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Research Article

Salvaging Maize (*Zea mays* L.) Landraces from Central and High Altitude Tribal Regions of Telangana for Conservation and Utilization

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ABSTRACT

Maize is a major food crop under cultivation since 3,500 BC. A survey was organized to collect maize genetic resources from high altitude tribal regions of Telangana resulting in sampling 37 accessions of landrace diversity which include agronomically superior and genotypes having potential as sources of resistance/ tolerance to different biotic and abiotic stresses. The named landrace diversity collected in maize include chinna makka, erra mokkajonna, jonthra, naatu mokkajonna and nakka mokkajonna. Among the qualitative traits, greater variability was observed in kernel colour, kernel type and kernel upper surface shape and among the quantitative characters the germplasm was more diverse for 100 seed weight (g), kernels/ row (no), ear length (cm) and ear width (cm). Though traditional landraces contributed genes towards development of improved varieties, however, currently they are under severe threat of replacement. The present article briefly narrates the nuances of exploration, information on landraces with special traits, diversity in the material and potential for utilization in breeding programmes.

Key words: *Conservation, Germplasm, Landraces, Maize, Telangana.*

INTRODUCTION

Maize or corn (*Zea mays* L.) is the world's third leading cereal crop after wheat and rice having great significance as food, fodder and raw material for several industrial products[13]. The centre of origin for maize is the Central American region[8] and was introduced into India by the Portuguese during the seventeenth century[10]. Maize is one the most important cereal crops in the sub-continent and being the secondary centre of diversity is bestowed with tremendous variation both in terms of qualitative and quantitative traits and also for sources of resistance to different biotic and abiotic stresses.

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The national priority for exploration and collection of maize germplasm was categorized as medium[12] given the significant amount of accumulated genetic diversity in the crop.

Telangana with 8.02 lakh hectares area and 26.6 lakh tonnes production accounted for 8.3% of the country's acreage and 10.4% of production in maize during 2016-17[6]. Maize is grown to a large extent in the districts of Mahaboobnagar, Medak, Karimnagar, Warangal, Ranga Reddy, Nizamabad, Adilabad and Khammam in erstwhile Telangana accounting for 99.6% of the total area with Mahaboobnagar alone accounting for 28.4% under the crop in the state[1]. Telangana with unique topography, climatic conditions and seed exchange among the ethnic groups have greatly influenced the development and distribution pattern of diversity and is a treasure trove for maize variability especially the tribal districts of Khammam and Warangal[19]. In this regard, there were clear-cut gaps existing in terms of un-surveyed/ under-surveyed regions in these two important districts especially with the representation of diversity with only three accessions from Khammam and seven accessions from Warangal in the National Gene Bank[14] prioritising future collection. Also, initiation of developmental activities for bringing the farmers in to the main stream of life especially in the maize growing pockets of Telangana, the local landraces under cultivation are insidiously being replaced by HYVs/ improved cultivars at an alarming rate[18] and there is a tremendous urgency and scope for collection and conservation of accumulated indigenous variability as well. Hence, a survey was contemplated and undertaken in collaboration with Professor Jayashankar Telangana State Agricultural University mainly in the central and high altitude tribal regions of present Bhadradri-Kothagudem and Jayashankar - Bhoopalapally districts of Telangana in order to collect, salvage and conserve the available endemic landrace diversity in maize.

MATERIAL AND METHODS

The planning, logistics and the sampling procedures for the collection of maize germplasm was followed as per guidelines suggested by Engels *et al*.[4] and Brown and Marshall[3]. The predominant soil type encountered is red soil and other types include red sandy loams (*chalka)* and red loams with clay base as well. The average annual rainfall ranges between 800 and 1,400 mm and the temperature between 21°C and 37°C. The explored area is basically sub-humid with sub-tropical predominantly hot and dry climate[1]. The method followed in most of the cases has been random/ non-random selective sampling depending on the population as the targeted species is cultivated in nature. Farmer's field was taken as a unit area and random samples of the populations and biased samples of elite material were collected[16]. Germplasm samples were also collected from cultivated fields, threshing yards and farm stores as well. Geographical coordinates of the collection sites were recorded using handheld global positioning system (Garmin 12). Passport information on the collected germplasm was recorded and documented for 39 variables. Wherever possible notes on associated indigenous traditional/ ethno-botanical knowledge was also recorded. DIVA-Geographical Information System (GIS) tool was used to analyse geographical coordinates of passport data to generated maps on diversity distribution[5]. All the collected 37 accessions were characterized for seven qualitative and eight quantitative cob and kernel morpho-agronomic descriptors[7,9] to unravel the inherent variability and potential of the material. Standard statistical procedures[20] were followed for analysis of data.

RESULTS AND DISCUSSION

The tribal groups have contributed immensely to the origin, evolution and accumulation of very significant diversity in several landraces by selection over a long period of domestication and seed exchange. The tribal groups *konda reddy*, *koya* and *nethakani* are associated with the patronage, sustainability

and *on-farm* conservation of the local landraces of maize. The named landrace diversity collected in maize include mainly *chinna makka*, *erra mokkajonna*, *jonthra*, *naatu mokkajonna* and *nakka mokkajonna.* Among the qualitative traits studied, greater variability was observed in kernel colour (brown, brownish-yellow, orange, orange-white, orange-yellow, purple, variegated, white, yellow), kernel type (dent, flint, pop, semi-dent, semi-flint, sweet) and kernel upper surface shape (shrunken, indented, level, rounded) (Table 1). The variability observed for quantitative traits in maize landrace germplasm from Telangana is provided in Table 2. The descriptive statistical analysis for minimum, maximum, mean, standard deviation and coefficient of variation revealed significant differences among 37 maize landraces for eight quantitative characters studied. The germplasm was found to be more diverse for 100 seed weight (g), kernels/ row (no), ear length (cm) and ear width (cm).

In the surveyed region, Cheepuruchelaka, Chennapuram and Nadimi Reddigudem are the most diversity rich pockets in general for maize genetic resources and Kotha Anjaneyapuram and Gandlagudem for high seed weight. The value of germplasm collections depends on the genetic variability present in the accessions for important trait components. The Indian material is especially noteworthy for its adaptation to tropical and sub-tropical conditions[11,24]. The local landraces are generally medium statured with early maturity, mostly free from pests and diseases, resistant to moisture stress with high seed weight and good taste. Similar observation and traits for higher adaptability and tolerance to fungal diseases from maize collections from the tribal pockets of Telangana was reported[21]. The tribal groups are still cultivating these landraces because of the above reasons for many years across the generations. In some pockets in Aswaraopeta of Bhadradri-Kothagudem district, cobs with purple kernels and some with xenia effect are also observed and collected. At Kukunuru and Aswapuram, the tribal groups follow a practice of placing the cobs along with husk above the hearth for safe storage/ good viability of seed for next season sowings. Seed and other agricultural produce along with bows/ arrows are stored in a separate place called *Ghar* by the ethnic groups (IDP-Internally Displaced Person) who migrated from Chattisgarh.

The promising accessions identified (Table 2) among the germplasm collected for important traits include *viz.* overall good agronomic expression (BB-14285, BB-14318 and BB-14320), ear length (BB-14294, BB-14295), prolificacy (BB-14298), kernel rows (BB-14298, BB-14315), kernels/ row (BB-14295, BB-14298, BB-14300), high seed weight (BB-14302, BB-14290) and resistant to biotic stresses (BB-14285, BB-14289). The accessions promising for multiple traits include BB-14285 for good agronomic expression and resistant to biotic stresses, BB-14294 for ear length and kernels/ row, BB-14295 for ear length and kernels/ row and BB-14298 for prolificacy, kernel rows and kernels/ row. A total of five accessions of maize germplasm (IC-206099 (*chinna jonna*), IC-206114, IC-206126, IC-206137 and IC-206150) collected earlier from the Warangal district were utilized to develop inbreds and the same were used as parents for developing hybrids by *Acharya N. G. Ranga Agricultural University*[23]. IC-430635 (IML-496), a landrace (*pedda mokkajonna*) collection from Khammam district was identified as a promising accession with adaptation and excellent agronomic performance across both the hill and plain zones during intensive phenotypic and molecular characterization during 2006-07[22]. In general, the germplasm from Warangal appears to be promising for earliness, kernel traits and high seed weight and a promising accession (IC-130712) was also identified after evaluation[2]. In the latest germplasm augmented also, accession BB-14302 with high seed weight (31.5 g) can be exploited for developing heterotic populations (inbreds/ parents) with high productivity and adaptability for utilization in maize improvement.

In the erstwhile Warangal and Khammam districts, the important landraces under cultivation used to be chinna *makka, deshavali makka, kodikal makka, mami jonna, naditari makka, pedda mokkajonna* and *pinna mokkajonna*[17]. In the present exploration except *chinna makka*, the other five landraces could not be collected due to genetic erosion as they are no longer under cultivation. However, surprisingly *chinna makka* is still under continuous patronage of the farming communities for its adaptability, stability, taste and quality traits. A total of four new landraces (*erra mokkajonna, jonthra, naatu mokkajonna, nakka mokkajonna*) which were not collected earlier could be augmented due to intensive surveying. Similar efforts were also made in high-altitude tribal zone of adjacent erstwhile Adilabad district as well resulting in salvaging endemic maize landraces *viz. chinna makka, ganagtriyelu, gourani makka, gundu makka, pedda makka, pelala makka, ragal makka, somaram makka* facilitating their conservation in the National Gene Bank[15].

The tribal groups are utilizing maize (flour/ *suji*) for preparation of porridge (*amabali/ jaava*) and also to cook *ghatka*, like rice and other food items which is good for health. Mostly the maize landraces are under cultivation by the ethnic groups in very small patches/ areas in the kitchen garden for their own consumption without any chemical inputs. They also believe that, consumption of hybrid maize may lead to knee pains and other health issues.

Table 1: Diversity for qualitative characters in maize germplasm collected from parts of Telangana

Descriptor	Variability for descriptor states
Cob size	Small, medium, big/ large
Husk cover	Good, intermediate, poor
Spindle colour	Light purple, white
Kernel row arrangement	Irregular, regular, spiral
Kernel type	Dent, flint, pop, semi-dent, semi-flint, sweet
Kernel upper surface Shape	Shrunken, indented, level, rounded
Kernel colour	Brown, brownish-yellow, orange, orange-white, orange yellow, purple, variegated, white, yellow

Table 2: Diversity and promising accessions identified for ear and kernel traits in maize germplasm collected from parts of Telangana

Traits	Min	Max	Mean	SD	CV%	Promising accessions (Values)
Ear length (cm)	9.3	21.0	14.1	3.6	25.3	BB-14294 (21.0), BB-14295 (21.0)
Ear width (cm)	2.2	5.0	3.7	0.7	18.9	BB-14316 (5.0)
Kernel rows (no)	10.0	20.0	13.2	2.0	15.2	BB-14298 (20.0), BB-14315 (17.0)
Kernels/ row (no)	10.0	46.0	28.4	9.2	32.4	BB-14295 (46.0), BB-14298 (44.0), BB-14300 (44.0)
Kernel length (mm)	6.0	11.0	8.7	1.3	14.9	BB-14303 (11.0), BB-14285 (10.1)
Kernel width (mm)	6.0	10.1	7.6	1.3	17.1	BB-14284 (10.1), BB-14285 (10.1)
Kernel thickness (mm)	3.0	5.0	4.0	0.7	17.5	BB-14284 (5.0), BB-14286 (5.0), BB-14288 (5.0), BB-14289 (5.0), BB-14290 (5.0), BB-14293 (5.0), BB-14302 (5.0), BB-14313 (5.0), BB-14321 (5.0)
100 seed weight (g)	8.8	31.5	16.9	5.6	33.1	BB-14302 (31.5), BB-14290 (26.2)

CONCLUSION

Diversity rich endemic pockets were surveyed and representative diversity was collected through random sampling from central and high altitude tribal regions of the present Bhadradri-Kothagudem and Jayashankar-Bhoopalapally districts of Telangana. A set of the collected maize germplasm is shared with

ICAR-Indian Institute of Maize Research which is the national active germplasm site for maintenance and also with Professor Jayashankar Telangana State Agricultural University. These two institutes initially characterize, evaluate and multiply the collected germplasm which will be conserved in the National Gene Bank and promising accessions identified will be utilized in maize improvement programmes in the national agricultural research system.

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