J. Plant Production, Mansoura Univ., Vol. 8 (1): 1 - 11, 2017

Influence of Azolla, Some Blue Green Algae Strains and Humic Acid on Soil, Growth, Productivity, Fruit Quality and Storability of "Canino" Apricot Cultivar Grown Under Clay Loamy Soil

Nevine M. Taha[1] and R. M. El-Shahat[2]
[1] Deciduous Fruits Res. Dept., Hort. Res. Inst., ARC, Giza, Egypt.
[2] Soils, Water and Environ. Res. Inst., ARC, Giza, Egypt

ABSTRACT

Filed experiments were conducted during 2014 and 2015 seasons in a private orchard in El-Nianaia, Minufiya governorate, Egypt to study the effect of foliar spray with in aqueous solutions of biofertilizer (azolla and blue green algae extract at the rate of 1 L/20L water for each, commercial liquid organic fertilizer of humic acid (H.A.) at the rate of 200 cm^3/20 L water and their combinations on vegetative growth, yield and fruit quality. Trees of apricot (*Prunus armeniaca* L.) cv. Canino at 10-years-old trees grown in clay loam soil at 3 x 4 m apart under flood irrigation system. The obtained results indicated that most of the used treatments improved the means of blade width and length, leaf surface area, weight and total chlorophyll. Also, fruit set %, yield/tree, the fruit dimensions, volume and weight, as well as stone weight and flesh weight % take various significance levels as compared to control in both seasons. However, the highest means in most of previous treatments were attained in both seasons with their combinations of Azolla, blue green algae extract and humic acid. The changes in the percent of weight loss, TSS, acidity and total sugars in juice were improved during the period of cold storage. The firmness of the fruits was descendingly decreased as the advancing of period of cold storage, but the opposite trends was right regarding TSS and weight loss %, which were progressively increased with prolonging the period of cold storage. Whereas acidity % was declined by all the applied treatments to reach the minimal values by either blue green algae treatments or when mixed with either Azolla or humic acid. In addition, leaf content of N, P, K and Mg as well as fruit content of N, P, K, Ca, Mg, Na, Fe, Zn and Cu were also increased. Hence, it can be recommended to spray the foliage of 10-years-old trees "Canino" apricot cv. grown under clay loamy soil with the aqueous extract Azolla + Blue green algae + humic acid, to increase both yield, fruit quality parameters and fruit storability period.

INTRODUCTION

Apricot (*Prunus armeniaca* L.) is a deciduous fruit tree belongs to Family Rosaceae, produces stone fruits which are used as fresh, dried or canned products. Apricot planted area in Egypt was 16433 feddan in 2013 and the productions were 98772 tons (Ministry of Agriculture Statistics). Apricot "Canino" cultivar characterized by high productivity and good quality in the various types of Egyptian soils.

Nowadays, the application of biofertilizers succeeded to minimize the amount of applied chemical ones and reduce the production costs and environmental pollution (El-Khawaga *et al*., 2003), especially N-Fixing Azolla and blue green algae which serve as an excellent source for utilizing solar energy efficiency for providing the soil with organic matter. Besides, both Azolla and blue green algae extracts are characterized by its content of such auxins, gibberellins, and cytokinins that enhance the plant growth.

The information in the literature regarding the effect of both Azolla and blue green algae on apricot cultivars is not available, while on other crops, the following results may be valid. In this concern, El-Shahat *et al*., (2011) found that addition of Azolla + urea at 90 kg/fed., increased the soil biological activity, but decreased EC and pH of tested saline soil. Also, gave the highest values of plant height and kernels, grain yield as well as protein, oil and carbohydrates content in grains kernels of maize compared with control. El-Sherif *et al*., (2013) stated that application of Azolla and blue green algae recorded the highest significant increase in nodule number and its dry weight and Faba bean yield components. Also, they increased the soil availability of N, P and K and its content in seeds and straw. On rice, Abd-El-Aal *et al*., (2013) revealed that application of Azolla + blue green algae + bio-straw produced the highest grain yield (3.62 ton/fed.) and weight of grain, and significantly increased N, P and K contents of grains and straw, as well as organic matter and N, P and K in soil, but slightly decreased soil EC and pH. Moreover, Mohamed *et al*., (2013) recommended to used biofertilizer (mixture of Azolla and Cyanobacteria) plus 750 g magnetite for achieving the highest total yield and improved fruit peel quality of Valencia orange trees grown in soil influenced by salinity, also reduced soil EC and pH and Na uptake, but increased leaf K content.

Similar observations were also attained by El-Zeky *et al*., (2005) on rice, El-Shahat (2007) on wheat, Aly *et al*., (2008) on sugar beet, El-Shahat (2014) on barley, Abo El-Khair *et al*., (2009) on potato, Aref *et al*., (2011) on rice and Hanna *et al*., (2013) on wheat.

On the other hand, humic acid and humates seems to be valuable in improving plant growth and correcting the occurrence of certain nutrient deficiency symptoms. This is attained through increasing the soil water holding capacity, improving soil structure and promoting soil microorganisms by providing them with energy which enhances their metabolic activity. They also may act as a source of N, P and S for plants (Higa and Widiana, 1991). Eissa *et al*., (2003) elicited that K-humate alone or in combination with super torn improved shoot length, leaf surface area, leaf chlorophyll content, fruit yield and size, fruit flesh thickness and acidity and crop monetary value of Canino apricot trees. Humic acid positively effect for yield, fruit quality and leaf chlorophyll of Florida prince peach trees (Abd El-Razek, *et al*., 2012). In this respect, humic acid has many effects due to its increase of cation exchange capacity, which affects the retention and availability of nutrients, or due to a hormonal effect, or a combination of both (Chunhua *et al*., 1998). "Canino" apricot leaves contained more N, P and K as a result of

application of humic acid which pressed the leaves to gain chlorophyll and more dry matter, increased retained fruits, fruit yield and enhanced fruit quality, Shaddad *et al*., (2005). Likewise, El-Segiiney (2006) declared that soil and foliar application of commercial organic fertilizer containing 2.9 % humic acid and 0.5 % for each of Fe, Zn, Mn and Cu caused a significant increase in vegetative growth parameters of Canino apricot trees and leaf content of chlorophyll, total carbohydrates, N, P, K, Ca, Fe, Mn and Zn.

The current work, however aims to explore the response of Canino apricot trees grown in clay loam soil to the individual or combined application of azolla, blue green algae and humic acid (Actosol) on soil properties and biological activity leaf chlorophyll content, leaf and fruit mineral, fruit set, yield, fruit quality at harvest and during cold storage.

MATERIALS AND METHODS

Field experiments were undertaken throughout the two consecutive seasons (2014 and 2015) in a private orchard at Minufiya governorate, Egypt, on nearly similar vigour, 10-years-old trees of apricot (*Prunus armeniaca* L.) cv. Canino.

These trees were grown in clay soil at 3 x 4 m apart under flood irrigation system and received the usual agricultural practices needed for such plantation. Each season the experimental soil analyzed before and after starting the study according to methods described by Page *et al*., (1982).

The experiment in each season involved the following eight treatments, as it laid down in a complete randomized block design with three replicates (Mead *et al*., 1993):

1- Control, where the selected trees devoted for each treatment fertilized with the recommended dose of ammonium nitrate (33.5 % N) 75 kg fed^{-1}, calcium superphosphate (15.5 % P_2O_5) 150 kg fed^{-1} and potassium sulphate (45 % K_2O) 100 kg fed^{-1}.
2- Azolla pinnata aqueous extract at the rate of (1 L/20 L) water. Wet Azolla was hardly crushed and blended in a mixture till giving a suspension. The resulted suspension was filterated represents the Azolla extract which will be used in spray treatments.
3- Blue green algae (*Nostoc muscorum* and *Anabaena oryzae*) strains aqueous extract at the rate of (1 L/20 L) water. Blue green algae biomas separates from its culture medium by filteration, and then mixed together to give a suspension. This suspension is filtered through Wathman paper (No. 1). The obtained filterate which used in blue green algae foliar spray treatments.

Both Azolla and blue green algae were obtained from Agric. Microbiol. Res. Dept., Soils, Water and Environ. Res. Inst. ARC, Giza, Egypt. Azolla was grown in the greenhouse up to the log phase on Yoshida medium (Yoshida *et al*., 1976), while blue green algae strains were grown in the Lab on BG 11 medium (Rippka *et al*., 1979) under continuous illumination (2000 lux) up to the log phase.

4- A commercial liquid of organic fertilizer, containing a minimum of 2.9 % humic acid (H.A.) 200 ml/20 L water.
5- Combined treatments were also created as follows; 1 L Azolla extract + 1 L blue green algae extract /20 L water.
6. 1 L Azolla extract + 200 ml H.A. /20 L water.
7. 1 L blue green algae extract + 200 ml humic acid /20 L water.
8. 1 L Azolla extract + 1 L blue green algae extract + 200 ml H.A. /20 L water.

The aqueous extract of both Azolla fern and algal blue green algae (1: 1, w/v) were kept at 4 °C till using.

The previous individual and combined treatments were foliar sprayed four times, viz. at the dormant buds stage (on Feb, 10^{th}), full bloom stage (on March, 15^{th}), after fruit set (on April, 16^{th}) and month pre-harvest of May. The twenty litres of solution prepared for each treatment sprayed on the soil surface around the tree on the trees were devoted for the treatment. In addition, all trees of the experiment received all the other agricultural practices, as usual.

Soil analysis:

The initial soil and rhizospheric samples collected before drying were used directly for determination of total viable bacteria and blue green algae applying serial dilution and plate count as CFU/1 g dry soil using, the medium of soil extract agar (Allen, 1959) and that of Allen and Staniar (1968) for two group, respectively, Carbon dioxide evolution (Gour *et al*., 1971) dehydrogenase (DHA) Casida *et al*., (1964).

The experiments soil was sampled initially before and after conducting the experiments to determine its physical and chemical analysis according AOAC (1995). The results of initial soil analysis are shown in Table (1).

The soil samples were air dried, exposed to physical and chemical analysis according to the standard method i.e., soil organic matter, total nitrogen, total phosphorus and potassium pH and EC in soil paste (1: 1.25 w.v.) (Page, 1982 and Houba *et al*., 1995).

Determination:

1- Leaf parameters:

About 20 leaves were taken from previously labeled branches for each replicate to measure blade width and length (cm), leaf area (cm^2) which was measured using a planimeter according to Nautigual *et al*., (1990) and leaf fresh weight (g).

2- Yield and fruit characteristics:

The percentages of fruit set and fruit drop, as well as yield (kg/tree) were calculated before picking, samples of 20 fruits from each replicate were taken to determine, fruit weight (g), fruit dimensions, fruit volume (cm^3) flesh and seed weight (g). Besides, changes of the firmness ($lb/inch^2$) and weight loss %, TSS, Acidity and total sugars were estimated during the different times of cold storage for 20 days at 4°C and 95 % RH.

- Flesh weight (%) was calculated as followed:

$$\text{Flesh weight (\%)} = \frac{\text{Flesh weight}}{\text{Fruit weight}} \times 100$$

3- Chemical properties of the fruits:

- Total soluble solids (TSS %) of fruit juice was evaluated by using the hand refractometer.
- Total acidity (%) was measured by titration method of A.O.A.C. (1995).

- TSS/acidity was calculated as a ratio.
- Vitamin C (ascorbic acid) was assessed by the method of A.O.A.C. (1995) as mg/100 g fruit flesh.
- Total sugars (%), was determined in pulp fruit samples according to A.O.A.C. (1995).
- Fruit firmness (lb/inch^2) was determined by Magnese-Taylor pressure tester.

4- Chemical composition of the soil; leaves and fruits:

In fresh leaf samples taken from the middle parts of the selected shoots, total chlorophyll content (mg/g f.w.) was quantificated according to Yadava (1986), while in dry ones, the contents of N, P, K and Mg, as well as the fruits contents of N, P, K, Ca and Mg as percentages, also contents of Na, Fe, Zn and Cu as ppm were assessed using the methods explained by Page *et al*., (1982) and Houba *et al*., (1995).

5- Statistical analysis:

The collected data were tabulated and undergone to the prepare analysis of variance using SAS Institute (2009), which was followed by Duncan`s New Multiple Range Test (Steel and Torrie, 1980) to compare the differences among means of various treatments.

RESULTS AND DISCUSSION

Chemical properties of soil:

Organic matter (OM %)

Application of Azolla, blue green algae and humic acid singly or combines on some chemical soil properties after Canino harvesting are monitored in Table (1). Inoculation with Azolla, blue green algae and Humic acid suspensions separately or combination together increased the soil organic matter percentage over control treatment and matter soil (zero time). The highest levels of organic matter were obtained in treatment T8 which gave average 1.22 % for two seasons followed by treatments T5 (Az. + HA) and T7 (Az. + BGA) (1.16 and 1.11), respectively.

Data in Table (1) represented that applied of Azolla, blue green algae and humic acid alone or combined with together decreased the soil pH from 8.20 to (7.96, 7.95, 7.94, 7.66 and 7.80) (T2 Az., T5 Az. + HA, T6 BGA + HA, T7 Az. + BGA and T8 Az + BGA + HA) i.e., lower than other treatments. These results were in harmony with those of El-Shahat (2007) who found that incorporation of Azolla decreased the soil pH.

As for soil EC in all treatments was recorded in Table (1). Application of T8 (Az. + BGA and H.A) and T5 decreased soil pH and EC (T5 1.35 and T8 1.40 dS/m^{-1}) as compared with the control treatment 1.70 dS/m^{-1}.

Summing up, it is quite clear that the application of mixture of T5 (Azolla + humic) and T8 (Azolla + blue green algae + humic acid) dropped EC from 1.70 to 1.35 and 1.40 dS/m^{-2}, respectively.

It is quite clear that the type of biofertilizer (Azolla and blue green algae) and humic acid markedly affect on soil OM %, pH and EC as their values changed with humic alone and their effect increased with inoculation with Azolla alone or combined with them.

- Available macronutrients content in soil:-

Data in Table (1) revealed that, Canino trees treated with mixture of Azolla, blue green algae and humic acid exhibited the highest mean values of N, P and K than other tested treatments. This treatment was considered as an available medium for most of beneficial microorganisms including nitrogen higher Azolla and blue green algae application of this mixture and humic acid play an important role in enhancing blue green algae, Azolla and other bacterial species to fix more atmospheric nitrogen which reflected on the increase of N, P and K content in the soil.

Generally higher increases were observed of nitrogen, phosphorus and potassium soil content occurring with Azolla, blue green algae and humic acid application then all treatments tested. On the other hand, inoculation T5 (Azolla with humic acid) T5 was more effective than Azolla alone or humic acid. Moreover, the highest NPK percentages were detected due to treatment T8 being 120, 6.36 and 320 mg/Kg soil, respectively. This trend was previously suggested by Abd El-Baky *et al*., (2008) who reported that spraying wheat cultivated under salt stress condition with algae extracts increased the NPK contents compared to those received 100 % N dose without algae extract spraying. These findings were observed by Strik and Standen (2003) who explained that, incorporation of Azolla increased significantly the soil organic matter, which in turn reflected upon its decomposition by the soil microorganisms that released the macro and micro-elements into soil leading to increase the soil available nitrogen, Awodum (2008) Azolla in produce soil chemical properties (O.M., N, P, K, Ca and Mg).

Table 1. Effect of different treatments on OM, pH, EC and NPK in soil.

Treatments	Soil texture	Organic matter %	pH (1:2.5)	E.C. (dSm^{-1})	(mg/kg soil) N (ppm)	P (ppm)	K(ppm)
Zero time	Clay loam	0.77e	8.16ab	1.64ab	80.00d	3.66g	201.0g
T1 control		0.79e	8.20a	1.70a	83.00d	3.80g	222.0f
T2 Azolla		0.95d	7.96c	1.41cd	96.00c	5.14c	280.0d
T3 BGA		0.93d	8.05bc	1.56ab	86.00d	4.20f	250.0e
T4 Humic		1.05c	8.10ab	1.60ab	85.00d	4.70e	300.0b
T5 Azolla + Humic		1.16ab	7.95c	1.35d	110.0b	6.18b	283.0cd
T6 BGA + Humic		1.07c	7.94c	1.50bc	105.00bc	5.05cd	285.0c
T7Azolla + BGA		1.11bc	7.66e	1.61ab	101.0c	4.90d	300.0b
T8 Azo. + BGA + Humic		1.22a	7.80d	1.40cd	120.00a	6.36a	320.0a

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range test at 5 % level.

- The effect of Azolla, blue green algae and humic acid on soil organism's activity on apricot yields.

Data in Table (2) indicated that, the soil biological activity for remained 90 days after treated in terms of total bacteria and blue green algae count, CO_2 and dehydrogenase activities in response to Azolla, blue green algae and humic acid foliar on tree and soil around the tree. Due to bacteria and blue green algae count, the highest values were recorded by the treatment received T8 (Az. + BGA + HA). The corresponding count values were 120.18 cfu x 10^5 and 156.46 cfu x 10^5, respectively. However, inoculation with Azolla and blue green algae counts T7 (Az. + BGA). Over those recorded by the control treatment. The treatment

received nitrogen only T1 (control) was less in total bacteria and blue green algae count (16.59 x 10^5 and 22.30 x 10^5 cfu) than all treatments. Caccaro *et al*., (2001) showed that, blue green algae have been reported to benefit plants by production growth promotion substances, vitamins, amino acid, polypeptides, anitbicterial and antifungal substances that exert phytopthogen biocontrol and polymers, especially exopdys-accharides, that improve plant growth and productivity swing to any of CO_2 evolution and dehydrogenase it was detected that inoculation with treatment 8 led to increase their values over all treatments and control. However, their highest values were (156.46 mg CO_2/100 g-1 soil and 105.45 mg H_2 TPE g^{-1} soil for dehydrogenase. The reported by Abd El-Rsooul *et al*., (2004) in wheat, Abd El-Baky *et al*., (2008) in rice and both Abo-El-Eyoun (2005) and El-Gamal (2006) in maize found that inoculation with blue green algae significantly increased these biological parameters over the control treatment and their values were comparable to those recorded the use of the full recommended nitrogen dose.

Generally, inoculation with Azolla, blue green algae and humic acid enhanced the biological activity in soil and this trend was more pronounced in the treatments.

Table 2. Effect of Azolla, blue green algae and humic acid on total bacteria, blue green algae count, CO_2 evolution and dehydrogenase activities in soil.

Treatments	T.C. bacteria CFU x 10^5	T.C. blue green algae CFU x 10^5	CO_2 evolution mg/100 g soil	Dehydrogenase (DHA) mg/g soil
Zero time	13.50i	19.30h	46.91h	18.35h
T1 control	16.59h	22.30g	56.17g	19.59h
T2 Azolla	46.63f	69.90d	111.3d	69.58e
T3 BGA	36.50g	43.22f	89.65f	57.60g
T4 Humic	50.46e	59.33e	94.75e	61.13f
T5 Azolla + Humic	69.76c	50.39c	130.70c	81.23c
T6 BGA + Humic	58.28d	60.30e	110.85d	73.45d
T7Azolla + BGA	79.00b	110.18b	135.30b	89.11b
T8 Azo. + BGA + Humic	120.18a	156.46a	156.46a	105.45a

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range test at 5 % level.

- Mineral composition of leaves and fruits:

N, P, K and Mg contents in Canino trees leaves:

The nitrogen percentages in leaves recorded significantly increases in all inoculation treatments (either individually or mixture) compared to T0 and T1 (zero time and control). In Table (3) the application of Azolla, blue green algae and humic acid T8 recorded the highest nitrogen percentage in leaves (2.30 and 2.36 %) in both seasons, respectively than the other separately inoculants.

The values of P and K concentrations of apricot (Canino) leaves were increased as affected by source of inoculant and dose of combined, with Azolla, Blue green algae and humic acid fertilizers. Higher values of P and K concentrations for (Canino) apricot leaves were achieved by T8 and T5 treatments than the other treatments. Mixture of T8 (Azolla, blue green algae and humic acid) enhanced their effect and resulted in increases of percentages to (0.26 and 0.29 % P) and (2.63 and 2.75 % K) while application of T5 gave (0.25 and 0.28 % P) and (2.23 and 2.27 % K) for both seasons.

Also, application of T8 (Azolla, blue green algae and humic acid) increased the Mg concentration in apricot (Canino) leaves compared with other individual biofertilizer extract and humic acid. The recored values of N, P, K and Mg concentrations in leaves increased for trees in soil treated with Azolla, blue green algae and humic acid.

These findings may indicate the role of both humic acid and biofertilizers in providing the plants with N, P, K, Ca, Mg and S (Higa and Widiana, 1991 and Awodun, 2008) due to improving soil fertility and increasing nutrients availability. Moreover, Patti *et al*., (1988) stated that the humic acid increased the permeability of plant membranes, so promoting the uptake of nutrients. Analogous observations were also explored by El-Seginy (2006) on Canino apricot, El-Zeky *et al*., (2005) on rice, El-Shahat *et al*., (2014) on barley and Aref *et al*., (2011) who declared that Azolla and/or blue green algae significantly increased N, P, and K content in rice grains and straw comparing with control treatment. Utilization of Azolla for increasing soil fertility, either alone or mixed with blue green algae increased the soil O.M. and N content.

Table 3. Effect of the application of Azolla, blue green algae and humic acid macro elements in apricot (Canino) leaves during 2014 and 2015 seasons.

Treatments	N (%)		P (%)		K (%)		Mg (%)	
	1st Season	2nd season	1st Season	2nd season	1st season	2nd season	1st season	2nd season
Zero time	1.57f	1.55f	0.10ef	0.10d	1.51e	1.60e	0.20e	0.23de
T1 control	1.83e	1.88e	0.11e	0.13c	1.80cd	1.83d	0.29c	0.24d
T2 Azolla	2.26ab	2.31ab	0.22b-d	0.22b	2.05c	2.13b	0.30bc	0.31c
T3 BGA	1.96d	2.00d	0.16de	0.20b	1.90cd	1.95c	0.27cd	0.29cd
T4 Humic acid	2.06cd	2.08cd	0.18cd	0.20b	1.88cd	1.91c	0.33bc	0.31c
T5 Azolla + Humic A.	2.19b	2.23b	0.25ab	0.28a	2.23b	2.27ab	0.39b	0.43b
T6 BGA + Humic A.	2.10bc	2.14bc	0.22b-d	0.23b	2.11bc	2.15b	0.28c	0.34c
T7Azolla + BGA	2.11bc	2.14bc	0.21bc	0.22b	2.16b	2.22ab	0.40b	0.41b
T8 Azo. + BGA + HA.	2.30a	2.36a	0.26a	0.29a	2.63a	2.75a	0.66a	0.59a

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range test at 5 % level.

El-Shahat *et al*., (2014) who pointed out that foliar spray with Azolla and mixed bacteria extracts enhanced the availability of N, P, K, Fe, Mn, Zn and Cu in the soil and recorded a significant increase in their uptake and content in barley grains and straw.

Nutrition status of "canino" apricot fruits:

The present results (Tables, 4 & 5) showed that, the combined treatment (Azolla + BGA + humic acid) was the most effective treatment which improved the nutrition status of "Canino" apricot fruits. This treatment- significantly increased macro nutrient (N, P, K, Ca and Mg) as well as micro nutrients (Na, Fe, Zn

and Cu) than both control and the other treatments. Moreover, this treatment was followed by BGA + humic acid treatment in descending order, while control treatment recorded the least nutrition.

Table 4. Effect of the application of Azolla, blue green algae and humic acid on some macro nutrients of (Canino) apricot fruits during 2015 season.

Treatments	N %	P %	K %	Ca %	Mg %
T1 control	1.33e	1.03f	10.13d	6.00d	5.32d
T2 Azolla	1.62d	1.11e	11.65c	7.15bc	6.16c
T3 BGA	1.63cd	1.13d	11.35c	7.09bc	6.13c
T4 Humic acid	1.61d	1.10d	11.30c	6.98c	6.03c
T5 Azolla + Humic acid	1.68b	1.22bc	12.38b	7.26b	7.18b
T6 BGA + Humic acid	1.64c	1.20c	12.39b	7.22b	7.20b
T7Azolla + BGA	1.69b	1.25b	12.40b	7.32ab	7.31b
T8 Az. + BGA + Humic acid	1.76a	1.33a	13.66a	7.65a	7.45a

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range test at 5 % level.

Table 5. Effect of the application of Azolla, blue green algae and humic acid on some micro nutrients of (Canino) apricot fruits during 2015 season.

Treatments	Na (ppm)	Fe (ppm)	Zn (ppm)	Cu (ppm)
T1 control	0.98g	0.11e	0.05ab	0.04b
T2 Azolla	1.00g	0.13d	0.03b	0.04b
T3 BGA	1.18f	0.14cd	0.07a	0.05ab
T4 Humic acid	1.31c	0.15bc	0.05ab	0.05ab
T5 Azolla + Humic acid	1.22e	0.16bc	0.05ab	0.05ab
T6 BGA + Humic acid	1.50b	0.16bc	0.07a	0.06a
T7Azolla + BGA	1.25d	0.17ab	0.07a	0.06a
T8 Azo. + BGA + Humic acid	1.67a	0.18a	0.07a	0.06a

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range test at 5 % level.

Effect of the application of Azolla, blue green algae and` humic acid on:

1- Leaf characters:

It was clear from data recorded in Table (6) that means of leaf characters expressed as leaf width and length (cm), leaf surface area (cm^2) and leaf weight (g) were improved in response to the various combinations between the two biofertilizers and humic acid applied in this study when compared to the control in the two seasons. However, the highest records attained in both seasons were found by the combination (Az. + BGA + HA.) followed by (Az. + HA). While, control and the initial of the different treatments application of Az., HA and BGA recorded less value.

Total chlorophyll content, data revealed the same pattern was observed with (Az. + BGA + H.A.) and (Az. + H.A) treatments which exhibited significant values and the highest values in the two seasons. As these two treatments alternated gave the maximal means without significant differences among them in most cases of the two seasons. The obtained results cleared the beneficial effect of both humic acid and biofertilizer enhanced the uptake of different nutrients and availibality of soil nutritional and reflected directly on nutritional status of the tree which improves the area, weight and total chlorophyll in leaves. Humic acid elevated the leaf chlorophyll content of peach trees (Abd El-Razek *et al.*, 2012). Also, in apricot (Shaddad, 2005), humic acid application improved plant growth and also acts as a source of N, P and S for plants and enhanced plant cell biomass (Higa and Wididana, 1991).

Table 6. Effect of the application of Azolla, blue green algae and humic acid on some leaf parameters of (Canino) apricot tree during 2014 and 2015 seasons.

Treatments	Leaf width (cm)	Leaf length (cm)	Leaf area (cm^2)	Leaf weight (g)	Total chlorophyll (mg/g f.w.)
			First season: 2014		
T1 control	7.78c	7.00c	37.50d	1.00c	38.17f
T2 Azolla	8.53b	7.30c	38.10d	1.30b	40.90b
T3 BGA	7.73c	7.03c	38.00d	1.20b	38.43f
T4 Humic acid	7.83c	7.27c	40.00c	1.20b	39.45e
T5 Azolla + Humic acid	9.33a	8.80a	55.40a	1.40ab	41.97a
T6 BGA + Humic acid	8.47b	8.00b	47.10b	1.40ab	39.80de
T7Azolla + BGA	8.80ab	7.37c	40.00c	1.35ab	40.40c
T8 Azo. + BGA + Humic acid	9.40a	8.97a	56.00a	1.50a	42.20a
			Second season: 2015		
T1 control	8.20bc	7.13c	37.80g	1.18b	38.20e
T2 Azolla	8.80b	7.70c	42.40e	1.35ab	41.10b
T3 BGA	7.93c	7.30c	40.20f	1.30b	38.40e
T4 Humic acid	8.73b	7.60c	42.00e	1.20b	40.50bc
T5 Azolla + Humic acid	9.70a	9.00ab	58.10b	1.50a	41.10b
T6 BGA + Humic acid	8.73b	8.50b	49.30c	1.38ab	39.40d
T7Azolla + BGA	8.33bc	7.60c	45.20d	1.42ab	40.53bc
T8 Azo. + BGA + Humic acid	9.97a	9.23a	61.60a	1.54a	42.23a

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range test at 5 % level.

Also, Strik and Staden (2003) stated that both BGA and Az. extracts characterized by their cytokinins, gibberellins and auxins content that enhance plant growth and improved the productivity. Norton (2004) suggested that use of azolla will keep the floodwater pH low and hence this led to fewer losses of applied fertilizer. Azolla improves soil structure and increases organic matter, total fixed N, P, K, Ca, Mg and Na in the soil (Awodun, 2008).

The previous results are in well agreement with these elicited by Eissa (2003) on Canino apricot, El-Zeky *et al.*, (2005) and Aref *et al.*, (2011) on rice and Mohamed *et al.*, (2013) on "Valencia orange".

2- Fruit set, drop, weight, yield and firmness:

Data in Table (7) exhibit that all the used treatments improved the percent of fruit set compared to control in the two seasons, it can observed the highest percent of fruit set in the 1st season with compared to the 2nd season that due to the effect of high waves temperatures during flowering, which cause damage to buds and flowers and fruit set. The combination of bio-fertilizers (Az. + BGA and HA) raised the highest percentage in both seasons respectively (46.9 and 35.8,

respectively) followed by Az. + HA which recorded (46.0 and 25.9 %, respectively). Fruit drop showed the opposite of this parameter which were significant decreased as a result of applying the different treatments. However, the greatest decrement in such parameter was occurred in the two seasons by the combination of Az. + BGA + H.A, which reduced the fruit drop % to 5.70 and 13.40 % in the first and second seasons, respectively and followed by (Az + BGA) treatment that diminished such trait mean to only (10.07) in 1st season, and (Az + HA) treatment (14.40) in the 2nd season.

Table (7) showed that Az. + BGA + HA treatment yielded the highest fruit weight (47.33 & 46.6 g) in both seasons, respectively, followed by (Az. + HA) with not different significant between them. While control resulted in the lowest fruit weight.

So, the greatest yield (kg/tree) obtained in the two seasons over the other treatments was recorded by either the application of the of biofertilizers (Az. BGA and H.A. followed by the combination of Az and HA, as these two treatments scored the greatest yield means which were closely near together with non-significant differences among them.

It was clear from data in Table (7) that HA combining with biofertilizer (Az + BGA) is the only treatment that caused a significant increment in fruit firmness in the two seasons, and it was evident that the combination between H.A. + Az + BGA are considered to do a balance in vegetative growth, yield and quality. We remarked that in increment in second season fruit quality like firmness, total sugars and Vit. C. The results are in agreement with those (El-Khawaga, *et al*., 2003) reported that when mineral N fertilizer was replacement by using humic acid and biofertilizer (algae) on peach. In addition both Azolla and BGA encourage the agronomists agriculturists to use those biofertilizers that influences the yield especially (Mussa, 2005). In this regard, Aref *et al*., (2009) revealed that the use of Azolla elevated the percent of organic matter in the soil to the highest content and improved growth, yield and yield components of barley cultivated in saline soil. This may be ascribed to the role of Azolla and humic acid in improving growth of leaves (as previously shown in Table (7), which is considered the manufacturer of carbohydrates and that consequently reflected positively on yield of the tree.

Table 7. Effect of the application of Azolla, blue green algae and humic acid on fruit set, drop, weight and yield of Canino tree during 2014 and 2015 seasons.

Treatments	Fruit set (%)	Fruit drop (%)	Fruit weight (g)	Yield (kg/tree)	Fruit firmness (lb/inch^2)
			First season: 2014		
T1 control	24.67e	25.50a	39.53c	35.53e	5.72e-g
T2 Azolla	39.83c	21.77b	44.10b	55.67d	6.13de
T3 BGA	27.93e	10.47d	43.33b	61.00cd	6.50b-d
T4 Humic	38.70c	25.00a	43.47b	57.00d	7.10a
T5 Azolla + Humic	46.00ab	16.40c	46.63a	66.83ab	6.73a-c
T6 BGA + Humic	41.33bc	15.10c	41.13bc	65.00a-c	6.17c-e
T7Azolla + BGA	33.50d	10.07d	44.13b	64.00bc	6.60a-d
T8 Azo. + BGA + Hu.	46.97a	5.70e	47.33a	70.00a	6.80ab
			Second season: 2015		
T1 control	16.80d	33.40a	35.87e	42.00c	6.33d-f
T2 Azolla	18.50cd	33.30a	43.37b	43.00c	6.97b-d
T3 BGA	18.37cd	24.90bc	41.77bc	45.50bc	7.25a-c
T4 Humic	19.00cd	227.7b	39.67d	44.80bc	7.93a
T5 Azolla + Humic	25.90b	25.40c	43.70b	48.50ab	7.43ab
T6 BGA + Humic	20.40c	14.50d	41.23cd	43.70c	7.63ab
T7Azolla + BGA	22.50bc	15.40d	43.60b	49.70a	6.57c-e
T8 Azo. + BGA + Hu.	35.80a	13.40d	46.60a	50.50a	7.49ab

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range test at 5 % level.

Adam (1999) observed the growth parameters and yield were significantly increased compared with control and related these increases to the amino acid and peptides produced in the algae. Also, Nanjappan *et al*., (2007) stated that, blue green algae have growth promoting activity a inoculates on plant. This stimulation by blue green algae (BGA) on plant growth may be attributed to their influence on increasing the biological activity.

- Fruit characters:

- Fruit Physical properties

Data in Table (8) it was also noticed that means of fruit height (mm), diameter (mm), volume (cm^3) and weight (mm) as well as seed weight (g) were markedly improved by the different fertilization treatments employed in this work with significant differences relative to control means in most cases of the two seasons.

- Fruit length and fruit diameter (cm):-

Data showed that, all applied treatments significantly increased fruit height than the control in the first season with no differences between them but in the second season control and Azolla recorded less fruit height. The treatment Az. + BGA + HA recorded the highest fruit diameter in the two seasons.

- Fruit size (cm^3)

Both treatments Az. + BGA + HA and Az + HA significantly improve fruit size in the two seasons (46.6 & 47.3) and (43.3 & 46.6), respectively. While the application of Az., HA and BGA treatments without combination were remarked greatly near the control.

- Seed weight (g):-

With regard to the effect of different treatments on seed weight data in Table (8) clear that, (AZ + BGA + HA) was the most inferior seed weight (1.7 gm) in the 1st season. While, HA treatment had the least mean (2.1 gm) in the 2nd season.

- Flesh weight (%):-

It's clear in the 1st season, flesh weight % was significant increase by (Az. + BGA) and (BGA + HA) treatments, followed directly by (Az. + BGA + HA). The other treatments had intermediate values but significantly higher than HA and control which recorded the lowest means with no significant difference between them.

The 2nd season was not in significant ranged like the 1st season where (Az. + BGA + HA) treatment occupied the highest means (96.40 %) followed by Az. (95.70 %), while control was the lowest means.

Data indicated that the role of supplying Az. BGA and H.A. is necessary for improving growth and fruit setting, and that of course leads finally to the highest yield and best quality. In this connection, Chaoudhury and Kennedy (2004) declared that Azolla can supplement the plants with their requirements of nutrients because its potentiality to release nutrients to the soil. Similar observations were also decided by Shaaban, Shabaan *et al*., (2015) cleared that combination yeast and humic acid significantly increased fruit weight, diameter and pulp weight of Canino apricot, Eissa (2003) on Canino apricot, El-Shahat (2007) on wheat, El-Shahat *et al*., (2011) on maize and El-Sherif *et al*., (2013) on Faba bean.

3- Chemical properties of the fruits:

The present data in Table (9) showed the effect of treatments on total soluble solids (%) (TSS), acidity (%) and TSS/acid ratio in juice. All treatments significantly increased TSS in compared with control during the two seasons. The highest value of juice TSS (%) was achieved by (Az. + BGA + H.A.) treatment followed by (BGA + H.A.), (Az. + BGA) treatments, the lasting (Az. + H.A.). Whereas, the other treatments and control attained the lowest juice TSS (%).

Regarding the fruit acidity (%) control treatment had the highest significant acidity than other treatments but the least values were recorded by BGA and (BGA + HA) in both seasons.

Data show that the highest degree TSS/acid ratio was corresponded with the good taste of apricot fruits. Thus, data obtained in Table (9) mentioned that the juice TSS/acid ratio followed the same trend of TSS (%). (BGA + HA) treatment elevated the degree to (19.0) followed by (Az + BGA) in the 1st season. While the 2nd season the combination between (Az + BGA + HA) and (BGA. + HA) occupied the highest degree followed significant by descending order (Az + HA) and (BGA) treatments which were no significantly different between them and the most inferior recorded by control treatment.

Table 8. Effect of the application of Azolla, blue green algae and humic acid on fruit characteristics of (Canino) apricot tree during 2014 and 2015 seasons.

Treatments	Fruit height (mm)	Fruit diameter (mm)	Fruit size (cm^3)	Seed weight (g)	Flesh weight (%)
	First season: 2014				
T1 control	37.80b	38.63d	35.3e	2.20a	94.03c
T2 Azolla	42.50a	43.08bc	39.50d	1.90d	94.80b
T3 BGA	43.95a	42.50c	40.00d	2.10a-c	94.70b
T4 Humic	43.50a	43.27a-c	41.20cd	2.00c	93.70c
T5 Azolla + Humic	44.00a	44.47ab	43.30ab	2.20ab	94.80b
T6 BGA + Humic	43.60a	44.00a-c	43.20b	2.10a-c	96.00a
T7Azolla + BGA	43.07a	44.00a-c	41.80bc	2.00bc	96.00a
T8 Azo. + BGA + Humic	44.20a	44.90a	46.60a	1.70e	95.30ab
	Second season: 2015				
T1 control	38.20d	40.00d	38.50c	2.80a	93.77d
T2 Azolla	40.30c	42.33bc	44.70b	2.30bc	95.70b
T3 BGA	42.17ab	40.57cd	42.30bc	2.20bc	94.80c
T4 Humic	43.23a	42.87b	44.10b	2.10c	95.10bc
T5 Azolla + Humic	43.27a	43.30b	46.60a	2.45b	93.00c
T6 BGA + Humic	42.30bc	43.60b	43.50b	2.20bc	94.43c
T7Azolla + BGA	43.17ab	43.00b	43.60b	2.40b	93.80d
T8 Azo. + BGA + Humic	43.30a	46.33a	47.30a	2.20bc	96.40a

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range test at 5 % level.

As for vitamin C content (mg/100 g), it was significantly increased in juice fruits of treated trees relative to control in both seasons the prevalence of combination (Azolla + BGA + HA) which gave the utmost high content in the two seasons, followed by Az + HA, Az. + BGA and BGA + HA treatments with no significant between them in the first season, but in the second season Az + HA treatment occupied the next position.

Data presented in Table (9) showed that, the biofertilizer Az and/or BGA treated with or without HA, these combinations were the highest significant treatments which elevated the total sugar percent in juice, foliar applications of Azolla, BGA and humic acid were the next combination highest significantly, while the control was the lowest in the two seasons.

It is clear from aforestated results that Blue green algae alone or mixed with either H.A. or Azolla play a vital role in improving the most characteristics of Canino fruits. This may be ascriber to the role of Blue green algae and Azolla in providing the plants with N and some other nutrients. They also improve the physical, chemical and biological properties of the soil and soil water interface. Blue green algae liberate extracellular organic compounds and photosynthetic O_2 during their growth Azolla prevents a rise in the pH, reduce water temperature, curb NH_3 volatilization and suppresses weeds; and both of them contribute biomass (Mandal *et al*., 2004). Further, both Blue green algae and Azolla extracts contain auxins, gibberellins- and cytokinin- like substances that enhance the plant growth and development (Mussa, 2005). On the same line, were these results documented by Eissa (2003) on Canino

apricot, Aly *et al*., (2008) on sugar beet, Abo El-Khair *et al*., (2009) on potato, Hanna *et al*., (2013) on wheat and Mohamed *et al*., (2013) whom reported that a mixture of Azolla and Blue green algae greatly improved fruit peel quality of "Valencia orange" fruits.

Table 9. Effect of the application of Azolla, blue green algae and humic acid on chemical properties of Canino apricot fruits during 2014 and 2015 seasons.

Treatments	TSS (%)	Acidity (%)	TSS/acid ratio	Vitamin C (mg/100 g f.w.)	Total sugars (%)
	First season: 2014				
T1 control	11.47e	1.50a	7.65f	1.80d	1.80d
T2 Azolla	12.40d	0.84c	14.76d	2.30bc	2.70e
T3 BGA	13.17c	0.78d	16.88bc	2.30bc	3.93b
T4 Humic acid	11.80de	0.97b	12.16e	2.20c	2.60c
T5 Azolla + Humic acid	14.13ab	0.83cd	17.02b	2.40b	4.47a
T6 BGA + Humic acid	13.63c	0.81cd	16.73bc	2.50b	4.77a
T7Azolla + BGA	14.07b	0.74d	19.01a	2.50b	4.50a
T8 Azo. + BGA + Humic acid	14.53a	0.87c	16.70c	3.00a	4.80a
	Second season: 2015				
T1 control	12.80e	1.17a	10.94d	2.30d	2.40e
T2 Azolla	13.00cd	0.93b	13.98c	2.90c	3.50d
T3 BGA	12.90e	0.76e	16.97ab	2.46d	4.90c
T4 Humic acid	12.90e	0.97b	13.30c	2.50d	3.30d
T5 Azolla + Humic acid	13.70b	0.87c	15.75b	2.80c	5.67b
T6 BGA + Humic acid	13.60bc	0.80d	17.00ab	3.20b	5.67b
T7Azolla + BGA	13.80b	0.78d	17.69a	2.70c	5.80b
T8 Azo. + BGA + Humic acid	14.50a	0.81cd	17.90a	3.40a	6.50a

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range test at 5 % level.

4- Changes of weight loss, firmness, TSS, acidity and total sugars during cold storage:

- Weight loss (%).

Likewise, Table (10) the percent of changes in fruit weight loss after 10 days cold storage (4 °C, 95 % RH), the trend increased from the first period (5.13 & 5.80) to the last period (11.2 & 9.6) after 20 days in the two seasons. Mean of weight loss percentage of control fruits was the highest than all other treatments and the lowest weight loss was recorded for (BGA + Az.) followed by Az +BGA + HA and BGA with significant differences between them in the 1st season. The 2nd season BGA + Az and (Az. + HA) treatments had the lowest weight loss fruits.

- Fruit firmness (lb/inch^2)

During cold storage, fruit firmness tended to decrease gradually depending on the effect of the foliar application of different treatments which maintained significantly firmness than control. The combination between (Az + BGA + HA) is considered lost firmness more slowly than other treatments and had the highest value at the end of cold process.

BGA + HA came immediately after (Az + BGA + HA) and recorded high firmness than other treatments, control had significant more softer fruits than the tested treatments in both seasons.

TSS (%):-

As shown in Table (11) TSS % increased gradually in cold storage and reached the highest percentage at the end of storage period (after 20 days at 4 °C), significant differences were observed between all treatments in the two seasons, (Az. + BGA + HA) treatment in the 1st and 2nd seasons recorded the highest means (14.7 & 14.9 %), respectively, followed by the combination between (Az. + BGA) in the second season, but control juice gave the lowest means of TSS % in both seasons.

From previous results, it is clear that using foliar application of humic and biofertilzers improved significantly TSS synthesis with in parallel decreased acidity in juice, the same trends of results were noticed by (Abd El-Ghany *et al*., 2001) with using biostimulants, which significantly improved TSS synthesis and decreased acidity in Thompson seedless grapevines.

The interaction in TSS with the progress of storage period could be occurred as a result of the conversion of organic matter to soluble solids throughout the enzymatic activities (Wahdan *et al*., 2011).

Eissa (2003) on Canino apricot and Mohamed *et al*., (2013) found that azolla mixed with blue green algae increased TSS % and improved peel quality of Valencia orange fruits.

Total Acidity (%):-

It is shown at Table (11) that acidity % content of fruits in all treatments decreased from the first time in cold storage to the end of process (after two days at 4 °C) in the two seasons.

BGA + Az. and BGA treatments fruits had the most inferior acidity percentage mean in the 1st season with no significant differences, they were followed by (Az + HA) and (BGA).

The 2nd season was in the same trend with the 1st season for about the interaction of cold storage period and the treatments showed that after 20 days, acidity % content was at its lowest value and control fruits had the highest acidity % (1.2 & 0.99 %) during the two seasons, respectively but (BGA) treatment had the lowest acidity (0.62 & 0.61 %) fruits, respectively, in the two seasons of study.

Table 10. Effect of application of Azolla, blue green algae and humic acid on changes of weight loss and firmness of (Canino) apricot fruits during the cold storage in 2014 and 2015 seasons.

Treatments	Changes of weight loss (%)				Changes of the firmness (lb/inch^2)			
	At picking	10 days after C.S.	20 days after C.S.	Mean	At picking	10 days after C.S.	20 days after C.S.	Mean
	First season: 2014							
T1 control	0.00 k	4.20hi	9.50d	7.60C	5.72e-g	4.99hi	4.43ij	5.05C
T2 Azolla	0.00k	4.80gh	10.60cd	7.70C	6.13de	5.33f-h	4.50ij	5.32BC
T3 BGA	0.00k	4.20hi	10.80cd	7.50C	6.50b-d	5.00hi	3.80k	5.10C
T4 Humic acid	0.00k	9.54d	14.50a	12.02A	7.10a	5.87ef	5.20gh	6.06A
T5 Azolla + Humic acid	0.00k	6.15f	11.79bc	8.97B	6.60a-d	5.73e-g	3.63k	5.32BC
T6 BGA + Humic acid	0.00k	6.47f	11.20c	8.84B	6.73a-c	5.67e-g	5.13gh	5.84A
T7Azolla + BGA	0.00k	3.30i	7.89e	5.60D	6.17c-e	5.33f-h	4.20jk	5.23BC
T8 Azo. + BGA + Humic acid	0.00k	0.900j	13.00b	6.95C	6.80ab	5.50f-h	4.17jk	5.49B
Mean	0.00C	5.13B	11.16A		6.47A	5.43B	4.38C	
	Second season: 2015							
T1 control	0.00 g	3.48f	8.70c	6.09C	6.33d-f	4.83ij	3.50m	4.89D
T2 Azolla	0.00g	6.40de	10.20b	8.30B	6.97b-d	5.13h-j	3.67m	5.26CD
T3 BGA	0.00g	7.10d	8.90c	8.00B	7.25a-c	5.71f-h	4.53j-l	5.83AB
T4 Humic acid	0.00g	7.40d	12.00a	9.70A	7.93a	6.30d-f	3.90lm	6.04AB
T5 Azolla + Humic acid	0.00g	6.20de	7.30d	6.75C	6.57c-e	5.22h-j	4.09k-m	5.29C
T6 BGA + Humic acid	0.00g	5.30e	11.40a	8.35B	7.43ab	6.00e-g	5.28h-j	6.24A
T7Azolla + BGA	0.00g	4.00f	8.87c	6.44C	7.63ab	5.47g-i	4.00lm	5.70B
T8 Azo. + BGA + Humic acid	0.00g	6.30de	9.00c	7.65B	7.49ab	6.17e-g	4.72i-k	6.13A
Mean	0.00C	5.77B	9.55A		7.20A	5.60B	4.21C	

Means within a column and raw having the same letters are not significantly different according to Duncan's Multiple Range test at 5 % level.

Table 11. Effect of application of Azolla, blue green algae and humic acid on changes of TSS, acidity and total sugars of (Canino) apricot fruits during the cold storage in the two of 2014 and 2015 seasons.

Treatments	Changes of TSS (%)				Changes of Acidity (%)				Changes of total sugars (%)			
	At picking	10.days after C.S.	20 days after C.S.	Mean	At picking	10.days after C.S.	20 days after C.S.	Mean	At picking	10.days after C.S.	20 days after C.S.	Mean
	First season: 2014											
T1 control	11.47m	11.73lm	12.13jk	11.78H	1.50a	1.40a	1.20b	1.37A	1.80m	3.57k	5.30gh	3.56F
T2 Azolla	12.40ij	12.47i	13.07h	12.64F	0.84d-f	0.80d-g	0.76e-h	0.80C	2.70l	4.60i	6.50de	4.60D
T3 BGA	11.80l	11.90kl	12.43ij	12.04G	0.78d-g	0.70g-j	0.62ij	0.70E	3.93jk	7.33c	9.87a	7.04A
T4 Humic acid	13.17h	13.33h	13.03h	13.18E	0.97c	0.90cd	0.90cd	0.92B	2.60l	4.17i-k	5.70fg	4.16E
T5 Azolla + Humic	13.63g	13.87fg	14.17d-f	13.89D	0.83d-g	0.78d-g	0.70g-j	0.77CD	4.47ij	5.30gh	6.93cd	5.57C
T6 BGA+Humic A	14.13d-f	14.30c-e	14.93a	14.46B	0.81d-g	0.73e-j	0.64h-j	0.73DE	4.77hi	6.07ef	7.10cd	5.98B
T7Azolla + BGA	14.07ef	14.13d-f	14.40b-d	14.20C	0.74e-i	0.70g-j	0.60j	0.68E	4.50ij	6.80cd	9.30ab	6.87A
T8 Azo. + BGA + Humic acid	14.53bc	14.67ab	14.87a	14.69A	0.87c-e	0.81d-g	0.72f-j	0.80C	4.80hi	6.70cd	8.77b	6.76A
Mean	13.15C	13.30B	13.63A		0.88A	0.83B	0.75C		3.70C	5.57B	7.43A	
	Second season: 2015											
T1 control	12.80e-h	13.23c-g	13.47c-g	13.17C	1.17a	1.10a	0.99b	1.08A	2.40l	4.80j	7.17g	4.79F
T2 Azolla	13.00d-h	14.03c-e	15.50ab	14.18B	0.93bc	0.84c-f	0.76f-i	0.84C	3.50k	5.77i	8.43e	5.90D
T3 BGA	12.90e-h	11.73h	12.20gh	12.28D	0.76f-i	0.70h-k	0.61k	0.69F	4.90j	8.40e	11.93b	8.41B
T4 Humic acid	12.80e-h	12.60f-h	12.47f-h	12.66CD	0.97b	0.92b-d	0.83d-f	0.91B	3.30k	5.63i	7.87f	5.60E
T5 Azolla + Humic	13.57c-f	14.37bc	15.47ab	14.47AB	0.87c-e	0.81e-g	0.72g-j	0.80CD	5.67i	7.17g	8.73de	7.19C
T6 BGA+Humic A	13.67c-f	12.70e-h	13.00d-h	13.12C	0.80e-h	0.75f-i	0.67i-k	0.74EF	5.67i	7.30g	8.90d	7.29C
T7Azolla + BGA	13.70c-f	14.30b-d	15.40ab	14.47AB	0.78e-h	0.72g-j	0.64jk	0.71F	5.80i	8.40g	11.40c	8.83B
T8 Azo. + BGA + Humic acid	14.40bc	14.47bc	15.90a	14.92A	0.81e-g	0.77e-i	0.74f-j	0.77DE	6.50h	9.10d	12.37a	9.32a
Mean	13.35B	13.43B	14.19A		0.89A	0.83B	0.75C		4.72C	7.07B	9.60A	

Means within a column and raw having the same letters are not significantly different according to Duncan's Multiple Range test at 5 % level.

- Total sugars in juice:-

As shown in Table (11), total sugars % increased significantly during cold storage from time to another and reached the maximum after 20 days at 4 °C, 95 % RH during the two seasons of study. The highest means of total sugars % were those BGA, (BGA + Az), (Az + BGA + HA) treatments with no significant differences between them in the 1st season. With regard to the 2nd season (Az + BGA + HA) treatment occupied the highest total sugars (9.32 %) while (BGA + Az.) and (BGA) treatments followed directly with (8.8 & 8.4 %), respectively. For about the interaction of cold storage time and treatments the same pattern mentioned was reported in the two seasons, whereas control was the lowest in both seasons.

Results clear the biological effect of BGA on increase total sugars synthesis in juice and these clarifications are supported by Hegezi *et al*., (2010) revealed that, the quality of yield greatly enhanced significantly than control treatment by inoculated with Blue green algae.

CONCLUSION

It can be concluded that using of combination of different sources of biofertilizers Azolla, blue green algae and humic acid, will induce sufficient improvement of plant growth, productivity, fruit quality and fruit nutrient contents.

REFERENCES

Abdel-Aal, Azza, A.M.; El-Sherif, M. H.; Shehata, Heba, S.H. and El-Shahat, R. M. (2013). Efficiency use of nitrogen, biofertilizers and composted biostraw on rice production under saline soil. J. Appl. Sci. Res., 9 (3): 1604-1611.

Abd El-Baky-Hanaa, H.; M. M. Haussein and G.S. El-Baroty (2008). Algae extracts improve antioxidant defense abilities and salt tolerance of wheat plant irrigated with sea water. Afr. J. Biochem. Res.; 2 (7): 151-164.

Abd El-Razek, E. Abd Allah, A.S.E. and Saleh, M.M.S. (2012). Yield and fruit quality of Florida prince peach trees as affected by foliar and soil applications of Humic acid. J. of Appl. Sci.Res. 8 (12): 5724-5729

Abd El-Ghany, A.A., I.A. Marwad, A. El-Samir and B.A. El- Said (2001). The effect of two yeast strains or their extraction on vines growth and cluster quality of 'Thompson seedless' grapevines. Assuit J. Agric. Sci., 32:214-224.

Abo El-Khair, Amal W.; Mohamed, A.A. and Abdel-Aal, Azza, A. M.; (2009). The role of biofertilizers in the availability of potassium for potato crop. J. Agric. Sci., Mansoura Univ., 34 (5): 4315-4328.

Adam, M. S. (1999). The promotive effect of the cyanobacterium *Nostoc muscorum* on the growth of some crop plants. Acta Microbiologica Polonica, 48 (2): 163-171.

Allen, M.M. and R,Y, Stanier (1968). Selective isolation of blue green algae from water and soil. J. Cen. Microbial, 51: 203-209.

Allen, O. N. (1959). Experiments in soil Bacteriology. 3rd Burgess Publ Co. USA pp. 117.

Aly, M. H.; Abdel-Aal, Azza A. M. And Mostafa, Soha, S. M. (2008). Enhancement of seed germination, plant growth performance and biological components for sugar beet plant as contributed by algal extracellular products. J. Agric. Sci., Mansoura Univ., 33 (12): 8823-8842.

A.O.A.C. (1995).."Official Methods of Analysis". 16th Ed., Association of Official Analytical Chemists. International, Virginia, USA.

Aref, Elham, M.; Abdel-Aal, Azza, A.M.; Shaban, K.h. A.H. and El-Shahat, R. M. (2009). Effect of azolla and blue green algae as biofertilizers on barley cultivated in saline soil. J. Agric., Sci., Mansoura Univ., 34 (12): 11599-11610.

Aref, Elham, M.; El-Shahat, R. M. And El-Gamal, Manal, A.H. (2011). Beneficial effects of azolla and blue green algae on rice production in saline soil. N. Egypt. Microbiol., 30 : 144-158.

Awodun, M. A. (2008). Effect of azolla species on physiochemical properties of soil. World J. Agric. Sci., 4 (2): 157-160.

Casida, L. E.; D.A. Klein and T. Santof (1964). Soil dehydrogenase activity. Soil Sci., 98: 371-376.

Chaoudhury, A.T. and Kennedy, I.R. (2004). Prospects and potentials for systems of biological nitrogen fixation in sustainable rice production. Biol. Fertile. Soils, 39: 219-227.

Chunhua, I., R. J. Cooper and D. C. Bowman (1998). Humic acid application affects photosynthesis, root development and nutrient content of creeping bentagrass. Hort. Sci., 33 (6) 1023-1025.

Eissa-Fawzia, M. (2003): Use of some biostimulants in activation of soil microflora for yield and fruit quality improvement of "Canino" apricot. J. Agric. Res. Tanta Univ., 29 (1) 175-194.

El-Khawaga, A. A.; El-Nagar, M., Assey, A.A. and Metwally, S.A. (2003). Influence of rhizbiainoculation and N, P and Bio-chemical fertilization regimes on growth and nodulation of two faba bean cvs. Egypt J. Appl. Sci., 30 (30: 651-675.

El-Seginy, Amal, M. (2006). Effect of the organic fertilizer (actosol) and EM biostimulant on vegetative growth and leaf chemical composition of young pear and apricot trees grown in calcareous soil. J. Agric., Sci, Mansoura Univ., 31 (5): 3147-3158.

El-Shahat, R. M. (2007). Blue green algae can compensate a part of mineral nitrogen required for wheat production. J. Agric. Sci., Mansoura Univ., 32 (2): 1347-1377.

El-Shahat, R. M.; Abo-Kora, Hanaa A. and Khafaga, E.E. (2011). Azolla inoculant contribution to improve some soil properties and *Zea mays* yield in saline soil. Egypt, H. Biotechanol., 37: 69-81.

El-Shahat, R. M.; Sherif, A. E. and Mohamed, Faten, M. (2014). Response of barley grown in saline soil to biofertilizer as a partial substitution of mineral fertilizer. Global J. of Sci., 2 (5): 144-153.

El-Sherif, M. H., El-Shaht, R. M. and Abdel-Kawi, Kh (2013). Improvement of growth and yield of faba bean by inoculation with azolla, blue green algae and rhizobia in saline sandy soil. J. Appl. Sci., Res., 9 (3): 1675-1682.

El-Zeky, M. M.; El-Shaht, R. M.; Metwaly, Gh. S. and Aref, Elham, M. (2005). Using of blue green algae or azolla as alternative sources of nitrogen for rice production. J. Agric., Sci,, Mansoura Univ., 30 (9): 5567-5577.

Gaur, A. C.; K. V. Sadasivan; O. P. Vitumal and R.S. Mathur (1971). A study of decomposition of organic matter in an alluvial soil, CO2 evolution, mycological and chemical transformations. Plant and Soil, 34: 17-28.

Hanna, Amal E.; El-Shaht, R. M.; Bishara, Maunira, M. and AbdelKowi, Kh. A. (2013). Inluence of some non traditional biofertilizers on growth of wheat in a clay saline soil. Egypt J. of Appl. Sci., 28 (7): 243-262.

Hegazi, Amal, Z.; Soha, S. M. Mostafa and Hamdina, M. I. Ahmed (2010). Influence of different Blue green algae application methods on growth and seed production of common bean under various levels of mineral Nitrogen fertilization. Nature and Science. 8 (11): 183-194.

Higa, T. and G. N. Widiana (1991). Changes in the soil microflora induced by effective microorganisms. Proc. The 1st Inter. Conf. Kyusei Nature Farming U.S.Dept. Agric. Washington D.C. USA, p153-162.

Houba, V.; Van Derlee, J. and Novozamsky, I. (1995). Soil and plant analysis. Part 5 B., 6th Ed., Dept. of soil Sci. and Plant Nutrition, Wageningen Agricultural Univ.

Mead, R.; Curnow, R. N. and Harted, A. M. (1993). Statistical Methods in Agriculture and Experimental Biology. 2nd Ed., Chapman & Hall Ltd., London, 335 pp.

Mandal, B.; Velkep, L. G. And Mandal, L. N. (2004). Beneficial effects of blue-green algae and azolla excluding supplying nitrogen on weltand rice fields. Biology and Fertility of soils, 28 (4): 329-342.

Marwaaha, T.S.; Singh, B.V. and Goyal, S. K. (1992). Effect of incorporation of azolla in Wheat (*Triticum aestivum* var. HD 2329). Acta Bot. India, 20: 218-220.

Mohamed, Hoda, M.; Al-Kamar, Faten A. and Abd-Elall, Azza, A. M. (2013). Effect of magnetite and some biofertilizer application on growth and yield of Valencia orange trees under El-Bustan Condition. Nature and Science, 11 (6): 46-61.

Mussa, El-Shymaa, S. (2005). Role of azolla in different ecosystems. M. Sc. Thesis, Botany Dept., Fac. Science (Girls branch), Al-Azhar Univ., Cairo, Egypt.

Nanjappan, K.; Radha, P.; Lata, N. and Kaushik, B.D. (2007). Evaluating the Potential of plant growth promoting blue green algae as inoculants for wheat. European –Journal-of –Soil-Biology. 43 (1): 23-30.

Nautigual, M.C.; Singh, P.K.; Shukiia, R.N.; Prakash, S. and Kummor, R. (1990). Correcting leaf area measurement by conventional methods. A. New approach of apple (*malus demestica* Borkh). J. Hort. Sci., 65: 15-18.

Norton, R. D. (2004). Agricultural Development policy: Concepts and Experiences. Jon Wiley and Sons, Ltd, Ny. 528p.

Page, A.I.; Miller, R. H. and Keeney, D. R. Eds (1982). Methods of soil Analysis. Part 2: Chemical and Microbiological properties 2nd Ed., Amer. Soc. of Agron. Madison, Wiscosin, U.S.A.

Patti, A. F.; Levi-Minzi, R.; Riffoldi, R. And Guidi, G. (1988). Liquid humic extracts and their uses in agriculture An overview in proceedings: science, Technlology and Utilization of Humic acids, Conf. held at CSIRO Division of Cool Technology (Australian), p.96-105.

Rippka, R.; Dervelles, J.; Waterburg, J. B.; Herdman, M. and Stanier, R.Y. (1979). Generic assignments strain historsis and properties of pure cultures of blue green algae. J. General Microbiol, 111: 1-16.

SAS Institute. (2009). SAS/STAT User`s Guides Statistics. Vers. 9.0, SAS. Institute Inc. Cary, N.C., USA.

Shaaban, Fatma, K. M.; Morsey, M. M. and Thanaa, Sh.M. Mohmoud (2015). Influence of spraying yeast extract and humic acid on fruit maturity stage and storability of "Canino" apricot fruits. International Journal of Chem-Tech, Research, 8 (6): 530-543.

Shaddad, G.; A. Khalil and M. A. Fathi (2005). Improving growth, yield and fruit quality of "Canino" apricot by using bio, mineral and humate fertilizers. Minufiya, J. Agric. Res., 30 (1): 317-328.

Steel, R. G. D. and Torrie, J. H. (1980). Principles and procedures of statistics. McGrow Hill Book Co., Inc., New York, P: 377-400.

Strik, W.A. and I.V. Staden (2003). Occurrence of cytokinin–like compounts in two aquatic ferns and their exudates. Environ. Fxp. Botany. 37: 569-571.

Wahdan, M.T.; Halil, S. E., Bassal, M. A. and Qaoud, E. M. (2011). Effect of calcium chloride and gibberellic acid on storability of "Sacory Abied" mango fruits under cold storage. Journal of American Science, 7 (5): 493-501.

Yoshida, S.; Forno, D. A.; Corek, J. H. and Gomez, K. A. (1976). Laboratory manual for physiology studies of rice. The Inter Rice Inst. (IRRI) Los Banes, Manila, Philippines, pp.61-65.

Yadava, Y. L. (1986). Rapid non-destructive methods to determine chlorophyll in intact leaves. HortScience, 21: 1449-1450.

تأثير كل من الأزولا والطحالب الخضراء المزرقة وحمض الهيوميك على إنتاجية وصفات الجودة والقدرة التخزينية الصنف المشمش الكانينو النامي فى أراض طميية طينية

نيفين مصطفى طه[١] ورضا محمد الشحات[٢]

[١] معهد بحوث البساتين – مركز البحوث الزراعية - – الجيزة – مصر.

[٢] معهد بحوث الأراضى والمياه والبيئة – مركز البحوث الزراعية – الجيزة – مصر.

تم إجراء تجربة حقلية خلال موسمين متتاليين ٢٠١٤، ٢٠١٥ فى محافظة المنوفية، مصر لدراسة تأثير الرش الورقى بمحلول مائى لبعض الأسمدة الحيوية المكونة من (الأزولا، والطحالب الخضراء المزرقة) بمعدل ١ لتر/٢٠ لتر ماء لكل منهما مع استخدام حمض الهيوميك بمعدل ٢٠٠ سم٣/٢٠ لتر ماء وقياساتها المختلفة على نمو أشجار المشمش من الصنف كانينو عمر ١٠ سنوات نامية فى أرض طينية طميية على أبعاد ٣ × ٤ متر تحت نظام الري الحوضى.دلت النتائج المتحصل عليها أن أغلب المعاملات المستخدمة حسنت متوسطات النمو لكل من عرض وطول الأوراق ومساحتها الكلية إضافة إلى الكلوروفيل الكلي وزادت من نسبة عقد الثمار وبالتالي محصول الأشجار وصفات الجودة لكل الثمار على الأشجار بمستويات واضحة مختلفة عند مقارنتها بمعاملة المقارنة (الكنترول) خلال موسمى النمو.وعلى أية حال تم التوصل إلى أن أعلى المتوسطات لأغلب المعاملات المطبقة كانت واضحة وخاصة فى المعاملات لكل من قياسات الأزولا، والطحالب الخضراء المزرعة وحمض الهيوميك مجتمعة. وقد أدت المعاملات إلى تحسين خواص الثمار بتقليل الفاقد فى الوزن وزيادة نسبة المواد الصلبة الكلية والسكريات مع زيادة فترة تخزين ثمار المشمش. وكذلك فإن حموضة الثمار قد انخفضت بتأثير المعاملات المستخدمة إما منفردة أو مجتمعة أدت المعاملات إلى زيادة محتوى الأوراق من العناصر الكبرى مثل النتروجين، الفوسفور، البوتاسيوم والماغنسيوم وكذلك زيادة الكثير من العناصر الصغرى والكبرى فى ثمار المشمش.لذا، فإنه يمكن أن نوصى باستخدام المخلوط الحيوى (الأزولا + الطحالب) مضافة إلى حمض الهيوميك رشاً على الأشجار لصنف المشمش الكانينو المنزرع فى تربة طينية طميية لتحسين الإنتاج وجودة الثمار والحصول على أفضل نتائج.