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Evaluation of Cassava Germplasm Accessions for High Tuber Yield and Starch Content for Industrial Exploitations

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Abstract

A total of 368 cassava germplasm accessions are being maintained at Tapioca and Castor Research Station, Yethapur. The trial on the evaluation of cassava germplasm accessions was laid out in Augmented Block Design (ABD). The accessions are being continuously evaluated for its growth parameters *viz.,* plant height (cm), stem girth (cm), branching habit and yield traits *viz.,* number of tubers, tuber yield plant^{-1} (kg) and quality parameters *viz.,* starch content (%). The experiment was conducted for the peiod from 2012 to 2015 and the results revealed that the plant height ranged from 108.51 cm (Me 519) to 385.41 cm (Me 287) and stem girth ranged from 3.90 cm (Me 75) to 16.4 cm (Me 724 and Me 725). The cassava accessions such as Me 50, Me 224, Me 460, Me 383, Me 866, Me 867, Me 868, Me 869 showed non-branching habit. The maximum (19.10) and minimum number of tubers (2.80) was recorded in Me 866 and Me 616, Me 656 respectively. Yield plant^{-1} ranged from 1.39 kg (Me 398) to 10.22 kg (Me 155). The lowest (13.00 %) and the highest starch content (30.40%) was recorded in Me 852 and Me 310 respectively. Among the accessions evaluated, Me 681 has excelled with high tuber yield plant^{-1} (7.53 kg) and starch content (29.33%) when compared to the local check YTP-1 (Me 833) with the tuber yield of 6.27 kg plant^{-1} and starch content of 26.70%.

Key words: cassava, germplasm, variability, tuber yield, starch

Introduction

Cassava popularly known as tapioca and is one of the most popular tuber crop grown in several tropical and sub-tropical parts of the world. This crop finds major position in tropical agriculture, due to its drought tolerance, wide flexibility to adverse soil, nutrient and management conditions including time of harvest. Apart from its role as a staple or subsidiary food, during the past few decades there has been growing recognition of the value of cassava roots as a low cost energy source for livestock and raw material for industrial starch. (Vincent Lebot, 2009). In Tamil Nadu during 2014-15, cassava was cultivated in an area of 83,526 hectares with the production of 24,99,280 tonnes. Cassava is majorly cultivated in Salem, Namakkal, Dharmapuri, Erode, Villupuram and Cuddalore districts. Certain crops which are propagated through vegetative propagation has lesser genetic variability and high number of clonal varieties that can be distinguished by tuber color and shape (Rousi et al., 1986; Grau et al., 2003; Emshwiller, 2006). However an alarming loss of variability is currently observed in array of crops (Altieri et al., 1987; Tapia and Estrella 2001). The collection and conservation of root and tuber crops germplasm is becoming increasingly urgent and forms the back bone of any breeding programme. The potential for genetic improvement of any crop relies on the ability to successful use of the existing genetic resources, including the related wild species. Morphological characterization has been used

for various purposes including identification of duplicates, studies of genetic diversity patterns and correlation with characteristics of agronomic importance (CIAT, 1993). Cassava is highly heterozygous and its progenies are heterogenous with wide morphological variations among them. This type of plant-plant variation is not acceptable to commercial growers due to the strong preference of farmers for a particular variety (Vincent Lebot, 2009). Considering its wider variations, it is mandatory to have the collections for future breeding programmes. Thus, evaluation of genetic relationship among diverse cultivars and landraces is critical for successful and efficient exploitation of the available genetic diversity in the germplasm (Mekbib and Deressa, 2016). Considering the importance in breeding programme its imperative to evaluate the cassava accessions for morphological traits like plant height, stem girth and yield parameters *viz.*, high tuber yield and starch content.

Materials and Methods

A field experiment was conducted during the period from 2012 to 2015 at Tapioca and Castor Research Station, Yethapur, Salem (11º 35' N latitude, 78 º 29' E longitude) under All India Coordinated Research Project on Tuber crops programme. A total of about 368 cassava germplasm accessions are being maintained at the station with the accession nomenclature of Me (*Manihot esculenta* Crantz). These accessions were collected from traditional and nontraditional areas of Tamil Nadu. The trial on the evaluation of cassava germplasm accessions was laid out in Augmented Block Design (ABD). The accessions are being continuously evaluated for its growth parameters *viz.*, plant height, stem girth, branching habit and yield traits *viz.*, number of tubers, tuber yield plant^{-1} and quality parameters *viz.*, starch content (%). Standard cultivation practices recommended for cassava as per crop production techniques of Horticultural crops (2013) published by TNAU were adopted uniformly for all experimental plots. The data on various parameters studied during the course of investigation were statistically analyzed applying the technique of analysis of variance suggested by Panse and Sukhatme (1985).

Results and Discussion

Results of germplasm evaluation revealed that the range of growth parameters *viz.*, plant height varied from 108.51 cm (Me 519) to 385.41 cm (Me 287), stem girth showed the variation from 3.90 cm (Me 75) to 16.4 cm (Me 724 and Me 725) (Table 1 and 2). The yield parameters *viz.*, number of tubers plant^{-1} was in the range of 2.80 (Me 616,

Table 1. Performance of selected cassava germplasm accessions under Yethapur condition

Accession	Plant height (cm)	Stem girth (cm)	Number of tubers (plant^{-1})	Yield plant^{-1} (kg)	Starch content (%)
Me 48	293.55	7.7	4.1	5.79	29.0
Me 182	254.70	9.5	7.0	4.48	29.7
Me 668	197.19	9.6	4.9	3.63	26.3
Me 681	180.10	11.5	8.7	8.24	29.5
Me 682	197.59	13.1	5.0	4.49	27.3
Me 833	243.20	7.6	10.6	9.69	26.8
Me 834	215.20	12.1	8.3	3.79	20.8
Me 867	202.81	12.1	10.7	9.41	29.5
Me 868	358.00	8.1	9.2	6.90	28.3
Me 869	198.27	14.8	10.3	6.10	27.6
Me 870	204.33	11.6	8.0	7.89	28.2
SEd	35.73	1.46	1.03	0.95	3.26
CD (0.05)	71.46	2.92	2.06	1.89	6.51
CV	16.23	13.36	17.48	15.03	18.68

Table 2. Grouping of cassava germplasm

Plant height (> 300 cm)	Me 14, Me 185, Me 199, Me 242, Me 287, Me 290, Me 868
Stem girth (> 10 cm)	Me 2, Me 169, Me 186, Me 199, Me 246, Me 278, Me 310, Me 319, Me 528, Me 606, Me 654Me 724, Me 767,
Non branching habit	Me 50, Me 224, Me 460, Me 383, Me 866, Me 867, Me 868, Me 869
No. of tubers plant^{-1} (> 10)	Me 11, Me 152, Me 155, Me 170, Me 224, Me 251, Me 489, Me 558, Me 702, Me 714, Me 746, Me 796, Me 802, Me 847, Me 861, Me 863, Me 866,

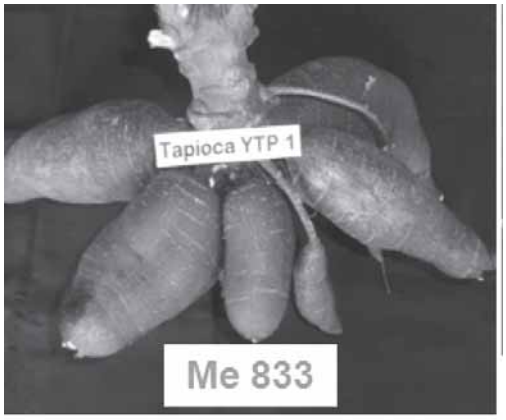
Tuber yield plant^{-1} (> 10 kg)	Me 155, Me 681, Me 833, Me 867, Me 870
Starch content (>28%)	Me 48, Me 199, Me 242, Me 293, Me 296, Me 310, Me 475, Me 519, Me 577, Me 681, Me 691, Me 798, Me 845, Me 865, Me 866, Me 867, Me 868, Me 869, Me 871

Me 656) to 19.10 (Me 866) and tuber yield plant^{-1} ranged between 1.39 kg (Me 398) and 10.22 kg (Me 155) whereas the starch content ranged from 13.00 % (Me 852) to 30.40 % (Me 310). The cassava accessions *viz.*, Me 50, Me 224, Me 460, Me 383, Me 866, Me 867, Me 868, Me 869 showed non-branching habit (Table 3).

Among the accessions evaluated, the accession Me 681 has excelled with high tuber yield (7.53 kg plant^{-1}) and starch content (29.33 %) consecutively for the last three years (Table 4). In Tamil Nadu, Cassava is being cultivated mainly for the extraction of starch by the processing

Table 3. Range for important traits of germplasm maintained at TCRS, Yethapur

Sl. No.	Traits	Range
1.	Plant height (cm)	108.51 (Me 519) to 385.41 (Me 287)
2.	Stem girth (cm)	3.90 (Me 75) to 16.4 (Me 724 and Me 725)
3.	No. of tubers plant^{-1}	2.80 (Me 616, Me 656) to 19.10 (Me 866)
4.	Yield plant^{-1} (kg)	1.39 (Me 398) to 10.22 (Me 155)
5.	Starch content (%)	13.00 (Me 852) to 30.40 (Me 310)



Tuber yield 8.85 kg/plant Starch content 26.90%

Tuber yield 7.04 kg/plant Starch content 30.10%

Tuber yield 7.76 kg/plant Starch content 31.00%

Best perfoming accessions for tuber yield and starch content

Table 4. Performance of Me 681 at TCRS, Yethapur

Accessions	Season 1		Season 2		Season 3		Overall mean	
	Tuber yield plant^{-1} (kg)	Starch content (%)	Tuber yield plant^{-1} (kg)	Starch content (%)	Tuber yield plant^{-1} (kg)	Starch content (%)	Tuber yield plant^{-1} (kg)	Starch content (%)
Me 681	7.10	28.50	8.24	29.50	7.65	30.20	7.53	29.33
Me 833 (YTP 1)	6.42	26.30	7.69	26.80	6.31	25.00	6.27	26.70

industries. The varieties with high starch content such as Me 833 (YTP1) and Me 681 may be useful for industrial exploitations. The potential for genetic improvement of any crop relies on the ability to successful use of the existing genetic resources, including the related wild species (Frison and Feliu, 2009). The germplasm collections maintained at our station are showing highly heterogenous variations and are catalogued for plant height, stem girth, colour of terminal bud, colour of petiole, colour of stem, branching habit, colour of tuber skin, presence or absence of neck, length of tuber, girth of tuber, tuber yield, colour of pulp, starch content and flowering habit. The variations exhibited by the individuals are highly useful for the breeding of new varieties to suit the industrial explotations. Hence, collection and conservation of diverse crop plants is essential for the breeding programme (Mekbib and Deressa, 2016). Similar finding was reported by Adebisi (2001), Maxted et al., (1997), Nahn et al., (1995) and Malice and Baudoin (2009). In Tamil Nadu, commercial cultivation by farmers prefers the accessions/varieties with medium growth habit, non-branching, maximum number of tubers, high tuber yield and starch content for industrial exploitations.

Conclusion

Collection of germplasm with wide genetic variability is much important for any breeding programme. There are about 368 cassava germplasm accessions are being maintained at Tapioca and Castor Research Station, Yethapur. The trial on the evaluation of cassava germplasm accessions revealed that Me 681 has excelled with high tuber yield (7.53 kg plant^{-1}) and starch content (29.33%) consecutively for the last three years. However, YTP-1 (Me 833) has exhibited the tuber yield of 6.27 kg plant^{-1} and starch content of 26.70%.

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