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Research Article

PR 10-45 - A Newly Evolved Non-Lodging Finger Millet Variety

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ABSTRACT

Finger millet is a hardy crop grown under diverse agro-climatic conditions. Most of the present varieties under cultivation are prone to lodging under cultivation in view of which development of varieties resistant to lodging would be useful in the current agricultural scenario where mechanical harvesting is a common practice. PR 10-45 is a cross derivative of GPU 28 and GE 4931. It is a long duration variety with semi dwarf plant height, erect plant type and sturdy culm with reddish brown semi compact ear heads having top curved fingers, synchronized maturity and unique non lodging character. The culture recorded 11.90% yield advantage over the check variety Godavari (PR 202) in the adaptive minikit trials conducted during 2013-14 to 2016-17. The entry has shown moderate resistant reaction to leaf blight, banded blight and leaf and neck blast diseases. It has also recorded resistance to defoliators (grass hoppers) and ear head caterpillar. The culture PR 10-45 recorded high values of Zinc (2.65mg/100g) and calcium (341.45 mg/100g) when compared to National check varieties GPU 67 and PR 202 (Godavari). Because of competitive performance over the current cultivars in terms of resistance to lodging, PR 10-45 was released for general cultivation in the state of Andhra Pradesh in the year 2020.

Keywords: *hardy, Lodging, Minikit, Sturdy culm.*

INTRODUCTION

Finger millet [*Eleusine coracana* (L.) Gaertn] popularly known as ragi is an annual plant widely grown as an important food crop in India. It accounts for about 85% of all millets produced in India and is cultivated over 1.19 million hectares in India (Sakamma et al., 2018). It is a staple food for a large section of farming community and economically weaker sections in many parts of India. Among the millets, finger millet ranks fourth on a global scale of production next to sorghum, pearl millet (*Cenchrus americanus*), and foxtail millet (*Setaria italica*) (Upadhyaya et al., 2007). It is a hardy crop that can be grown in diverse environmental conditions from almost at sea level in south India to high lands of Himalayas and from soils on hill slopes to rich soils in the Indo-gangetic plains.

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Although grown under dry lands, it provides an assured harvest, thus making it indispensable in specific ecosystems. Finger millet will be an ideal crop for climate resilient agriculture due to its adaptation in semi-arid tropics which are characterized by unpredicted weather and erratic rainfall. However lodging is one of the yield limiting factors in finger millet production (Degu et al., 2009).

It contains rich amounts of protein, mineral nutrient as compared to other major cereals like wheat, rice, and sorghum (Gupta et al., 2017; & Sharma et al., 2017). Finger millet contains a large proportion of carbohydrates and thus provides bulk of energy in diets. It is also rich in proteins, sulphur containing amino acids and because of its low glycemic index with high fibre it is recommended for diabetic patients. Apart from the major nutrients, it also contains iron and calcium, which is deficient in most Indian women. High calcium, high soluble fibre, low fat, high diastatic power of malted grains renders finger millet unique. It has proved to be very effective in controlling blood glucose level of diabetics. Consumption of finger millet prevents constipation and cholesterol.

Finger millet is known for several health benefits and some of the health benefits are attributed to its polyphenol and dietary fiber contents. Finger millet is considered as a coarse grain because of its fibrous and tough outer layer that irritates the tongue and not readily accepted for people accustomed for the consumption of wheat and rice. Apart from palatability it lacks gluten characteristic of wheat and hence does not lend itself for the preparation of chapathis or baked products. It has remained as the food of the lower socio-economic groups and traditional consumers, because of its coarse texture and intense colour of seed coat. Finger millet carbohydrates are reported to have the unique property of slower digestibility and can be regarded as food for long sustenance. The excellent malting qualities have added to the uniqueness of the grain in expanding its utility range in food processing and value addition.

MATERIALS AND METHODS

The finger millet culture PR 10-45 was evolved at Agricultural Research Station, Peddapuram affiliated to Acharya N G Ranga Agricultural University (ANGRAU), Guntur. The cross was made between GPU 28 and GE 4931 and elite plants were selected from F_2 generation onwards. They were evaluated for their sustained performance, homozygosity and the culture PR10-45 was identified as the best. The culture was evaluated for its yield performance along with national and state level check varieties at Agricultural Research Station, Peddapuram starting from 2010-11 to 2013-14, Multi location testing during 2011-2013 and adaptive minikit testing during 2013-14 to 2016-2017 in the farmers' holdings of various districts of Andhra Pradesh. Thus, the culture was tested over 137 locations across different parts of the state. Besides, the reaction of the culture against important pest and disease was screened and as per the standard procedures the grain qualities were analysed.

RESULTS AND DISCUSSION

Yield performance over the check

The progress in breeding for grain yield of any crop is phylogenetically controlled, environmentally influenced. (Fisher, 1936). The yield performance of the any genotype is ascertained through rigorous testing at the place where it was evolved. The culture PR 10-45 recorded an yield advantage of 31.8% (4083 kg/ha) over the check variety Godavari [(PR 202); 3097 kg/ha] in the yield evaluation trials conducted at Agricultural Research Station, Peddapuram during 2010-11 to 2011-12 (Table 1). The stability and yield superiority of the genotype is known through testing over different locations. In the multi location trials (Table 2) conducted at different locations of the state, the culture was compared with different check varieties of finger millet popular at respective locations and found to have shown superiority of 5.27% (2730 kg/ha) on weighted mean basis over the check varieties (2683 kg/ha) and over the locations. The culture (1731 kg/ha) recorded

17.0 % increase over the check Godavari (1479 kg/ha) in the adaptive minikit trials conducted by the District Agricultural Advisory and Transfer of Technology Centres (DAATTC) of ANGRAU (Table 3) and 6.7% (1734 kg/ha) over the check Godavari (1625 kg/ha) in the adaptive minikit trials conducted by Department of Agriculture in different districts of Andhra Pradesh and found tolerant to lodging at all the locations (Table 3).

Reaction to pests and diseases

Blast is one of the major disease in finger millet which causes economic loss to finger millet growing farmers. The culture PR 10-45 was found moderately resistant to blast and BLB diseases (Table 4). The hoppers destroy seedlings and feed on leaves, and when the infestations are heavy, resowing of the crop is inevitable. Grey weevils, Myllocerus occasionally become serious on millets and have a wide distribution. The culture PR 10-45 showed moderate resistant reaction to defoliators (grass hoppers and grey weevil), ear head caterpillars and aphids (Table 5).

Grain quality characteristics

The culture PR 10-45 recorded high values of Zinc (26.5 ppm) and calcium (341.4 ppm) when compared to National check varieties GPU 67 and PR 202 (Table 6) making it a nutrient dense variety.

Morphological characters

PR 10-45 is a long duration variety with semi dwarf plant height, erect plant type and sturdy culm with reddish brown semi compact ear heads having top curved fingers of 9-12 in number, synchronized maturity and unique non lodging character. It matures in 115-120 days and attains 50% flowering in 80-85 days after sowing. It has a erect plant type with 100-110 cm plant height. It has purple pigmentation during anthesis. The 1000 grain weight is 2.75g. (Table 7).

Table 1: Summary of yield data of Finger millet entry PR 10-45 (kg/ha) in station trials at Agricultural Research Station, Peddapuram from 2009-10 to 2011-12:

Trial name	Year of testing	Grain yield (kg/ha)		Percentage increase / decrease over
		R 10-45	Check variety (Godavari)	
Observational Yield Trial	*kharif*, 2010	3959	2821	40.3
Preliminary Yield Trial	*rabi*, 2010	3065	2480	23.6
Advanced Yield Trial	*kharif*, 2011	4378	3140	39.4
Advanced Yield Trial	*rabi*, 2011	4931	3950	24.8
Mean		**4083**	**3097**	31.8

Table 2: Summary of yield data of Finger millet entry PR 10-45 (kg/ha) in the multi location trials 2011-12 to 2013-14:

#	Name of the location	Year of testing	Grain yield (q/ha)		Name of the Check	% increase or decrease over check
			PR 10-45	Check variety		
1	Peddapuram	*kharif*, 2011	3948	3136	Godavari (PR 202)	25.8
2	Perumallapalle	*Kharif 2011*	2401	3002	Saptagiri	-20.0
3	Vizianagaram	*kharif*, 2011	2037	2329	Srichaitanya (VR 847)	-12.5
4	Peddapuram	*kharif*, 2012	3470	3100	Godavari (PR 202)	11.9
5	Perumallapalle	*kharif*, 2012	1698	1958	Vakula	-13.2
6	Vizianagaram	*kharif*, 2012	2430	3127	Srichaitanya (VR 847)	-22.2
7	Peddapuram	*kharif*, 2013	2435	2261	Godavari (PR 202)	7.6
8	Perumallapalle	*Rabi, 2011-12*	3122	2941	Saptagiri	6.2
9	Perumallapalle	*Rabi 2012-13*	3236	2418	Vakula	33.8
10	Vizianagaram	*kharif*, 2013	2521	2560	Srichaitanya (VR 847)	-1.5
			2730	2683		5.27 (weighted mean)

Table 3: Summary of yield data of Finger millet entry PR 10-45 (kg/ha) in the adaptive minikit trials 2013-14 to 2015-16:

Year	Number of locations	Grain yield (kg/ha)		% increase over check (Grain yield)
		(PR 10-45)	(Godavari-PR 202)	
Minikits conducted by DAATTC's				
2013-14	18	1744	1500	16.3
2014-15	13	1345	1241	8.4
2015-16	25	1546	1362	13.5
2016-17	16	2301	1811	27.1
Total/Mean	**72**	**1731**	**1479**	**17.0**
Minikits conducted by Dept. of Agriculture				
2013-14	13	1711	1592	7.5
2014-15	25	1567	1467	6.8
2015-16	27	1818	1711	6.3
Total/Mean	65	1734	1625	6.7
Total/Grand mean	**137**	**1733**	**1552**	**11.9**

Table 4: Mean Reaction of Finger millet entry PR 10-45 to diseases in all India co-ordinated trials in 2011-12 to 2013-14.

S.No.	Disease name	IVT (2011-12)		AVT III (2012-13)		AVT III (2013-14)		Mean	
		PR 10-45	PR 202©	PR 10-45	PR 202©	PR 10-45	GPU-67©	PR 10-45	GPU-67©
1	Leaf blast	2.04	2.11	3.00	2.20	2.9	3.2	**2.64**	**2.50**
2	Neck blast (%)	6.03	10.53	8.10	9.20	6.7	12.6	**6.94**	**10.77**
3	Finger blast (%)	9.67	9.50	12.40	10.80	13.9	8.5	**11.99**	**9.60**
4	Brown spot (G)	0.17	0.17	0.00	0.20	0.5	1.5	**0.22**	**0.62**
5	Banded Blight (%)	0.00	0.00	0.00	0.00	36.3	20.1	**12.10**	**6.70**
6	Leaf Blight (%)	0.00	1.66	0.30	0.00	0.00	0.00	**0.10**	**0.55**
7	Foot rot (%)	0.00	0.00	0.30	0.30	7.8	10.4	**2.70**	**3.56**
6	Cercospora Leaf Spot (G)	4.00	4.00	0.00	0.00	0.00	0.00	**1.33**	**1.33**

(Source: AICSMIP Annual Report 2011-12, 2012-13 & 2013-14)

Table 5: Mean Reaction of Finger millet entry PR 10-45 to pests in All India Co-ordinated trials in 2011-12 to 2013-14.

Insect name	Trial	PR 10-45			GPU-67		
		Bangalore	Ranchi	Mean	Bangalore	Ranchi	Mean
Grasshopper	**IVT**	1.33	2.33	**1.83**	0.66	0.00	**0.33**
	(AVT III)	1.33	2.00	**1.66**	0.66	0.33	**0.49**
	(AVT III)	0.66	4.00	**2.33**	0.66	2.00	**1.33**
	Mean	**1.10**	**2.77**	**1.93**	**0.66**	**0.77**	**0.71**
Myllocerus weevil	**IVT**	1.33	2.66	**1.99**	0.00	0.66	**0.33**
	(AVT III)	1.33	1.66	**1.49**	0.33	0.66	**0.49**
	(AVT III)	0.00	5.66	**2.83**	1.66	2.33	**1.99**
	Mean	**0.88**	**3.32**	**2.10**	**0.66**	**1.21**	**0.93**
Ear head Caterpillar	**IVT**	0.00	2.00	**1.00**	0.00	0.00	**0.00**
	(AVT III)	1.00	1.66	**1.33**	0.00	0.66	**0.33**
	(AVT III)	0.00	7.00	**3.50**	0.00	2.00	**1.00**
	Mean	**0.33**	**3.55**	**1.94**	**0.00**	**0.88**	**0.44**

(*Source: AICSMIP Annual Report 2011-12, 2012-13 & 2013-14*)

Table 6: Data on Quality Characteristics:

Nutrient	PR 10-45	GPU 67	Godavari (PR 202)
Zinc (Zn) (mg/100g)	2.65	1.68	1.86
Iron (Fe) (mg/100g)	4.41	4.79	4.62
Calcium (Ca) (mg/100g)	341.45	335.9	339.4
Carbohydrates (g/100g)	65.0	67.0	66.0
Protein %	7.28	7.31	7.25

(*Source: AICSMIP Annual Report 2013-14, page no. PHY 3*)

Table 7: Morphological characteristics of PR 10-45:

S.N.	Characteristics	Status
1.	Plant growth habit	Erect
2.	Plant pigmentation at leaf juncture	Present on all parts
3.	Leaf sheath pubescence	Absent
4.	Days to 50% flowering	81 days
5.	Days to maturity	117 days
6.	Glume: Colour	Light purple
7.	Stem: Culm branching	Absent
8.	Flag leaf: Blade length (cm)	33.9 cm
9.	Flag leaf: Blade width (cm)	0.88 cm
10.	Peduncle length (cm)	11.25 cm
11.	Ear: shape	Semi Compact
12.	Finger: Branching	Absent
13.	Finger: Position of branching	NA
14.	Finger: Multiple whorl	Absent
15.	Ear head: Length (cm)	9.0 cm
16.	Finger: Length (cm)	9.0 cm
17.	Finger: Width (cm)	1.0 cm
18.	Finger: Number on main ear	9
19.	No. of productive tillers/plant	3
20.	Plant height at maturity (cm)	101.8
21.	Seed: Shattering	Absent
22.	Seed: Covering by glumes	Intermediate
23.	Seed: Colour	Copper brown
24.	Seed: Shape	Round
25.	Seed: Surface	Non wrinkled
26.	Pericarp: Pesistance after threshing	Persistent
27.	1000 grain weight (g)	2.75 g

CONCLUSIONS

Considering the superior performance of the finger millet culture PR 10-45 in terms of lodging tolerance and high grain yield, the culture was released for general cultivation by the farmers in Andhra Pradesh during 2020.

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