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Partial Replacement Of Mineral N Fertilizers By Using Humic Acid and *Spirulina Platensis* Algae Biofertilizer in Florida Prince Peach Orchards

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ABSTRACT

The possibility of replacing 40 to 90 % of chemical N fertilizers Florida prince peach orchards by using humic acid at 40 to 90 ml/ tree/ year and the biofertilizer *Spirulina platensis* algae at 5 to 30 ml/ tree/ year was investigated during 2010 and 2011 season. Results reveal that decreasing percentages of inorganic N from 100 to 50 % out of the suitable N and at the same time increasing levels of humic acid from 40 to 80 ml/ tree/ year and *Spirulina platensis* algae biofertilizer from 5 to 25 ml/ tree/ year resulted in major promotion on the leaf area and its content of N, P and K, yield and fruit quality comparing with using the suitable N completely via inorganic form or using inorganic N form at percentages lower than 50 %. Using N via 40 % inorganic N form even with the application of organic and biofertilizers considerably caused adverse effects on growth, nutritional status of the trees and yield. For promoting yield of Florida prince peach trees as well as replacing of 50 % inorganic N, it is advised to fertilize the trees with the suitable N (500 g N/ tree/ year) via 50 % inorganic N source + humic acid at 80 ml/ tree/ year + *Spirulina platensis* algae biofertilizer at 25 ml/ tree/ year.

Key words: Partial replacemen,chemical N fertilizers,algae biofertilizer,peach orchards

Introduction

Nitrogen fertilization is considered an important and limiting factor for fruiting of citrus crops (Nijjar, 1985). More studies are needed for finding out the best N management that was responsible for improving yield quantitively and qualitatively and reducing environmental pollution. A great attention was realized to fulfill the requirements of citrus crops from organic and biofertilizers as an alternative to the organic fertilizers. Organic fertilizers not only increase organic matter % in the soil but also enhance the availability of most nutrients and water use efficiency (El- Haddad *et al*., 1993). Biofertilization has become in the last few decades a positive alternative to mineral fertilizers. It is beneficial in fixation of N and enhancing nutrient uptake, Biofertilizers secrete higher amounts of hormones, vitamins B and antibiotics (Higa and Wididana, 1991; Myint, 1999 and Kannaiyan, 2002). *Spirulina platensis* algae is a photosynthetic blue green micro alga. It considers an essential biofertilizer and has been largely studied due to its commercial importance as a source of proteins, vitamins, essential amino acids and fatty acids (Leduy and Thorein, 1977; Ciferri and Tibani, 1985; Vonshak and Richmond, 1985 and Vonshak, 1986). Enriched organic fertilizers with biofertilizers especially *Spirulina platensis* algae was beneficial in improving yield quantitively and qualitatively rather than application of organic fertilizers alone (Ahmed *et al*., 2011).

Peach tree is one of the most important deciduous fruits grown in Egypt. Extension of the cultivated area nowadays is due to its highly economic value, exporting potential and introducing new low chilling peach cvs such as Floridaprince (Shaltout, 1987). Peach cv. Floridaprince is an early ripening variety introduced from Florid, USA and has been released for general cultivation in the state of Punjab, India during 1997. It exhibited a high adaptation with the local environmental conditions. It records superior yield and fruit quality in comparison with the other peach cvs (Kanwar *et al*., 2000). Adjusting N management as well as replacement inorganic N partially by using organic and biofertilizers are considered the major merits of pomolgists (Davis and Ghabbour, 1998; Mansour, 1998; Mansour *et al*., 1998; Myint, 1999; Kannaiyan, 2002; Fathi *et al*., 2002; Eissa- Fawzia, 2003; Kabeel *et al*., 2005; Shaddad *et al*., 2005; Barakat *et al*., 2007; Kabeel *et al*., 2007; Seleem- Basma and Abd El- Hameed, 2008; Allam, 2008; Kabeel *et al*., 2008; El- Naggar, 2009; Gad El-Kareem and Refaai, 2011).

The goal of this study was examining the possibility of replacing chemical fertilizers partially by using humic acid and *Spirulina platensis* algae to improve yield quantitively and qualitatively in Florida prince peach trees orchards.

Materials And Methods

This study was carried out during 2010 and 2011 seasons on twenty -one uniform in vigour 12- years old Florida prince peach trees budded onto Nemagaurd peach rootstock and grown in a private peach orchard

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located at Sohag district, Sohag Governorate.. The trees are planted at 4 × 4 meters apart. Training system was open centre vase. Soil texture is sandy. Analysis of the soil (according to **Wilde *et al*., 1985**) are shown in Table (1).

Table 1: analysis of the tested soil

Characters	values
Sand %	: 84.0
Silt %	: 12.00
Clay %	: 4.00
Texture	: Sandy
$CaCO_3$ %	: 18.3
O. M. %	: 1.00
pH (1:2.5 extract)	: 7.92
E.C (1: 2.5 extract) mm hos/ 1cm/ 25° C)	: 0.91
Total N %	: 0.05
Available P (ppm, Olsen)	: 1.2
Available K (ppm, ammonium acetate)	: 22.3

The present experiment included the following seven treatments from inorganic N as well as humic acid and *Spirulina platensis* Algae:-

1- Using the suitable N (500 g N/ tree) via 100 % inorganic (2427 g ammonium sulphate/ tree/ year).

2- Using the suitable N via 90 % inorganic (2184 g ammonium sulphate/ tree/ year) + soil addition of 40 ml Deca (humic acid compound) + 5 ml *Spirulina platensis* algae/ tree/ year.

3- Using the suitable N via 80 % inorganic (1942 g ammonium sulphate/ tree/ year) + soil addition of 50 ml Deca + 10 ml *Spirulina platensis* algae/ tree/ year.

4- Using the suitable N via 70 % inorganic (1699 g ammonium sulphate/ tree/ year) + 60 ml Deca + 15 ml *Spirulina platensis* algae/ tree/ year.

5- Using the suitable N via 60 % inorganic (1456 g ammonium sulphate/ tree/ year) + 70 ml Deca + 20 ml *Spirulina platensis* algae/ tree/ year.

6- Using the suitable N via 50 % inorganic (1214 g ammonium sulphate/ tree/ year) + 80 ml Deca + 25 ml *Spirulina platensis* algae/ tree/ year.

7- Using the suitable N via 40 % inorganic (971 g ammonium sulphate/ tree/ year) + 90 ml Deca + 30 ml *Spirulina platensis* algae/ tree/ year.

Each treatment was replaced three times, one tree per each. Inorganic N fertilizer namely ammonium sulphate (20.6 % N) was divided into three equal batches and added on growth start, just after fruit setting and at three weeks later. Deca as a humic compound containing 85 % humic acid was added once at growth start. *Spirulina platensis* Algae was added once at the growth start.

The selected trees received all horticultural practices that are usually applied in orchard except those dealing with N fertilization, biofertilization and humic acid which included in the present study. The present treatments were arranged in a complete randomized block design.

Twenty leaves from the middle parts of the ten tagged shoots were selected from each tree at the last week of March in both seasons for measuring the leaf area according to the following equation that was reported by Ahmed and Morsy (1999). Leaf area (cm^2) = (leaf width x leaf length) + 2.28. In order to determine percentages of N, P and K in the leaves, twenty leaves from the middle parts of the ten tagged shoots were selected from each tree at the last week of March (According to Summer, 1985). They were dried at 70° C and digested using concentrated H_2SO_4 and H_2O_2 and kept for determination of N, P and K (as percentages) according to the procedures that outlined by Wilde *et al*., (1985).

When total soluble solids % in the juice of the fruits from control trees (trees receiving N as 100 % inorganic form) reached 9.0 to 9.5 % (according to Gad El- Kareem, 2009), harvesting took place (last week of April). Yield expressed in weight (kg.) was recorded. Twenty fruits were randomly taken from each tree for determination of fruit weight (g.) and dimensions (height and diameter in cm.) firmness (pound/ $inch^2$) by pressure tester, percentages of pulp and seeds, pulp/ seeds, total soluble solids %, total and reducing sugars (Lane and Eynon 1965, volumetric method, A.O.A.C, 1995) and total acidity % (as g malic acid/ 100 ml juice).

Statistical analysis was done according to the procedure that outlined by Mead *et al*., (1993). Means were compared using the new L.S.D test at 5 %.

Results And Discussion

Leaf area and its content of N, P and K in the leaves:

Data in Table (2) clearly show that varying N management was accompanied with significant variation on the leaf area and its content of N, P and K. Using the suitable N through 50 to 90 % inorganic + 40 to 90 ml

humic acid + 5 to 25 ml *Spirulina platensis* algae / tree/ year significantly enhanced the leaf area and percentages of N, P and K in the leaves comparing with using N completely via inorganic form or using inorganic N at percentage lower than 50 %. The promotion was associated with reducing inorganic N from 100 to 50 % and at the same time increasing levels of humic acid from 40 to 80 ml/ tree/ year and *Spirulina platensis* algae from 5 to 25 ml/ tree/ year. Reducing inorganic N from 50 to 40 % of the suitable N even with using humic acid and *Spirulina platensis* algae significantly declined the leaf area and its content of N, P and K. The maximum values were recorded on the tree that received N via 50 % inorganic + 80 ml humic acid + 25 ml *Spirulina platensis* algae/ tree/ year. The lowest values were recorded on the trees that received N through 40 % inorganic + 90 ml humic acid + 30 ml *Spirulina platensis* algae/ tree/ year. These results were true during both seasons.

The promoting effect of organic and biofertilizers on enhancing soil fertility explain the present results.

Similar trend was noticed by Allam (2008) and Refaai (2011).

Yield:

It is clear from the obtained data in Table (3) that application of the suitable N through 50 to 90 % inorganic form plus 40 to 80 ml humic acid and 5 to 25 ml *Spirulina platensis* Algae significantly improved the yield per tree comparing with N via inorganic form at 100 % or when the inorganic N was applied at percentages lower than 50 %. Reducing the percentages of inorganic N from 100 to 50 % and at the same time increasing levels of humic acid and *Spirulina platensis* algae caused a gradual promotion on the yield. The maximum yield (32.2 and 33.3 kg) was presented on the trees that fertilized with the suitable N via 50 % inorganic plus 80 ml humic acid + 25 ml *Spirulina platensis* algae. The lowest yield (14.0 and 15.1 kg/ tree) was obtained as a result of using the suitable N through 40 % inorganic plus 90 ml humic acid + 30 ml *Spirulina platensis* Algae/ tree/ year. These results were true during the two seasons.

The beneficial effect of organic and biofertilization on enhancing soil fertility and the uptake of different nutrients surely reflected on stimulating growth characters and nutritional status of the trees in favour of producing more fruits (Davis and Ghabbour, 1998 and Kannaiyan, 2002).

These results are in agreement with those obtained by Allam (2008); Kabeel *et al*., (2008); El- Naggar (2009) and Refaai (2011).

Physical and chemical characters of the fruits:

It is evident from the data in Tables (3& 4& 5) that using the suitable N via 40 to 90 % inorganic form along with using humic acid and *Spirulina platensis* algae significantly was accompanied with improving quality of the fruits in terms of increasing fruit weight, total soluble solids % and total and reducing sugars % and decreasing total acidity % comparing with using N completely via inorganic form (without using organic and biofertilizers) or when the suitable N was applied via inorganic form at percentages lower than 50 %. The promotion was associated with reducing inorganic percentages and at the same time increasing levels of both organic and biofertilizers. Undesirable effects on fruit quality were recorded with using inorganic N completely via inorganic form. The best results with regard to quality parameters were recorded when the trees received the suitable N via 40 % inorganic plus humic acid at 90 ml/ tree and *Spirulina platensis* algae at 30 ml/ tree. Fruit firmness did not change statistically point of view. These results were true during the two seasons.

The promoting effect of organic and biofertilizers in building sugars and plant pigments (Kannaiyan, 2002) surely reflected on enhancing fruit quality.

These results are in agreement with those obtained by Ahmed *et al*., (2007); Barakat *et al*., (2007) and Alaam (2008).

As a conclusion, supplying Florida prince peach trees with the suitable N through 50 % inorganic form as well as application of humic acid at 80 ml/ tree/ year + 25 ml *Spirulina platensis* Algae is suggested to promote yield quantitively and qualitatively.

Table 2: Effect of different proportion of inorganic N, humic acid and *Spirulina platensis* algae on the leaf area and its content of N, P and K (as percentages) in the leaves of Florida prince peach trees during 2010 and 2011 seasons.

Treatments	Leaf area (m^2)		Leaf N %		Leaf P %		Leaf K %	
	2010	2011	2010	2011	2010	2011	2010	2011
100 % inorganic N.	35.0	35.8	1.91	1.95	0.16	0.17	1.22	1.25
90 % inorganic N + 40 ml Deca + 5 ml S.	36.5	37.3	1.98	2.01	0.19	0.20	1.30	1.33
80 % inorganic N + 50 ml Deca + 10 ml S.	38.1	38.9	2.06	2.09	0.21	0.24	1.37	1.38
70 % inorganic N + 60 ml Deca +15 ml S.	39.4	40.2	2.14	2.17	0.24	0.27	1.43	1.44
60 % inorganic N + 70 ml Deca + 20 ml S.	41.0	41.7	2.21	2.24	0.27	0.31	1.50	1.52
50 % inorganic N + 80 ml Deca + 25 ml S.	42.6	43.4	2.30	2.33	0.30	0.35	1.57	1.59
40 % inorganic N + 90 ml Deca + 30 ml S.	33.9	33.8	1.62	1.65	0.13	0.11	1.10	1.09
New L.S.D at 5 %	1.1	1.2	0.06	0.05	0.02	0.03	0.05	0.06

Deca = Humic acid compound (85 %).
S = *Spirulina plantensis* algae.

Table 3: Effect of different proportion of inorganic N, humic acid and *Spirulina platensis* algae on the yield and some physical characters of the fruits of Florida prince peach trees during 2010 and 2011 seasons.

Treatments	Yield/ tree (kg.)		Fruit weight (g.)		Fruit height (cm.)		Fruit diameter (cm.)	
	2010	2011	2010	2011	2010	2011	2010	2011
100 % inorganic N.	20.0	21.7	51.0	51.2	4.40	4.44	4.60	4.64
90 % inorganic N + 40 ml Deca + 5 ml S.	22.1	23.8	55.5	54.6	4.51	4.55	4.71	4.76
80 % inorganic N + 50 ml Deca + 10 ml S.	24.3	25.4	59.0	59.9	4.64	4.69	4.85	4.90
70 % inorganic N + 60 ml Deca +15 ml S.	27.0	28.1	62.9	63.9	4.75	4.80	4.96	5.00
60 % inorganic N + 70 ml Deca + 20 ml S.	29.4	30.5	66.0	68.0	4.90	4.96	5.10	4.21
50 % inorganic N + 80 ml Deca + 25 ml S.	32.2	33.3	69.9	72.0	4.99	5.11	5.19	5.31
40 % inorganic N + 90 ml Deca + 30 ml S.	14.0	15.1	74.6	76.7	5.11	5.22	5.30	5.43
New L.S.D at 5 %	2.0	1.9	3.0	2.9	0.09	0.10	0.08	0.07

Deca = Humic acid compound (85 %).
S = *Spirulina plantensis* algae.

Table 4: Effect of different proportion of inorganic N, humic acid and *Spirulina platensis* algae on some physical characters of the fruits of Florida prince peach trees during 2010 and 2011 seasons.

Treatments	Firmness (pound/ $inch^2$)		Pulp %		Seed %		Pulp/ seeds	
	2010	2011	2010	2011	2010	2011	2010	2011
100 % inorganic N.	9.00	9.00	90.0	90.5	10.0	9.5	9.0	9.5
90 % inorganic N + 40 ml Deca + 5 ml S.	9.11	9.11	90.9	91.0	9.1	9.0	10.0	10.1
80 % inorganic N + 50 ml Deca + 10 ml S.	9.17	9.18	91.9	93.0	8.1	7.0	11.3	13.3
70 % inorganic N + 60 ml Deca +15 ml S.	9.18	9.18	92.8	94.0	7.2	6.0	12.9	15.7
60 % inorganic N + 70 ml Deca + 20 ml S.	9.25	9.19	94.0	95.2	6.0	4.8	15.7	19.8
50 % inorganic N + 80 ml Deca + 25 ml S.	9.25	9.20	95.0	96.9	5.0	3.1	19.0	31.3
40 % inorganic N + 90 ml Deca + 30 ml S.	9.25	9.20	95.1	96.9	4.9	3.1	19.4	31.3
New L.S.D at 5 %	NS	NS	0.6	0.6	0.7	0.6	0.9	1.0

Deca = Humic acid compound (85 %).
S = *Spirulina plantensis* algae.

Table 5: Effect of different proportion of inorganic N, humic acid and *Spirulina platensis* algae on some chemical characteristics of the fruits of Florida prince peach trees during 2010 and 2011 seasons.

Treatments	T.S.S %		Total sugars %		Reducing Sugars %		Total acidity %	
	2010	2011	2010	2011	2010	2011	2010	2011
100 % inorganic N.	9.0	9.2	6.6	6.8	2.4	2.3	0.722	0.710
90 % inorganic N + 40 ml Deca + 5 ml S.	9.3	9.6	7.0	7.1	2.5	2.6	0.691	0.688
80 % inorganic N + 50 ml Deca + 10 ml S.	9.8	9.9	7.4	7.5	2.8	2.9	0.669	0.660
70 % inorganic N + 60 ml Deca +15 ml S.	10.2	10.7	7.8	8.1	3.0	3.2	0.640	0.638
60 % inorganic N + 70 ml Deca + 20 ml S.	10.6	11.2	8.1	8.6	3.1	3.4	0.618	0.615
50 % inorganic N + 80 ml Deca + 25 ml S.	10.9	11.6	8.2	9.0	3.4	3.7	0.601	0.601
40 % inorganic N + 90 ml Deca + 30 ml S.	11.3	12.0	9.0	9.5	3.6	4.2	0.582	0.578
New L.S.D at 5 %	0.3	0.3	0.3	0.3	0.2	0.2	0.012	0.014

Deca = Humic acid compound (85 %).
S = *Spirulina plantensis* algae.

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