

Impact of Tree Age and Ripening Stages on Physical Characteristics of Kinnow (*Citrus Reticulata Blanco*)

Amit Kochhar¹, Navdeep Gandhi², Vikramjeet Brar³

^{1,2,3}Department of Agriculture, D.A.V College, Abohar, (India)

ABSTRACT

A study was conducted to determine the impact of different plant age and maturity stages on physical characteristics of kinnow (*Citrus reticulata Blanco*). The fruits were harvested from three different age groups i.e. 4 years, 8 years and 12 years respectively at premature stage (11th November) and at mature stage (25th January). The study was carried out at Agriculture Lab, D.A.V College, Abohar during the year 2016-17. Various physical parameters such as fruit size (length and breadth), fruit weight, fruit volume and specific gravity were evaluated. Total of 15 samples were taken from all age groups and at different maturity stages (5 samples from each age group at two stages). It was concluded that kinnow fruit samples showed significant increase in its physical characters in all age groups during maturity. The fruit samples from 8 year old plants with maturity showed best quality characteristics and January month is suited as best for harvesting of Kinnow.

Keywords : Harvesting, Kinnow, Maturity stages, Physical characters, Tree age.

INTRODUCTION

Kinnow (*Citrus reticulata* cv. Kinnow Blanco) is a variety of citrus cultivated extensively in India and Pakistan. It is a hybrid of "King" (*Citrus nobilis*) x "Willow Leaf" (*Citrus deliciosa*) developed by H. B. Frost at the Citrus Research Centre of the University of California, Riverside, USA. After evaluation, the Kinnow was released as a new variety for commercial cultivation in 1935. In India this variety was introduced by J.C. Bakhshi in 1954 at the Punjab Agricultural University, Regional Fruit Research Station, Abohar (Rachna, [1]). The tree grows vigorously with large and upright position, symmetrical in shape with a few scattered thorns. The leaves are broadly lanceolate and medium in size. The base of the tree is somewhat rounded rather than obtuse in shape and the apex is moderately acuminate. The fruit colour resembles with that of 'King' (*Citrus nobilis*) i.e deep yellowish orange. The fruit has smooth surface with glossy look. The shape is medium to slightly oblate with regular medium size. It has 9-10 segments with very high sugar content (Rajput, [2]). Kinnow is a leading cultivar grown in Punjab due to its high yield and good quality. The factors which have contributed to the success of this fruit are its beautiful golden-orange colour (a major asset from marketing view point), its abundant juice and its excellent aroma and taste [1]. The colour of rind becomes golden yellow to orange towards the maturity. Kinnow fruits are used for juice purpose along with Musambi from November onwards. The optimum period of maturity of Kinnow in Punjab is from mid-December onwards [1]. The farmers practicing kinnow plantation were facing the problems in obtaining the quality yield from the different aged orchards and the best time to harvest the kinnow was exactly not known. Several researches had been done in recent years regarding this problem but climatic conditions play a vital role in obtaining best quality kinnow

so the results differ accordingly. The research being done here takes into account the physical changes that occur during the ripening stages in different age groups to determine the best aged orchard yielding quality fruits and to evaluate the best time for harvesting of fruits. This research would help farmers in analysing the maturity indices of kinnow which would help them in harvesting the best yield from suitable age group.

II. MATERIALS AND METHODS

The study was carried out on fruits of kinnow (*Citrus reticulata* Blanco) taken from three different age groups i.e 4 years, 8 years, and 12 years. Five samples of each age group were harvested from a private kinnow orchard situated at Rajpura Village, Abohar Tehsil Fazilka (Punjab) in the month of November 2016 and January 2017. These fruit samples were brought to Agriculture Lab, D.A.V College, Abohar. Total of 15 samples were collected from all age groups and at two maturity stages (five samples from each age group at two stages).

The physical parameters i.e. fruit size, fruit weight, fruit volume and specific gravity were taken into consideration. Average length and breadth of samples were measured using vernier's calliper and was expressed in millimetres, fruit weight was evaluated with the help of digital weighing balance and expressed in grams, fruit volume was determined by using water displacement method with graduated cylinder and expressed in millilitres and specific gravity was calculated by dividing weight with volume of fruit and was represented in kgml^{-1} .

III. RESULTS AND DISCUSSIONS

3.1 Fruit size

3.1.1 Fruit length

Fruit length of kinnow showed a significant increase in all age groups during ripening of the fruit. Data regarding the change in length of the fruit has been presented in Table 4.1. It has been observed that fruits from 8 year old plants have maximum fruit length i.e 61.20 mm. Among the stages, the maximum fruit length has been recorded in mature fruits i.e 63.58 mm. The findings of this research are similar with that of George *et al* [3] who observed increase in length of pineapple from stage I to stage IV. The findings of Kamboj *et al* [4] also showed the effect of age on fruit length of pear in which maximum fruit length was recorded in 20 year old plants and minimum in 8 year old plants.

3.1.2 Fruit breadth

Fruit breadth also depicted a significant rise in kinnow fruits in all age groups during maturity. The data recorded has been shown in Table 4.2. It has been observed that maximum fruit breadth was of fruits of 8 year old plants i.e. 75.42 mm and among the ripening stages, mature fruits had maximum breadth i.e 79.87 mm. Similarly Morakinyo and Bamboye [5] observed that in oil palm fruit lets when age of Dura cultivars increases from 20 to 50 years, the fruit breadth also increased 18.78 to 25.96 mm respectively. Gunduz *et al* [6] observed increase in fruit breadth in cornelian cherry from light yellow stage to dark red stage during ripening.

3.2 Fruit weight

The Table 4.3 shows the observations recorded in present study in kinnow depicting the changes in fruit weight in different age groups and changes in fruit weight at different maturity stages. It is clearly observed that 8 year old plants had maximum weight among different age group orchards i.e 193.49 gm whereas among the stages, mature fruits show maximum weight of 216.08 gm. Nakorn *et al* [7] found the similar results in pummelo in

which the fruit weight increased as the tree age increased from 4 years to 8 years. Opara *et al* [8] studied the changes in fruit weight among different stages of ripening in tomato and found that the weight increased from mature green stage to deep red stage as the fruit progressed towards maturity.

3.3 Fruit volume

The change in fruit volume of kinnow has been presented in Table 4.4 in which different observations regarding fruit volume of different age groups and at different maturity stages are shown. From the data it has been observed that fruit volume of 8 year old plants had been recorded the maximum i.e. 197.20 ml among the age groups. The mature fruits showed maximum fruit volume i.e. 213.00 ml followed by premature fruits i.e. 149.53 ml. Similar growth in fruit volume was observed by Ishak *et al* [9] in a study on ambarella in which it was found that fruit volume increased from green fruits to ripe fruits during ripening. Similarly, Hossain *et al* [10] also observed rise in fruit volume in sapota rapidly up to 105 DAF (Days after fruit set).

3.4 Specific gravity

The change in specific gravity in kinnow was observed among different age groups and at different ripening stages. The data pertaining to change in specific gravity has been presented in Table 4.5. The maximum specific gravity has been recorded in 12 year old plants i.e. 0.98. There was increase in specific gravity observed as the fruit progressed towards maturity and maximum value has been recorded in mature fruits i.e. 1.01. Similar results regarding change pattern during ripening stages were observed by Ghanbarian *et al* [11] in cantaloupe in which it was analysed that specific gravity decreased from stage 1 to stage 4 during fruit ripening.

VI. OBSERVATIONS AND TABLES

Table 4.1: Impact of Tree age and ripening stages on fruit length (mm)

STAGE	AGE			
	4 yr	8 yr	12 yr	AVERAGE
PREMATURE	54.43	55.14	53.49	54.35
MATURE	62.06	67.27	61.43	63.58
AVERAGE	58.24	61.20	57.46	

Table 4.2 : Impact of Tree age and Ripening stages on fruit breadth (mm)

STAGE	AGE			
	4 yr	8 yr	12 yr	AVERAGE
PREMATURE	65.96	67.09	66.27	66.44
MATURE	77.26	83.76	78.61	79.87
AVERAGE	71.61	75.42	72.44	

Table 4.3: Impact of Tree age and Ripening stages on fruit weight (gm)

STAGE	AGE			
	4 yr	8 yr	12 yr	AVERAGE
PREMATURE	126.22	148.80	145.80	140.27
MATURE	209.68	238.18	200.38	216.08
AVERAGE	167.95	193.49	173.09	

Table 4.4: Impact of Tree age and Ripening stages on fruit volume (ml)

STAGE	AGE			
	4 yr	8 yr	12 yr	AVERAGE
PREMATURE	144.00	152.40	152.20	149.53
MATURE	200.00	242.00	197.00	213.00
AVERAGE	172.00	197.20	174.60	

Table 4.5: Impact of Tree age and ripening stages on specific gravity (kg ml⁻¹)

STAGE	AGE			
	4 yr	8 yr	12 yr	AVERAGE
PREMATURE	0.87	0.97	0.95	0.93
MATURE	1.04	0.98	1.01	1.01
AVERAGE	0.95	0.97	0.98	

V. CONCLUSION

The results concluded from the present investigation are that the kinnow fruit samples collected from the different age groups showed a significance growth pattern in physical characters. The characters like fruit size (length and breadth), fruit weight, fruit volume and specific gravity increased gradually as the age of the plants increases and all these parameters also showed same pattern of growth during ripening of the fruit except the specific gravity which decreased as the plant progressed towards maturity.

So it has been concluded from the research that the 8 year old orchard is best for quality kinnow production and best time for harvesting is at maturity stage in the month of January. This research being done on physical characteristics would help farmers to estimate the best aged orchards and the appropriate maturity indices for quality production of kinnow.

REFERENCES

- [1] Rachna, Post-Harvest studies in kinnow mandarin, doctoral diss., Punjab Agricultural University, Ludhiana, India, 2013.
- [2] C.B.S Rajput and R.S Haribabu, *citriculture* (Kalyani Publishers, New Delhi, 2004).
- [3] D. S. George, Z. Razali, and C. Somasundrum, Physiochemical changes during growth and development of pineapple (*Ananas comosus* L. Merr. cv. Sarawak), *Journal of Agricultural Science and Technology*, 18(2), 2016, 491-503.
- [4] S. Kamboj, N. Gandhi, K. Singh, and K. Singh, Effect of plant age on physical and chemical characters of pear, *Proc Emerging Trends Bio Agri Sci*, 75-82.
- [5] T. A. Morakinyo and, A. I. Bamgboye, Effects of age on some physical properties of oil palm fruitlets, *Agricultural Engineering International: CIGR Journal* 17(3), 2015, 342-352.
- [6] K. Gunduz, O. Saracoglu, M. Özgen, and S. Serce, Antioxidant, physical and chemical characteristics of cornelian cherry fruits (*Cornus mas* L.) at different stages of ripeness, *Acta Scientiarum Polonorum, Hortorum Cultus* 12(4), 2013, 59-66.
- [7] S. N. Nakorn and C. Chalumpak, Effect of tree age and fruit age on fruit development and fruit quality of pummelo var. Tabtimsiam, *International Journal of Agricultural Technology* 12(3), 2016, 637-645.
- [8] U.L. Opara, M.R. Al-Ani, and N. M. Al-Rahbi, Effect of fruit ripening stage on physio-chemical properties, nutritional composition and antioxidant components of tomato (*Lycopersicon esculentum*) cultivars, *Food Bioprocess Technol* 5(8), 2012, 3236-3243.
- [9] S. A. Ishak, N. Ismail, M. A. M. Noor, and H. Ahmad, Some physical and chemical properties of ambarella (*Spondias cytherea* Sonn.) at three different stages of maturity, *Journal of Food Composition and Analysis* 18(8), 2005, 819-827.
- [10] Md. M. Hossain, Physio-chemical changes during growth and development of sapota fruit (*Manilkara achras* Mill.), *Turkish Journal of Agricultural and Natural Sciences* 3(1), 2016, 58-64.
- [11] D. Ghanbarian, Z. A. Shojaei, A. Ebrahimi, and S. Yuneji, Physical properties and compositional changes of two cultivars of cantaloupe fruit during various maturity stages, *Iran Agricultural Research* 25(2), 2007, 117-126.