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RESPONSE OF TWO STRAWBERRY CULTIVARS TO BIO- AND CHEMICAL FERTILIZERS AND THEIR EFFECT ON PESTS INFESTATION

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ABSTRACT

This study was conducted at the Horticulture Research Station of Barrage (1999-2000) and (2000-2001) seasons to study the effect of the partial substitution of nitrogen and phosphorus chemical fertilizers with the biofertilizer "Microbein" on yield, fruit quality (weight, firmness, T.S.S., titratable acidity and ascorbic acid %) and fruit chemical constituents (N, P, K) of Camarosa and Oso Grande strawberry cultivars.Morever, to study their susceptibility to infestation by Tetranychus urticae, Bemisia tabaci and Myzus persicae. Each cultivar received five fertilizer treatments [Microbein alone, Microbein + (25, 50 & 75 % of the recommended doses of nitrogen and phosphorus fertilizers (RNPF), and the control (check) one (100 % of the recommended doses of nitrogen and phosphorus without Microbein)

Camarosa cv. gave higher yield than Oso Grande cv.. Data indicated that Camarosa cv. gave higher fruit weight, firmness and titratable acidity and high fruit percentage of phosphorus and potassium. Whereas Oso Grande cv. showed higher values of T.S.S., ascorbic acid and high percentage of nitrogen fruit content.

Results indicated that combined Microbein with 50 and 75 % of the RNPF showed no significant differences on yield as compared as the control treatment during the first season. Whereas in the second season, treatment of Microbein + 75 % RNPF showed significant yield increase over the control treatment.Chmical fertilizers combined with Microbein as well as Microbein alone gave similar or even higher fruit weight and firmness during April as compared with the control one. On the other hand, the control treatment showed the highest value of T.S.S. during March 2001.Whereas in April 2001, no significant differences were observed between all fertilizer treatments with regard to fruit titratable acidity and ascorbic acid contents. Nitrogen and phosphorus fruit contents significantly increased with Microbein treatments as compared with the control one. Potassium fruit content was higher in the control treatment than in the other ones.

The treatment of Microbein + 75 % (RNPF) showed the least infestation of the two strawberry cultivars by T. urticae and M. persicae throughout the two seasons followed by the control treatment. The highest infestation was recorded in Microbein treatment alone, while the control was applied for B. tabaci infestation.

Camarosa cv. was characterized by its high infestation with M. persicae, while Oso Grande cv. was more attacked by T. urticae and B. tabaci. The peak infestation with T. urticae was recorded in April, while M. persicae and B. tabaci were in February.

INTRODUCTION

Among the different vegetable crops in Egypt, strawberry Fragaria x ananassa Duch, is considered as one of the most important ones for both local consumer and export. Oso Grande cultivar is one of the predominant

commercial cultivars in Egypt, while Camarosa (new cv. from California) with its excellent colour and its well adaptation to the Egyptian environmental conditions is important for sustaining the agriculture industry in Egypt.

Good yield and good quality depend mainly on good agricultural practices without any traces of chemical fertilizers or biological pollution as a result of using high rates of chemical fertilizers and chemical control.

Strawberry is a small plant with potential of giving very large fruit yield compared with its size. Accordingly, a generous fertilization regime should be scheduled beside the organic manure. So, the plant needs a continuous supply of nitrogen, phosphorus and potassium. With application of nitrogenous and phosphorus chemical fertilizers to the soil, some problems could be arise, e.g. some nitrogen of the nitrogenous fertilizers is expected to be lost via nitrate reduction and ammonia volatilization. In addition, some N-fertilizers can be leached to the surface and under-ground water, causing environmental pollution (Attia, 1990; Hammad and Karamity, 1993). Furthermore, immobilization of phosphorus is the most important problem of phosphate fertilization in Egypt, i.e. due to soil alkalinity, phosphorus of the applied fertilizers could be converted to unavailable form for plant absorption (Abdel-Hafez, 1966; Abdel-Nasser and Makawi, 1979; El- Dahatory *et al*., 1989). Furthermore, from the economical point of view, the high prices of such fertilizers may increase the production costs of the agricultural crops. Therefore, the current trend is to explore the possibility of supplementing chemical fertilizers with bio-fertilizers of microbial origin in order to decrease the costs of production as well as lowering environmental pollution. Wang (1996) reported yield increase of strawberry due to combined application of diazotrophs and fertilizer nitrogen. Also, Wang *et al*. (1997) reported this increment in strawberry yield by using different biofertilizer application or their combination compared with the control treatments. On other vegetables, Abdel-Ati *et al*. (1996) on potato reported that the highest values of tuber yield in the plants inoculated with Azosipisillum (N2 fixing bacteria) and B1 megaterium (phosphate solubilizing bacteria). Fruit yield, average fruit weight and number of fruit per sweet pepper plant were at highest in plants inoculated with the mixture of phosphorein (containing solubilizing bacteria) and Biogein (containing N2 fixing bacteria), (Abdalla *et al*., 2001).

The relation between minerals content of plant tissues and their effect on insect infestation has been taken in consideration in the recent years. It is generally found that increasing nitrogen fertilizer quantities increased the population of sap-sucking insects (McClure, 1980). The growth of herbivorous insect frequently is limited by the nitrogen concentration of the host plant (Mattson, 1980).

Strawberry plants are subjected to several pests among which are the whiteflies, aphids and mites. They affect not only the fruit size, but also the quality of the fruits (Walsh *et al*., 1998).

Tetranychus urticae, is an economic pest of strawberry its damage is expressed as stippling, scarring and bronzing of the leaves and calyx resulting in reducing the vegetative growth of the plant and in extreme cases, plant mortality (Scances *et al*., 1981).

Also, aphids cause great damage due to their honey-dew and some virus diseases are transmitted by aphids and whiteflies causing leaf rolling and Aster yellow which might lead to plant death at severe infestation.

Few works concerning the effect of biofertilizers on the population trend of some main insects of different crops has been undertaken.

The present study was carried out to investigate the effect the biofertilizer "Microbein" and the partial substitution of the chemical N and P fertilizers on yield and quality of the two strawberry cultivars Camarosa and Oso Grande. Moreover, their ability to resist the infestation of some pests; *Tetranychus urticae, Bemisia tabaci* and *Myzus persicae* was also determined.

MATERIALS AND METHODS

I- Plot location and experimental design:

The study was carried out at Barrage Research Station, Horticultural Research Institute, Kalubia Governorate during the two growing seasons of strawberry (December-May) 1999-2000 and 2000-2001. The experimental design was complete randomized block with 4 replicates. The plot area was 12 m2 contained 4 rows, 3 m length and 0.75 m width, the transplants of the two strawberry cultivars (Camarosa "cv.1" and Oso Grande "cv.2") were planted at 30 cm within rows. The two experiments were planted on mid of October for each season. Physical and chemical analysis of the soil was showed in Table (1) according to Jackson method (1958).

II- Experimental treatments:

Each cultivar received 5 fertilizer treatments. The five treatments of fertilizers were as follows: F1, Microbein alone (Microbein is a biofertilizer containing live cells of efficient bacteria strains for nitrogen fixation and phosphorus solubilizing bacteria (PSB). It was supplied at 5 kg/fed. fixed with wet soft soil (1 : 10 ratio) into the root absorption zone of the plant. Three treatments included soil inoculation with the biofertilizer (Microbein) combined with N and P fertilizers at rates of (F2 = 25 %), (F3 = 50 %) and (F4 = 75 %) of the recommended doses. F5, the check treatment received 205 kg N/fed. and 46.5 kg P2O5/fed. (the recommended rates) without Microbein. Nitrogen fertilizer was applied in the form of Ammonium sulfate (20.5 % N), phosphorus was applied in the form of calcium superphosphate (15.5 % P2O5). Potassium fertilizer was applied to all treatments at rate of 240 kg K2O/fed. in the form of potassium sulfate (48 % K2O). All chemical fertilizers (starting one month after planting) were applied in ten equal portions, five before flowering and five after flowering, Microbein was applied with the first and second chemical fertilizer applications. The other agriculture practices were followed as the recommendation of Ministry of Agriculture. No chemical control was applied to avoid the effect of pest populations.

Table (1). The physical and chemical properties of the soil and manure chemical.

Physical properties :	
Clay	32.5 %
Silt	22.5 %
Fine sand	41.14 %
Coarse sand	1.32 %
Soil rtpe	Clay loam
A. Soil Chemical :	
pH	7.60
E.C.	1.58
Orange matter	2.10
Total N %	0.120
Available N	45.0 ppm
Available P_2O_5	7.4 ppm
Available K	80.0 ppm
Zn	1.3 ppm
B. Manure chemical :	
Organic matter %	30.27
Total N %	2.265
Available N	440.00 ppm
Available P_2O_5	29.00 ppm
Available K	275.00 ppm
Zn	1.5 ppm

III- Data recorded:

A- Yield estimation:

Total yield of fruits expressed as (ton/fed.) was recorded for each treatment at the end of each growing season.

B- Fruit quality:

Ten fruits from each treatments were chosen randomly during March, April and May (last harvest) to record the following data:

1- Fruit weight (g).
2- Fruit firmness: expressed as (g/cm^2), by using Chatillon penetrometer (N.Y., USA) Gauge-R with needle 3 mm in diameter.

About 500 g from each treatment were used to determine:

3- Total soluble solids (T.S.S.) by using a hand refractometer.
4- Total titratable acidity (TA) in April 2001: expressed as (g citric acid/100 g juice) according to A.O.A.C. (1990).
5- Ascorbic acid (in April 2001): expressed as (mg/100 g fresh weight fruit) according to A.O.A.C. (1990).

C- Chemical fruit constituents:

About 250 g of fruits (in April 2001), from each treatment were used after drying and grounded to determine the following:

Nitrogen % was determined according to Koch and McMeckin (1924), phosphorus % was determined according to Troug and Meyer (1939), potassium (mg/100 g dry weight) determined according to Brown and Lilleland (1946).

D- Pest estimation:

Six weeks after planting, weekly samples of five strawberry leaves from each cultivar were picked-up randomly from the plant of each replicate and each treatment. The sample was kept in separate paper bag till examination in the laboratory to determine the population of *Tetranychus urticae* (moving stages), *Bemisia tabaci* (nymphs and pupae) and *Myzus persicae* (nymphs and adults).

Data analysis:

All obtained data were statistically analyzed for variance using MSTSTC software, the mean values were compared at 5 % levels of L.S.D. (Snedecor and Cochran, 1980).

RESULTS AND DISCUSSION

A- Yield estimation:

Total fruit yield at the end of the season expressed as (ton/fed.) is shown in Table (2). Data revealed that Camarosa cultivar produced higher fruit yield than Oso Grande one. It exceeded it by 112 % and 119.8 % during the two seasons, respectively.

With respect to fertilizer treatments, data in the same table indicated that combined Microbein with 50 and 75 % of the recommended nitrogen and phosphorus fertilizer rates showed no significant differences as compared with the check treatment during the first season. Whereas during the second season the treatment of 75 % of N and P combined with Microbein surpassed the check one. Treatments received Microbein alone or combined with 25 % of N and P fertilizers produced the lowest fruit yield during the two seasons. These results were coincided with those obtained by Wange (1996) and Wange *et al*. (1997) on strawberry. This increase in fruit yield due to different biofertilizer applications or their combinations were also reported by many investigators on various plant species (Brown *et al*., 1964 and Pandey and Kumar, 1989 on some vegetables; Kumaraswamy and Madalager, 1990 on tomato; Karuthamani *et al*., 1995 on pumpkin, Terry *et al*., 1996 on tomato; Abdel-Ati *et al*., 1996 on potato; Sorial *et al*., 1998 on artichoke; Hewedy, 1999 on tomato; Nameda and Gupta, 1999 on pigeon pea; and Abdalla *et al*., 2001 on sweet pepper).

The interaction between cultivars and fertilizer treatments had no significant effect on total yield of fruits, this was true during the two growing seasons. These results were not in agreement with those obtained by Wange *et al*. (1997) using Australian, Sujata and Labella strawberry cultivars and using various biofertilizers or their combinations, where Sujata was better than the two others in the presence of biofertilizers.

Table (2). Effect of N, P fertilizer rates and Microbein on the average yield (ton/fed.) of two strawberry cultivars (Camarosa "C1" and Osegrande "C2" during (1999-2000) and (2000-2001).

	1999-2000			2000-2001		
Cultivars / **Fertilizer**	**CV.1**	**Cv.2**	**Mean**	**CV.1**	**Cv.2**	**Mean**
F1	6.105	2.573	4.339 c	6.850	2.860	4.855 c
F2	6.563	2.840	1.701 bc	7.725	3.295	5.510 b
F3	6.740	3.205	4.973 ab	7.850	3.598	5.724 ab
F4	6.930	3.417	5.174 a	7.925	3.985	5.955 a
F5	6.327	3.330	4.829 a	7.550	3.500	5.525 b
Mean	6.533 a	3.073b		7.580a	3.448b	
Cl.SD		0.254			0.222	
Fl.SD		0.401			0.351	
CFL.SD		-			-	

B- Fruit quality:

1- Fruit weight (g):

Data illustrated in Fig. (1-A) indicated that Camarosa gave higher average fruit weight (g) than Oso Grande through the two seasons. However, differences were not significant during March and May in the second season. Data of fertilizer treatments illustrated in Fig. (1-B) emphasized that applying Microbein alone or combined with N and P fertilizers gave similar or higher fruit weight as compared with the check treatment in March and April of the two successive seasons. While in May, applying Microbein alone tended to decrease the average fruit weight as compared with all other treatments including the check one. These results were in agreement with those obtained by Wange (1996). On the other hand, Wange *et al*. (1997) indicated that microbial inoculation significantly increased the average fruit weight of the strawberry plant as compared with the check treatment. Similarly, Abdalla *et al*. (2001) working on sweet pepper plant found that the average fruit weight was higher in plant inoculated with a mixture of phosphorine and Biogein.

The interaction effects between cultivars and fertilizer treatments (Fig. 1-C), showed that the differences between treatments were significant only during April (2000) and March (2001). It was obvious that in April 2000 the two cultivars showed higher average fruit weight when received Microbein alone or combined with N and P fertilizers at rates of 25, 50 and 75 % as compared with the check one. While in March (2001), Camarosa gave similar fruit weight to that of the check one when received Microbein alone or combined with 50 % N and P. No significant differences were shown between treatments received 25, 50 and 75 % of N and P fertilizers combined with Microbein. Oso Grande gave the highest fruit weight by receiving 25 % of N and P fertilizers + Microbein as compared to the check one. Similar significant results were reported by Wange *et al*. (1997) on strawberry.

fig1

2- Fruit firmness (g/cm²):

Data illustrated in Fig. (2-A) indicated that Camarosa showed higher significant average fruit firmness comparing to Oso Grande throughout the two seasons. In this respect, Ahmed (2001), reported no differences in fruit firmness betw2een the two strawberry cultivars used.

Fig. (2-B) illustrated that applying Microbein alone or combined with 25, 50 and 75 % of the (RNPF) led to give similar or even higher fruit firmness as compared with the check one during April in the two seasons as well as during May (2001).

It could be concluded that, the treatment of Microbein combined with 50 % of (RNPF) led to increase the fruit firmness during the two growing seasons comparing with the others, whereas Microbein combined with 75 % of (RNPF) showed high fruit firmness only in May 2000.

The interactions between cultivars and fertilizer treatments were significant during May 2000, March, April and May 2001. In March and April 2001, Fig. (2-C) indicated that applying the biofertilizer Microbein alone or combined with 25 % and 50 % of (RNPF), led significantly, to an increase in fruit firmness of Camarosa cultivar. While Oso Grande plants received Microbein combined with 50 and 75 % of (RNPF) showed similar response to that of the check ones. Regarding to the responses of the two cultivars to the fertilizer treatments, no clear trends could be observed during May 2000, as well as 2001.

3- Total soluble solid (T.S.S.) %:

Regarding total soluble solid of fruits, no significant differences were observed between the two cultivars during March and April of the two seasons, while in May, Oso Grande showed higher value than Camarosa. As illustrated in Fig. (3-A), Oso Grande showed 13.8 and 13.7 % T.S.S. during 1*st* and 2*nd* seasons, respectively. While, Camarosa was 11.3 % T.S.S. in both seasons. Similar trend was obtained by Show *et al*. (1997) who reported significant differences between 24 strawberry cultivars. T.S.S. % was also significantly affected by fertilizer treatments during March and April 2001 as illustrated in Fig. (3-B), also, the check treatment showed the highest value of T.S.S. % as compared with all other treatments in March. While, a slight differences were shown between the check and those received Microbein either alone or combined with 75 % of (RNPF) in April.

The interactions showed significant effects in May 2000 and throughout the second season of 2001 as presented in (Fig. 3-C). In May 2000, Camarosa cv. gave the highest value with 75 % of (RNPF) combined with Microbein. While, cv. Oso Grande showed the least one as compared with the check treatment. During March and May 2001, Camarosa cv. showed high values of T.S.S. with the check, as well as, with 75 % of (RNPF) combined with Microbein treatment, while in April, the check treatment exceeded all the other treatments. Oso Grande gave similar responses with Microbein,as well as with 75 % of (RNPF) combined with Microbein treatment, as compared with the check one in March and April 2001, but it gave the lowest value with the treatment of 75 % of (RNPF) combined with Microbein at the end of the same season as compared with the control.

fig2

fig3

4- Titratable acidity (TA) (g. citric acid/100 g juice):

With respect to fruit acidity, data showed in Fig. (4-A) and (4-B) emphasized that Camarosa fruits had significantly higher acidity than that of Oso Grande. On the other hand, fertilizer treatments did not affect significantly this character.

As for the interaction effect, Camarosa cv. showed high acidity values with the application of either Microbein alone or combined with 75 % of (RNPF). While, Oso Grande showed the highest value of acidity when Microbein was combined with 50 % of (RNPF).

5- Ascorbic acid (mg/100 g fresh weight):

Results illustrated in Figs. (4-C) and (4-D) clearly indicated that Oso Grande contained the higher amount of Ascorbic acid as compared with camarosa.

On the other hand, fertilizer treatments did not affect this character significantly, whereas the interaction between cultivars and fertilizer treatments indicated that the best significant result was obtained when Camarosa plants were treated with Microbein alone. While with Oso Grande the best results were obtained with the check treatment. These differences in titratable acidity and ascorbic acid constituents for the two cultivars could be due to genetical constitutions. Such results are in agreement with those illustrated by Show *et al*. (1997) who found great variation among the 24 cultivars and selections, reflecting primarily genetical constitutions.

C- Chemical fruit constituents:

1- Nitrogen, N (g/100 g dry weight):

Data illustrated in Fig. (5-A) indicated that fruits produced by Oso Grande cultivar contained higher nitrogen content than those produced by Camarosa one. Regardless cultivar effect, Fig. (5-B) clearly showed that applying Microbein alone or combined with 25, 50 or even 75 % of (RNPF) increased the fruit nitrogen content than the check treatment.

2- Phosphorus, P (g/100 g dry weight):

Fig. (5-A) also showed that Camarosa fruit contained higher phosphorus percentage than Oso Grande fruit. Regarding fertilizer treatments, it could be noticed that combination of Microbein with 25, 50 and 75 % (RNPF) tended to increase significantly phosphorus fruit content as compared with the check treatment as shown in (Fig. 5-B).

3- Potassium, K (mg/100 g dry weight):

Results in Fig. (5-A) also indicated that the amount of potassium in Camarosa fruit was significantly higher than that in Oso Grande fruit. Responses to fertilizer treatments (Fig. 5-B) also indicated that potassium percentage in the check treatment, significantly exceeded all that of the other fertilizer ones.

fig4

fig5

D- Pest estimations:

1-Effect of fertilizer treatments on pests infestation:

Data recorded in Tables (3 & 4) showed the effect of the 5 fertilizer treatments on the average numbers of *T. urticae, B. tabaci* and *M. persicae* on the two strawberry cultivars during the two successive seasons (1999-2000) and (2000-2001).

Table (3). Effect of N, P fertilizer rates and Microbein on the average numbers of moving stages of *T. urticae*, (n and P) of *B. tabaci* and (n and a) M*. persicae* (indv./leaf) on 2 strawberry cultivars (Camarosa cv.1 and Oso Grande cv.2) during 1*st* season 1999/2000.

Pests	*Tetranychus urticae*			*Bemisia tabaci*			*Myzus periscae*		
Cultivars Fertilizers	cv.1	cv.2	Mean	cv.1	cv.2	Mean	cv.1	cv.2	Mean
F1	72.09	88.69	80.39	0.41	0.89	0.65	1.17	0.62	0.89
F2	70.47	76.82	73.64	0.42	1.07	0.74	0.62	0.29	0.45
F3	69.56	88.32	78.94	1.10	1.29	1.19	0.99	0.50	0.74
F4	48.42	64.91	56.66	0.92	1.96	1.44	0.47	0.25	0.36
F5	69.34	73.89	71.61	0.75	1.25	1.00	0.67	0.37	0.52
Mean	65.97	78.52		0.72	1.29		0.78	0.40	
F value of cultivars			63.97			42.38			244.740
LSD value of cultivars			3.23			0.18			0.049
F value of fertilizers			28.93			10.63			65.67
LSD value of fertilizers			5.10			0.28			0.08
F value of cultivars x fertilizers			3.51			2.35			6.016
LSD value of cultivars x fertilizers			7.22			-			0.112

n = nymph **p = pupae** **a = adult**

Table (4). Effect of N, P fertilizer rates and Microbein on the average numbers of moving stages of *T. urticae*, (n and P) of *B. tabaci* and (n and a) M*. persicae* (indv./leaf) on 2 strawberry cultivars (Camarosa Cv.1 on Oso-Grande Cv.2) during 2*nd* season 2000/2001.

Pests	***Tetranychus urticae***			***Bemisia tabaci***			***Myzus periscae***		
Cultivar Fertilizer	**cv.1**	**cv.2**	**Mean**	**cv.1**	**cv.2**	**Mean**	**cv.1**	**cv.2**	**Mean**
F1	79.80	81.47	80.63	0.24	0.29	0.26	1.87	0.32	1.09
F2	61.05	77.94	69.49	0.36	0.36	0.36	1.51	0.17	0.84
F3	57.25	76.14	67.59	0.57	0.66	0.61	1.66	0.30	0.98
F4	33.69	44.41	39.05	0.51	0.52	0.51	1.40	0.14	0.77
F5	58.27	69.50	64.53	0.46	0.44	0.42	1.57	0.24	0.90
Mean	58.27	69.89		0.42	0.44		1.60	0.23	
F value of cultivars			15.37			0.12			469.34
LSD value of cultivars			6.09			-			0.12
F value of fertilizers			21.32			7.60			3.28
LSD value of fertilizers			9.64			0.22			0.28
F value of cultivars x fertilizers			1.04			0.35			0.53
LSD value of cultivars x fertilizers			-			-			-

n = nymph **p = pupae** **a = adult**

The differences of average numbers on the two cultivars were significant except for *B. tabaci* in the first season and not significant. Camarosa cultivar was characterized by low infestation of *T. urticae* and *B. tabaci* and preferred by *M. persicae* compared with the Osegrande cultivar. The average numbers of *T. urticae* and *B.* tabaci were higher in first season than that in the second one. Contrary *M. persicae* recorded high population in the second season than that in the first season. Data showed that the effect of fertilizer treatments was highly significant differences between the average numbers of *T. urticae* and *M. persicae* on the two cultivars and the treatments. The high average numbers of *T. urticae* (80.39 and 80.63 ind./leaf) and *M. persicae* (0.89 & 1.09 ind./leaf) were detected in the Microbein treatment for both seasons, respectively. While the lowest average numbers of *B. tabaci* was in the same treatment. The highest averages of *B. tabaci* was (1.44 ind./leaf) in the treatment of Microbein combined with 75 % of (RNPF) in the first season as compared with the check one. In the 2*nd* season, the highest average number of *B. tabaci* was (0.62 ind./leaf) in the treatment of Microbein combined with 50 % of (RNPF) which was nearly to that of the check one. The fertilizer treatment of 75 % of (RNPF) combined with Microbein was characterized by its lowest numbers of *T. urticae* and *M. persicae* during the two seasons compared with the check treatment, where *T. urticae* was of (56.66 & 39.00 ind./leaf) and for *M. persicae* (0.36 & 0.77 ind./leaf). Statistical analysis showed significant differences between the average numbers of each pest on two strawberry cultivars and the fertilizer treatments on the population of the three pests.

From Table (3), data showed that the high average numbers of *T. urticae* on Camarosa cultivar was (72.09 ind./leaf) in the Microbein biofertilizer treatment and the lowest average numbers was (48.42 ind./leaf) in the treatment of Microbein combined with 75 % of (RNPF) both compared with the check treatment (69.34 ind/leaf). The same trend was recorded for Oso Grande where the highest average was (88.69 ind./leaf) and the lowest average was (64.91 ind./leaf) in the Microbein and Microbein combined with 75 % of (RNPF) treatments, respectively, compared with the check one (73.89 ind./leaf). While the highest average number of *M. persicae* were recorded in the Microbein treatment (1.17 and 0.62 ind./leaf) for Camarosa and Oso Grande, respectively. The lowest average was recorded in the treatment of Microbein combined with 75 % (0.47 and 0.25 ind./leaf) for Camarosa and Oso Grande cultivar, respectively, both compared to the check treatment (0.67 and 0.37 ind./leaf) for both cultivars. Many studies found that the high level of nitrogen fertilizer caused high infestation of pests as Gabr (1991), Bentz *et al*. (1995) and Balaj and Veeravel (1977). Others deduced that the moderate level of nitrogen and the addition of phosphorus and potassium to nitrogen reduce the infestation of insect and with crop yield as Omar *et al*. (1993) found that the combination of nitrogen, phosphorus and potassium increase population of *M. persicae* and *T. urticae* on tomato plant. Megahed (1994) recorded that the combination of nitrogen and phosphorus fertilizer affected negatively the population density of *B. tabaci* and the addition of potassium decreased significantly the population. El-Sayed (1997) found that the numbers of thrips tended to decrease in density at high

potassium level for garlic plant. Sing *et al*. (1997) and Kumap *et al*. (1998) also deduced the same result for aphid on Brassica and Mustard treated with high level of nitrogen caused high infestation, while moderate level and combination gave lowering of infestation.

2- Fluctuation of pest population:

The fluctuation of the three pest populations were illustrated for both cultivars during the two seasons in Figs. (6A & B) and (7A & B). The population of *T. urticae* was recorded in low numbers at the beginning of the seasons then increased steadily till March and reaching its maximum population in April during the both seasons and for both cultivars. High population of *B. tabaci* was found on both cultivars in February in the second season, while its higher population was in December of the first season on Camarosa cultivar and in January on Oso Grande cultivar. The high population of *M. persicae* was detected in February on Camarosa cultivar and in January on Oso Grande cultivar during the two seasons. The results agree with Doss *et al*. (1997) they found that the infestation of *T. urticae* was during March reaching the maximum during April on six strawberry cultivars and *B. tabaci* reach its maximum population during November and December.

The results indicated that the fertilizer treatment of Microbein + 75 % of (RNPF) was the best one as compared with the check treatment, followed by the other three treatments where the infestation by three pests was lowest and the fruit yield was high. Increasing of *T. urticae* and *M. persicae* infestation was always associated with a decreasing in produced yield. The yield loss may be due to *T. urticae* fed on the flower buds and sap of strawberry plants.

fig6

fig7

CONCLUSION

From the previous results, we can deduce or recommend the using of the fertilizer treatment [Microbein + 75 % or 50 % (RNPF)] because it can guarantee of offering a high yield and good fruit quality beside a least infestation by pests and consequently a reduction in using chemical fertilizers, as well as, chemical pesticides which will in turn decrease the pollution of both fruit and environment. Moreover, it will be also more economic for the farmer himself.

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إستجابة صنفين من الفراولة للسماد الحيوى والكيماوى وأثر ذلك على الإصابة بالآفـــات

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أجريت الدراسة بمحطة بحوث البساتين بالقناطر لمدة موسمين متتاليين (١٩٩٩-٢٠٠٠) و (٢٠٠٠-٢٠٠١) لتقييم الإحلال الجزئى للسماد الكيماوى (نيتروجين وفسفور) بسماد الميكروبين الحيوى على كمية المحصول وجودة الثمرة (وزن، صلابة، المواد الصلبة الكلية الذائبة، الحموضة، فيتامين C) وكذلك تأثير هذه المعاملات على الإصابة بالافات (العنكبوت الأحمر، الذبابة البيضاء، والمنّ) لصنفى الفراولة (كماروزا و أوزوجراند) حيث كانت المعاملات كالاتى : ميكروبين، (ميكروبين + ٢٥، ٥٠، ٧٥ % من معدلات التسميد النيتروجينى والفسفورى الموصى به)، ومعاملة المقارنة (التسميد الموصى به بدون ميكروبين).

أظهرت النتائج فروق معنوية بين الصنفين حيث أن صنف كاماروزا كان الأعلى فى كمية المحصول وكذلك فى وزن الثمرة، الصلابة، نسبة الحموضة والمحتوى الفسفورى والبوتاسى للثمرة. بينما كان الصنف أوزجراند أكثر فى محتوى الثمار من المواد الصلبة الذائبة الكلية، فيتامين C وأعلى فى نسبة المحتوى النيتروجينى فى الثمرة.

أظهرت نتائج تأثير معاملات التسميد على المحصول عدم وجود فروق معنوية بين المعاملات فى الموسم الأول، بينما فى الموسم الثانى أعطت معاملة (الميكروبين + ٧٥ % من النيتروجين والفسفور الموصى بهما) أعلى محصول مقارنةً بمعاملة الكنترول. كذلك أعطت معاملات التسميد ومعاملة الميكروبين بمفرده مقارنة بمعاملة المقارنة نفس النتائج أو أعلى منها بالنسبة لوزن الثمرة والصلابة فى الموسم الأول (أبريل) وأعلى نسبة للمحتوى النيتروجينى والفسفورى للثمرة فى الموسم الثانى والعكس بالنسبة للمواد الصلبة الذائبة الكلية ومحتوى البوتاسيوم فى الثمرة فى الموسم الثانى. كما أظهرت الدراسة أنه لاتوجد فروق معنوية للمعاملات على الحموضة وفيتامين C فى الثمار.

بالنسبة للإصابة بالحشرات، أظهرت النتائج أن معاملة [ميكروبين + ٧٥ % من النيتروجين والفسفور الموصى بهما) كانت الأفضل حيث تميزت بقلة إصابة صنفى الفراولة بالعنكبوت الأحمر والمن خلال الموسمين، ويتبعها معاملة المقارنةوسجلت معاملة (الميكروبين فقط) أعلى إصابة بالافتين والعكس كان بالنسبة للذبابة البيضاء. تميز الصنف كماروزا بإصابة عالية من المنّ، بينما صنف الأوزجراند تميز بارتفاع الإصابة بالعنكبوت الأحمر والذبابة البيضاء، وكانت أعلى إصابة بالعنكبوت الأحمر فى شهر أبريل، بينما أعلى إصابة بالذبابة البيضاء والمن كانت فى شهر فبراير.

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