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EFFECT OF SOME BIOFERTILIZERS ON THE YIELD AND FRUIT QUALITY OF STRAWBERRY

BY

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ABSTRACT

The field experiment was carried out on strawberry plants (*Fragaria X ananassa* Duch) cv. Chandler in the two successive seasons 1997/1998 and 1998/1999. The aim of this study was to investing the effect of both biofertilizers, i.e., Phosphorein, Nitrobein and Rhizobactrein + 0%, 25%, 50% and 75% of the recommended does of P or N, respectively to each of the biofertilizers in order to substitute part of the mineral fertilizers with biofertilizers which in turn could reduced environmental pollution. To study the effect on the yield (early, late and total) and fruit physical and chemechals characteristics of strawberry. Data indicated that biofertilizer treatments enhanced the earliness of yield, fruit length, diameter, size, anthocyanin, T.S.S, and V.C. content. The other characteristics studied in this investigation didn't significantly influenced by the treatments used in this research.

INTRODUCTION

The successful experiment on the application of biofertilizers is suggested as a sustainable way of icreasing crop yield which would reduce the use of chemicals in fertilizing the crops and improve soil fertility. This part of the review endeavors to describe some aspects of the physical and chemical characteristics of many vegetable plants as affected by applying biofertilizers. In strawberry, Wange *et al.*, (1997) reported that microbial inoculation significantly increased the number of fruits/ plant and total weight of fruits of three strawberry cultivars as compared with the control. Ouda (2000) noticed that the treatment of 25% or 50% from the recommended NPK in the presence of biofertilizers (Phosphrein, Rhizobactrei and Microbein) produced significant higher values of tomato fruit yield.

Hewedy (1999b) reported that the highest values of average fruit weight were recorded from tomato plants inoculated with dual or multi biofertilizers + 75 of the recommended does of NPK comparing with control treatment (100% of recommended does of NPK without (biofertilizers). Abdella *et al.*, (2001) mentioned that inculation of pepper plants with mixture of Phosphorein + Biogein under plstic house conditions resulted in the highest fruit weight.

In the other point of view, Selvi *et al.*, (1997) noticed that the tomato plants received NPK + Micronutrients + Composted Coir Pith (CCP) + biofertilizers (Azospirillium) increased the total soluble solids of the fruits.

Antipchuk *et al.*, (1982) stated that the application of different Azotobacter strains to the soil increased fruit sugars content in tomato fruit. In addition to the foundation by El- Shimi *et al.*, (2002) who reported that the inoculation of strawberry transplants with Microbeian increased the fruit content of vitamin C comparing with the control.

MATERIALS AND METHODS

The presente investigation was conducted at the experimental farm of Horticulture Research Station at El-Kanater El-Khairia, Kalubia governorate during the two successive seasons of 1997/1998 and 1998/1999 to study the effect of using biofertilizers technique with different rates of mineral fertilizers to minimize the use of nitrogen and phosphorus chemical fertilizers needed for the strawberry plants and to study the effect of some bio-fertilizer on the yield and fruit characters of strawberry. The soil of the experimental field was clay loam in texture and the soil characteristics are shown in Table (1).

Table (I): Physical and chemical soil properties of the field.

Soil parameter	Values
Coarse sand	1.1%
Fine sand	34.0%
Silt	33.5%
Clay	31.4%
Textural class	Clay loam
EC (on saturation extract) dSm^{-1}	0.66
Soluble ions meL^{-1}	
Ca^{++}	3.1
Mg^{++}	1.1
Na^{+}	1.9
K^{+}	0.6
HCO^{-3}	2.5
CO_2	0.0
Cl^{-}	1.9
$S0_4$	3.3
S.P. (Saturation percent)	48.0
pH (1:2.5 w/v soil : suspension)	8.0

Data were recorded on the plants after 150 days from transplanting. The surface irrigation by furrows was applied and other agricultural practices took place whenever it was necessary According to Hassan (1989).

This study was carried on strawberry plants (*Fragaria x ananassa* Duch.) using cultivar (Chandler). The source of transplants is Strawberry and

Non-traditional Horticultural Crops Center, Faculty of Agriculture, Ain Shams university. The experimental design was the complete randomize blocks with three replicates. The area of each plot was 14.00 m^2 and consisted of four rows, each row was 80 cm. wide and 4 m. long and the space between the plants were 25 cm.. Transplanting was done on the 31st and the 21St October in both successive seasons previously mentioned.

Three treatments of biofertilizers and mineral fertilizers at different rates were used in this experiment as follow:

1- Phosphorein biofertilizer treatments:

1000 kg./fed. ammonium sulphate 20.6% N (206 kg. N/fed.) + 500 kg./fed. potassium sulphate 48% K_2O (240 kg. K_2O/fed.) + 250 g. Phosphorein (phosphate dissolving bacteria) were added to levels of 0, 50, 100 or 150 kg/fed. of mono super phosphate 15.5% P_2O_5 (0.0, 7.75, 15.50 or 23.25 kg. P_2O_5/fed.).

2-Nitrobein biofertilizer treatments:

200 kg./fed. mono super phosphate 15.5% P_2O_5 (31 kg. P_2O_5/fed.) + 500 kg./fed. potassium sulphate 48% K_2O (240 kg. K_2O/fed.) + 400 g./fed. Nitrobein (nitrogen fixation bacteria) were added to levels of 0, 250, 500 or 750 kg./fed. ammonium sulphate 20.6% N (0, 51.5, 103 or 154.5 kg. N/fed.).

3 - Rhizobactrein biofertilizer treatments:

200 kg./fed. mono super phosphate 15.5% P_2O_5 (31 kg. P_2O_5/fed.) + 500 kg./fed. potassium sulphate 48% K_2O (240 kg. K_2O/fed.) + 200 g./fed. Rhizobactrein (nitrogen fixation bacteria) were added to levels of 0, 250, 500 or 750 kg/fed. ammonium sulphate 20.6% N (0, 51.5, 103 or 154.5 kg. N/fed.).

4-The control treatment received 1000 kg. ammonium sulfate 20.6% N, 200 kg. mono super phosphate 15.5% P_2O_5 and 500 kg. potassium sulfate 48% K_2O per feddan (206 kg. N/fed, 31 kg. P_2O_5/fed. and 240 kg. K_2O/fed) according to the Ministry of Agriculture recommendations.

The amount taken from each biofertilizers as the growing bacteria on peat moss (as a carrier) was mixed with suitable amount of wet clean sand and added to the bottom of the rows then covered with soil and the land immediately watered.

Data were recorded on:

A- Yield:

1- The early yield were calculated from the first day of harvesting up to the middle of March (the last date of export strawberry fruits to the European markets).
2- The late yield was calculated from the middle of March to the last day of harvesting.
3- The total yield was calculated from early and late yield.

B- Fruit characteristics:

a) Physical characteristics: Ten fruits from every plot were taken randomly at 3/4 color to determine average fruit length, diameter, weight, firmness and fruit size.

b) Chemical characteristics: Twenty fruits were taken randomly at 3/4 color from every plot to determine the contents of anthocyanin, total soluble solids, total sugars, ascorbic acid and juice pH.

Determination procedures:

Fruit physical characteristics:

1- Length and diameter: The average length and diameter of fruits were determined by using the Vernier Caliper.

2- Size: The average size fruit was measured in cm^3. by using water displacement.

3- Firmness: The average fruit firmness was tested by using a Chatillon penetometer (N.Y., U.S.A) Gauje-R with a needle 0.4 mm in diameter. data were recorded as $kg./cm^2$.

Fruit chemical characteristics:

1- Anthocyanin: The anthocyanin pigment was determined calorimetrically according to De Loose (1970).

2- T.S.S. The total soluble solids percentage was determined by using abbe refractometer as described by A.O.A.C. (1990).

3- Total Sugars: The total sugars were determined in dry matter according to Mcilory (1948).

4- Ascorbic Acid: The ascorbic acid was determined mg./100g. fresh weight by using the dye 2-6 dichiorophenolindophynol method as described by A.O.A.C. (1990).

5- Fruit Juice pH: The fruit juice pH was measured by using pH meter (model Accumet 25).

Statistical analysis

Data were subjected to statistical analysis using the analysis of variance method and the means of treatments were compared by using the Least Significant Difference (L.S.D.) at 0.05 level of probability according to Snedecor and Cochran, (1980).

RESULTS AND DISCUSSION

A - Yield:

Data in Table (2) show that applying biofertilizers as phosphorein, nitrubein or rhizobactrein combined with using the additives from mineral fertilizers significantly increased the early yield comparing with the control in the two seasons of the experiment. In this respect, using Phosphorein biofertilizer plus Zero at 250 g/fed. kg. P_2O_5/fed., Nitrobein at 400g. or Rhizobactrein at 200g. plus 154.5 kg. N/fed. gave the best results in the second season. However, these results are true in the first season when the plants treated by Nitrobein or Rhizobactrein plus 103 kg. N/fed.

Table (2): Effect of biofertilizers and NPK mineral nutrient levels on early, late and total yield (kg per plot) in the two seasons of 1997/1998 and 1998/1999.

Treatments \ Character		Early yield		Late yield		Total yield	
		1997/1998	1998/1999	1997/1998	1998/1999	1997/1998	1998/1999
250g Phosphorein +	00.00 P_2O_5 + 206N + 240 K_2O kg./fed	2.76	3.49	22.76	26.13	25.52	29.62
	07.75 P_2O_5 + 206N + 240 K_2O kg./fed	2.46	2.55	24.48	23.89	26.94	26.44
	15.50 P_2O_5 + 206N + 240 K_2O kg./fed	2.71	2.52	26.60	26.17	29.31	28.69
	23.25 P_2O_5 + 206N + 240 K_2O kg./fed	2.43	2.81	25.11	27.55	27.54	30.36
400 g Nitrobein +	00.00 N + 31 P_2O_5 + 240 K_2O kg./fed	2.71	2.91	22.32	27.89	25.03	30.81
	51.50 N + 31 P_2O_5 + 240 K_2O kg./fed	2.65	2.46	26.14	27.27	28.79	30.72
	103 N + 31 P_2O_5 + 240 K_2O kg./fed	3.32	3.03	26.47	27.38	30.16	30.41
	154.5 N + 31 P_2O_5 + 240 K_2O kg./fed	2.69	3.90	27.49	31.43	30.18	35.33
200 g Rhizobactrei+	00.00 N + 31 P_2O_5 + 240 K_2O kg./fed	2.92	3.15	23.24	26.34	26.16	29.48
	51.50 N + 31 P_2O_5 + 240 K_2O kg./fed	2.69	2.99	26.82	26.63	29.84	29.63
	103 N + 31 P_2O_5 + 240 K_2O kg./fed	3.08	3.19	26.17	26.06	29.25	29.24
	154.5 N + 31 P_2O_5 + 240 K_2O kg./fed	2.62	4.08	27.57	29.12	30.20	33.20
Control (206 N + 31 P_2O_5 + 240 K_2O kg./fed)		1.66	1.61	21.01	19.69	22.67	21.30
L.S.D. at 5%		0.75	0.73	1.53	2.35	2.20	2.36

From the presented data in Table (2) it is clear that all fertilizer treatments used in this experiment significantly increased the late yield in the two seasons of 1997/1998 and 1998/1999 except that resulted from Nitrobein + 0.0 kg. N/fed. as compared with the control.

The best results were obtained from Nitrobein plus 154.5 kg. N/fed. followed by Rhizobactrein plus 154.5 kg. N/fed. in the second season, while in the first one the opposite was true.

Regarding the total yield, the data illustrated in Table (2) cleare the effect of using the different biofertilizer types plus the different rates of NPK as mineral nutrients in the two seasons of study. It is obvious that all treatments

significantly increased the total yield in the two seasons. The best result is that caught from the treatments of using Nitrobein at 400g. or Rhizobactrein at 200g/fed plus the application of mineral fertilizers at 154.5 KgN + 31 Kg P_2O_5 + 240 Kg K_2O/fed. During the two seasons of study.

B -Fruit characteristics:

a- Physical characteristics:

The presented data in Table (3) show the effect of applying biofertilizers with different levels of mineral fertilizers on strawberry fruit length in the two growing seasons. Generally speaking, there is no significant effects attributed to any of these treatments in this experiment although the results tend to show a few increase in this character. However, application of phosphorein plus the lowest rate of mineral fertilizers (BPK) reflected the highest values in this respect.

Fruit diameter as affected by the three types of fertilizers used in this investigation in the two seasons of growth is presented in Table (3) The presented data show clearly that applying biofertilizers in the two growing seasons significantly increased the fruit diameter comparing with the control. In this concern, application of Phosphorein bio-fertilizer either alone or plus all the levels of P_2O_5 caused a significant increase in the fruit diameter in the second season only.

Concerning the effect of Nitrobein and Rhizobactrein biofertilizers, the presented data show clearly that using them with all N levels increased fruit diameter significantly in the two seasons except with zero of N level in the first one comparing with the control.

Data in Table (3) show the results of using biofertilizers plus the various levels of P_2O_5 and N on the fruit weight in 1997/1998 and 1998/1999 seasons. It can be concluded that there is no significant effect on the fruit weight attributed to using any of various fertilizer types in this study.

The present results shown in Table (3) about applying biofertilizers with different mineral fertilizers in the two seasons of study indicate that such treatments had no significant effect on fruit firmness in both seasons comparing with the control.

Speaking about the using Phosphorein biofertilizer + P_2O_5 there is no stable trend can be seen in the results of fruit firmness in the two seasons.

In case of using Nitrobein + N, the firmer fruits were obtained when 51.5 kg. N/fed. was added comparing with the control in the two seasons.

Regarding Rhizobactrein treatments, the firmer fruits were found when plants treated with 103 kg. N/fed in the first season and 154.5 kg. N/fed in the second one comparing with the control.

Table (3): Effect of biofertilizers and NPK mineral nutrient levels on fruit physical characteristics in the two seasons of 1997/1998 and 1998/1999.

Treatments / Character		Fruit length (cm)		Fruit diameter (cm)		Fruit weight (g)		Fruit firmness (kg./cm2)		Fruit volume (cm3)	
		97/98	98/99	97/98	98/99	97/98	98/99	97/98	98/99	97/98	98/99
250g Phosphorein +	00.00 P_2O_5 + 206N + 240 K_2O kg./fed	3.30	3.57	2.39	2.52	12.66	13.09	179.00	170.50	12.00	17.67
	07.75 P_2O_5 + 206N + 240 K_2O kg./fed	3.13	3.47	2.28	2.26	12.42	12.06	167.00	171.83	12.67	15.67
	15.50 P_2O_5 + 206N + 240 K_2O kg./fed	3.13	3.20	2.33	2.48	9.76	12.52	175.00	179.17	14.33	14.67
	23.25 P_2O_5 + 206N + 240 K_2O kg./fed	3.13	3.40	2.37	2.40	12.04	12.64	184.50	173.83	16.00	16.00
400 g Nitrobein +	00.00 N + 31 P_2O_5 + 240 K_2O kg./fed	2.97	3.13	2.42	2.46	11.49	10.59	165.67	172.67	13.33	14.00
	51.50 N + 31 P_2O_5 + 240 K_2O kg./fed	2.93	3.23	2.50	2.48	12.58	10.69	173.50	180.33	12.67	12.33
	103 N + 31 P_2O_5 + 240 K_2O kg./fed	2.90	2.87	2.46	2.49	11.33	9.10	154.67	168.50	13.33	13.33
	154.5 N + 31 P_2O_5 + 240 K_2O kg./fed	3.27	3.70	2.50	2.51	10.86	10.28	161.00	164.67	13.33	12.67
200 g Rhizobactrei+	00.00 N + 31 P_2O_5 + 240 K_2O kg./fed	3.17	3.57	2.33	2.31	10.24	10.68	144.33	179.17	12.67	14.30
	51.50 N + 31 P_2O_5 + 240 K_2O kg./fed	3.17	3.33	2.53	2.35	13.11	11.32	170.67	173.17	14.67	15.67
	103 N + 31 P_2O_5 + 240 K_2O kg./fed	3.27	3.23	2.54	2.46	13.73	12.63	173.90	172.67	16.00	17.17
	154.5 N + 31 P_2O_5 + 240 K_2O kg./fed	3.27	3.57	2.50	2.27	12.93	13.22	165.67	179.33	14.00	14.33
Control (206 N + 31 P_2O_5 + 240 K_2O kg./fed)		2.90	2.90	2.14	1.87	9.82	9.00	157.17	171.50	10.67	10.33
L.S.D. AT 5%		N.S	N.S	0.30	0.30	N.S	N.S	N.S	N.S	1.86	2.23

The fruit size changes due to the application of various biofertilizers and mineral nutrients in the two seasons of are exhibited in Table (3). The obtained figures show obviously that using biofertilizers significantly increased fruit size comparing with the control in the two growing seasons.

In this respect, the biggest fruits in the two seasons were obtained from using Rhizobactrein + 103 kg. N/fed.

b- Chemical characteristics:

General speaking about the fruit chemical characteristics as affected by applying biofertilizers, the obtained data declared obviously that the used treatments in this investigation improved the fruit chemical properties in both seasons as compared with the control.

Changes in the fruit anthocyanin content as affected by various fertilizer levels during the two seasons of 1997/1998 and 1998/1999 are presented in Table (4). The anthocyanin pigment was significantly increased in both seasons due to the use of biofertilizers and the addition of P_2O_5 or N in different levels as compared with the control.

Phosphorein biofertilizer plus 23.25 kg. P_2O_5/fed caused the highest concentration of anthocyanin pigment in the fruits in the first season while this result was true when 7.75 kg. P_2O_5/fed. was used in the second one as compared with the control and the other levels of P_2O_5.

The same results were obtained by using both Nitrobein or Rhizobactrein plus 154.5 kg. N\fed. in both seasons.

Presented data in Table (4) show the changes happened in the fruit total soluble solids due to the use of various fertilizers levels in the two seasons of 1997/1998 and 1998/1999.

Applying biofertilizers +P_2O_5 or N mineral nutrients significantly increased fruit T.S.S. concentration in both seasons as compared with the control. It is easily to say the increase of mineral fertilizer levels added to every biofertilizer increased the T.S.S. percentage in the fruits.

Data in Table (4) detect the effect of different biofertilizers + P_2O_5 or N levels on strawberry fruit sugar content in the two seasons of the experiment. In this regard, obtained results indicate clearly that applying different bio and mineral fertilizer levels caused un significant decrease in the total sugar percentage in the fruits comparing with the control in both seasons.

The same data recorded in Table (4) summarize the effect of different bio and mineral fertilizer levels used in this study on V.V. content in the two seasons of growth. It is obvious that applying different fertilizer levels significantly increased V.C. content in strawberry fruits comparing with the control in the first season. Regarding the second season, there is no significant effect on this character can be attributed to any of the fertilizer treatments in this study.

Table (4): Effect of biofertilizers and NPK mineral nutrient levels on fruit chemical characteristics in the two seasons of 1997/1998 and 1998/1999.

Treatments	Character	Anthocyanin (mg/100g F.W)		T.S.S (%)		Total sugars (%)		V.C. (mg/ 100 g F. w)		Juice (pH)	
		97/98	98/99	97/98	98/99	97/98	98/99	97/98	98/99	97/98	98/99
250g Phosphorein +	00.00 P_2O_5 + 206N + 240 K_2 O kg./fed	78.33	74.7	10.20	10.13	6.08	4.47	43.07	43.87	3.50	3.40
	07.75 P_2O_5 + 206N + 240 K_2 O kg./fed	82.65	84.18	10.13	10.27	6.78	4.62	43.07	45.43	3.53	3.50
	15.50 P_2O_5 + 206N + 240 K_2 O kg./fed	84.78	75.83	10.40	10.40	5.62	5.54	43.10	43.90	3.53	3.47
	23.25 P_2O_5 + 206N + 240 K_2 O kg./fed	88.09	79.96	10.60	10.53	6.31	4.08	48.90	45.47	3.53	3.57
400 g. Nitrobein +	00.00 N + 31 P_2O_5 + 240 K_2 O kg./fed	76.54	84.04	10.00	10.40	6.70	5.08	41.50	43.43	3.50	3.57
	51.50 N + 31 P_2O_5 + 240 K_2 O kg./fed	84.01	83.59	10.47	10.60	6.54	4.00	43.07	43.07	3.43	3.53
	103 N + 31 P_2O_5 + 240 K_2 O kg./fed	83.42	76.34	10.60	10.47	6.93	4.31	43.87	47.03	3.47	3.67
	154.5 N + 31 P_2O_5 + 240 K_2 O kg./fed	90063	84.63	10.73	10.73	5.93	4.85	45.47	47.03	3.47	3.73
200 g. Rhizobactrei+	00.00 N + 31 P_2O_5 + 240 K_2 O kg./fed	78.16	76.57	10.13	10.27	6.01	4.77	43.10	45.43	3.53	3.53
	51.50 N + 31 P_2O_5 + 240 K_2 O kg./fed	82.65	75.26	10.27	10.40	6.39	5.08	48.13	43.10	3.63	3.57
	103 N + 31 P_2O_5 + 240 K_2 O kg./fed	84.01	77.67	10.47	10.53	6.39	5.31	43.90	44.67	3.53	3.57
	154.5 N + 31 P_2O_5 + 240 K_2 O kg./fed	89.61	90.89	10.67	10.67	6.31	5.93	45.47	44.67	3.60	3.73
Control (206 N + 31 P_2O_5 + 240 K_2 O kg./fed)		74.17	66.55	9.73	9.40	7.70	7.62	39.50	45.50	3.23	3.37
L.S.D. AT 5%		6.50	9.09	0.57	0.56	N.S	N.S	3.49	3.35	0.18	0.14

The presented data in Table (4) show significant increase in juice pH in both seasons of study as affected by applying biofertilizers and added mineral fertilizers as compared with the control.

This trend of increasing didn't reach the level of significant in the second season when the plants treated with Phosphorein + 0.0, 7.75 or 15.5 kg. P_2O_5/fed.. Phosphorein plus 23.25 kg. P_2O_5/fed., Nitrobein plus 154.5 kg. N/fed. and Rhizobactrein plus 154.5 kg. N/fed. had the best results of the fruit juice pH in the two seasons of the experiment.

Now more than ever the importance of an adequate supply of plant nutrient to ensure efficient crop production. Growers are continually striving to overcome nutrient deficiencies in order that yield may more nearly approach the genetic limit of crop plants. As a result of this effort, great progress in fertilizer technology and in the use of plant nutrients especially the biofertilizer compounds has been made all over the world. Improved technology had led to the production of some biofertilizers which have some kinds of phosphate solubilizing bacteria and nitrogen fixation organisms. These micro-organisms have a specific role to play in plant growth and yield particularly when inoculated, these organisms colonize the rhizosphere and enhance plant growth by providing it with nitrogen and phosphorus (Kundu and Gaur 1980 on wheat and Alagawadi and Gaur 1988 on chick pea).

The available phosphorus level for plants is usually low in Egypt soils, since it rapidly converts to tri-calcium-P, thus becomes un-accessible by plants (Mahmoud and Abd El-Hafez 1982). It is thought that the P-biofertilizers are of the utmost importance for soil fertility as they improve the biological, physical and chemical properties of soil (Abdel-Moniem *et al.*, 1988, El-Dahtory *et al.*, 1989). The phosphate solubilizing bacteria utilize organic compounds as carbon and energy source and produce organic acids thereby solubilizing insoluble inorganic phosphates (Pareek and Gaur 1973).

Concerning yield and fruit characteristics which were increased by using that mineral P-levels plus Phosphorein may be due to the promotion happened in the plant growth which returned to enhancement of the yield and fruit characteristics, this increment was in agreement with those of P-solubilizing bacteria improved soil fertility and plant productivity by releasing P-element from rock or tri-calcium-P (Forster and Freter 1988 and Hauka *et al.*, 1990). Moreover, Amara (1994) and Kavimandan and Gaur (1971) found that Bacillus and Pseudomonas are two of the bacteria decomposing organic phosphate which improved yield.

Concerning the other two biofertilizers used in this investigation, Nitrobien and Rhizobactrien which have nitrogen fixation bacteria, it is known that nitrogen fixation organisms such as Azospirillium spp. able to produce plant growth substances Tien *et al.*, (1979) and there are plenty of circumstantial evidence that these bacteria produce auxins and other plant growth substances in the plant rhizosphere (Inbal and Feldman 1982, Jain and Patrriquin 1985,

Kapulink *et al.*, 1985, Also, Jagnow *et al.*, (1991) reported that Azotobacter and Azospirillium strains produc adequate amount of IAA and cytokinins which increase the surface area per unit root length and are responsible for root hair branching with an eventual increase in uptake of nutrients from the soil.

Respecting the biofertilizers effect on the vegetative growth characteristics, beside the nitrogen is important to constructions of chlorophyll which increase photosynthesis resulting in assimilation of more carbohydrates as well as higher soluble sugars and gibberellins and dry matter content of fruits leading to increase fruit yield and improved quality (Abd El-Fattah and Sorial 2000). Also the increasing of yield might be due to the fact that biofertilizers stimulate both vegetative and root growth or to the changes of the root morphology (Carletti *et al.*, 1996 and Barakat and Gabr 1998) and enhance uptake of minerals (Pol 1998). Moreover, the present data and many investigators indicated that the inoculation of N mineral fertilizer at the lowest levels combined with application? biofertilizers produced early, late and total yield increases, that were significant higher than those obtained by applying the highest N mineral level without biofertilizers treatment (control). This means that inoculation with biofertilizers can reduce N-mineral fertilizers applications without reducing either productivity or the fruit quality. After enhancement of photosynthesis carbohydrates commonly appear in leaf cells during or immediately after photosynthesis, these are the hexoses, starch, D-glucose and D-fructose (Meyer and Anderson 1952).

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تأثير بعض المخصبات الحيوية على المحصول وجودة ثمار الفراولة

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أجريت تجربتان حقليتان على نباتات الفراولة صنف شاندلر في موسمي ١٩٩٧/١٩٩٨، ١٩٩٨/١٩٩٩ في محطة بحوث البساتين بالقناطر الخيرية بمحافظة القليوبية بجمهورية مصر العربية. وكان الهدف من هذه الدراسة هو بحث تأثير المخصبات الحيوية (الفوسفورية (بكتريا مذيبة للفوسفات) والنيتروبين والريزوباكترين (بكتريا مثبتة للنيتروجين) وذلك بإحلالها محل ١٠٠%، أو ٧٥%، أو ٥٠% أو ٢٥% من التسميد المعدني الموصى به من الفوسفور أو النيتروجين حسب المخصب المستخدم وذلك في محاولة للحد من استخدام التسميد المعدني وإبدال جزء منه بالتسميد الحيوي مما يعود بالنفع على خفض معدلات تلوث البيئة وتأثير هذه المعاملات على المحصول وجودة ثمار الفراولة (الشيلك). ويمكن تخليص أهم النتائج المتحصل عليها في الآتي:

١- **المحصول:** أدت كل معاملات الأسمدة الحيوية مع المعدلات المختلفة من التسميد المعدني إلى زيادة معنوية في المحصول المبكر والمتأخر وكذلك المحصول الكلي في كل من موسمي الزراعة عند المقارنة بالكنترول.

٢- **الصفات الثمرية:**

أ- **الصفات الطبيعية:**

- أدى استخدام الأسمدة الحيوية مع معدلات الأسمدة المختلفة من التسميد المعدني إلى زيادة غير معنوية في طول ووزن وصلابة الثمار في الموسمين.
- أدى استخدام الأسمدة الحيوية مع كل المعدلات المستخدمة من التسميد المعدني إلى زيادة معنوية في قطر الثمار في الموسم الثاني من الزراعة.
- كل المعاملات المستخدمة في هذه الدراسة أدت إلى زيادة حجم الثمار معنوياً في كلا موسمي الزراعة.

ب- **الصفات الكيماوية:**

- أدت معاملة الريزوبا كترين + ١٥,٥ كجم/ فدان إلى زيادة محتوى الثمار من الأنثوثيانين.
- كان لكل امعاملات تأثير معنوي إيجابي على محتوى الثمار من المواد الصلبة الذائبة الكلية في موسم الدراسة الثاني.
- أدى استخدام الأسمدة الحيوية مع المعدلات المختلفة من التسميد المعدني إلى نقص غير معنوي في السكريات الكلية بالثمار.
- أعطت المعاملات المختلفة للأسمدة الحيوية والأسمدة المعدنية زيادة معنوية في محتوى الثمار من حمض الأسكوربيك في الموسم الأول.

نتج عن استخدام المعاملات المستخدمة في هذه الدراسة نقص معنوي في حموضة العصير في موسمي الزراعة فيما عدا معاملات الفوسفورين بدون أو مع ٧,٧٥ و ١٥,٥ كجم فو$_٢$أ$_٥$/ فدان في الموسم الثاني من الدراسة.