Biochemical Screening of Elite Kagzi Lime in Jammu Subtropics.

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Abstract

A research employing seed-originated germplasm collected from several places in Jammu sub-tropics, J&K (UT), was conducted between 2015 and 2021 in order to choose better strains of kagzi lime (*Citrus aurantifolia* Swingle). The objective was to identify genotypes with better fruit quality in terms of total soluble solids (˚Brix), acidity (%), peel thickness (cm), juice content (%), ascorbic acid (mg/100g of juice). The findings of the factor analysis showed that the KL3 and KL13 had the highest TSS (7.67 ˚Brix), KL1 and KL11 had the maximum acidity (6.79 %), KL1 and KL11 strain had the lowest peel thickness (1.44 mm), KL1 and KL11 had maximum juice content (46.00%), KL1, KL5 and KL11 had maximum ascorbic acid (23.50 mg/100 ml of juice). This study shows the need of choosing superior genotypes for enhanced fruit quality and output while shedding information on the genetic variety of kagzi lime germplasm in Jammu sub-tropics. The results of this study might be used to create breeding programs and encourage the growth of high-quality kagzi lime cultivation in the area.

Key words: Kagzi lime, Germplasm, Fruit quality, Breeding programs, Jammu sub-tropics.

1. Introduction

Kagzi lime (*Citrus aurantifolia* Swingle), behind the mandarin and sweet orange, is the third most important species in terms of fruit production. In addition, it's known by multiple names in English, including Spur Lime, Mexican Lime, Acid Lime, and Pati Lime. In India, 317 thousand hectares are planted with lime and lemon, which yield 3717 thousand MT (Anonymous 2019). In Jammu & Kashmir, citrus is grown in sub-tropical areas different districts Jammu, Kathua, Samba, Udhampur, Reasi, and Rajouri districts etc. In this region, old citrus germplasm, predominantly from seedlings origin are established naturally or propagated through seeds and are at present mostly growing along a strip of roads, riverbanks, undulated terrain in mountainous tracts, government revenue lands, etc., exhibit a wide range of variability in desirable horticultural traits like fruit shape, size, juice consistency, bearing regularity, fruit yield, tolerance/ resistance to various biotic and abiotic stresses etc. much of the areas in Jammu region under rainfed conditions and citrus especially lime is one of most important fruit crops of *kandi* belt (Ahmed et al. 2021). The key component of an effective modern citrus production is genetically superior, disease-free propagation material. In the history of citriculture, bud mutations have happened somewhat often, and there are several documented cases of their economic use (Conti et al. 2021). Numerous studies have examined the assessment of acid lime genotypes and variations during ambia and mrigbahar in different Indian regions. Regarding growth traits, blossoming, fruit development, and maturity, the genotypic character varies according on the genotype and amongst bahars. (Sonwane *et al*. 2020). To boost and optimise lime production in rainfed settings, a thorough investigation was carried out in Jammu subtropical regions to find superior genotypes based on their growth, yield, and quality. It is crucial to remember that human selection, extended cultivation, seed propagation, frequent bud mutation, inter- and

intraspecific hybridization, apomixis, and genus-wide pollination all contribute to the substantial variety found in species and cultivars (Pawar *et al*. 2020). In Jammu & Kashmir, citrus is grown in sub-tropical areas different districts Jammu, Kathua, Samba, Udhampur, Reasi, and Rajouri districts etc. In this region, old citrus germplasm, predominantly from seedlings origin are established naturally or propagated through seeds and are at present mostly growing along a strip of roads, riverbanks, undulated terrain in mountainous tracts, government revenue lands, etc., exhibit a wide range of variability in desirable horticultural traits like fruit shape, size, juice consistency, bearing regularity, fruit yield, tolerance/ resistance to various biotic and abiotic stresses etc. most of the areas in Jammu region under rainfed conditions and citrus especially lime is one of most important fruit crops of *kandi* belt. However so far, no local variety has been released by the SKUAST-Jammu. These studies aimed to screening of superior strains, which has yield potential to be cultivated under rainfed conditions of Jammu region. After a survey in the citrus growing areas of Jammu subtropics, some elite germplasms were selected on the basis of their growth, yield and quality were multiplied and transferred to Research farm at RRSS, Raya- SKUAST-Jammu. The given results of fruit quality information has been published in the annual Report of SKUAST-Jammu and research paper has also been published in Magazine Indian Horticulture (2018) July- August Diversity in Kagzi lime germplasm is promising to Jammu subtropics (Prospect). However so far, no local variety has been released by the SKUAST-Jammu. With the objectives to developed high yield, droughts tolerate and good fruit quality location specific lime efforts with the collaboration of scientists from ACHR Udheywallla and Division of Fruit Science Chatha-Jammu during year 2015- 2021.These studies aimed to screening of superior strains, which has yield potential to be cultivated under rainfed conditions of Jammu region. In conclusion, investigating the morphological variety of Kagzi lime genotypes in the subtropics of Jammu has the potential to greatly enhance lime output in rainfed environments. The genetic diversity of the available germplasm may be utilized to find better strains with desired characteristics.

2. Materials and Methods

Rainfed Research Sub-station for Sub-tropical Fruits (RRSS) at Raya, Samba, SKUAST-Jammu, J&K (UT), the current study was carried out between 2015 and 2021. Different kagzi lime strains tree features were noticed, and the specifics were noted. The peak stage of fruiting, which occurred in August and mid-February to March, was recorded during the investigation. Genotypes of the acid lime (*Citrus aurantifolia* Swingle) were gathered between 2015 and 2021 in Jammu and Kashmir (UT) sub-tropics. A total of 15 acid lime genotypes were gathered from various sites in Jammu subtropics, during the peak fruiting season of 2015–2021 for biochemical characteristics. At least 20 healthy fruits from each genotype were chosen for further examination after the fruits were randomly taken from each genotype. For each genotype, a vernier caliper was used to measure the thickness of the peel. The average peel thickness of ten fruits from each genotype was determined. Using a manual citrus juicer, the fruit juice was extracted. The skin of the chosen fruits were carefully peeled off once they had been cleaned. After that, a muslin cloth was used to filter the liquid to get rid of any remaining solids. Weighing the extracted juice to assess the juice content of each genotype. The weight of the juice that was extracted per 100 g of fruit was used to compute the percentage of juice content. A portable refractometer was used to determine the juice TSS concentration. Juice was dropped onto the refractometer prism, and the reading was obtained. By titrating the juice against a standard solution of 2,6-dichlorophenolindophenol (DCPIP) according to the accepted procedure, ascorbic acid concentration was measured (AOAC 1995). By employing phenolphthalein as an indicator and titrating the juice against 0.1 N NaOH solution, the acidity of the juice was evaluated (AOAC 1995). Analysis of variance (ANOVA) was performed on the data gathered for each parameter, and the means were separated using Duncan's multiple range test (DMRT) at the 5% level of significance. The data recorded for six years in respect of all the above parameters were pooled and average of six years data were subjected to statistical analysis and

for interpretation of results. The analysis of the data was analyzed by one way classification method (Panse and Sukhatme, 1978).

Fig 1: Exploitation of superior strains of lime in Himalayan foothills

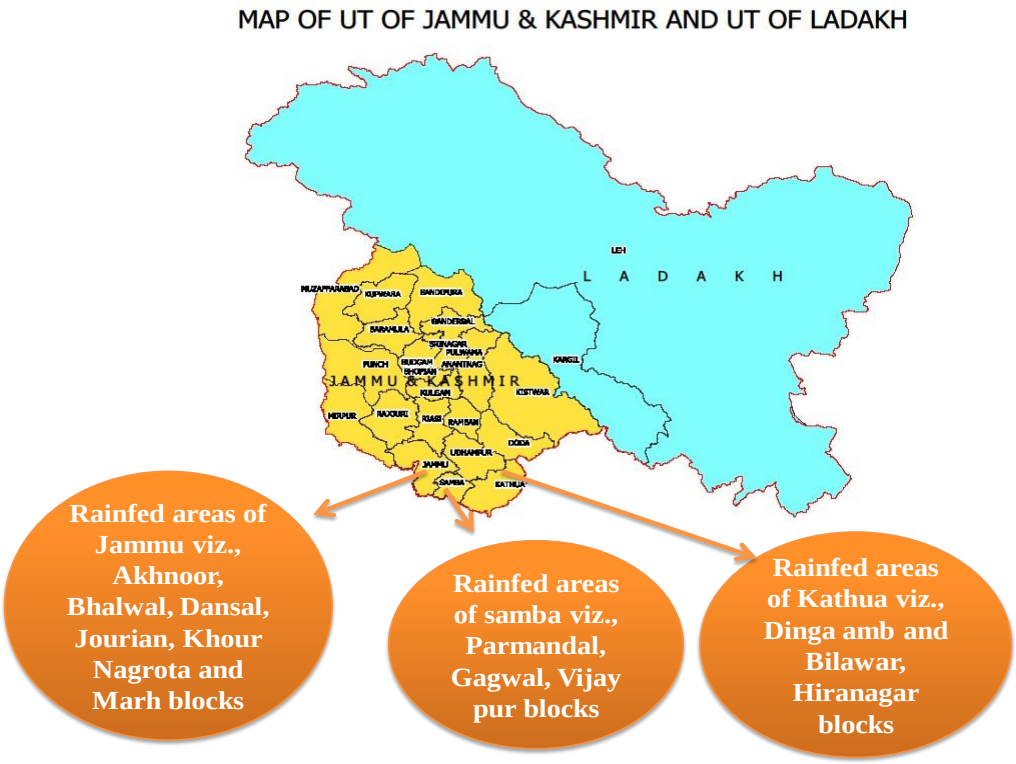


Fig 2. Data processing approach during screening of elite strains of kagzi lime

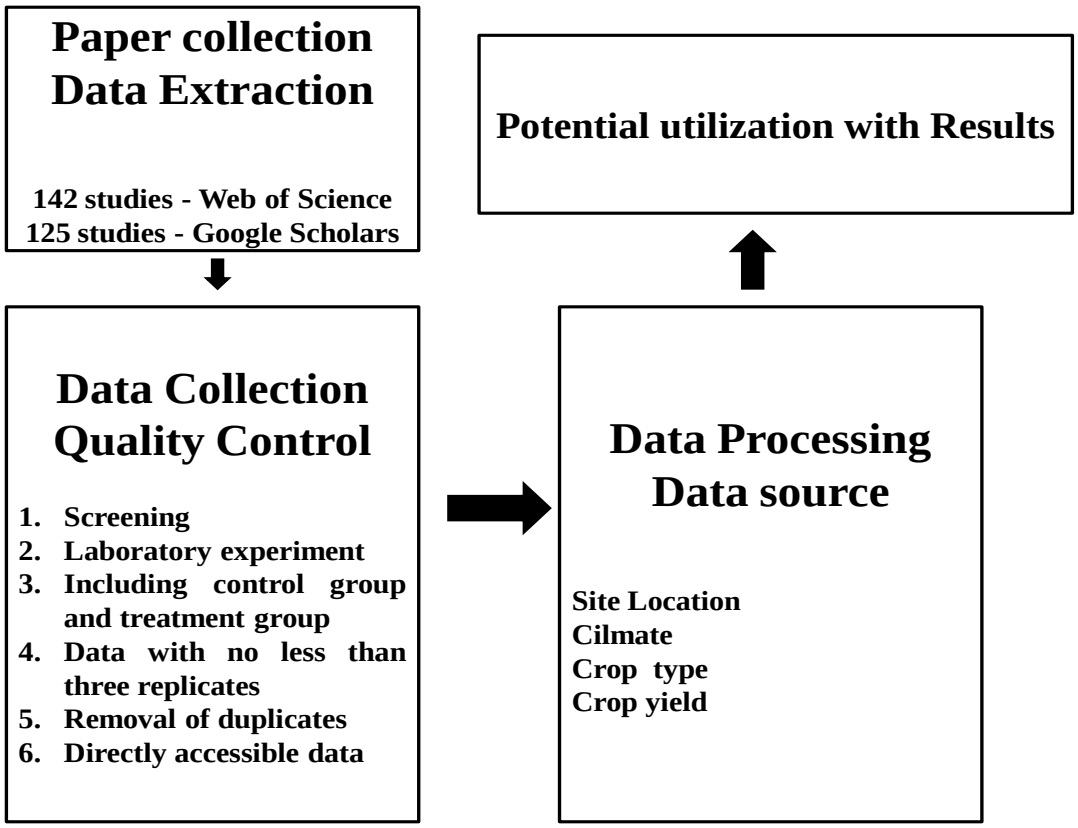
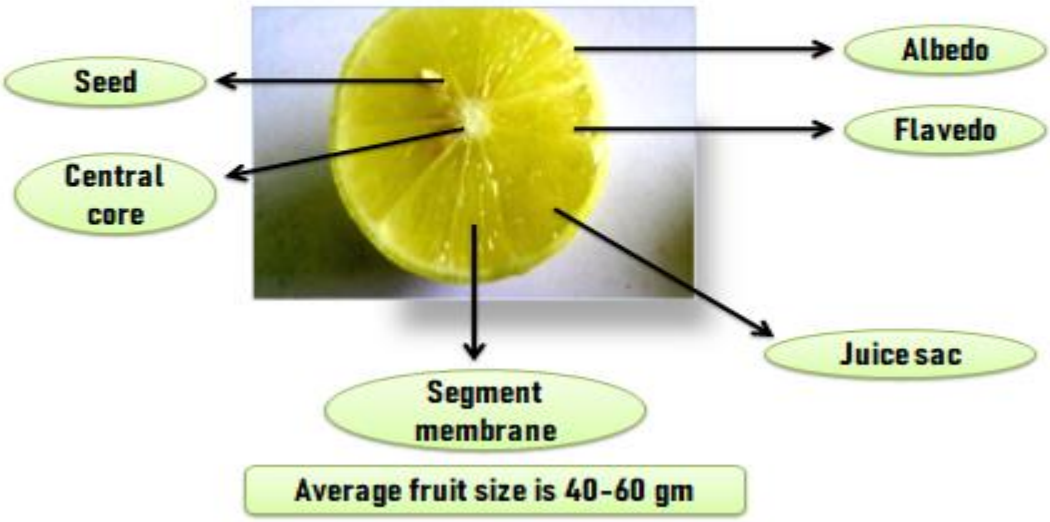


Fig 3. Best strain of Kagzi lime with average fruit size of 40-60 gm.



3. Results and discussions

Total Soluble Solids (T.S.S.) is a significant measure that represents the sugar content in Kagzi lime fruits and is used to assess the ripeness and quality of the fruit. The KL3 and KL13 both strains has the highest T.S.S value, measuring 7.67 (˚Brix). This is may be due to the genetic make-up of the strain and/or the environmental and cultural circumstances in which it was produced may both have contributed to the greater T.S.S value in the KL3 and KL13 strains. The transformation of starch and related insoluble carbohydrates into soluble forms of sugar may be the cause of the rise in TSS concentration (Hulme, 1970).

Table 1: Fruit quality parameters of Kagzi lime (*Citrus aurantifolia* Swingle) strains.

S.NO.	Genotypes	TSS (˚Brix)	ACIDITY (%)	PEEL THICKNESS (CM)	JUICE CONTENT (%)	ASCORBIC ACID (MG/ 100G)
1	**KL1**	7.20	6.79	1.44	46.00	23.50
2	**KL2**	7.30	6.50	1.66	45.40	22.50
3	**KL3**	7.67	5.80	1.70	45.00	23.00
4	**KL4**	7.01	6.58	1.66	44.70	21.50
5	**KL5**	6.92	6.44	1.75	44.00	23.50
6	**KL6**	6.99	6.37	1.80	42.00	22.50
7	**KL7**	7.00	6.36	1.66	42.50	21.22
8	**KL8**	6.91	6.44	1.46	42.30	22.11
9	**KL9**	6.90	6.37	1.66	43.40	22.33
10	**KL10**	6.70	6.36	1.70	43.40	22.11
11	**KL11**	7.20	6.79	1.44	46.00	23.50
12	**KL12**	7.30	6.50	1.66	45.40	22.50
13	**KL13**	7.67	5.80	1.70	45.00	23.00
14	**KL14**	7.01	6.58	1.66	44.70	21.50
15	**KL15**	6.92	6.44	1.75	44.00	23.50
	Mean	6.81	6.28	1.66	43.54	22.58
	C.V.	0.83	0.36	1.52	0.04	0.65
	S.E.	0.03	0.01	0.01	0.01	0.08
	C.D. 5%	0.10	0.04	0.04	0.04	0.24
	C.D. 1%	0.13	0.05	0.06	0.05	0.33
	Range Lowest	6.67	5.79	1.42	50.21	21.19
	Range Highest	7.62	6.77	1.79	54.63	23.51

A fruit acidity is reported as a percentage and is based on how much acid, primarily citric acid, is contained in it. With a score of 6.79%, KL1 and KL11 both strains has the highest acidity. Numerous elements, including soil and climatic conditions, harvest ripeness, and genetic diversity, may contribute to KL1 high acidity. The acidity levels of fruits can also be impacted by environmental variables including temperature and rainfall (Pandey and Singh 2012). Additionally, the genetic diversity of the strain can be a major factor in determining the acidity levels (Khalid *et al.* 2005). As a result, the KL1 strain may be genetically predisposed to have greater amounts of acidity than other strains. During development, the acidity rises and

reaches levels that are less than ideal for enzymatic activity. To promote growth and development in lemons, imported sucrose must be catabolized before it reaches vacuolar acid levels that can sustain physiological rates of acid hydrolysis (Echeverria, 1990). These findings agree with the previous research conducted by Jature and Chakrawar (1981) who studied physico-chemical characters of 89 Kagzi lime strains. They found highest acidity (8.5%) in ABD 7, followed by ABD 5 (8.40%) and PBN 1 (8.29%). Bagde and Patil (1989) also reported that the highest acidity (8.29%) in Chakradhar lime.

The KL1 and KL 11 genotypes measured the minimal peel thickness, 1.44 mm, in each case. The highest peel thickness measured in KL6 was 1.80 mm. It may be the result of how fruit develops, where food stuff that has been stored in the fruit's inedible parts may have moved to the edible parts (Khodade, 1987).

The findings demonstrated that the genotypes KL1 and KL11 had the highest juice percentage (46.00), followed by KL2 and KL12 (45.40), while KL6 had the lowest juice percentage (42.00). This may be because fully formed larger fruits produce proportionally more juice than smaller ones. Fruit volume and juice content have a very strong positive correlation. According to Hittalmani and Rao (1976), the juice content of Kagzi lime fruits rose steadily but fluctuated, reaching a maximum value of 51.1% at maturity. Of the 27 clones, clone no. 15 had a juice percentage of 48.12, according to Prasad (1989).

A study of genotypes KL1, KL5, and KL15 revealed the highest ascorbic acid levels (23.50 mg/100 ml), with KL3 and KL13 genotypes following closely behind with 23.00 mg/100 ml apiece. Since the fruit produces ascorbic acid from precursors of hexose sugar, an increase in ascorbic acid was linked to a quick rise in total sugar (Mapson, 1970). The rate of respiration reduced as the fruit grew more mature. As the season came to a conclusion, there were changes in the contents of carbon compounds that produce respiration activity, primarily in the form of sugars and acids (Soni and Randhawa, 1969). These findings are consistent with those of Tirthakar et

al. (2004), who investigated fruit quality characteristics of 48 acid lime genotypes in the Akola District and found that the highest ascorbic acid content in juice was 31.86 mg/100 ml. Similarly, Srinivas et al. (2006) found that the highest ascorbic acid content in seedling strains of Kagzi lime was 39.70 mg/100 ml. These outcomes agree with the previous research conducted by Mukhim et al. (2005) and Srinivas et al. (2006). To fully comprehend the underlying causes of the variance in T.S.S. among the Kagzi lime strains, more investigation is necessary.

4. Conclusions

Significant differences in fruit quality criteria were found in the study on Jammu subtropical kagzi lime germplasm originating from seeds. KL1 and KL11 displayed the highest acidity and juice content, as well as the thinnest peel, while KL3 and KL13 displayed the highest total soluble solids. These results highlight how crucial it is to choose better genotypes in order to improve fruit output and quality. This study offers insightful information for breeding initiatives that support the region's high-quality kagzi lime production.

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