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MORPHOLOGICAL AND BIOCHEMICAL VARIATIONS IN DIFFERENT SEX FORMS OF KODAMPULI (*GARCINIAGUMMI-GUTTA* L.)

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Abstract: Kodampuli seedlings segregate into males and bisexuals at flowering. A study has been carried Out to differentiate the sex by morphological and biochemical characters. The results indicated that there is no significant differences between male and bisexual plants in terms of morphological characters except the colour of emerging flush in which pink and pinkish shades were more prevalent in bisexuals than in male Significant differences between male and bisexual trees were noticed with respect to total phenol of young (208.60 mg/100g and 118.10 mg/100g respectively) and mature (1397.82 mg/100g and 794.53 mg/100g respectively) leaves. The thin layer chromatographic profile of phenolics showed one additional spot in male than in bisexual plants, Electrophoresis revealed similar banding pattern for peroxidase enzymes in both male and bisexual plants.

Key wards: *Garcinia gummi-gutta*, isoenzyme, kodampuli, phenol content, sex determination, thin layer chromatography

INTRODUCTION

Kodampuli (*Garcinia gummi-gutta L.)* is one of the potential under-exploited fruit crops, currently gaining much commercial, industrial and medicinal importance. The dried rind is sold in the market at the rate of Rs, 200 per kg and has an unique use in fish curries for imparting its delicate flavour (Sarah, 1998). Kodampuli rind is the only richest natural source of (-)-hydroxy citric acid (HCA). The derivatives of the acid are potent metabolic regulators of obesity. The unique acid lowers the blood lipids such as cholesterol and triglycerides by triggering the fatty acid oxidation in the liver via. thermogenesis. It mobilizes me body's fat stores and dissolves fat in the liver and also throughout the body paving way for weight management (Majeed, 1994).

In kodampuli, apart from long pre-bearing period, segregation of seedlings is recognized as one of the major problems of cultivation. The seedlings segregate into productive bisexual and unproductive male trees. Sex is revealed only after flowering, for which the seedlings take 7-8 years. Presently the only option to overcome this problem is the use of vegetatively propagated materials or top working of male plants (Sarah and Muthulakshmi, 1998). Even though vegetative propagation is standardized, the large scale adoption ofthis method is constrained due to non-availability of orthotropic shoots in sufficient numbers which are required for the production of plants with normal growth habit. So, seedlings continue to be the major propagating material. Hence, a study was carried out to identify the sex of the plants morphologically and biochemically at the College of Horticulture, Thrissur during 1996-98.

MATERIALS AND METHODS

Fifteen each of well-differentiated male and bisexual trees of 25 to 30 years were selected. Morphological observations like plant height, spread, collar girth, height at first branching, canopy shape and branching habit, colour of the young flush, latex, bark and feeder roots and leaf characters like length, width, length / width ratio, leaf area, petiole length, internodal length and leaf shape were made during March-April, 1998, Biochemical analyses were also carried out in the fully opened well matured leaves i.e., fourth to fifth leaf from the tip of the growing shoot to determine the essential oil content, total acidity, total phenol, thin layer chromatography for the leaf phenolics and isozyme analysis for peroxidase enzyme.

RESULTS AND DISCUSSION

Regarding the plant height, the male plants ranged from 6.23 m to 9.20 m and the bisexual plants ranged from 5.90 m to 8.65 m (Table **I).** The average heights of male and bisexual plants were 7.20 m to 7.15 m respectively. The analysis of variance indicated no significant difference in this character between male and bisexual trees and the values were found to be broadly overlapping. This is in contrast to observation made by Flach (1996) in nutmeg trees where a slight difference in the tree size between female and male trees. But Thomas (1997) observed no significant difference bet-

ween male and female nutmeg trees in terms of height of the tree. Regarding plant spread, the mean spread of male plants was 43.66 m an that of bisexuals was 42.58 m^2. The spread for male ranged from 66.36 m^2 5.93 m^2 for bisexuals plants and 52.14 m^2 to 87.12 m^2 (Table 1). The difference in this character was not significant enough to discriminate between male and bisexual plant. Similar observation was noticed by Thomas (1997) in nutmeg trees.

Collar girth of the bisexual plants ranged from 73.83 cm to 120.89 cm with a mean of 108.97 cm and that of males from 75.28 cm to 137.13 cm with a mean of 103.98 cm (Table 1). The analysis of variance did not reveal any pronounced difference between male and bisexual plants. This is in contrast to the report by Nyong *el al.* (1994) in odum (*Melicia excelsa*) wherein females were found to possess more girth in the collar region. The branching height varied from 63.87 cm to 110.0 cm in males and 67.19 cm to 123.0 cm in bisexuals with a mean of 80.26 cm for male and 80.7 cm for bisexual plants. Here also, the analysis of variance did not show any pronounced difference between male and bisexual plants.

Different canopy shapes like conical, pyramidal, round and dome were noticed in both male and bisexual trees. Both the trees showed similar branching habits like horizontal, drooping and erect. Regarding the colour of the young flush, green, pink and its shades were observed in both male and bisexual trees: But pink and pinkish shades were most widely prevalent in bisexual trees. Sherly (1994) observed that the colour of emerging leaves had marked difference among the male and hermaphrodite trees. In male trees, the emerging leaves were light green in colour while they showed a pinkish red colour in hermaphrodite trees. So, colour of the flush may be an indicator to some extent for sex determination in kodampuli. There were no marked differences between male and bisexual trees with respect to colour of latex, bark and feeder roots. Both male and bisexual trees possess latex with different shades of yellow, bark exhibiting internally cream colour and externally brown colour and feeder roots of brown and cream colour, With respect to leaf characters, the observations are presented in Table 2 and 3. The length of leaves in male and bisexual trees was found to range from 6.93 cm to 13.33 cm and 6,63 cm to 13.97 cm respectively. Leaf width ranged from 3.10 cm to 6.20 cm in males and 3,90 to 6.90 cm in bisexuals. Length by width ratio ranged from 2.16 to 3.72 cm in males and 2.30 to 3.80 cm in bisexuals Leaf area recorded in male plants ranged from 28.54 to 73.97 cm^2 in bisexual it ranged from 29.08 to 76.05 cm^2 But statistical analysis of these values showed no significant differences between male and bisexual trees. This observation is contradictory to the earlier one made by Mathew *et al.* (1996) in kodampuli that the leaves of bisexual trees were found to posses higher leaf width and leafarea. There were no significant differences for the petiole length and internodal length of the leaves ofmale and bisexual trees.

A variety of leaf shapes like oblong, elliptic, obovatc, oblanceolate and lanceolate were noticed in both the trees. Leaf apex, namely, acute, obtuse and acuminate were noticed in male as well as bisexual trees. Both the sexes showed acute and acuminate leaf base.

Data regarding the biochemical characters of the leaves of male and bisexual plants are presented in Table 4, The essential oil content of leaf in both male and bisexual plants ranged from 0,03 to 0,06 per cent. Mean values for oil content in male and bisexual plants were 0,047 per cent and 0.046 per cent respectively. Analysis of variance showed no significant difference between male and bisexual plants. Thomas (1997) recorded no difference between the male and female trees in terms of oil content. Regarding the total acidity of leaf, the range varied from 0.48 to 0.77 per cent in male plants and 0.48 to 0.78 per cent in bisexual plants. The average total acidity in male plants was 0.57 per cent and that of bisexual plants was 0,59 per cent. Analysis of variance showed no significant difference between male and bisexual plants in terms of total acidity of leaves. The total phenol content of mature leaves ranged from 970.0 to 1567.0 mg/100 g with an average of 1397.82 mg/100 g in male plants while in bisexual plants, it varied from 520.3 to 987.9 mg/100 g with a mean of 794.53 mg/100g. Of the !5 male plants analyzed, 13 plants had total phenol content of 1200 mg/100 g and above. On the other hand, none of the fifteen bisexual plants showed a total phenol

content of 1200 mg/100g and above. The total phenol content of young leaves ranged from 192 to 222 mg/100g in male plants and 59.1 to 201.0 mg/100g in bisexuals. The average total

Table 1 Plant characters of male and bisexual trees

	Height of plant (m)		Spread (m²)		Collar girth (cm)		Height al branching (cm)	
	Male	Bisex-ual	Male	Bisexual	Male	Bisexual	Male	Bisexual
Mean	7.20 ± (0.19)	7.15± (0.18)	73.66 (0.92)	72.58 ± (1.92)	103.98 ± (3.70)	108.97 ± (3.70)	80.20 - (8.97)	SO,70± 2.97)
Range	6.23-9.20	5.90-865	66.36-85.93	52.14-87.12	75.28-137.13	73.83-120.89	63.87-110.0	67.19-123.0

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Table 2. Leaf length, leaf width and length/width ratio of male and bisexual plants

	Leaf length (em)		Lcat width (em)		Length widt raliu	
	Mate	Bisexual	Male	Bisexual	Mak	Bisexual
Mean	9.37 ± (0.40)	9.70 ± (0.46)	4.91 ± (0.21)	5.38 ± (0.21)	2.84 ± (0.10)	2.92 ± (0.10)
Range	6.93-13.33	6.63-13.97	3.10-6.20	3.90-6.90	2.16-3.72	2.30-3.80

Values in parentheses indicate the standard error

Table 3. Leaf area, internodal length and petiole length of male and bisexual plants

	Leaf area (cm²)		Internodal length (cm)		Petiole length (cm)	
	Male	Bisexual	Male	Bisexual	Male	Bisexual
Mean	49.48 ± (2.66)	52.1 8 ± (2.66)	5.58 ± (0.16)	5.57±(0.16)	0.87 ± (0.16)	0.86 ± (0.46)
Range	28.54-73.97	29.08-76.05	4,30-<).80	4.10-6.80	0.50-1.30	0.60-1.40

Values in parentheses indicate the standard error

Table 4. Essential oil, total phenol and total acidity in leaves of male and bisexual planls

	Essential oil (%)		Total phenol (mg/ UK) g)				Tolal acidity (%)	
	Male	Bisexual	Young		Mature		M;dc	Bisexual
			Mate	Bisexual	Male	Bisexual		
Mean	0.047 ± (0.0)	0.046 ± (0.0)	208.6± (7.07)	118.10 + (7.07)	1397.82 ± (31.94)	794.53 ± (7.07)	0.57 ± (0.02)	(0 V) ± (0.02
Range	0,03-0.06	0.03-0.06	192.0-222.0	59.10-201.00	970,0-1567.0	520.3-987.9	0.48-0.77	0.48-0.78

Values in parentheses indicate the standard error

phenol content of young loaves was 208.fi mg/100g in male and 118.1 mg/100g in bisexuals. Out of 15 male plants taken for analysis, 10 planls had a total phenol content of 200 mg/100g and above. On the other hand, only one plant of the 15 bisexuals showed a total phenol content of above 200.00 mg/100 g and above. The rest registered a lower total phenol content of below 200 mg/100g. Analysis of variance showed a significant difference between males and bisexuals with respect to total phenol content of young as well as mature leaves. Thomas (1997) also reported the presence of" higher total phenol content in the leaves of male nutmeg trees than in female ones. Regarding the thin layer chromatography of phenolics of leaves, the profile of phenolic extract after acid hydrolysis showed five distinct spots with Rf values 0.055, 0.089, 0.137, 0.200 and 0,438 in male plants. In bisexual plants, only four spots with Rf values 0,069, 0.131, 0.193 and 0.401 were observed Packiyasothy *el al,* (1991) reported two additional phenolic spots in the profile of male plants than that of the female plants in nutmeg. Presence of more phenolic groups and high concentration of

phenolics in the male plants indicate the synthesis and accumulation of phenolics have a direct relation in the sex of the trees.

The present study indicates the possibility of differentiating male and bisexual trees of kodampuli on the basis of flush colour of the emerging leaves, total phenol content of young and mature leaves and thin layer chromatographic profile of leaf phenolics.

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