	33.7	9.7	11.1	2.7	15.3	2.7
Control	10.0	9.0	1.3	19.8	6.5	6.3	2.5	11.6	1.6
$LSD_{5\%}$	7.0	2.1	0.9	17.2	4.3	5.2	1.4	2.2	1.4

*** NL = leaf number, PL = petiole length, SFW = shoot fresh weigh, FRW = root fresh weight, SDW = shoot dry weight, RDW = root dry weight, RL = root length.**

Considering reproductive development, results also revealed that the average number of flower trusses/plant in 1998/1999 was more than double that produced in 1999/2000 due to the increase in all growth parameters in the first season (Table 3). The organic fertilizer treatments, PCM and FD had resulted in plants with significantly higher number of flower trusses as compared with NPK or the control treatments. This may be due in part to the positive effect of PCM and FD in increasing branch crown number as previously noted.

Fresh CM and AM were comparable to NPK but less than the combination AM+CM on their effect on flower trusses formation during the two seasons.

The observed enhancement of strawberry plant growth with the application of composted manure may be attributed to the increased nutrient availability for a longer period throughout the season and would be expected to improved soil physical and chemical properties as reported by many workers (Hotlink *et al*., 1991; Funt and Bierman, 2000 and Meissner, 2000). In fact, the analysis of manure types presented in Table (2) clearly showed that both PCM and FD had more N levels than all other manure utilized which would be expected to support growth for a longer period without leaching as compared to the mineral applied N. The increase in growth by composed manure was in agreement with the results of Funt and Bierman (2000) on strawberry, EL-Sheikh and Salama (1997) on tomato, Abd-El-Fattah and Saleh (1999) on cowpea, and Abou-Hadid *et al*. (2001) on cucumber.

2- Mineral Nutrient Analysis

The concentration of some macro and micro nutrients in leaf tissues of strawberry plants in response to organic and mineral fertilizer treatments are presented in Table (4). In 1998/1999, leaves of PCM, FD and AM+CM treated plants had the highest detected N, followed by CM, AM and NPK which were not significantly different. In 1999/2000, foliage N of FD, PCM, AM+CM was comparable to NPK treatment. Results also demonstrated that FD followed by NPK-treated plants had significantly higher foliage P content than all other treatments (Table 4).

Table 4. Foliage nutrient contents of strawberry plants in response to organic and mineral fertilizers.

Character	N %	P %	K %	Mn ppm	Fe ppm	Zn Ppm	Cu ppm
Treatment				**(1998-1999)**			
PCM	2.73	0.243	2.1	139.3	143.3	30.6	1.36
FD	2.37	0.316	2.3	133.3	125.0	32.3	1.62
AM	2.00	0.223	1.6	106.0	133.3	23.3	1.33
CM	2.06	0.203	1.8	153.3	123.3	19.3	1.30
AM+CM	2.33	0.253	2.1	121.0	109.0	28.2	1.66
NPK	2.10	0.290	1.6	117.3	128.0	19.3	1.66
Control	1.70	0.171	1.2	98.3	96.0	13.3	0.80
$LSD_{5\%}$	0.51	0.055	0.2	36.3	24.8	5.6	NS
				(1999-2000)			
PCM	2.36	0.253	2.1	152.6	136.6	32.0	1.96
FD	2.38	0.313	2.0	131.3	122.6	34.3	1.33
AM	1.90	0.206	1.23	104.0	105.0	27.3	1.33
CM	2.00	0.193	1.60	152.2	110.0	19.2	1.66
AM+CM	2.10	0.243	1.86	119.3	116.0	26.6	2.60
NPK	2.20	0.283	1.41	109.0	123.3	19.0	1.33
Control	1.66	0.180	1.03	86.6	78.3	15.6	0.66
$LSD_{5\%}$	0.23	0.043	0.28	42.0	14.9	7.7	0.97

Potassium content in leaf tissue of FD, PCM and AM+CM-treated plants did not differ significantly, but was higher than all other treatments, in both seasons.

Significant differences among treatments were also observed for foliage micronutrient contents. The highest concentration of Mn was detected in CM, PCM and FD-treated plants. The same trend was also true for Fe but NPK-treated plants had similar Fe concentration to the organic CM, PCM and FD-treatments. Zinc content was also significantly the highest in PCM and FD organic treatments, in both seasons. Differences among treatment for Cu concentration were not significant in 1998/1999 while in 1999/2000, leaves of PCM and AM+CM-treated plants had significantly the highest Cu content. In general, leaves of the control plants had significantly the least concentration

of all nutrients tested. This was expected based on the poor organic matter and nutrients available in soil of the control plats (Table 1).

The obtained results showed that most nutrients in PCM and FD treatments followed the adequate ranges recommended by Hochmuth and Albregts (1994) in strawberry leaf tissues, indicating the efficiency of both treatments in supplying the nutrient requirement of the crop.

The observed increase in mineral composition in leaf tissue from organic manure treatment in general, and the composted forms (PCM and FD) in particular, is in agreement with the report of Hotlink *et al*. (1991) who found positive effects of organic compost on increasing nutrient availability, cation exchange capacity and micronutrients. The same findings were also reported by Rubeiz *et al*. (1998) on strawberry; Warman (1990) and Steffen *et al*. (1995) on tomato; Abdel-Fattah and Saleh (1999) on cowpea, and Abou-Hadid *et al*. (2001) on cucumber.

3- Fruit yield

Strawberry fruit yield by harvest month as well as total yield and average fruit weight are presented in Table (5). Results demonstrated that most organic manure treatments, in general, outperformed the traditional NPK and the control in 1998-1999 and 1999-2000. Composted chicken manure in pelleted form (PCM) followed by Fertile Desert (FD) significantly produced higher early (March) yield than all other treatments in 1998-1999 season. However, early yield of AM+CM treated plants was significantly the highest during 1999-2000 season. Mid (April) and late (May) yield was significantly greater in plants amended with PCM and FD in the first season and PCM in the second season as compared with all other treatments. The increase in midseason yield in response to PCM was more than 2 times in the first season and 4.7 times in the second as compared with the control. In addition, April yield of NPK-treated plants was 4 times less than PCM plants in the second season.

As a result of greater yield accumulation during the harvest periods in response to organic fertilization with PCM and FD, plants from both treatments had a significantly higher total yield than those from other treatments, especially in 1998-1999 season. However, in 1999-2000, plants from PCM significantly produced the highest total yield, followed by FD treatment (Table 5). Several trends were observed in monthly yield as shown in Table (5). The peak fruit harvest was generally in April with a decline in May yield for most treatments. In addition, the decline in yield was more pronounced in the control than NPK treatment. In this respect, early, mid, and late yield in the first season was 41%, 39% and 20% from the total, respectively for NPK and 47%, 37% and 16% for the control. Similar trend was also observed in the second season.

Results also revealed that the average fruit weight during the harvest period was also greater in PCM and FD organic treatments while plants of the control had significantly the least fruit size in both seasons (Table 5).

The positive effects of PCM and FD on fruit weight may have contributed to the observed increase in yield of these treatments. In addition, both PCM and FD with their high level of N among other nutrients (Table 2), may work as slow released fertilizers, increasing nutrients availability and

supporting growth throughout the growing season in a better way than did other treatments. Plants of PCM and FD treatments also produced more branch crowns and flower trusses which act as major yield components in strawberries. Recent studies indicated that composted manure has the potential to foster the biological process in soil, help in the creation and preservation of soil fertility (Funt and Bierman, 2000 and Meissner, 2000). Such effects might have contributed to the increase in strawberry yield with the composted manure treatments. These results are in accordance with those of Albreghs and Howard (1981), Rubeiz *et al*. (1993 and 1998) and Rocker and Meesters (1995). In contrast, fertilization with mineral nutrients only, especially in sandy soils with poor organic matter, had resulted in relatively lower yield than composted organic treatments suggesting nutrient leaching and less nutrients available to support growth. This is in agreement with the results of Kopanski and Kawecki (1994) who found less strawberry yield if mineral N was applied alone as compared with N+FYM. Many researchers have noted the positive effects of composted organic manure on vegetable yield, including Steffen *et al*. (1995) and El-Sheikh and Salama (1997) on tomato, Abd-El-Fattah and Saleh (1999) on cowpea, and Abou-Hadid *et al*. (2001) on cucumber.

4- Fruit Quality

Strawberry fruit quality measured as fruit TSS, ascorbic acid and total sugar contents as well as titratable acidity in response to organic culture treatments are presented in Table (5). Results showed no significant differences among treatments for fruit TSS in both seasons. On the other hand, the ascorbic acid content was significantly the highest in fruit harvested from PCM and FD-fertilized plants in both seasons. A significant increase in fruit total sugars was also detected in response to PCM, while titratable acidity was slightly higher in fruits from FD-treated plants as compared with the other treatments. However, fruit quality measurements were significantly the least in plants from the untreated control plots. The superior quality and higher sugar contents in strawberry fruits were previously reported by Gliessman *et al*. (1996b) and Cayuela *et al*. (1997) in response to organic as compared to mineral fertilizer treatment. It was suggested that under organic system, soil biotic life increase and as a result, plants synthesis more vitamins and other beneficial products these organisms produced. Similar findings were also reported by El-Sheikh and Salama (1997) on tomato where organic fertilizer increased fruit vitamin C, acidity and total sugars.

In conclusion, the present investigation demonstrated the validity of producing strawberry fruits using organic manure as the sole nutrient supplier. The composted sources of chicken manure in pelleted form or the plant manure fertile desert generally showed better growth and foliage nutrient contents as well as greater yield, fruit weight and improved most fruit quality components as compared with NPK fertilizers.

Table 5. Monthly and total yield and fruit quality characteristics of strawberry plants in response to organic and mineral fertilizer.

	Yield Kg/Fed				Ave. Fruit Wt(g)	TSS %	Ascorbic Acidmg/g Fwt	Total Sugar g/100g Dwt	Titrat. Acidity g citric/100g Frt.
	March	April	May	Total					
Treatment					**(1998 – 1999)**				
PCM	2746.7	3186.7	1723.3	7656.7	9.90	7.3	55.3	25.7	1.067
FD	2563.3	3153.3	1640.0	7356.7	9.37	7.16	52.3	24.6	1.167
AM	1966.0	1783.3	1260.0	5009.3	8.59	6.76	45.0	24.6	1.033
CM	2136.7	2450.0	1116.7	5703.4	8.61	6.50	41.6	22.3	1.10
AM+CM	2360.0	2393.3	1240.0	5993.3	8.64	6.53	42.0	22.0	0.867
NPK	2243.3	2176.7	1116.7	5536.7	8.48	7.0	43.3	24.3	0.867
Control	1713.0	1363.3	576.7	3653.0	7.20	6.43	30.0	19.3	0.767
$LSD_{5\%}$	510.4	659.5	465.6	748.4	1.46	NS	9.8	2.9	0.242
					(1999 – 2000)				
PCM	2093.7	3898.7	1879.2	7871.6	8.97	6.06	55.0	25.0	1.00
FD	1800.3	3074.3	1459.7	6334.3	8.37	5.80	55.0	23.3	1.13
AM	1282.0	1154.0	1302.3	3738.3	6.60	6.13	38.6	21.0	0.866
CM	1799.7	1818.3	1194.0	4812.0	7.40	5.80	37.0	21.6	1.03
AM+CM	2863.3	1547.0	1123.3	5533.6	7.82	6.73	46.6	23.6	1.00
NPK	1243.7	957.7	864.7	3066.1	6.83	6.0	45.3	22.6	0.86
Control	1092.3	819.7	394.3	2306.3	5.50	5.6	37.0	18.6	0.80
$LSD_{5\%}$	515.8	495.0	340.1	1224.0	1.42	NS	11.2	2.3	0.325

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تأثير التسميد العضوى والكيماوى على صفات النمو والمحصول والجودة فى الفراولة

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أجريت تجربتان حقليتان بالمزرعة التجريبية لكلية الزراعة- جامعة قناة السويس خلال موسمى ١٩٩٨/ ١٩٩٩ و١٩٩٩/٢٠٠٠ بهدف دراسة تأثير التسميد العضوى والكيماوى على صفات النمو ومحتوى الأوراق من العناصر والمحصول وجودة الثمار فى الفراولة صنف شندلر.اشتملت معاملات التسميد العضوى على١) سبله مخلفات الدواجن المتحللة فى صورة حبيبات كروية، ٢) سبله المخلفات النباتية المتحللة Fertile Desert، ٣) سبله المواشى، ٤) سبله الدواجن الطازجة، ٥) خليط من سبله المواشى وسبله الدواجن الطازجة. كما اشتملت التجارب أيضًا على معاملة تسميد كيماوى NPK فقط ومعاملة بدون أى أسمدة للمقارنة.

أوضحت النتائج زيادة معنوية فى معظم صفات النمو باستخدام سبله الدواجن المتحللة وذلك فى صورة زيادة عدد الأوراق والتيجان للنبات وزيادة الوزن الطازج والجاف للمجموع الخضرى والجذرى وكذلك طول الجذور وعدد النورات الزهرية بالنبات. وكان تأثير سماد المخلفات النباتية متساويا مع أو تالياً لتأثير سبله الدواجن المتحللة على تحسين صفات النمو مقارنة بمعاملة NPK أو تلك بدون تسميد. أظهرت النتائج أيضا زيادة معنوية فى محتوى الأوراق من عناصر النتروجين و البوتاسيوم والمنجنيز والزنك للنباتات المعاملة بالأسمدة العضوية المتحللة من سبله الدواجن أو المخلفات النباتية أو خليط سبله الدواجن الطازجة + سبله المواشى بينما احتوت أوراق النباتات المعاملة بسبله المخلفات النباتية على أعلى تركيز من الفوسفور. وبالنسبة للمحصول فقد بينت النتائج زيادة معنوية فى المحصول المبكر(مارس) بإضافة السبلة المتحللة للدواجن أو المخلفات النباتية فى موسم ١٩٩٨/١٩٩٩ أو بإضافة خليط سبله الدواجن الطازجة + سبلة المواشى فى موسم ١٩٩٩/٢٠٠٠. كما أنتجت معاملة سبله الدواجن المتحللة وسبله المخلفات النباتية أعلى محصول معنوى لشهرى أبريل ومايو. وعلى ذلك فقد أعطت معاملة سبلة الدواجن المتحللة يليها سبلة المخلفات النباتية أعلى محصول معنوى كلى وأعلى متوسط لوزن الثمرة. وبالنسبة لمكونات الثمار لم يكن الفرق معنويا بين المعاملات فى نسبة المواد الصلبة الذائبة إلا أن الثمار الناتجة من معاملة سبلة الدواجن المتحللة احتوت على أعلى قيمة للسكريات الكلية كما زاد مستوى حمض الاسكوربيك فى الثمار الناتجة من معاملتى السبلة المتحللة للدواجن والمخلفات النباتية.