Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(6): 1711-1713
Received: 12-09-2017
Accepted: 14-10-2017

Ommala D Kuchanwar
Soil Science and Agricultural Chemistry section, College of Agriculture, Nagpur, Amravati Road, Nagpur, M.S, India

NH Bhujade
Soil Science and Agricultural Chemistry section, College of Agriculture, Nagpur, Amravati Road, Nagpur, M.S, India

Neha K Chopde
Soil Science and Agricultural Chemistry section, College of Agriculture, Nagpur, Amravati Road, Nagpur, M.S, India

Bhagyashree S Patil
Soil Science and Agricultural Chemistry section, College of Agriculture, Nagpur, Amravati Road, Nagpur, M.S, India

Correspondence
Ommala D Kuchanwar
Soil Science and Agricultural Chemistry section, College of Agriculture, Nagpur, Amravati Road, Nagpur, M.S, India

Effect of fertigation on leaf nutrient content and fruit quality of high density plantation of Nagpur mandarin

Ommala D Kuchanwar, NH Bhujade, Neha K Chopde and Bhagyashree S Patil

Abstract
The present investigation was carried out to study the effect of fertigation on leaf nutrient status and fruit quality of high density plantation of Nagpur mandarin. A field experiment was carried out at Centre of Excellence for Citrus (CEC) Bharatnagar, Horticulture farm, College of Agriculture, Nagpur, Maharashtra on 6 year old Nagpur Mandarin having spacing 6 x 3 m. The treatments comprised of soil application of NPK fertilizers and five fertigation treatments i.e. 160, 140, 120, 100 and 80 per cent of the recommended dose of NPK fertilizers (1200:400:600 g NPK plant^{-1}). The leaf nutrient content increased with increase in levels of NPK and highest content of N (2.63 %) and P (0.18 %) were recorded for 160 % of RDF through fertigation. The fruit quality parameters such as juice content (52.32 %), TSS (11.06º Brix) and acidity (0.81%) were recorded under 120 % of RDF through fertigation.

Keywords: Fertigation, Nagpur mandarin, Nutrients, TSS, Ascorbic acid

Introduction
Citrus is often regarded as a queen of all fruits. It is one of the important subtropical fruit crops and is the largest grown fruit in the world, originates from the wet tropics in Southeast Asia. It is the third largest fruit crop grown next to banana and mango in India. In India it is cultivated on 329900 ha i.e. 3.9% of the total area under fruit crops with annual production of 3431400 MT. In India the average productivity of mandarin is 10.4 t ha^{-1}. (National Horticulture Board 2015) [7]. Citrus is cultivated between 40ºN and 40ºS, up to 1800 m altitude in the tropics and up to 750 m altitude in the subtropics.
Advanced Fertigation (AF) is a fertigation management system has been developed over the last two decades to increase yield and quality of many permanent horticultural crops. Fertigation can be defined as the application of fertilizers dissolved in irrigation water and allows water and nutrients to be placed in the zone of greatest root activity, allowing rapid utilization by plants. The overall aim of AF is to develop an irrigation and nutrition management program that increases yield and fruit quality, where the fundamental principle is that nutrients are applied regularly to a smaller volume of soil at a low application rate and at a high frequency to meet crop demand.

Materials and Methods
About 50 leaves from non-fruiting terminals were randomly collected from all the side of plants (Srivastava *et. al.*, 1994) [12]. Nitrogen content in leaves was determined as described by Piper (1966) [9], while Phosphorus and Potassium contents as described by Jackson (1967) [4]. Zn, Fe, Cu and Mn content were determined by using atomic absorption spectrophotometer method given by Issac and Kerber (1971) [3].
The fruits were washed thoroughly and wiped out with tissue paper. Weight of fruit was taken, and thickness of peel (cm) was measured. Volume and the juice extracted from the fruit was measured. The acidity of juice was determined by titrimetric method (Ranganna, 2001) [10]. The total soluble solids (TSS) of fruit were determined by using digital refractometer by Lacey (2009) [6]. Ascorbic acid was determined by the Spectrometric method by Lacey (2009) [6].

Results and Discussion
Leaf nutrient status
The data pertaining in table 1 revealed that, different fertigation treatment had significant and non-significant effect on leaf nutrient status of Nagpur mandarin.

Nitrogen
The observations recorded on total leaf nitrogen content revealed that, there was very small difference in leaf N content among all the treatments. However treatment T_2- Fertigation with 160 % of RDF (2.63 %) showed highest total leaf N content which was at par with treatment T_3- Fertigation with 140 % of RDF (2.61 %) during fruit development stage (after 6 months of fertigation) followed by treatmentT_4- Fertigation with 120 % of RDF (2.58 %),T_5- Fertigation with 100 % of RDF (2.56 %) and T_6- Fertigation with 80 % of RDF (2.54 g kg^{-1}) but T_2 was significantly superior over treatment T_1- soil application with RDF. The higher leaf N under optimal fertilizer level was also observed earlier in Nagpur mandarin (Panigrahi and Srivastava, 2011) [8].

Phosphorus
From the data obtained after leaf testing, the fertigation treatment T_2- Fertigation with 160 % of RDF (0.18 %) had recorded significantly the higher leaf P content which was significantly superior over all other treatments. Except it is at par with treatments T_3- Fertigation with 140 % of RDF (0.17 %), TreatmentT_4- Fertigation with 120 % of RDF (0.15 %), T_5- Fertigation with 100 % of RDF (0.15 %) and T_6- Fertigation with 100 % of RDF (0.14 %) showed very close values during fruit development stage (six months after the fertigation).
According to Kohli *et al.* (2000) [5] the range of optimum phosphorous concentration in mandarin oranges 0.12 - 0.16 % and thus the concentration of P in leaves of mandarin under fertigation appears to be below optimum to optimum during fruit development stage.

Potassium
From the data obtained after leaf testing, the treatment T_2 Fertigation with 160 % of RDF (1.82 %) had recorded significantly the higher leaf K content and treatment T_1 (Soil application with RDF) recorded lowest leaf K content (1.66 %).
Venkataramana *et al.* (2014) [13] conducted experiment on fertigation for sweet orange at Tirupathi and found that, the highest concentration of K (1.67%) observed in 100% recommended dose of N and K fertigation.

Copper
The highest copper concentration T_2 (6.11 mg kg^{-1}) at fruit development stage was observed with the treatment receiving T_2- Fertigation with 160 % of RDF through drip which was at par with T_1-Soil application with RDF (5.91 mg kg^{-1}) and all the other fertigation treatments.

Iron
The highest iron concentration T_2 (76.53 mg kg^{-1}) at fruit development stage was observed with the treatment receiving T_2- Fertigation with 160 % of RDF through drip which was at par with treatment T_3- Fertigation with 140 % of RDF (75.49), T_4- Fertigation with 120 % of RDF (74.29) and T_5- Fertigation with 100 % of RDF (72.91) but it was found superior over treatments T_6- Fertigation with 80 % of RDF and T_1- Soil application with RDF.

Manganese
The data regarding Mn concentration in leaf. The results revealed that the Mn concentration had shown non significant influence with nutrient application through drip and soil application during the year of experimentation. From this study, the value of Mn concentration ranged from 54.09 mg kg^{-1} to 58.46 mg kg^{-1}. Chahill *et al.* (1991) [1] suggested optimum value of leaf Mn as 62.0 ppm for citrus plant.

Zinc
The results revealed that, the Zn concentration in the leaf was significantly influenced by the fertigation levels and treatment T_2-Fertigation with 160 % of RDF (13.06 mg kg^{-1}) showed highest value. Zn concentration which was statistically at par with treatment T_4- Fertigation with 140 % of RDF (15.46 mg kg^{-1}) and all the other fertigation treatments and it was significantly superior overT_1 -Soil application with RDF (15.12 mg kg^{-1}).

Fruit quality
The data pertaining in table 2 revealed that, different fertigation treatment had significant and non-significant effect on fruit quality status of Nagpur mandarin

Fruit weight
The data furnished in table 2 had shown the significant influence of the micro-irrigation and fertigation treatments on the average weight of fruit individually. Average weight of fruit ranged from 125.97 to 138.15 g.
Data revealed that, among fertigation levels highest value of average weight of fruit was observed in treatment T_1- soil application with RDF (138.15 g) which was at par with treatment T_2- Fertigation with 160 % of RDF (136.16 g) and T_3- Fertigation with 140 % of RDF (135.15 g).
Higher fruit weight in soil application with RDF (T_1) treatment was primarily due to less number of fruits per plant in that treatment; with increased nutrient availability per fruit.

Fruit length
Data revealed that, fruit length was highest in treatment T_1- soil application with RDF (6.70 cm) which was significantly superior over all other treatments followed by treatmentT_2- fertigation with 160 % of RDF (6.35 cm), T_3- fertigation with 140% of RDF (6.33 cm) and T_4-fertigation with 120 % of RDF (6.26 cm).
The data pertaining to physical parameters of Nagpur mandarin fruits are presented in table 2. The fruit weight ranged from 125.97 to 138.15 g. The fruit length ranged from 5.68 to 6.70 cm, while fruit diameter is 5.96 to 6.83 cm. The juice content varied from 46.16 to 52.32 per cent while the acidity varied from 0.81 to 0.84 per cent similar observations were recorded by Desai *et al.* (1986) [2]. The total soluble solids in fruit juice ranged from 9.31 to 11.06 °Brix the similar observation recorded by Shirgure and Shrivastava (2013) [11]. The ascorbic acid content in fruit juice ranged from 35.67 to 35.80 mg/100 ml.

Fruit diameter
It was seen from the data that, fruit diameter was highest in treatment T_1-soil application with RDF (6.83 cm) which was significantly superior over all other treatments followed by treatmentT_2- fertigation with 160 % of RDF (6.47 cm), T_3- fertigation with 140% of RDF (6.43 cm) and T_4-fertigation with 120 % of RDF (6.23 cm).

Juice content
From the observed data it was revealed that, treatment T_4- fertigation with 120 % of RDF (52.32 %) showed significantly superior juice content per cent over all the other treatments followed by treatments T_2-fertigation with 160 %

of RDF (49.65 %), T_3-fertigation with 140 % of RDF (49.55 %) and T_5-fertigation with 100 % of RDF (48.61 %) which were at par. Treatment T_1- soil application with RDF (46.16 %) showed lowest juice content.

Total Soluble Solids (TSS) (°Brix)

The highest TSS was recorded in treatment T_4-fertigation with 120 % of RDF (11.06°Brix) which was significantly superior over all other treatments followed by treatments T_3-fertigation with 140 % of RDF (10.76°Brix) and T_2-fertigation with 160 % of RDF (10.64°Brix) which were at par with each other.

Acidity (%)

Data pertaining to acidity as influenced due to the fertigation levels is presented in table 2. The results revealed that, the fertigation levels had not influenced acidity of fruit during experimentation.

It was seen from the observations that, acidity value ranged from 0.81-0.84 %.

It was found that, treatment T_4- Fertigation with 120 % of RDF (0.81 %) showed lowest acidity value followed by treatment T_2-Fertigation with 160 % of RDF (0.82 %) and T_3-Fertigation with 140 % of RDF (0.82 %).

Ascorbic Acid (mg/100 ml)

The data in table11 indicate that, fertigation treatments had non-significant influence on the Ascorbic acid. It was seen from the observations that Ascorbic acid value ranged from35.67 to35.80 mg/100 ml.

The highest Ascorbic acid was recorded in treatment T_2-fertigation with 160 % of RDF (35.80 mg/100 ml) and lowest Ascorbic acid was found in treatment T_6-fertigation with 80 % of RDF (35.67 mg/100 ml).

Table 1: Leaf nutrient status of Nagpur mandarin.

Treatments	N	P	K	Cu	Fe	Mn	Zn
	(%)			ppm			
T_1- Soil application with RDF	2.51	0.13	1.66	5.91	69.88	55.43	15.12
T_2- Fertigation with 160% of RDF	2.63	0.18	1.82	6.11	76.53	58.46	15.59
T_3- Fertigation with 140% of RDF	2.61	0.17	1.76	6.04	75.49	57.27	15.46
T_4- Fertigation with 120% of RDF	2.58	0.15	1.73	6.03	74.29	56.42	15.46
T_5- Fertigation with 100% of RDF	2.56	0.15	1.70	5.97	72.91	55.16	15.39
T_6- Fertigation with 80% of RDF	2.54	0.13	1.68	5.92	71.22	54.09	15.35
F test	Sig.	Sig.	Sig.	Sig.	Sig.	N.S.	Sig.
SE (m) ±	0.04	0.01	0.02	0.08	1.44	1.30	0.09
CD at 5%	0.11	0.02	0.05	0.24	3.93	-	0.27

Table 2: Physical and chemical parameters of Nagpur mandarin fruit.

Treatments	Weight of fruit (g)	Fruit length (cm)	Fruit diameter (cm)	Juice content (%)	TSS (°Brix)	Acidity (%)	Ascorbic acid (mg/100 ml)
T_1- Soil application with RDF	138.15	6.70	6.83	46.16	9.31	0.84	35.70
T_2- Fertigation with 160% of RDF	136.16	6.35	6.47	49.65	10.64	0.82	35.80
T_3- Fertigation with 140% of RDF	135.15	6.33	6.43	49.55	10.76	0.82	35.78
T_4- Fertigation with 120% of RDF	133.42	6.26	6.23	52.32	11.06	0.81	35.79
T_5- Fertigation with 100% of RDF	128.32	5.84	6.07	48.61	10.22	0.84	35.75
T_6- Fertigation with 80% of RDF	125.97	5.68	5.96	47.12	10.08	0.83	35.67
F test	Sig.	Sig.	Sig.	Sig.	Sig.	N.S.	N.S.
SE (m) ±	1.16	0.05	0.03	0.49	0.07	0.05	0.10
CD at 5%	3.49	0.16	0.09	1.49	0.24	-	-

References

1. Chahill BS, Dhatt AS, Ranbir S, Dhillon DS. Study of leaf nutrient standard in Kinnow. Indian J. Hort. 1991; 48:315-320.
2. Desai VT, Choudhari KG, Choudhari SM. Studies on the nutritional requirement of sweet orange J. Maharashtra Agric. Univ. 1986; 11(2):145-147.
3. Issac RA, Kerber JD. In Instrumental method for analysis of soil and plant tissue (Waise, L. M. Eds), Soil Sci. Soc. Am. Madison Wisconism, USA, 1971.
4. Jackson ML. Soil chemical analysis prentice hall of India, Private Limited. New Delhi, 1967.
5. Kohli RR. Srivastava A. K. Hucche A. D. Leaf nutrients limits for optimum yield of Nagpur mandarin. Indian J. of Agri. Sciences. 2000; 70(5):328-330.
6. Lacey WJ. Measuring maturity of citrus. 2009. ISSN 0726-934X 1-4.
7. NHB. Data base, National Horticulture Board, ICAR. New Delhi, 2015.
8. Panigrahi P. Srivastava AK. Deficit irrigation (DI) scheduling for matured Nagpur mandarin (*Citrus reticulate* Blanco) trees of central India. Ind. J. Soil Cons. 2011; 39(2):149-154.
9. Piper CS. Soil and Plant analysis Adelaide, Australia, 1966.
10. Ranganna R. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2nd edition, Tata Mcgraw Hill. 2001, 860.
11. Shirgure PS, Srivastava AK. Nutrient-water interaction in citrus: recent developments. Agricultural Advances. 2013; 2(8):224-236.
12. Srivastava AK, Kohli RR, Huchche AD, Dass HC. Nutrient management studies in Nagpur mandarin and acid lime. Annual Rep. National Research Centre for Citrus, Nagpur, Maharashtra, India, 1994.
13. Venkataramana KT, Mukanda laxmi L, Gopal K, Shivarama krishna VNP, Nagalakshmi T, Gouri Sankar T. Nitrogen and potassium based fertigation response on plant growth, yield and quality of sweet orange (*Citrus sinensis* linn. osbeck) cv. Sathgudi. Research and Reviews: Journal of Agriculture and Allied Sciences. E-ISSSN: 2319-9857.