

CHARACTERIZATION OF GUAVA CULTIVARS AND LANDRACES OF NEPAL

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ABSTRACT

This study involved two experiments with the aim to identify the superior guava cultivars and landraces of Nepal during May to September 2006. The first experiment comprised of different cultivars and landraces at farmers field of 4 districts, viz Chitwan, Jhapa, Dang and Dhading. It revealed that fruits collected from Bankatta, Dang had the highest fruit length and the fruits collected from Chitwan had the highest fruit diameter as well as weight. The fruits collected from Kirat Colony, Jhapa, had the highest TSS content. Vitamin C was found as the highest in fruit collected from Muralibhanjyang, Dhading. The number of seeds and total acidity was also observed as the highest in this cultivar. The 2nd experiment carried out at Rampur guava orchard was laid out in a randomized complete block design (RCBD) with 24 treatments replicated thrice. The experiment was carried out on 5 years old plants growing at a distance of 4 m² in square system. Significant variations were found among cultivars and landraces regarding physico-chemical character of fruits such as fruit weight, fruit size, maturity days, productivity, total soluble solid, titrable acidity, TSS: TA ratio and ascorbic acid content. It can be concluded that the guava cultivars at different places of the country as well as those planted at Rampur guava orchard vary in physicochemical characteristics that can be utilized in the breeding program to develop new and more improved cultivars.

Key words: Guava fruit, Total Soluble Solid (TSS), titrable acidity (TA), Vitamin C

Introduction

Guava (*Psidium guajava* L.), popularly known as poor man's apple, is one of the most common high value fruit crops. It offers the opportunity for higher productivity even in marginal land with favorable income generation and environmental effects. Literature suggests that it has been cultivated since early times and gradually became a crop of commercial significance (Chattopadhyay, 1996). This crop is extensively distributed throughout the country except in some temperate areas i.e. Manang, Mustang, Dolpa, Mugu, Humla and Jumla districts. This fruit is cultivated in almost all agro-ecological regions of Nepal ranging in altitude from 115 masl at Bara to 1600 masl at Terhathum (Shrestha et al., 2004). The major pocket areas of guava are located in the mid hill and terai districts of Nepal, such as Kavre, Dhading, Tanahun, Sankhuwasava, Chitwan, Kaski, Terhathum, Lamjung, Arghakhanchi, Ilam, Dhankuta, Nawalparasi, Dang, Kanchanpur, Surkhet, Doti, Bara, etc. (Shrestha et al., 2004). The variation in physico-chemical characters of fruit among the different guava cultivars has been reported by Roy and Ahmed (1951).

Guava wilt, a major biotic constraint, was reported from major guava growing pockets/districts of Nepal (Shrestha, 2004). Almost all of the commercial cultivars are susceptible to this disease. The production and productivity of guava can only be improved if wilt problem is managed properly. The only practical and effective way to minimize this problem is the cultivation of wilt resistant guava cultivars as well as the wilt free saplings containing wilt tolerant/resistant rootstock. Earlier studies conducted at Rampur, Chitwan indicated

the variation among guava cultivars/landraces with respect to the resistance against wilt disease (Shrestha, 2004). Few of the cultivars/landraces collected from various places in the country are suitable for using as scion while others for using as a resistant rootstock. But, sufficient information especially related to fruit physical as well as chemical characters is needed for commercial cultivation. Therefore, the study was conducted with an urgent need to have thorough study of cultivars/landraces present in different locations/districts of the country and Rampur orchard (where more than 50 cultivars/landraces of guava were collected from different parts of country and India) with respect to physico-chemical characteristics of fruits prior to recommending them for their cultivation as commercial cultivars and as rootstock for the production of wilt free saplings.

Materials and Methods

Two experiments were carried out in 2006. The specific locations where the 1st experiment was conducted were: Jhapa (Jalthal, Dangibari, Kirat Colony, Haldibari, Kaptanbari, Satasi, Budhabare, Siddhipani, Gopaldanda and Sanischare), Chitwan (Panchakanya, Madhavpur, Sukranagar, Rodhigaun, Fulbari), Dhading (Bunrang, Dhusa, Dhadingbesi, Muralibhanjyang, Benighat, Rechowk, Sankosh) and Dang (Hapur, Manpur, Bankatta, Sisahaniya, Narti and Ghorahi). The 2nd experiment was carried out in guava orchard at Horticulture farm, Rampur, Chitwan (225 masl).

For the analysis of the physico-chemical properties of fruits, bearing fruit trees at different age group were selected in the 1st experiment. Each tree at the specific location was considered as a treatment and ten fruits from each of the selected plants were considered as replication. In the 2nd experiment, 5 years old guava plants propagated sexually except Lalit (prepared by grafting) which were uniform regarding shape, size and vigor and were spaced 4m² in square system were selected. This experiment was laid out in Randomized Complete Block Design (RCBD) with twenty-four treatment replicated thrice. A single plant of each cultivar/landrace was considered as a treatment. Therefore, seventy-two plants were selected for the 2nd experiment.

The fruits were harvested at full maturity with appearance of slightly yellow color. Ten representative fruits (two from each of the four directions and remaining two from middle portion of the plant) were sampled for study. Fruit were weighed using balance while length and diameter was measured using Vernier caliper. Fruit were horizontally cut and average number of segments and seed was counted. Flesh color was observed visually. To calculate the maturity days, days from flowering to ripening was recorded by observing the flowers and fruits only in the second experiment. When 50% flowers opened, the flowering date was recorded and when 50% fruits ripened, then ripening date was recorded. Total fruit yield in terms of number and weight (Kg) was recorded per plant in the case of the second experiment.

The total soluble solids content of fruit juice was measured with the help of a Handheld Refractometer (Model: Erma, Japan) and expressed as OBrix. The titrable acidity in terms of anhydrous citric acid was measured by titrating the juice against 0.1N sodium hydroxide (NaOH) solution using phenolphthalein indicator. TSS and TA ratio was calculated simply by dividing the TSS of the sample by the respective TA content. The ascorbic acid/ vit C content of juice was determined by volumetric method using 2, 6-dichlorophenol indophenol dye (Sadasivam and Manickam, 1991).

For the 1st experiment, the mean value and the standard deviation were calculated using MS Excel. For the 2nd experiment, data were compiled using Microsoft Excel and analyzed statistically by using MSTAT-C. Means were separated by using Duncan's Multiple Range Test (DMRT) at 5% level of significance (Gomez and Gomez, 1984).

Result and Discussion

Experiment 1

The result of the physio-chemical characteristic of the fruits collected from different places in 4 districts of the country viz: Chitwan, Dhading, Jhapa and Dang are presented in the following section.

Chitwan

The highest fruit weight was found in the K.G.1 collected from Fulbari of Chitwan, which was 7.1 cm in length, 8.0 cm in diameter, 251 g in weight and 94.78 g/100g in vitamin C content. The highest TSS content (11.50 Brix) was estimated in Fulbari Local where as the highest acidity was found in fruits collected from Panchakanya. Only the fruit collected from Madhavpur had pink flesh, where as rest fruits had white flesh. The wilt resistant Chinese guava was collected from Sukranagar which had the lowest length (2.8 cm), breadth (2.5 cm) and weight (9.94 g) (Table 1).

Dhading

Fruit were collected from Bungrang, Dhadingbesi, Muralibhanjyang, Richok, Dhusa, Sankosh of Dhading. The fruits from Muralibhanjyang had the greatest fruit length (6.6 cm), diameter (7.6 cm) and weight (220.6 g) including the vitamin C content (116.38g/100g). The TSS content was recorded as the highest in fruit collected from Sankosh Bikase-1 and the highest titrable acidity in Sankosh Bikase-2 collection. All the fruits collected from Dhading had white flesh (Table 2).

Dang

Fruit were collected from Hapur, Manpur, Bankatta, Sisahaniya, Narti and Dharna of Dang. The highest length (7.3 cm), diameter (7.8 cm) and weight (180 g) as well as the titrable acidity were recorded in fruits from Bankatta. T.S.S. content was observed as the highest (11.900 Brix) from Barhamashe of Sisahaniya, while the lowest from fruits of Dharna. Vitamin C was recorded as the highest from fruits of Manpur (Table 3).

Jhapa

Various places of Jhapa like: Jalthal, Dangibari, Kirat colony, Haldibari, Kaptanbari, Budhabare, Siddhipani, Gopaldanda, Sanischare and Satashi were visited to collect the fruit samples. Fruits with the highest length (6.33cm), diameter (6.34 cm) and weight (160 g) were of Jalthal. T.S.S. and vitamin C content was obtained as the highest (14.20 Brix and 71.72 mg/100g fruit respectively) in Haldibari collection (Table 4).

Experiment 2

Fruit Size, Shape and Texture

The guava cultivars/landraces at fruit orchard established at Rampur, Chitwan were highly significantly different with respect to fruit weight, length and diameter (Table 5). The mean value of fruit weight, length, diameter for all the cultivars/landraces was measured as 60.38 g, 4.63 cm, and 4.67 cm respectively. The highest fruit weight of 104.12 g was recorded with Allahabad Safeda which was statistically at par with KG-1 (90.43 g). The lowest fruit weight was measured as 28.33g in Kaski Local, Kathe. The longest fruit (5.78 cm) was obtained with KG-1 which was statistically at par with Allahabad Safeda (5.61cm), where as the shortest fruit was 3.78 cm in Kaski Local, Kathe (KF2). The highest fruit diameter of 5.64 cm was recorded in Allahabad Safeda, which was statistically at par with KG-1 (5.34 cm), Kavre Collection, Allahabad Red and Bikasi Seto where as the shortest

fruit diameter was measured as 3.64 cm in Kaski Local, Kathe (KF2). Among 24 guava cultivars/landraces, fruit of 10 guava cultivars/landraces were round in shape while 6 of them were ovoid and rest 8 were pear shaped (Table 5). Regarding the surface texture, 9 guava cultivars/landraces were smooth, 8 were semi-rough and 7 were rough.

The present finding is in conformity with the reports of Daulta et al. (1998) and Crane and Balerdi (2005) who mentioned that the weight, length, diameter of fruit varies with cultivars. Most economically significant fruit traits show quantitative variation which is controlled by a combination of genetical and environmental factors (Thiapong and Boonprakob, 2005). Therefore, variation in the fruit weight of these cultivars/landraces might be attributed to the genetic diversity, especially the variation in the length and diameter. The variation in size and shape of the fruit might have resulted from different intensity of pollination, flowering and fruiting. Higher pollination increases the diameter of fruits resulting in shorter fruit length. Fruit size, shape and texture varies with genetic makeup, crop load, season and pollination. More pollination results in more number of seeds and seeds are the source of auxin which influences the shape and size of fruit. Distributions of seeds in the fruits also influence the shape of fruits. A similar reason was reported by Sapkota (2006) in Acid lime.

Seed Number and Flesh Color

The mean number of seed per fruit for all the cultivars/landraces was measured as 236.75. The highest number of seed per fruit (452.17) was recorded in Kavre Collection where as the lowest seed number per fruit was measured as 45.71 in Dadeldhura Collection (Table 5). With respect to flesh color, creamy white flesh was recorded in 17 guava cultivars/landraces whereas the minimum number of cultivars (7) was observed as pink fleshed.

The present finding is in conformity with report of Chauhan and Dhaliwal (1993) who mentioned that the seed number per fruit varies with different cultivars. Iyer and Subramanyam (1976) have also reported higher seed number due to cross pollination. Morton (1987) mentioned that the flesh color of fruit of plant varied with different cultivars. Therefore, variation in the seed per fruit and the flesh color may be attributed to the genetic characters, intensity of pollination and seasonal effect. Similar reason was stated by Sapkota (2006) in Acid lime.

Maturity Days and Productivity

The mean maturity days of fruits for all the cultivars/landraces was measured as 105.14. The longest duration of 121.67 days was taken by fruits of Red Fleshed where as the shortest period of 91 days in Red Fleshed (Table 5). Regarding the productivity, the mean number of fruit per plant and fruit production in Kg/plant for all the cultivars/landraces was measured as 308.65 and 17.50 respectively (Table 5). The highest number of fruit per plant was recorded as 720 in Dhankuta Local where as the lowest number was measured as 56 in KG-1. The present finding is in line with the report of Shrestha (1996) who mentioned that the number of fruit per plant fluctuates with different cultivars. Likewise, the highest fruit production (32.99 Kg/ plant) was recorded in Allahabad Red where as the lowest production (4.04 Kg/plant) in Dadeldhura Collection.

The present finding is in conformity with the report of Shrestha (1996) who mentioned that the maturity period of fruits differs with cultivars. Morton (1987) reported that the total time taken from flowering to fruit maturation ranged from 90 to 150 days. Crane and Balerdi (2005) mentioned that the fruit production (Kg/plant) varies with cultivars. Daulta et al. (1998) reported that the yield ranged from 86 kg/tree/year in Banarasi Surkha and 114kg/tree/year in Hisar Safeda. Such variation with respect to maturity days and yield of fruits might be due to the variation in physiological process, hormonal effect, genetic character and environmental factors (Acquach, 2002).

Chemical Character

The mean TSS content, TA, TSS/TA ratio and ascorbic acid content of fruits for all the cultivars/landraces was measured as 7.420 Brix, 0.57%, 14.21 and 71.18 mg/100 g pulp (Table 6). Among different cultivars/landraces, the highest TSS content of 10.620 Brix was recorded in Kaski Local, Kathe. Similar result was found in Dadeldhura Collection (10.330Brix), where as the lowest TSS (5.70 Brix) in Kathmandu Collection. The highest titrable acidity of 0.99% was recorded with Dadeldhura Collection which was statistically at par with Lamjung Collection and Lucknow-49 where as the lowest titrable acidity was measured as 0.3% in Red Fleshed. The highest TSS:TA ratio of 22.99 was recorded in Red Fleshed whereas the lowest TSS:TA ratio was measured as 8.43 in Lamjung Collection. The highest ascorbic acid content of 166.95 mg/100g pulp was recorded in Makawanpur Collection, where as the lowest ascorbic acid content was measured in Dhankuta Local.

The present finding is in harmony with the finding of Chauhan and Dhaliwal (1993) and Daulta et al. (1998) who observed that the TSS and TA of fruit varied with different cultivars. The variation in the TSS content of fruits among different cultivars/landraces might be due to the temperature effect, volume of juice, etc. Generally, the TSS decreases with increase in temperature and juice volume. However, varying proportions of the seedlings showing higher acidity may be attributed to transgressive segregation. The variation in the chemical quality parameters in guava fruits could be due to genetic factor. The variation in TSS: TA ratio of fruits is mainly due to the variation in the TSS and TA content of fruits of these cultivars/landraces. In addition, Ghosh and Chattopadhyay (1996) mentioned that the ascorbic acid content of guava fruit varies with cultivars.

Conclusion

The study on different cultivars and landraces at farmers' field of 4 districts revealed that fruits collected from Bankatta, Dang had the highest fruit length and the fruits from Chitwan had the highest fruit diameter as well as weight. The fruits collected from Jhapa, Kirat Colony had the highest TSS content. Vitamin C content, number of seeds and total acidity was found to be present in the highest amount in fruit collected from Dhading, Muralibhanjyang. In the 2nd experiment also, significant variation was recorded among cultivars and landraces. The highest and lowest fruit weight was found in Allahabad Safeda and Kaski Local respectively. The longest and shortest fruit length was found in KG-1 and Kaski Local, Kathe respectively. The longest and shortest fruit diameter was found in Allahabad Safeda and Kaski Local, Kathe respectively. Fruits in majority of cultivars are round in shape, smooth in fruit surface texture with creamy white flesh. The longest duration for fruit maturity was counted in Red Fleshed. The highest and lowest number of fruit per plant was found in Dhankuta Local and KG-1 respectively while the highest and lowest production of fruit in Kg/plant was found in Allahabad Red and Dadeldhura Collection respectively. The highest TSS content in fruit was found in Kaski Local, Kathe while the highest TA content was recorded in Dadeldhura Collection. Consequently, the highest TSS:TA ratio of fruit was found in Red Fleshed. The highest ascorbic acid content of fruit was observed in Makawanpur Collection. Based on these findings, it can be concluded that the cultivars and landraces viz. Allahabad Red, Kaski collection, Dhankuta Local and Kavre Collection were found high yielders with medium fruit size, medium maturity days with sweet taste.

The present study indicated that there was a huge genetic diversity among the different guava cultivars and landraces for various phenotypic and economic characters. Many of these variations have economic importance for their commercial cultivation. Therefore, there is also a good potential to recommend them for commercial exploitation and they can be utilized in the breeding program to develop new and more improved cultivars. But, this study covers limited plants of the guava cultivars and landraces of Nepal. Assessment of

all available cultivars and landraces and their periodic quality assessment are required. So, it needs further investigation for more conclusive results.

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Table 1. Physical and chemical properties of guava fruits of Chitwan, 2006

Cultivar/Landrace	Fruit length (cm)	Dia. (cm)	Skin color	Pulp color	Fruit wt (g)	Segment/fruit	Seed/fruit	TSS (°Brix)	TA (%)	Vit C (mg/100g)
Panchakanya/Tripathi	5.1	5.06	Greenish white	White	73.4	5	362	8.5	1.39	81.36
Madavpur /Red fleshed/Poudeh	4.46	5.02	Yellowish green	Pink	65.2	6	580	8.5	0.72	51.34
Madavpur/Local/Poudeh	4.36	4.64	Yellowish green	White	62.2	6	460	7.7	1.11	50.55
Sukranagar/Kusmakar/Chinese	2.84	2.5	Greenish white	White	9.94	4	48	9.35	0.93	57.66
Rodhigaun/Local/Thulo	5.86	4.82	Greenish white	White	79.5	4	453	9.7	1.11	63.19
Rodhigaun/ Local/ Narayan	4.12	4.06	Greenish white	White	38	4	186	8.05	1.23	41.07
Sukranagar/Local/ Kusmakar	5.48	4.8	Yellowish green	White	60	5	508	9.35	0.93	57.66
Fulbari/ Local/Adhikari	5.03	4.38	Greenish	White	42.8	5	182	11.5	1.15	43.44
Fulbari/KG1/ Adhikari	7.15	8	Yellowish	White	251	5	320	5.85	0.64	94.79

Table 2. Physical and chemical properties of fruits of Dhading, 2006

Cultivar/Landrace	Fruit length (cm)	Dia. (cm)	Skin color	Pulp color	Fruit wt (g)	Segment/fruit	Seed/fruit	TSS (°Brix)	TA (%)	Vit C (mg/100g)
Bungrang Local	4.85	4.34	Yellow	White	45	4	288	11	0.96	54.97
Dhusa/ Gothebhanjyang	5.66	5.08	Yellow	White	75.1	5	220	9.73	0.77	73.54
Dhadingbesi collection/Maidi	5.46	4.78	Yellow	White	65.64	5	486	8.8	0.93	94.24
Chudamani/ Murlibhanjyang	6.62	7.62	Yellow	White	220.6	5	28	9.07	0.26	116.38
Bhenighat/Richok/Bikase	6.42	7.06	Yellow	White	192.87	5	341	11	0.64	69.25
Benighat /Richok/Local	5.26	4.74	Yellow	White	66	5	503	7.03	0.66	67.11
Dhusa/Local	5.58	5	Yellow creamy	White	76.7	4	257	11	0.92	54.28
Sankosh/ /Bikase-2	6.28	4.92	Yellow	White	88.56	4	680	11.03	1.05	122.09
Sankosh//Local	4.98	4.4	Grey white	White	52.6	4	299	10.57	0.83	116.38
Nar/Murlibhanjyang	5.08	4.5	Grey white	White	81.73	4	234	11.45	0.84	99.96

Table 3. Physical and chemical properties of fruits of Dang, 2006

Cultivar/Landrace	Length (cm)	Dia. (cm)	Fruit wt (g)	No. of locule	TSS (°Brix)	TA (%)	Vit C (mg/100g)
Hapur Local	5	4.4	44	4	8.8	0.81	37.32
Hapur Bikase	5.9	6	76	4	7.8	1.2	98.64
Manpur/ Gehendra	4.6	4.1	48	4	7.8	0.79	103.97
Bankatta/Dilli	7.3	7.8	180	4	9.6	1.37	80.65
Manpur/ Bisnumani	3	3.9	36	5	8.4	1.11	47.99
Sisahaniya	5.1	5.1	56	4	8	1.02	53.99
Nari Local	6.2	4.5	44	5	6.9	1.28	71.32
Sisahaniya Baramase	4.9	4.6	50	5	11.9	0.61	34.66
Dharna	6.1	6.2	100	5	9.5	0.61	41.32

Table 4. Physical and chemical properties of fruits of Jhapa, 2006

Cultivar/Landrace	Length (cm)	Dia. (cm)	Segment	Skin color	Flesh color	Seed/Fruit	Fruit wt. (g)	TSS (°Brix)	TA (%)	Vit C (mg/100 g)
Jalthal/ Arjun	6.33	6.34	5	Greenish white	White	360	160	10	1.02	63.38
Jhapa/S/S	4.54	4.28	4	Yellowish white	White	155	46.5	6.9	0.73	53.93
Jhapa/S/M	5.12	4.88	4	Yellowish white	White	214	69.94	6.9	0.96	68.39
Jhapa/S/L	4.86	5.68	5	Yellowish white	White	217	96.1	9.5	1.06	60.05
Jhapa/Dangbari/Large	5.4	4.92	5	Yellowish white	White	490	76.6	10.1	1.01	47.26
Kirat colony/Pokharel	5.84	4.44	5	Yellowish white	White	211	65	14.2	0.98	53.38
Haldibari/Bindu	5.16	5.44	5	Yellowish white	White	232	88.18	10.9	1.34	71.72
Kaptanbari/Thulo/Acharya	5.55	6.53	5	Greenish white	White	77	134.85	9	0.66	24.46
Satas/ Kadariya	5.04	3.86	4	Greenish white	White	235	36.96	10.3	1.23	45.04
Budhabare collection	5.93	6.43	5	Greenish white	White	174	140	9.3	1.02	46.7
Siddhipini/Gopal	5.28	4.78	4	Greenish white	White	610	65	9.2	1.01	23.35
Gopaldanda/ Naite/ Dhimal	5.36	3.98	4	Yellowish white	White	313	40.14	9.1	1.23	20.57
Sanischare/ Timilsina	4.98	5.8	5	Yellowish white	White	488	107.48	5.4	0.81	54.49
Gopaldanda/ Golo/Dhimal	4.94	4.66	5	Greenish white	White	499	60.72	7.9	1.3	16.68
Shiddipani/ Pashupati	5.88	5.42	4	Greenish white	White	512	103.02	8.7	1.66	28.36
Jalthal/Mina	5.23	6.3	6	Greenish white	White	259	126.8	7.8	1.01	24.46
Kaptanbari/Naite/Acharya	4.96	4.16	4	Greenish white	White	291	43	10.7	1.02	26.13

Table 5. Physical quality parameters of guava fruit at Rampur, Chitwan, 2006

SN	Cultivar/landrace	Fruit length (cm)	Fruit diameter (cm)	Fruit wt. (g)	Fruit shape	Fruit surface texture	Seed/ fruit	Flesh color	Maturity days	No. of fruit/ plant	Fruit wt. (Kg/plant)
1	Allahabad Red (BF3)	5.23 bc	5.16 abcd	76.13 bcd	2	1	113.23 lm	2	111.33 d	433.3 c	32.99 a
2	Dadeldhura Collection (DF6)	4.84 cdefg	4.88 bcdef	64.17 def	3	3	45.17 o	1	98.67 gh	63 i	4.04 o
3	Kavre Collection (KVF14)	4.60 efghij	5.33 abc	80.03 bc	1	1	332.9 d	2	116.33 bc	154.7 gh	12.37 ijkl
4	Dhankuta Local (DF3)	4.31 ghijkl	3.95 hi	36.45 hijk	3	1	124.1 l	1	91.33 i	720 a	31.00 ab
5	Bara Local (BF4)	4.14 jkl	4.27 gh	47.33 fghij	1	3	342.13 d	1	102.33 fg	428 c	20.25 ef
6	Red Fleshed (TF3)	4.27 hijkl	4.32 fgh	50.35 efghi	2	1	193.27 j	2	91 i	198 fg	9.10 klm
7	Red Fleshed (BT)	3.87 kl	3.89 hi	30.17 jk	1	2	91.1 n	2	121.67 a	280 e	8.44 lmn
8	Bhoteodar Local (LF4)	4.65 defghij	5.01 bcd	68.67 cde	3	2	285.33 g	1	103.67 f	306.7 de	21.05 e
9	Kaski Local, Kathe (KF2)	3.77 l	3.64 i	28.33 k	3	3	237.8 hi	1	113.67 cd	470 c	13.31 hijk
10	Kavre Collection (KVF2H)	4.86 cdef	4.73 cdefg	63.60 cdef	1	1	452.17 a	1	102.33 fg	466 c	29.63 ab
11	Arghakhanchi Red (AF3R)	4.77 cdefgh	4.34 fgh	54.40 efgh	2	2	184.17 j	2	111.67 d	119.7 hi	6.50 mno
12	Makawanpur Collection (MF1)	4.37 fghijk	4.25 gh	50.40 efghi	1	3	124.17 l	1	101.67 fg	164 gh	8.27 lmn
13	Lamjung Collection (KF6)	4.71 cdefghi	5.01 bcd	67.63 cde	3	2	303.27 e	1	113.67 cd	243.3 ef	16.45 fghi
14	Kaski Collection (KF5)	4.68 defghij	4.69 defg	58.67 defg	2	2	355.13 c	1	103.67 f	540 b	31.68 ab
15	Bikase Seto (GF6)	4.38 fghijk	4.23 gh	43.50 gk	2	1	229 i	2	107.33 e	260 ef	11.31 jkl
16	Red Fleshed (KVF13H)	5.12 bcd	4.67 defg	60.67 defg	2	3	290.4 ef	1	101.33 fg	421.7 c	25.58 cd
17	Bikasi Seto (LF7)	4.77 cdefgh	5.11 abcd	64.03 cdef	1	1	297.73 ef	1	103.33 f	350 d	22.41 de
18	Lucknow-49 (BF2)	5.02 cde	4.90 bcdef	75.40 bcd	1	3	109.3 m	1	103.67 f	196.7 fg	14.82 ghij
19	KG-1 (MF2)	5.78 a	5.34 ab	90.43 ab	3	2	248.83 h	1	97 h	56 i	5.06 no
20	Kathmandu Collection (KATHF4H)	4.55 efghij	5.01 bcd	67.57 cde	1	2	150.97 k	1	97.67 h	280.7 e	18.94 ef
21	Lamjung Local (LF6)	4.48 efghij	3.82 hi	34.03 ijk	3	1	155 k	1	92 i	543.3 b	18.48 efg
22	Allahabad Safeda (BF1)	5.61 ab	5.64 a	104.12 a	1	2	375.13 b	1	92 i	266 ef	27.69 bc
23	Lalit	4.21 ij	4.93 bcde	68 cde	3	2	366.97 bc	2	117.33 b	246.7 ef	16.77 fgh
24	Indian (RG)	4.20 ijkl	4.89 bcdef	65 cdef	1	3	274.7 g	1	117.33 b	200 fg	13 hijk
	Mean	4.63	4.67	60.38	1.92	1.96	236.75		105.14	308.653	17.5
	F-test	**	**	**	**	**	**	**	**	**	**
	SEM±	0.1633	0.1817	5.619			4.384		1.168	22.13	1.299
	LSD (≤ 0.05)	0.4649	0.5171	16			12.48		3.325	62.99	3.697
	C.V (%)	6.09	6.73	16.12			3.21		1.92	12.42	12.85

Table 6. Chemical quality parameters of guava fruit at Rampur, Chitwan, 2006

SN	Cultivars/landraces	TSS (0Brix)	TA (%)	TSS : TA ratio	Ascorbic acid (mg/100g)
1	Allahabad Red (BF3)	6.37 gh	0.40 hijk	16.85 bcd	72.37 cdef
2	Dadeldhura Collection (DF6)	10.33 a	0.99 a	10.59 ghi	69.63 cdef
3	Kavre Collection (KVF14)	8.27 bc	0.6 fgh	13.84 cdefgh	76.17 bcdef
4	Dhankuta Local (DF3)	6.4 gh	0.42 hijk	16.11 bcdef	39.5 f
5	Bara Local (BF4)	6.33 gh	0.41 hijk	15.68 bcdef	90.65 bcd
6	Red Fleshed (TF3)	7 efg	0.37 ijk	19.07 ab	42.06 ef
7	Red Fleshed (BT)	8.25 bcd	0.57 fghi	15.14 bcdefg	57.84 cdef
8	Bhoteodar Local (LF4)	8.1 bcde	0.45 ghijk	17.92 bc	49.87 def
9	Kaski Local, Kathe (KF2)	10.62 a	0.65 defg	16.66 bcde	57.1 cdef
10	Kavre Collection (KVF2H)	6.83 fgh	0.43 hijk	15.92 bcdef	47.28 ef
11	Arghakhanchi Red (AF3R)	8.93 b	0.73 def	12.65 defghi	72.37 cdef
12	Makawanpur Collection (MF1)	6.5 gh	0.44 hijk	14.94 bcdefg	166.95 a
13	Lamjung Collection (KF6)	8 bcdef	0.96 ab	8.43 i	80 bcdef
14	Kaski Collection (KF5)	5.82 gh	0.43 hijk	13.65 cdefgh	87 bcde
15	Bikase Seto (GF6)	8.15 bcde	0.8 bcd	10.26 ghi	44.57 ef
16	Red Fleshed (KVF13H)	6.93 efg	0.30 k	22.99 a	54.75 cdef
17	Bikasi Seto (LF7)	6.67 gh	0.57 fghi	11.87 defghi	71.63 cdef
18	Lucknow-49 (BF2)	8.42 b	0.94 abc	9.41 hi	86 bcde
19	KG-1 (MF2)	7.08 defg	0.77 cde	9.27 hi	95.9 bc
20	Kathmandu Collection (KATHF4H)	5.7 h	0.49 ghijk	11.6 efghi	116.25 b
21	Lamjung Local (LF6)	9.08 b	0.58 efg	15.76 bcdef	43.99 ef
22	Allahabad Safeda (BF1)	5.72 h	0.35 jk	16.94 bcd	65.74 cdef
23	Lalit	5.92 gh	0.53 ghij	11.45 fghi	68.15 cdef
24	Indian (RG)	6.6 gh	0.47 ghijk	14.05 bcdefgh	52.5 def
	Mean	7.42	0.57	14.21	71.178
	F-test	**	**	**	**
	SEM±	0.3894	0.06055	1.497	12.58
	LSD	1.109	0.1724	4.263	35.58
	C.V. (%)	9.09	18.32	18.25	30.41

References

- Acquach, G. (ed). 2002. Plant physiology. Horticulture-Principles and Practices. 2nd ed. Pearson Education, Inc. pp. 141-176.
- Chattopadhyay. T. K. 1996. A textbook on Pomology (Tropical Fruits) Vol. 2. Kalyani Publishers, New Delhi, India.
- Chauhan, P. S. and G. S. Dhaliwal. 1993. Studies on variation in the TSS, acidity and sugars of fruits of open-pollinated seedlings of guava. Haryana J. Hort. Sci. 22(1): 13-16.
- Cheema, G. S. and G. B. Deshmukh. 1927. Culture of guava and its improvement of selection in western India. Bombay Department of Agri. Bull. 148.
- Crane, H. J. and C. F. Balerdi. 2005. Guava growing in the Florida Home Landscape. Online available at <http://plants.ifas.ufl.edu/assessment.html>. Retrieved: March 6, 2007.
- Daulta, B. S., N. R. Godara, S. K. Bhatia, H. K. Singh and S. S. Bisla. 1998. New guava hybrids: 'Hisar Safeda' and 'Hisar Surkha'. Indian J. Hort. 46 (3): 22.
- Ghosh, S. N. and N. Chattopadhyay. 1996. Commercial cultivation of guava. The J. Hort. 9: 121-127.
- Gomez, K. A. and A. A. Gomez. 1984. Statistical procedures for agricultural research. 2nd ed. John Wiley and Sons., New York.
- Iyer, C. P. A. and M. D. Subramanyam. 1976. Improvement of guava by selection and hybridization. Annual report 11 HR. Bangalore, India.
- Mitra, S. K. and T. K. Bose. 1996. Guava. In: T. K. Bose and S. K. Mitra. (eds). Fruits: Tropical and Sub-tropical. Naya Prokash, Calcutta., India. pp.280-300.
- Morton, J. 1987. Guava. In: J. F. Morton (ed). Fruits of warm climates. Julia F. Morton Publishers, Miami. pp. 356-363.
- Roy, R. S. and S. F. Ahmed. 1951. Description of Bihar guava varieties. Indian J. Hort. 8 (3) : 22-23.
- Sadasivam, S. and A. Manickam. 1991. Biochemical Methods. Coimbatore., India.
- Sapkota, D. 2006. Characterization and evaluation of Acid lime (*Citrus aurantifolia* Swingle) landraces at Rampur, Chitwan Condition. Thesis, M.Sc.Ag. Tribhuvan University/ IAAS, Rampur, Chitwan. pp. 31-46.
- Shrestha, A. K. 2004. Orchard management for commercial guava production. (In Nepali). Directorate of Research and Publications, Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal. pp. 1-45.
- Shrestha, A. K., P. R. Bhurtyal and T. Chapagain. 2004. Guava Orchard Management: Prospects and Constraints. Proceedings of the Farmers Field Day cum Workshop on Guava Farming. 20 June, 2004. IAAS, Rampur, Chitwan, Nepal.
- Shrestha, G. K. 1996. Guava. World commercial fruits at a glance. Technica Concern, Kathmandu, Nepal. pp. 77-79.
- Thaipong, K. and U. Bounprakob. 2005. Genetic and environmental variance components in guava fruit qualities. Hort. Sci. 104: 37-47.