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Comparative studies on red and yellow kokum (*Garcinia indica* Choisy) types under hill zone of Karnataka for morphological characters

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Abstract
Forty seven genotypes of kokum selected from farmer's field near Sirsi of 10 years Age were compared based on the colour of the fruits into red and yellow fruit bearing genotypes and were evaluated for growth characters for three years. Among all the growth parameters plant height found maximum in the yellow types and other characters found highest in the red types. The tree height varied from 3.94 to 9.98 m. A maximum tree height, stem diameter at breast height among the red types was recorded in the genotype GI-33(9.60m and 43.28cm, respectively), trunk diameter at the base in GI-01 (89.67cm), number of branches GI-24 (144nos.), North-South spread of 5.73m (GI-13) and East-West spread of 5.95m (GI-01). Among yellow genotypes maximum plant height, stem diameter at breast height and number of branches in the genotype GI-38 (9.98 m, 49.62m and 126nos., respectively), Plant spread at North-South and East-West directions found highest in GI-19 (5.68m and 5.65m, respectively).

Keywords: *Garcinia indica*, yellow kokum, genotypes, growth characters

Introduction
Garcinia indica Choisy has a tremendous potential as a spice, colorant with high medicinal values. It is a slow-growing slender, tropical evergreen tree which grows to a height of 10–18 meters naturally spread in Western Ghats and also in North-Eastern states. The fruits are globose or round, purple coloured (generally) when ripe, about 4 cm in diameter with fleshy rind enclosing 2-8 large pulpy seeds. The tree is either dioecious or polygamous (Singh *et al*., 1993) [11].

In Maharashtra, kokum is reported to be cultivating in 1,200 ha area and 10,200 MT productions fruits with a productivity of 8.50 t per ha (Patil *et al*., 2012) [8]. In Goa, kokum rind production is estimated at 10,200 tons from 1,200 ha area (Korikanthimath and Desai, 2012) [7]. The total area estimated in Karnataka is about 1,200 ha with an annual yield of 8,000-10,000 tons of dried rind (Devi *et al*., 2012, Ramachandran *et al*., 2014, Hegde, 2019) [2, 9, 4]. Fruit rind of *G. indica* is rich source of acids. The major portion of acids in the species is hydroxy citric acid [(-)-HCA] (1, 2 dihydroxypropane-1, 2, 3-tricarboxylic acid). Kokum rinds on a dry weight basis contain about 20-30 per cent of (-)-HCA (Swami *et al*., 2014) [12]. The seed kernels is a source of valuable edible, hard and brittle fat (melting point 39 to 43 °C) known commercially as 'kokum butter' yields up to 45 per cent. Kokum has great genetic diversity present all along the - area of the Western Ghats of India. But there is little work on this crop, particularly on the evaluation of the diversity and the selection of superior types. Though the species is widely distributed in the Western Ghats, off late some of the innovative farmers are cultivating this crop on a commercial scale. Two types of kokum were identified in the Western Ghats of Karnataka. One is red fruit producing and another one is yellow fruit producing type. Red fruit bearing is common type in kokum which is distributed all along the kokum growing area. The yellow colored fruiting kokum is a unique type of kokum, mainly found in Karnataka (particularly Uttar Kannada dist.). It is normally called as '*bili murugalu*' (white kokum). An estimated about 10-12% of the total population of kokum is yellow fruited type in this region (Hegde, 2019) [4]. The present experiment was carried out to assess the variability in the morphological characters between the red and yellow genotypes.

Material and Methods

The planting of kokum in a single location was found in *Melina* Karsulli village, Sirsi ta. Uttara Kannada dist. of Karnataka. Preliminary information on the plantation was collected from the farmer. These genotypes were originally collected from the nurseries located different parts of the Uttara Kannada region and planted. About 10 years old, uniformly grown red and yellow fruit bearing trees were selected for the study. Among forty seven genotypes thirty six were of red and eleven were of yellow fruit producing types. These genotypes were assessed for their growth characters of individual genotype for three consecutive years from 2016-17 to 2018-19.

Results and Discussion

The results on comparative study of red and yellow genotypes clearly indicated that there was wide variability in the plant height among the selected genotypes. A slightly increased plant height was observed in the selected yellow genotypes *i.e.* 3.98 to 9.98 m and in red type it varied from 3.94 to 9.60 m. This result showed that yellow type kokum plants grow faster than the red types Trunk diameter at base ranged from 31.62cm to 89.64cm in red type whereas, this was ranged from 36.83 to 63.24cm in yellow type. These results indicated maximum trunk girth at base recorded in the red type. Stem diameter at breast height showed maximum variation which was ranged from 17.42 to 43.28cm in red types and 20.80 to 49.62cm in the yellow types. Number of branches in red type ranged from 24 to 144 nos. and in yellow type 46 to 126 nos. The N-S and E-W plant spreads, in red type ranged from 2.93 to 5.73 m and 2.92 to 5.95 m, respectively. In yellow type, plant spread ranged from 3.05 to 5.68 m and 2.72 to 5.65 m.

Among the thirty six red types maximum plant height and trunk diameter at the base were recorded in the genotypes GI-33 and GI-01 during the study period (Table 1). Minimum plant height and trunk diameter at the base was recorded in the genotype GI-29 (2.52m, 3.13m and 3.94m respectively, 25.76cm, 27.41cm and 31.62cm, respectively). The maximum per cent increase over three years (24.21% and 25.88% respectively) in the growth of the plant was noticed in the genotype GI-29 with minimum plant height (9.39% and 15.36%). Eleven yellow kokum genotypes were observed for the growth characters among them GI-38 (8.20, 8.98 and 9.98m, respectively) recorded the maximum plant height from first year of the study to third year of study and the genotype GI-22 (2.90, 3.41 and 3.98m, respectively) recorded with the minimum plant height. The per cent increase over previous year showed maximum result in the genotype GI-19 (18.38%) during the first year and GI-22 (16.72%) in the third year of the study. Trunk diameter at the base of the tree recorded maximum result in the genotype GI-15 (57.24, 57.49 and 63.24cm in 1st, 2nd and 3rd year, respectively) and which was found to be minimum in the genotype GI-22 (30.40, 32.68 and 36.83cm, respectively). GI-16 and GI-25 (8.23% and 13.50%) recorded highest per cent increase over previous for two year of the study.

Stem diameter at breast height in the study period observed maximum in the genotype GI-33 (36.44, 39.88 and 43.28cm, respectively) which was followed by GI-01 (35.98, 39.28, 42.76cm, respectively) and GI-29 showed minimum stem diameter at breast height (14.66, 16.09 and 17.42cm, respectively) (Table 2). Per cent increase showed maximum result in the genotype GI-29 (9.75%) during the second year and GI-47 (11.55%) in the third year. Maximum number of branches was recorded in the genotype GI-24 (124, 132 and 144 nos., respectively) and GI-11 (108, 115 and 126 nos., respectively) identified as the second genotype with maximum number of branches. Genotype GI-31 identified with minimum number of the branches. Maximum per cent increase was recorded in the genotype GI-44 (13.64%) in the second year and GI-31 (20%) in the third year. Stem diameter at breast height and number of branches recorded maximum result in the genotype GI-38 (41.76, 45.68 and 49.62m, respectively and 108, 115 and 126nos. respectively). This was minimum in the genotype GI-22 (17.5, 19.18 and 20.80m, respectively) and in GI-08 (39, 42 and 46nos. respectively) (Table 2). Per cent increase over previous year found highest in the genotype GI-22 (9.60%) and GI-08 (9.13%) in stem diameter at breast height and number of branches showed maximum per cent increase in the GI-14 (9.46% and 17.28%) in the second and third year of the study.

North-South Spread of selected genotype ranged from 2.37 (GI-37) to 4.73m (GI-13), 2.70 (GI-37) to 5.28m (GI-13), 2.93 (GI-37) to 5.73m (GI-13) in the first, second and third year of the study (Table 3). Per cent increase over previous year showed maximum result in the genotype GI-37 (15.61%) and GI-11 (9.95%) in the second and third year. East-West spread of the plant recorded maximum result in the genotype GI-01 (4.98, 5.42 and 5.95m, respectively) during the study period. Minimum spread was observed in the genotype GI-37 (2.38 and 2.63m) in the first and second year and GI-17 (2.92m) in the third year. Per cent increase over previous year showed maximum results in the genotype GI-35 (13.24%) and GI-37 (12.60%) (Table 3). Plant spread at North-South and East-West direction found highest in GI-19 (4.72, 5.21 and 5.68m, respectively) (4.68, 5.13 and 5.65m, respectively) in yellow type. This was found minimum in the genotype GI-18 (2.50, 2.82 and 3.05m, respectively) and GI-22 (2.27, 2.53 and 2.73m, respectively). Maximum per cent increase in plant spread over previous year were found in GI-22 (8.77%) and GI-36 (7.85%) in North-South direction and in East-West direction was GI- 22 (2.72 and 7.51%) for two year of study (Table 6). The growth parameters are the important characters which have direct influence on the yield of the tree. The growth parameters are genetically controlled factors. Kirtikar and Basu (1999) [6], Godbole and Das (2000) [3] reported that kokum tree height ranged from 10 to 20 m. Abraham *et al.* (2002) [1] noted the tree spread of 2.48 m to 7.2 m in female trees of kokum. In *G. tinctoria* trees grow to a height of 20 m (Herbert *et al.*, 2006) [5]. The variation in the tree height reported by earlier workers might be due to the differences in the age group of the trees and also the location of the study. The 10 years old trees were used for the present study. Further, it is a genotypic character; hence the genotypes studied will show different growth characters. Sawant *et al.* (1997) [10] recorded trunk girth at the base of the plant as 1.10 m, N-S spread (4.60 m) and E-W spread (4.60 m) in kokum.

Table 1: The plant height (m) and trunk diameter (cm) in red kokum and yellow type (*G. indica* Choisy) genotypes during 2016-17 to 2018-19

Sl. No.	Genotype	Plant height (m)					Trunk diameter at base (cm)				
		2016-17	2017-18	% Increase	2018-19	% Increase	2016-17	2017-18	% Increase	2018-19	% Increase
Red type											
1.	GI-01	5.60	6.38	13.93	7.15	12.07	77.32	84.58	9.39	89.64	5.98
2.	GI-02	5.30	6.02	13.58	6.82	13.29	45.32	47.89	5.67	53.15	10.98
3.	GI-03	6.38	6.99	9.56	7.71	10.30	41.34	44.57	7.81	49.18	10.34
4.	GI-04	4.65	5.11	9.89	5.84	14.29	33.08	35.24	6.53	39.84	13.05
5.	GI-05	4.56	4.98	9.21	5.38	8.03	43.10	45.75	6.15	51.28	12.09
6.	GI-06	3.82	4.25	11.26	4.77	12.24	32.00	34.65	8.28	38.27	10.45
7.	GI-09	4.50	5.00	11.11	5.62	12.40	35.10	37.42	6.61	42.16	12.67
8.	GI-10	4.85	5.48	12.99	6.07	10.77	34.68	36.52	5.31	41.38	13.31
9.	GI-11	6.55	7.31	11.60	8.09	10.67	55.12	58.74	6.57	64.59	9.96
10.	GI-12	3.45	3.80	10.14	4.34	14.21	36.18	38.35	6.00	43.35	13.04
11.	GI-13	6.52	7.12	9.20	8.00	12.36	30.50	32.57	6.79	36.91	13.33
12.	GI-17	4.79	5.28	10.23	5.80	9.85	37.32	39.86	6.81	44.52	11.69
13.	GI-20	3.80	4.39	15.53	4.98	13.44	34.84	37.18	6.72	41.73	12.24
14.	GI-21	4.03	4.67	15.88	5.32	13.92	36.28	38.56	6.28	43.41	12.58
15.	GI-23	5.50	6.21	12.91	6.91	11.27	43.56	46.57	6.91	51.68	10.97
16.	GI-24	5.78	6.42	11.07	7.12	10.90	56.46	60.07	6.39	66.13	10.09
17.	GI-26	2.86	3.40	18.88	4.18	22.94	54.92	58.40	6.34	64.39	10.26
18.	GI-27	2.80	3.30	17.86	4.12	24.85	30.04	32.08	6.79	36.42	13.53
19.	GI-28	4.01	4.52	12.72	5.28	16.81	37.06	39.41	6.34	44.36	12.56
20.	GI-29	2.52	3.13	24.21	3.94	25.88	25.76	27.41	6.41	31.62	15.36
21.	GI-30	4.90	5.48	11.84	6.28	14.60	46.92	50.01	6.59	55.47	10.92
22.	GI-31	3.07	3.51	14.33	4.07	15.95	52.34	55.79	6.59	61.52	10.27
23.	GI-32	6.69	7.52	12.41	8.28	10.11	41.76	44.42	6.37	49.69	11.86
24.	GI-33	7.84	8.76	11.73	9.60	9.59	50.32	53.67	6.66	59.21	10.32
25.	GI-34	4.93	5.58	13.18	6.31	13.08	34.68	36.92	6.46	41.62	12.73
26.	GI-35	3.57	3.95	10.64	4.64	17.47	29.32	31.21	6.45	35.66	14.26
27.	GI-37	5.40	6.12	13.33	6.96	13.73	42.48	45.52	7.16	50.29	10.48
28.	GI-39	7.20	8.10	12.50	9.11	12.47	38.24	40.68	6.38	45.63	12.17
29.	GI-40	4.80	5.72	19.17	6.45	12.76	42.68	45.39	6.35	50.57	11.41
30.	GI-41	5.32	6.14	15.41	6.88	12.05	44.90	47.78	6.41	53.14	11.22
31.	GI-42	6.18	6.82	10.36	7.56	10.85	33.76	36.03	6.72	40.22	11.63
32.	GI-43	5.00	5.56	11.20	6.24	12.23	26.68	28.39	6.41	32.64	14.97
33.	GI-44	3.85	4.39	14.03	5.01	14.12	40.46	43.06	6.43	48.12	11.75
34.	GI-45	5.28	5.90	11.74	6.65	12.71	26.68	28.87	8.21	32.65	13.09
35.	GI-46	3.56	4.38	23.03	4.82	10.05	35.56	37.89	6.55	42.28	11.59
36.	GI-47	4.00	4.82	20.50	5.43	12.66	43.04	45.87	6.58	51.04	11.27
Yellow type											
37.	GI-07	3.82	4.37	14.40	4.94	13.04	35.92	38.23	6.43	43.06	12.63
38.	GI-08	3.54	4.02	13.56	4.50	11.94	33.76	35.88	6.28	40.32	12.37
39.	GI-14	5.45	6.13	12.48	6.74	9.95	43.98	47.02	6.91	52.13	10.87
40.	GI-15	5.35	6.01	12.34	6.64	10.48	54.24	57.49	5.99	63.24	10.00
41.	GI-16	4.72	5.35	13.35	5.92	10.65	30.50	33.01	8.23	36.92	11.84
42.	GI-18	3.12	3.57	14.42	4.05	13.45	33.96	36.07	6.21	40.06	11.06
43.	GI-19	3.70	4.38	18.38	4.80	9.59	34.84	37.14	6.60	41.87	12.74
44.	GI-22	2.90	3.41	17.59	3.98	16.72	30.40	32.68	7.50	36.83	12.70
45.	GI-25	3.85	4.48	16.36	5.21	16.29	32.26	34.29	6.29	38.92	13.50
46.	GI-36	4.50	5.08	12.89	5.73	12.80	42.68	45.85	7.43	50.58	10.32
47.	GI-38	8.20	8.98	9.51	9.98	11.14	52.18	55.48	6.32	61.34	10.56

Table 2: The Stem diameter at breast height (cm) and number of branches in red kokum and yellow type (*G. indica* Choisy) genotypes during 2016-17 to 2018-19

Sl. No.	Genotype	Stem diameter at breast height (cm)					No. of branches				
		2016-17	2017-18	% increase	2018-19	% Increase	2016-17	2017-18	% increase	2018-19	% increase
1.	GI-01	35.98	39.28	9.17	42.76	8.86	83.00	88.00	6.02	97.00	10.23
2.	GI-02	30.66	33.52	9.33	36.42	8.65	86.00	92.00	6.98	101.00	9.78
3.	GI-03	32.00	35.04	9.50	38.00	8.45	57.00	60.00	5.26	65.00	8.33
4.	GI-04	22.66	24.78	9.36	26.92	8.64	45.00	48.00	6.67	52.00	8.33
5.	GI-05	29.78	32.54	9.27	35.36	8.67	49.00	52.00	6.12	58.00	11.54
6.	GI-06	22.66	24.74	9.18	26.92	8.81	58.00	61.00	5.17	68.00	11.48
7.	GI-09	23.54	25.58	8.67	27.98	9.38	82.00	87.00	6.10	96.00	10.34
8.	GI-10	24.72	27.01	9.26	29.34	8.63	51.00	54.00	5.88	60.00	11.11
9.	GI-11	35.66	38.94	9.20	42.32	8.68	108.00	115.00	6.48	126.00	9.57
10.	GI-12	23.12	25.22	9.08	27.44	8.80	86.00	92.00	6.98	101.00	9.78
11.	GI-13	20.90	22.75	8.85	24.80	9.01	28.00	30.00	7.14	35.00	16.67

12.	GI-17	21.32	23.31	9.33	25.34	8.71	35.00	38.00	8.57	43.00	13.16
13.	GI-20	24.72	27.05	9.43	29.34	8.47	44.00	47.00	6.82	51.00	8.51
14.	GI-21	21.78	23.81	9.32	25.86	8.61	46.00	49.00	6.52	54.00	10.20
15.	GI-23	27.66	30.25	9.36	32.82	8.50	65.00	69.00	6.15	76.00	10.14
16.	GI-24	28.64	31.36	9.50	33.98	8.35	124.00	132.00	6.45	144.00	9.09
17.	GI-26	27.98	30.67	9.61	33.26	8.44	47.00	50.00	6.38	54.00	8.00
18.	GI-27	17.76	19.48	9.68	21.12	8.42	73.00	77.00	5.48	84.00	9.09
19.	GI-28	25.08	27.45	9.45	29.76	8.42	56.00	60.00	7.14	65.00	8.33
20.	GI-29	14.66	16.09	9.75	17.42	8.27	56.00	60.00	7.14	65.00	8.33
21.	GI-30	31.64	34.65	9.51	37.58	8.46	45.00	48.00	6.67	53.00	10.42
22.	GI-31	34.12	37.34	9.44	40.54	8.57	18.00	20.00	11.11	24.00	20.00
23.	GI-32	31.48	34.47	9.50	37.36	8.38	70.00	75.00	7.14	82.00	9.33
24.	GI-33	36.44	39.88	9.44	43.28	8.53	65.00	69.00	6.15	75.00	8.70
25.	GI-34	22.66	24.75	9.22	26.92	8.77	74.00	78.00	5.41	85.00	8.97
26.	GI-35	19.56	21.37	9.25	23.22	8.66	52.00	55.00	5.77	60.00	9.09
27.	GI-37	28.8	31.53	9.48	34.20	8.47	56.00	60.00	7.14	66.00	10.00
28.	GI-39	28.44	31.16	9.56	33.78	8.41	52.00	55.00	5.77	61.00	10.91
29.	GI-40	30.24	33.08	9.39	35.88	8.46	59.00	62.00	5.08	68.00	9.68
30.	GI-41	31.54	34.55	9.54	37.48	8.48	66.00	70.00	6.06	77.00	10.00
31.	GI-42	22.86	25.03	9.49	27.12	8.35	46.00	49.00	6.52	54.00	10.20
32.	GI-43	20.96	22.96	9.54	24.92	8.54	48.00	51.00	6.25	57.00	11.76
33.	GI-44	34.48	37.75	9.48	40.96	8.50	22.00	25.00	13.64	30.00	20.00
34.	GI-45	27.98	30.65	9.54	33.26	8.52	52.00	56.00	7.69	60.00	7.14
35.	GI-46	19.56	21.4	9.41	23.22	8.50	62.00	67.00	8.06	72.00	7.46
36.	GI-47	32.72	34.82	6.42	38.84	11.55	50.00	53.00	6.00	59.00	11.32
Yellow type											
37.	GI-07	21.94	24.02	9.48	26.08	8.58	52.00	55.00	5.77	61.00	10.91
38.	GI-08	22.76	24.76	8.79	27.02	9.13	39.00	42.00	7.69	46.00	9.52
39.	GI-14	32.52	35.54	9.29	38.64	8.72	74.00	81.00	9.46	95.00	17.28
40.	GI-15	35.04	38.28	9.25	41.58	8.62	60.00	64.00	6.67	71.00	10.94
41.	GI-16	21.52	23.54	9.39	25.54	8.50	47.00	50.00	6.38	55.00	10.00
42.	GI-18	19.56	21.42	9.51	23.22	8.40	42.00	45.00	7.14	49.00	8.89
43.	GI-19	17.76	19.42	9.35	21.12	8.75	79.00	84.00	6.33	92.00	9.52
44.	GI-22	17.50	19.18	9.60	20.80	8.45	43.00	46.00	6.98	50.00	8.70
45.	GI-25	20.9	22.88	9.47	24.80	8.39	80.00	85.00	6.25	94.00	10.59
46.	GI-36	23.54	25.66	9.01	27.98	9.04	44.00	47.00	6.82	52.00	10.64
47.	GI-38	41.76	45.68	9.39	49.62	8.63	108.00	115.00	6.48	126.00	9.57

Table 3: The spread of the plants (N-S and E-W) (m) in red kokum and yellow type (*G. indica* Choisy) genotypes during 2016-17 to 2018-19

Sl. No.	Genotype	Plant spread (N-S) (m)					Plant spread (E-W) (m)				
		2016-17	2017-18	% increase	2018-19	% increase	2016-17	2017-18	% Increase	2018-19	% Increase
1.	GI-01	4.26	4.78	12.21	5.12	7.11	4.98	5.42	8.84	5.95	9.78
2.	GI-02	4.03	4.43	9.93	4.81	8.58	4.12	4.55	10.44	4.93	8.35
3.	GI-03	3.28	3.62	10.37	3.92	8.29	3.50	3.83	9.43	4.19	9.40
4.	GI-04	3.66	4.03	10.11	4.38	8.68	3.05	3.34	9.51	3.64	8.98
5.	GI-05	3.20	3.53	10.31	3.82	8.22	2.89	3.23	11.76	3.48	7.74
6.	GI-06	2.63	2.94	11.79	3.18	8.16	3.31	3.62	9.37	3.98	9.94
7.	GI-09	3.32	3.72	12.05	3.94	5.91	3.23	3.53	9.29	3.87	9.63
8.	GI-10	3.43	3.82	11.37	4.17	9.16	3.68	4.03	9.51	4.38	8.68
9.	GI-11	3.50	3.82	9.14	4.20	9.95	3.79	4.18	10.29	4.55	8.85
10.	GI-12	3.62	3.95	9.12	4.31	9.11	4.04	4.41	9.16	4.82	9.30
11.	GI-13	4.73	5.28	11.63	5.73	8.52	4.66	5.09	9.23	5.54	8.84
12.	GI-17	2.50	2.75	10.00	3.02	9.82	2.42	2.71	11.98	2.92	7.75
13.	GI-20	3.35	3.73	11.34	4.08	9.38	3.23	3.53	9.29	3.83	8.50
14.	GI-21	3.44	3.82	11.05	4.14	8.38	3.46	3.77	8.96	4.12	9.28
15.	GI-23	3.24	3.66	12.96	3.97	8.47	3.94	4.31	9.39	4.69	8.82
16.	GI-24	4.27	4.79	12.18	5.18	8.14	4.69	5.13	9.38	5.58	8.77
17.	GI-26	4.24	4.52	6.60	4.92	8.85	4.87	5.33	9.45	5.79	8.63
18.	GI-27	3.29	3.50	6.38	3.79	8.29	3.14	3.49	11.15	3.75	7.45
19.	GI-28	2.76	3.14	13.77	3.40	8.28	2.71	3.05	12.55	3.38	10.82
20.	GI-29	2.54	2.88	13.39	3.07	6.60	3.58	3.95	10.34	4.26	7.85
21.	GI-30	3.68	4.08	10.87	4.41	8.09	4.29	4.70	9.56	5.13	9.15
22.	GI-31	4.38	4.85	10.73	5.28	8.87	4.76	5.21	9.45	5.69	9.21
23.	GI-32	3.23	3.52	8.98	3.73	5.97	3.78	4.13	9.26	4.53	9.69
24.	GI-33	4.22	4.60	9.00	4.96	7.83	4.12	4.51	9.47	4.92	9.09
25.	GI-34	2.89	3.22	11.42	3.47	7.76	2.82	3.14	11.35	3.37	7.32
26.	GI-35	2.37	2.70	13.92	2.93	8.52	2.72	3.08	13.24	3.34	8.44
27.	GI-37	2.37	2.74	15.61	2.93	6.93	2.38	2.62	10.08	2.95	12.60

28.	GI-39	3.76	4.14	10.11	4.46	7.73	3.88	4.24	9.28	4.65	9.67
29.	GI-40	3.51	4.02	14.53	4.33	7.71	4.59	5.02	9.37	5.48	9.16
30.	GI-41	3.07	3.39	10.42	3.67	8.26	3.24	3.54	9.26	3.88	9.60
31.	GI-42	3.10	3.40	9.68	3.67	7.94	3.17	3.47	9.46	3.79	9.22
32.	GI-43	3.98	4.26	7.04	4.63	8.69	3.22	3.52	9.32	3.87	9.94
33.	GI-44	4.46	5.02	12.56	5.43	8.17	4.12	4.50	9.22	4.94	9.78
34.	GI-45	4.72	5.22	10.13	5.65	8.24	3.67	4.02	9.54	4.37	8.71
35.	GI-46	4.60	5.09	10.65	5.52	8.45	2.80	3.08	10.00	3.35	8.77
36.	GI-47	3.44	3.65	6.10	3.98	9.04	3.45	3.79	9.86	4.18	10.29
Yellow type											
37.	GI-07	4.31	4.74	9.98	5.17	9.07	4.07	4.47	9.83	4.87	8.95
38.	GI-08	3.60	4.00	11.11	4.35	8.75	3.13	3.40	8.63	3.75	10.29
39.	GI-14	3.89	4.36	12.08	4.73	8.49	4.23	4.63	9.46	5.14	11.02
40.	GI-15	3.48	3.80	9.20	4.17	9.74	3.50	3.83	9.43	4.20	9.66
41.	GI-16	3.26	3.62	11.04	3.92	8.29	3.89	4.26	9.51	4.67	9.62
42.	GI-18	2.50	2.82	12.80	3.05	8.16	3.71	4.06	9.43	4.46	9.85
43.	GI-19	4.72	5.21	10.38	5.68	9.02	4.68	5.13	9.62	5.65	10.14
44.	GI-22	3.08	3.35	8.77	3.62	8.06	2.27	2.53	11.45	2.72	7.51
45.	GI-25	3.35	3.78	12.84	4.14	9.52	4.40	4.81	9.32	5.25	9.15
46.	GI-36	3.04	3.31	8.88	3.57	7.85	2.79	3.15	12.90	3.44	9.21
47.	GI-38	4.06	4.55	12.07	4.94	8.57	4.04	4.41	9.16	4.83	9.52

Conclusion

It can be concluded from the present investigation that among red and yellow types morphological characters found higher in the red type when compared with the yellow type. Out off thirty six red genotypes, GI-33 recorded maximum plant height, tree girth at the base in the genotype GI-01, number of branches in the genotype GI-24, N-S spread was found maximum in GI-13, E-W spread in GI-01 during the study period. Among yellow genotypes maximum plant height, stem diameter at breast height and number of branches recorded in the genotype GI-38, trunk diameter at the base in the genotype GI-15, plant spread observed maximum in the genotype GI-19. This result indicated that among red genotypes, GI-33 and yellow genotype GI-38 found best with respect to the growth characters.

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