

Original Research Article

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Evaluation of the Elite Strains of Acid Lime (*Citrus aurantifolia* Swingle L.) for the Growth and Yield Parameters

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ABSTRACT

In Kagzi lime the existing variability is less due to the problem of polyembryony which suppresses the zygotic seedlings. However, to some extent variation is seen in the seedling progeny with respect to morphological, physico-chemical parameters and also in productivity. In any crop, the improvement by selection method involves identification of prosperous types from a genetic stock or population. This can be from homogeneous population of heterozygous individuals in vegetatively propagated crops or from a population resulting from hybridization. Thus variability in the population is a pre-requisite for crop improvement and is considered as a boon to a plant breeder. As variability makes pre - requisite for selection criteria, it is the most quickest and effective method of breeding, particularly in perennial crops. Hence, the present research was carried through survey of forty orchards from Indi and Sindagi taluks of Vijayapura district during the fruiting season of 2015-16. The fruits were used for studying the physico-chemical characters and variety cultivated in the study area was Kagzi lime. The observations on various parameters were recorded in Hasth bahar seasons. Among the 40 selections, KLS-15 (63.75 kg) and KLS-13 (52.67 kg) had maximum yield, whereas minimum number of seeds obtained in KLS-20 (8.50). KLS-31 contained maximum juice (55.40 %), which is useful for juice extraction. For overall acceptability, KLS-15 has shown good results. It should be further multiplied and popularized for the benefit of the farming communities.

Keywords

Acid lime,
Vijayapura,
Variability, Yield
parameter

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Introduction

Acid lime is commercially important citrus crop grown across different states of the country. It is more popular for its uses in preparation of refreshing juice, making of pickles and in seasoning foods which are very popular not only in India but also in other parts of the world. Plant is small, bushy with small but sharp spines. Leaves are small with narrowly winged petioles. Flowers and fruits are small. Fruits are round to oval, maturing irregularly throughout the year greenish yellow in colour and thin skinned. Core is solid at maturity and juice is highly acidic. Kagzi lime is a good source of Vitamin- C (62.90 mg/100 ml), Vitamin- B1, Vitamin- B2 and minerals like Calcium (90 mg /100 ml), Phosphorus (20 mg/100 ml) and Iron (0.3 mg/100 ml). It is a part of our daily salad dish as used to garnish different foods. It is also used for preparing beverages such as limeade and lime Rickey. Huge range of important products are also made from lime viz., lime juice, lime cordial, lime oil, calcium citrate, dried or dehydrated lime peel, lime powder, pickle, jams, jellies, marmalades, flavoring jams and alcoholic / non-alcoholic drinks. It is a good source of edible citric acid and essential ingredient of almost all the herbal cosmetics.

In acid lime the existing variability is less due to the problem of polyembryony which suppresses the zygotic seedlings. However, to some extent variation is seen in the seedling progeny with respect to morphological, physico-chemical parameters and also in productivity. In any crop, the improvement by selection method involves identification of prosperous types from a genetic stock or population. This can be from homogeneous population of heterozygous individuals in vegetatively propagated crops or from a population resulting from hybridization. Thus variability in the population is a pre-requisite

for crop improvement and is considered as a boon to a plant breeder. As variability makes pre - requisite for selection criteria, it is the most quickest and effective method of breeding, particularly in perennial crops.

In order to address the above points, the survey and selections were carried out in Indi and Sindagi taluks of Vijayapura district which comes under Northern Dry Zone of Karnataka with the following specific objective to identify the elite strains of Kagzi lime for better yield.

Materials and Methods

During the survey work a total of 40 well maintained orchards were selected from Indi and Sindagi taluks and each orchard was taken as one treatment, by recording the observation twenty orchards were chosen from five villages viz., Lachyan, Mavinahalli, Ingalgi, Atharga and Tadawalga of Indi taluk and twenty orchards from four villages viz.. Bandal, Harnal, Somapura and Budihal of Sindagi taluk. In each orchard, best 3 plants were selected and each plant is considered as one replication, the selected plants were marked with paint for identification and for collection of fruit samples during September 2016 to April 2017.

Methodology was adopted as per the guidelines of Central Citrus Research Institute, Nagpur, Maharashtra.

1. Age of the orchards: 10 to 12 years.
2. Sample size: five fruits in each North-south and East-west directions of the tree were collected
3. Statistical Design: Randomized Block Design.
4. Total number of treatments: 40 (each orchard was treated as one treatment).
5. Replications: 2 (each plant from a selected orchard was one replication).

6. The plant and fruit characters of the selected 10-12 year old healthy vigorous growing trees were studied for the following characters.

Tree characters

The following tree characters were recorded by visual observations and the tree details of the Kagzi lime selections are presented in the Table 1.

i) Flowering month: Flowering month was noted down during the peak flowering of the tree.

- a. Early (Before September 15)
- b. Mid (September 15 to October 1)
- c. Late (After October)

ii) Fruiting (harvest) month: Fruiting (harvest) month was noted down during the peak fruiting of the tree.

- a. Early (Before March)
- b. Mid (March 15 to April 1)
- c. Late (After April)

Plant growth parameters

Details of the Kagzi lime selections growth parameters are presented in the Table 2.

Plant height (m): The height of the tree was recorded from the ground level to the top most branching level, and expressed in meter.

Trunk diameter (cm): The trunk diameter was measured at 20 cm height above the ground level and expressed in centimeter.

Plant canopy spread (m): The spread of the tree canopy was recorded with the help of measuring tape in East-West and North-South directions and was expressed in meters.

Fruit yield and yield attributing parameters

The fruits were labeled after they were plucked from the tree. The following observations were recorded after selection of each trees from different places and details of the Kagzi lime selections yield attributing parameters are presented in the Table 3 and 4.

Fruit weight: Weight of fruit was recorded in grams using physical balance and average of eight fruits was taken as mean weight of fruit.

Number of fruits per plant: Total number of fruits in a plant at different pickings was counted

Fruit yield per plant (kg): Fruit yield was compared by multiplying the number of fruits with fruit weight of respective strains and was expressed in kilograms.

Equator diameter: Fruit equator diameter was measured in centimeter with the help of vernier calipers at the point where the maximum breadth was observed.

Polar diameter: Fruit polar diameter was measured in centimeter using vernier calipers at the point where the fruit length was maximum.

Fruit shape: Freshly harvested fruits were carefully observed to record the shape and the shape was recorded as round or oval.

Fruit shape index: Fruit shape index was calculated by dividing fruit length with fruit breadth and expressed in square centimeter.

Fruit size: This was calculated by multiplying fruit length with fruit breadth and expressed in square centimeter

Fruit volume: The volume of fruit was recorded in millimeter by water displacement

method and average of eight fruit was recorded.

Number of seeds: The seeds of eight fruits in each replication were counted and the mean number of seeds per fruit was calculated.

Statistical analysis

The data on various characters were subjected to Fisher's method of analysis of variance and the interpretation of data as given by Panse and Sukhatme in 1967. The level of significance used for 'F' and 't' tests was $p=0.05$. Critical difference (CD) values were calculated whenever the 'F' test was significant.

Results and Discussion

Plant growth parameters

Various growth characters *viz.*, plant height, trunk diameter and plant canopy spread were studied.

The maximum tree height (4.62 m) was recorded in KLS-24 and it was significantly superior over the other treatments. The maximum height of the plant was due to the vigorous growth and also may be due to some amount of genetic influence. This was in concurrence with the earlier findings of Madhavi and Babu (2003), Shinde *et al.*, (2004) and Srinivas *et al.*, (2006). Similarly, trunk diameter is an important character which contributes significantly on yield of plant as it supports primary branches as well as secondary branches essential for fruit bearing. In the present study, the highest trunk diameter (44.75 cm) was recorded in KLS-16 which may be due to some amount of genetic influence in these treatments. Shinde *et al.*, (2004) got similar results in Kagzi lime strain number KLN-83 who observed that the seedling tree attained the maximum diameter

of trunk with thick (18 inches) in seven year old plant. The maximum plant canopy spread was recorded in KLS-18 (3.84 Sq.cm). This was concurrence with the earlier findings of Dubey *et al.*, (2014) the study revealed that canopy volume was found higher in MS-7 followed by MS-3 the lowest canopy volume was recorded in Valencia. Deshmukh *et al.*, (2015) also observed the maximum plant spread in PDKV lime (30.82 m²) followed by vikram (28.96 m²) and minimum in Mangali-pattu (20.68 m²).

Yield and yield attributing parameters

Yield is the most significant trait of a cultivar as it signifies the economic importance of the crop.

The number of fruits per plant is the most important yield component and it influences the yield directly. The number of fruits per tree showed wide variance among the treatments studied and was the highest in KLS-15 (1802). The higher number of fruits per tree obtained may be due to more vegetative growth results to higher rate of photosynthesis and helps in more number of fruits. This was in concurrence with the earlier findings of Jature and Chakrawar (1981) who found significant variation in the fruit number which ranged from 600 to 2100 in the Kagzi lime strains. Ingle *et al.*, (2004) and Srinivas *et al.*, (2006) also observed maximum number of fruits in PDKV lime (1578) and seedling strain of Kagzi lime (2350), respectively.

Similarly, fruit yield per plant also varied widely among the treatments studied and it ranged from 23.96 kg to 63.75 kg. The KLS-15 recorded highest fruit yield (63.75 kg/plant). The higher yield was due to more number of fruits per tree. Yield being a polygenic and complex character, it is determined by various vegetative and reproductive characters. This differential

yielding ability is primarily ascribed to number of fruits retained per shoot and average fruit weight. This implies that the selection for more fruit number will automatically lead to higher yield. These results are in line with Jature and Chakrawar (1981) who reported that the Kagzi lime fruit yield ranged between 21.93 and 174.66 kg/plant under Marathwada conditions. Badiyala *et al.*, (1992) also studied sixty seven types of Kagzi lime strains and yield ranged from 30.00 kg to 195.00 kg/tree. Srinivas *et al.*, (2006) showed fruit yield ranged from 21.43 kg to 101.25 kg in seedling strains of Kagzi lime.

The fruit weight being dependent character which influences the yield through fruit characters like fruit volume, polar and equator diameter, peel thickness, number of seeds, juice weight, and juice volume. Thus the maximum fruit weight (40.89 g) was recorded in the KLS-6. It was due to the more number of seeds or more quantity of juice per fruit. These results support the earlier findings made by Chakrawar (1978) reported higher mean fruit weight of Kagzi lime in Mrig Bahar (54.00 g), compared to Ambe Bahar (33.13 g). Prasad (1989) reported the highest fruit weight 41.40 g among 27 Kagzi lime clones studied. Desai and Ranpise (1995) reported the selection Sai Sharbati (RHR-L-49) recorded the maximum fruit weight of 49.78g. The maximum fruit weight (45.53 g to 47.33 g) in Kagzi lime was noticed in cultivar Vikram followed by PKM-1 (44.70 g-42.53 g) during both seasons reported by Kumar *et al.*, (2011).

The maximum equator diameter (4.17 cm) and polar diameter (4.29 cm) was recorded in the KLS-15. It was due to the enlargement of fruit in terms of diameter which was be due to both cell elongation and cell division. Hulme (1970) reported that cell division continued to take place during initial stages of fruit growth and at later stage only cell elongation

occurred. These result are in accordance with the earlier findings of Srinivas *et al.*, (2006) who recorded maximum equator diameter and polar diameter of 4.75 cm and 5.50 cm in KLS-139 strain and seedling strain of Kagzi lime respectively. The maximum fruit volume (35.17 ml) was recorded in the KLS-6. It was due to the higher fruit weight might have increased the fruit volume. The maximum fruit size was recorded in KLS 14. However, KLS 16 recorded lower fruit size (9.08 sq. cm) as compared to KLS 14 (16.91 Sq.cm) which may be due to less equator and polar diameter in KLS16. There by fruit size is reduced. These results are in conformity with the earlier findings of Jature and Chakrawar (1981) in Marathwada region who reported mean fruit size of 22.62 sq.cm in Kagzi lime.

The maximum fruit shape index (1.26) was recorded in the KLS-28 which was due to shorter fruit length, These results are in conformity with the earlier findings of Prasad (1989) who reported maximum fruit shape index in each clone number 25 and 11 (1.33) among different Kagzi lime clones studied.

Less number of seeds per fruit is a desirable character in Kagzi lime. Normally the fruits with less number of seeds may contain more edible part in the fruits. Data showed that the minimum number of seeds recorded in KLS-20 (8.50 seeds/fruit), followed by KLS-38 (8.93), Similar results were also reported by Prasad (1989) and Desai and Ranpise (1995) in clone 22 (6.63 seeds/fruit) of Kagzi lime and Sai-sharbati (6.16 seeds/fruit). Athani and Hulamani (1999) observed comparatively less number of seeds per fruit in Raichur strain (7.08) whereas Shinde *et al.*, (2004) found the maximum number of seeds per fruit in Pramalini (9.02), followed by Vikram (7.12).

Thin rind is a desirable character in Kagzi lime crop improvement.

Table.1 Tree details of Kagzi lime selections

Sl. No.	Genotypes	Place	Farmer Name
1	KLS-1	Lachyan	Mahantappa B. Lalasangi
2	KLS -2	Lachyan	Gudusava B. Athanur
3	KLS -3	Lachyan	Sangavva Basaveshwara
4	KLS -4	Lachyan	Shivappa S. Malashetti
5	KLS -5	Lachyan	Jattilingaraj K. Godekar
6	KLS -6	Mavinahalli	Vittal M. Karale
7	KLS -7	Mavinahalli	Sahebgoud S. Biradar
8	KLS -8	Mavinahalli	Tukaram S. Barani
9	KLS -9	Mavinahalli	Hanumant C. Hakki
10	KLS -10	Mavinahalli	Dhaarma Wader
11	KLS -11	Atharga	Siddram M. Metri
12	KLS -12	Atharga	Prabhu S. Hunagura
13	KLS -13	Atharga	Dullappa Irappa
14	KLS -14	Atharga	Bheemaraj S. H.
15	KLS -15	Atharga	Malkappa B.
16	KLS-16	Atharga	MallappaSiddappa C.
17	KLS-17	Tadawalga	Dalavayappa L. G.
18	KLS-18	Tadawalga	Sharanappa H. Garag
19	KLS-19	Tadawalga	Bheemashekar L. Gagagani
20	KLS-20	Tadawalga	Mallayappa L. Kundali
21	KLS-21	Harnal	Mallappa P. Hirekurabaragi
22	KLS-22	Harnal	Shrimanth S. Develamani
23	KLS-23	Harnal	Dundavva S. Walikar
24	KLS-24	Harnal	Shankarappa S. Develamani
25	KLS-25	Bandal	Lingappa D. Develanavar
26	KLS-26	Bandal	Dayananda Shankaralingappa
27	KLS-27	Bandal	Mallikarjun M. K.
28	KLS-28	Bandal	Parvathi L. Malagani
29	KLS-29	Bandal	Bagesh Lurade
30	KLS-30	Bandal	Bharavantharay T. Talawar
31	KLS-31	Bandal	Baramma S Tavalamani
32	KLS-32	Somapura	Siddappa Devalamani
33	KLS-33	Somapura	Sushilabai S. Hiremath
34	KLS-34	Somapura	Basayya Hoiremath
35	KLS-35	Somapura	Shivalingappa G. Bammagodi
36	KLS-36	Budihal	Siddappa M. Almel
37	KLS-37	Budihal	RavindrappaVadachan
38	KLS-38	Budihal	Mahanteyya S. Hiremath
39	KLS-39	Budihal	Shrishail B. Hiremath
40	KLS-40	Budihal	Siddramayya S. Hiremath

Table.2 Genetic variability of growth parameters in different strains of Kagzi lime

Strains	Plant height (m)	Trunk diameter (cm)	Plant canopy spread (m)	Flowering time	Fruiting time
KLS-1	3.95	32.32	3.69	Oct1 st -15 th	March 15 th -31 st
KLS-2	4.00	38.29	3.28	Oct1 st -15 th	March 15 th -31 st
KLS-3	3.65	30.56	3.06	Oct1 st -15 th	March 15 th -31 st
KLS-4	3.53	30.08	3.02	Oct1 st -15 th	March 15 th -31 st
KLS-5	4.36	32.88	3.77	Oct1 st -15 th	March 15 th -31 st
KLS-6	3.75	31.23	3.61	Oct1 st -15 th	April 1 st -15 th
KLS-7	3.95	33.41	2.96	Oct1 st -15 th	March 15 th -31 st
KLS-8	3.93	33.23	3.65	Oct1 st -15 th	April 1 st -15 th
KLS-9	3.82	29.83	3.66	Sept15 th -31 st	Before Mar15 th
KLS-10	3.51	30.05	3.11	Sept15 th -31 st	March 15 th -31 st
KLS-11	3.66	31.18	3.55	Oct1 st -15 th	March 15 th -31 st
KLS-12	3.55	30.30	3.65	Oct1 st -15 th	April 1 st -15 th
KLS-13	3.85	32.34	2.93	Oct1 st -15 th	March 15 th -31 st
KLS-14	3.36	40.25	2.87	After Oct 15 th	April 1 st -15 th
KLS-15	4.14	37.50	3.36	Oct1 st -15 th	April 1 st -15 th
KLS-16	4.15	44.75	3.84	Oct1 st -15 th	March 15 th -31 st
KLS-17	3.81	38.50	3.27	Oct1 st -15 th	March 15 th -31 st
KLS-18	4.00	40.50	3.02	Oct1 st -15 th	March 15 th -31 st
KLS-19	3.84	43.00	3.36	After Oct 15 th	April 1 st -15 th
KLS-20	3.77	37.00	3.01	Oct1 st -15 th	March 15 th -31 st
KLS-21	4.21	42.50	3.46	Oct1 st -15 th	March 15 th -31 st
KLS-22	4.05	37.53	3.52	Sept15 th -31 st	April 1 st -15 th
KLS-23	4.16	40.25	3.27	Oct1 st -15 th	March 15 th -31 st
KLS-24	4.62	44.25	3.83	Oct1 st -15 th	March 15 th -31 st
KLS-25	4.16	40.50	3.38	Oct1 st -15 th	March 15 th -31 st
KLS-26	4.12	39.00	3.16	Oct1 st -15 th	March 15 th -31 st
KLS-27	3.70	38.25	3.03	Oct1 st -15 th	March 15 th -31 st
KLS-28	3.70	37.00	3.79	Oct1 st -15 th	April 1 st -15 th
KLS-29	4.06	37.75	3.11	Oct1 st -15 th	April 1 st -15 th
KLS-30	3.81	39.00	2.81	Oct1 st -15 th	March 15 th -31 st
KLS-31	4.01	40.25	3.23	Oct1 st -15 th	March 15 th -31 st
KLS-32	3.94	39.50	3.10	Oct1 st -15 th	April 1 st -15 th
KLS-33	4.04	39.75	3.80	Sept15 th -31 st	March 15 th -31 st
KLS-34	3.84	22.00	2.67	Sept15 th -31 st	Before Mar15 th
KLS-35	4.29	40.50	3.79	Oct1 st -15 th	March 15 th -31 st
KLS-36	3.21	29.30	3.15	After Oct 15 th	After April
KLS-37	4.42	40.50	3.11	Oct1 st -15 th	April 1 st -15 th
KLS-38	4.20	39.75	3.37	Sept15 th -31 st	March 15 th -31 st
KLS-39	4.09	42.00	3.02	Sept15 th -31 st	March 15 th -31 st
KLS-40	3.94	40.75	3.64	Oct1 st -15 th	March 15 th -31 st
Mean	3.94	36.69	3.32	-	-
SEm	0.21	1.31	0.22	-	-
CD at 5%	0.60	3.76	0.82	-	-

Table.3 Genetic variability of yield parameters in different strains of Kagzi lime

Strains	Fruit weight (g)	Fruit volume (ml)	Total fruits per plant	Yield per plant (kg)	Equator diameter (cm)	Polar diameter (cm)	Number of seeds	Peel thickness (cm)
KLS-1	37.62	31.93	1197.00	39.39	4.00	4.11	11.33	0.86
KLS-2	40.22	32.98	1281.50	40.91	4.07	3.84	12.14	0.91
KLS-3	37.68	31.69	963.50	33.16	3.96	3.88	12.40	0.81
KLS-4	37.43	31.33	1167.00	40.99	3.96	3.88	10.91	1.01
KLS-5	31.68	32.91	1086.00	38.18	4.17	3.84	11.13	0.89
KLS-6	40.89	35.17	1374.00	43.24	3.99	3.86	11.85	0.73
KLS-7	28.57	32.32	1209.00	29.31	4.05	3.80	12.03	0.81
KLS-8	37.16	31.65	1379.00	48.01	4.15	3.60	9.88	0.90
KLS-9	36.35	31.23	1083.00	29.49	4.14	3.59	9.22	0.86
KLS-10	34.24	32.26	1154.00	41.87	3.96	3.81	12.02	1.06
KLS-11	28.90	32.04	1165.50	30.49	4.06	4.02	11.96	0.99
KLS-12	36.65	31.46	1300.50	47.40	3.96	3.87	9.33	0.86
KLS-13	35.30	31.78	1471.00	52.67	3.94	3.68	9.15	0.91
KLS-14	26.52	31.70	1223.00	38.13	4.05	3.96	11.85	0.70
KLS-15	40.73	31.55	1802.00	63.75	4.36	4.16	11.69	1.30
KLS-16	33.00	31.40	1233.00	33.57	4.09	3.77	13.18	0.92
KLS-17	34.34	31.53	1290.00	30.67	4.10	3.42	12.40	1.03
KLS-18	31.92	30.89	1205.00	42.57	4.14	3.56	10.36	1.02
KLS-19	28.82	28.27	1217.50	45.99	4.12	3.34	10.35	0.94
KLS-20	33.05	32.61	1320.00	53.90	4.02	3.73	8.50	0.72
KLS-21	26.10	29.94	796.50	30.58	3.96	4.16	11.80	0.81
KLS-22	37.62	31.22	1125.50	43.51	4.00	4.08	10.77	0.82
KLS-23	31.34	32.70	1345.50	48.23	4.12	3.58	12.68	0.85
KLS-24	29.33	31.89	850.00	31.72	3.98	3.41	11.91	1.01
KLS-25	38.97	32.35	1001.00	25.07	3.99	3.58	11.38	1.03
KLS-26	34.20	32.86	1031.00	31.99	4.13	3.60	9.05	0.96
KLS-27	34.55	30.80	1328.50	43.19	3.96	4.10	11.39	0.92
KLS-28	36.84	31.46	1150.00	32.68	3.98	3.16	10.64	0.81
KLS-29	40.46	31.01	1165.00	46.60	4.04	4.00	11.00	0.84
KLS-30	34.32	30.59	1057.50	28.16	4.00	3.77	11.25	0.97
KLS-31	33.86	31.89	870.00	23.96	4.15	4.13	9.15	1.05
KLS-32	32.55	29.30	1285.00	39.73	4.09	4.19	11.73	0.94
KLS-33	38.16	31.21	1189.50	34.04	3.99	3.70	10.24	1.02
KLS-34	30.45	33.50	1303.00	43.49	4.10	3.29	10.51	0.81
KLS-35	35.51	33.06	1340.50	36.84	4.25	4.29	12.89	0.79
KLS-36	32.78	33.33	1142.50	36.35	4.03	3.62	13.16	0.98
KLS-37	27.11	33.94	1361.00	37.69	4.04	3.51	12.47	1.02
KLS-38	24.33	32.78	1007.50	34.18	4.10	3.75	8.93	1.15
KLS-39	38.59	31.25	1033.00	29.58	4.18	3.78	11.83	1.23
KLS-40	38.23	31.54	1141.00	38.84	4.17	3.60	11.77	1.04
Mean	34.16	31.83	1191.85	38.53	4.06	3.76	11.15	0.93
SEm	2.28	0.92	81.48	4.98	0.04	0.14	0.60	0.05
CD at 5%	6.53	2.62	233.09	14.26	0.12	0.41	1.72	0.15

Table.4 Genetic variability of fruit quality traits in different strains of Kagzi lime

Strains	Fruit shape index	Fruit size (Sq. cm)	Fruit Shape
KLS-1	0.98	16.44	Oval
KLS-2	1.06	15.61	Round
KLS-3	1.02	15.36	Round
KLS-4	1.02	15.33	Round
KLS-5	1.06	15.58	Round
KLS-6	1.04	15.38	Round
KLS-7	1.07	15.37	Round
KLS-8	1.17	14.93	Round
KLS-9	1.16	14.86	Round
KLS-10	1.04	15.07	Oval
KLS-11	1.01	16.28	Round
KLS-12	1.03	15.34	Round
KLS-13	1.07	14.50	Round
KLS-14	1.02	16.03	Round
KLS-15	1.08	15.40	Round
KLS-16	1.01	17.35	Round
KLS-17	1.20	14.01	Oval
KLS-18	1.16	14.73	Round
KLS-19	1.24	13.73	Round
KLS-20	1.08	14.99	Oval
KLS-21	0.95	16.49	Round
KLS-22	0.98	16.31	Round
KLS-23	1.06	14.77	Oval
KLS-24	1.17	13.56	Round
KLS-25	1.12	14.27	Oval
KLS-26	1.12	14.84	Round
KLS-27	0.97	16.23	Oval
KLS-28	1.26	12.57	Round
KLS-29	1.01	16.16	Round
KLS-30	1.07	15.08	Round
KLS-31	1.01	17.14	Round
KLS-32	0.98	17.14	Oval
KLS-33	1.08	14.75	Round
KLS-34	1.25	13.50	Round
KLS-35	0.97	17.80	Oval
KLS-36	1.07	14.60	Round
KLS-37	1.15	14.20	Round
KLS-38	1.10	15.39	Oval
KLS-39	1.08	15.40	Round
KLS-40	1.16	15.00	Round
Mean	1.08	15.28	-
SEm	0.04	0.60	-
CD at 5%	0.11	1.70	-

The data showed that the minimum rind thickness (0.72 cm) was recorded in KLS-20, It was due to the development of fruit where in the stored food material from the non-edible part of fruit might have been translocated to the edible part (Khodade, 1987). The rind thickness declined while that of the juice increased during the course of development of fruit. These results are in accordance with the results of Prasad (1989) who reported that the peel thickness ranges from 0.89 mm to 2.13 mm in acid lime.

In conclusion, among all Kagzi lime selections the maximum tree height (4.62 m) was recorded in KLS-24, the highest trunk diameter (44.75 cm) were recorded in KLS-16.

The highest number of fruits per plant (1802.00) was recorded in KLS-15. The maximum fruit weight (40.89 g) was recorded in the KLS-6. The maximum equator diameter and polar diameter (4.17 cm and 4.29 cm) was recorded in the KLS-15. The maximum peel thickness (1.30cm) was recorded in the KLS-15 followed by KLS-39 (1.23 cm), KLS-38 (1.15 cm), KLS-10 (1.06 cm) and KLS-31 (1.05) These treatments were on par with each other and the treatment KLS-15 significantly superior over the remaining treatments. The maximum number of seeds (13.18) was recorded in the KLS-16 followed by KLS-36 (13.16), KLS-35 (12.89), and KLS-23 (12.68) was significantly differ over the rest of the treatments and statistically on par with each other.

The maximum fruit size (17.80 Sq. cm) was recorded in the KLS-35 followed by KLS-16 (17.35 Sq. cm), KLS-31, KLS-32 (17.14 Sq. cm), KLS-21 and (16.49 Sq. cm). These treatments were statistically on par with each other, and KLS-35 was significantly superior over the other remaining treatments.

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Author contributions

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