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EFFECT OF SOME MICROBIAL AND MINERAL FERTILIZERS ON QUALITY AND STORAGE ABILITY OF "ANNA" APPLE FRUITS BY

Fatma E. Ibrahim * and Gabr, M. A. **

* Department of Fruit Handling Researches
** Department of Deciduous Fruit Trees Researches
Horticulture Research Institute, A.R.C, Giza

ABSTRACT

The effect of microorganism biofertilizers beside mineral fertilizers with the hope of decreasing the use of mineral fertilizers, on fruit quality and storability was studied. Seven years old "Anna" apple trees budded on MM.106 rootstock grown at a newly reclaimed sandy soil, were involved in this study. The obtained results indicate that all biomicrobial fertilizer treatments improved fruits TSS while did not affect fruit texture, acidity and fruit color (L* & a* value) whereas caused a reduction in b* value. F3 treatment which received microbial fertilization + 25 % of recommended mineral fertilizers had fruits highest the loss of weight %, decay %, TSS %, while (F2) treatment which received microbial fertilization + 50 % of recommended mineral fertilizers significantly decreased fruit firmness.

Moreover, Storage period intervals gradually increased loss of fruit weight % and TSS while, decreased fruit firmness, texture and acidity %.There was no clear trend of storage intervals on fruit color (a* and b* value) during storage in both seasons.

Besides, no decayed fruits were obtained until 60 days of storage under 0°C. Records of (L* value) increased gradually from 0 day up to 60 days since their records significantly decreased at 80 days interval then resumed the increase at 100 days of storage period. At 0 day, fruit color (a* and b* value) and TSS recorded the lowest values, while acidity % was the highest. Although, 20 and 40 days of storage intervals recorded the highest a* and b* values, respectively, 100 days storage recorded the lowest values of acidity. These study showed that using microbial fertilizers beside 50 % of recommended mineral fertilizers give the more preferable dose in producing fruits with high quality and long storageability.

INTRODUCTION

Apple (Malus domestica, Borkh) is the most popular fruit in the local Egyptian markets. Its productivity reached about 533360 tons in 2003 (Ministry of agriculture and soil reclamation statistics, 2003) 'Anna' is the greatest cultivated variety of apples for its low chilling requirements, high productivity, regular bearing and acceptable fruit characters.

Concerning the non-target effects of chemical fertilization employed in agriculture on tree nutrition towards integrated management technique that employ combinations of cultural practices like microbial fertilization and the use of chemical fertilizers in its different phases to provide trees with nutrient elements. So the biological fertilizers have a great importance over the chemical fertilizers from the standpoint of environmental safety, quality of fruits. Accordingly, during the last decade, several studies were carried out on the dual inoculation of different plants with nitrogen fixers (NF) and arbuscular mycorrhizal (AM) fungi, (Rahman and Parsons, (1997); Amora-Lazcano *et al.*, (1998) and Bethlenfalvy *et al.*, (1999). Johnson and Hummel (1985) reviewed that infection of plant roots with vesicular arbuscular mycorrhizal (VAM) fungi enhanced element uptake, water uptake and growth, which in turn could affect fruit quality during storage period.

Preharvest factors can influence most, if not all, quality parameters of tropical and subtropical fruits (Hofman and Smith, 1993). General relationships are noted in temperate and tropical fruits between nitrogen and color, disorders, postharvest disease incidence, fruit size and firmness (Raese and Williams, 1974). Improvement of biofertilizers for fruit quality were stated on fruit weight, volume, color, firmness, juice volume, V.C content, TSS and acidity % of pomegranate (Safia *et al.*, 1999) flame seedless grapevine, (El-Sayed, 2002; Ahmed *et al.*, 2003 and Abd El-Hady, 2003), 'Ettmani' guava (El- Sharkawy and Mehaisen, 2005) and 'Canino' apricot (Ibrahim *et al.*, 2005), as well as, reducing weight loss % of coriander; parsley and dill herbs during storage period (Nahed Rashed, 1999). On the other hand, different rates of fertilizers had a marked effect on the intensity and direction of proto pectin hydrolysis, respiration, polyphenol oxidase and ascorbic oxidase activities in stored fruits. The climacteric rise of respiration in fruits with using high fertilizer rates started considerably earlier than control fruits (Guz and Paduchikh, 1984).

Therefore, the present study was conducted to decrease the use of chemical nitrogenous and phosphorus fertilizers via using a suitable microbial fertilizers for 'Anna' apple trees and their influences on fruit quality and storage ability.

MATERIALS AND METHODS

This study has been conducted on seven years old 'Anna' apple trees budded on MM.106 rootstock during three successive seasons of 2002, 2003 and 2004 (the recorded data were only for 2003 & 2004 seasons). Trees were grown at Elbostan district of Elbehira governorate where drip fertigation system was applied.

All trees were subjected to the common horticultural practices, while treatments were applied as follow:

1. (C): Control trees received only a recommended doses of chemical fertilizers (0.750 Kg ammonium sulphate + 1.0 Kg calcium super- phosphate + 1.0 Kg potassium sulphate) per tree according to Wassel *et. al.* (1996) and Mansour, (1998).

2. (F1): Trees were microbial, inoculated and received 100% of recommended doses of chemical fertilizers.
3. (F2): Trees were microbial inoculated combined with 50% of recommended doses of chemical fertilizers.
4. (F3): Trees were microbial inoculated combined with 25% of recommended doses of chemical fertilizers.

Anyhow, Microbial inoculum consisted of bacterial strains of asymbiotic nitrogen fixers found on "Biogine" and " Rhizobacterine " while phosphorus release bacteria found on " Phosphorine " and vesicular arbuscular mycorhizal (VAM) fungi. Biogine, Rhizobacterine and Phosphorine were a traditional biomicrobial fertilizers produced by General Authority of Agricultural Equilibrium Fund, Giza, Egypt. The mycorhizae inoculum was prepared and provided from Soil Microbiology Laboratory of Sakha Agricultural Research Station (A.R.C.).

Inoculation of trees was applied at the end of February (immediately after the bud burst) added in six holes (5 cm in wide and 3 cm in depth) of soil per tree; under drippers were rhizosphere, when trees were irrigated. Each tree received 5 gm. Biogine + 5 gm. Rhizobacterine + 5 gm. Phosphorine + 5 gm. of arbuscular mycorrhizal (AM) fungi.

At all events, treatments were arranged as a factorial experiment in a random complete blocks design. Computerized statistical analyses were done for data by 'Irristat' package. Samples of fruits from each fertilization treatment were picked when the total color of fruits reached about 50 %, fruit firmness was nearly 12 Lb/inch^2 and T.S.S was around 10.5 according to the optimum indices of maturity carried out by ADS project (1982) . Each 30 fruits were considered as a replicate of storage interval and packed in carton boxes and dressed in polyethylene sheets (30 mm.). All fruits were stored for twenty days intervals, at 0° C and 90 - 95% relative humidity up to 100 days. At the end of every storage period, fruits were taken for conducting the following estimates:

1. **Physical changes and decay disorders:**

a. Percentage of decay: decay percentage was determined for each treatment according to McCormack and Brown (1973).
b. Percentage of weight loss was calculated according to the initial weight.
c. Fruit firmness: Magness – Taylor type pressure tester has a standard 7/16 of inch^2 plunger was used to determine fruit firmness (Lb/inch^2).
d. Fruit texture was determined by using a modern texture analyzer instrument by penetrating a cylinder (3mm. diameter) to constant distance with a constant speed (2mm./second). The results were expressed as a resistance force of the skin (gm. /cm.^{2}) for initial every twenty days intervals during storage period.
e. Peel color measurements (L, a & b values): where a* (green-red), b* (blue-yellow) and L* (gloss) scale readings were determined by using a Hunter colorimeter type: DP - 9000. The instrument was calibrated with white and black standards as recommended by McGuire, 1992 and Voss, 1992.

2. **Chemical properties:**

Total soluble solids (TSS %) was determined by using Abbe refractometer and total acidity percentage was expressed as percent Malic acid per 100g juice and estimated according to A.O.A.C., (1990).

3. **Statistical analysis:**

From the statistical point of view, the completely randomized design was adopted.

The obtained data were statistically analyzed according to Snedicor and Cochran (1990) using the new L.S.D values.

RESULTS AND DISCUSSION

Fruit weight Loss percentage:

Biomicrobial combined with mineral fertilizers data of Table (1) illustrated that regardless of storage period, treatment F3 (microbial fertilization + 25 % of recommended mineral fertilizers) had the highest significant loss of weight percentage of 5.38 & 5.26 % against 3.49 & 3.08 % of the control in both seasons. On the other hand, trees received microbial fertilization + 50 or 100% of recommended mineral fertilizers (F2 & F3) did not affect loss of weight percentage of 'Anna' apple fruits, significantly.

As for storage intervals, regardless of fertilization treatments, data showed that loss of weight percentage of 'Anna' apple fruits significantly increased as storage period was advanced. It was clear that rate of weight loss of fruits increased gradually from starting storage period, up to 20, 40, 60, 80 and then 100 days. Significant differences were mostly noticed among intervals of storage period.

Referring to the interaction between fertilization treatments and storage intervals, data of Table (1) showed that treatment (F3) after 100 days of storage had the highest significant loss of weight percent which gave 10.79 & 10.58 % in both seasons, respectively.

The obtained results confirmed those reported by Tang *et al.*, (1989). They found that Bio – microbial fertilization reduced weight loss % during storage through reducing the moisture loss, which may be due to enhancing calcium absorption and transportation to the upper part of bearing trees that increased fruit content of calcium.

Fruit decay percentage:

Data tabulated in Table (2) show that regardless of storage interval, treatment F3 had the highest significant fruit decay percentage as it gave 8.34 & 5.56 % compared with the control (2.78 & 1.85 %) in both seasons. On the other hand, F2 & F3 treatments did not affect decay % of 'Anna' apple fruits, significantly.

Table (1): Effect of some biomicrobial and mineral fertilizers on loss weight % of 'Anna' apple fruits during cold storage (0° C).

Treat.*(A)	Storage period in days (B)												Mean	
	0		20		40		60		80		100			
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
F1	0	0	1.26	1.12	2.32	2.13	3.64	3.29	4.80	4.55	7.29	7.07	3.22	3.03
F2	0	0	1.48	1.48	2.79	2.93	4.08	4.06	5.55	4.55	7.71	8.53	3.60	3.59
F3	0	0	1.92	1.78	3.94	3.84	6.26	6.74	9.36	8.60	10.79	10.58	5.38	5.26
Control	0	0	1.51	1.24	2.70	2.21	4.45	3.83	5.24	5.27	7.03	5.95	3.49	3.08
Mean	0.00	0.00	1.54	1.41	2.94	2.78	4.61	4.48	6.24	5.74	8.21	8.03	3.92	3.74
L.S.D at 5% **			A				B				A x B			
1st Season			0.3675				0.4501				0.9002			
2nd Season			0.402				0.4254				0.5210			

Table (2): Effect of some biomicrobial and mineral fertilizers on decay % of 'Anna' apple fruits during cold storage (0° C).

Treat.*(A)	Storage period in days (B)												Mean	
	0		20		40		60		80		100			
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
F1	0	0	0	0	0	0	0	0	0	0	11.11	11.11	1.85	1.85
F2	0	0	0	0	0	0	0	0	5.56	0	16.67	22.22	3.71	4.63
F3	0	0	0	0	0	0	5.56	0	16.67	0	27.78	22.22	8.34	5.56
Control	0	0	0	0	0	0	0	0	0	0	16.66	11.11	2.78	1.85
Mean	0.00	0.00	0.00	0.00	0.00	0.00	1.39	0.00	5.56	0.00	18.06	16.67	4.17	3.47
L.S.D at 5% **			A				B				A x B			
1st Season			3.465				4.244				8.487			
2nd Season			3.924				4.807				9.614			

*:- C: Control - F1: biomicrobial fertilization + 100% of recommended mineral fertilization doses – F2: biomicrobial fertilization + 50% of recommended mineral fertilization doses – F3: biomicrobial fertilization + 25% of recommended mineral fertilization doses

As respect of storage intervals, data of Table (2) cleared that there was no decayed fruits until 60 days of storage under 0° C. while fruits started to be decayed after 60 days storage in 2003 season and 100 days in 2004 season. 100 days of storage period recorded the highest significant percent of decayed fruits which reached 18.06 & 16.67 % in both seasons.

Referring to the interaction between fertilization treatments and storage periods, data showed that F3 treatment after 100 days of storage had the highest significant decay percentage as it gave 27.78 & 22.22 % in both seasons, respectively. Indirectly, inoculation with bio – microbial fertilizers could introduce a suitable condition for the tree to improve its physiological status which gives a chance to produce fruits with good qualities and store well.This role may be due to enhancing calcium absorption and transportation to the upper part of bearing trees (Tang *et al.*, 1989) which increased fruit content of calcium and directly affected reducing decay %.

Fruit firmness:

Data of Table (3) cleared that regardless of storage intervals, treatment F3 which received microbial fertilization + 25% of recommended mineral fertilizers had the highest fruit firmness as it recorded 10.03 & 9.75 in both seasons, respectively. Statistical analyses on the other hand, showed that differences were significant in the second season only as compared with the control (9.80 & 9.51). These treated trees with microbial fertilization + 50 % of recommended mineral fertilizers (F2) decreased fruit firmness of 'Anna' apples in 2003 season, significantly.

As for storage periods, regardless of fertilization treatments, data showed that fruit firmness was significantly decreased with ascending order with advanced storage, in both seasons. It was clear that rate of fruit firmness gradually decreased as storage periods increased. Statistical analyses showed that differences among intervals of storage period were almost significant.

As respect of the interaction between fertilization treatments and storage intervals, data of Table (3) indicated that treatment F3 at 0 day of storage had the highest fruit firmness as gave 13.7 & 13.6 in both seasons, respectively. On the other hand, F2 treatment after 100 days of storage under 0° C recorded the lowest fruit firmness (5.9 & 5.1) in both seasons. The obtained results confirmed those reported by El – Sharkawy and Mehaisen (2005). They found that 50 % of chemical fertilizers + bio – fertilizers induced the highest reduction in fruit firmness.

Fruit texture:

Table (4) showed that all treatments did not affect significantly fruit texture in comparison with the control in both seasons. F2 & F3 treatments increased fruit texture of 'Anna' apples without significant differences in the second season.

Table (3): Effect of some biomicrobial and mineral fertilizers on firmness (lp/in^2) of 'Anna' apple fruits during cold storage (0°C).

Treat.*(A)	Storage period in days (B)												Mean	
	0		20		40		60		80		100			
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
F1	13.7	13.6	11.8	12.1	10.2	10.6	9.2	9.1	7.7	6.8	6.1	6.1	9.78	9.72
F2	12.3	13.1	12.0	12.3	10.3	10.7	8.7	8.8	7.6	6.1	5.9	5.1	9.47	9.35
F3	12.6	13.4	12.0	12.2	11.2	10.9	9.9	9.9	8.1	6.8	6.4	5.3	10.03	9.75
Control	13.3	13.3	11.8	11.7	10.6	10.3	9.8	8.8	7.9	6.1	6.1	5.2	9.92	9.23
Mean	12.98	13.35	11.90	12.08	10.58	10.63	9.40	9.15	7.83	6.45	6.13	5.43	9.80	9.51
L.S.D at 5% **			A				B				A x B			
1st Season			0.3693				0.4523				0.9047			
2nd Season			0.3872				0.4742				0.9484			

Table (4): Effect of some biomicrobial and mineral fertilizers on Texture (3mm) of 'Anna' apple fruits during cold storage (0°C).

Treat.*(A)	Storage period in days (B)												Mean	
	0		20		40		60		80		100			
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
F1	0.105	0.128	0.078	0.067	0.060	0.069	0.055	0.061	0.042	0.038	0.028	0.031	0.061	0.066
F2	0.090	0.106	0.065	0.089	0.066	0.073	0.056	0.063	0.038	0.035	0.026	0.029	0.057	0.066
F3	0.092	0.115	0.074	0.061	0.079	0.063	0.044	0.050	0.031	0.029	0.025	0.025	0.058	0.057
Control	0.098	0.104	0.078	0.079	0.064	0.072	0.059	0.061	0.041	0.039	0.036	0.033	0.063	0.065
Mean	0.096	0.113	0.074	0.074	0.067	0.069	0.054	0.059	0.038	0.035	0.029	0.030	0.060	0.063
L.S.D at 5% **			A				B				A x B			
1st Season			0.002122				0.002599				0.005197			
2nd Season			0.007610				0.008218				0.01644			

*:- C: Control - F1: biomicrobial fertilization + 100% of recommended mineral fertilization doses – F2: biomicrobial fertilization + 50% of recommended mineral fertilization doses – F3: biomicrobial fertilization + 25% of recommended mineral fertilization doses

As respect of storage period, data of Table (4) showed that fruit texture decreased significantly as storage period advanced in both seasons. The highest significant values of fruit texture were recorded for 0 day storage (0.096 & 0.113), while lowest significant values were obtained after 100 days storage (0.29 & 0.30). Other intervals of storage period were in between. Differences among intervals of storage period under 0° C were significant statistically.

Concerning the interaction between fertilization treatments and storage intervals, it is quite evident that F1 treatment at 0 day of storage had the highest significant fruit texture as it recorded 0.108 & 0.128 in both seasons, respectively. F3 treatment gave the other way around in this respect when it (0.025) recorded in both seasons. Indirectly, inoculation with bio – microbial fertilizers could introduce suitable conditions for the trees improve its physiological status which give a chance to produce fruits with good qualities and storage ability. This role may be due to enhancing calcium absorption and transportation the upper part of bearing trees Tang *et al.*, (1989). Increased fruit content of calcium and directly affected fruit firmness and texture.

Fruit color (L* value):

Data of Table (5) showed that all fertilizer treatments used did not affect fruit color significantly with one exception, where treatment F3 reduced L* value which recorded the lowest significant value (39.42) in season 2003.

As respect of storage period, data observed that L* value increased gradually in a significant manner from 0 day (39.87 & 36.88) up to 60 days (44.9 & 43.91) of storage under 0° C. condition in both seasons. Rapidly, L* value records significantly decreased at 80 days interval (38.49 & 36.85) and then increased at 100 days (44.26 & 49.64) of storage period.

Referring to the interaction between fertilization treatments and storage intervals, data of Table (5) showed that treatment which received fertilization treatment + 25% of recommended mineral fertilizers (F3) at 40 days of storage recorded the lowest L* value which gave 32.7 in season 2003. While, in the same season and at the same interval, treatment of (F1) (fertilization treatment + 100 % of recommended mineral fertilizers) recorded the highest L* value which gave 55.39.

Fruit color (a* value):

Data of Table (6) showed that regardless of storage interval, all fertilizer treatments did not affect significantly a* value of fruit peel color. In spite of (F2 & F3) treatments which received fertilization + 50 & 25% of recommended mineral fertilizers respectively increased a* value, but significant differences were nil as compared with the control.

Concerning storage intervals period, data illustrated that there was no clear trend of storage intervals concerning a* value records during storage periods in both seasons. Although, at the initiation of storage (0 day), a* value recorded the lowest value (22.16 & 23.27), while 20 days of storage interval took the other way around as it gave (33.0 & 33.21) in both seasons, respectively.

Table (5): Effect of some biomicrobial and mineral fertilizers on color (L* value) of 'Anna' apple fruits during cold storage (0°C)

Treat.*(A)	Storage period in days (B)												Mean	
	0		20		40		60		80		100			
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
F1	37.76	36.60	42.64	44.14	55.39	39.27	44.09	38.00	36.50	38.25	44.62	50.30	43.50	41.09
F2	38.86	36.20	46.53	43.33	43.33	44.87	44.05	39.15	36.96	35.17	40.36	49.64	41.68	41.39
F3	37.84	38.71	43.48	42.58	32.70	44.90	42.75	47.58	36.34	37.43	45.83	46.73	39.82	42.99
Control	45.01	35.99	37.03	42.91	46.23	45.86	48.72	50.91	44.17	36.56	46.21	51.89	44.56	44.02
Mean	39.87	36.88	42.42	43.24	44.41	43.73	44.90	43.91	38.49	36.85	44.26	49.64	42.39	42.37
L.S.D at 5% **			A				B				A x B			
1st Season			3.629				4.444				8.889			
2nd Season			3.413				4.180				8.359			

Table (6): Effect of some biomicrobial and mineral fertilizers on color (a* value) of 'Anna' apple fruits during cold storage (0°C).

Treat.*(A)	Storage period in days (B)												Mean	
	0		20		40		60		80		100			
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
F1	25.75	24.69	28.32	27.46	19.97	27.67	26.45	30.30	26.84	22.73	28.47	22.32	25.97	25.86
F2	25.25	22.29	31.85	30.72	34.66	25.14	31.33	36.69	22.97	28.49	36.17	23.81	30.37	27.86
F3	20.92	20.49	33.09	34.90	29.15	29.28	36.38	31.19	23.00	21.19	25.45	30.45	28.00	27.92
Control	16.72	25.59	38.75	39.74	31.89	23.29	24.25	22.72	20.06	23.63	24.49	20.20	26.03	25.86
Mean	22.16	23.27	33.00	33.21	28.92	26.35	29.60	30.23	23.22	24.01	28.65	24.20	27.59	26.87
L.S.D at 5% **			A				B				A x B			
1st Season			5.312				6.506				13.01			
2nd Season			4.269				5.229				10.46			

*:- C: Control - F1: biomicrobial fertilization + 100% of recommended mineral fertilization doses – F2: biomicrobial fertilization + 50% of recommended mineral fertilization doses – F3: biomicrobial fertilization + 25% of recommended mineral fertilization doses

Data of the interaction between microbial fertilization treatment and storage interval, showed that apples of the control recorded the significant lowest a* value as gave 16.72 at 0 day of storage in season of 2003. On the other hand, treatment F2 (microbial fertilization + 50 % of recommended mineral fertilizers) recorded the highest a* value (36.69). These results are in harmony with those obtained by Abdel – Hamid *et al.*, (2004), on "Crimson Seedless" grape. They found that treatments of 50 % or 25 % nitrogen fertilization + bio – fertilizer were superior in their effect in increasing anthocyanin pigment content.

Fruit color (b* value):

Table (7) showed that regardless of storage period intervals, all treatments of fertilization used reduced significantly b* value of fruit peel. Control apples fruits recorded the highest significant values (25.27 & 31.72) in both studied seasons, respectively.

As respect of storage period intervals, without considering treatments of fertilization treatments, data demonstrated that there was no clear trend of storage. Whatever, at starting of storage period (0 day), b* value of 'Anna' apples recorded the lowest value (13.68), when 40 days interval fruit storage was concerned as it gave (34.48) in the first season.

Regardless the interaction between fertilization treatments and storage period intervals, data of Table (7) showed that control apple fruits recorded the lowest with highest significant b* value (13.13 – 47.22) at 0 and 60 days of storage respectively, in season of 2003.

Total soluble solids percentage (TSS %):

Data presented in Table (8) clearly showed that regardless of storage period intervals, all fertilizer treatments used improved juice total soluble solids percentage (TSS) of 'Anna' apple fruits. Treatment F3 had the highest significant TSS where it recorded 13.02 & 13.58 % as compared with the control (12.78 & 13.22 %) in both seasons. Whatever, fertilization treatment + 100 or 50 % of recommended mineral fertilizers (F1 & F2) improved total soluble solids % without significant differences.

As for storage period intervals, data showed that TSS was significantly increased in ascending order with increasing storage period. Difference among intervals was almost statistically significant.

The obtained results are assured by the findings of Safia *et al* (1999). They found that yeast soil application (Sacchromyces cerevesiae) on Manfalouty Pomegranate increased T.S.S %. Moreover, Mansour (1998) on "Anna" apples, found that bio – fertiligation with phosphorene, active dry yeast and Nitrobeine significantly improved quality of fruits mainly increasing total soluble solids.

Table (7): Effect of some biomicrobial and mineral fertilizers on color (b* value) of 'Anna' apple fruits during cold storage (0°C).

Treat.*(A)	Storage period in days (B)												Mean	
	0		20		40		60		80		100			
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
F1	14.25	13.00	23.69	22.49	14.44	39.40	25.48	25.22	14.93	14.43	32.50	25.48	20.88	23.34
F2	13.08	14.93	21.23	24.97	14.56	32.55	40.45	23.19	14.69	11.72	31.36	22.10	22.56	21.58
F3	14.26	12.24	21.63	23.58	15.37	31.25	24.15	30.12	12.68	14.42	27.94	28.20	19.34	23.30
Control	13.13	18.48	22.39	65.05	16.63	34.73	47.22	28.88	17.77	15.25	34.50	27.92	25.27	31.72
Mean	13.68	14.66	22.24	34.02	15.25	34.48	34.33	26.85	15.02	13.96	31.58	25.93	22.01	24.98
L.S.D at 5% **			A				B				A x B			
1st Season			2.574				3.153				6.306			
2nd Season			3.036				3.718				7.436			

Table (8): Effect of some biomicrobial and mineral fertilizers on TSS % of 'Anna' apple fruits during cold storage (0°C).

Treat.*(A)	Storage period in days (B)												Mean	
	0		20		40		60		80		100			
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
F1	12.4	12.8	12.6	13.7	13.1	13.2	13.1	13.5	13.1	12.9	13.3	13.5	12.93	13.27
F2	11.9	12.6	12.3	13.1	13.5	13.1	13.9	13.1	12.3	13.1	13.7	13.1	12.93	13.02
F3	12.0	13.3	12.2	13.3	12.9	13.5	13.2	13.8	13.8	13.7	14.0	13.9	13.02	13.58
Control	11.9	13.1	12.0	13.0	13.0	13.2	13.2	13.4	13.0	13.1	13.6	13.5	12.78	13.22
Mean	12.05	12.95	12.28	13.28	13.13	13.25	13.35	13.45	13.05	13.20	13.65	13.50	12.92	13.27
L.S.D at 5% **			A				B				A x B			
1st Season			0.1775				0.2174				0.4348			
2nd Season			0.09489				0.1162				0.2324			

*:- C: Control - F1: biomicrobial fertilization + 100% of recommended mineral fertilization doses – F2: biomicrobial fertilization + 50% of recommended mineral fertilization doses – F3: biomicrobial fertilization + 25% of recommended mineral fertilization doses

Meanwhile, the interaction between fertilization treatments and storage period intervals showed that treatment F3 at 100 days of storage had the significant highest TSS as it gave 14.0 & 13.9 % value in both seasons, respectively. On the other hand, the control treatment at 0 day recorded the lowest TSS percent (11.9 %) in 2003 season. The obtained results are also assured by the findings of Abdel – Hamid *et al.*, (2004) on "Crimson Seedless" grape. They found that a slight increase in T.S.S % was obtained with treatments of 50 or 25 % nitrogen fertilization + bio – fertilizer.

Acidity percentage:

Regardless of storage period intervals, data of Table (9) declared that fertilizer treatments did not show any clear affect on fruit juice acid content. In spite of microorganism fertilization treatments, acidity % increased in first season but they reduced in the second one, without significant differences in both. Whatever, control treatment gave the highest significant acidity percent (0.58 %), but F1 treatment recorded the lowest one (0.52 %) in the second season. Other treatments were in between.

As respect of storage period intervals, data of Table (9) showed that acidity percentage content significantly decreased with ascending order as storage period advanced with significant differences among intervals.

Referring to the interaction between fertilization treatments and storage period intervals, data of Table (9) indicate that acidity % of 'Anna' apple fruits showed that the control treatment at 0 day of storage had the highest significant acidity percentage as it gave 0.75 & 0.96 % in both seasons, respectively. On the other side, after 100 days of storage, treatment F3 had the lowest significant acidity % as recorded 0.42 & 0.41 % in both seasons.

The obtained results are confirmed with those reported by Abdel – Hamid *et al.*, (2004) on "Crimson Seedless" grape. They found that the least titratable acidity was obtained with treatment of 50 % nitrogen fertilization + bio – fertilizer.

Also these results go in line with those reported. Also Safia *et al* (1999). They found that yeast soil application (Sacchromyces cerevesiae) on Manfalouty Pomegranate, decreased total acidity. Similar results were also obtained by Mansour (1998) on "Anna" apples. He found that, bio – fertilization with phosphorene, Active dry yeast and Nitrobeine significantly improved fruit quality as it caused a decrease in total acidity in fruit juice.

CONCLUSION

Concisely, the obtained results of this study can conclude as follow:

1- Microorganism's bio – fertilization was revealed to be effective in reducing the chemical fertilization as it improved fruit quality and storability of "Anna" apples.

Table (9): Effect of some biomicrobial and mineral fertilizers on acidity % of 'Anna' apple fruits during cold storage (0° C).

Treat.*(A)	Storage period in days (B)												Mean	
	0		20		40		60		80		100			
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
F1	0.69	0.64	0.58	0.59	0.56	0.58	0.47	0.47	0.47	0.44	0.45	0.40	0.54	0.52
F2	0.73	0.70	0.67	0.68	0.58	0.52	0.45	0.47	0.50	0.48	0.43	0.44	0.56	0.55
F3	0.75	0.74	0.65	0.67	0.52	0.56	0.40	0.41	0.46	0.44	0.41	0.40	0.53	0.54
Control	0.75	0.96	0.51	0.51	0.58	0.62	0.49	0.54	0.43	0.42	0.39	0.41	0.53	0.58
Mean	0.73	0.76	0.60	0.61	0.56	0.57	0.45	0.47	0.47	0.45	0.42	0.41	0.54	0.55
L.S.D at 5% **			A				B				A x B			
1st Season			0.02122				0.02599				0.05197			
2nd Season			0.02225				0.02725				0.05451			

*:- C: Control - F1: biomicrobial fertilization + 100% of recommended mineral fertilization doses – F2: biomicrobial fertilization + 50% of recommended mineral fertilization doses – F3: biomicrobial fertilization + 25% of recommended mineral fertilization doses

2- Bio – microbial fertilization + 50 % as a recommended mineral fertilization dose, caused the lowest percentages of fruit weight loss, decay and acidity content of "Anna" apples.
3- Bio – microbial fertilization + 25 % as a mineral fertilization dose, gave the highest b* value and total soluble solids during cold storage.

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تأثير بعض المخصبات الحيوية والتسميد المعدنى على الجودة والقدرة التخزينية لثمار التفاح "الأنا"

فاطمة عصمت إبراهيم ، محمد عبد السلام جبر

معهد بحوث البساتين – مركز البحوث الزراعية – الجيزة.

- أجريت الدراسة خلال موسمى ٢٠٠٣ & ٢٠٠٤ بمعهد بحوث البساتين – قسم بحوث تداول الفاكهة على ثمار تفاح "أنا" قطفت فى مرحلة اكتمال النمو حيث تم فرز الثمار لاستبعاد التالف والغير مطابق للمواصفات ، ثم عبئت الثمار فى عبوات كرتون سعة ٣ كجم وتم التخزين على درجة الصفر المئوى ورطوبة نسبية ٩٠ – ٩٥ % لمدة ١٠٠ يوم وقدرت بعض الصفات الطبيعية والكيميائية للثمار طوال فترة التخزين .

- وجد أن المعاملة بالتسميد الحيوى + ١٠٠ % أو ٥٠ % تسميد معدنى أدت إلى تقليل النسبة المئوية للفقد فى الوزن مع زيادة فى صلابة وقوام الثمار، كما وجد أن المعاملة بالتسميد الحيوى + ١٠٠ % تسميد معدنى وكذا الكنترول أدت إلى تقليل النسبة المئويه للتالف فى الموسمين .
- زادت النسبة المئوية للفقد فى الوزن والتالف من الثمار بزيادة فترة التخزين ولم تتأثر قيم*b (تطور اللون من الأزرق إلى الأصفر) وقيم *a (تطور اللون من الأخضر إلى الأحمر) بزيادة فترة التخزين . بينما زادت قيم *L (اللمعان) بالتقدم فى التخزين حتى ٦٠ يوم ثم بدأت القيم فى النقصان عند ٨٠ يوم ثم إزدادت مرة أخرى حتى ١٠٠ يوم من التخزين البارد.
- زادت نسبة المواد الصلبه الذائبة بالمعاملة بالتسميد الحيوى + ٢٥ % تسميد معدنى بزيادة فترة التخزين البارد. وعموما فإن نسبة المواد الصلبة الذائبة فى الثمار تزداد بزيادة فترة التخزين البارد خلال الموسمين.
- عموما يتضح من البحث أن إستخدام التسميد الحيوى + ٥٠ % تسميد معدنى أدى إلى تحسين صفات الجودة للثمار لفترة ١٠٠ يوم تخزين بارد وبالتالى تخفيض الكمية المستخدمة من التسميد المعدنى وبالتالى تقليل التكاليف .