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ANALYSIS OF FRUIT QUALITY OF KINNOW MANDARIN HYBRID IN ARID IRRIGATED AREAS OF RAJASTHAN

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ABSTRACT: The present study on physico-chemical characteristics of Kinnow fruit in Bikaner district at the farmer's field during 2010 revealed that peel percentage, juice recovery percentage and ascorbic acid content, total soluble solids were acceptable, whereas other quality attributes needed to be improved by regulating orchard management practices such as recommended doses of manures and fertilizers as well as foliar application of micronutrients etc. The bearing Kinnow trees of 10 years age are required to be fertilized by application of Single Super Phosphate (1.5 kg/tree), Muriate of Potash (350 g/tree) and Zinc sulphate (500 g /tree) in the month of January to the soil and by application of 50-60 kg well rotten FYM per tree.

Keywords : *Kinnow Mandarin, fruit length, peel thickness. TSS/Acidity ratio*

Kinnow (*Citrus nobilis* × *Citrus deliciosa*) is a highly preferred mandarin hybrid in North India. It is very juicy and highly prized for its nutritional value. Kinnow cultivation is becoming very popular among farmers of Bikaner district in Indira Gandhi canal command area of Khajuwala, Chattargarh and many orchards have come up in those areas giving an average yield of 256 q/ha. Bikaner district has approximately 2.81 lac hectare canal irrigated area which has great potential for expanding area under Kinnow cultivation. It is also being grown in the areas irrigated by tube wells of good quality water. Survey was undertaken at the orchards of private fruit growers in Bikaner district during 2010 for assessing fruit quality of Kinnow.

MATERIALS AND METHODS

Studies were conducted on 10 year old healthy and vigorously growing uniform trees of Kinnow mandarin budded on Jatti Khatti (*C. jambheri*) rootstock during the year 2010 at orchards of private fruit growers in Bikaner district of Rajasthan state. The fruit samples were collected during ripening time in the month of December. Four orchards were selected for the study and details of locations of the orchards along with name of owners are given in Table 1.

The soil fertility status of Kinnow orchards surveyed are given in Table 2.

At locations Khajuwala 1 and Khajuwala 2, the Kinnow trees received recommended doses of farmyard manure and half of the recommended doses of inorganic fertilizers whereas at Nokha 1 and Chattargarh 1, the Kinnow trees received half of the recommended doses of farmyard manure and 1/4th of the recommended doses of inorganic fertilizers. At none of the locations, foliar applications of micronutrients were made. Plant protection measures were appropriately adopted at all the locations. The source of irrigation was canal water at locations Chattargarh1, Khajuwala 1 and Khajuwala 2 which had pH 8.1, EC 1.06 dSm^{-1}, Na+ 7.40 Meq/litre, Ca++ + Mg++ 5.0 Meq/litre and Cl^{-1} 17.50 Meq/litre whereas at Nokha Kinnow orchard received irrigation through tube well which had pH 8.19, EC 0.86 dS m^{-1}, Na+ 6.04 Meq/litre, Ca++ + Mg++ 2.50 Meq/litre and Cl^{-1} Meq/litre (Bhatnagar, 4).

Table 1 : Location of orchards selected.

S. No.	Name of fruit growers	Village/Chak	Location
1.	Rajasthan Go Sewa Sangh	Chattargarh	Chattargarh 1
2.	Sh. Narendra Kiradoo	22KYD, Khajuwala	Khajuwala 1
3.	Sh. Shiv Pratap Verma	14 BD, Khajuwala	Khajuwala 2
4.	Sh. Hanuman Panchariya	Nokha	Nokha 1

For recording observations, 4 fresh fruits were randomly plucked from each experimental tree from all four directions and at each orchard; five trees were randomly selected for assessing the physico-chemical characteristics of fruits. Observations were recorded for fruit weight, fruit length, breadth, circumference, weight of juice vesicles, peel thickness, total number of seeds, segment number, segment size, seed percentage, peel percentage, rag percentage, total soluble solids, total titratable acidity of juice, ascorbic

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acid, total sugars and reducing sugars. The per cent was determined by titrating the juice against N/10 NaOH using phenolphthalein as an indicator and has been expressed in terms of citric acid. The total titratable acidity was determined by titration method (A.O.A.C. 1). Total sugar content was determined by using Anthrone reagent method (Dubois *et al.,* 6) and reducing sugar content was measured by Nelsons Modification of 'Somogyis Method' (Somogyi, 17).

Table 1 : Soil fertility status of Kinnow orchards.

Locations/Soil Properties	Khajuwala 1	Khajuwala2	Nokha 1	Chattargarh 1
Soil pH(1:2)	8.20	8.24	8.56	8.59
EC (1:2) dSm^{-1}	0.17	0.13	0.38	0.24
O.C.(%)	0.36	0.33	0.31	0.17
Available N (mg kg^{-1})	74.40	49.77	46.84	39.29
Available P (mg kg^{-1})	24.71	21.13	27.60	8.56
Available K (mg kg^{-1})	120.32	115.20	109.59	90.20
Available S (mg kg^{-1})	28.65	35.36	14.63	32.14

RESULTS AND DISCUSSION

The data on physicochemical characteristics of Kinnow fruit are presented in Table 3. The fruit weight of kinnow varied significantly from each other in different orchards due to variations in soil fertility status as mentioned in Table 1.Fruit weight varied from minimum (146.88g) at the orchard of Khajuwala 1 to maximum (171.47g) at the orchard of Nokha 1. Average weight of kinnow fruits was recorded between 112.82g to 170.80 g at Faisalabad, Pakistan by Ahmad *et al.* (2) which is almost similar to the results of present investigations. The size of the kinnow fruits varied significantly in different orchards. The fruit length ranged from 5.38 cm (at the orchards of Khajuwala 2) to 7.36 cm (at the orchard of Nokha 1). Fruit length of kinnow was reported from 6.43 cm to 7.90 cm by Ahmad *et al.* (2) which is almost similar to the present findings. A diameter of 65.68 mm in kinnow fruits has

Table 3: Physico-chemical characteristics of Kinnow fruit.

Locations/Characters	Chattargarh 1	Khajuwala 2	Khajuwala 1	Nokha1	Pooled S.E.(±)	Pooled C.V (%)
Fruit weight (g)	163.87	147.08	146.88	171.47	5.18	17.66
Length (cm)	5.80	5.38	5.45	7.36	0.14	13.37
Breadth (cm)	6.44	6.58	6.72	6.74	0.12	9.84
Circumference (cm)	20.85	24.29	22.65	24.31	1.55	42.43
Juice vesicles wt./fruit	116.73	111.88	116.06	131.09	3.80	17.19
Juice (ml)	67.50	72.87	75.25	81.00	2.02	14.61
Peel thickness (cm)	0.37	0.33	0.32	0.43	0.09	13.78
Total seeds (Nos)	40.75	35.50	25.25	43.13	1.53	23.11
Segment (Nos)	12.62	11.12	10.50	11.95	0.23	10.67
Seed (%)	2.22	1.85	1.56	2.27	0.07	21.45
Pee l(%)	23.38	19.28	17.16	24.26	0.69	17.96
Rags (%)	1.40	1.56	1.19	1.71	0.07	26.43
Segment (%)	71.52	76.22	79.32	76.47	1.01	7.11
Juice recovery (%)	41.11	49.60	51.39	47.97	0.94	10.50
TSS (^{o}Brix)	10.11	10.07	9.56	10.17	0.15	8.32
Total acidity (%)	1.20	1.44	1.39	0.62	0.06	25.64
TSS/Acidity ratio	8.42	6.99	6.87	16.40	0.74	44.65
Ascorbic Acid (mg/100 ml juice)	29.10	27.95	27.88	27.00	0.45	8.55
Total sugars (%)	8.18	8.12	8.15	8.50	0.05	3.30
Reducing sugars (%)	4.78	3.97	4.02	5.40	10.13	16.29

also been reported by Sayyad *et al.* (16). The fruit breadth varied from 6.44 cm (at the orchard of Chattargarh1) to 6.74 cm (at the orchard of Nokha 1) which are in agreement with reports of Monga *et al.* (11) and Sandhu and Randhawa (15). Fruit circumference of the Kinnow fruit varied from minimum (20.85 cm) at the orchard of Chattargarh 1 to maximum (24.31 cm) at the orchard of Nokha 1. the highest juice vesicles weight per fruit (131.09g) was recorded in the fruits of Nokha 1, whereas lowest weight of juice vesicles per fruit (111.88g) was recorded in the fruits of Khajuwala 2.

Peel thickness varied from 0.32 cm (at the orchard of Khajuwala 1) to 0.43 cm (at the orchard of Nokha1). Seed percentage in Kinnow fruits varied from 1.56 per cent (at the orchard of Khajuwala 1) to 2.27 per cent (at the orchard of Nokha 1).

Peel percentage varied from 17.16 per cent (at the orchard of Khajuwala 1) to 24.26 per cent (at the orchard of Nokha 1). Peel percentage of Kinnow fruits was also reported between 27.10 to 31.24 per cent by Sandhu and Randhawa (15) and 26.6 to 29.7 per cent by Josan *et al.* (9) at Punjab. Less peel percentage obtained under present investigation suggests better fruit quality on the basis of it as reported by Davies and Albrigo (5).

The juice recovery percentage of Kinnow fruits ranged from 41.11 per cent (at the orchard of Chattargarh 1) to 51.39 per cent (at the orchard of Khajuwala 1) which are in close confirmity with Ahmad *et al.* (3) who reported 46.3% juice recovery in Kinnow fruits. Total number of seeds varied from 25.25 (at the orchard of Khajuwala 1) to 43.12 (at the orchard of Nokha 1). Likewise, Ahmad *et al.* (3) also reported that total number of seeds in Kinnow fruits varied from 26.12 to 29.12 which are in conformity to the results of present findings.

The total soluble solids content in Kinnow fruits varied from 9.56° brix (at the orchard of Khajuwala 1) to 10.17° brix (at the orchard of Nokha 1). Average total soluble solids content in Kinnow (11.86° brix) was also reported by Khan *et al.* (10) under semi arid plains. The lower amount of total soluble solids in arid irrigated plains of Rajasthan might be due to higher temperature at the time of fruit ripening thus facilitating early maturity of fruits.

The total titratable acidity percentage varied from 0.62 per cent (at the orchard of Nokha 1) to 1.44 per cent (at the orchard of Khajuwala 2). It has been reported from 0.8 to 1.7 per cent by Sandhu and Randhawa (15); 0.83 to 1.21 per cent by Josan et al. (9) and 0.91 to 1.27 per cent by Dhillon *et al.* (7) in Punjab which are in close agreement to the results of present findings.

The TSS/Acidity ratio varied from 6.87:1 (at the orchard of Khajuwala 1) to 16.40:1 (at the orchard of Nokha1). , TSS/Acidity ratio of 12:1 to 14:1 Jawanda *et al.* (8) is considered to be optimum for Kinnow fruits at the time of full maturity under semi arid conditions, whereas varied TSS/Acidity ratio of 11:1 Mehta and Bajaj (11); 11.01:1 (Monga *et al.,* (12); 8.41:1 to 10.61:1 (Sandhu and Randhawa, (15); and 8.7:1 to 14.5:1 by Josan *et al.* (9) are also in close accordance with the findings of present investigations.

Ascorbic acid content ranged from 27.00 mg/100 ml juice (at the orchard of Nokha1) to 29.10 mg/100 ml juice (at the orchard of Chhatargarh 1). Differences in ascorbic acid content in Kinnow fruits as 24.5 mg/100 ml (Mehta and Bajaj, 11); 22.90 to 27.60 mg/100 ml. Sandhu and Randhawa (15); 23.6 to 30.4 mg/100 ml. (Dhillon *et al.,* 7) had also been reported.

The total sugar percentage varied from 8.12 per cent (at the orchard of Khajuwala 2) to 8.50 per cent (at the orchard of Nokha 1). Average total sugar percentage of Kinnow fruits from 4.8 to 5.6 per cent reported by Khan *et al.* (10) are in support of present findings. The reducing sugar percentage varied from 3.97 per cent (at Khajuwala 2) to 5.4 per cent (at Nokha1). Similarly, 3.20% and 4.90% reducing sugars in kinnow fruits had also been reported by Sandhu *et al.* (14) and Premi *et al.* (13), respectively which are in line of present results.

Conclusion

The present study harnesses the underestimated potential of Kinnow mandarin under arid irrigated tracts of Bikaner district and fruits of excellent quality can be produced with good quality canal water incorporated with sufficient quantities of organic matter coupled with inorganic fertilizers as well as foliar feeding of micronutrients to which the sandy soils response very quickly.

REFERENCES

1. A.O.A.C (1970). *Official Methods of Analysis*. Association of Official Agricultural Chemists. 10 th ed., Washington D.C.
2. Ahmad Din, Muhammad, A. Saima, P. and Muhammad, A. A. (2012) Evaluation of Kinnow mandarin as influenced by pre-harvest management practices. *J. Agric. Res.,* **50**(3), pp: 381-390.

3. Ahmad, S., Chatha, Z.A., Nasir, M. A., Aziz, A., Virk, N. A and Rehman, (2006). An effect of pruning on the yield and quality of Kinnow fruit. *J. Agri. Social Sci.,* **2** (1): 51-53.
4. Bhatnagar, P. (2000). Nutritional survey of orchards in Bikaner district of Rajasthan. *Ph.D Thesis,* Approved by Rajasthan Agricultural University, Bikaner, pp: 171.
5. Davies, F. S. and L. G. Albrigo, (1994). In : *Environmental constraints on growth, development and physiology of citrus.* Davies, F.S. and L.G. Albrigo (eds.), pp: 51–82. CAB Int. Wallingford, UK.
6. Dubois, M., Gillers, K., Hamilton, J.K., Robers, P.A. and Smith, F. (1951). A colorimetric method for determination of sugar. *Nature*, **16** : 167.
7. Dhillon, G.S., Dhatt, A.S. and Singh, S.N. (1994). Effect of plant growth regulators on physico-chemical characteristics of Kinnow. *Punjab Hort. J.,* **34**(3-4):14-19
8. Jawanda, J.S., Arora, J.S. and Sharma, J.N. (1973). Fruit quality and maturity studies of Kinnow mandarin at Abohar. Punjab Hort. J., **13**(1):3-12.
9. Josan, J.S., Monga, P.K. and Thatai, S.K. (1994). Influence of physiological maturity of the tree on phytochemistry of Kinnow fruits. Punjab Horti. J., **34**(1-2):22-26
10. Khan, A.S., Naseer, M., Malik, A.U., Basra, S.M.A, Khalid, M.S., Khalid, S., Amin, M, Saleem, B.A.,Rajwana, I.A. and Din M.U., (2011). Location, Soil and tree nutrient status influence the quality of 'Kinnow' Mandarin. *Int. J. Agric. Biol.,* **13**: 498–504..
11. Mehta, Urmil and Bajaj, Satinder (1984). Physico-chemical characteristics of Kinnow, Blood Red and Villa franca. *Punjab Hort. J.,* **23**(3-4):171-174.
12. Monga, P.K., Singh, H., Thatai, S.K. and Kumar, H. (1992). Effect of shade by wind break and direction of tree on fruit quality in Kinnow mandarin. I*ndian J. Hort.,* **49**(4): 321-325.
13. Premi, B.B., Lal, B.B., Kaushal and Joshi, V.K. (1996). Extracting Kinnow juice for making squash. *Indian Horticulture,* **41** (1) : 33-34. April-June
14. Sandhu, K.S., Bhatia, B.S. and Shukla, P.C. (1990). Effect of lye treatment on quality of Kinnow mandarin fruit. *Indian J. Hort.,* **47**(1): 55-59.
15. Sandhu, S.S. and Randhawa, J.S. (1994). Physico-chemical status of graded Kinnow fruits. *Punjab Hort. J.,* **34**(1-2):10-15.
16. Sayyad, F. G., Chinchorkar, S.S., Patel, S.K. and Yaduvanshi, B.K. (2013). Some physical and frictional properties of Phule Mosambi and Kinnow. *HortFlora Res. Spectrum,* **2**(2) : 158-161.
17. Somogyi, M. (1952). Notes on sugar estimation. *J. Biol. Chem,* **200** : 245.

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