Pak. J. Agri. Sci., Vol. 48(2), 103-106; 2011
ISSN (Print) 0552-9034, ISSN (Online) 2076-0906
http://www.pakjas.com.pk

A COMPARISON AMONG FIVE LOQUAT GENOTYPES CULTIVATED AT HASAN ABDAL AND WAH

Azhar Hussain, Nadeem A. Abbasi*, Ishfaq A. Hafiz and Syed Zia ul Hasan

Department of Horticulture, PMAS-Arid Agriculture University Rawalpindi, Pakistan
***Corresponding author's e.mail: nadeemabbasi65@yahoo.com**

Loquat is an important fruit of some parts of Pakistan including Hasan Abdal and Wah. In spite of its importance, no research work on the description of loquat genotypes of these areas was available. This study was conducted to describe the loquat genotypes of these areas. Five genotypes of loquat were identified in Hasan Abdal and Wah. Different codes were assigned to these genotypes as there was no named cultivar. Fruit weight was highest in HW4 (16.20 g), while lowest in HW5 (9.54 g). Flesh seed ratio was highest in HW2 (2.55) followed by HW4 (2.50) with non significant difference, while lowest in HW5 (1.67). Genotype HW4 was also at the top in terms of fruit yield per plant (50.30 kg) and was followed by HW2 (46.41 kg) with a significant difference. Lowest yield per plant was observed in HW5 (30.50 kg).
Keywords: Loquat, subtropical fruit, genotypes, fruit weight, yield

INTRODUCTION

Loquat (*Eriobotrya japonica* Lindl.) is a sub-tropical fruit tree that originated in China, where it is under cultivation for over 2000 years (Lin *et al*., 2007). Presently it is cultivated mainly in China, Spain, Turkey, Pakistan, India, Italy and Brazil. So far, it has been grown in more than 30 countries of the world (Feng *et al*., 2007) and is becoming an important industry in China, Spain, Japan, India, Pakistan and Turkey (Janick, 2007). In Pakistan, its production is 13,159 tons, 98% of which comes from the Khyber Pakhtunkhwa and Punjab provinces (Hussain *et al*., 2009b).
Since it flowers in the autumn, it is a good source of nectar when other resources are scarce (Merino and Nogueras, 2003). The fruit develops during winter and ripens at early spring. In Pakistan, loquat fruit becomes available in the months of March/April when no other fresh fruit is available in the market, hence gives good returns.
Besides its nutritive importance, it is also useful for the medicinal properties. In China and Japan, its leaves are used as therapeutic agents to inhibit inflammation and fibrosis (Yoshioka *et al*., 2010) and are used to treat skin diseases and to relieve pain, inflammation (Nishioka *et al.*, 2002) and cough (Sakuramata *et al*., 2004). Leaves also contain anti-tumor agents (Ito *et al*., 2002). Loquat seed extract has an inhibitory effect on liver disorders (Yoshioka *et al*., 2010).
Wah, Hasan Abdal and surrounding areas are among the important loquat growing areas of Punjab (Hussain *et al*., 2007). Although loquat is successfully cultivated in these areas, there is no record of cultivars as most of the plants originated from seeds as a result of open pollination (Hussain *et al*., 2009a). A detailed study of loquat genotypes may provide a base for the proper identification and preservation of local germplasm, which would be helpful in the establishment of orchards with uniform loquat plants of known cultivars (Hussain *et al*., 2009b).

MATERIALS AND METHODS

The study was conducted at a private loquat orchard located at Hasan Abdal near historical Wah Gardens. Five loquat genotypes were identified over there. Different codes were assigned to these five genotypes, which are; HW1, HW2, HW3, HW4 and HW5. Trees of these five genotypes having uniform age and size were selected and marked with permanent tags. Experiment was laid out in Randomized Complete Block Design (RCBD) with three replications, each replication having one tree/genotype.
Fruit characteristics at mature stage were recorded from 20 fruits randomly selected from different sides at the middle of the canopy. Parameters included length of fruit, width of fruit, width/length index, fruit weight, flesh to seed ratio, fruits/bunch and yield/tree. Number of fruits/bunch was calculated by taking the average of 10 bunches from each tree randomly selected on the four sides at the middle of the canopy. Fruit yield/plant was recorded in kg. The period from full bloom to maturity was also recorded. The time when the greenness of the fruits completely disappeared was considered as the mature stage (Badenes *et al*., 2000).
Fruit length and fruit width were recorded with the help of 'vernier calipers'. Fruit width/length index was measured by dividing fruit width by fruit length. Fruit weight was measured with the help of electric balance by a precision scale of ±0.01 g.
Flesh to seed ratio was calculated with the help of following formula:

$$\text{Flesh to seed ratio} = \frac{\text{(Fruit weight – Seeds weight)}}{\text{Seeds weight}}$$

Seed characteristics including number of seeds/fruit, weight of individual seed and seed content/fruit were also recorded. Number of seeds/fruit was calculated by counting the total seeds contained by 20 berries and then taking the average. Individual seed weight was noted by dividing the total seeds' weight by the total number of seeds. Seed content/fruit was noted by recording the total weight of seeds extracted from 20 berries and then taking the average.

To reduce the environmental effects, data from two crop years were used. Statistical analysis was carried out using MSTATC package (MSTATC, 1999) and the means were compared by Duncan's Multiple Range test at 5% level of significance (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

***Fruit and seed morphology*:** Fruit skin colour was orange in HW1 and orange yellow in other genotypes. Pulp colour was orange in all the genotypes except HW4 which had yellow pulp. In Spain, orange yellow skin as well as pulp colour has been observed in a number of loquat varieties including 'Cardona', 'Algerie', and 'Golden Nugget'. 'Buenet' has orange skin and pulp colour (Llácer *et al*., 2003). In China, 'Hanwuzhong' cultivar has the same skin and pulp colour as in HW4 i.e., orange yellow and yellow respectively (He *et al*., 2007). Orange pulp colour has been observed in 'Kumquat loquat' and 'Sour loquat' (Huang *et al*., 2007). Genotypes except HW4 had some other similarities among themselves including fruit shape (round), fruit shape at the apex (raised) and seed colour (light brown). HW4 had obovoid fruit shape, flat shape at the apex and brown seed colour. Fruit shape at the basal end was obtuse in HW1, HW2 and HW3, while round in other two genotypes.

Seed shape was elliptic in all the five genotypes (Table 1). Fruit shape of HW4 resembles with that of the loquat cultivars, 'Magdal' and 'Tanaka' in Spain, which have been reported to have obovoid shape of fruit and elliptical seeds. The other four genotypes have round fruits and elliptical seeds as has been observed in 'Saval-2' (Llácer *et al*., 2003).

***Fruit characteristics*:** Fruit characteristics of the genotypes are given in Table 2. Fruit length was maximum in HW2 (3.66 cm) followed by HW4 (3.62 cm) and HW3 (3.53 cm), all the three being at par. Lowest fruit length with significant difference was noted in HW5 (2.87 cm). Maximum fruit width was observed in HW4 (3.18 cm) followed by HW2 (2.90 cm) with a significant difference. Fruit width was significantly lowest in HW1 (2.53 cm).

Width length index was highest in HW5 (0.89) followed by HW4 (0.88) both being at par. HW1 had the lowest width length index (0.77). Fruit weight was highest in HW4 (16.20 g) followed by HW2 (15.65 g) both being at par. Minimum fruit weight was noted in HW5 (9.54 g) which was significantly low than the other genotypes. Flesh seed ratio by weight was highest in HW2 (2.55) followed by HW4 (2.50) with non significant difference. HW5 had the lowest flesh seed ratio by weight (1.67) and was significantly at the bottom. Maximum number of fruits per bunch were recorded in HW1 (18.92) followed by HW5 (15.42) with a significant difference. This number was lowest in HW4 (11.05). Time taken from full bloom to maturity was highest in HW2 (127.83 days) which was significantly higher than HW5 (124.17 days) and all other genotypes. This period was shortest in HW3 (121.50 days). Genotype HW4 was at the top in terms of fruit yield per plant (50.30 kg) and was followed by HW2 (46.41 kg) with a significant difference. Lowest yield per plant was observed in HW5 (30.50 kg).

The highest fruit weight observed in HW4 (16.20 g) was somewhat comparable with 'Kumquat loquat' (Huang *et al*. 2007) which had a fruit weight of 18.00 g and even greater than 'Taishan Zhong' cultivar which has fruit weight of 12.80 g (He *et al*., 2007). But such fruit size and weight is not so much admirable because there are a number of cultivars in China, Spain, Turkey and even Pakistan which have fruit weights many times higher than that of HW4. In Japan, 'Satomi' and 'Fusakikari' had fruit weight of 65 g and 75 g respectively (Nakai *et al*., 1990). 'Hongdenglong' in China (Jiang *et al*., 2001), 'Algerie' in Spain (Llácer *et al*., 2003), 'Nespolone di Trabia' in Italy (Insero *et al*., 2003) and 'Ottawiani' in Turkey (Yalcin and Paydas, 1995) were observed to have fruit weight of 63.1 g, 65.0 g, 50.40 g and 49.78 g, respectively.

Genotypes of Hasan Abdal and Wah have flesh seed ratio lower than that found in the leading loquat cultivars of the

Table 1. Fruit and seed morphology of 5 loquat genotypes at Hasan Abdal and Wah

Genotypes	Skin colour	Pulp colour	Fruit shape	Fruit shape at the basal end	Fruit shape at the apex	Seed colour	Seed shape
HW1	Orange	Orange	Round	Obtuse	Raised	Light brown	Elliptic
HW2	Orange yellow	Orange	Round	Obtuse	Raised	Light brown	Elliptic
HW3	Orange yellow	Orange	Round	Obtuse	Raised	Light brown	Elliptic
HW4	Orange yellow	Yellow	Obovoid	Round	Flat	Brown	Elliptic
HW5	Orange yellow	Orange	Round	Round	Raised	Light brown	Elliptic

Table 2. Fruit characteristics of 5 loquat genotypes at Hasan Abdal and Wah

Fruit characteristics	Year	HW1	HW2	HW3	HW4	HW5	CV %
Fruit length (cm)	Year I	3.28 ab	3.68 a	3.53 a	3.59 a	2.88 b	6.54
	Year II	3.25 b	3.65 a	3.54 ab	3.64 a	2.86 c	5.85
	Mean	3.27 B	3.66 A	3.53 A	3.62 A	2.87 C	6.20
Fruit width (cm)	Year I	2.55 c	2.91 ab	2.79 bc	3.15 a	2.56 c	4.62
	Year II	2.50 c	2.88 b	2.79 b	3.20 a	2.53 c	4.11
	Mean	2.53 C	2.90 B	2.79 B	3.18 A	2.54 C	4.37
Width Length Index	Year I	0.77 b	0.79 b	0.79 b	0.88 a	0.89 a	3.05
	Year II	0.77 b	0.79 b	0.79 b	0.88 a	0.88 a	2.80
	Mean	0.77 B	0.79 B	0.79 B	0.88 A	0.89 A	2..92
Fruit weight (g)	Year I	13.51 b	15.86 a	14.82 ab	15.82 a	9.65 c	7.62
	Year II	13.19 b	15.45 a	14.98 a	16.58 a	9.43 c	5.98
	Mean	13.35 C	15.65 AB	14.90 B	16.20 A	9.54 D	6.85
Flesh seed ratio	Year I	2.27 b	2.56 a	2.23 b	2.50 a	1.68 c	4.27
	Year II	2.23 b	2.54 a	2.25 b	2.49 a	1.66 c	3.57
	Mean	2.25 B	2.55 A	2.24 B	2.50 A	1.67 C	3.94
Fruits per bunch	Year I	19.10 a	14.67 bc	13.83 c	11.23 d	15.63 b	4.09
	Year II	18.73 a	14.17 bc	13.30 c	10.87 d	15.20 b	5.69
	Mean	18.92 A	14.42 C	13.57 C	11.05 D	15.42 B	4.93
Days from full bloom to maturity	Year I	123.00 b	127.67 a	121.00 b	122.33 b	123.67 b	1.14
	Year II	124.33 b	128.00 a	122.00 b	123.00 b	124.67 b	0.70
	Mean	123.67 B	127.83 A	121.50 C	122.67 BC	124.17 B	0.95
Yield per tree (kg)	Year I	41.18 b	45.78 a	35.30 c	49.50 a	29.95 d	5.01
	Year II	42.88 c	47.03 b	36.40 d	51.10 a	31.05 e	3.65
	Mean	42.03 C	46.41 B	35.85 D	50.30 A	30.50 E	4.36

Means not sharing a letter differ significantly at $p < 0.05$
Small letters relate to the means of Year I or Year II while capital letters to the combined analysis

Table 3. Seed characteristics of five loquat genotypes at Hasan Abdal and Wah

Genotypes	Number of seeds per fruit			Seed weight (g)			Seed content per fruit (g)		
	Year I	Year II	Mean	Year I	Year II	Mean	Year I	Year II	Mean
HW1	2.97 c	3.02 d	2.99 D	1.39 a	1.36 a	1.38 A	4.13 ab	4.09 c	4.11 B
HW2	3.42 bc	3.45 c	3.43 C	1.30 b	1.26 b	1.28 B	4.45 a	4.36 bc	4.40 A
HW3	4.67 a	4.72 a	4.69 A	0.98 d	0.98 d	0.98 E	4.59 a	4.62 ab	4.61 A
HW4	3.83 b	3.87 b	3.85 B	1.18 c	1.23 b	1.21 C	4.52 a	4.75 a	4.64 A
HW5	3.17 c	3.23 cd	3.20 CD	1.14 c	1.10 c	1.12 D	3.60 b	3.55 d	3.58 C
CV %	6.64	5.55	6.11	3.66	2.91	3.31	6.68	4.07	5.53

Means not sharing a letter differ significantly at $p < 0.05$
Small letters relate to the means of Year I or Year II while capital letters to the combined analysis

world. In Turkey, 'Gold Nugget', 'Baffico' and 'Kanro' in Turkey were found to have a flesh seed ratio of 3.83, 4.16 and 5.42, respectively (Durgac *et al*., 2006). In Italy, flesh seed ratio in 'Vainiglia', 'Ferdinando' 'Peluche' and 'Magdal' have been found to be 5.4, 5.3, 5.9 and 6.5 respectively (Insero *et al*., 2003). In Spain 'Cardona', Buenet', 'Peluches' and 'Tanaka' were observed to have high flesh seed ratios of 6.20, 7.08, 7.48 and 5.38 respectively (Llácer *et al*., 2003).

Fruit yield per plant in the genotypes of Hasan Abdal and

Wah is higher than that of 'Kanro' (Karadeniz, 2003), which produced 24.5 kg fruit per plant. But the leading loquat cultivars have been reported to give much better yields in the other countries. Yield per plant in 'M. Marie', 'Champagne de Grasse' (Karadeniz, 2003) in Turkey and 'Algarie' (Hermeso and Farre, 2003) in Spain has been reported to be 69 kg, 70 kg and 74 kg, respectively.

***Seed characteristics*:** Significant differences were observed among the genotypes with respect to the seed characteristics studied (Table 3). The highest number of seeds per fruit was observed in HW3 (4.69) followed by HW4 (3.85) with a significant difference. This number was the lowest in HW1 (2.99). All the genotypes were significantly different among each other with respect to seed weight. Seed weight was highest in HW1 (1.38 g) followed by HW2 (1.28 g) while minimum in HW3 (0.98 g).

Genotypes HW4, HW3 and HW2 remained at top with reference to seed content per fruit (4.64 g. 4.61 g and 4.40 g, respectively). These genotypes remained at par with each other while significantly different from the other genotypes with reference to seed content per fruit. The lowest seed content per fruit was observed in HW5 (3.58 g). In Italy, 'Algarie' variety has 4.10 seeds per fruit and average seed content per fruit is much higher (7.90 g) than the above genotypes. But the fruit weight of Algarie (57.70 g) is more than three times the weight of HW4 (Insero *et al*., 2003). 'Crisanto Amadeo' and 'Buenet' in Spain had 3.60 and 2.50 seeds per fruit, respectively (Llácer *et al*., 2003). In China, 'Taicheng 4' (Xie *et al*., 2007) and 'White loquat' (Huang *et al*., 2007) were reported to have only 1.32 pand 2 seeds per fruit, respectively.

REFERENCES

Badenes, M.L., J. Martınez-Calvo and G. Llácer. 2000. Analysis of a germplasm collection of loquat (*Eriobotrya japonica* Lindl.). Euphytica 114**:**187-194.

Durgac, C., A. Polat and O. Kamilogl. 2006. Determining performances of some loquat (*Eriobotrya japonica*) cultivars under Mediterranean coastal conditions in Hatay, Turkey. New Zealand J. Crop and Hort. Sci. 34:225-230.

Feng, J.J., Q. Liu, X.D. Wang, J.W. Chen and J.D. Ye. 2007. Characterization of a new loquat cultivar 'Ninghaibai'. Acta Hort. 750:117-124.

Gomez, K.A. and A.A. Gomez. 1984. Statistical Procedures for Agricultural Research. 2nd Ed. John Villey and Sons. Inc. New York, USA. p.680.

He, X.L., S.Q. Lin, X.H. Yang, Y.L. Hu, G.B. Hu and J.H. Bu. 2007. Resources of Eriobotrya in Guangdong, China. Acta Hort. 750:197-202.

Hermeso, J.M. and J.M. Farre. 2003. Long term field behaviour of the loquat cvs. Gold Nugget and Algerie in Malaga, Spain, p.57-59. In: G. Llácer and M.L. Badenes (eds.). Proc. First Int. Sympo. Loquat. 11-13 April, 2002, Valencia, Spain.

Huang, G.X., J.C. Pan, X.L. He, X.H. Yang and S.Q. Lin. 2007. A Preliminary report of investigation on genus *Eriobotrya* plants in Guangxi and their characteristics. Acta Hort. 750:101-105.

Hussain, A., N.A. Abbasi and A. Akhtar. 2007. Fruit characteristics of different loquat genotypes cultivated in Pakistan. Acta Hort. 750:287-291.

Hussain, A., N.A. Abbasi, I.A. Hafiz, Z. Ahmad and S.M.S. Naqvi. 2009a. Molecular characterization and genetic relationship among loquat (*Eriobotrya japonica* Lindl.) genotypes of Pakistan assessed by RAPD markers. Pak. J. Bot. 41:2437-2444.

Hussain, A., N.A. Abbasi, I.A. Hafiz and A. Akhtar. 2009b. Morpho-physical characteristics of eight loquat (*Eriobotrya japonica* Lindl.) genotypes cultivated in Chakwal district, Pakistan. Pak. J. Bot. 41:2841-2849.

Insero, O., P. Rega and A. De Luca. 2003. Comparison among ten loquat cultivars in Campania area. p. 67-70. In: G. Llácer and M.L. Badenes (eds.). Proc. First Int. Sympo. Loquat. 11-13 April, 2002, Valencia, Spain.

Ito, H., E. Kobayashi, S.H. Li, T. Hatano, D. Sugita, N. Kubo, S. Shimura, Y. Itoh, H. Tokuda, and H. Nishino. 2002. Antitumor activity of compounds isolated from leaves of *Eriobotrya japonica*. J. Agric. Food Chem. 50:2400-2403.

Janick, J. 2007. Genetic alteration associated with fruit domestication. Acta Hort. 750:27-35.

Jiang, Q.L., H.M. Wang, T.X. Bai and H.G. Zhang. 2001. Hongdenglong, a late loquat variety. South China Fruits 30**:**27.

Karadeniz, T. 2003. Loquat (*Eriobotrya japonica* Lindl.) growing in Turkey, p. 27-28. In: G. Llácer and M.L. Badenes (eds.). Proc. First Int. Sympo. Loquat. 11-13 April, 2002, Valencia, Spain.

Lin, S., X. Huang, J. Cuevas and J. Janick. 2007. Loquat: An ancient fruit crop with a promising future. Chronica Hort. 47:12-15.

Llácer, G., M.L. Badenes and J.F. Calvo. 2003. Plant material of loquat in Mediterranean countries. p. 45-52. In: G. Llácer and M.L. Badenes (eds.). Proc. First Int. Sympo. Loquat. 11-13 April, 2002, Valencia, Spain.

Merino, N. and I. Nogueras. 2003. Loquat as a winter nectar source for birds in central Spain. Ardeola 50:265-267.

MSTAT. 1999. User's manual for MSTAT-C, Version 1, Michigan State University. East Lansing, Michigan. p.450.

Nakai, S., S. Yahata and S. Morioka. 1990. Characteristics of new loquat *(Eriobotrya japonica* Lindl.) cultivars 'Satomi' and 'Fusahikari'. Bulletin of the Chiba Horticultural Experiment Station 4:1-7.

Nishioka, Y., S. Yoshioka, M. Kusunose, T.L. Cui, A. Hamada, M. Ono, M. Miyamura, S. Kyotani and T.L. Cui. 2002. Effects of extract derived from *Eriobotrya japonica* on liver function improvement in rats. Biol. Pharma. Bull. 25:1053-1057.

Sakuramata, Y., H. Oe, S. Kusano and O. Aki. 2004. Effects of combination of CaiapoReg. with other plant-derived substance on anti-diabetic efficacy in KK-Ay mice. Bio Factors 22:149-152.

Xie, H.J., D. Chen, G.L. Jiang and H.Z. Wu. 2007. Introduction of loquat to the Panxi Region of China. Acta Hort. 750:71-76.

Yalcin, H. and S. Paydas. 1995. Adaptation of some local and foreign loquat cultivars to Adana ecological conditions. Proc. Turkish Second National Hort. Congr. 13-16 Oct. 1992, Üzmir, Turkey. p.648-652.

Yoshioka, S., A. Hamada, K. Jobu, J. Yokota, M. Onogawa, S. Kyotani, M. Miyamura, T.Saibara, S.Onishi, Y. Nishioka. 2010. Effect of *Eriobotrya japonica* seed extract on oxidative stress in rats with non-alcoholic steatohepatitis. J. Pharmacol. 62:241-246.