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Genetic Diversity in Appemidi (Unique Aromatic Pickle Mango) Genotypes from Western Ghats Regions of Chikmagalur (Karnataka), India

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ABSTRACT

Keywords

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Mango (*Mangifera indica* L.) is having enormous diversity in its taste, flavour and fruit form. Their taste and flavour were unique to particular region. The Western Ghats region of Karnataka is having large diversity of unique pickling type mango, called Appemidi (tender mango). Because of unscientific management and with rapid deforestation in several of these areas, an exploratory survey was conducted in Western Ghat regions of Chikmagalur to conserve these unique types and also to review the morphological traits. This resulted in collection of 40 unique accessions which have been grafted and conserved in field gene bank nursery. The outcome of this study not only promote some accessions domestication but also can be used in further breeding programme.

Introduction

India is a land of diversity with diverse flora and fauna. Mango the most popular and choicest fruit crop of India having originated in Indo-Myanmar region (Mukherjee, 1953), both wild and cultivated forms of mango exhibit unusual diversity in fruit forms, flavour and taste (Mukherjee, 1948; Naik and Gangolly, 1950). Western Ghats and the peninsular region of India are diversity rich centres for *Mangifera indica* varieties. There are several unique types which are highly aromatic and unique taste for pickling which is commonly known as Appemidi found in

Western Ghats regions of Karnataka. A very large unexploited varietal diversity in mango can be seen especially in the Western Ghats region of Karnataka. This region is known for the pickling types of mango viz., 'Appemidi' (midi means tender mango in Kannada). These are found on the river banks, which is also one of the reasons for this diversity. The appemidi is not just an ordinary mango; its fragrance is so strong that adding just a few midis to an ordinary pickle can change its taste and aroma. "Appemidi" is the king of all tender mangoes as far as its use in pickle industry is concerned. The local populace who has conserved few of them in their backyard after

evaluating them for varied uses has selected some of these. Since, there is a large unexplored diversity, several important ones have not yet been evaluated and conserved.

Appemidi a unique aromatic pickle types mainly used for whole fruited tender mango pickles. These indigenous types are gaining importance in the export market because of their suitability for pickling as whole fruit (Radhakrishna Holla, 2007). But the local people are unaware of the importance of these indigenous types, plants were not managed scientifically and blatantly cutting the branches for harvesting of fruits to sell in local markets. Therefore a survey was conducted in this area to collect for conserving these unique types and also attempt was made to evaluate these types.

Materials and Methods

Germplasm with diverse genetic base is the major source for breeding programmes. Further, preservation of germplasm is a worldwide concern and conservation of specific diverse gene pools will be useful to breeders. Thus, an attempt was made to study the diversity of indigenous mango genotypes of Western Ghats regions of Chikmagalur District, Karnataka, by conducting a survey.

A three phase survey was conducted at Gonibeedu, Marebylu, Aldur, Balehonnur, Kudige, Soppinakadu, Arenuru, Magundi, Bynduru, Elelmadlu, Kanathi and Chimankudige places of Chikmagalur district, western ghat regions of Karnataka. Forty indigenous types were collected from different regions and each genotype names were given depending upon their place of collection. The leaves, Inflorescence, fruit and tree were characterized.

In each accession, three trees were selected to represent three replications and basic

statistical measures such as mean, SEd, CV and SEM were worked out. Ten randomly-selected tender fruits (to the extent possible, before formation of the stony endocarp) were used for biometric observations in each accession and replication. Leaf characters like leaf shape, tip, leaf margin, texture, color of young flush, fragrance, leaf venation and Fruit characters like shape, flavour and latex flow were recorded. Weight of individual fruits was recorded and expressed in grams.

Results and Discussion

Various morphological characterizations were done for the 40 Appemidi genotypes collected from survey. In order to describe them systematically, morphological characterization of these entire 40 genotypes were carried out as per the standard descriptor for mango by IBPGR (2006) comprising of leaf, inflorescence, fruit and other parameters.

The application of morphological markers is the simplest of formal standardised methods of evaluating crop genetic diversity. Morphological characterisation is the first step that should be done before more profound biochemical or molecular studies are carried out (Hoogendijk and Williams, 2001) and it allows for the study of plant variation using visual attributes. The tree growth observed were erect, spreading and drooping in habit (Simi, 2006).

Leaf characterization

Leaf characters described include orientation of leaf shape, tip, leaf margin, texture, color of young flush, fragrance, leaf venation etc. leaf characters showed much variation among the genotypes. Naik and Gangolly(1950) also used leaf characters as secondary and tertiary characters for varietal identification.

The surveyed genotypes showed horizontal

and semi erect type of leaf orientation with medium venation and coriaceous texture. Leaf shape predominantly oblong type, with wavy margins.

Majority of genotypes showed light green color of young leaves with dark green mature or fully developed leaves with mild fragrance (Table 1). Simi (2006) reported that lanceolate type of leaf shape and acuminate character of leaf tip and light green with brown tinge colour of young flush predominantly appeared in traditional mango types of southern Kerala.

Inflorescence characterization

The inflorescence characters predominantly noticed were the terminal position, pyramidal shape of inflorescence, light green colour and densely flowered panicles (Table 2). Simi (2006) also reported dominance of terminal inflorescences, pyramidal shape of inflorescence and densely flowered panicles in southern Kerala.

Jyothi *et al.*, (2009) reported more than 70 per cent of the mango tree had broadly pyramidal inflorescence and are densely flowered which give them a bunch like appearance.

Fruit characterization

Fruits have been the major descriptors for identification of different varieties of fruit crops (Toili *et al.*, 2013). Variability in mango types show that fruit shape was the most important and stable character for discriminating varieties from each other. Other fruit characters also have a degree of varying importance for the purpose of identification.

Presences of beak, fruit size, sinus, cavity of stalk insertion are also important for studying variability in mango germplasm (Ram and Rajan, 2003). Fruits have been exclusively used as the major descriptors for identification

of different varieties of fruit crops (Toili *et al.*, 2013).

Different fruit shapes were observed, i.e. round, elliptic, Obovoid, ovoid and oblong. Simi,(2006) also reported four types of fruit shapes such as round, oblong, ellipsoid, and oblong ellipsoid. NavPrem, (2014) characterized nine sucking mango genotypes and observed fruit shapes such as ovate, oblong and ovate oblong in their study.

The fruit length was ranged from 3.40 cm to 5.65 cm and the maximum fruit length was recorded in genotype Chimankudige-3 (5.65 cm).Dinesh (2015) evaluated 130 mango varieties for fruit characteristics and reported that Maharaja Pasand, Sora and Tenneru had higher fruit length (>20 cm) (Table 3).

The fruit diameter was differed significantly with a mean of 3.00 cm while, the fruit diameter was ranged from 2.22 cm to 3.92 cm among the cultivars studied. Maximum fruit diameter was recorded in genotype Arenuru-1 (3.92 cm). The mean fruit thickness was 2.33 cm, while it ranged from 1.52 cm to 2.95 cm. The maximum fruit thickness was recorded in genotype Agrahara (2.95 cm)

The fruit weight of mango cultivars studied in the present investigation was ranged from 12.22g to 21.12 g with a mean fruit weight of 16.33 g, significantly maximum fruit weight was recorded in genotype Arenuru-2 (21.12 g) followed by Soppinakadu-2 (21.09g) (Table 3).

Vasugi *et al.*, (2008), evaluated the unique pickle types and reported that fruit weight ranged from 17.43 g in Kanappe-1 to 191.75g in Gaddalalli Appe which is attributed to the inherent nature of different accessions and are heritable under all environments.

Table.1 Leaf Characteristics of forty surveyed Appemidi genotypes from Western Ghats regions of Chikmagalur

Cultivar	Leaf attitude in relation to branch	Thickness of pelvinus	Leaf venation	Leaf texture	Leaf shape	Leaf margin	Leaf pubescence	Colour of young leaf	Intensity of anthocyanin pigmentation	Colour of fully developed leaf	Leafy bracts	Leaf tip	Leaf fragrance
Agrahara	Horizontal	T	Medium	Coriaceous	Elliptic	Wavy	Present	LG	Low	DG	Present	Pointed	Strong
Gonibeedu-1	Horizontal	T	Medium	Coriaceous	Oblong	Wavy	Present	LB	High	DG	Present	Pointed	Strong
Gonibeedu 2	Horizontal	T	Medium	Coriaceous	Oblong	Wavy	Present	LB	High	DG	Present	Pointed	Strong
Gonibeedu -3	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LB	Medium	DG	Present	Not Pointed	Strong
Gonibeedu-4	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LB	Medium	DG	Present	Not Pointed	Strong
Gonibeedu-5	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	Low	Green	Absent	Pointed	Mild
Kamanmori-1	Horizontal	T	Medium	Coriaceous	Oblong	Wavy	Present	LB	Medium	DG	Present	Pointed	Mild
Kamanmori-2	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	Low	DG	Present	Pointed	Mild
Chimankodige 1	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	Low	DG	Present	Pointed	Mild
Chimankodige 2	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	High	Green	Absent	Pointed	mild
Chimankodige-3	Horizontal	T	Medium	Coriaceous	Oblong	Wavy	Present	Brown	High	DG	Present	Not Pointed	Strong
Chimankodige-4	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	Low	Green	Absent	Pointed	Mild
Heruru-1	Horizontal	T	Medium	Coriaceous	Oblongceolate	Wavy	Present	LG	Low	DG	Absent	Not Pointed	mild
Heruru-2	Horizontal	T	Medium	Coriaceous	Oblongceolate	Wavy	Present	LG	Low	DG	Absent	Not Pointed	mild
Elemadlu-1	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	Low	DG	Present	Pointed	Mild
Elemadlu-2	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	High	Green	Absent	Pointed	mild
Marebilu-1	Horizontal	T	Medium	Coriaceous	Oblongceolate	Wavy	Present	LG	Low	DG	Absent	Not Pointed	mild
Marebilu-2	Horizontal	T	Medium	Coriaceous	Oblongceolate	Wavy	Present	LG	Low	DG	Absent	Not Pointed	mild
Marebilu-3	Horizontal	T	Medium	Coriaceous	Oblong	Wavy	Present	Brown	High	DG	Present	Not Pointed	Strong
Marebilu-4	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	Low	Green	Absent	Pointed	Mild
Soppinakadu-1	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	Low	DG	Present	Pointed	Mild
Soppinakadu-2	Horizontal	T	Medium	Coriaceous	Oblongceolate	Wavy	Present	LG	Low	DG	Absent	Not Pointed	mild
Soppinakadu-3	Horizontal	T	Medium	Coriaceous	Oblongceolate	Wavy	Present	LG	Low	DG	Absent	Not Pointed	mild
Kumrumane1	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	High	Green	Absent	Pointed	mild
Kumrumane-2	Horizontal	T	Medium	Coriaceous	Oblongceolate	Wavy	Present	LG	Low	DG	Absent	Not Pointed	mild
Marigundi	Horizontal	T	Medium	Coriaceous	Oblong	Wavy	Present	Brown	High	DG	Present	Not Pointed	Strong
Doobla	Horizontal	T	Medium	Coriaceous	Oblong	Wavy	Present	Brown	High	DG	Present	Not Pointed	Strong
Kudige	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	Low	Green	Absent	Pointed	Mild
Bynduru	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LB	Medium	DG	Present	Not Pointed	Strong
Arenuru-1	Horizontal	T	Medium	Coriaceous	Oblong	Wavy	Present	LB	High	DG	Present	Pointed	Strong
Arenuru-2	Horizontal	T	Medium	Coriaceous	Oblong	Wavy	Present	LB	Medium	DG	Present	Pointed	Mild

Maagodu	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	Low	DG	Present	Pointed	Mild
Horatti jeerige-1	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	High	Green	Absent	Pointed	mild
Horatti jeerige-2	Horizontal	T	Medium	Coriaceous	Oblongceolate	Wavy	Present	LG	Low	DG	Absent	Not Pointed	mild
Banakal	Horizontal	T	Medium	Coriaceous	Oblongceolate	Wavy	Present	LG	Low	DG	Absent	Not Pointed	mild
Heggudlu	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	Low	DG	Present	Pointed	Mild
Kanathi-1	Horizontal	T	Medium	Coriaceous	Oblong	Wavy	Present	Brown	High	DG	Present	Not Pointed	Strong
Kanathi-2	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	Low	Green	Absent	Pointed	Mild
Kanathi-3	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LB	Medium	DG	Present	Not Pointed	Strong
Shantipura	Semi erect	T	Medium	Coriaceous	Oblong	Wavy	Present	LG	High	Green	Absent	Pointed	mild

T= Thick; LG= Light Green; LB= Light Brown; DG= Dark Green

Table.2 Inflorescence characteristics of forty surveyed Appemidi genotypes from Western Ghats regions of Chikmagalur

Cultivar	Regularity of flowering	Inflorescence position	Inflorescence axis growth habit	Inflorescence shape	Inflorescence anthocyanin coloration	Presence of leafy bracts	Density of flowers in inflorescence	Flower type	Inflorescence colour	Nature of Disc	Hairiness
Agrahara	Regular	Terminal	Semi Erect	Conical	weak	Absent	Dense	Penta	LG	Swollen	Absent
Gonibeedu-1	Regular	Terminal	Semi Erect	Pyramidal	Medium	Absent	Sparse	Penta	YG	Swollen	Absent
Gonibeedu 2	Regular	Terminal	Semi Erect	Pyramidal	Medium	Absent	Sparse	Penta	YG	Swollen	Absent
Gonibeedu -3	Biennial	Terminal	Semi Erect	Broadly pyramidal	Medium	Absent	Dense	Penta	GwR	Swollen	Sparse
Gonibeedu-4	Biennial	Terminal	Semi Erect	Broadly pyramidal	Medium	Absent	Dense	Penta	GwR	Swollen	Sparse
Gonibeedu-5	Biennial	Terminal	Semi Erect	Pyramidal	Absent	Absent	Sparse	Penta	LG	Swollen	Sparse
Kamanmori-1	Biennial	Terminal	Semi Erect	Broadly pyramidal	Absent	Absent	Sparse	Penta	YG	Swollen	Sparse
Kamanmori-2	Biennial	Terminal	Semi Erect	Conical	Absent	Absent	Sparse	Penta	YG	Swollen	Sparse
Chimankodige 1	Biennial	Terminal	Semi Erect	Conical	Absent	Absent	Sparse	Penta	YG	Swollen	Sparse
Chimankodige 2	Biennial	Terminal	Semi Erect	Conical	Strong	Absent	Dense	Penta	GwR	Swollen	Dense
Chimankodige-3	Biennial	Terminal	Semi Erect	Broadly pyramidal	Strong	Absent	Sparse	Penta	GwR	Swollen	Sparse
Chimankodige-4	Biennial	Terminal	Semi Erect	Pyramidal	Absent	Absent	Sparse	Penta	LG	Swollen	Sparse
Heruru-1	Biennial	Terminal	Semi Erect	Conical	Medium	Absent	Dense	Penta	GwR	Swollen	Absent
Heruru-2	Biennial	Terminal	Semi Erect	Conical	Medium	Absent	Dense	Penta	GwR	Swollen	Sparse
Elemadlu-1	Biennial	Terminal	Semi Erect	Conical	Absent	Absent	Sparse	Penta	YG	Swollen	Sparse
Elemadlu-2	Biennial	Terminal	Semi Erect	Conical	Strong	Absent	Dense	Penta	GwR	Swollen	Dense
Marebilu-1	Biennial	Terminal	Semi Erect	Conical	Medium	Absent	Dense	Penta	GwR	Swollen	Absent
Marebilu-2	Biennial	Terminal	Semi Erect	Conical	Medium	Absent	Dense	Penta	GwR	Swollen	Sparse
Marebilu-3	Biennial	Terminal	Semi Erect	Broadly pyramidal	Strong	Absent	Sparse	Penta	GwR	Swollen	Sparse
Marebilu-4	Biennial	Terminal	Semi Erect	Pyramidal	Absent	Absent	Sparse	Penta	LG	Swollen	Sparse
Soppinakadu-1	Biennial	Terminal	Semi Erect	Conical	Absent	Absent	Sparse	Penta	YG	Swollen	Sparse
Soppinakadu-2	Biennial	Terminal	Semi Erect	Conical	Medium	Absent	Dense	Penta	GwR	Swollen	Sparse
Soppinakadu-3	Biennial	Terminal	Semi Erect	Conical	Medium	Absent	Dense	Penta	GwR	Swollen	Absent

Kumrumane1	Biennial	Terminal	Semi Erect	Conical	Strong	Absent	Dense	Penta	GwR	Swollen	Dense
Kumrumane-2	Biennial	Terminal	Semi Erect	Conical	Medium	Absent	Dense	Penta	GwR	Swollen	Absent
Marigundi	Biennial	Terminal	Semi Erect	Broadly pyramidal	Strong	Absent	Sparse	Penta	GwR	Swollen	Sparse
Doobla	Biennial	Terminal	Semi Erect	Broadly pyramidal	Strong	Absent	Sparse	Penta	GwR	Swollen	Sparse
Kudige	Biennial	Terminal	Semi Erect	Pyramidal	Absent	Absent	Sparse	Penta	LG	Swollen	Sparse
Bynduru	Biennial	Terminal	Semi Erect	Broadly pyramidal	Medium	Absent	Dense	Penta	GwR	Swollen	Sparse
Arenuru-1	Regular	Terminal	Semi Erect	Pyramidal	Medium	Absent	Sparse	Penta	YG	Swollen	Absent
Arenuru-2	Biennial	Terminal	Semi Erect	Broadly pyramidal	Absent	Absent	Sparse	Penta	YG	Swollen	Sparse
Maagodu	Biennial	Terminal	Semi Erect	Conical	Absent	Absent	Sparse	Penta	YG	Swollen	Sparse
Horatti jeerige-1	Biennial	Terminal	Semi Erect	Conical	Strong	Absent	Dense	Penta	GwR	Swollen	Dense
Horatti jeerige-2	Biennial	Terminal	Semi Erect	Conical	Medium	Absent	Dense	Penta	GwR	Swollen	Absent
Banakal	Biennial	Terminal	Semi Erect	Conical	Medium	Absent	Dense	Penta	GwR	Swollen	Sparse
Heggudlu	Biennial	Terminal	Semi Erect	Conical	Absent	Absent	Sparse	Penta	YG	Swollen	Sparse
Kanathi-1	Biennial	Terminal	Semi Erect	Broadly pyramidal	Strong	Absent	Sparse	Penta	GwR	Swollen	Sparse
Kanathi-2	Biennial	Terminal	Semi Erect	Pyramidal	Absent	Absent	Sparse	Penta	LG	Swollen	Sparse
Kanathi-3	Biennial	Terminal	Semi Erect	Broadly pyramidal	Medium	Absent	Dense	Penta	GwR	Swollen	Sparse
Shantipura	Biennial	Terminal	Semi Erect	Conical	Strong	Absent	Dense	Penta	GwR	Swollen	Dense

Table.3 Fruit morphological characterization of surveyed Appemidi genotypes

Cultivars	Fruit Length (cm)	Fruit Diameter (cm)	Fruit thickness (cm)	Fruit weight (g)	Sap burning time (seconds)
Agrahara	5.22	3.52	2.95	14.35	11.52
Gonibeedu-1	4.25	2.55	1.92	16.67	14.48
Gonibeedu 2	4.62	2.97	2.42	13.55	15.46
Gonibeedu -3	4.47	3.07	2.65	16.45	14.08
Gonibeedu-4	4.12	2.77	2.10	12.80	17.34
Gonibeedu-5	4.12	3.09	2.10	14.60	18.92
Kaman mori-1	5.23	2.98	2.18	13.35	16.98
Kaman mori-2	4.95	2.98	2.18	14.12	16.73
Chimankodige 1	4.15	3.48	2.25	13.22	16.55
Chimankodige 2	3.40	3.05	2.42	12.22	16.17
Chimankodige-3	5.65	2.95	1.52	15.75	16.15
Chimankodige-4	4.40	3.25	2.40	19.12	16.42
Heruru-1	4.50	2.22	2.59	18.32	16.32
Heruru-2	4.52	2.30	2.40	19.90	16.05
Elemadlu-1	5.23	2.55	2.60	17.30	16.58
Elemadlu-2	5.33	2.55	2.80	17.93	16.98
Marebilu-1	3.62	2.75	2.07	14.40	16.15
Marebilu-2	3.70	2.60	2.10	14.83	16.19
Marebilu-3	4.58	2.93	2.25	15.20	15.82
Marebilu-4	3.50	3.07	2.27	14.35	16.37
Soppinakadu-1	4.92	3.10	2.32	18.92	19.00
Soppinakadu-2	4.95	3.27	2.25	21.09	24.66
Soppinakadu-3	4.95	3.075	2.325	20.425	19.17
Kumrumane1	4.27	3.10	2.40	20.15	17.31
Kumrumane-2	4.27	3.10	2.37	20.00	17.51
Doobla	4.60	2.70	2.15	16.19	25.95
Marigundi	5.50	3.10	2.70	16.74	12.27
Kudige	4.92	3.05	2.71	15.12	28.25
Bynduru	4.16	2.75	2.07	14.30	12.31
Arenuru-1	3.80	3.92	2.07	15.31	27.02
Arenuru-2	4.42	3.38	2.25	21.12	27.88
Maagodu	4.58	3.25	2.25	15.02	15.67
Horatti Jeerige-1	4.72	3.55	2.65	16.15	15.70
Horatti Jeerige-2	4.60	3.25	2.68	16.15	15.75
Banakal	5.54	3.10	2.90	13.75	14.05
Heggudlu	5.03	3.07	2.05	20.31	10.40
Kanathi-1	3.60	3.07	2.15	16.07	25.38
Kanathi-2	4.31	3.10	2.20	15.73	22.87
Kanathi-3	4.11	2.70	2.28	16.26	25.38
Shantipura	4.53	2.78	2.35	16.09	15.05
Mean	4.53	3.00	2.33	16.33	18.82
C.D.	0.60	0.29	0.25	2.48	--
SE (m)	0.22	0.10	0.09	0.89	7.26
F-Test	*	*	*	*	*
C.V.	9.51	6.82	7.76	10.84	77.32

Sap burning is one of the traditional practices followed to select the best tender fruits for pickle purpose. Therefore we also carried out sap burning test for surveyed fruit samples. Out of forty genotypes the mean time was 18.82 seconds, the maximum sap burning time was recorded in the genotype Kudige (28.25 seconds).

These unique genotypes scions were collected and grafted to conserve our traditional diversity of mango. Conservation plays an important role to avoid the extinction of unique types and to maintain our traditional wealth.

In conclusion, knowledge of genetic variability strongly facilitates breeding for wider geographic adaptability. Several studies have been conducted from time to time on morphological description of mango (Burns and Prayag, 1921; Mukherjee, 1948; Naik and Gangolly, 1950; Singh and Singh, 1956; Gangolly *et al*, 1957; Rajan *et al*, 1999 and Dinesh and Vasugi, 2002).

One of the characteristic features of mango varieties present in India has been expression of a character in a particular environment where the variety may have originated. In the present study, a given unique indigenous type of mango belonging to Western Ghat region has shown distinct characteristics. Conservation of indigenous types is a must to identify desirable traits in these genotypes for further use in the breeding programme. Evaluation of these types can help in the identification of better genotypes for products *viz.*, pickle, which are gaining commercial importance.

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