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PRELIMINARY STUDIES ON FERTILIZATION OF MANGO TREES UNDER U.A.E. CONDITIONS
II- RESPONSE OF AMRAPALI MANGO TREES TO NITROGEN AND POTASSIUM FERTILIZATION

[38]

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ABSTRACT

Response of Amrapali mango (*Mangifera indica* L.) trees to nitrogen and potassium fertilizers were studied throughout two successive seasons (2002 and 2003) at the eastern farm of Dibba Al- Fujaira Fruit Research Station , in the eastern coast of United Arab Emirates (UAE). Trees were 10 year old and planted at (65 trees/ donum). Four fertilization treatments of 1- control : sterilized pellets of chicken manure (500 g N/tree/year, 2- Urea (1000g N /tree/year + Potassium sulphate 400g K2O/tree/year , 3- Urea (500g N/tree/year +Potassium sulphate 400g K2O/tree/year and 4- Urea (500g N /tree/year +Potassium sulphate 800g K2O/tree/year.The best results were obtained with the second treatment (2N:1K) which gave balanced levels of most nutrient elements of leaf macro and micro mineral contents, greatest yield and best fruit quality was closely related to control and (1N:2K) treatments.

Keywords: Mango, Amrapali, Fertilization, Nitrogen, Potassium, Yield, Fruit quality, Leaf mineral content

INTRODUCTION

The evaluation of inorganic N and K fertilizers regarding their effects on Amrapali mango cv. was carried out in the eastern farm of Dibba Al-Fujaira Fruit Research Station, in the eastern coast of UAE. This research was aimed to determine the optimum level of both N and K fertilizers by which the highest yield and best fruit qualities could be achieved. **Abd-El-Al *et al* (1994)** reported that, when three rates of K fertilizer (0, 500 or 1000 g/ tree/ year) were applied to mango cv. Hindi-Be-Sinnara as either soil or foliar application. Fruit number per tree, fruit number per panicle and fruit juice TSS concentration were increased with raising K application rate. K application rate and method had no clear effect on the leaf N and P contents, but leaf K content increased with increasing K application rate (regarding of application method). **Sergent *et al* (1995)** In 4-year trials initiated with 6-year-old mango trees of the cultivar Haden, whereas fertilization was applied N at 0, 600, 1200 or 1800 g/tree, while K at 0, 600, 1200 or 1800 g/tree

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and basal P at 600 g/tree, in 7 different combinations. There were no significant effects of N and K treatments on yield. In terms of K application rate, it was concluded that the rates in such study were sub-optimal. Fruit number/tree was greatest when both K and N were applied together at the highest rates, but tended to decrease with increasing K application rate in the absence of N application. Yields differed considerably between years (attributed to the irregular bearing phenomenon). **Banik *et al* (1997)** working on mango trees fertilization reported that, high N and low K (1500 and 500 g/plant, respectively) promoted vegetative growth as indicated by plant height, trunk girth and canopy spread. High N and K (both at 1500 g/plant) promoted fruiting. Fruit quality (in terms of TSS, sugar content and acidity) was the best following the application of 1000 g N, 500 g P2O5 and 1500 g K2O/plant. **Dutta and Dhua (1999)** declared that, levels of potassium (125-1500 g/tree) significantly increased the N, P, K, Zn and Mn contents of mango leaves, but decreased level of Fe. The application of 1500 g K produced the highest leaf N, P, K, Zn and Mn content. The content of N, P, K, Zn and Mn of mango fruit were also increased with the application of K whereas Ca and Fe contents significantly decreased. **Reddy *et al* (2000)** studied the nutritional requirement of Totapuri mango and suggested that, N application significantly influenced the tree growth and fruit yield of young Totapuri trees while P and K application did not. Average fruit size and total soluble solids of pulp were significantly influenced by N nutrition during the tenth year but other fruit quality attributes were unaffected. N at 50 g/tree/year of age resulted in the best canopy development while N at 100 g/tree/year of age gave maximum fruit yield. Tree growth and yield were very poor when N was not applied and also with very high N rates. **Sharma *et al* (2000)** working on NPK fertilization on Deshehari mango cv. reported that, the highest fruit yield of 132.0 kg/tree was recorded for the 800 g N + 200 g P + 300 g K treatment. The same treatment gave the highest values for fruit weight (166.0 g) and pulp weight (104.4 g), while 400 g N + 0 g P + 300 g K gave the highest stone weight (37.0 g). No significant differences in the total soluble solids were observed among the different NPK treatments. **Smith, (2000)** reported, the necessity of ensuring N availability throughout the growing season. Combining the records over the three seasons, revealed that N3 (900 g/tree per annum) and N4 (1350 g) levels would appear to correspond to the highest yields. Too high levels of N application tended to reduce yields and also delayed colour development. A polynomial regression of the N:K ratio versus yield for the T3 timing of application (half in January/February and half at the start of flowering) gave an optimum N:K ratio in the range 1.9-2.2 and demonstrates the importance of the specific N and K levels in mango nutrition. **Satapathy and Banik (2002)** evaluated the effect of inorganic fertilizers (N, P, and K) on flowering, fruit growth, yield and fruit quality of mango cv. Amrapali. The highest hermaphrodite/male flowers ratio was recorded by applying 50 g N and 100 g each of P and K per plant per year. Application of 100 g of each N, P, and K per plant per year markedly increased the number of fruits/tree, yield, pulp percent and also improved fruit quality.

MATERIAL AND METHODS

This investigation was carried out through two successive seasons (2002 and 2003) in the eastern farm of Dibba Al- Fujaira Fruit Research Station, in the eastern coast of United Arab Emirates (UAE) on 10 year old newly introduced dwarf Amrapali mango trees budded on seedy rootstocks grown in sandy soil with (soil analyses shown in Table, 2) and bubbler irrigation system was used with well water (425 ppm salinity). Planting distance was 4 ×4 meters apart. Basal amount of nitrogen and potassium was counted as 50g N and 40g K2O /year of tree age till ten year old. In this study two N and K levels (500 & 1000g N) and (400 & 800g K2O) per tree both annually applied in combination to represent 3 N&K ratios (approximately 2:1, 1:1, and 1:2), besides chicken manure at 500g N/tree were investigated during two experimental seasons. This, N & K fertilization treatments were as follows:

1- Sterilized pellets of chicken manure at 500 g N /tree/year.
2- Urea at 1000g N /tree/year +Potassium sulphate 400g K2O/tree/year.
3- Urea at 500g N /tree/year +Potassium sulphate 400g K2O/tree/year .
4- Urea at 500g N /tree/year +Potassium sulphate 800g K2O/tree/year.

Urea and organic fertilization (4% N as shown in table 3) were added at four equal doses from October to April at two months interval. Potassium fertilizer was added on three equal doses from October to April. The treatments were arranged in a randomized complete block design in a simple experiment with four replicates for each treatment and each replicate was represented by one tree. Other orchard management were carried out as usual. Twenty leaves of 4-6 months age of spring growth flushes were collected at random from each replicate at level of 1.5m from the soil surface and around the tree representing different directions. The leaf samples were washed several times with tap water then rinsed with distilled water, dried at 70°C in an electric oven till constant weight , grounded in an electric mill and digested according to **Chapman and Prat (1961)**. Nitrogen was determined by MicroKjeldahl method **(according to A.O.A.C., 1990)**. Phosphorus was determined by the method of **Truog and Meyer (1929)**. Potassium was determined by the method of the flame photometer according to **Brown and Lilleland (1946)**. Calcium and magnesium were determined by titration against versenate solution **(Chapman and Pratt, 1961)**. Iron, zinc and manganese were estimated by using Atomic Absorption technique. All these macro and micro elements were determined through the two studied seasons. The yield as number of fruits per tree was recorded at fruit mature stage. Samples consisting of ten mature fruits were randomly taken from each replicate to determine, average fruit weight (g), fruit length (cm), fruit width (cm), fruit thickness (cm), total soluble solids percent, total acidity percent and ascorbic acid content (according to **A.O.A.C., 1985**).

All data obtained during 2 seasons of this study were statistically analyzed using the analysis of variance as reported by **(Snedecor and Cochran, 1980)** and the differences between means were differentiated by using Duncan,s range test.

Table 1. Analysis of chicken manure fertilizer used in the present study (Dry matter basis)

Organic matter	pH	N	P	K	Ca	Mg	Na	Moisture	C/N ratio	Intensity
90%	6.35	4%	4.8%	3.7%	10.3%	0.86%	0.45%	9.94%	10 /18.7	0.65 g/L

Table 2. Chemical and mechanical soil analysis

Chemical analysis											
				Milliequivalent / liter							
S.P. %	$CaCo_3$	pH	ECe mmhos	Cations				Anions			(%)
				Ca++	Mg++	Na+	K+	CO_3	HCO_3	Cl-	
30.8	4.0	8.22	10.09	17	59	24.7	2.71	Nil	3.6	38	3.4
ppm											
N		P		K		Ca		Mg			
25.6		17.8		153.9		378.4		732.2			
Mechanical soil analysis											
%								Texture			
Clay		Silt		Sand							
5.96		3.80		90.24				Sand			

RESULTS AND DISCUSSION

A- Leaf mineral content

Data presented in Table (3) show the effect of nitrogen and potassium fertilization on leaf mineral content of Amrapali mango trees.

Concerning the macronutrients Leaf nitrogen percent in the first season was not significantly affected by any treatment. But in the second season, 2nd treatment (2N:1K) showed the highest significant value compared with any other treatments. Leaf phosphorus percent in the first season lack significance among treatments but in the second season, 1st and 3rd treatments gave the lowest significant value compared to other treatments. Leaf potassium percent showed insignificant differences among treatments in the first season. In second season 4th treatment (1N:2K) showed higher significant value compared to the 2nd one. Leaf calcium percent had insignificant differences among treatments in both seasons. Leaf magnesium percent showed insignificant differences among treatments in both studied seasons.

Regarding the micronutrients: Leaf zinc content had no significant response to different N-K treatments in both seasons. Leaf Fe content had no firm trend regarding the response to N-K treatments, whereas in 1st season differences didn't reach level of significance while in 2nd season second treatment (2N:1K) surpassed statistically other investigated treatments, specially 1st and 4th ones. Leaf manganese content recorded higher significant value with first treatment than those of third and fourth treatments in the first season, meanwhile in the second season, third treatment gave higher significant value than those of second one.

Finally: it could be concluded that , the 2nd treatment (1000 g N + 400 g K2O showed the best results for leaf nitrogen and potassium percent compared with those of other treatments. These results are contrary to those found by. **Reddy *et al* (2000)** on Totapuri mango who suggested that, N application significantly influenced the tree growth and fruit yield of young Totapuri trees while P and K application did not.

B- Tree yield and fruit quality

Data in Table (4) reveals the effect of nitrogen and potassium fertilizers on yield and fruit quality of Amrapali cv. mango trees. Concerning the yield per tree expressed either as number or weight in Kg of fruits per each individual tree, no specific trend could be detected for the influence of various N-K treatments during both 2002 & 2003 seasons. Whereas, the 4th N-K treatment (1N:2K) was the superior in 1st season but the reveres was true in 2nd one, regardless of yield was estimated either as number or weight (Kg) of fruit per tree. Moreover, the inferiority of control was so obvious and significant in the 1st season i.e. less than one fourth or one half with comparing to the analogous ones of the other investigated treatments for the yield as number and weight (kg) of fruit, respectively. During the second season (2003) the depressive effect of control on yield per fruit was too slight to reach level of significance with comparing to other investigated treatments except 2nd one (2N:1K). Such trend may reflect the beneficial cumulative effect of organic manure resulted by its annual successive application.

Table 3. Effect of nitrogen and potassium fertilizers on Amrapali mango leaf macro and micro-nutrients content in 2002and 2003 seasons

Treatments	Macro-nutrients %					Micro-nutrients ppm		
	N	P	K	Ca	Mg	Zn	Fe	Mn
First season 2002								
Control	1.30a	0.17a	0.67a	1.61a	0.82a	9a	34.7a	21.0a
2N:1K	1.28a	0.18a	0.80a	1.23a	0.82a	4a	34.3a	11.0ab
1N:1K	1.51a	0.25a	1.15a	1.07a	0.80a	4a	21.3a	5.70b
1N:2K	1.33a	0.20a	0.87a	1.23a	0.77a	7a	26.0a	7.00b
Second season 2003								
Control	1.27b	0.16b	0.88ab	0.810a	0.81a	8a	30b	8.0ab
2N:1K	1.40a	0.19a	0.80b	0.82a	0.82a	8a	64a	5.7b
1N:1K	1.10c	0.16b	0.95ab	0.77a	0.77a	8a	43ab	8.3a
1N:2K	1.25b	0.19a	1.07a	0.80a	0.80a	11a	16b	6.3ab
Optimum level	1.88	0.15	0.95	2.44	0.32	7.71-18.3	657-961	13-408

Control : organic fertilizer only 1N : 500g N/tree / year 1K : 400g K2O /tree / year
Values having the same letters within the same column are not statically different at 5% level .
Optimum level according to **Raghupathi and Bhragava (1999)** and **Kumar and Nauiyal (1977).**

In spite of the trend of response during one season didn't completely coincide with that of other season, it could be safely concluded as an average of two seasons was concerned that the 2nd treatment (2N:1K) was the most effective, while the reverse was true with the 3rd treatment (1N:1K).

Regarding the response of fruit physical properties: of Amrapali mango cv. (average fruit weight and dimensions – length width & thickness) to different N-K treatments, data obtained during both 2002 & 2003 seasons are presented in Table (4). It is quite evident that heaviest fruit weight was related to (2N:1K) and control fertilized trees during 1st (2002) and 2nd (2003) seasons, respectively. However as an average of two seasons was concerned control was the superior which showed the heaviest fruit weight (190g) descending followed by (2N:1K); (1N:2K) and (1N:1K) treatments which exhibited fruits with an average weight of 162; 148 and 137 g per each respectively.

Table 4. Effect of nitrogen and potassium fertilizers on Amrapali mango tree yield and fruit quality in 2002and 2003 seasons

Treatments	Yield						Fruit weight (g)		
	Fruit N0/tree			Kg/tree					
	1st	2nd	Mean	1st	2nd	Mean	1st	2nd	Mean
Control	41c	117bc	79b	4.47d	31.35b	18b	108b	271a	190a
2N:1K	94b	304a	62c	11.65b	58.68a	36a	129a	194b	162b
1N:1K	91b	124b	52d	7.540c	25.16c	16b	84c	190b	137c
1N:2K	194a	108c	151a	19.10a	20.86c	15b	100b	196b	148c

Treatments	Fruit dimensions					
	Length (cm)		Width (cm)		Thickness (cm)	
	1st	2nd	1st	2nd	1st	2nd
Control	7.6a	9.7a	5.1bc	6.8a	4.8b	6.5a
2N:1K	7.8a	8.6ab	5.6a	6.6a	5.3a	6.2ab
1N:1K	7.1b	8.1ab	4.8c	6.1b	4.5b	6.3ab
1N:2K	7.7a	6.6b	5.3b	6.1b	4.8b	5.8b

Treatments	Fruit chemical properties					
	TSS %		Acidity %		Ascorbic acid mg / 100 g F.wt.	
	1st	2nd	1st	1st	2nd	1st
Control	13.9a	19.0ab	0.21d	0.22b	64c	66b
2N:1K	9.0c	17.0b	0.71b	0.16c	42d	45c
1N:1K	8.9b	20.0a	0.75a	0.17c	82b	66b
1N:2K	8.9c	20.0a	0.33c	0.88a	97a	88a

Control : organic fertilizer only 1N : 500g N/tree/ year 1K : 400g K2O/tree/year
Values having the same letters within the same column are not statically different at 5% level .

Nevertheless, 3 fruit dimensions (length, width and thickness) of Amrapali mango cv., followed approximately the same trend previously detected with average fruit weight. Herein, the greatest values of average fruit length width and thickness were markedly coupled with the (2N:1K) and organic manure treated trees during both 2002 & 2003 seasons, respectively. However the average was found with the third treatment (1N:1K) fertilization treatment especially in 1st season; whereas the decreases were more pronounced.

As for the fruit chemical properties: of Amrapali mango cv. In response to N-K treatments, Table (4) shows that (2N:1K) treatment resulted generally in the lowest fruit juice TSS %. Moreover, control (chicken manure only) increased TSS % during both seasons, while both (1N:1K) and (1N:2K) treatments resulted in the highest TSS % during 2003 season.

Meanwhile, the fruit juice total acidity% of Amrapali mango cv. in response to N-K treatments didn't follow firm trend during both seasons, except with control whereas fruit acidity during both seasons was to great extent stable from one hand with intermediate value as compared those of other treatments from the other side. On the contrary 3 other treatments i.e. (2N:1K), (1N:1K) and (1N:2K) each showed the highest level in a given season. Herein, the two former treatments (2N:1K) and (1N:1K) induced fruits had significantly the highest acidity % in 1st season but the lowest in 2nd one while with the later treatment (1N:2K) the trend took other way around (lower acidity in 1st season and significantly highest acidity in 2nd one).

Referring the fruit juice vitamin C (ascorbic acid) content, Table (4) shows that the level was significantly increased with raising the K:N ratio. Hence, (1N:2K) treatment was the superior followed by (2N:1K) treatment was inferior. Such trend was to great extent stable during both 2002 & 2003 seasons.

The obtained results revealed that productivity of Amrpali mango trees was obtained increased by raising the N:K ratio, whereas the (2N:2K) treatment exhibited statistically the highest yield/ tree followed by control. Meanwhile fruit chemical and physical properties were clearly improved by control and raising the K:N ratio to the greatest rate (1N:2K), respectively. These results are in harmony with those of **Satapathy and Banik (2002).**

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مجلة حوليات العلوم الزراعية ، كلية الزراعة ، جامعة عين شمس ، القاهرة ، م٥٠ ، ع(٢)، ٥٦٣-٥٧٢ ، ٢٠٠٥

دراسات أولية على تسميد أشجار المانجو تحت ظروف الإمارات العربية المتحدة

٢- استجابة أشجار المانجو أمربالي للتسميد النيتروجيني والبوتاسي

[٣٨]

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أجريت هذه الدراسة لمعرفة مدى استجابة أشجار المانجو أمربالي لمعاملات التسميد النيتروجيني والبوتاسي خلال موسمين متتاليين (٢٠٠٢ - ٢٠٠٣) بالمزرعة الشرقية - محطة أبحاث الفاكهة - دبا - الفجيرة - دولة الإمارات العربية المتحدة . وذلك على أشجار عمرها ١٠ سنوات (٦٥ شجرة /دونم) . أجريت أربعة معاملات تسميد كما يلي : ١- مقارنة (تسميد عضوي فقط ٥٠٠جم ن /شجرة سنة) ٢ -١٠٠٠جم ن + ٤٠٠ جم بو١٢ (١:٢) /شجرة سنة ٣- ٥٠٠جم ن + ٤٠٠ جم بو١٢/شجرة سنة (١:١) ٤- ٥٠٠جم ن + ٨٠٠جم بو١٢/شجرة سنة (٢:١) . وقد أوضحت النتائج أن المعاملة الثانية (٢ن :١ بو١٢) أعطت المستويات المتوازنة من العناصر الغذائية الكبرى والصغرى بالأوراق وكذلك أفضل النتائج بالنسبة للمحصول بينما تحسنت خصائص الثمار الطبيعية والكيماوية بمعاملتي المقارنة و(١ ن: ٢بو) على التوالي .

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