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EFFECT OF SOME PREHARVEST ORGANIC TREATMENTS ON QUALITY OF MANGO FRUITS DURING STORAGE

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ABSTRACT: *The present study was carried out at Horticultural Research Station at El – Kanater El-Khaireia, Kalyubeia, Governorate, on the mango trees (Alphonse cv.). Fruits were healthy, nearly uniform in their shape, vigor, size in possible, during the successive two seasons (2010 and 2011). Yeast was used as soil and foliar application at rate 10 L. fed.$^{-1}$. Mixed cultural (1:1:1) from Azotobacter chroococcum, Bacllius megaterium and Bacllius circulans as a source of biofertilizers of N, P and K respectively at rate of 5 L. fed.$^{-1}$. The both microorganism were used in presence of 50 % from mineral nitrogen fertilizer. Compost was used at rate of 12 ton fed.$^{-1}$ (equal 25 kg compost per tree). All these organic preharvest treatments were applied on mango trees to study its effect on growth, fruit quality and enhancement of fruit storability as compared to treatment which received recommended NPK mineral fertilizer. Collected fruits from each treatment and stored at 8 °C, 85 – 90 % RH or ambient temperature (28 ±2 °C) and 65 % RH with or without packing with ceran shrinkable film of low density polyethylene and studying some physical and chemical properties of fruits. The obtained results clearly showed that the application of various organic treatments had a significant effect on all fruit quality parameters tested, where it reduced physiology loss weight, slow change in acid content, and slower decrease in V. C and increased both total sugars and TSS. All studied treatments which received preharvest organic treatments exhibited significant higher contents of fruit nutrients as compared to the mineral fertilizers (NPK).*

Key word: *Organic- biofertilizer- Mango fruits-cold storage-packaging.*

INTRODUCTION

Mango (*Mangifera indica* L.)Is one of the most important tropical fruits marketed throughout the world. As well as in Egypt, preferred for its high nutritional value and its good taste. It is considered as the third main fruit crop, the fruiting area under mango orchards reached 169068 feddans produced 598084 ton fruits according to 2011 statistics. Alphonso is the most popular mango (*Anacardiceae, Mangifera indica* L.) cultivar in Egypt; this fruit is blessed with attractive color, ample, sweet, low fiber-containing pulp and short shelf life. However, there are several problems associated with the marketing of mango fruit. Mangoes soften very quickly and extensively. Loss of fruit firmness increases susceptibility to bruising and decay during shipping and storage. Application of some organic treatments in mango orchard organic fertilizer (compst and or biofertilizer) means producing clean fruits and juice as well as increased quality and shelf life of the produced fruit. Biofertilizer and/or compost for fruit crops has called the attention of research workers particularly mangoes growers to achieve: 1.

Reducing plant requirements of mineral nitrogen by more than 25%, 2) improving the availability of various nutrients for plant uptake, 3) increasing the resistance of plant to root diseases, 4) improving the productivity of trees, 5) improvement fruit quality and 6) reducing the environmental pollution (Kannaiyan, 2002, Planes-Leyva *et al*, 2003, Abd El-Naby 2000, Abd El-Moniem-Eman *et al* 2003, El-Mehrat 2005, Mohamed *et al* 2008 and Ahmed, 2012). Natural preharvest treatments and packaging help up to 80% loss of the fruit by fungal attack before being fully ripe. It is important to reduce the rate of fruit softening to maintain the fruits inherent resistance to bruising and decay. The main objective of the study was elucidating effect of application of some organic treatments on

the subsequent storage behavior of mango fruits as well as estimating the suitable temperature and best method of fruit wrapping that extends the storage life and keeping fruit quality.

MATERIALS AND METHODS

The present work was carried out for two consecutive seasons (2010 and 2011) at the farm of Horticultural Research Station at El-Kanater, El-Khaireia, Kalyabeia Governorate, on mango fruits (Alphonse cultivar). Twenty one fruitful trees of about 20 years old were selected. The trees were healthy, nearly uniform in their shape, vigor, possible size and representive for both orchard and cultivar. The mechanical, physical and chemical analysis of soil used are shown in Table (1) according to Jackson 1973. Three types of organic cultural treatments were used as follows, 1) Yeast was applied at two methods the first one as foliar spray and the second as soil addition, both methods at rate 10 L/fed., 2) plant growth promoting rhizobactria (PGPR) are used as biofertilizers and the bacterial used were *Azotobacter chroococum* as free N-fixing bacteria, *Bacillus megathreum* as phosphate dissolving bacteria and *Bacillus circulans* as potassium releas bacteria. The mixed cultural from prevorius bacteria were used at rate 5L/fed, the number for each culture was (-x10 ^{9} cell / mel) Liquid culture. These strains of yeast and PGPR were kindly obtained from Biofertilizer Production Unit, Microbiology Department Soil, Water and Environment Institute, and 3) added organic fertilizer (compost) at rate 25 Kg compost/tree (equal 12 tons/fed.) Table (2) shows some physical and chemical analysis for compost used. NPK-mineral fertilizers were used at two levels (100 and 50%) of recommended doses. 7 treatments were applied as follows:

1- Control treatment, where the trees received 100% NPK mineral fertilizers (T1).
2- Control treatment, where the trees received 50% NPK mineral fertilizers (T2).
3- The trees treated with foliar spray of yeast (10L/fed) + 50% of mineral NPK (T3).
4- The trees treated with soil application of yeast (10L/fed)+50% of mineral NPK (T4).
5- The trees treated with PGPR (5L/fed) +50% of mineral NPK (T5).
6- The trees treated with 25 Kg compost/tree + PGPR (T6).
7- The trees treated with 25 Kg compost/tree + foliar yeast (T7).

The trees were subjected to the pervious treatments at fixed timing during March, April, and May of every season. The harvested yield of every trees used as a single replicate, then divided into groups and the following treatments were applied, 1) Individual seal package with ceran shrinkable film of low density polyethylene's (25 micronthickness, 2) Fruit without packing considered as control, 3) Half the quantity of the experimented fruits were stored at 8^{0}C-relative humidity of 85-90% and the half at ambient temperature (28± 2^{0}C-65RH).

Samples were taken periodically at 4 days intervals for fruits stored at ambient temperature and at 7 days for fruits stored at 8 ^{0}C for physical and chemical analysis as follows:-

1- **Physiology loss in weight (PLW):** The accumulative loss in weight of fruit was due to the physiological activities (respiration and transpiration) was calculated as percentage (%) thoroughout the experimental period.
2- **Titratable acidity:** acidity was determined in terms as anhydrous citric acid percentage after titeration against 0.1Nsodium hydroxide using phenolphthalein as an indicator according to (A.O.A.C, 2003).
3- **Total soluble solids (TSS):** Hand refractometer was used to determine the total soluble solids percentage in fruit juice (A.O.A.C, 2003).
4- **Vitamin C**: Ascorbic acid (V. C) was determined using 2-6 dichlorophenol indophenol titration using 4% oxalic acid according to (A.O.A.C, 2003).
5- **Total Sugar**: Total sugars in the pulp were determined adopting the calorimetric method for determination of sugars and related and related substances according to (A.O.A.C, 2003).

Table (1): some mechanical, physical and chemical analysis of the chard soil.

Property	Values
Mechanical analysis:	
Send	35.50
Silt	33.45
Caly	31.45
TEXTURE	Loam silty clay
Physical analysis:	
PH	8
EC.dsm^2	0.66
O.M. %	1.80
T.N %	0.17
Total carbonate %	2.5
Chemical analysis:	
Available macro- Nutrients	
P PPm	14
K PPm	0.61
Ca PPm	3.10
Available micro- Nutrients	
Zn PPm	1.0
Cu PPm	1.3
Fe PPm	5.0

Table (2): some physical and chemical characteristic of compost used.

characteristic	Values
Weight of m^3(kg)	580
Humidity %	26.75
pH	8.2
E.C.dsm^2	4.73
Totale nitrogen %	1.41
Organic matter %	36.42
Organic carbon %	21.13
Aches %	73.25
C/N ratio	18.1
Total phosphorus	0.71
Total potassium	0.83
Fe ppm	371.40
Mn ppm	57.30
Cu ppm	29.53
Zinc ppm	47.11
Nematoda (worm)	Nil
Total E. colr	Nil
Weed seed	Nil

6- **Fruit mineral analysis:** Total nitrogen (N %) and total phosphorus were determined by standard methods as (A.O.A.C, 2003). Potassium (K %), calcium (Ca %), Magnesium (Mg %). Iron (ppm), Zinc (ppm) and Cupper (ppm) were directly determined in the digested solution of each replicate by a perkin Elmer Atomic Absorption spectrophotometer model 2380 (A.O.A.C, 2003).

Statistical analysis: these experiments were two factors, randomized complete block design with three replication. All data were subjected to statistical analysis according to the procedures reported by (Little and Hills, 1978).

RESULTS AND DISCUTION

Physiological weight loss (PWL):-

Mango fruits are one of climacteric fruit, which show a high respiration activity during its ripening stage which reflects a pronounced loss in weight. Data in Tables (3& 4) show the effect of different organic pre and postharvest treatments on the percentage of PWL. Results revealed that untreated treatments and received 100 & 50 % of mineral fertilizers scored the highest values of PWL at the two seasons as compared to all tested treatments. Moreover, PWL scored up to 34 % and 14% for the unpacked fruits and packed in ceran sheet (individually), respectively at 12 days of storage at room temperature (28± 2^0C). Packaging the fruits in the ceran allowed the fruits to keep its freshness for longer period due to reducing the evaporation of water as well as the film created modified atmosphere surrounding the fruits. These data are in agreement with Abd-El Rahman and Sheikh (1994) and Gonzalez *et al* (1995) were they found that modified atmosphere created by packaging in three (3) low density polyethylene films delayed and reduce losses of weight. Application of various organic treatments (yeast as soil or foliar applied, PGPR as soil applied and addition of compost with or without yeast or PGPR led to scored significant differences as compared to treatments received minerals fertilizers and recorded lower values at PWL of mango fruits. Combination between yeast application, PGPR and compost and reduced level of chemical fertilizers (50%) retarded the weight loss (PWL) could be due to the effect of various organic treatments on slowing down the biochemical reaction releasing and more availability of macro and micronutrients and there by the reduction of water loss. In this respect this data are in line with those Mansour (1998), Ebrahiem *et al* (2000), El- Mehrat (2005) who studied the benefits of yeast, PGPR (biofertilizer) and compost were effective in maintaining fruit physical and chemical properties of fruits. On the other hand, lowering the storage temperature (8^0C) reduced the water loss of the fruits either packed or unpacked as compared storage temperature 28± 2^0C among all tested treatments. Data presence in Table (4) indicated that application of various organic pre and postharvest treatments gave significant increases and lower values of PWL as compared to treatments received 100 and 50 % rates of mineral fertilizers as well as the stored period at 8^0C was longer, up to 35 days, as compared to 24 days at 28± 2^0C. In this respect this data are in line with those Oosthuyse *et al* (2000). Cool storage delays after harvest on the extent of ripening during and fruit quality after cool storage.

Titratable acidity:-

Regarding the periodical changes in juice titratable acidity as effected with various investigated organic treatments under study on Alphonse mango cultivar, it could be clearly noticed from the data in Tables (5 and 6), that fruit juice total acidity (%) responded to packing treatment, where the individual packing of fruits in ceran film led to slow change in their acidity content if compared with unpacked fruits through out the duration period of storage for the two seasons. Concerning the influence of storage temperature, fruit stored at 28± 2^0C weather they were individual packed or not showed a lower values of total acidity percentage associated with minimum number of storage days 24 and 12 respectively. Meanwhile the opposite trend was detected with fruits stored at 8^0C, where the same low acidity percentage was

Table 3

Table 4

Table 5

Table 6

detected since the lowest values of total acidity (%) resulted after 35 days for those fruits individually packed or unpacked. However, total acidity in zero time periods was always higher if compared to all tested treatments. The fruits subjected to preharvest treatment of mineral fertilizers (100 and 50%) had significant lower values of total acidity. The response of juice acidity to the different organic treatments (yeast, PGPR with or without compost) in presence of 50% mineral fertilizers, data in Tables (5 & 6) clearly illustrated that fruits had significantly lower values of total acidity (%). Combining 50%mineral fertilizer with yeast, PGPR and /or compost was the best treatment as compared to all tested treatments. In this respect, the obtained results are agreement with Mclauchlan *et al* (1994), El-Mogy *et al* (1998), Ebrahiem *et al* (2000), El-Mehrat (2005) and Ahmed (2012) who reported that the various organic treatments were very effective in increasing percentage of total sugars, total soluble solids, V. C and total acidity.

Total soluble solids (TSS):

A gradual increase in the TSS (%) took place continuosly as duration of storage was extended in days during the two seasons as shown in Table(7& 8). The obtained results observed that the higher TSS % content in Alphonse mango cv. fruits during cold storage (8^0C) and the individual treatments recorded higher values of TSS% as compared to unpacked ones, in generally. These data are in agreement with Oosthuyse 1993, Yantara *et al*, 1995, and Naragane *et al*, 1996 who reported that storage fruits at low temperature (11- 15^0C) and individual seal package of fruits in polyethylene film led to extend the storage life up to 4- 6 weeks by preventing over-ripening .

Generally, application of various organic treatments (yeast as soil or foliar application, PGPR and compost addition recorded higher concentration of TSS% as compared to control (100% mineral fertilizers). In this respect, Ahmed *et al* 2004, Mansour 1998, Ahmed-Samah 2011, and Hasan 2001 reported that biofertilizer (PGPR)and/or treatment with yeast resulted in the most pronounced increase in the amount of total soluble solids (TSS%) at grapefruit, Anna apple, Bartamuda date palm, and banana respectively. Data in Table (7& 8) pointed out that the application of mineral fertilizers either 100% or 50% induced significantly the highest values of TSS% in comparison to organic treatments and such trend was detected during two seasons. However, application of compost (organic fertilizer) treatment in combination with yeast or PGPR in pretenses of 50% mineral fertilizer led to score the highest TSS% values throughout storage period among all tested treatments.

Ascorbic Acid (vitamin C):-

Mango fruits is considered to be one of the major source of V. C Data in Tables (9&10) explained the influence of different preharvest treatments on V. C content (mg/100g pulp F.W.). Storage temperature played quite significant role in dealing V. C digression in the pulp of the fruits, where it was noticed that fruits kept at 28± 2^0C with or without exposing to the different natural preharvest treatments lost their content of V. C faster than fruits stored at 8^0C among all various storage period days. Application of 100 and 50% of mineral fertilizers recorded the lowest V. C values as compared to zero time and /or among all tested organic treatments and it was significantly decreased differences. On the other hand, application of various organic preharvest led to scored higher V. C values and observed significant increases as compared to mineral fertilizers applied. Moreover, application of yeast as foliar application, with or without addition compost and application of PGPR (biofertilizers) in precence of compsot led to recoreded the highest V. C values as compared to other all tested treatments and give significant increases. Againe, combining packaging with different organic preharvest treatments exhibited a significant effect on V. C decrease during fruits ripening at any of the two used temperature and the effect was significant when the fruits were stored at lower temperature (8^0C) and packed individually. These results coincided with those published by Mansour 1998,

Table 7

Table 8

Table 9

Table 10

Hasan 2001, Abd El-Naby 2000, Ahmed *et al* 2004, El Mehrat 2005, Ahmed- Samah 2011 and Ahmed 2012 indicated that the effect of both biofertilizer (PGPR) and organic fertilizers (compost) were significantly increases in the amount of total soluble solids (TSS),V. C content and total sugars content of fruits.

Total sugars:

Total sugar content of pulp of Alphonse mango fruits where estimated (as g-glucose/ 100g pulp F. W.), found to be affected by the change in storage temperature, packaging as well as organic preharvest treatments. It was noticed that fruits stored at low temperature (8^0C) were more sweeter than those kept at room temperature (28± 2^0C) which could explained by the faster and higher rate of respiration at the higher temperature using more sugars during this phenomena (Tables, 11& 12). Packaging the fruits with ceran sheet acted as modifying agent for the atmosphere surrounding the fruits and effecting in delaying sugar formation or delaying the ripening process. Generally, packed individually ceran film fruits gave lower amounts of sugar content as compared to unpacked treatment at both temperature (8^0C or 28± 2^0C) among all days of stored period .These results are in agreement with Allam 1983 and Ketsa *et al* 1992 who reported that external polyethylene sealing of fruit retarded ripening and sugar accumulation as well as using low temperature throughout stored period and allowed the fruit to be stored longer. Application of various organic treatments with packaged fruits and storing showed a significant effect on delaying sugar accumulation (Tables, 11& 12). However, application of yeast and /or PGPR alone or in combination with compost led to scored significant increases at total sugar content in fruits as compared to treatments received 100 and 50 % mineral fertilizers among all tested treatments. These results agreed with those explained by Batagurki *et al*, 1995, Hasan 2001, El Mehrat 2005, Ahmed-Samah 2011, and Ahmed 2012 where they found that application of various organic treatments improved fruits quality especially sugar content.

Fruit mineral content at maturity stage:

Regarding the effect of different rates(100 & 50%) of mineral fertilizers data obtained (Table, 13) revealed that fruit content of all macro and micro elements under study i,e (N, P, K, Ca, Mg, Zn, Fe, and Cu) were significantly responded by the application of mineral fertilizers as compared to other treatments. With respect to effect of application various organic preharvest treatments resulted in a significant increase in pulp nutrients contents and recorded higher values in all macro and micro elements tested. How, the highest values were obtained at the treatment received 25 Kg compost and 10 L yeast / fed. As foliar application in presence of 50% mineral fertilizer (T7). The results are in agreement with Mansour *et al* 2004, El Mehrat 2005 and Ahmed 2012 who reported that application of various organic treatments gave a positive effect on fruits physical and chemical properties and fruit quality.

Conclusion

From the obtained results it can be concluded that, application of compost with yeast and or PGPR as preharvest organic treatments were more pronounced effect on fruit storability among different degree of temperature used with or without packing fruits as well as fruit quality of mango fruits (Alphonse cv.) moreover, the application of preharvest organic treatments led to reduce the cost of production, environment pollination and gave healthy product.

Table 11

Table 12

Table 13

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تأثير بعض المعاملات العضوية قبل الحصاد علي جودة ثمار المانجو أثناء التخزين

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الملخص العربي

أجريت هذه الدراسة خلال موسمين متتاليين هما ٢٠١٠ و ٢٠١١ علي أشجا ر مانجو بالغة و مطعومة بصنف ألفو نس وذلك في أرض طمية بمنطقة القنا طر محا فظة القليوبية.

تم أستخدام الخمائر كأضافة أرضية ورش بمعد ل ١٠لتر/فدان و تم أستخدام خليط (١:١:١) من المزارع البكتيرية – أزوتوبكتر كروكوكم كمصدرللنتروجين والباسليس ميجاتيريم كمصدر للفوسفور والبا سليس سيركيولونس كمصدر للبوتاسيوم – كسماد حيوى بمعدل ٥ لتر/ فدان فى وجود ٥٠٪ من التسميد المعدنى الموصى بة و تم أستخدام الكمبوست بمعدل ١٢ طن/ فدان (٢٥ كجم / شجرة) مع خليط المزارع البكتيرية بنفس المعدل و الخميرة رشا بنفس المعدل مقا رنة بالتسميد المعدنى ٥٠٪ – ١٠٠ ٪ الموصى بة و ذلك لتقدير مدى تأثير التسميد العضوى و الحيوى على نمو أشجار المانجو وكذلك علي جودة الثمار. تم جمع الثمار مكتملة النمو من كل معاملة على حدة وتم تغليف نصف الثمار بالسيران والنصف الأخر بدون لف ثم قسمت الثمار إلى مجموعتين تم تخزين مجموعة على درجة حرارة ٨ درجة مئوية ورطوبة ٨٥ – ٩٠٪ والأخرى على درجة حرارة الغرفة ٢٨± ٢ درجة مئوية ورطوبة ٦٥٪ وتم دراسة الصفات الطبيعية و الكيماوية للثمار أثناء التخزين المبرد. أظهرت النتائج المتحصل عليها أن أستخدام التسميد العضوى و الحيوى مع اللف بالسيران و التخزين المبرد قد أعطى نتائج جيدة من حيث تقليل الفقد فى الوزن للثمار و تأخير أنخفاض فيتامين ج وزيادة نسبة السكريات الكلية وزيادةالمواد الصلبة الذائبة الكلية ونقص فى الحموضة . أعطت الثمار المعاملة بالمعاملات العضوية فروق معنوية فى محتوى العناصر الغذائية وذلك مقارنة بمعاملات التسميد المعدنى .

Table (3): Effect of some organic treatments on loss weight percentage during storage of mango fruits at room temperature (28± 2^{0}C) in 2010 and 2011seasons.

Para. / Treat.	Days of Storage																			
	Zero		Without packing						Seal package											
			4		8		12		4		8		12		16		20		24	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	0.0	0.0	12.8	17	20.2	24.0	30.0	29	4.2	2.0	11.5	9.0	18.8	12.0	20.0	20.0	22.2	28.0	25.0	41.0
T_2	0.0	0.0	13.0	18.5	20.5	26.0	30.7	34.0	4.9	3.0	12.6	10.0	19.3	14.0	16.0	22.0	20.0	31.0	24.0	43.0
T_3	0.0	0.0	6.6	8.1	10.1	17.0	13.5	23.0	2.4	3.0	7.1	7.0	8.3	1.0	11.5	15.0	13.4	18.0	21.8	31.0
T_4	0.0	0.0	8.2	10.0	19.5	18.0	19.5	23.o	3.4	1.0	7.1	4.0	10.0	15.0	11.9	14.0	14.5	23.0	24.0	39.0
T_5	0.0	0.0	8.4	8.0	12.4	16.0	12.4	20.0	1.4	5.0	5.9	7.0	8.7	10.0	12.1	12.0	15.4	15.0	24.3	25.0
T_6	0.0	0.0	7.1	6.7	8.1	16.0	13.8	23.0	2.0	4.0	6.1	5.0	9.3	9.0	12.1	13.0	15.7	19.0	21.2	35.0
T_7	0.0	0.0	6.7	7.0	8.2	22.0	12.6	24.0	2.3	3.0	5.1	6.0	9.3	9.0	14.0	13.0	18.9	21.0	22.2	31.0
LSD $_{at\ 5\%}$	0.0	0.0	2.6	2.9	1.6	3.3	1.4	4.2	0.99	1.3	1.2	1.7	1.5	1.9	1.4	4.8	1.4	5,2	1.7	5.5

S1= season one. S2= season two. T1= 100% mineral fertilizers. T2= 50% mineral fertilizers. T3= Foliar spray of yeast + 50%mineral NPK.
T4= Soil application of yeast + 50%mineral NPK. T5= PGPR + 50 %mineral NPK.
T6= 25 Kg compost/tree + PGPR.
T7= 25 Kg compost/tree + Foliar yeast.

Table (4): Effect of some organic treatments on loss weight percentage during storage of mango fruits at 8^{0}C in 2010 and 2011seasons.

Para. / Treat.	Days of Storage																					
	Zero		Without packing										Seal package									
			7		14		21		28		35		7		14		21		28		35	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	0.0	0.0	1.63	1.30	2.10	2.90	3.90	4.3	5.7	5.20	9.40	11.20	0.50	0.25	1.8	1.7	2.00	2.40	2.6	2.80	3.60	3.80
T_2	0.0	0.0	1.77	1.90	2.30	2.07	3.10	4.00	5.9	5.70	9.80	11.70	0.60	0.27	1.0	0.9	1.60	2.00	2.5	3.00	3.90	4.00
T_3	0.0	0.0	1.10	1.20	1.40	2.30	2.90	3.00	4.2	4.90	6.30	7.40	0.20	0.30	0.80	0.7	1.5	1.40	1.7	1.9	2.4	2.60
T_4	0.0	0.0	1.17	1.20	1.33	2.30	2.60	2.96	3.90	4.6	6.30	7.80	0.30	0.40	0.90	0.8	1.30	1.83	1.6	1.96	2.9	3.00
T_5	0.0	0.0	1.40	1.10	1.70	2.6	2.80	3.10	4.10	4.20	6.40	7.60	0.30	0.42	0.8	0.7	1.10	1.3	1.4	1.6	2.70	2.90
T_6	0.0	0.0	1.17	1.20	1.40	2.50	2.70	3.4	3.90	4.10	6.10	7.40	0.30	0.40	0.90	0.9	1.10	1.20	1.20	1.60	2.80	3.10
T_7	0.0	0.0	1.40	1.20	1.60	2.57	2.67	3.00	4.20	4.60	6.10	7.30	0.40	0.40	1.00	0.95	1.3	1.20	1.50	1.70	2.30	3.30
LSD at 5%	0.0	0.0	0.25	0.18	0.24	0.51	0.59	0.62	0.41	0.91	0.67	0.55	0.19	0.10	0.40	0.26	0.40	0.38	0.38	0.42	0.52	0.41

S1=season one. S2=season two. T1=100% mineral fertilizers. T2=50% mineral fertilizers. T3=Foliar spray of yeast + 50%mineral NPK.
T4=Soil application of yeast + 50%mineral NPK. T5=PGPR +50 %mineral NPK.
T6= 25 Kg compost/tree +PGPR.
T7= 25 Kg compost/tree +Foliar yeast.

Table (5): Effect of some organic treatments on acidity percentage during storage of mango fruits at room temperature (28± 2^{0}C) in 2010 and 2011 seasons.

Para. / Treat.	Days of Storage																			
	Zero		Without packing						Seal package											
			4		8		12		4		8		12		16		20		24	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	2.23	1.56	0.97	0.82	0.58	0.38	0.18	0.14	1.30	1.31	0.72	0.86	0.53	0.51	0.41	0.46	0.29	0.37	0.22	0.21
T_2	2.18	1.50	0.93	0.73	0.48	0.32	0.12	0.10	1.28	1.25	0.69	0.78	0.48	0.44	0.38	0.40	0.23	0.29	0.16	0.19
T_3	1.74	1.97	1.22	0.99	0.78	0.48	0.33	0.27	1.68	1.56	1.51	0.98	1.02	0.58	0.90	0.52	0.80	0.42	0.32	0.24
T_4	2.14	1.90	1.72	0.95	1.12	0.47	0.31	0.23	1.72	1.52	1.46	1.01	1.22	0.60	0.96	0.51	0.91	0.41	0.35	0.25
T_5	1.73	1.84	1.30	0.92	1.0	0.46	0.34	0.23	1.71	1.47	1.59	1.01	1.37	0.61	1.05	0.49	0.32	0.39	0.25	0.23
T_6	1.51	1.71	1.27	0.86	0.52	0.43	0.39	0.22	1.54	1.37	1.32	0.96	1.11	0.57	0.69	0.46	0.49	0.37	0.25	0.22
T_7	1.23	1.84	1.21	0.94	0.51	0.46	0.40	0.20	1.64	1.47	1.52	0.97	1.20	0.59	0.85	0.94	0.80	0.40	0.35	0.24
LSD at 5%	0.38	0.39	0.11	N.S	0.19	0.09	0.06	N.S	0.07	0.07	0.08	0.06	0.07	0.02	0.03	0.01	0.04	N.S	0.01	N.S

S1=season one. S2=season two. T1=100% mineral fertilizers. T2=50% mineral fertilizers. T3=Foliar spray of yeast + 50%mineral NPK.
T4=Soil application of yeast + 50%mineral NPK. T5=PGPR +50 %mineral NPK.
T6= 25 Kg compost/tree +PGPR.
T7= 25 Kg compost/tree +Foliar yeast.

Table (6): Effect of some organic treatments on acidity percentage during storage of mango fruits at 8^{0}C in 2010 and 2011 seasons.

Para. / Treat.	Days of Storage																					
	Zero		Without packing										Seal package									
			7		14		21		28		35		7		14		21		28		35	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	2.23	1.56	2.01	1.20	1.65	0.84	1.07	0.50	0.49	0.31	0.14	0.19	1.28	1.53	1.04	1.28	0.70	0.90	0.33	0.53	0.15	0.28
T_2	2.18	1.50	1.41	1.06	1.42	0.75	0.96	0.41	0.41	0.26	0.11	0.13	1.14	1.44	0.97	1.23	0.62	0.79	0.29	0.39	0.16	0.17
T_3	1.74	1.97	1.67	1.37	1.55	0.96	1.50	0.67	0.80	0.39	0.31	0.23	1.69	1.89	1.37	1.59	1.05	1.00	0.73	0.65	0.23	0.36
T_4	2.14	1.90	2.06	1.28	1.76	0.89	1.21	0.83	1.04	0.37	0.39	0.22	1.76	1.80	1.31	1.57	1.06	1.07	0.88	0.64	0.36	0.35
T_5	1.73	1.84	1.70	1.30	1.57	0.90	1.51	0.63	0.59	0.40	0.30	0.22	1.51	1.73	1.09	1.47	0.91	1.03	0.79	0.62	0.26	0.34
T_6	1.51	1.71	1.47	1.13	1.33	0.97	0.79	0.56	1.01	0.34	0.40	0.20	1.58	1.59	1.05	1.35	0.99	0.95	0.73	0.57	0.26	0.31
T_7	1.23	1.84	1.58	1.22	1.52	0.86	0.86	0.60	0.80	0.36	0.35	0.21	1.37	1.75	1.21	1.49	1.04	0.99	0.82	0.60	0.25	0.33
LSD at 5%	0.38	0.39	0.08	0.06	0.09	N.S	0.12	0.08	0.03	N.S	0.06	N.S	0.11	0.07	0.08	0.04	0.200	N.S	0.05	0.06	0.03	N.S

S1=season one. S2=season two. T1=100% mineral fertilizers. T2=50% mineral fertilizers. T3=Foliar spray of yeast + 50%mineral NPK.
T4=Soil application of yeast + 50%mineral NPK. T5=PGPR +50 %mineral NPK.
T6= 25 Kg compost/tree +PGPR.
T7= 25 Kg compost/tree +Foliar yeast.

Table (7): Effect of some organic treatments on total soluble solids (TSS) percentage during storage of mango fruits at room temperature (28± 2^{0}C) in 2010 and 2011 seasons

Para. / Treat.	Days of Storage																			
	Zero		Without packing						Seal package											
			4		8		12		4		8		12		16		20		24	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	7.07	8.67	10.60	12.87	15.20	18.13	12.87	14.33	8.00	10.67	10.13	12.67	12.20	15.33	15.20	16.33	14.07	15.60	12.67	12.33
T_2	6.93	7.80	10.13	14.2	14.40	16.40	11.60	13.60	7.40	9.60	9.60	11.33	11.13	15.00	14.53	15.73	13.87	14.13	12.20	10.67
T_3	7.33	7.87	10.47	14.07	14.87	18.33	17.13	19.40	8.07	9.93	10.27	11.87	13.60	15.47	15.27	16.47	16.00	19.00	17.00	18.73
T_4	7.20	7.87	9.60	13.80	13.67	20.27	15.67	20.13	7.67	9.87	10.93	11.87	12.80	14.93	13.80	16.93	14.73	19.27	18.27	19.00
T_5	7.07	7.40	9.73	12.40	13.07	17.47	16.80	18.53	7.53	9.40	10.27	11.47	12.87	16.00	15.53	16.60	16.20	18.60	17.60	18.00
T_6	8.20	7.60	9.20	15.33	13.73	17.13	15.47	18.27	8.40	9.60	11.67	11.60	12.87	14.73	16.93	16.73	17.87	18.00	15.80	21.03
T_7	7.13	7.80	9.40	15.87	13.47	18.20	16.33	20.00	8.07	9.80	10.67	11.67	12.67	14.33	13.53	16.33	16.07	18.33	17.67	18.00
LSD at 5%	0.30	0.31	0.33	0.83	0.51	0.55	0.23	0.58	0.32	0.35	0.51	0.25	0.53	0.44	0.45	0.53	0.36	0.27	0.87	0.51

S1=season one. S2=season two. T1=100% mineral fertilizers. T2=50% mineral fertilizers. T3=Foliar spray of yeast + 50%mineral NPK.
T4=Soil application of yeast + 50%mineral NPK. T5=PGPR +50 %mineral NPK.
T6= 25 Kg compost/tree +PGPR.
T7= 25 Kg compost/tree +Foliar yeast.

Table (8): Effect of some organic treatments on total soluble solids (TSS) percentage during storage of mango fruits at 8^0C in 2010 and 2011 seasons.

Para. / Treat.	Days of Storage																					
	Zero		Without packing										Seal package									
			7		14		21		28		35		7		14		21		28		35	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	7.07	8.67	10.80	9.00	12.53	12.00	15.47	17.00	14.20	16.87	11.60	15.00	9.60	9.07	11.93	11.07	12.27	15.13	15.20	17.87	13.20	16.67
T_2	6.93	7.80	9.00	8.67	10.60	11.73	12.07	14.53	13.40	16.80	11.20	14.63	8.33	8.20	10.74	10.27	11.53	12.47	13.67	16.67	12.87	16.00
T_3	7.33	7.87	8.93	8.80	11.60	12.47	13.27	14.80	16.33	19.00	21.13	19.00	9.00	8.27	11.80	10.27	12.53	12.60	13.87	15.60	15.13	18.67
T_4	7.20	7.87	9.13	9.00	9.53	12.00	11.27	15.13	15.87	22.00	19.93	21.67	8.00	8.80	13.00	10.80	13.73	13.33	14.60	15.40	15.20	18.93
T_5	7.07	7.40	9.27	8.40	10.07	11.53	13.40	14.47	15.67	20.93	18.07	20.00	9.13	8.13	12.13	10.27	14.00	12.27	14.47	18.53	15.27	18.53
T_6	8.20	7.60	8.53	8.53	10.53	11.53	11.40	14.60	15.60	18.67	17.33	18.00	8.80	8.00	10.80	10.00	12.60	12.20	13.73	14.67	15.40	17.93
T_7	7.13	7.80	10.60	8.27	11.80	11.20	15.13	14.20	16.00	18.87	18.60	21.67	9.47	8.20	13.27	10.13	13.60	12.67	14.60	14.67	14.93	18.67
LSD at 5%	0.30	0.31	0.38	0.12	0.46	0.13	0.45	0.31	0.61	0.28	0.83	1.85	0.34	0.40	0.52	0.37	0.36	0.22	0.54	0.47	0.30	0.55

S1=season one. S2=season two. T1=100% mineral fertilizers. T2=50% mineral fertilizers. T3=Foliar spray of yeast + 50%mineral NPK.
T4=Soil application of yeast + 50%mineral NPK. T5=PGPR +50 %mineral NPK.
T6= 25 Kg compost/tree +PGPR.
T7= 25 Kg compost/tree +Foliar yeast.

Table (9): Effect of some organic treatments on V. C mg/100g fresh weight during storage of mango fruits at room temperature (28± 2^{0}C) in 2010 and 2011 seasons.

Para. / Treat.	Days of Storage																			
	Zero		Without packing						Seal package											
			4		8		12		4		8		12		16		20		24	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	50.30	44.00	44.30	37.90	30.40	34.85	29.60	31.15	49.10	42.31	44.00	41.37	40.20	40.45	38.60	37.17	35.58	32.53	28.22	27.63
T_2	43.10	41.33	41.00	36.00	28.70	29.60	26.70	25.67	41.70	40.10	37.70	39.00	34.00	37.73	30.20	34.43	27.33	28.17	24.33	23.53
T_3	64.10	64.00	58.40	54.23	49.70	45.95	39.30	41.40	69.50	62.73	67.30	59.59	57.10	56.90	52.70	50.94	48.03	42.47	36.23	35.97
T_4	66.10	60.67	60.40	51.57	47.00	39.77	39.40	40.16	68.00	53.73	64.70	51.04	55.40	51.77	49.00	46.73	48.95	40.57	36.36	34.21
T_5	60.10	55.00	57.10	46.75	49.00	35.74	36.00	37.60	57.70	53.88	52.60	51.20	49.60	48.64	48.30	43.30	40.83	36.53	37.33	31.12
T_6	57.30	52.33	61.20	44.07	44.00	38.57	38.50	36.00	54.50	50.99	53.50	48.42	48.70	45.96	46.70	40.30	39.43	35.00	34.83	30.05
T_7	59.20	52.67	64.10	44.47	47.70	39.23	39.10	36.14	56.20	51.70	56.90	49.13	50.70	46.67	49.00	41.93	48.03	35.99	36.20	30.93
LSD at 5%	5.53	2.15	3.71	1.87	3.98	1.56	4.93	1.19	2.11	2.01	1.35	1.99	1.92	1.68	1.78	2.44	1.39	1.51	1.12	1.37

S1=season one. S2=season two. T1=100% mineral fertilizers. T2=50% mineral fertilizers. T3=Foliar spray of yeast + 50%mineral NPK.
T4=Soil application of yeast + 50%mineral NPK. T5=PGPR +50 %mineral NPK.
T6= 25 Kg compost/tree +PGPR.
T7= 25 Kg compost/tree +Foliar yeast.

Table (10): Effect of s`ome organic treatments on V. C mg/100g fresh weight during storage of mango fruits at 8^0C in 2010 and 2011 seasons.

Para. / Tret.	Days of Storage																					
	Zero		Without packing										Seal package									
			7		14		21		28		35		7		14		21		28		35	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	50.30	44.00	43.99	40.93	39.20	39.00	30.00	37.03	24.67	33.43	24.00	30.10	40.93	43.83	39.08	41.27	39.95	37.13	30.79	33.38	28.20	31.59
T_2	43.10	41.33	40.00	40.20	36.33	36.77	26.47	35.87	23.33	30.00	19.67	25.80	38.00	40.47	36.67	38.73	36.00	35.00	29.00	30.00	25.33	26.60
T_3	64.10	64.00	64.99	57.60	52.82	54.59	48.73	51.50	37.73	46.27	35.57	41.10	62.93	63.40	59.60	60.02	50.84	53.40	48.12	47.70	38.91	44.87
T_4	66.10	60.67	64.29	50.10	54.00	50.45	47.94	48.77	35.86	43.92	34.21	39.18	56.77	60.03	53.39	56.70	49.90	50.87	43.00	43.83	38.95	43.51
T_5	60.10	55.00	52.67	49.80	49.07	47.31	43.23	44.53	37.83	39.75	34.20	36.37	55.60	54.45	50.25	51.67	47.04	46.37	47.04	41.40	38.67	38.97
T_6	57.30	52.33	55.33	47.07	49.78	44.72	41.05	42.37	33.34	38.13	30.03	34.37	53.31	50.87	50.22	49.13	43.69	44.60	43.27	40.47	37.07	38.45
T_7	59.20	52.67	57.86	48.71	52.87	46.26	46.79	43.50	34.73	49.47	33.97	35.50	55.87	52.10	52.13	49.60	48.93	45.53	44.57	41.17	38.53	39.02
LSD at 5%	5.53	2.15	1.08	1.71	1.06	1.86	1.31	1.68	1.37	1.63	1.17	1.34	0.67	1.93	1.43	1.78	1.49	1.43	0.98	1.25	1.16	1.37

S1=season one. S2=season two. T1=100% mineral fertilizers. T2=50% mineral fertilizers. T3=Foliar spray of yeast + 50%mineral NPK.
T4=Soil application of yeast + 50%mineral NPK. T5=PGPR +50 %mineral NPK.
T6= 25 Kg compost/tree +PGPR.
T7= 25 Kg compost/tree +Foliar yeast.

Table (11): Effect of some organic treatments on sugar g/100g fresh weight during storage of mango fruits at room temperature (28± 2^{0}C) in 2010 and 2011 seasons.

Para. / Treat.	Days of Storage																			
	Zero		Without packing						Seal package											
			4		8		12		4		8		12		16		20		24	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	6.01	7.37	9.01	13.49	12.92	16.26	10.94	12.77	6.80	9.07	8.61	10.77	10.37	13.03	12.92	15.47	11.96	13.26	10.37	10.23
T_2	5.00	6.38	7.80	12.42	11.97	15.19	9.67	11.58	5.13	8.16	8.02	9.63	9.53	12.75	12.73	13.88	11.00	13.00	6.80	9.07
T_3	5.91	6.69	7.82	10.54	11.56	15.30	13.71	16.49	6.69	8.44	9.10	10.09	10.71	13.15	13.09	14.00	13.54	16.27	14.34	16.12
T_4	6.12	6.69	7.83	11.73	11.62	17.23	13.32	17.11	6.52	8.39	9.29	10.27	10.88	12.69	13.73	14.39	14.24	16.38	15.41	16.15
T_5	6.01	6.29	8.27	10.54	11.11	14.85	13.43	16.75	6.40	7.99	8.73	10.20	10.94	13.60	13.20	14.11	14.10	15.81	14.28	15.64
T_6	6.66	6.46	7.15	13.05	11.67	16.04	12.42	16.85	6.47	8.56	8.92	9.86	10.94	12.00	12.73	13.88	13.34	15.30	14.01	15.02
T_7	7.26	6.63	7.99	13.49	11.44	14.28	13.03	16.53	6.70	8.16	9.07	9.92	11.77	12.18	13.50	14.22	13.81	15.58	14.60	16.30
LSD at 5%	0.61	0.32	0.63	0.61	0.23	0.31	0.51	0.42	0.47	0.63	0.70	0.31	0.38	0.38	0.52	0.68	0.65	0.24	0.43	0.35

S1=season one. S2=season two. T1=100% mineral fertilizers. T2=50% mineral fertilizers. T3=Foliar spray of yeast + 50%mineral NPK.
T4=Soil application of yeast + 50%mineral NPK. T5=PGPR +50 %mineral NPK.
T6= 25 Kg compost/tree +PGPR.
T7= 25 Kg compost/tree +Foliar yeast.

Table (12): Effect of some organic treatments on sugar g /100g fresh weight during storage of mango fruits at 8^{0}C in 2010 and 2011 seasons.

Para. / Tret.	Days of Storage																					
	Zero		Without packing										Seal package									
			7		14		21		28		35		7		14		21		28		35	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	6.01	7.37	9.18	7.65	10.65	10.20	13.15	15.30	12.07	14.34	9.86	12.00	8.16	7.71	10.14	9.41	10.43	12.86	12.92	15.75	11.22	15.19
T_2	5.00	6.38	8.00	7.30	9.82	9.73	11.22	14.73	10.90	14.17	9.93	11.00	7.99	7.40	9.95	9.10	11.00	12.37	11.57	15.77	10.87	14.87
T_3	5.91	6.69	7.59	7.48	9.92	10.09	11.28	12.58	13.88	16.15	17.65	15.20	7.65	7.03	10.03	8.73	10.65	10.48	11.79	13.26	12.86	15.87
T_4	6.12	6.69	7.59	7.14	9.69	9.86	12.15	12.41	13.93	16.15	16.30	16.15	7.76	7.03	11.11	8.73	11.90	10.48	12.64	12.35	13.49	15.92
T_5	6.01	6.29	7.88	6.97	8.56	9.93	11.39	12.24	13.32	16.83	16.32	15.20	7.76	6.63	10.31	8.44	11.90	10.14	12.30	11.90	12.98	15.02
T_6	6.66	6.46	7.25	7.25	8.95	9.80	9.69	12.41	13.26	15.87	16.00	14.97	7.48	6.86	10.18	8.50	10.71	10.37	11.69	12.47	13.09	15.24
T_7	7.26	6.63	9.01	6.91	10.03	9.52	12.86	12.07	13.49	16.04	16.43	15.30	8.05	6.97	11.11	8.61	11.56	10.77	11.96	12.47	13.69	15.87
LSD at 5%	0.61	0.32	0.61	0.17	0.38	0.43	0.41	0.22	0.70	0.24	0.74	1.79	0.29	0.30	0.42	0.22	0.43	0.18	0.64	0.26	0.29	0.31

S1=season one. S2=season two. T1=100% mineral fertilizers. T2=50% mineral fertilizers. T3=Foliar spray of yeast + 50%mineral NPK.
T4=Soil application of yeast + 50%mineral NPK. T5=PGPR +50 %mineral NPK.
T6= 25 Kg compost/tree +PGPR.
T7= 25 Kg compost/tree +Foliar yeast.

Table (13): Effect of some organic treatments on fruits minerals content (mg/100 g dry weight) at maturity stage of mango fruits in 2010 and 2011 seasons.

Ele. / Treat.	N%		P %		K %		Ca%		Mg%		Zn ppm		Fe ppm		Cu ppm	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	1.07	1.23	0.20	0.38	1.33	1.30	0.59	0.64	0.50	0.54	102.30	107.0	319.0	330.0	10.0	16.17
T_2	0.93	1.07	0.19	0.30	1.19	1.17	0.55	0.55	0.36	0.39	87.0	95.0	283.0	298.0	8.80	14.17
T_3	1.60	1.70	0.41	0.44	1.65	1.69	0.80	0.87	0.71	0.70	112.70	123.70	39.1	396.70	18.80	19.17
T_4	1.27	1.53	0.37	0.49	1.59	1.66	0.88	0.95	0.90	0.76	143.30	126.70	397	403.3	19.0	21.0
T_5	1.50	1.80	0.36	0.41	1.38	1.40	1.03	1.04	0.67	0.51	146.70	133.7	368	385	13.17	17.33
T_6	1.63	1.50	0.37	0.49	1.45	1.49	0.88	0.93	0.63	0.66	107.3	115.3	387	395	15.67	19.33
T_7	1.79	1.77	0.39	0.51	1.48	1.65	0.76	0.94	0.88	0.73	112.3	127.3	403	506.7	18.67	20.83
LSD at 5%	0.35	0.18	0.06	0.07	0.08	0.07	0.08	0.05	0.06	0.09	2.11	2.25	2.27	2.26	1.33	1.78

S1=season one. S2=season two. T1=100% mineral fertilizers. T2=50% mineral fertilizers. T3=Foliar spray of yeast + 50%mineral NPK.
T4=Soil application of yeast + 50%mineral NPK. T5=PGPR +50 %mineral NPK.
T6= 25 Kg compost/tree +PGPR.
T7= 25 Kg compost/tree +Foliar yeast.