Partial Replacement of Inorganic Nitrogen Fertilizer by Spraying Some Vitamins, Yeast and Seaweed Extract In Ewaise Mango Orchard under Upper Egypt Conditions

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Abstract: During 2012 and 2013 seasons, attempts were carried out for replacing 40 to 80 % mineral N by spraying seaweed extract at 2 %, yeast at 2 % or vitamins A & D & K each at 50 ppm in Ewaise mango orchards situated at upper Egypt conditions. A remarkable promotion on the leaf area, chlorophylls a & b, total carotenoids, total chlorophylls, leaf total carbohydrates %, leaf C/N as well as nutrients namely N P K Mg, Zn, Fe and Mn in the leaves, fruit retention %, yield and fruit quality was observed with supplying the trees with the suitable N (1000 g N/ tree/ year) through 60 to 80 % mineral source in combined with spraying seaweed extract at 2 %, yeast at 2 % or vitamins A, D & K each at 50 ppm in relative to using N completely via mineral source or when mineral N was added at percentages lower than 60 %. Both total acidity % and nitrite content in the pulp were greatly reduced. Using N as mineral N at percentages lower than 60 % gave unfavourable results. For replacing 40 % of mineral N as well as improving yield and fruit quality of Ewaise mango trees grown under upper Egypt conditions, it is advised to fertilize the trees with N at 1000 g N/ tree/ year via 60 % mineral N plus spraying seaweed extract four times at 2 %.
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1. Introduction

Poor cropping is considered to be a serious and major problem that faces mango growers in Upper Egypt. This problem is attributed mainly to poor fruit retention and / or extensive dropping of flowers and fruits. Unfavourable environmental conditions, malnutrition, application of higher amounts of mineral N and undesirable physiological conditions around the trees are considered important reasons for such problem **(Miller *et al*., 1990)**. Therefore, it is necessary for avoiding the excessive use of mineral N partially by using some biostimulants namely seaweed extract, yeast and vitamins. Seaweed extract had higher amounts of essential nutrients, amino acids, vitamins, antioxidants and natural hormones **(Tung *et al*., 2003).** The same authors revealed that using seaweed extract increases the tolerance of the trees to environmental stress and pest and fungal attack. Yeast is beneficial in improving fruiting of fruit crops owing to its higher content of IAA, amino acids, fats, ash, glutathione and vitamins B. It is also responsible in activating photosynthesis process through enhancing the release of CO_2 **(Abou- Zaid, 1984).** Vitamins with their antioxidative properties play an important role in plant defense against oxidative stress induced by unfavourable conditions. Application of vitamins is accompanied with enhancing alpha keto glutaric acid biosynthesis which is united with ammonia to form amino acids and proteins. They are favourable in the biosynthesis of proteins and natural hormones and enhancing cell division and building of most organic foods. Their positive action on chelating hazard radicals and controlling the incidence of pests could results in extending the shelf- life of cells and producing healthy trees **(Rao *et al*., 2000).**

Fruiting in different mango cvs was remarkably improved with using the suitable mineral N **(Reddy *et al*., 2003; Madhavi *et al*., 2008; Bal *et al*., 2009 and Mabrouk, 2013)** as well as spraying seaweed extract **(Ebeid- Sanaa, 2007; Mouftah, 20007; Mohamed *et al*., 2008; El- Sayed- Esraa, 2010 and Abd El- Motty- Elham *et al*., 2010)**, yeast **(Ahmed, 2001; Abd El- Moniem- Eman *et al*., 2003; Mouftah, 2007; Mohamed *et al*., 2008 and Abd El- Motty- Elham *et al*., 2010)** and citric acid **(Ahmed *et al*., 1998; Saied, 2005; Mahmoud *et al*., 2007; Hamad, 2008 and Badran and Ahmed, 2009).**

The target of this study was elucidating the effect of replacing 40 to 80 % mineral N by using seaweed extract, yeast and some vitamins in relative to the application of mineral N at 100 %. Selecting the best stimulant applied with mineral N at various proportions for producing higher yield and improving fruit quality is considered another goal.

2. Material and Methods

This investigation was conducted during two successive experimental seasons 2012 and 2013 on uniform in vigour thirty 8- years old Ewaise mango trees onto seedling rootstock (on year status). The trees are grown in a private orchard located at Waborate El- Mataana village, Esna district, Luxor

Governorate. The selected trees are planted at 7 × 6 meters apart (7 m between rows and 6 m between trees). The trees were irrigated through furrow (surface) irrigation system. The soil texture of the tested orchard is silty clay with a water table depth not less than two meters.

Soil analysis was done according to **Wilde *et al*. (1985)** and the obtained data are given in Table (1).

Table (1): Mechanical, physical and chemical analysis of the tested orchard soil.

Characters	Values
Particle size distribution:	
Sand %	: 10.1
Silt %	: 50.7
Clay %	: 39.2
Texture	: Silty clay
pH (1:2.5 extract)	: 7.49
E.C (1:2.5 extract) (mmhos/ cm/ 25° C)	: 0.69
O.M. %	: 2.92
$CaCO_3$ %	: 1.74
Total N %	: 0.15
Available P (Olsen method, ppm)	: 4.2
Available K (ammonium acetate, ppm)	: 411.0

The selected trees were kept under the normal horticultural practices, except for the treatments of this study. This study included the following ten inorganic N, seaweed extract, yeast and vitamins A, D & K treatments.

1- Application of the suitable N (1000 g N/ tree/ year) completely via inorganic form namely ammonium nitrate (33.5 % N) (3.0 kg/ tree/ year).
2- Application of the suitable N through 80 % inorganic N (2.4 kg ammonium nitrate/ tree/ year) + spraying seaweed extract at 2 %.
3- Application of the suitable N through 80 % inorganic N + spraying yeast at 2 %.
4- Application of the suitable N through 80 % inorganic N + spraying the three vitamins namely A, D and K each at 50 ppm.
5- Application of the suitable N through 60 % inorganic N (1.8 kg ammonium nitrate/ tree/ year) + spraying seaweed extract at 2 %.
6- Application of the suitable N through 60 % inorganic N + spraying yeast at 2 %.
7- Application of the suitable N through 60 % inorganic N + spraying the three vitamins namely A, D & K each at 50 ppm.
8- Application of the suitable N through 40 % inorganic N (1.20 kg ammonium nitrate/ tree/ year) + spraying seaweed extract at 2 %.
9- Application of the suitable N through 40 % inorganic N + spraying yeast at 2 %.
10- Application of the suitable N through 40 % inorganic N + spraying the three vitamins namely A, D & K each at 50 ppm.

Each treatment was replicated three times, one tree per each. Mineral N fertilizer source namely ammonium nitrate (33.5 % N) at the named levels (3.0, 2.4, 1.8 and 1.2 kg/ tree) was splitted into three equal batches and added at growth start (last week of Feb.), just after fruit setting (1st week of April) and at one month later (1st week of May). All the trees received N at fixed rate namely 1000 g N/ tree/ year (according to **Chandler, 1987**). The three biostimulants namely seaweed extract, yeast and the three vitamins namely A, D & K at the named concentrations were sprayed four times at growth start (last week of Feb.), just after fruit setting (1st week of April) and at one month intervals (1st week of May and June). Vitamins A, D and K at 50 ppm were solubilized in 10 ml ethyl alcohol (50 mg/ I water for each vitamin). Chemical analysis of yeast (according to **Abou- Zaid, 1984 and Gaser- Aisha *et al*. 2006)** and seaweed extract (according to **James, 1994**) are shown in Tables (2 & 3). Triton B as a wetting agent was added at 0.3 ml/ I water to all solutions of seaweed extract, yeast and the three vitamins. Foliar application of these biostimulants was carried out till runoff (20 L/ tree).

The pure yeast powder was activated by using sources of carbon and nitrogen with ratio of 6: 1. This ratio is suitable to get the highest vegetative production of yeast. Each ml of activated yeast contained about 12000

yeast cells **(Barnett *et al.*, 1990).** Such technique allowed yeast cells to grow multiplied efficiently during conductive aerobic and nutritional conditions to produce de novo beneficial bioconstituents i.e. phytohormones, carbohydrates, proteins, amino acids, fatty acids; vitamins, enzymes, minerals ... etc, hence allowed such constituents to release out of yeast tissues in readily form. Such techniques for yeast preparation based on 1) nutritional media of glucose and casein as favourable sources of Cl N and other essential elements (P, K, Mg, Fe, Mn, Cu, B and Mo, Na and cl) in suitable balance (**Barnett *et al.*, 1990)** and 2) air pumping and adjusting incubation temperature. The media then subjected to two cycles of freezing and thawing for disruption of yeast tissues and releasing their bioconstituents directly before using.

Table (2): Chemical analysis of the used yeast extract (according to **Abou- Zaid, 1984 and Gaser- Aisha *et al.* 2006).**

Characters	Values
a- Amino acids (mg/ 100 g d.w)	
Arginine	: 1.99
Histidine	: 2.63
Isoleucine	: 2.31
Leucine	: 3.09
Lycine	: 2.95
Methionine	: 0.72
Phenyl alanine	: 2.01
Threonine	: 2.09
Tryptophan	: 0.45
Valine	: 2.19
Glutamic acid	: 2.00
Serine	: 1.59
Aspartic acid	: 1.33
Cystine	:0.23
Proline	: 1.53
Tyrosine	: 1.49
b- Carbohydrates (mg/ 100 g d.w)	
Carbohydrates %	: 23.2
Glucose %	: 13.33
c- Vitamins (mg/ 100 g d.w)	
B_1	: 2.23
B_2	: 1.33
B_6	: 1.25
B_{12}	: 0.15
Thiamin	: 2.71
Riboflavin	: 4.96
Ensitol	: 0.26
Biotin	: 0.09
Nicotinic acid	: 39.88
Panthothenic acid	: 19.56
Pamino benzoic acid	: 9.23
Folic acid	: 4.36
Pyridoxine	: 2.90
d- N %	: 7.3
e- Fats %	: 3.5
f- Ash %	: 6.7

Table (3): Analysis of seaweed extract (according to **James, 1994).**

Characters	Values
Moisture %	: 6.0
O.M. %	: 45 – 60
Inorganic matter %	: 45 – 60
Protein %	: 6 – 8
Carbohydrates %	: 35 – 50
Aliginic acid %	: 10 – 20
Mannitol %	: 4 – 7
Total N %	: 1.0 – 1.5
P %	: 0.02 – 0.09
K %	: 1.0 – 1.2
Ca %	: 0.2 – 1.5
S %	: 3 – 9
Mg %	: 0.5 – 0.9
Cu (ppm)	: 1.0 – 6.0
Fe (ppm)	: 50 – 200
Mn (ppm)	: 5 – 12
Zn (ppm)	: 10 – 100
B (ppm)	: 20 – 100
Mo (ppm)	: 1 – 5
Cytokinins %	: 0.02
IAA %	: 0.03
ABA %	: 0.01

Statistical analysis was done using randomized complete block design (RCBD) with three replicates, each with one Ewaise mango trees. Each block contained ten treatments.

During both seasons the following parameters were measured.

1. Leaf area in the Spring growth cycle (cm2) (according to **Ahmed and Morsy, 1999).**
2. Plant pigments namely chlorophylls a & b, total carotenoids and total chlorophylls (according to **Hiscox and Isralstam, 1979).**
3. Leaf content of N, P, K and Mg (as percentages) and Zn, Fe and Mn (as ppm) (according to **Wilde *et al*., 1985).**
4. Leaf total carbohydrates and C/N in the leaves (according to **A.O.A.C., 1995).**
5. Percentage of fruit retention.
6. Harvesting was conducted at the first week of July. for both seasons and yield expressed in weight (kg.) and number of fruits/ tree was recorded.
7. Physical properties of the fruits namely fruit weight (g.) and dimensions (length, width & thickness), percentages of pulp & peel and seed and edible/ non- edible portions.
8. Chemical characteristics of the fruits namely total soluble solids, total, reducing and non- reducing sugars (**Lane and Eynon, 1965** method), total acidity % as g citric acid/ 100 g pulp and vitamin C content (mg L- ascorbic acid/ 100 g pulp) **(A.O.A.C., 1995).** Nitrite in the pulp (as ppm) was also determined (according to **Sen and Donaldson, 1978**).

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

3. Results

1- Leaf area and its chemical composition:

It is clear from the data in Tables (4 & 5 & 6 & 7 & 8) that supplying Ewaise mango trees with the suitable N (1000 g N/ tree/ year) through 60 to 80 % mineral N besides foliar application of any one of seaweed extract at 2 %, yeast at 2 % or the three vitamins A & D & K each at 50 ppm significantly was accompanied with

stimulating the leaf area and its content of plant pigments (chlorophylls a & b, total carotenoids and total chlorophylls), total carbohydrates and C/N in relative to using N completely via mineral N source or when mineral N was applied at percentages lower than 60 % of N even with the application of the three biostimulants. Spraying seaweed extract at 2 %, yeast at 2 % and the three vitamins with mineral N source at 40 to 80 % of N, in descending order was significantly favourable for promoting the leaf area and these organic and mineral leaf content. The best material applied with mineral N was seaweed extract. All nutrients except N were gradually enhanced with reducing mineral N percentage from 100 to 40 %. The maximum values of leaf area, plant pigments and total carbohydrates were recorded on the trees that received N as 60 % mineral N plus spraying seaweed extract at 2 %. The lowest values of these parameters were recorded on the trees that received N through 40 % mineral plus spraying the three vitamins each at 50 ppm. The highest P, K, Mg, Zn, Fe and Mn in the leaves were observed on the trees that received N as 40 % mineral N plus spraying seaweed extract at 2 %. Values of N were maximized in the trees that received N completely via mineral N without spraying any biostimulant. These results were true during both seasons.

2- Percentage of fruit retention and yield per tree:

Data in Tables (8 & 9) clearly show that amending Ewaise mango trees with the suitable N through 60 to 80 % plus spraying seaweed extract, yeast or the three vitamins significantly was significantly followed by great promotion on fruit retention and yield expressed in weight (kg.) and number of fruits per tree in relative to using N completely via mineral N or when mineral N was applied at 40 % even with application of any biostimulant. A significant decline on these parameters was observed when mineral N was applied at percentages lower than 60 %. Using N completely via mineral N source significantly improved fruit retention % and yield/ tree compared to using mineral N at percentages lower than 60 % of N. Using seaweed extract, yeast and the three vitamins in combined with mineral N at 40 to 80 % of N, in descending order was significantly favourable in improving fruit retention and yield. The best results with regard to fruit retention and yield/ tree were obtained due to supplying the trees with N as 60 % mineral N plus spraying seaweed extract at 2 %. Under such promised treatment, yield per tree reached 64.2 and 67.5 kg during both seasons, respectively. The minimum values (28.5 and 30.3 kg) were recorded with using N as 40 % mineral N plus spraying the three vitamins each at 50 ppm. The percentage of increase on the yield due to using the promised treatment over the check treatment (using N as 100 % mineral N) reached 71.2 and 68.3 %. Similar results were announced during both seasons.

3- Fruit quality:

Data listed in Tables (9-14) obviously reveal that using the suitable N through 60 to 80 % mineral N plus any biostimulant (seaweed extract, yeast or the three vitamins) significantly improved fruit quality in terms of increasing fruit weight and dimensions (length & width & thickness), edible to non- edible portions, pulp weight %, total soluble solids %, T.S.S/ acid, total, reducing and non- reducing sugars % and vitamin C while decreasing percentage of peels and seeds and total acidity % in relative to using N completely via mineral source or when mineral N was applied at percentages lower than 60 % even with the application of any one of the three biostimulants. Nitrite content in the fruit pulp was gradually reduced with reducing the percentages of mineral N from 100 to 40 %. The reduction on nitrite content was significantly associated with using seaweed extract, yeast and the three vitamins with mineral N at 40 to 80 %, in descending order. The promotion on both physical and chemical characteristics was significantly attributed to using seaweed extract, yeast and the three vitamins with mineral N at 40 to 80 %, in descending order. The best biostimulant in improving fruit quality and reducing pulp nitrite content was seaweed extract followed by yeast and using the three vitamins occupied the last position in this respect. Significant unfavourable effects on fruit quality were observed with using the suitable N as 40 % mineral N even with the application of any one of these biostimulants. Using N completely via inorganic form was significantly preferable than using N via 40 % mineral N with the application of any one of the three biostimulants. The best results with regard to fruit quality were observed with using N as 60 % mineral N plus foliar application of seaweed extract at 2 %. These results were true during both seasons.

Table (4): Effect of spraying seaweed extract, yeast and vitamins A, D and K as a partial replacement of inorganic N fertilizer on the leaf area as well as chlorophylls a and b in the fresh leaves of Ewaise mango trees during 2012 and 2013 seasons.

Inorganic, seaweed extract, yeast and vitamins A & D & K treatments	Leaf area (cm^2)		Chlorophyll a (mg/ 100 g F.W)		Chlorophyll b (mg/ 100 g F.W)	
	2012	2013	2012	2013	2012	2013
Using N as 100 % inorganic N	81.3	83.0	20.0	21.1	7.5	8.2
Using N as 80 % inorganic N + seaweed extract at 2 %	86.3	88.1	21.3	22.4	9.6	10.3
Using N as 80 % inorganic N + yeast at 2 %	84.7	86.7	20.8	21.9	8.4	9.1
Using N as 80 % inorganic N+ vitamins A&D&K each at 50 ppm	83.0	84.7	20.3	21.4	8.0	8.7
Using N as 60 % inorganic N + seaweed extract at 2 %	94.7	96.6	25.7	26.8	12.3	13.0
Using N as 60 % inorganic N + yeast at 2 %	90.3	92.0	22.7	23.9	11.7	12.4
Using N as 60 % inorganic N + vitamins A & D & K each at 50 ppm	88.3	90.0	22.0	23.2	10.7	11.4
Using N as 40 % inorganic N + seaweed extract at 2 %	79.7	81.7	19.2	20.4	7.1	7.8
Using N as 40 % inorganic N + yeast at 2 %	77.9	79.6	18.6	19.7	6.7	7.3
Using N as 40 % inorganic N + vitamins A & D & K at each 50 ppm	76.1	77.8	18.0	19.2	6.2	6.9
New L.S.D at 5 %	**1.4**	**1.5**	**0.4**	**0.3**	**0.3**	**0.4**

Table (5): Effect of spraying seaweed extract, yeast and vitamins A, D and K as a partial replacement of inorganic N fertilizer on the total chlorophylls, total carotenoids in the fresh leaves and percentage of total carbohydrates in the dry leaves of Ewaise mango trees during 2012 and 2013 seasons.

Inorganic, seaweed extract, yeast and vitamins A & D & K treatments	Total chlorophylls (mg/ 100 g F.W)		Total carotenoids (mg/ 100 g F.W)		Total carbohydrates %	
	2012	2013	2012	2013	2012	2013
Using N as 100 % inorganic N	27.5	29.3	6.8	8.0	17.7	18.0
Using N as 80 % inorganic N + seaweed extract at 2 %	30.9	32.7	9.1	10.3	19.4	19.8
Using N as 80 % inorganic N + yeast at 2 %	29.2	31.0	8.3	9.5	18.8	19.2
Using N as 80 % inorganic N+ vitamins A&D&K each at 50 ppm	28.3	30.1	7.6	8.8	18.3	18.6
Using N as 60 % inorganic N + seaweed extract at 2 %	38.0	39.8	11.7	12.9	21.0	21.2
Using N as 60 % inorganic N + yeast at 2 %	34.4	36.3	10.8	12.0	20.5	20.7
Using N as 60 % inorganic N + vitamins A & D & K each at 50 ppm	32.7	34.6	10.0	11.2	19.9	20.3
Using N as 40 % inorganic N + seaweed extract at 2 %	26.3	28.2	5.8	7.0	17.0	17.2
Using N as 40 % inorganic N + yeast at 2 %	25.3	27.0	5.0	6.2	16.2	16.4
Using N as 40 % inorganic N + vitamins A & D & K at each 50 ppm	24.2	26.1	4.1	5.3	15.5	15.6
New L.S.D at 5 %	**0.7**	**0.6**	**0.7**	**0.6**	**0.5**	**0.6**

Table (6): Effect of spraying seaweed extract, yeast and vitamins A, D and K as a partial replacement of inorganic N fertilizer on C/N in the leaves as well as percentages of N and P in the leaves of Ewaise mango trees during 2012 and 2013 seasons.

Inorganic, seaweed extract, yeast and vitamins A & D & K treatments	Total carbohydrates/ nitrogen (C/N)		Leaf N %		Leaf P %	
	2012	2013	2012	2013	2012	2013
Using N as 100 % inorganic N	8.7	8.5	2.04	2.11	0.21	0.22
Using N as 80 % inorganic N + seaweed extract at 2 %	9.9	9.8	1.95	2.02	0.38	0.39
Using N as 80 % inorganic N + yeast at 2 %	9.9	9.8	1.90	1.96	0.34	0.35
Using N as 80 % inorganic N+ vitamins A&D&K each at 50 ppm	9.9	9.7	1.84	1.91	0.29	0.30
Using N as 60 % inorganic N + seaweed extract at 2 %	12.1	11.8	1.73	1.80	0.40	0.41
Using N as 60 % inorganic N + yeast at 2 %	12.3	11.9	1.67	1.74	0.36	0.37
Using N as 60 % inorganic N + vitamins A & D & K each at 50 ppm	12.4	12.1	1.61	1.68	0.33	0.34
Using N as 40 % inorganic N + seaweed extract at 2 %	11.1	10.8	1.53	1.60	0.46	0.46
Using N as 40 % inorganic N + yeast at 2 %	11.1	10.8	1.46	1.52	0.41	0.41
Using N as 40 % inorganic N + vitamins A & D & K at each 50 ppm	11.2	10.7	1.39	1.46	0.37	0.31
New L.S.D at 5 %	**0.8**	**0.9**	**0.05**	**0.06**	**0.03**	**0.02**

Table (7): Effect of spraying seaweed extract, yeast and vitamins A, D and K as a partial replacement of inorganic N fertilizer on the leaf content of K & Mg (as percentages) and Zn (as ppm) of Ewaise mango trees during 2012 and 2013 seasons.

Inorganic, seaweed extract, yeast and vitamins A & D & K treatments	Leaf K %		Leaf Mg %		Leaf Zn (ppm)	
	2012	2013	2012	2013	2012	2013
Using N as 100 % inorganic N	1.19	1.23	0.59	0.62	81.0	82.3
Using N as 80 % inorganic N + seaweed extract at 2 %	1.38	1.42	0.72	0.78	89.0	90.4
Using N as 80 % inorganic N + yeast at 2 %	1.33	1.37	0.68	0.73	86.0	87.3
Using N as 80 % inorganic N+ vitamins A&D&K each at 50 ppm	1.27	1.31	0.64	0.69	83.0	84.3
Using N as 60 % inorganic N + seaweed extract at 2 %	1.45	1.49	0.77	0.82	95.3	96.6
Using N as 60 % inorganic N + yeast at 2 %	1.40	1.44	0.74	0.79	93.0	94.3
Using N as 60 % inorganic N + vitamins A & D & K each at 50 ppm	1.35	1.39	0.71	0.76	90.0	91.3
Using N as 40 % inorganic N + seaweed extract at 2 %	1.53	1.58	0.88	0.93	102.9	104.2
Using N as 40 % inorganic N + yeast at 2 %	1.49	1.53	0.83	0.88	99.0	100.9
Using N as 40 % inorganic N + vitamins A & D & K at each 50 ppm	1.44	1.47	0.79	0.84	95.5	96.8
New L.S.D at 5 %	**0.04**	**0.05**	**0.03**	**0.03**	**1.2**	**1.1**

Table (8): Effect of spraying seaweed extract, yeast and vitamins A, D and K as a partial replacement of inorganic N fertilizer on the leaf content of Fe and Mn (as ppm) and percentage of fruit retention of Ewaise mango trees during 2012 and 2013 seasons.

Inorganic, seaweed extract, yeast and vitamins A & D & K treatments	Leaf Fe (ppm)		Leaf Mn (ppm)		Fruit retention %	
	2012	2013	2012	2013	2012	2013
Using N as 100 % inorganic N	81.9	83.0	60.0	61.1	0.53	0.56
Using N as 80 % inorganic N + seaweed extract at 2 %	94.3	95.4	66.3	67.4	0.65	0.68
Using N as 80 % inorganic N + yeast at 2 %	91.9	93.0	64.3	65.4	0.61	0.64
Using N as 80 % inorganic N+ vitamins A&D&K each at 50 ppm	88.8	89.9	62.9	64.0	0.57	0.60
Using N as 60 % inorganic N + seaweed extract at 2 %	98.3	99.4	75.3	76.4	0.87	0.90
Using N as 60 % inorganic N + yeast at 2 %	96.9	98.0	73.3	74.4	0.79	0.82
Using N as 60 % inorganic N + vitamins A & D & K each at 50 ppm	94.1	95.2	71.0	72.2	0.71	0.74
Using N as 40 % inorganic N + seaweed extract at 2 %	103.8	105.0	89.0	90.2	0.49	0.52
Using N as 40 % inorganic N + yeast at 2 %	101.0	102.2	84.0	85.2	0.45	0.48
Using N as 40 % inorganic N + vitamins A & D & K at each 50 ppm	99.0	100.9	80.0	81.2	0.41	0.44
New L.S.D at 5 %	**1.3**	**1.2**	**1.4**	**1.5**	**0.03**	**0.03**

Table (9): Effect of spraying seaweed extract, yeast and vitamins A, D and K as a partial replacement of inorganic N fertilizer on the number of fruits/ tree, yield/ tree and fruit weight of Ewaise mango trees during 2012 and 2013 seasons.

Inorganic, seaweed extract, yeast and vitamins A & D & K treatments	Number of fruits/ tree		Yield/ tree		Fruit weight (g.)	
	2012	2013	2012	2013	2012	2013
Using N as 100 % inorganic N	218.0	231.0	37.5	40.1	172.0	173.8
Using N as 80 % inorganic N + seaweed extract at 2 %	249.0	262.0	48.0	51.0	192.9	194.7
Using N as 80 % inorganic N + yeast at 2 %	240.0	253.0	44.4	47.2	185.0	186.7
Using N as 80 % inorganic N+ vitamins A&D&K each at 50 ppm	229.0	242.0	40.9	43.6	178.7	180.3
Using N as 60 % inorganic N + seaweed extract at 2 %	289.0	302.0	64.2	67.5	222.0	223.6
Using N as 60 % inorganic N + yeast at 2 %	271.0	284.0	56.9	60.1	210.0	211.7
Using N as 60 % inorganic N + vitamins A & D & K each at 50 ppm	260.0	273.0	52.0	55.1	200.0	201.9
Using N as 40 % inorganic N + seaweed extract at 2 %	209.0	222.0	34.5	37.1	165.0	166.9
Using N as 40 % inorganic N + yeast at 2 %	199.0	211.0	31.2	33.5	157.0	158.9
Using N as 40 % inorganic N + vitamins A & D & K at each 50 ppm	190.0	200.0	28.5	30.3	150.0	151.7
New L.S.D at 5 %	**8.0**	**9.0**	**2.0**	**2.5**	**6.1**	**5.9**

Table (10): Effect of spraying seaweed extract, yeast and vitamins A, D and K as a partial replacement of inorganic N fertilizer on the length, width and thickness of fruits of Ewaise mango trees during 2012 and 2013 seasons.

Inorganic, seaweed extract, yeast and vitamins A & D & K treatments	Fruit length (cm.)		Fruit width (cm.)		Fruit thickness (cm.)	
	2012	2013	2012	2013	2012	2013
Using N as 100 % inorganic N	8.65	8.86	6.61	6.70	5.15	5.18
Using N as 80 % inorganic N + seaweed extract at 2 %	9.29	9.50	7.11	7.20	5.52	5.55
Using N as 80 % inorganic N + yeast at 2 %	9.00	9.21	6.92	7.00	5.42	5.45
Using N as 80 % inorganic N+ vitamins A&D&K each at 50 ppm	8.79	9.00	6.75	6.84	5.25	5.29
Using N as 60 % inorganic N + seaweed extract at 2 %	10.45	10.66	7.66	7.75	5.92	5.97
Using N as 60 % inorganic N + yeast at 2 %	9.97	10.25	7.50	7.59	5.75	5.80
Using N as 60 % inorganic N + vitamins A & D & K each at 50 ppm	9.64	9.85	7.33	7.42	5.63	5.68
Using N as 40 % inorganic N + seaweed extract at 2 %	8.50	8.71	6.48	6.58	5.04	5.11
Using N as 40 % inorganic N + yeast at 2 %	8.20	8.50	6.40	6.49	4.97	5.04
Using N as 40 % inorganic N + vitamins A & D & K at each 50 ppm	8.00	8.31	6.31	6.40	4.90	4.93
New L.S.D at 5 %	**0.12**	**0.10**	**0.05**	**0.06**	**0.05**	**0.04**

Table (11): Effect of spraying seaweed extract, yeast and vitamins A, D and K as a partial replacement of inorganic N fertilizer on the percentages of pulp, peels and seeds in the fruits of Ewaise mango trees during 2012 and 2013 seasons.

Inorganic, seaweed extract, yeast and vitamins A & D & K treatments	Pulp %		Peels %		Seeds %	
	2012	2013	2012	2013	2012	2013
Using N as 100 % inorganic N	76.7	75.0	14.7	14.8	8.6	10.2
Using N as 80 % inorganic N + seaweed extract at 2 %	82.9	81.2	12.9	13.1	4.2	5.7
Using N as 80 % inorganic N + yeast at 2 %	81.0	79.3	13.2	13.4	5.8	7.3
Using N as 80 % inorganic N+ vitamins A&D&K each at 50 ppm	78.9	77.2	14.0	14.2	7.1	8.6
Using N as 60 % inorganic N + seaweed extract at 2 %	85.6	84.0	11.6	11.8	2.8	4.2
Using N as 60 % inorganic N + yeast at 2 %	85.0	83.3	12.0	12.0	3.0	4.7
Using N as 60 % inorganic N + vitamins A & D & K each at 50 ppm	84.9	83.2	12.4	12.5	2.7	4.3
Using N as 40 % inorganic N + seaweed extract at 2 %	74.0	72.4	15.1	15.3	10.9	12.3
Using N as 40 % inorganic N + yeast at 2 %	71.9	70.2	15.7	15.9	12.4	13.9
Using N as 40 % inorganic N + vitamins A & D & K at each 50 ppm	70.0	68.3	16.1	16.2	13.9	15.5
New L.S.D at 5 %	**1.8**	**1.7**	**0.4**	**0.3**	**0.7**	**0.8**

Table (12): Effect of spraying seaweed extract, yeast and vitamins A, D and K as a partial replacement of inorganic N fertilizer on edible to non edible proteins, total soluble solids % and total acidity in the fruits of Ewaise mango trees during 2012 and 2013 seasons.

Inorganic, seaweed extract, yeast and vitamins A & D & K treatments	Edible/ non-edible proteins		Total soluble solids %		Total acidity %	
	2012	2013	2012	2013	2012	2013
Using N as 100 % inorganic N	3.29	3.00	16.9	17.0	0.309	0.320
Using N as 80 % inorganic N + seaweed extract at 2 %	4.85	4.32	17.5	17.6	0.261	0.270
Using N as 80 % inorganic N + yeast at 2 %	4.26	3.83	17.2	17.2	0.271	0.280
Using N as 80 % inorganic N+ vitamins A&D&K each at 50 ppm	3.74	3.39	17.0	17.1	0.300	0.310
Using N as 60 % inorganic N + seaweed extract at 2 %	5.94	5.25	18.2	18.3	0.220	0.229
Using N as 60 % inorganic N + yeast at 2 %	5.67	4.99	17.9	18.0	0.225	0.234
Using N as 60 % inorganic N + vitamins A & D & K each at 50 ppm	5.62	4.95	17.7	17.8	0.230	0.239
Using N as 40 % inorganic N + seaweed extract at 2 %	2.85	2.62	16.7	16.8	0.339	0.348
Using N as 40 % inorganic N + yeast at 2 %	2.56	2.36	16.5	16.6	0.370	0.379
Using N as 40 % inorganic N + vitamins A & D & K at each 50 ppm	2.33	2.15	16.2	16.3	0.411	0.420
New L.S.D at 5 %	**0.21**	**0.18**	**0.2**	**0.3**	**0.030**	**0.031**

Table (13): Effect of spraying seaweed extract, yeast and vitamins A, D and K as a partial replacement of inorganic N fertilizer on T.S.S/ acid as well as percentages of total and reducing sugars in the fruits of Ewaise mango trees during 2012 and 2013 seasons.

Inorganic, seaweed extract, yeast and vitamins A & D & K treatments	T.S.S/ acid		Total sugars %		Reducing sugars %	
	2012	2013	2012	2013	2012	2013
Using N as 100 % inorganic N	54.7	53.1	14.9	15.0	7.5	7.6
Using N as 80 % inorganic N + seaweed extract at 2 %	67.0	65.2	16.0	16.1	8.2	8.3
Using N as 80 % inorganic N + yeast at 2 %	63.5	61.4	15.6	15.8	8.0	8.1
Using N as 80 % inorganic N+ vitamins A&D&K each at 50 ppm	56.7	55.2	15.3	15.5	7.8	7.9
Using N as 60 % inorganic N + seaweed extract at 2 %	82.7	79.9	17.1	17.2	9.0	9.1
Using N as 60 % inorganic N + yeast at 2 %	79.6	76.9	16.8	17.0	8.7	8.8
Using N as 60 % inorganic N + vitamins A & D & K each at 50 ppm	77.0	74.5	16.4	16.5	8.4	8.5
Using N as 40 % inorganic N + seaweed extract at 2 %	49.3	48.3	14.7	14.8	7.4	7.5
Using N as 40 % inorganic N + yeast at 2 %	44.6	43.8	14.5	14.5	7.1	7.1
Using N as 40 % inorganic N + vitamins A & D & K at each 50 ppm	39.4	38.8	14.2	14.2	6.9	7.0
New L.S.D at 5 %	**2.1**	**2.4**	**0.2**	**0.3**	**0.2**	**0.2**

Table (14): Effect of spraying seaweed extract, yeast and vitamins A, D and K as a partial replacement of inorganic N fertilizer on the percentage of non- reducing sugars, vitamin C content (mg/ 100 g pulp) and nitrite (ppm) in the fruit pulp of Ewaise mango trees during 2012 and 2013 seasons.

Inorganic, seaweed extract, yeast and vitamins A & D & K treatments	Non- reducing sugars %		Vitamin C (mg/ 100 g pulp)		Nitrite in the pulp (ppm)	
	2012	2013	2012	2013	2012	2013
Using N as 100 % inorganic N	7.4	7.9	33.3	34.0	1.82	1.75
Using N as 80 % inorganic N + seaweed extract at 2 %	7.8	7.8	38.3	39.0	1.51	1.44
Using N as 80 % inorganic N + yeast at 2 %	7.6	7.1	36.8	37.5	1.62	1.55
Using N as 80 % inorganic N+ vitamins A&D&K each at 50 ppm	7.5	7.6	35.0	35.7	1.78	1.71
Using N as 60 % inorganic N + seaweed extract at 2 %	8.1	8.1	44.9	45.7	0.64	0.57
Using N as 60 % inorganic N + yeast at 2 %	8.1	8.2	43.0	43.7	0.95	0.87
Using N as 60 % inorganic N + vitamins A & D & K each at 50 ppm	8.0	8.0	41.0	41.8	1.04	0.97
Using N as 40 % inorganic N + seaweed extract at 2 %	7.3	7.3	31.7	32.5	0.41	0.34
Using N as 40 % inorganic N + yeast at 2 %	7.4	7.4	30.0	30.7	0.50	0.43
Using N as 40 % inorganic N + vitamins A & D & K at each 50 ppm	7.3	7.2	28.3	29.2	0.59	0.51
New L.S.D at 5 %	**0.2**	**0.2**	**1.1**	**1.3**	**0.05**	**0.04**

4. Discussion

It is worth to mention that the excessive use of mineral N resulted in stimulating growth at the expense of fruiting as well as increasing environmental pollution **(Miller *et al.*, 1990).** The beneficial of seaweed extract, yeast and vitamins on fruiting of fruit crops is mainly attributed to their positive action on enhancing growth and nutritional status of the trees in favour of enhancing productive capacity. Seaweed extract had higher amounts of essential nutrients, amino acids, vitamins, antioxidants and the natural hormones. In addition, using seaweed extract is very essential for enhancing the tolerance of the trees to drought, salinity, pests and other unfavourable environmental conditions **(Tung *et al.*, 2003)**. Yeast is essential for enhancing growth and fruiting states due to its higher own content of vitamins B, IAA, amino acids, fats, nutrients and glutathione and it is responsible for enhancing photosynthesis through its role in increasing the release of CO_2 **(Abou- Zaid, 1984)**. Vitamins with their antioxidative properties play an important role in plant defense against oxidative stress induced by unfavourable conditions. Application of vitamins is accompanied with enhancing alpha keto glutaric acid biosynthesis which is united with ammonia to form amino acids and proteins. They are favourable in the biosynthesis of proteins and natural hormones and enhancing cell division and building of most organic foods. Their positive action on chelating hazard radicals and controlling the incidence of pests could results in extending the shelf- life of cells and producing healthy trees **(Rao *et al.*, 2000).**

These results are in agreement with those obtained by **Madhavi *et al.* (2008); Bal *et al.* (2009) and Mabrouk (2013)** who worked on mineral N; **El-Sayed – Esraa (2010) and Abd El- Motty- Elham *et al.* (2010)** who worked on seaweed extract; **Mohamed *et al.* (2008) and Abd El- Motty- Elham *et al.* (2010)** who worked on yeast and **Hamad (2008) and Badran and Ahmed (2009)** who worked on some vitamins.

Conclusion

Supplying Ewaise mango trees growing under upper Egypt conditions with the suitable N (1000 g/ tree/ year) through 60 % mineral N plus foliar application of seaweed extract at 2 % four times is accompanied with promoting yield quantitively and qualitatively and at the same time reducing environmental pollution.

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