

## Research Article

# Evaluation of Vegetative and Floral Characteristics of Four New Loquat (*Eriobotrya japonica* Lindl.) Genotypes under Submontaneous Conditions of Punjab

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**Abstract**

Four loquat genotypes viz. Benazir, Gola, Japani and Sufeda were evaluated at the experimental orchard of the PAU, Regional Research Station, Gurdaspur. Genotypes Gola and Sufeda had spreading tree habit, while Japani and Benazir had semi upright tree habit. Shape of leaf tip was blunt acute in Benazir where as sharp acute in Gola, Sufeda and Japani genotypes. The highest plant height (10.35m) and plant spread (11.55m) were observed in Japani. Gola had the lowest plant height (6.50m) and plant spread (7.50m). The highest leaf length (41.50cm), leaf breadth (12.50cm), leaf area (519.42m<sup>2</sup>) were noted in Japani. Gola had the lowest leaf length (22.50cm), leaf breadth (6.50cm) and leaf area (146.58m<sup>2</sup>). The highest trunk diameter (130cm) and shoot length (5.30m) were observed in Japani. Gola had the lowest trunk diameter (60cm) and shoot length (3.30m). Early flowering (29<sup>th</sup> September) and late flowering (14<sup>th</sup> October) were noticed in Japani and Sufeda genotype respectively. Sufeda took the maximum time (49days) from flowering to full bloom. The period from flowering to full bloom was shortest (38days) in Japani genotype. Number of flowers per panicle was highest (66) in Japani and lowest (40) in Gola. Maximum (24.50cm) and minimum (13cm) panicle length were observed in Japani and Gola respectively.

Maximum (16cm) and minimum (9.50cm) panicle breadth were observed in Japani and Gola respectively. Shape of panicle was truncate conical in Japani, but it was conical in Benazir, Gola and Sufeda. Japani took the maximum time (159days) from full bloom to maturity. This period was shortest (137days) in Benazir. Benazir ripened early (3<sup>rd</sup> April) while Sufeda ripened late (26<sup>th</sup> April) among all the genotypes. Number of fruits per panicle was highest (30) and lowest (16) in Japani and Gola respectively. Japani had the highest yield (90kg/tree), but Sufeda had the lowest yield (52kg/tree).

**Keywords:** Evaluation, vegetative and floral characteristics, loquat (*Eriobotrya japonica* Lindl.), submontaneous conditions

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**Introduction**

Loquat (*Eriobotrya japonica* Lindl.) belongs to the family Rosaceae, sub-family Pomoideae is a sub-tropical evergreen fruit tree. It was originated in China where it is under cultivation for over 2000 years [1]. So far, loquat has been grown in over 30 countries in the world. China is the leading country in loquat cultivation followed by Spain and Japan [1]. Loquat is mainly cultivated in China, Japan, Pakistan, India, Madagascar, Mauritius Island, the Mediterranean countries, United States, Brazil and Australia [2, 3]. This fruit is introduced in India in the name of "Japanese medlar". In India, commercial cultivation of this fruit carried in the states of Uttar Pradesh, Punjab, Delhi, Assam, Himachal Pradesh and Maharashtra. In Punjab, it can be grown successfully in Gurdaspur, Hoshiarpur, Ropar, Patiala and Amritsar districts. Loquat fruit needs more attention as its fruit becomes available in the months of March and April, when none of the other fresh fruit is available in the market, hence fetch good returns. Increasing trend in loquat area as well as production indicates its great potential in the country. Loquat is a small, evergreen fruit tree that blooms in falls and early winter. Loquats are successfully grown in the Mediterranean and are well adapted to subtropical and temperate climates [4, 5]. Generally, loquat is grown between 20° and 35° North or South latitudes, however, it can be cultivated up to 45° latitudes [6]. Well established trees can tolerate a drop in temperature to -12°C [5], and temperatures above 35°C may negatively affect tree growth [4]. Loquat fruit develops during winter and ripens at early spring. Besides being sweet and juicy, it is very nutritious and also has the medicinal properties. Loquat have sucrose, laevulose, malic acid and lower quantity of tartaric, citric, and succinic acid, minerals (phosphorous & calcium), vitamins (A, B & C), and various sugars [7]. Fruit and leaves of loquat have been considered to have high medicinal value [8]. In China and Japan, its leaves are used as therapeutic agents to inhibit inflammation and fibrosis [9] and are used to treat skin diseases and to relieve pain, inflammation [10] and cough

[11]. Leaves also contain antitumor agents [12]. Loquat seed extract has an inhibitory effect on liver disorders [9]. Besides, loquat cultivars have a variable range of total phenol content and a relatively high total antioxidant capacity, which is crucial for human health [13]. It is eaten as a fresh fruit and mixes well with other fruits in fresh fruit salads or fruit cups. The fruits are also commonly used to make jam, jelly and chutney and are often served poached in light syrup. Firm and slightly immature fruits are best for making pies or tarts. 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 [14].

## Materials and Methods

The evaluation of four loquat genotypes was conducted at the experimental orchard of the PAU, Regional Research Station, Gurdaspur. The loquat germplasm *viz.* Benazir, Gola, Japoni and Sufeda were planted at a distance of 6.5m × 6.5m. in Randomized Block Design with three replication each and each replication having four plants per genotype. Bearing plants of these genotypes with almost same size and apparently good health were tagged to study their characteristics. The growth strength and phenological observations e.g. tree height, tree spread (north-south and east-west), tree trunk diameter, shoot length, leaf length, leaf breadth, leaf area, tree habit, shape of leaf tip, date of flowering, flowering to full bloom, number of flowers per panicle, shape of panicle, panicle length, panicle breadth, number of fruits per panicle, days from full bloom to maturity, date of fruit maturity and fruit yield of the genotypes were determined. Flower buds were observed from full rest until fruit set. Flowering was observed in detail from the beginning of blossoming to the formation of small fruits. The period in which 5% of the flowers blossomed was assumed as "beginning of blossoming", the period in which 70% of the flowers blossomed was assumed as "full bloom", and the period in which the flowers drop 70% of their petals after pollination was assumed as "end of blossoming". When the greenness of the fruits disappeared completely, it was considered as the mature stage [15]. Data was analysed statistically by Randomized Block Design as described by [16] for each year and ultimately the pooled estimates for both the years were worked out.

## Results and Discussion

Significant differences were observed with reference to various characteristics among different genotypes.

### Tree Habit

Genotypes Gola and Sufeda had spreading tree habit, while Benazir and Japoni genotypes had semi upright tree habit (Table 1). Tree habit was upright in KK1, spreading in CS1, CS2 and CS3, while semi upright in KK2, KK3, KK4, KK5 loquat genotypes [14]. Loquat cultivar, 'Peluches' in Spain has spreading tree habit. Buenet, Saval-2 and Crisanto Amadeo, Algeria, Cardona, Tanaka, Buenet and Saval 2 loquat genotypes have upright tree habit. Italiano-1 loquat genotype have been reported to have semi upright tree habit [17]. Loquat genotypes TB3 and TB11 had upright tree habit; TB8, TB12 and TB15 had spreading tree habit; TB1, TB2, TB4, TB5, TB6, TB7, TB9, TB10, TB13 and TB14 had semi upright tree habit [18].

**Table 1** Evaluation of vegetative growth characteristics of different genotypes of loquat

Variety	Plant height (m)	Tree trunk diameter (cm)	Shoot length (cm)	Plant spread (North - South) (m)	Plant spread (East-West) (m)	Leaf length (cm)	Leaf breadth (cm)	Leaf area (cm <sup>2</sup> )	Tree habit	Shape of leaf tip
Benazir	8.25	90.00	3.60	9.45	10.70	30.50	10.00	280.08	Semi Upright	Blunt Acute
Gola	6.50	60.00	3.30	7.50	8.65	22.50	6.50	146.58	Spreading	Sharp Acute
Japoni	10.35	130.00	5.30	11.55	11.75	41.50	12.50	519.42	Semi Upright	Sharp Acute
Sufeda	7.00	80.00	3.80	8.65	9.80	26.60	8.50	200.12	Spreading	Sharp Acute
CD (5%)	2.46	2.35	0.84	2.49	NS	3.38	1.69	103.96	-	-

### Shape of Leaf Tip

Shape of leaf tip was blunt acute in Benazir where as sharp acute in Gola, Japoni and Sufeda genotypes (Table1). Blunt acute shape of leaf tip was observed in KK2, KK3 and KK4 loquat genotypes, whereas it was sharp acute in genotypes KK1 and KK5, CS1, CS2 and CS3 [14]. Shape of leaf tip was sharp acute in TB6, whereas blunt acute in loquat genotypes TB1, TB2, TB3, TB4, TB5, TB7, TB8, TB9, TB10, TB11, TB12, TB13, TB14 and TB15 [18].

### ***Tree Height and Tree Spread***

The highest plant height (10.35m), plant spread (north-south) (11.55m) and plant spread (east-west) (11.75m) were obtained from Japani. Gola had the lowest plant height (6.50m), plant spread (north-south) (7.50m) and plant spread (east-west) (8.65m) (Table 1).

### ***Leaf Length, Breadth and Leaf area***

The highest leaf lengths (41.5cm), leaf breadth (12.50cm), leaf area (519.42m<sup>2</sup>) were obtained from Japani. Gola had the lowest leaf length (22.50cm), leaf breadth (6.50cm), leaf area (146.58 cm<sup>2</sup>) (Table 1). Maximum leaf length (28.14 cm), leaf width (9.67 cm) and leaf area (167.70 cm<sup>2</sup>) were observed in KK2, KK1, KK1 loquat genotypes respectively [14]. Hanwuzhong is a loquat variety in China which has average leaf length of 26.50 cm and leaf width of 9 cm [19]. In China, Jidanbai cultivar of loquat has a leaf length of 25.50 cm and leaf width of 7.80 cm, while the leaf length and leaf width in case of Ruantiaobaisha cultivar was 21.10 cm and 7.10 cm respectively [20]. Maximum leaf width (9.06cm) and leaf area (148.33 cm<sup>2</sup>) were noted in CS2 loquat genotype [14]. Maximum leaf length (30.16cm), leaf width (9.81cm) and leaf area (215.43 cm<sup>2</sup>) were observed in TB8, TB15 and TB15 genotypes respectively [18]. Mojia No.1 loquat cultivar in China which had a leaf length of 19.80 cm and leaf width of 5.20 cm [19].

### ***Tree Trunk Diameter and Shoot Growth***

The highest trunk diameter (130cm) and shoot length (5.30m) were obtained from Japani. Gola had the lowest trunk diameter (60cm) and shoot length (3.30m) (Table 1). [21] Reported that Sayda and Lapta B2 loquat cultivar had the greatest tree trunk diameter and annual shoot growth was higher for cultivar Akko XIII.

### ***Flowering and Panicle Size***

All genotypes significantly differed in floral characteristics (**Table 2**). Early flowering (29<sup>th</sup>September) was noticed in Japani genotype. But Sufeda genotype showed late flowering (14<sup>th</sup>October). Sufeda took the maximum time (49days) from flowering to full bloom. The period from flowering to full bloom was shortest (38days) in Japani genotype. Number of flowers per panicle was highest in Japani (66) followed by Banazir (51), while lowest in Gola (40). Maximum panicle length was observed in Japani (24.50cm) which as followed by Banazir (19.50cm). Gola had the lowest length of panicle (13cm). Maximum panicle breadth was observed in Japani (16.0cm) which was followed by Banazir (12.50cm). Gola had the lowest breadth of panicle (9.50cm). [22] Reported that blossoming period of the experimental cultivars of loquat ranged from 23<sup>rd</sup> November to 27<sup>th</sup> January. Sayda completed its flowering much earlier than HCG and Gold Nugget loquat cultivars. [14] Noted that number of flowers per panicle was highest in KK4 loquat genotype (177.89). 'Madgal' variety of loquat, which had 178 flowers per panicle in Spain [17]. Loquat cultivars Nespalone di Trabia, Ferdinando, Vainiglia and Nespalone di Ficarazzi have been reported to produce 108.10, 130.40, 176.20 and 158.40 flowers per panicle respectively [23]. TB6 genotype of loquat had the lowest size of panicle (17.99 cm). TB5 loquat genotype took the maximum time (50.50 days) from flowering to full bloom. The period from flowering to full bloom was shortest (39 days) in TB9 genotype of loquat [18]. Size of panicle was largest (20.72 cm) in KK4 and smallest (15.44 cm) in loquat genotype. KK5 KK3 genotype of loquat took maximum time (44 days) from flowering to full bloom. Number of days from flowering to full bloom was lowest (38.17days) in KK4 loquat genotype [14]. CS1 loquat genotype had the maximum number of flowers per panicle (157.68) and maximum panicle size (20.47 cm). CS3 loquat genotype had the minimum number of flowers per panicle (144.40) and minimum panicle size (18.31 cm). CS3 took maximum time from flowering to full bloom (39 days) while this time was least in case of CS2 (34.50 days) genotypes of loquat [14]. In China, number of flowers per panicle has been noted as 61 in Ningbai2 [20] and 134 in Luoyangqing loquat cultivars [24]. Number of flowers per panicle was highest in TB4 (172.82) followed by TB7 (164.07), while lowest in TB12 (75.15) loquat genotypes. Maximum panicle size (23.20 cm) was observed in TB1 loquat genotype [18]. In literature, different loquat cultivars have been reported to have different number of flowers per cluster, such as 72 in Zhaozhong and 92 in Qingzhong [25]; 130.40 in Ferdinando and 176.20 in Vainiglia [23], 189 in Golden Nugget, 227 in Buenet and 273 in Saval 2 [17].

### ***Shape of Panicle***

Shape of panicle was truncate conical in Japani it was conical in Banazir, Gola and Sufeda (Table 2). While shape of panicle in both the loquat varieties Cardona and Italiano-1 was conical [17]. Shape of panicle was truncate conical in

TB1, TB4 and TB10; it was cylindrical in TB3, TB6, TB7 and TB15, while conical in TB2, TB5, TB8, TB9, TB11, TB12, TB13, TB14 loquat genotypes [18]. Algeria, Tanaka, Peluches, Buenet, Saval-2 and Crisanto Amadeo genotypes of loquat also have conical shape of panicle [17].

**Table 2** Evaluation of flowering and fruiting characteristics of different genotypes of loquat

Variety	Date of flowering	Flowering to full bloom	Number of flowers per panicle	Shape of panicle	Length of panicle (cm)	Breadth of panicle (cm)	Number of fruits per panicle	Full bloom to maturity	Date of fruit maturity	Fruit yield (kg/tree)
Benazir	4 <sup>th</sup> Oct	45.00	51.00	Conical	19.50	12.50	25.00	137.00	3 <sup>rd</sup> Apr	77.00
Gola	9 <sup>th</sup> Oct	42.00	40.00	Conical	13.00	9.50	16.00	142.00	10 <sup>th</sup> Apr	52.00
Japani	29 <sup>th</sup> Sep	38.00	66.00	Truncate conical	24.50	16.00	30.00	159.00	13 <sup>th</sup> Apr	90.00
Sufeda	14 <sup>th</sup> Oct	49.00	46.00	Conical	16.00	11.50	20.00	146.00	26 <sup>th</sup> Apr	65.00
CD (5%)	-	2.28	4.07	-	3.21	3.94	4.24	1.77	-	4.24

### *Full Bloom to Maturity Period*

Japani took the maximum time (159 days) from full bloom to maturity. This period was shortest (137 days) in Banazir (Table 2). Loquat genotypes Tret2 and Tret3 took maximum time from full bloom to maturity (121 and 121.50 days respectively). On the other hand, Tret5 took the least time from full bloom to maturity (112.83 days) [26]. Time taken from full bloom to maturity was longest in HW2 (127.83 days) and shortest in HW3 (121.50 days) genotypes of loquat [27]. Banazir ripened early (3<sup>rd</sup> April) while Sufeda ripened late (26<sup>th</sup> April). The earliest maturing loquat cultivar was Sayda (9<sup>th</sup> May) and the latest was Şampiyon (27<sup>th</sup> May) [21]. KK3 loquat genotype took maximum days (131) from full bloom to maturity. KK4 loquat genotype required the least time (115.50 days) from full bloom to maturity [14]. TB3 loquat genotype took the maximum time (136.2 days) from full bloom to maturity. This period was shortest (117.5 days) in TB13 genotype of loquat [18].

### *Number of Fruits*

Number of fruits per panicle were highest in Japani (30) followed by Banazir (25), while lowest in Gola (16) (Table 2). [27] Reported the maximum and minimum number of fruits per bunch in HW1 (18.92) and HW4 (11.05) genotypes of loquat respectively. Maximum number of fruits per bunch in loquat genotypes was observed in KK3 (16.27) while KK5 had the lowest values with reference to number of fruits per bunch (8.83) [14]. Number of fruits per bunch was highest (13.50) in TB1 and minimum (6.38) in TB14 genotypes of loquat [18]. Tret1 had the maximum number of fruits per bunch (14.70) and minimum number of fruits per bunch was observed in Tret5 (12.53) genotypes of loquat [26].

### *Fruit Yield*

Japani had the highest yield (90kg/tree) followed by Banazir (77kg/tree). Sufeda had the lowest yield (52kg/tree) (Table 2). Loquat varieties Şampiyon and Laptal had the highest (56.80 kg/tree) and lowest yield (9.30 kg/tree) respectively [21]. Highest yield per tree was recorded in TB7 (89.85 kg) genotype of loquat [18]. Loquat genotype HW4 was at the top in terms of fruit yield per plant (50.30 kg). Lowest yield per plant was observed in HW5 (30.50kg) loquat genotype [27]. Fruit yield of loquat variety KK2 (49.03 kg/ tree) is much better than that of Kanro which yielded 24.50 kg per tree [14] while it was very low as compared with M. Marie', Champagne de Grasse [7] and Algeria [28], which gave 69 Kg, 70 kg and 74 kg fruits per tree respectively. [26] reported that yield per tree was highest (54.93 kg) and lowest (33.71 kg) in Tret4 and Tret5 respectively.

### **Conclusion**

It was concluded that Japani genotype of loquat was found to be superior with respect to all growth, flowering and fruiting characteristics as compared to Banazir, Gola and Sufeda genotypes.

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