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EFFECT OF MINERAL AND BIOFERTILIZATION ON THE PRODUCTIVITY AND SOME ANTIOXIDANTS OF CANTALOUPE GROWN IN NEWLY RECLAIMED SOIL

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ABSTRACT

The experiment was conducted to evaluate cantaloupe yield, fruits quality and storability in response to different levels of NPK and biofertilizer. The following treatments were studied in split plot design with four levels of NPK, (untreated (control), 50-25-50 kg NPK/fed., 100-50-100 kg NPK/fed. and 150-100-150 kg NPK/fed.). Biofertilizers used with two rates, (untreated (control) and 200gm microbein + 300gm phosphorien /fed.). All mineral fertilizer levels and the biofertilizer significantly increased total yield/plot, total yield/fed. (ton) and average weight of cantaloupe fruits compared with control. The combination between mineral fertilizer levels and biofertilizer gave the highest total yield/plot, total yield/fed. (ton) and average fruit weight compared with individual application. The fruits quality parameters increased by applied mineral fertilizers or biofertilizer only or combination at harvest. Application mineral fertilizers and biofertilizer increased antioxidant capacity for fruits. The pulp of fruits become more darkening, yellow and less green with improve the color and their clarity especially with the utilization of biofertilizer application. All fruits quality parameters decreased at the end of storage as compared with quality parameters at harvest but, the mineral fertilizers and bio in single application or in combinations reduced this decrement during both seasons.

INTRODUCTION

The Cucurbitaceae family includes several species of cultivated plants of great economic importance, including watermelon (*Citrullus lanatus* L.), squash (*Cucurbita maxima* L.), cucumber (*Cucumis sativus* L.) and cantaloupe (*Cucumis melo* L.) (Ritschel *et al.*, 2004).

Cantaloupe is one of the most consumed fruit crops worldwide due to its pleasant flavour and nutritional value. Melon (*Cucumis melo* L.) is one of the popular vegetables grown in Egypt.

Melon is a good source of minerals, vitamins, energy in form of carbohydrates, a very good source of vitamins A, C and β- carotene and can be used as fresh, dried and juice fruit.

The area under cultivation of cantaloupe during 2007-2008 become 102777 feddan and produced approximately 875003 tons with an average of 10.200 tons per feddan (according to statistics of Ministry of Agriculture).

The nutrient requirements of crops depend upon soil texture; types of previous vegetation cover, cropping intensity and soil moisture (Denton and Swarup, 1990). Nitrogen, phosphorus and potassium elements perform different functions in crops growth and development and none of them can be substituted to act for one another in its special function in the crop, therefore, there is need for fertilizer application in order to obtain optimum yield from cultivated crop (Adepetu, 1986). Nitrogen (N) is one of the nutrients of major importance in the growth of melon. Lack of nitrogen causes the plant to be stunted and becomes yellow in appearance. Adequate supply of nitrogen is essential for vigorous vegetative growth, seed formation and optimum yield of melon. As N rates applied to the plants are increased, plant growth, yield and fruit- set are increased. At high rate of N, it has been found that yields again declined. Nitrogen fertilizer has been reported to increase the yield of melon with observation showing that plants that receive low N level are smaller and show N deficiency symptoms. the effects of N on melon showed that application of N increased number of leaves and leaf size (leaf area) which resulted in increased number of fruits and total yield.

Phosphorus is required for all plant life, being a structural constituent of nucleic acid, as well as being involved in metabolic energy transfer through Adenosine triphosphate (Ozanne, 1980). Phosphorus does not exist as abundantly in the soil as nitrogen and potassium. Similarly, the plants requirement of P is not as large as N and yet, it is very essential for plant growth and development and breakdown of sugar and the transfer of energy (Mitchel *et al.*, 1980). In view of this important role in physiological processes, it's deficiency would be disastrous leading to immediate and severe disruptions of metabolism and plant development (Epstein, 1972). Characteristics symptoms of P deficiency in melon are changes in leaf colour from a dark green colour to a much duller green, and slender stems (Gorski, 1985). Unlike N, once P is removed from the soil, it can only be replenished from external sources (Sanyal and De Datta, 1991). The need for continued P additions in many subtropical soils is as a result of slow conversion of P to plant unavailable forms, or P fixation (Smithson and Sanchez, 2000).

It is known that fruit quality of melon altered with fertilization and in particular by supplying sufficient potassium (Panagiotopoulos *et al.*, 2001). The higher available K levels around the root zone increased leaf, flower, fruit formation and fruit number (Davies and Winsor, 1967; Besford and Maw, 1975). Kim *et al.* (1991) found that application of K fertilizer was often associated with increased sugar concentrations.

Adeyemi (1991) reported that N P K (15-15-15) fertilizer was most effective at the rate of 500 kg ha^{-1} for melon where soil is low to medium fertility.

Fertilizer plays an important role among the environmental influences on crop production (Rashid and Khan, 2008), however. with increasing chemical fertilizer costs, cantaloupe growers are seeking alternative cultural practices that reduce production costs without reducing fruit yield or quality (Studstill *et al.*, 2006).

Application of beneficial microbes in agricultural practices started 60 years ago and there is now increasing evidence that these beneficial microbial populations can also enhance plant resistance to adverse environmental stresses, e.g., water and nutrient deficiency and heavy metal contamination (Shen, 1997). Biofertilizer has been identified as a partial sustainable farming. The application of biofertilizer had similar effects when compared with organic fertilizer or chemical fertilizer treatments. Microbial inoculum not only increased the nutritional assimilation of plant (total N, P and K), but also improved soil properties, such as organic matter content and total N in soil. The utilization of biofertilizer for melon plants is feasible, since it leads to high productivity with an excellent final quality of fruits, as compared to the utilization of exclusively mineral sources.

The phytochemical in plant tissues responsible for the antioxidant capacity are thought to be mainly vitamins C and E and carotenoides compounds. Strong evidence can be found in the literature supporting ascorbic acid as the most important antioxidant (Omaye *et al.*, 1988). The antioxidant activity of phenols is mainly due to their redox properties, which allow them to act as reducing agents, hydrogen donators, singlet oxygen quenchers and metal chelators (Rice-Evans *et al.*, 1995).

Therefore, this study was set up to determine the appropriate individual and combined levels of NPK fertilizers and biofertilizer for optimum cantaloupe fruit yield and to improve fruits quality and storability.

MATERIALS AND METHODS

The Experiment was carried out in the Experimental Farm at El-Kassasin, Hort. Res. Station, Ismailia Government, Egypt, during winter seasons of 2009-2010 and 2010-2011 to study the effect of bio and mineral nitrogen, phosphorus and potassium fertilizers on yield, fruit quality and storability of fruits for 3 weeks at room temperature(24°C) of cantaloupe plants under sandy soil conditions. The physical and chemical properties of the experimental soil are presented in Table 1.

Soil property	1st season	2nd season
Physical properties		
Sand %	96.5	95.6
Silt %	1.7	1.6
Clay %	1.8	2.8
OM %	0.03	0.08
Texture	sandy	sandy
Chemical properties		
pH	8.1	8.1
Available N (p.p.m)	5.4	6.9
Available P (p.p.m)	5.5	6.2
Available K (p.p.m)	52	64

Soil samples were taken from 25cm soil depth

This experiment included 8 treatments, which were the combinations between 4 levels of mineral fertilizers (NPK) and 2 rates of biofertilizers as follows :

a. Mineral levels

1. Untreated(control),
2. 50-25-50 kg NPK/fed.,
3. 100-50-100 kg NPK/fed., and
4. 150-100-150 kg NPK/fed.

b. Biofertilizers rates

1 Untreated(control),

2. 200gm microbein + 300gm phosphorien/fed.

These treatments were arranged in a split plot in a randomized block design with three replicates. Mineral fertilizers levels were randomly arranged in the main plots, while biofertilizers rates were randomly distributed in the sub plots.

Enriching seedling roots with biofertilizers suspension was done by dissolving 200gm microbein + 300gm phosphorien /4L water, mixing with Arabic gum and dipping the roots for 3 minutes in the suspension before transplanting.

The source of biofertilizers was General Organization for Agricultural Equalization found.

Muskmelon F1 Hybrid (Bander) cultivar was used in this study and was obtained from Egyptian Company of Seeds, Oils and Chemicals (Cairo). Seeds were sown on 16th and 5th of December in 2009 and 2010 seasons in seedling trays and were transplanted on 10th and 2nd of January in 2010 and 2011 seasons, respectively.

Plot area was 21 m² which contained two drippers line with 7 m length and 1.5m wide, whereas, the distance between drippers was 50cm, plants were transplanted at 40 cm apart. One line (10.5 m²) was used for samples to measure vegetative growth and the other line (10.5 m²) was used for yield determination.

All plots received equal amounts of chicken manure at rate of 20 m^3/fed. and one third of mineral N,P and K fertilizers were added during soil preparation. Nitrogen, phosphorus and potassium fertilizers were added as ammonium sulphate (20.5%N), calcium superphosphate (15.5%P_2O_5) and potassium sulphate (48-52%k_2O), respectively. The rest of N,P and K were divided into 2 equal portions and added to the soil, the first portion was added 30 days after transplanting, the other was added after 60 days of transplanting.

All the normal agricultural practices of growing cantaloupe plants were done as mentioned by Ministry of Agriculture.

Data recorded

A. Yield and its components

Fruits of each plot were harvested at full-ripe maturity stage after 100 days of transplanting then counted, weighed and the following data were calculated:

1. Average fruit weight (gm),
2. Yield/plot, and
3. Total yield / fed.

B. Fruit quality

Fruit quality was immediately evaluated at harvest time and at the end of storage (after 21 days at ambient temperature at 24 ºC) to determine the following parameters:

1- Total soluble solids (TSS), total titrable acidity and ascorbic acid (vit.C) content were determined as quality indexes. General parameters were measured following the official methods (AOAC, 2005):TSS content was measured using Abbe refractometer (Japan) at 20 °C with value being expressed as Brix. Titrable acidity was measured by titration with 0.1 N NaOH solution and calculated as g citric acid /100 ml juice. Ascorbic acid was determined by visual titration, using 2,6-dichlorophenol indophenol method and expressed as mg/100gm/FW.

2- Alcohol soluble color: Alcohol soluble color of all juice were determined by the method of Meydov *et al.* (1977) as follows: juice was centrifuge at 2000 rpm for 20 min. to precipitate the substances causing turbidity. The supernatant was then diluted to 1:1 with 95 %ethyl alcohol and filtered through whatman No. 42 filter paper to obtain a fully clarified extract. The percent absorption of light for such an extract was measured at a wave length of 420 nm. The blank was consisted of an equal mixture of ethyl alcohol and distilled water.

3- Total phenolic content (TPC): For extraction of total phenols, 1 g samples were placed in 3mL of 1.2 mol L−1 HCl in 80% methanol/water. The samples were vortexed for 1 min, and subsequently heated to 60 ◦C for 3 h. During incubation the samples were vortexed every 30min. After incubation the samples were cooled at room temperature and centrifuged at 3000 × g for 1–2 min to remove solids. Quantification of total phenols was performed using Folin–Ciocalteu reagent diluted 10-fold before use. Absorbance readings of reactions containing 200 µL extract and 0.5mL Folin–Ciocalteu reagent plus water up to 10mL were performed at 760 nm after 2 h incubation at room temperature (Ferrante *et al.*, 2008).

4- Antioxidant activity: Radical-Scavenging activity of fruit juices and mixtures was measured according the method of Brand-Williams *et al.* (1995). Twenty millilitres of methanol were added to an aliquot of juice (10 g) and homogenized at 20,500 rpm for 25 sec. Subsequently, this mixture was centrifuged at 20,000 rpm at 4 C° for 25 min. The supernatant was diluted with methanol(1:25). The extract (1.0 ml) was dissolved in 1.0 ml methanol and added to 0.5 ml methanolic solution containing DPPH (2, 2- diphenyl-1-picryl hydrazyl) 0.5mM. The control sample was prepared using 2.0 ml methanol and 0.5 ml of the same methanolic solution containing DPPH . The reaction mixture was shaken and left to stand for 30 min at room temperature in the dark. The O.D of the remaining DPPH was measured in a 1 cm cuvette at 517 nm and at 25°C. The radical scavenging activity (S) of each extract was expressed by the following formula:

$$S = 100 - [(Ax/Ao)]*100$$

Where: Ax is the optical density of DPPH solution in presence of cantaloupe juice

Ao is the optical density of DPPH solution in the absence of the sample (control).

5-Total Carotenoids: Carotenoids were extracted using methanol (99.9%) as solvent. Samples were kept in a dark room at 4 ◦C for 24 h. Absorbance readings were performed at 470nm and carotenoid concentrations were calculated by Lichtenthaler's formula and expressed as β-carotene (Ferrante *et al.*, 2008).

6- Color Assessment: Color attributes (L, a and b) were evaluated before and after storage fruits using a Minolta color Reader CR-10, Minolta Co. Ltd., *Japan.). Color was recorded using the CIE-L* a* b* uniform color space [(CIE* (the commission international de lEclairage)- Lab], where L* indicates lightness, a* indicates chromaticity on a green (-) to red (+) axis, b* chromaticity on a blue (-) to yellow (+) axis. Numerical values of a* and b* were converted into hue angle ($H^o = \tan^{-1} b^*/a^*$) and chroma [$chroma = (a^{*2}+b^{*2})^{1/2}$] (Bolin and Huxsoll, 1991). The L* value is a useful indicator of darkening during storage, either from oxidative browning reactions or increasing pigment concentrations .The a* value is a measure of redness, while, b* value is highly correlated with carotenoids. The H° is an angle in a color wheel 360, with 0, 90, 180, and 270 representing the hues red- purple, yellow, bluish- green and blue, respectively, while chroma is the intensity or purity of the hue. Together, L*, H° and chroma give an accurate description of the color of a sample.

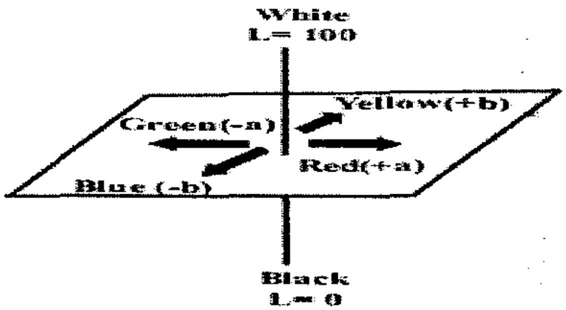

Figure 1: Hunter L, a, b color scale

C. Statistical analysis

Analysis of variance was performed using ANOVA procedures. Significant differences between means were determined by Duncan's multiple range test at 0.05 level of probability.

RESULTS AND DISCUSSION

1-Yield and its components

a. Effect of mineral fertilizer levels and biofertilizer on yield:

Results in Table 2 illustrated the effect of mineral fertilizer levels and biofertilion total yield/plot, total yield/fed (ton) and average weight of cantaloupe fruits.

Fertilization of cantaloupe in sandy soil with NPK at 150-100 and 150 kg /fed. Recorded the maximum total yield/fed. (15.49 and 18.20 ton/fed. in the 1st and 2nd seasons, respectively) and average fruit weight (554.70 and 609.30 gm in the 1st and 2nd seasons, respectively) followed by NPK at 100-50-100 kg/fed.

Fertilization of cantaloupe with 200 gm microbin + 300 gm phosphorin/ fed. gave the higher total yield /fed. (12.78 and 15.41 ton/fed. in the 1st and 2nd seasons, respectively) and average fruit weight (515.26 and

562.92 gm in the 1st and 2nd seasons, respectively) than unfertilizer with biofertilizers.

The increases in the total yield/fed. were about 57 and 40% for NPK at 100-50-100 kg/fed., respectively and 81 and 56 for NPK at 150-100-150 kg/fed., respectively over the control (unfertilized) in the 1st and 2nd seasons, respectively. Also, the increases in total yield/fed. were about 12 and 7% for biofertilizers with 200 gm microbien + 300 gm phosphorien over the control (unfertilized) in the 1st and 2nd seasons, respectively. The trend of results agree with of Adam *et al.* (2002), Mohammad (2004), Olaniyi (2008) with respect to NPK and Fernandes *et al.* (2003) with respect to biofertilizer.

Table (2). Effect of mineral fertilizer levels and biofertilizer on yield/plot, total yield / fed. and average weight of cantaloupe fruits during winter seasons of 2009-2010 and 2010-2011.

Characters / Treatments		2009-2010 season				2010-2011 season			
		Total yield/ plot (kg)	Total yield/ fed (ton)	Average weight of fruit (gm)	Relative yield%	Total yield/ plot (kg)	Total yield/ fed (ton)	Average weight of fruit (gm)	Relative yield%
mineral	L0	21.35^{d}	8.54^{d}	447.56^{d}	100	29.18^{d}	11.67^{d}	480.36^{d}	100
	L1	27.19^{c}	10.87^{c}	485.92^{c}	127	33.84^{c}	13.53^{c}	525.52^{c}	116
	L2	33.63^{b}	13.45^{d}	523.66^{b}	157	40.69^{b}	16.28^{b}	570.97^{b}	140
	L3	38.73^{a}	15.49^{a}	554.70^{a}	181	45.50^{a}	18.20^{a}	609.30^{a}	156
Bio	0	28.50^{b}	11.40^{b}	490.67^{b}	100	36.07^{b}	14.43^{b}	530.12^{b}	100
	Bio	31.95^{a}	12.78^{a}	515.26^{a}	112	38.54^{a}	15.41^{a}	562.92^{a}	107

L0 control L1(50-25-50 N-P- K , respectively) L2(100-50-100 N-P -K , respectively) L3(150-100-150 N-P- K , respectively)

b. Effect of interaction between mineral fertilizer levels and biofertilizer on yield:

Results in Table (3) illustrated the effect of interaction between the mineral fertilizer levels and biofertilizer on total yield/plot or fed and average weight of fruit.

The interaction between NPK at 150-100 and 150 kg/fed. and biofertilizer at 200gm microbin + 300 gm phosphorin gave the maximum values for yield/plot, yield/fed. and average fruit weight (16.14 and 18.59 ton/fed. in the 1st and 2nd seasons, respectively) with no significant differences with the interaction between NPK at 150-100 and 150 kg/fed. NPK, respectively and without biofertilizer (control) with respect to yield/plot and yield/fed. in the second only.

The increases in total yield/fed. where about 84 and 55% for the interaction between NPK at 100-50-100 kg/fed., respectively and without biofertilizer and 100 and 62% for the interaction between NPK at 150-100-150 kg /fed., respectively and biofertilizers with microbin at 200gm microbin + 300 gm phosphorin/fed. over the control (unfertilized with NPK and biofertilizers) in the 1st and 2nd seasons, respectively.

These results are similar with Adam *et al.* (2002) who found that higher mineral NPK fertilizer level combined with Biofertilizer significantly gave the maximum total fruit yield of cantaloupe compared with lower mineral level and zero biofertilizer. Similar results were reported on squash by (Abd El- Fattah and Sorial, 2000; Saad, 2002; Sorial, 2006).

Table (3). Effect of interaction between mineral fertilizer levels and biofertilizer on yield/plot, total yield / fed. and average weight of cantaloupe fruits during winter seasons of 2009-2010 and 2010- 2011.

Characters / Treatments		2009-2010 season				2010-2011 season			
		Total yield/ plot (kg)	Total yield/ fed (ton)	Average weight of fruit (gm)	Relative yield%	Total yield/ Plot (kg)	Total yield/ Fed (ton)	Average weight of fruit (gm)	Relative yield%
Mineral X Bio									
0	0	20.16^{e}	8.06^{e}	437.06^{e}	100	28.70^{f}	11.48^{f}	456.96^{e}	100
0	Bio	22.53^{de}	9.01^{de}	458.07^{d}	112	29.67^{f}	11.87^{f}	503.76^{d}	100
L1	0	25.22^{d}	10.80^{d}	469.60^{d}	134	32.34^{e}	12.94^{e}	513.10^{d}	113
L1	Bio	29.16^{c}	11.66^{c}	502.25^{c}	145	35.35^{d}	14.13^{d}	53^{7}.95^{c}	123
L2	0	31.50^{c}	12.60^{c}	513.23^{c}	156	38.74^{c}	15.49^{c}	553.73^{c}	135
L2	Bio	35.76^{b}	14.30^{b}	534.08^{b}	177	42.65^{b}	17.06^{b}	588.22^{b}	149
L3	0	37.11^{b}	14.84^{b}	542.78^{b}	184	44.52^{ab}	17.80^{ab}	596.90^{b}	155
L3	Bio	40.36^{a}	16.14^{a}	566.63^{a}	200	46.48^{a}	18.59^{a}	621.90^{a}	162

L0 control L1(50-25-50 N-P- K , respectively) L2(100-50-100 N-P -K , respectively) L3(150-100-150 N-P- K , respectively)

2. Frit quality

2-1. TSS, acidity and vit. C

a. Effect of mineral fertilizer levels and biofertilizer on TSS%, Acidity% and Vitamin C:

Concerning the effect of NPK, data in Table 4 showed that NPK at different levels didn't reflect significant effect on TSS% and acidity content in fruits at harvest and after storage periods except acidity% after storage period in the 2nd season, whereas had significant effect on vit.C in both seasons at harvest and after storage. Fertilization of cantaloupe plants with NPK at 150-100-150 kg/fed., respectively recorded the maximum values of vit.C at harvest (25.56 and 26.81 mg/100gm FW in the 1st and 2nd seasons, respectively).

Total soluble solids, acidity and vit.C in fruits of cantaloupe decreased with increasing storage period from zero days to 21 days at ambient temperature (Table 4 and 5).

Respecting NPK effect, at harvest the amount of vit.C was ranged from 18.43 to 25.56 mg/100gm FW in the 1st season and from 13.35 to 32.66 mg/100gm FW in the2nd season, but after storage period, the amount was from 11.81 to 15.40 mg/100gm FW in the 1st season and from 4.25 to 6.90 mg/100gm FW in the2nd season. Generally, when fruits become over ripe vit.C content declines concurrently with degradation of fruit tissue (Kalt, 2005). A positive effect was observed on vitamin C concentration with increasing N application rate (Zhao-Hui *et al.*, 2008).

b. Effect of interaction between mineral fertilizer levels and biofertilizer on TSS%, acidity% and vitamin C:

The effect of the interaction between mineral fertilizer levels and biofertilizer application on total soluble solids, acidity and vitamin C of cantaloupe fruits at harvest and after storage was shown in Table (5).

Table (4): Effect of mineral fertilizer levels and biofertilizer on TSS%, Acidity% and Vitamin C of cantaloupe fruits at harvest and after storage during winter seasons of 2009- 2010 and 2010-2011.

Treatments \ Characters		At harvest			After storage		
		TSS%	Acidity%	Vit. C mg/100gm FW	TSS%	Acidity%	Vit. C mg/100gm FW
		2009-2010 season					
Mineral	L0	6.83 ^{a}	0.14 ^{a}	18.43 ^{c}	5.66 ^{a}	0.09 ^{a}	11.81 ^{a}
	L1	8.38 ^{a}	0.13 ^{a}	21.05 ^{b}	6.65 ^{a}	0.10 ^{a}	13.51 ^{a}
	L2	7.66 ^{a}	0.14 ^{a}	22.95 ^{b}	6.10 ^{a}	0.01 ^{a}	13.95 ^{a}
	L3	8.56 ^{a}	0.15 ^{a}	25.56 ^{a}	6.31 ^{a}	0.09 ^{a}	15.40 ^{a}
bio	0	7.16 ^{a}	0.15 ^{a}	21.75 ^{a}	5.80 ^{a}	0.09 ^{a}	13.26 ^{a}
	Bio	8.55 ^{a}	0.14 ^{a}	22.25 ^{a}	6.55 ^{a}	0.09 ^{a}	13.89 ^{a}
		2010-2011 season					
Mineral	L0	7.03 ^{a}	0.13 ^{a}	13.35 ^{b}	5.96 ^{a}	0.09 ^{b}	4.25 ^{a}
	L1	8.18 ^{a}	0.19 ^{a}	31.93 ^{a}	7.35 ^{a}	0.15 ^{a}	4.76 ^{a}
	L2	7.66 ^{a}	0.20 ^{a}	32.66 ^{a}	6.30 ^{a}	0.14 ^{ab}	6.70 ^{a}
	L3	8.46 ^{a}	0.16 ^{a}	26.81 ^{a}	6.51 ^{a}	0.12 ^{ab}	6.90 ^{a}
bio	0	7.24 ^{a}	0.18 ^{a}	18.60 ^{b}	6.11 ^{a}	0.13 ^{a}	5.22 ^{a}
	Bio	8.43 ^{a}	0.16 ^{b}	33.77 ^{a}	6.95 ^{a}	0.12 ^{a}	6.10 ^{a}

L0 (Control) L1(50-25-50 N-P- K , respectively) L2(100-50-100 N-P -K , respectively) L3(150-100-150 N-P- K , respectively)

Table (5): Effect of interaction between mineral fertilizer levels and biofertilizer on TSS%, acidity% and vitamin c of cantaloupe fruits at harvest and after storage during winter seasons of 2009- 2010 and 2010-2011.

Treatments \ Characters		At harvest			After storage		
		TSS%	Acidity%	Vit. C mg/100gm FW	TSS%	Acidity%	Vit. C g/100gm FW
Mineral X Bio		2009-2010 season					
0	0	6.36 ^{b}	0.14 ^{b}	18.16 ^{b}	5.06 ^{b}	0.09 ^{a}	10.93 ^{d}
0	Bio	7.30 ^{ab}	0.13 ^{b}	18.17 ^{b}	6.26 ^{ab}	0.08 ^{a}	12.70 ^{cd}
L1	0	7.70 ^{ab}	0.12 ^{b}	20.70 ^{ab}	6.06 ^{ab}	0.08 ^{a}	13.13 ^{bc}
L1	Bio	9.06 ^{a}	0.14 ^{b}	21.40 ^{ab}	7.23 ^{a}	0.10 ^{a}	13.16 ^{bc}
L2	0	6.46 ^{b}	0.19 ^{a}	25.36 ^{a}	5.83 ^{ab}	0.10 ^{a}	15.30 ^{ab}
L2	Bio	8.86 ^{a}	0.14 ^{b}	25.76 ^{a}	6.36 ^{ab}	0.10 ^{a}	15.50 ^{a}
L3	0	8.13 ^{ab}	0.15 ^{ab}	22.76 ^{ab}	6.26 ^{ab}	0.11 ^{a}	13.70 ^{abc}
L3	Bio	9.00 ^{a}	0.15 ^{ab}	23.13 ^{ab}	6.36 ^{ab}	0.10 ^{a}	14.20 ^{abc}
Mineral X Bio		2010-2011 season					
0	0	6.66 ^{a}	0.14 ^{de}	13.40 ^{d}	5.26 ^{b}	0.09 ^{d}	3.36 ^{b}
0	Bio	7.40 ^{a}	0.12 ^{e}	13.30 ^{d}	6.66 ^{ab}	0.09 ^{d}	5.13 ^{ab}
L1	0	7.56 ^{a}	0.19 ^{bc}	21.76 ^{c}	6.70 ^{ab}	0.15 ^{ab}	4.03 ^{ab}
L1	Bio	8.80 ^{a}	0.20 ^{b}	42.10 ^{a}	8.00 ^{a}	0.16 ^{a}	5.46 ^{ab}
L2	0	6.63 ^{a}	0.24 ^{a}	22.33 ^{c}	6.03 ^{ab}	0.17 ^{a}	6.23 ^{ab}
L2	Bio	8.70 ^{a}	0.15 ^{d}	43.00 ^{a}	6.56 ^{ab}	0.12 ^{bcd}	7.16 ^{a}
L3	0	8.10 ^{a}	0.15 ^{d}	16.93 ^{cd}	6.46 ^{ab}	0.11 ^{cd}	7.23 ^{a}
L3	Bio	8.81 ^{a}	0.17 ^{cd}	36.70 ^{b}	6.56 ^{ab}	0.13 ^{bc}	6.63 ^{ab}

L0 (Control) L1(50-25-50 N-P- K , respectively) L2(100-50-100 N-P -K , respectively) L3(150-100-150 N-P- K , respectively)

The interaction between NPK and biofertilizer reflected a significant effect on TSS%, acidity% and vit.C in fruits at harvest and after storage period, except TSS% at harvest in 2nd season and acidity% after storage period in the 1st season. In general the interaction between NPK at 50-25-50 kg/fed. and biofertilizer, the interaction between NPK at 100-50-100 kg/fed. and without biofertilizers and the interaction between NPK at 100-50-100 kg/fed. with biofertilizers gave the highest values of TSS%, acidity and vit.C, respectively at harvest and before storage period.

These results are in agreement with those of Fallik *et al.* (2001) who found that TSS decreased from the time of harvest to the end of storage.

These results corresponded with of Ali and Selim (1996) that interaction between biofertilizers and mineral fertilizers significantly increased vitamin C in tomato fruits. Abd-El- Rahman *et al.* (2001) indicated that inoculation of plants with biofertilizers and NPK improve fruit storability and quality such as ascorbic acid and acidity.

2.2 Phenols, antioxidants and total carotenoids

a. Effect of mineral fertilizer levels and biofertilizers on total phenols, antioxidants activity and total carotinoids:

The effect of bio and mineral fertilizer on total phenols, antioxidants activity and carotenoide at harvest and after storage of cantaloupe fruits was shown in Table 6.

The obtained results in Table 6 indicated that fertilization of cantaloupe plants grown in sandy soil with NPK at different levels had significant effect on free radical scavenging activity evaluated by (2, 2-diphenyl-1- picryl hydrazyl) method DPPH (ascorbic acid equivalent antioxidant capacity, AEAC) and total carotenoids (TC) in fruits at harvest and after storage period in both seasons and total phenols (TP) after storage period in the 1st season. NPK at 150-100-150 kg/fed respectively gave the highest values for DPPH and TC in fruits at harvest and after storage period followed by NPK at 100-50-100kg/fed. respectively.

Respecting the effect of microbin and phosphorin on TP, DPPH and TC in fruits at harvest, the obtained results in Table 6 showed that inoculation with microbin at 200gm/fed. + phosphorin at 300 gm/fed. increased TP, DPPH in both seasons and TC in the 1st season, whereas after storage period, microbin+ phosphorien increased TP in the 1st season and DPPH in both seasons.

Total phenol, the total antioxidants(expressed as ascorbic acid equivalent when determined by DPPH method) and total carotenoids in fruits of cantaloupe decreasing with increasing storage period from 0 days to 21 days at ambient temperature (Table 6 and 7). Respecting NPK (Table5), the amount of total phenol (TP) at harvest was ranges from 213.5 to272 mg/100 gm FW as gallic acid in the 1st season and from 277.5 to 313.4 mg/100 gm FW as gallic acid in the 2nd season, but after storage the amount of TP was ranges from 147.71 to 225.93 mg/100gm FW as gallic acid in the 1st and from 194.60 to 227.88 mg/100gm FW as gallic acid in the 2nd season, also the amount of total carotenoids (TC) at harvest was ranged from 243.46 to 348.96 µg/g FW in the 1st season and from 281.95 to 560.95 µg/g FW in the 2nd season, but after storage the amount was ranged from 133.55 to 196.16 µg/g in the 1st season and from 216.63 to 509.32 µg/g FW in the 2nd season. Antioxidant activity evaluated by DPPH (AEAC), at harvest was ranged from 18.41 to 22.51% in the 1st season and from 20.44 to 24.55% in the 2nd season, but after storage DPPH was ranged from 5.50 to 7.71% in the 1st season and from 6.11 to 8.56% in the 2nd season. The phytochemical in plant tissues responsible for the antioxidant capacity are thought to be mainly vitamins C and E and carotenoides compounds. Strong evidence can be found in the literature supporting ascorbic acid as the most important antioxidant (Omaye *et al.*, 1988). The antioxidant activity of phenols is mainly due to their redox properties, which allow them to act as reducing agents, hydrogen donators, singlet oxygen quenchers and metal chelators (Rice-Evans *et al.*, 1995).

Table (6): Effect of mineral fertilizer levels and biofertilizer on total phenols, DPPH (AEAC) *and total carotinoids of cantaloupe fruits at harvest and after storage during winter seasons of 2009-2010 and 2010 -2011.

Characters / Treatments		At harvest			After storage		
		TP**	DPPH***	TC****	TP**	DPPH***	TC****
		2009-2010 season					
Mineral	L0	260.00 ^{a}	18.41^{d}	243.46^{b}	147.71^{c}	5.50^{d}	133.55^{b}
	L1	213.40 ^{a}	20.97^{c}	304.32^{ab}	194.40^{b}	5.94^{c}	166.94^{a}
	L2	233.50 ^{a}	21.96^{b}	325.04^{ab}	215.33^{b}	7.71^{a}	183.63^{a}
	L3	272.60 ^{a}	22.51^{a}	348.96^{a}	225.93^{a}	7.12^{b}	196.16^{a}
bio	0	227.02^{b}	20.73^{b}	284.25^{b}	179.76^{b}	6.41 ^{a}	164.85 ^{a}
	Bio	162.78^{a}	21.20^{a}	326.64^{a}	226.92^{a}	6.73 ^{a}	175.29 ^{a}
		2010-2011 season					
Mineral	L0	299.00 ^{a}	20.44^{d}	281.95^{c}	209.61 ^{a}	6.11^{d}	216.63^{c}
	L1	234.70 ^{a}	23.28^{c}	465.18^{b}	219.36 ^{a}	6.60^{c}	346.45^{b}
	L2	313.40 ^{a}	24.82^{a}	471.51^{b}	227.88 ^{a}	7.90^{b}	374.62^{b}
	L3	277.50 ^{a}	24.55^{b}	560.95^{a}	194.60 ^{a}	8.56^{a}	509.32^{a}
Bio	0	268.33^{b}	22.94^{b}	444.03 ^{a}	177.15^{b}	7.12^{b}	349.36 ^{a}
	Bio	338.97^{a}	23.60^{a}	445.77 ^{a}	237.58^{a}	7.47^{a}	374.16 ^{a}

L0 (Control) L1(50-25-50 N-P- K , respectively) L2(100-50-100 N-P -K , respectively) L3(150-100-150 N-P- K , respectively)
*AEAC: ascorbic acid equivalent antioxidant capacity
**Total phenol mg/ 100 g FW as gallic acid
***DPPH methodto determine radical scavenging capacity (%)
* ***Total Carotinoids µg/g FW (fresh weight)

b. Effect of interaction between mineral fertilizer levels and biofertilizer on total phenol content, antioxidant activity and total carotenoide:

Data presented in Table 7 indicated the effect of interaction between mineral fertilizer levels and biofertilizer on total phenol content, antioxidant activity and total carotenoide in cantaloupe fruits at harvest and at the end of storage.

In the 1st season, in general, the interaction between NPK at 150-100-150 kg/fed. and inoculation with microbin + phosphorin gave the highest values of TP and TC contents at harvest and after storage period and the interaction between NPK at 100-50-100kg/fed. and biofertilizers gave the highest values of DPPH at harvest and after storage period. In the 2nd season, the interaction between NPK at 50-25-50kg/fed. and biofertilizers recorded maximum values of TP and TC at harvest and after storage, but the *interaction between NPK at 150-100-150 kg/fed.* and biofertilizers recorded the maximum values of DPPH at harvest and after storage period.

Table (7): Effect of interaction between mineral fertilizer levels and biofertilizer on total phenols, DPPH (AEAC)* and total carotinoids of cantaloupe fruits at harvest and after storage during winter seasons of 2009-2010 and 2010 -2011.

Characters / Treatments		At harvest			After storage		
		TP*	DPPH**	TC***	TP*	DPPH**	TC***
Mineral X Bio		2009-2010 season					
0	0	254.96^{a}	18.29^{h}	219.11^{c}	135.63^{c}	5.27^{h}	108.51^{b}
0	Bio	265.10^{a}	18.54^{g}	267.80^{bc}	169.80^{c}	5.73^{g}	158.59^{ab}
L1	0	191.93^{b}	20.47^{f}	267.80^{bc}	166.73^{c}	5.86^{f}	175.29^{a}
L1	Bio	235.00^{ab}	21.48^{e}	340.84^{ab}	222.06^{b}	6.02^{e}	$158/.59^{ab}$
L2	0	196.50^{b}	22.24^{b}	268.67^{bc}	175.06^{c}	7.57^{b}	183.63^{a}
L2	Bio	270.06^{a}	22.79^{a}	381.42^{a}	255.60^{ab}	7.85^{a}	183.64^{a}
L3	0	264.23^{a}	21.94^{b}	381.42^{a}	241.63^{ab}	6.93^{d}	191.98^{a}
L3	Bio	280.96^{a}	21.99^{c}	316.5^{ab}	270.23^{a}	7.30^{c}	200.33^{a}
Mineral X Bio		2010-2011 season					
0	0	287.46^{bc}	20.30^{h}	222.16^{e}	202.23^{bc}	5.85^{h}	180.22^{e}
0	Bio	310.53^{bc}	20.58^{g}	341.74^{d}	217.00^{bc}	6.36^{g}	253.05^{de}
L1	0	224.50^{d}	22.72^{f}	541.26^{ab}	201.76^{bc}	6.51^{f}	477.18^{ab}
L1	Bio	424.90^{a}	23.84^{e}	581.63^{a}	236.96^{b}	6.59^{e}	541.46^{a}
L2	0	288.43^{bc}	24.35^{d}	490.11^{abc}	157.46^{d}	7.70^{d}	413.54^{bc}
L2	Bio	338.36^{b}	25.30^{a}	452.91^{bc}	298.30^{a}	8.11^{c}	335.71^{cd}
L3	0	272.93^{cd}	24.41^{c}	529.55^{ab}	191.13^{cd}	8.41^{b}	425.69^{bc}
L3	Bio	282.10^{bc}	24.69^{b}	400.82^{cd}	198.06^{bcd}	8.72^{a}	267.21^{de}

L0 (control) L1(50-25-50 N-P- K , respectively) L2(100-50-100 N-P -K , respectively) L3(150-100-150 N-P- K , respectively)
*AEAC: ascorbic acid equivalent antioxidant capacity
**Total phenol mg/ 100 g FW as gallic acid
***DPPH methodto determine radical scavenging capacity (%)
* ***Total Carotinoids µg/g FW (fresh weight)

2.3. Color index

2.3.1. Hunter L*, a* and b*

a.Effect of mineral fertilizer levels and biofertilizer on Hunter color values:

Data presented in **Table 8** illustrated the effect of mineral fertilizer levels and biofertilizer on Hunter L*, a*, and b* values in fruits at harvest and after storage periods during both seasons.

Concerning the effect of mineral fertilizer levels on hunter L* value, during the 1st season a positive correlation was found between increasing mineral fertilizer levels and increasing darkening in fruits at harvest. Control treatment recorded the lower values compared with other treatments at harvest and after storage in both seasons.

Concerning a* value, fertilization increasing NPK levels significantly increased a* values at harvest and stored fruits during 1st season. During the second season a* value was reduced and the redness was reduced and the fruits pulp were nearest to green yellow color. Also, a* values more lowest compared with a* values in the 1st season, and no significant difference was recorded between all treatments and control at harvest and at the end the storage.

Hunter b* value was an indicator to yellow color. Fertilization with NPK significantly reduced yellow color and b* value which is indicator to decrease caroteniode, this effect observed at harvest and stored fruits during first season. During second season control treatment recorded the highest b* value and no significant different between it and the first level of mineral fertilizer at harvest and at the end of storage. the reduction in carotenoiede with increase NPK levels may due to increasing N level which enhanced chlorophyll formation. A promotion effect of organic and inorganic fertilizers on chlorophyll contents might be attributed to the fact that N is a constituent of chlorophyll molecule. Moreover, nitrogen is the main constituent of all amino acids in proteins and lipids that acting as a structural compounds of the chloroplast (Badr and Fekry, 1998; Arisha and Bradisi, 1999). Similar results obtained by Ferrante *et al.* (2008) who studied the effect of nitrogen fertilization levels on melon fruit quality at the harvest time and during storage and found that the lowest value of total carotenoids was observed in the highest N fertilization level.

Application of biofertilizer significantly decreased L* value at harvest and after storage during the 1st season. This results indicator to increase pulp darkening and lightening decrease which reduce the quality and overall acceptability of cantaloupe fruits. Nevertheless, in the second season no significant difference obtained with applied biofertilizer and between control at harvest fruits and the end of storage.

Table (8): Effect of mineral fertilizer levels and biofertilizer on L*, a* and b* of cantaloupe fruits at harvest and after storage during winter seasons of 2009-2010 and 2010-2011.

Characters / Treatments		At harvest			After storage		
		L*	a*	b*	L*	a*	b*
		2009-2010 season					
Mineral	L0	79.36^{a}	10.31^{d}	36.73^{a}	71.23^{a}	17.55^{d}	19.05^{a}
	L1	78.20^{b}	11.88^{b}	31.64^{b}	71.46^{a}	17.95^{c}	17.84^{b}
	L2	75.98^{c}	11.44^{c}	25.78^{c}	70.56^{b}	18.18^{b}	16.21^{c}
	L3	72.45^{d}	12.08^{a}	21.87^{d}	64.40^{c}	18.31^{a}	12.96^{d}
Bio	0	77.15^{a}	11.27^{b}	29.49	71.29^{a}	17.95^{b}	17.43^{a}
	Bio	75.84^{b}	11.58^{a}	28.51	67.54^{b}	18.05^{a}	15.60^{a}
		2010-2011 season					
Mineral	L0	79.33^{a}	3.11^{a}	35.68^{a}	78.22^{a}	3.11^{a}	26.11^{a}
	L1	75.51^{ab}	3.40^{a}	34.00^{a}	72.83^{ab}	3.48^{a}	24.77^{ab}
	L2	70.91^{ab}	3.65^{a}	26.04^{b}	71.20^{bc}	3.81^{a}	20.39^{bc}
	L3	63.68^{b}	4.00^{a}	24.24^{b}	66.59^{c}	4.33^{a}	16.78^{c}
Bio	0	73.63^{a}	3.42^{a}	30.22^{a}	73.58^{a}	3.52^{a}	22.66^{a}
	Bio	71.09^{a}	3.65^{a}	29.76^{a}	70.84^{a}	3.85^{a}	21.36^{a}

L0 (Control) L1(50-25-50 N-P- K , respectively) L2(100-50-100 N-P -K , respectively) L3(150-100-150 N-P- K , respectively)

L*: lightness to darkening (100-0) a*: green (-) to red (+) b* blue (-) to yellow (+)

Concerning, a* value during the first season at harvest and after storage the markedly increased in redness was observed compared with control and this effect increase quality the fruits. This may be due to continue in maturation during storage and degraded in chlorophyll and enhancing yellow color formation. During the second season ,at harvest and after storage no significant differences rerecorded between treatments in a* values. The decrease in green colour (increase a* value) in melon was most likely due to decline in the chlorophyll content as the fruit developed and ripened (Pratt, 1971). The a* values increase demonstrated consistent increase cantaloupe maturity. Therefore a* and hue angle values appeared to provide a good indication of maturity.

Regarding, b* values application of biofertilizer did not gave any significantly difference in b* value or yellow color during both first and second season at harvest and at the end of storage cantaloupe fruits.

b. Effect of interaction between mineral fertilizer levels and biofertilizer on Hunter color values:

Data in **Table 9** illustrated the interaction between mineral fertilizer levels and biofertilizer on Hunter L*, a* and b* values at harvest and storage of cantaloupe fruits.

Table (9): Effect of interaction between mineral fertilizer levels and biofertilizer on L*, a* and b* of cantaloupe fruits at harvest and after storage during winter seasons of 2009-2010 and 2010-2011.

Characters / Treatments		At harvest			After storage		
		L*	a*	b*	L*	a*	b*
Mineral X Bio		2009-2010 season					
0	0	80.13^{a}	10.10^{h}	36.73^{a}	75.10^{a}	17.48^{h}	19.46^{a}
0	Bio	78.60^{b}	10.52^{g}	36.73^{a}	67.36^{f}	17.63^{g}	18.65^{b}
L1	0	78.40^{b}	11.10^{f}	32.82^{b}	71.83^{c}	17.90^{f}	17.84^{c}
L1	Bio	78.00^{b}	11.78^{e}	30.47^{c}	71.10^{d}	18.01^{e}	17.84^{c}
L2	0	76.50^{c}	11.83^{d}	25.78^{d}	72.60^{b}	18.14^{d}	17.02^{d}
L2	Bio	75.46^{d}	11.93^{c}	25.78^{d}	68.53^{e}	18.22^{c}	15.40^{e}
L3	0	73.60^{e}	12.06^{b}	22.65^{e}	65.63^{g}	18.28^{b}	15.40^{e}
L3	Bio	71.30^{f}	12.11^{a}	21.09^{f}	63.10^{h}	18.34^{a}	10.52^{f}
Mineral X Bio		2010-2011 season					
0	0	80.38^{a}	3.06^{a}	36.07^{a}	79.98^{a}	3.00^{a}	26.11^{a}
0	Bio	78.29^{a}	3.16^{a}	35.29^{a}	76.47^{ab}	3.23^{a}	26.11^{a}
L1	0	76.76^{a}	3.30^{a}	34.25^{a}	73.34^{ab}	3.40^{a}	25.86^{a}
L1	Bio	74.26^{a}	3.50^{a}	33.74^{a}	72.33^{b}	3.56^{a}	23.68^{ab}
L2	0	73.42^{a}	3.63^{a}	26.23^{b}	71.54^{b}	3.80^{a}	20.44^{abc}
L2	Bio	68.41^{a}	3.66^{a}	25.86^{b}	70.86^{b}	3.83^{a}	20.35^{abc}
L3	0	63.95^{a}	3.70^{a}	24.32^{b}	69.47^{bc}	3.90^{a}	18.23^{bc}
L3	Bio	63.40^{a}	4.30^{a}	24.16^{b}	63.72^{c}	4.70^{a}	15.32^{c}

L0 (Control) L1(50-25-50 N-P- K , respectively) L2(100-50-100 N-P -K , respectively) L3(150-100-150 N-P- K , respectively)
L*: lightness to darkening (100-0) a*: green (-) to red (+) b* blue (-) to yellow (+)

Concerning Hunter L* value, it is found that all treatments significantly reduced Hunter L* value compared with control at harvest and at the end of storage during the first season. During the second season it is observed that no significant difference was indicated between all treatments in hunter L* value at harvest. Whereas, at the end of storage control treatment recorded the optimal L* value and no any significant different between it and mineral fertilizer alone or biofertilizer alone.

Concerning a* value during the 1st season at harvest and at the end of storage, increasing the mineral fertilizer levels with biofertilizer increased a* values and redness. During the second season no significant differences were recorded between all treatments in a* value at harvest and after storage compared with control treatment and a* decreased in this season compared with the first season as indicator to increase the green color.

Concerning b* value, the interaction between mineral fertilizer levels and biofertilizer was reduced with increasing mineral NPK levels and significantly decrease Hunter b* value (yellow color) causing increase green color at harvest and after storage during both seasons.

2.3.2. Acohol soluble color, hue and chroma

a. The effect of mineral fertilizers levels and biofertilizer on alcohol soluble color, hue and chroma:

The effect of mineral fertilizers levels and biofertilizer on alcohol soluble color, hue and chroma at harvest and at the end of storage cantaloupe fruits was shown in Table 10.

Concerning the effect of mineral fertilizer levels, it is found that fertilization with the 3rd level of NPK gave the maximum ASC at harvest fruits and at the end of storage during both seasons. This may be due to the increase of reducing sugar and soluble sugar from degradation the higher molecules weight which react with nitrogen compound in Millared reaction and gave the browning pigments.

There was a tendency toward higher soluble sugar concentrations in cantaloupe fruits with increasing N supply (Zhao-Hui *et al.*, 2008).

Concerning hue value, it's found that no any treatments exceeded on control treatment during both seasons at harvest and at the end of storage.

Increase chroma was a good indicator for obtained a clear color without any darkening or browning pigments which had bad influence on the color and appearance. There were a significantly decreased in chroma values with increase the rate of NPK at harvest cantaloupe fruits and at the end of storage during the first season. During the second season the control treatments recorded the highest chroma at harvests and at the end of storage.

Concerning, alcohol soluble color (ASC) during both seasons fertilization with biofertilizer did not record any significant difference between it and control treatment at harvest and at the end of storage.

Concerning hue value, fertilization with biofertilizer significantly improve the color hue values compared with control treatment at harvest and after storage of cantaloupe fruits. It is observed that hue values decreased after storage compared with the fruits at harvest, this may be due to degradation happened in fruits pigments during storage period. During the 2nd season no significant difference was found as a result of using biofertilizer compared with control treatment at harvest cantaloupe fruits or at the end of storage.

The same results was obtained with chroma value as hue value as resulted to use biofertilizer.

Table (10): Effect of mineral fertilizer levels and biofertilizer on alcohol soluble color, Hue value and Chroma value of cantaloupe fruits at harvest and after storage during winter seasons of 2009- 2010 and 2010- 2011.

Characters / Treatments		At harvest			After storage		
		ASC	Hue value	Chroma value	ASC	Hue value	Chroma value
		2009-2010 season					
Mineral	L0	0.180^{b}	14.77^{d}	31.51^{a}	0.252^{b}	7.28^{a}	17.79^{a}
	L1	0.200^{b}	15.13^{c}	27.03^{b}	0.265^{b}	6.51^{b}	16.78^{b}
	L2	0.210^{b}	17.47^{b}	21.33^{c}	0.314^{ab}	6.38^{b}	15.27^{c}
	L3	0.310^{a}	19.90^{a}	17.47^{d}	0.373^{a}	7.59^{a}	12.08^{d}
bio	0	0.220^{a}	16.78^{b}	24.74^{a}	0.296^{a}	6.64^{b}	16.37^{a}
	Bio	0.230^{a}	16.86^{a}	23.93^{b}	0.306^{a}	7.23^{a}	14.59^{b}
		2010-2011 season					
Mineral	L0	0.123^{c}	87.67^{a}	35.72^{a}	0.221^{c}	86.70^{a}	26.16^{a}
	L1	0.219^{b}	87.67^{a}	34.03^{a}	0.393^{b}	86.50^{a}	24.82^{ab}
	L2	0.254^{b}	86.37^{ab}	26.10^{b}	0.456^{b}	84.88^{a}	20.48^{bc}
	L3	0.310^{a}	85.26^{b}	24.33^{b}	0.562^{a}	81.66^{b}	16.96^{c}
bio	0	0.215^{a}	87.00^{a}	30.26^{a}	0.388^{a}	85.38^{a}	22.73^{a}
	Bio	0.239^{a}	86.48^{a}	29.83^{a}	0.428^{a}	84.54^{a}	21.47^{a}

L0 (Control) L1(50-25-50 N-P- K , respectively) L2(100-50-100 N-P -K , respectively) L3(150-100-150 N-P- K , respectively)

ASC: alcohol soluble color (non enzymatic browning), hue: intensity of color, chroma: clarity of hue (the color free from browning)

b. The effect of interaction between mineral fertilizer levels and biofertilizer on alcohol soluble color, hue and chroma

The effect of interaction between mineral fertilizer levels and biofertilizer on alcohol soluble color, hue and chroma at harvest and after storage of cantaloupe fruits was shown in Table 11.

Concerning, alcohol soluble color (ASC) the combination between mineral fertilizer at 150-100-150 with or without biofertilizer significantly increased ASC at harvest of cantaloupe fruits during first season, whereas, at the end of storage mineral fertilizer at 150-100-150 with biofertilizer significantly recorded maximum browning compared with control. The maximum browning in the 2nd season was recorded by using mineral fertilizer at 100-50-100 with biofertilizer and 150-100-150 with or without biofertilizer.

Concerning hue value, the application of mineral fertilizer at 150-100-150 with biofertilizer gave the best color (hue value) during the 1st season at harvest and at the end of storage of cantaloupe fruits. On the contrary, this treatment recorded the lowest hue value in the 2nd season at harvest and after storage fruits.

Concerning chroma value, fertilization with biofertilizer markedly gave the highest chroma value at harvest during 1st season while, at the end of storage the control treatments recorded optimal value of chroma. During the 2nd season the first four treatments recorded the highest value of chroma at harvest cantaloupe fruits. At the end of storage the interaction between treatments significantly did not record any increase in chroma compared with control except the last treatment which recorded the lowest chroma values.

Table (11): Effect of interaction between mineral fertilizer levels and biofertilizer on alcohol soluble color, Hue value and Chroma value of cantaloupe fruits at harvest and after storage during winter seasons of 2009-2010 and 2010-2011.

Characters / reatments		At harvest			After Storage		
		ASC	Hue value	Chroma value	ASC	Hue value	Chroma value
Mineral X Bio		2009-2010 season					
0	0	0.171^{b}	15.08^{g}	31.39^{b}	0.246^{b}	7.35^{b}	18.15^{a}
0	Bio	0.190^{b}	14.46^{h}	31.64^{a}	0.257^{ab}	7.21^{b}	17.42^{b}
L1	0	0.197^{b}	15.16^{e}	28.02^{c}	0.264^{ab}	6.86^{c}	16.75^{d}
L1	Bio	0.204^{b}	15.09^{f}	26.04^{d}	0.267^{ab}	6.33^{de}	16.81^{c}
L2	0	0.206^{b}	17.57^{c}	21.30^{f}	0.307^{ab}	6.20^{e}	16.06^{e}
L2	Bio	0.213^{b}	17.37^{d}	21.37^{e}	0.321^{ab}	6.55^{cd}	14.48^{g}
L3	0	0.308^{a}	19.31^{b}	18.25^{g}	0.368^{ab}	6.33^{de}	14.51^{f}
L3	Bio	0.316^{a}	20.50^{a}	16.86^{h}	0.379^{a}	8.85^{a}	9.66^{h}
Mineral X Bio		2010-2011 season					
0	0	0.109^{c}	87.68^{a}	36.11^{a}	0.169^{d}	86.07^{ab}	26.18^{a}
0	Bio	0.138^{c}	87.66^{a}	35.33^{a}	0.247^{d}	87.33^{a}	26.14^{a}
L1	0	0.204^{b}	87.90^{a}	34.28^{a}	0.365^{c}	86.98^{a}	25.90^{a}
L1	Bio	0.235^{b}	87.44^{a}	33.78^{a}	0.420^{bc}	86.21^{ab}	23.73^{ab}
L2	0	0.240^{b}	86.41^{ab}	26.28^{b}	0.431^{bc}	84.97^{ab}	20.53^{abc}
L2	Bio	0.269^{ab}	86.34^{ab}	25.92^{b}	0.481^{ab}	84.79^{ab}	20.44^{abc}
L3	0	0.307^{a}	86.02^{ab}	24.38^{b}	0.562^{a}	83.50^{ab}	18.34^{bc}
L3	Bio	0.314^{a}	84.50^{b}	24.28^{b}	0.462^{a}	79.82^{b}	15.57^{c}

L0 (control) L1(50-25-50 N-P- K , respectively) L2(100-50-100 N-P -K , respectively) L3(150-100-150 N-P- K , respectively)

ASC: alcohol soluble color (non enzymatic browning), hue: intensity of color, chroma: clarity of hue (the color free from browning)

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تأثير التسميد المعدني و الحيوي علي الإنتاجية وبعض مضادات الأكسدة للكنتالوب المنزرع في الأراضي المستصلحة حديثا.

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أجريت هذه التجربة لتقدير مدي استجابة محصول الكنتالوب و خصائص الجودة للثمار و القدرة التخزينية للأنواع المختلفة من السماد سواء السماد المعدني و المحتـوي علـي عناصـر النيتروجين و الفسفور و البوتاسيوم بمعدلات مختلفة أو السماد الحيوي. حيث كان تصميم التجربة قطاعات منشقة و كان العامل الأول هو NPK والذي استخدم بمستويات مختلفة (كنترول و ٥٠- ٢٥- ٥٠ كجم NPK / فدان و ١٠٠- ١٥٠- ١٠٠ كجم NPK/فدان و ١٥٠-١٠٠-١٥٠ كجـم NPK للفدان) بينما كان العامل الثاني كان التسميد الحيوي بمعدلين هما (كنترول و خليط مكـون من ٢٠٠ جرام ميكروبين+٣٠٠ جرام فوسفورين /فدان). كل مستويات التسميد المعدني و الحيوي أدت إلي زيادة المحصول الكلي للقطعة التجريبية و المحصول الكلي للفدان و متوسط وزن ثمـار الكنتالوب. وقد سجل التفاعل ما بين نوعي السماد المعدني و الحيوي اعلي زيادة في المحـصول الكلي للقطعة التجريبية و المحصول الكلي للفدان و متوسط وزن الثمار مقارنة باستخدام كلا مـن نوعي السماد بمفردهما. وقد ازدادت مقاييس الجودة للثمار بتطبيق نـوعي التـسميد بمفـردهم أو مجتمعين مع بعضهم. كما ازداد النشاط المضاد للأكسدة باستخدام التسميد المعدني و الحيوي. وقد ازدادت دكانة لون اللحم و أيضا اللون الأصفر و انخفض اللون الأخضر مع حدوث تحـسن فـي اللون ومدي صفائه باستخدام نوعي التسميد وخاصة مع إضافة التسميد الحيوي. جميـع مقـاييس الجودة انخفضت بعد التخزين إذا قورنت بمقاييس الجودة عند الحصاد ولكـن بدرجـة اقـل فـي المعاملات المستخدم فيها التسميد المعدني فقط أو الحيوي فقط أو معاملات التفاعل بينهمـا خـلال الموسمين.

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