

***Luffa hermaphrodita*: First Report of its Distribution and Cultivation in Adilabad, Andhra Pradesh, South India**

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Abstract

*To salvage and conserve the current spectrum of landrace diversity in different agri-horticultural crops from the district of Adilabad in Andhra Pradesh, India, 14 special agri-biodiversity surveys were undertaken during 2010–12. In these surveys, a *Luffa* species having small, elliptical, and cluster bearing fruits was seen being cultivated in the backyards of the tribal farmers in 10 mandals of Adilabad district. Close observation of the plants and fruit samples in-situ and characterization for 24 qualitative and 13 quantitative traits, especially the nature of flowering and fruiting, during field evaluation at National Bureau of Plant Genetic Resources (NBPGR) Regional Station, Rajendranagar, Hyderabad confirmed the plant species as *Luffa hermaphrodita* Singh & Bhandari, popularly known as satputiya. The satputiyas traditionally occur in the Indo-Gangetic plains and the cultivation of this species in Adilabad district is the first report of its distribution in South India.*

India is one of the twelve centers/regions of diversity of crop plants in the world and the Indian gene center possesses about 166 species of agri-horticultural crop plants (Zeven and de Wet, 1982) and 320 species of wild relatives distributed in eight phyto-geographical/agroecological zones (Arora and Nayar, 1984). The antiquity of agriculture and the ethnic diversity in the subcontinent has played a major role in diversification of crop resources resulting in accumulation of rich genetic diversity

in several crop species and their wild progenitors in this region.

Many cultivated and wild species of Cucurbitaceae were domesticated in the prehistoric times in the New and Old Worlds and are associated with human culture. Almost all the cucurbits are of tropical origin (Africa, America, and Asia) and these are distributed all over the world in different ecological zones (Sirohi *et al.*, 2005). Of 110 genera and 640 species reported under the family Cucurbitaceae in the world, 36 genera and

100 species are reported in India including 38 endemic species (Chakravarty, 1982). The different agroecological/phyto-geographical regions of India hold rich diversity and the subcontinent is considered to be the center of origin for a number of cultivated and wild cucurbit species (Arora, 1991; Rathore *et al.*, 2005) and also a primary center of diversity of crops such as smooth or sponge gourd (*Luffa cylindrica* M.Roem.), ridged gourd [*Luffa acutangula* (L.) Roxb.], and pointed gourd (*Trichosanthes dioica* Roxb.).

The genus *Luffa* Miller, taxonomically belonging to the tribe Luffeae, sub-family Cucurbitioideae, and family Cucurbitaceae is distributed mainly in tropical Asia and Africa (Jeffrey, 2005). The genus has a long history of cultivation in tropical Asia and Africa and the probable center of origin and the primary center of diversity for *Luffa* is India (Sirohi *et al.*, 2005). *Luffa* has nine species in the world of which seven [*L. acutangula*, *L. cylindrica*, *L. echinata* Roxb., *L. graveolens* Roxb., *L. hermaphrodita* Singh & Bhandari, *L. tuberosa* Roxb., and *L. umbellata* M. (Klein) Roem.] occur in India (Chakravarty, 1982; Umesh, 1995; Sirohi *et al.*, 2005). Of these seven species, three – *L. acutangula*, *L. cylindrica*, and *L. hermaphrodita* – are edible species and cultivated in tropical and subtropical climates and the remaining four species occur wild, mostly confined to northwestern/eastern Himalayas, northeastern plains, east coast, and peninsular tract (Arora and Nayar, 1984). The national priority for exploration and collection of cucurbits germplasm was categorized as medium (IBPGR, 1980) given the significant amount of accumulated genetic diversity in the crop.

Characteristics of the study area

Adilabad is the fifth largest district in Andhra Pradesh, India, which lies between 18°40' and 19°56' N latitudes and 77°47' and 80°00' E longitudes with a total geographical area of 16,128 km². It is bounded by Yavatmal and Chandrapur districts in the North, Chandrapur in the East, Karimnagar and Nizamabad in the South, and Nanded district in the West. Adilabad is administratively divided into 52 *mandals* (district sub-units) encompassing 1,752 revenue villages and is also covered up to 44.8% area mostly by dry deciduous forests. About 65% of the district is inhabited by tribal groups to an extent of 17.8% of the total population (second in the state of Andhra Pradesh) with *Gond*, *Naikpod*, *Kolam* [Primitive Tribal Group (PTG)], *Pardhan*, *Koya*, *Manne*, *Andh*, *Thoti* (PTG), *Lambada*, and *Yerukala* as the major groups. The tribal population is dominated by the *Gond* (52%), *Lambada* (22%), *Kolam* (8%), and others (*Naikpod*, *Koya*, *Andh*, *Manne*, *Pardhan*, and *Porja* – 8%). The most important river that traverses the district is the Godavari with Penganga, Wardha, Pranahita, Kadem, and Peddavaagu as the tributaries and the rivulets flowing through are Satnala, Swarna, and Suddavaagu. The major crops of the district are rice, sorghum, cotton, pigeonpea, maize, soybean, etc. Very deep black cotton soils are predominant; *chalkas* (red and sandy loams) are also found. The average annual rainfall ranges between 700 and 1,200 mm, mostly precipitated during the southwest monsoon. The minimum and maximum temperatures range between 5°C and 52°C (Anonymous, 2005; Pandravada *et al.*, 2011). Adilabad is a rich abode and

a treasure trove for ethnic diversity in different agri-horticultural crops, which is a vibrant and indispensable component in the overall conservation strategies.

Materials and methods

A total of 14 agri-biodiversity surveys were undertaken during 2010–12 covering 358 villages belonging to 52 *mandals* of Adilabad district of Andhra Pradesh for collection, conservation, and inventory and documentation of various crop groups. Population samples of germplasm were collected from tribal farmers' fields, threshing yards, farm stores, and also augmented from the market. The overall collection tactics and logistics were taken into consideration as suggested by Bennett (1970) and Astley (1991). The germplasm collections were properly cleaned, processed, and packed in aluminium foil pouches for medium-term conservation in the Medium Term Storage Module facility at National Bureau of Plant Genetic Resources (NBPGR) Regional Station, Rajendranagar, Hyderabad. The collections of *Luffa* sp. were characterized and evaluated for morpho-agronomic traits, which include important qualitative and quantitative descriptors (Srivastava *et al.*, 2001), during *kharif* (rainy season) 2012 at

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NBPGR Regional Station, Rajendranagar, Hyderabad. The agronomic operations were taken up and experimental plots were prepared based on the recommended package of practices (APAU, 1996).

Results and discussion

In total, 1,658 accessions of germplasm belonging to 12 agri-horticultural crop groups were collected from Adilabad district. These included 46 diverse lines comprising six named landraces belonging to ridged gourd, smooth gourd, and other *Luffa* spp. Among these, 14 *Luffa* genotypes, which were characterized by small, oval/elliptical, and cluster bearing fruits were seen cultivated in black soils in the backyards by the tribal farmers belonging to *Gond*, *Koya*, *Lambada*, and *Manne* groups. Close observation of the plants and fruit samples in-situ and characterization for 24 qualitative and 13 quantitative traits, especially the nature of flowering and fruiting, during field evaluation at NBPGR Regional Station, Rajendranagar, Hyderabad confirmed the ridged gourd cultivars as *Luffa hermaphrodita*, popularly known as *satputiya*. We observed that this species was distributed or domesticated or found as an escape in 10 *mandals* (Adilabad, Asifabad, Bejjur, Dahegaon, Dandepally, Jainad, Kagaznagar, Luxettipet, Talamadugu, and Tamsi) out of 52 in the

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district of Adilabad with good distribution in Kagaznagar area (Fig. 1). The passport data of *L. hermaphrodita* collections sampled from Adilabad district is given in Table 1. The qualitative and quantitative distinguishing morphological characters of this species are given in Tables 2 and 3 respectively. The collections of *L. hermaphrodita* are characterized by flowering in bunches with 7–15 flowers; however, only 3–8 ultimately develop into fruits (Fig. 2). The cultivars of this species also are polymorphic with respect to their fruit morphology (no. of fruits per inflorescence; shape; size). The fruits are very small (fruit length 5.5–8.2

cm) with faint ridge markings on the surface. The seed is black, shiny, smooth, linear-ovoid with a narrow beak, all the characters confirming the identity of these accessions as *L. hermaphrodita*.

Many species of *Luffa* must have evolved gradually through introgression and selection from wild forms which occur in different parts of the country. These species or landraces contain valuable genes having resistance to diseases and pests and stress environments with wider adaptability in diverse agroecological zones (Umesh, 1995). *Luffa hermaphrodita*, popularly known as *satputiya*, is a domesticated or semi-wild

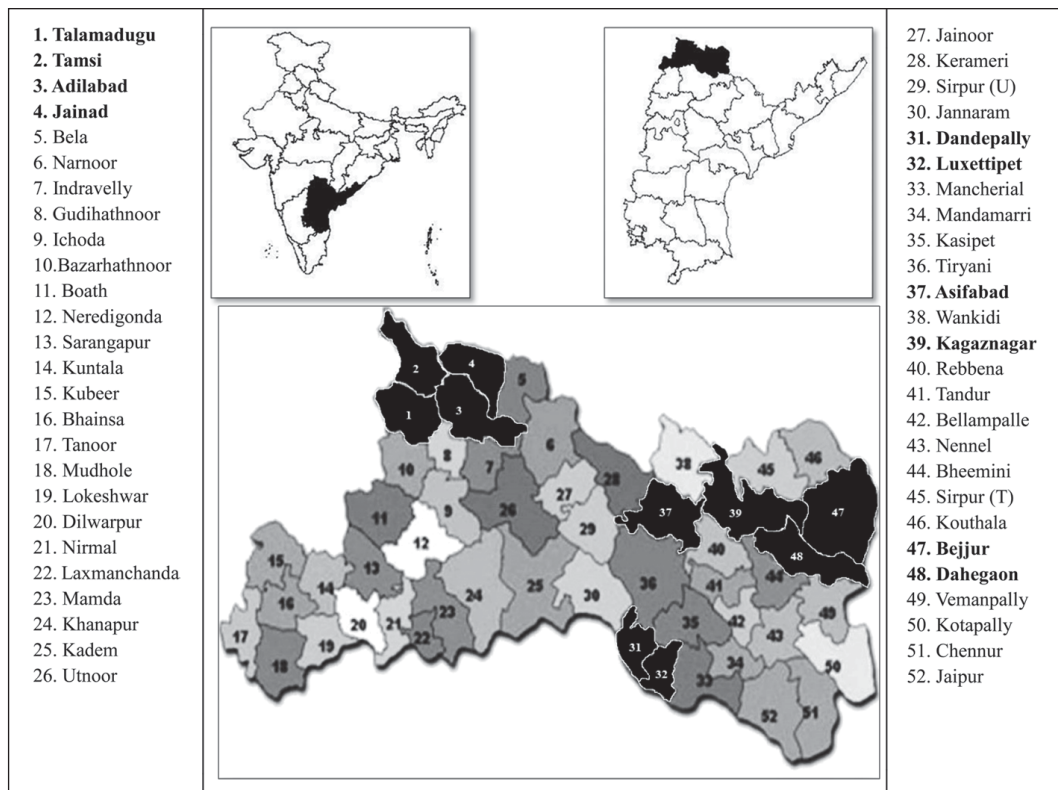


Figure 1. Distribution of *Luffa hermaphrodita* in mandals (black) in Adilabad District of Andhra Pradesh, India.

Table 1. Passport data of *Luffa hermaphrodita* collections sampled from Adilabad district, Andhra Pradesh.

| Collector | Alternate ID | Village | Collection site | | | Altitude (m) |
|------------|------------------|--------------|-----------------|----------|-----------|--------------|
| | | | <i>Mandal</i> | Latitude | Longitude | |
| PSR-13241 | NAIP-BD-ADB-1187 | Chirrakunta | Asifabad | 19.18.68 | 79.15.85 | 227 |
| PSR-13288 | NAIP-BD-ADB-1234 | Karnapet | Dandepally | 19.00.55 | 79.10.30 | 205 |
| PSRJ-12984 | NAIP-BD-ADB-343 | Gannaram | Kagaznagar | 19.22.08 | 79.34.57 | 196 |
| PSRJ-12986 | NAIP-BD-ADB-345 | Gannaram | Kagaznagar | 19.22.08 | 79.34.57 | 196 |
| PSRJ-13111 | NAIP-BD-ADB-470 | Kondapalli | Bejjur | 19.18.57 | 79.45.79 | 148 |
| PSRJ-13138 | NAIP-BD-ADB-497 | Kesalapur | Dahegaon | 19.15.16 | 79.35.03 | 155 |
| PSRJ-13139 | NAIP-BD-ADB-498 | Kesalapur | Dahegaon | 19.15.16 | 79.35.03 | 155 |
| RJR-271 | NAIP-BD-ADB-785 | Chellampalle | Luxettipet | 18.58.03 | 79.14.57 | 204 |
| RJR-282 | NAIP-BD-ADB-796 | Lingapur | Dandepally | 19.01.12 | 79.06.53 | 189 |
| RJR-491 | NAIP-BD-ADB-1636 | Kopparla | Tamsi | 19.43.49 | 78.27.68 | 278 |
| RJR-506 | NAIP-BD-ADB-1651 | Pippalgaon | Jainad | 19.42.13 | 78.39.36 | 254 |
| RJR-509 | NAIP-BD-ADB-1654 | Jamni | Adilabad | 19.39.37 | 78.41.89 | 309 |
| RJR-685 | NAIP-BD-ADB-1830 | Kharjalli | Talamadugu | 19.39.97 | 78.27.82 | 311 |
| RJR-690 | NAIP-BD-ADB-1835 | Nipani | Tamsi | 19.44.81 | 78.27.53 | 269 |

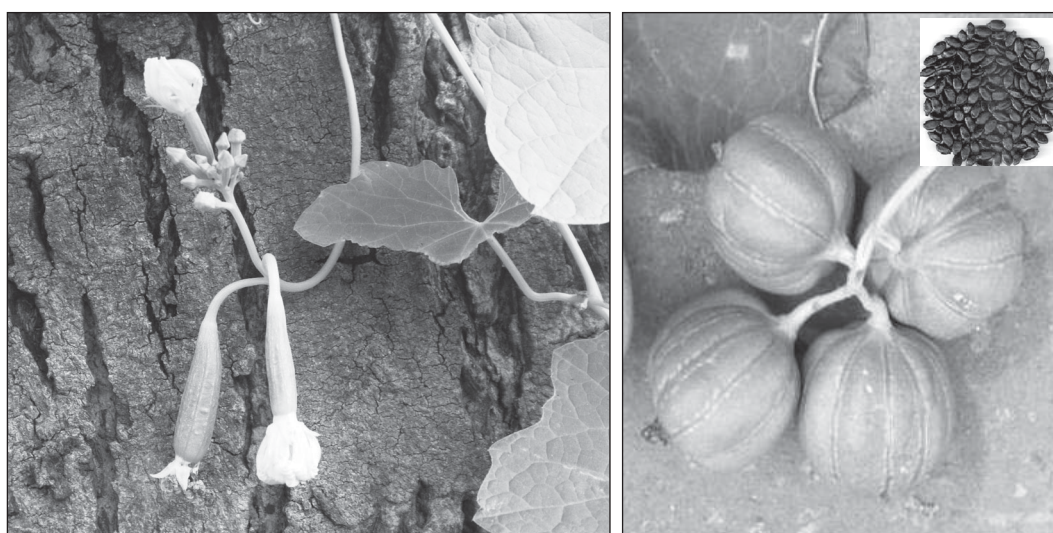
**Figure 2. *Luffa hermaphrodita*: (left) flowering in bunches; (right) fruiting in typical clusters and (inset) seeds.**

Table 2. Qualitative traits of *Luffa hermaphrodita* collected from Adilabad district, Andhra Pradesh.

| Descriptor | Descriptor state |
|------------------------|--|
| Early plant vigor | Good |
| Plant growth habit | Long viny |
| Stem pubescence | Smooth |
| Stem shape | Round |
| Tendrils presence | Present |
| Tendrils type | Coiled |
| Tendrils branching | Unbranched |
| Leaf margin | Serrate |
| Leaf shape | Cordate |
| Leaf size | Large |
| Leaf pubescence | Intermediate |
| Sex type | Monoecious/hermaphrodite/andromonoecious |
| Peduncle shape | Smoothly round |
| Peduncle attachment | Hard |
| Fruit shape | Globular/round/elliptical/oblong-ellipsoidal |
| Fruit skin color | Green |
| Fruit ridge shape | Superficial |
| Continuity of ridges | Continuous/discrete |
| Fruit skin luster | Matt |
| Skin hardness of fruit | Soft |
| Fruit ridges | Faint |
| Flesh texture | Smooth |
| Seed shape | Ovate, beaked |
| Spermoderm pattern | Reticulate |

A total of 14 agri-biodiversity surveys were undertaken during 2010–12 covering 358 villages belonging to 52 mandals of Adilabad district of Andhra Pradesh for collection, conservation, and inventory and documentation of various crop groups.

taxon originated from *L. graveolens*, the wild progenitor which occurs in Bihar and northwards to Sikkim (wide distribution in northeastern plains) and south of it to Tamil Nadu and sporadic elsewhere in Eastern Himalayas (Arora and Nayar, 1984). It was also described as one of the 60 endemic and/or rare species of wild relatives or

Table 3. Quantitative traits of *Luffa hermaphrodita* collected from Adilabad district, Andhra Pradesh.

| Descriptor | Range | | Average |
|---|---------|---------|---------|
| | Minimum | Maximum | |
| Vine length at maturity (cm) | 68.0 | 100.0 | 79.2 |
| Internode (4 th –5 th) length (cm) | 5.0 | 6.0 | 5.4 |
| Branches (no.) | 2.0 | 5.0 | 4.0 |
| Peduncle length (cm) | 4.2 | 6.2 | 5.1 |
| Time to first female flowering (days) | 38.0 | 44.0 | 40.0 |
| Primary branches (no.) | 2.0 | 5.0 | 3.0 |
| Fruit length (cm) | 5.5 | 8.2 | 7.7 |
| Fruit width (cm) | 4.1 | 5.0 | 4.4 |
| Fruit weight (g) | 27.5 | 38.0 | 34.2 |
| Ridges per fruit (no.) | 9.0 | 10.0 | 9.5 |
| Fruits per cluster (no.) | 3.0 | 8.0 | 4.8 |
| Seeds per fruit (no.) | 53.0 | 65.0 | 63.0 |
| 100-seed weight (g) | 7.1 | 10.9 | 9.0 |

related taxa belonging to vegetable plant category out of 320 wild relatives of crop species reported in India (Arora and Pandey, 1996). The hermaphrodite sex forms in *L. hermaphrodita* with compound racemes which is a primitive character is believed to have been derived from the monoecious species *L. graveolens* (Umesh, 1995). Minor cucurbitaceous vegetables have their importance mainly in the areas of their occurrence (Ram and Srivastava, 1999) and due to varied climate, physiography, and edaphic factors, the Indian subcontinent is rich with genetic diversity in cucurbits with domesticated, semi-domesticated, or wild species occurring in local pockets (Ram and Srivastava, 1999).

Luffa hermaphrodita, which is characterized by smooth skin in tender fruits borne

in clusters, is another potential edible species distributed primarily in parts of north-central India, Gangetic plains, Bihar, Rajasthan, Uttar Pradesh, and West Bengal (CSIR, 1962; Umesh, 1995; Sirohi *et al.*, 2005; Ajmal Ali and Pandey, 2005–06; Ram *et al.*, 2007; Nayar *et al.*, 2009a, 2009b). *Luffa hermaphrodita*, which is a hermaphrodite species bearing bisexual flowers, is easily crossable with *L. acutangula* with fertile hybrids (Umesh, 1995). Generally, the cultivars bear seven fruits in each inflorescence and this appears to be a constant feature. Based on this trait, it is locally called “*satputria*” or “*satputiya*” meaning seven children (Ajmal Ali and Pandey, 2005–06). A cross derivative of *satputiya* with the common monoecious strain (*L. acutangula*) is reported to yield five times as many fruits as the monoecious

parent bears and unlike the *satputiya*, is suitable for summer cultivation as well (CSIR, 1962). The fruits also develop internal fibrous spongy network on drying as observed in sponge gourds.

In Adilabad, *L. hermaphrodita* is under cultivation since a long time and referred to as *gutti beera* (clustered ridged gourd) in Telugu denoting its cluster bearing nature and *todka* in Gondi. The fruits are eaten when tender and are tasty. Unlike ridged gourd, the fruits of *L. hermaphrodita* can be consumed without removal of the skin as it is soft and gets cooked homogeneously. It is generally not consumed as a sole vegetable and invariably some pulse, generally split dhal of green gram, chickpea, or pigeonpea is added to supplement protein requirement. Green gram is added to *gutti beera* by most of the tribal households, which they claim as tasty and the best combination. Interestingly, cultivation of *L. hermaphrodita* is confined to only backyards or kitchen gardens of the tribal groups and the fruits are never sold and not seen in the markets or *shandies*. *Luffa hermaphrodita*, which is less known or underutilized, forms an important minor vegetable having a role in nutritional and livelihood security especially in the rainy season when the availability of different vegetables is scarce and costs are prohibitive. This cucurbit also has tremendous potential for commercial exploitation as well as for diversification of the spectrum of vegetables under cultivation.

High genetic variability with low genetic erosion is reported for this species (Umesh, 1995). The fruit is diuretic, expectorant, and used in curing biliousness, bronchitis, diseases of spleen and ulcers and the seed

is emetic and cathartic as well (Ram and Srivastava, 1999).

The *satputiyas* are traditionally cultivated in the Indo-Gangetic plains and the occurrence and cultivation of this species in Adilabad district is the first report of its distribution in South India. The fact that *L. hermaphrodita* is mainly occurring in the *mandals* adjoining Maharashtra gives credence to the movement of this particular species down south from the northern parts of the country as an escape or human intervention some time back and got established.

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