



RESEARCH ARTICLE

STUDIES ON QUALITY, GRADING, WAXING, PACKAGING AND MARKETING OF KINNOW (*CITRUS NOBILIS* × *CITRUS DELICIOSA*)

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ABSTRACT

Kinnow fruit grown in Punjab and is having maximum area of orchard in Punjab therefore it becomes necessary to study the impact of different maturity or harvesting stages on fruit quality and its marketing. Keeping this view studies were conducted at four different stages of fruit harvesting viz., 1st – 15th January, 16th – 31st January, 1st – 15th February, 16th – 28th February. The month of February is best for fruit quality and for fruit processing also. For better fruit marketing farmers are advised to regularly keep a check on farmer's portal of Punjab government which provides rates of all the markets in Punjab.

INTRODUCTION

Kinnow (*Citrus reticulata* Blanco), belong to family Rutaceae. Kinnow, a hybrid mandarin was developed by Dr. H.B. Frost by crossing King (*Citrus nobilis*) and Willow leaf (*Citrus deliciosa*) mandarin in the year 1915. Kinnow was first introduced for commercial cultivation in 1935. The Kinnow was introduced in North India 1947. Kinnow is a sub-tropical fruit and it is one of the most famous fruits grown all over the world. It is a commercially vital fruit crop of India and grown across with a production of 111.47 thousand MT from an area of 1077.7 thousand hectares (Saxena and Gandhi, 2015) which accounts 12.5% of the total fruit production. The Citrus plantation is confined within 40° North-South latitudes. The citrus fruits comprised of mandarins, sweet oranges, lime and lemons are the major economic significance in India. Kinnow ranks first with respect to area and production, followed by sweet orange, limes and lemons. In Punjab, the area under Kinnow cultivation was 500 hectare in 1970 which increased to 52840 hectares with annual production of 1168570 tonnes (Anonymous 2020). In hot climate, plants can grow up to 35 feet high. Kinnow tree is highly productive and produce 2000 fruits per tree. It peels easily and has high juice content. Kinnow is commercial grown in the arid irrigated and sub mountains zone of Punjab i.e. Ferozepur, Faridkot, Muktsar, Bathinda, Mansa, Hoshiarpur, Ropar and Gurdaspur.

The present investigations were undertaken with the following objectives:

- To study the effect of waxing and grading on the marketing of Kinnow in Punjab market.
- To evaluate the profit and loss account after grading and waxing of Kinnow marketing in Punjab.

REVIEW OF LITERATURE

The present investigations entitled “Studies on quality, Grading, Waxing, Packaging and Marketing of Kinnow (*Citrus nobilis* × *Citrus deliciosa*)” were carried out in the orchard of the Gopal fruits Rampura Narainpura (Abohar) Fazilka during the years 2021-2022. The relevant literature is reviewed under the following heads and subheads.

Harvest and post-harvest practices

Harvesting: Studies carried out by Jawanda *et al.*, (1973) on Kinnow revealed that physiochemical characteristics of fruits located in the outer periphery and inside differed greatly. Outer fruits contained a higher amount of acidity, TSS, reducing sugar and total sugars and ripened earlier than the inner fruits. As a maturity standard for Kinnow, TSS/acid ratio of 12:1 for outer fruits and 14:1 for inner fruits was suggested for best quality fruits and packing should be done from end January to first fortnight of February. Mazumber (1976) suggested that mid of December to early January and the first fortnight of November as the optimum time of harvest for Kinnow and

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Nagpur Santra respectively, under Allahabad conditions. Lemon fruits, grown in the foothills of Nagaland, should be harvested when fruits size, juice content, TSS, ascorbic acid and acid contents are at optimum level. In general, fruits of spring, rainy and winter flushes should be harvested at 135-150, 120-125 and 195-210 days after fruits set respectively (Sema and Sanyal 2003). Deka *et al.* (2006) conducted an experiment to minimize post-harvest losses by establishing standardization of maturity indices for harvest so that the shelf life of Kinnow fruits can be maximized. They concluded the best harvest time is 230-250 days after flowering. The fruit's external colour becomes orange from December to February. The best harvesting time in Punjab Northern India is mid-January to mid-February when the fruits attains a total soluble solid to acid ratio of 12.1 to 14.1 (Aulakh, 2008).

Grading: Studies carried out by Jawanda *et al.*, (1973) on Kinnow revealed that physicochemical characteristics of fruits located in the outer periphery and inside differed greatly. The overall quality of medium grades 6-8 cm was the best. Peleg and Ramraz (1975) reported main reasons for sizing fruits as the ability to market pattern packed, uniformly graded fruit to enhance "sales appeal" the ability to fill shipping containers by count, which is faster and cheaper than filling by weight and ability to mechanize pattern packing of fruit in shipping containers. In general, blemished fruit is removed and the desired grades are left on the line. It is common practice to grade fruits on a simple roller conveyor, although variously improved graders have been devised (Hunter *et al.*, 1958, Bowman *et al.*, 1975). Chandawat *et al.*, (1980) reported that the TSS of grade A (complete orange) Kinnow fruits was higher compared to grade B (yellow-green) and grade C (mature green) fruits. However, in all the grades, the TSS increased rapidly until the second week of storage.

Waxing: Rao and Bhaskara Rao (1959) reported that sweet orange fruits when treated with Indole butyric acid (IBA), 2, 4-D and 2, 4, 5-T along with wax emulsions, 2, 4-d treatment was found to extend the storage life of oranges which might be due to slower rate of development of yellow rind colour and due to retardation of water loss. Garg and Ram (1973) reported reduced losses in weight, respiration rate and wastage in Kagzi lime fruit with a subsequent increase in shelf life and marketability due to the application of 9 percent wax-emulsion. Bureau of Indian standards (1974) suggested that a known quantity of Citrashine may be filled in the buffer storage tank of the sprayer. The sprayer should be adjusted for the wax application rate of 1.5 kg per ton of fruits.

Physical parameters of fruit quality

Fruit Size and Weight: Ladaniya and Singh (1998) reported that the diameter, length and weight of Nagpur mandarin fruit decreased from October to December after 280 days of fruit set whereas optimum fruit growth attained merely 280 days after fruit set under Nagpur conditions. Weight, size and volume of fruit are directly related to the growth and development of fruits. The increase in weight and volume of the fruit followed more or less similar trend as the growth of the fruit. The rate of increase in weight and volume of the fruit was up to middle of October in Columbia lemon and up to late December in "Hill" lemon and thereafter it slowed down in both varieties (Soni and Randhawa, 1969), Kinnow fruits proved to be superior in having weight and large size of fruits were recorded in "Nagpur Santra" (Mazumbar, 1976 and

Bhullar, 1978) conducted an experiment on physicochemical characters of different Mandarin cultivars namely Butwal, Emperor, Kinnow, Nagpur, Srinagar and Sylhet and found that the fruits of "Kinnow" were medium in size, globose to oblate in shape and deep orange peel colour during ripening. Bhatnagar *et al.*, (2012) studied seasonal variation in physicochemical characteristics of Ambebahar and Meigbahar of "Nagpur" mandarin at Jhalawar district of Rajasthan and observed that during both the bahar fruit weight was increased. The blood red had the lowest weight where those of kinnow were the heaviest (Metha and Bajaj, 1984). However, the decrease in weight of kinnow mandarin at the later stage of ripening were also observed (Jawanda *et al.*, 1973). Singh *et al.*, (1998) revealed that the length, diameter, weight and volume of fruit continually increased with the advancement of fruit development whereas slow growth of these parameters was observed in the 3rd stage of development but fruit volume increased gradually up to the last date of fruit picking. Johnsan *et al.*, (1988) reported that low fruit diameter, length, breadth and weight in the beginning at the initial stage which increased subsequently in fruit dimension, weight and volume until maturity of Balady, a sweet orange were reported by Higazi *et al.*, (1982).

Peel Percent: The peel thickness of Valencia orange reached to a maximum early in stage-1 and 2nd i.e. the cell division and cell enlargement period and then become thinner with very little subsequent change in thickness of fruit rind with advancement of maturation were reported (Landaniya and Singh, 1998) in Nagpur mandarin, (Rao *et al.*, 1977) in Tahiti and Kagzi lime and (Goren and Monselise, 1965) in Shamuti orange. However, in mandarin (Jawanda *et al.*, 1973) recorded the highest peel thickness on January 1st and 31st from the inner and outer position, respectively. Further, the peel thickness curve of fruit showed characteristic peak at the beginning of July in grapefruit (Herzog and Monselise, 1968), Shamuti orange (Goren and Monselise, 1964) and other citrus fruit (Goren, 1965 and Kuraoka and Kikuki, 1961).

Juice Percent: Wutscher and Shull (1978) studied the performance of 29 mandarin hybrids in South Texas for pomological characters and recorded the higher juice percent in Florida juice ranges 48.5-63.0 while in California, it ranged 43.1-59.6 percent, respectively. Deshmukh *et al.*, (1999) noticed the effect of film wrapping and low temperature (6°C) on storage quality of sweet orange (cv. Mosambi) and reported that both the treatments were found effective over control treatment in lowering decrease in juice content during post-harvest life of fruits. Dhatt *et al.*, (1999) reported that the kinnow fruit at room temperature (11-23°C) after dipping in thiabendazole (500 ppm), imazalil (300, 500 and 1000 ppm) and 2, 4-D (250 and 500 ppm) and individually seal packed in 10 thick HDPE bags. They reported that percent juice recovery was observed almost at the same level in various treatments except in unwrapped fruit which maintained the lowest percentage after 30 days of storage. But, after 60 days inconsistent trend prevailed among the different treatments as regards to juice content. A study revealed that the juice percent increased with the advancement of maturity up to 280 days.

Biochemical characteristics of fruit quality

Total Soluble Solids: Total soluble solids and TSS/Acidity ratio are the reliable indices for assessing the maturity of citrus. The significant increase in total soluble solids with increased

duration of fruit retention have been observed and record the highest TSS in kinnow mandarin (Jawanda *et al.*, 1973 and Chopra and Joshi, 1971), sweet orange (Jawanda, 1961), Blood red, Villa franca orange and kinnow (Metha and Bajaj, 1984). However, Singh *et al.*, (1998) reported that the TSS of juice increased from 3.8 to 11 percent from fruit set till ripening in kinnow fruits but marked increase in TSS was noticed as 6.5 percent on 15th July and 8.4 percent on 14th November and then from 29th November to 8th February i.e. upto full stage. Dhillon *et al.*, (1977) packed kinnow fruits in perforated and non-perforated polythene bags and stored them in cold storage. They observed a significantly higher percentage of total soluble solids in untreated fruits and minimum TSS in fruits treated with wax and wax-h Benlate. They further observed that the fruits packed in perforated polythene bags showed more TSS than those packed in non-perforated ones. It has been observed that total soluble solids increased rapidly at first and then slower rate (Samson, 1986). The highest (12.5 percent) TSS was recorded in honey tangerine followed by Wilking, menola and overload (Choan *et al.*, 1966).

Marketing

Marketing and Economics: Shende (1970) observed that in Narkhed block of Nagpur district, one acre orange orchard gave an output of Rs.2,393.43 with an input of Rs. 1,259.49 per domestic market. Channel-III (producer – retailer – consumer) was the best channel for local marketing whereas the Channel-I (producer – pre-harvest contractor – wholesaler – retailers – consumer) was found to be the best channel from consumer's point of view. An improvement in the efficiency of the marketing system encompassing kinnow was suggested in the study. Pratibha Goyal *et al.*, (2012) it was found that the contractors take all type of produce at one rate irrespective of the quality of fruit as the post harvesting grading is not done by them while local retailers take good quality of produce and pay on the basis of grades of the produce. Thus, ultimately local retailers pay lesser price as compared to contractors. The contractors preferred to take the produce from medium size farmers as they got uniform quality and large quantity at one place. Large quantity made it economical for the contractor to carry the produce distant markets.

MATERIAL AND METHODS

The present investigations entitled "Studies on Quality, Grading, Waxing, Packaging and Marketing of Kinnow (*Citrus nobilis* × *Citrus deliciosa*)" were carried out in the orchard of Abohar (Distt. Fazilka) areas during the years 2022. The materials used and methods adopted are given below:

Equipment's and Layout: Studies were carried out at GOPAL'S FRUITS Waxing plants and its machinery and other infrastructure was used for Washing, Waxing, Drying, Grading and Marketing of Kinnow.

Harvest and post-harvest methods

Harvesting: Kinnow fruit harvested by farmers of Abohar areas at proper harvesting stage by recommended practices. These fruits were shifted to grading and waxing plant of Gopal's fruits (Abohar).

CLEANING, GRADING AND WAXING

After harvesting the sorting of fruit was done in the waxing plant Machinery to separate unsound and damaged fruits, the fruits were subjected to post-harvest grading washing. The Kinnow fruits were washed in clean water followed by a dip in 0.01% chlorinated water (Sodium hypochlorite 4% of 2.5 ml/litre water). The fruits were graded A, B, C, D and E by machine partially dried under shade and Citrasoul (UPL) Wax applied in the machine. Citrasoul Wax price 70,000 rupees 500litre.1kg Wax is using in 10 Tonnes Kinnow waxing. The waxed fruits again dried before packing. The kinnow fruits were further graded on variable size grader to obtain the uniform size of the kinnow fruits for further handling.

FRUIT QUALITY

Fruit weight and Size: Ten fruits of each grade were taken at random after the grading and waxing mean fruit weight was worked out in grams.

Fruit Length: Length of ten randomly selected fruits from every grade was measured with the help of meter rod, and the average value was calculated and expressed in centimeter.

Fruit Diameter: The diameter of ten randomly selected fruit from every grade was measured with the help of meter rod, and the average value was calculated and expressed in centimeter.

Seed Number per Fruit: For the purpose of seed content in kinnow fruits, random sample of ten fruit was taken and an average number of seeds per fruit were counted.

Seed weight: The weight of ten seeds from each sample fruits was recorded on an electronic balance and mean weight per seed was worked out.

Peel Percentage: Peel was removed and weighed. The percentage of peel was calculated on a fresh weight basis.

Juice Percentage: The juice of randomly selected ten fruits was extracted with the help of juice extractor. The juice was strained through a muslin cloth and weighed and was expressed a percentage of the total fruit weight.

Rag percentage: The weight of rag of the fruits was recorded and the percentage was worked on the basis of total fruit weight.

Chemical parameters

Total Soluble Solids (TSS): The total soluble solids content in the juice were determined with the help of hand refractometer. A drop of juice was placed on the prism facing the light source and value was recorded. Care was also taken to clean the prism with distilled water and dry it before taking the next reading.

Marketing Analysis: The fruits of all treatments were sold in different markets in auction rate of each market was recorded. The data were analyzed as followed.

Market Studies

Gross Price: The actual price of all the treatments of different markets and at different rates was recorded.

Expenditure: The expenditure born on each treatment was recorded and calculated on the basis of Rs/Kg.

Net Price: The net price of treatment was calculated by subtracting the expenditure of each treatment from the gross income.

Profit per kg and profit per acre over control: The profit per kg was calculated by subtracting purchase price from the Net treatment price and the profit per acre was estimated by assuming total yield per acre 12 to 15 tonnes and out of this good fruit for a distant market (A,B) was estimated 10 tonnes thus from the grading data.

Good fruit = Total A+B / fruit grade

Fruit Sold in the local market-C = below C grade

RESULTS AND DISCUSSION

The data of the present investigations “Studies on Quality, Grading, Waxing, Packaging and marketing of Kinnow (*Citrus nobilis* × *Citrus deliciosa*)” were statistically analyzed and are being discussed as under in this chapter:

Table 4.1.1 Fruit quality parameters of Kinnow at harvest from 1st to 15th Jan 2022

1 st -15 th JAN	A	B	C
Fruit weight	185	138	108
Fruit Dia. Width	6.7	6.5	5.5
Fruit length	5.5	5.5	5.1
Peel weight (%)	25.8	23.5	20
Pulp weight (%)	66.2	69	72
Rag weight (%)	20	21	25
Juice weight (%)	52	55	54
Juice volume (%)	41.4	46.2	44.5
No. of seed	17.5	15	12
Seed weight (gm)	2.1	1.9	1.5
TSS %	7.6	8	7.9

Table 4.1.2 Fruit quality parameters of Kinnow at harvest from 16th - 31st Jan 2022.

16 th -31 st Jan	A	B	C
Fruit weight	210	142	125
Fruit Dia. Width	6.8	6.5	6.2
Fruit length	5.7	5.4	5.1
Peel weight (%)	24	23.5	23.75
Pulp weight (%)	68	70	69
Rag weight (%)	20	21	20.5
Juice weight (%)	55	54.5	55.5
Juice volume (%)	43.5	46	46.3
No. of seed	15	12	12.5
Seed weight (gm)	2.2	2.1	1.9
TSS %	9	8	10

Table 4.1.3 Fruit quality parameters of Kinnow at harvest from 1st - 15th Feb 2022

1 st -15 th Feb	A	B	C
Fruit weight	208	144	130
Fruit Dia. Width	7	6.8	6
Fruit length	5.8	5.6	5.2
Peel weight (%)	25	24	23
Pulp weight (%)	66	68	69
Rag weight (%)	22	21	21.1
Juice weight (%)	51	53	53.9
Juice volume (%)	41.7	43.6	44
No. of seed	17	15	14.8
Seed weight (gm)	2.5	2.1	1.8
TSS %	11	9.5	9

Table 4.1.4 Fruit quality parameters of Kinnow at harvest from 16th - 28th Feb 2022

16 th -28 th Feb	A	B	C
Fruit weight	199	139	129
Fruit Dia. Width	6.9	6.5	6.3
Fruit length	5.4	5.2	5
Peel weight (%)	24.8	23.8	22.5
Pulp weight (%)	64	65	66
Rag weight (%)	21	20	23
Juice weight (%)	54	53	52
Juice volume (%)	40.1	38.5	36.5
No. of seed	18	14	13
Seed weight (gm)	2.7	2.4	2.1
TSS %	11.2	10.8	10

Fruit Harvesting and Quality for Marketing of Kinnow:

The fruits were Graded, Washed and Waxed in Waxing Plant. Then these fruits were analyzed for physiochemical traits of fruit quality and the results are discussed under following subheads:

Summary

The present investigation entitled “Studies on Quality, Grading, Waxing, Packaging and Marketing of Kinnow (*Citrus nobilis* × *Citrus deliciosa*)” was carried out in village Rampura Naryanpura Sitto gunno (Abohar) 2022. It was carried out to study the effect of Grading and Waxing on the Marketing of Kinnow in Punjab and distant markets of India as well as to evaluate the profit and loss account after grading and waxing of Kinnow. The results obtained from present investigation are summarized below: According to research programme data for various fruit quality parameters was recorded at four different stages viz., 1st to 15th January, 1st to 15th February, 16th to 28th February. Fruits were graded as A, B, and C on grading machine and were observed for weight, diameter, fruit length, peel percentage, rag percentage, juice weight, juice volume, number of seeds, seed weight and TSS at four stages.

The maximum fruit weight was observed at 16-31 January for A grade Kinnow being 220.40 gm which closely followed by grade A being 213.50 gm in 16 to 28 Feb stage and minimum was 113.30 gm and 114.30 gm on 1 to 15 and 16 to 28 Feb in C grade Kinnow similarly highest was recorded at 16 to 28 Feb in C grade which was 8.4 in grade A and minimum was 6.5 at both stages of January for C grade. From January to mid-February fruit length was 6.8 in A grade and minimum 5.5 in grade C at 1-15 Feb stage. 30.1 peel weight (%) was highest in grade C from 16 to 31 January and 69.6 were lowest in grade C from 16 to 31 January. Rag weight (%) was 29.8 highest in grade C from 16-31 January and 20.1 were lowest in grade A from 01-15 January.

Juice weight was 50.50% in grade B at 1-15 January stage and lowest was recorded to be 39.30% in grade C at 16-31 January. Juice volume was 50.0% in grade B at 1-15 January stage and lowest was recorded to be 39.0% in grade C at 16-31 January. Number of seeds was found to be the maximum in 19.5 in grade A at 1-15 January and lowest 8.0 from 16-31 January. Seed weight was found to be the maximum in 2.7 gm in grade A at 1-15 January and lowest 1.0 gm from 16th - 31st January. TSS was maximum 12.0 I whole February in grade A and minimum 9.5 in grade A and C at Feb month. Acidity was maximum 1.2 in grade A and C at 1-15 Jan and minimum 0.8 in grade A at whole Feb.

CONCLUSION

These results clearly indicate that fruit weight is directly related to the diameter of fruit also, fruit weight reduces as the fruit gets aged which can be due to drying fruit juice vesicles. Peel weight is also related directly to the size of fruit as grade A fruit having more peel weight as compared to the grade C fruit. Juice development in fruit is noticed at its peak at the fruit stage 16-31 January and in fruit of grade B which can be due to the less percentage and more juicy vesicles of the fruit. Fruit development or maturation in February has more TSS and is of best quality. Fruit shall be harvested till month of February, thereafter fruit starts getting drying and the juice vesicles due to over maturation get dry and lose its juice quantity and quality. Fruit harvesting is the major crucial cultural practice for getting optimum yield and market price so it shall be left on trees for longer duration after maturity as this can lead to fruit quality loss which will fetch less price and can ultimately be less productive for a farmer. For getting proper and maximum price of fruit farmer shall check Agri. Portal which provides rates of different markets of India and Punjab. These portals can lead to the less exploitation of farmers in the market and by middleman as they do not provide proper rates of the farmer produce. Fruit can be stored before 15th Feb. after 15th February, fruit cannot be stored because it becomes soft. Fruit should not be sold on distant market because it is difficult to transport to long distances.

REFERENCES

- Adetunjai, C. O., Fawole, O.B., Arowora K.A., Nwaubani, S.J., Ajayi, E.S., Oloke J.K., Majolagbe, O.M., Ohundele, B.A., Aina, J.A. and Adetunji, J.B. (2012). Effect of edible coating of aloe vera gel on quality and postharvest physiology of pineapple fruits during ambient storage. *Global Journal Science frontier Research*, 12 39-43.
- Ahmad M. S., Thakur K. S. and Kaushal L. B. B. (2005) Post-harvest treatment to retain Kinnow storage quality. *Indian J Hort.* 62(1):63-67.
- Anonymous (2016), Area and production of citrus in India. <http://www.nhb.govt.in>.
- Aulakh P. S., Thind S. K., Arora P. K. (2008) Kinnow. *Punjab agricultural university, Abohar*.
- Ayoub and Abu-Goukh. (2009). Effect of 2, 4, 5-Trichlorophenoxyacetic acid and waxing on quality and storability of lime fruits. *University of Khartoum. Agricultural sciences*. 17(2): 183-197.
- Bhatnagar P., Singh J., Jain M. C., Singh B., Manmohan J. R. and Dashora. (2012). Studies on seasonal variation in developing fruits of Nagpur Mandarin (*Citrus reticulata* Blanco) under Jahalawar conditions. *The Asian journal of Horticulture*. 7(2):263-265
- Bhole B. D., Mahalle Y. P., Korde M. D. and M. II, (1992) Price spread in marketing of oranges, *Maharashtra J Agri. Econ.* 4(1): 33-35.
- Bhullar J. S. (1978). Kinnow- A promising mandarin for Himachal Pradesh. *The Punjab Horticultural Journal*. 18(3/4): 131-134.
- Bhullar J. S., Agnihotri R. P. and Farmohan H. L. (1980) Effect of various treatments on extending the post-harvest life 'Blood Red' fruits. *Indian J Hort.* 37: 250-54.
- Bowan (195) *Efficiency in Manually Grading Citrus Fruit*, Packinghouse Newsletter No 73. Univ of Florida, AREC, Lake Alfred. In: Wadowakshi W F, Nagy S and Grierson W (ed) (1986) *Fresh Citrus Fruits*. AVI AVI Publishing Co., Westport, CT.
- Bureau of Indian Standards (1974) *Guide for Storage of Citrus Fruits*. IS: 7192.
- Burhan Ahmad and Khalid Mustafa (2006). Forecasting Kinnow Production in Pakistan: An Econometric. *International Journal of Agriculture and Biology*. 4: 455-458.
- Chandawat, B.S., Gupta, A.K. and Singh, B.P. (1980). Storage behaviour of different grades of kinnow fruits. *Punjab Horticulture Journal*. 20: 156-160.
- Chohan G. S., Nuriyal J. P. and Bakshi J. C. (1966). Studies on the performance of some promising citrus varieties at Abohar (Punjab). *Pb Hort J.* 6:56-61
- Chopra S. K. and Joshi J. D. (1971). Kinnow, a mandarin with a difference. *Indian Horticulture*. 15(4): 9 11.
- Cohen E. 1988. The chemical composition and sensory flavour quality of 'Mineola' tangerines. I. Effects of fruit size and within tree position. *Hort. Sci.* 63(1): 175-178.
- Daoka B. C., Sharma S. and Borach S. (2006). Post-Harvest Practices for shelf-life extension Khasi mandarin. *Indian J. Hort.* 63 (3): 251-255.
- Dashora L. K. and Shafaat Mohammed. (1988). Effect of 2, 4-D, wax emulsion and their combination on the shelf life of sweet orange (*Citrus sinensis* Osbeck) cv. Mosambi. *South India Horticulture*. 36(4): 172-176.
- Deka B. C., Sharma S. and Borah S. C. (2006). Post-harvest practices for shelf life extension of khasi mandarin. *Indian J Hort.* 63(3):251-255.
- Deshmukh V. U., Kulkarni K. D. and Kulkarni D. N. (1999). Effect of packaging and low temperature on storage quality of sweet orange (*Citrus sinensis* cv. Mosambi). Intl Symp Citri 186:P4 (Abstr). Intl Soc Citri, Nagpur, India.
- Devkota R. P, S. S. Grewal and A. S. Dhatt. (1978). Maturity determination in Kinnow mandarin. *Punjab Hort. J.* 18(3-4): 131-135.
- Dhatt A. S., Randhawa J. S. and Singh S. N. (1991). Effect of individual seal packaging in high density polyethylene (HDPE) film on storage life quality of Kinnow. *J Plant Sci Res* 7:84-85.
- Dhatt A. S., Randhawa J. S., Rattanpal H. S. and Singh S. N. (1999). Effect of date of harvest, polymeric film, sealing method and fungicides on ambient storage of Kinnow mandarin. *Intl Symp Citri 195:16*(Abstr). Intl Soc Citri, Nagpur, India.
- Dhillon B. S., Bains P. S. and Randhawa J. S. (1977). Studies on the storage of Kinnow mandarin. *J Res (PAU)* 14: 434-438.
- Erickson L. C. (1968). The general physiology of citrus. In: Reuther, L.D. Batchelor and H.J. Webber (Editors), *The Citrus Industry*, Vol. II. University of California, Berkeley, pp. 86-126.
- Gangwar, L.S.; Dinesh Singh and Singh, D.B. (2007). Estimation of Post-Harvest Losses in Kinnow Mandarin in Punjab Using a Modified Formula. *Agricultural Economics Research Review*. 20: 2-5.
- Garcia A.P., Garcia-Lenaz M. F. and Ortiz-Marcide J. M. (1992). Evolution of fruit and juice parameters during the maturation of Grapefruit (*C. paradisi* Macf). *Proc. Int. Soc. Citriculture*. 420-422.
- Goren R. (1965). Hesperidin content in the Shamouti orange fruit. *Pmc. Amer. Soc. Hort, Sci* 6:2B0-2m.
- Goren R. and S.P. Monselise. (1964). Morphological features and changes in nitrogen content in developing Shamouti orange fruits. *Ismel J. Agric Iks.* 14:65-68.

- Harding P.L., Sunday M. B. and P. L. Davis. (1959). Seasonal changes in Florida Tangebs, U.S. Dept.Agr.Tech.BuiL No.12.
- Hunter D. L., Kafer F. and Meyer C. H. (1958). *Apple sorting: Methoda and equipments*. Marketing Res Rept 230.USDA Agricultural Marketing Services.
- Iwagaki I. (1981). Tree configuration and pruning of Satsuma mandarin in Japan. Proc. Intl. Soc. Citriculture. 1:169-172.
- Jawanda J.S. (1961). Maturity Standards for sweet orange in the Punjab. Punjab Hort.J. 1: 207-2
- Josan I.S., Monga P. K, Chohan G. S. and Sharma J. S. 1988. Biochemical changes during development and ripening in the fruits of Wiiking Mandarin. *Ind, J. Hort.* 45:13- 17.
- Kale, T.S. (1974). A study into economic of orange production. M.Sc. (Agri.).Thesis submitted to MAU, Parbhani.
- Ketsa. S. (1988).Effect of fruit size on juice content and chemical composition of tangerine. *J. Hort. Sci.* 63(1):171-174.
- Landaniya, M.S. and Shyam Singh. (1998). Post-harvest technology on Nagpur mandarin (*Citrus reticulata Blanco*).NRCC, Nagpur, Technical Bulletin-2, pp44.
- Mahajan B. V. C., Dhatt A. S. and Sandhu K. S. (2005). Effect of different post-harvest treatments on storage life of kinnow. *J Food Sci & Tech.* 42:296-99.
- Mahajan B.V.C. and Dhatt A.S. (2011). Postharvest management and processing of citrus fruits. In: Prospectus and Problums of citrus in Punjab (Eds. Aylakh, P.S. and other)). Punjab Agricultural University, Ludhiana, India. Pp 98-105.
- Mahajan B.V.C., Dhillon W. S. and Kumar M. (2013). Effect of surface coating on the shelf life and quality of kinnow fruits during storage. *Journal of post harvest technology.* 1(01): 008-015.
- Mahajan B.V.C., Kapoor S. and Tandon R. (2018) Transformation in Physico-chemical and Bioactive Constituents in variable grades of Kinnow Mandarin during Different Stages of Maturity. *Nutri Foods Scilnt J.* 6(1): 555-679.
- Pratibha, Goyal, Minni Singh, Ajayvir (2012). Marketing practices of kinnow farmers in Punjab, *Internat. Res. J. agric. Eco.&Stat.*, 3(2):249-252.
