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A short duration high yielding culture - Barnyard millet ACM 10145

C.Vanniarajan*, G. Anand, S.Kanchana[1], V. Veeranan, Arun Giridhari[1] and V.G. Renganathan

Department of Plant Breeding and Genetics,
Agricultural College and Research Institute, Madurai-625 104, Tamil Nadu, India.
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ABSTRACT

A short duration high yielding barnyard millet culture ACM 10145 was developed at the Department of Plant Breeding and Genetics, Agricultural College and Research Institute, TNAU, Madurai. The culture inflorescence is pyramidal shape, incurved compact raceme and yield on an average 1700 kg/ha and 2500 kg/ha grain under rain-fed and irrigated condition which was 22 % and 17.6 % improved yield over VL 172 and CO (Kv) 2 respectively.. The grains are yellowish grey, oval and bold in size (1.09 mm) with high iron content (16 mg/100g). The white rice recovery of the milled rice and good taste that well suits the consumer's preferences and acceptance. The culture recorded the quality and average yield of fodder is also better than local check CO (Kv) 2.

Key words: ACM 10145, Barnyard millet, Nutrition, Qualitative traits, Short duration.

INTRODUCTION

Barnyard millet (*Echinochloa frumentacea* (Roxb.) Link) is the fastest growing crop among all millets. Barnyard millet species are known for their fast maturity, high storability, and the ability to grow on poor soils (Yabuno, 1987). In India, this millet is either harvested as a weed along with a main crop or is grown in a mixture with finger millet and foxtail millet (Gupta *et al.,* 2009). It is generally cultivated on hilly slopes in tribal areas where few other agricultural options exist and is indispensible in the northwest Himalayan region (Gupta *et al.,* 2009). In India, it is cultivated in tribal belts of Orissa, Maharashtra, Gujarat, Madhya Pradesh, Tamil Nadu, Bihar and hills of Uttar Pradesh. In Tamil Nadu, it is locally known as kudiraivali and is cultivated in dryland and hill areas of Ramnad, Madurai, Virudhunagar, Theni, Salem, Namakkal, Viluppuram, Dindigul, Coimbatore and Erode districts. Nutritionally grains are rich in fibre content, phosphorus, calcium, magnesium, iron and zinc content. Due to low glycemic index and high dietary fibre, it helps in preventing diabetes and cardio vascular disease with regular intake. It is reportedly known for its high degree of tolerance against drought, salinity and water logging conditions. The straw has a good fodder value. The fodder also contain good amount of protein and digestible fibre. The area under barnyard millet is about 1.95 lakh hectares and production of 1.67 million tonnes with the productivity of 857 kg/ha. As there is a huge demand for the produce, barnyard millet is being grown in *kharif, rabi* and summer under irrigated and rainfed condition. The latest released variety in barnyard millet was CO (Kv) 2, which was supposed to be a high yielding line released during the year 2009, with the objective of higher yield. Nevertheless, it performance in drought prone regions in the southern districts of Tamil Nadu was mere satisfactory due to their photosensitivity and longer duration. Hence the objectives of genetic improvement were to produce an early maturing, high yielding line which suits all seasons in southern districts of Tamil Nadu. In order to fulfill the above objectives, the culture, ACM 10145 an high yielding, early maturing, high milling percent culture with desirable cooking quality traits was developed at Department of Plant Breeding and Genetics, Agricultural College & Research Institute, Madurai.

MATERIALS AND METHODS

The culture, ACM 10 145 is a pureline selection from Aruppukottai local, a village which is about 70 km away from Madurai, Tamil Nadu. Single plant with desirable attributes for yield (early maturity, increased raceme numbers, high fodder and grain yield) and micronutrient content was selected from the local collection where high percent of variability observed for morphological as well as nutritional traits. The selected lines were advanced as single plant to progeny rows. The progenies were assessed for their performance in comparison with the check CO (Kv)2 under station trials at AC & RI, Madurai, from summer 2009 to *rabi* 2012, Multi Location Trials during 2012-13, All India Coordinated Small Millets Improvement Project – Barnyard millet Advanced Varietal Trials, during 2013, Adaptive Research Trial during 2013-16 and under Large scale demonstration from 2014-2016. Simultaneously the culture was evaluated for its grain qualities and its end user acceptability.

*Corresponding author's e-mail: vanniarajan.c@tnau.ac.in
[1]Department of Food Science & Technology, Home Science College and Research Institute, Madurai-625 104, Tamil Nadu, India.

RESULTS AND DISCUSSION

Morphological features of the culture: A wide variation was found in barnyard millet crop in Aruppukottai regions of Virudunagar district of Tamil Nadu for yield, inflorescence related traits and nutritional traits (data not shown). The culture ACM 10145 that excelled over the mean of evaluated local land races was further selected through pureline based breeding was found to be maturing in 95-100 days, high yielding, grows up to a height of 130-170 cm and produces on an average of 3-8 productive tillers. The plant of ACM 10145 culture was green, erect type, pyramidal shaped compact panicle, incurved racemes, white plumose stigma and closer flag leaf to lower raceme (Table 2).The grains of this line are yellowish grey colour and oval shape. The thousand grain weight measure between 3.4 - 3.8 g and individual grain thickness is 1.09 mm which were different

Table 1: Mean performance of ACM 10145 over check in various trials for grain yield.

Trials	ACM 10145(kg/ha)		CO (Kv)2(kg/ha)	
	Grain	Fodder	Grain	Fodder
Station trials	2284	3721	1748	2683
Multilocation trial (2012-13)	2677	2984	2312	2425
AICSMIP – BAVT (2013)	1722	6325	1769*1411**	4900
Adaptive Research Trial (2013-14, 2014-15 and 2015-16)	1655	3119	1411	3152
Large scale demonstration trial	1955	2788	1693	2413
Overall weighted mean yield in kg/ha	1722	3115	1463	2873
Percent increase over the check	**17.6**	**8.5**		

** Regional check - VL172, * Local check - CO (Kv)2

Table 2: Botanical and morpho-agronomic description.

S. No	Characteristics	ACM 10145
1.	Plant height	130-170 cm
2.	No. of Basal tillers	4-9
3.	No. of productive tillers	3-8
4.	Flag leaf length (cm)	24.2-30.8
5.	Flag leaf width (cm)	3.4-4.6
6.	Peduncle length (cm)	7.8-13.1
7.	Inflorescence length (cm)	21.6-27.5
8.	Length of lower raceme (cm)	3.5-4.9
9.	Days to 50 % flowering	56-58
10.	Days to maturity	95 – 100
11.	Grain yield per plant (g)	35-48
12.	Straw yield per plant (g)	52-70
13.	Thousand grain weight (g)	3.2 – 3.8
14.	Harvest index	0.40 – 0.47
15.	Growth habit	Erect
16.	Plant pigmentation at flowering	Green
17.	Culm branching	Present
18.	Degree of lodging at maturity	Low
19.	Inflorescence colour	Green
20.	Inflorescence shape	Pyramidal
21.	Inflorescence compactness	Compact
22.	Shattering of inflorescence	Absent
23.	Grain colour	Yellowish grey
24.	Grain shape	Oval
25.	Grain size	Bold
26.	Shape of lower raceme	Straight
27.	Lower raceme thickness	slender
28.	Length of lower raceme (cm)	Medium (3.5-4.2), present closer to flag leaf
29.	Spikelet arrangements	Arranged around rachis
30.	Senescence	Absent
31.	Branching of lower raceme	Absent
32.	Inflorescence exertion at maturity	Full exertion
33.	Stigma colour	White
34.	Shape of raceme	In-curved

and higher than that of local check (CO (Kv) 2) and national check (VL 172) (Table 3). The morphological differences between the culture and two checks namely CO (Kv) 2 and VL 172 were given in Table 3.

Enhancement of yield: The mean performance of the culture, ACM 10145 and the varieties, CO (Kv)2 and VL 172 for grain yield were consolidated in Table 1. The results of station trials proved that, the culture ACM 10145 showed superiority compared to CO (Kv) 2. It recorded an average grain yield of 2284 which is30 per cent increase over the check CO (Kv) 2. Henceforth it was further forwarded to Multi Location Trial in various locations of Tamil Nadu and identified that the culture recorded an average yield of 2984 kg/ha which was 23 per cent increase over check CO (Kv) 2 (2425 kg/ha). An average yield of 1722 kg/ha was recorded by ACM 10145 culture in AICSMIP – BAVT trials conducted in six locations of India with national check VL 172 which was 22 per cent higher than that of national check (Annexure I). The culture was promoted to Adaptive Research Trials (ART) across various parts of Tamil Nadu from 2013-2016. The results of the ART trials estimated that the culture, ACM 10145 recorded increased grain yield of 17.6 per cent over check variety CO (Kv) 2. Under Large scale demonstration trials, the culture registered an average yield of 1955 kg/ha where the local check registered 1693kg/ha which is 15.5 per cent increase over check. From the overall trials conducted at various locations, the culture ACM 10145 registered 17.6 per cent increase yield over check variety CO (Kv) 2. Correspondingly it also registered 8 per cent higher fodder than the check CO (Kv)2 though some of locations showed that on par with CO (Kv) 2 (Table 1).

Grain quality and nutritional parameters: The ACM 10145 culture grains were analyzed for nutritional status in various forms were given in Table 4. The culture ACM 10145 showed good amount of fat 3.6-5.5 %, crude fibre 6.8 -10.1 %, protein 9.5 – 11.8 % and iron 11.5 -17.5 mg/100g compared to CO (Kv) 2. Milling percentage of ACM 10145, CO (Kv)2 and VL 172 were found to be 70, 64 and 64 percent respectively. Through sensory analysis (infra red) of milled rice, the recovery of whiteness was recorded 32.40 % by ACM 10145, whereas CO (Kv) 2 and VL 172 registered about 24.20 and 25.20 percent respectively (Table 3). The fodder quality comparison was given in Table 5.

Table 3: Comparison between barnyard millet ACM 10145 culture, CO (Kv)2 and VL 172.

Characteristics	ACM 10145	CO (Kv)2	VL 172
Days to maturity	95 – 100	100-105	93-95
Plant pigmentation at flowering	Green	Pink at basal stem	Green
Inflorescence shape	Pyramidal	Cylindrical	Pyramidal
Inflorescence compactness	Compact	Compact	Intermediate
Grain colour	Yellowish grey	Grey	Grey + Straw white
Length of lower raceme (cm)	Medium (3.5-4.2), present closer to flag leaf	Medium	Medium
Stigma colour	White	Purple	White
Shape of raceme	In-curved	Top-curved	Top-curved
Thousand grain weight (g)	3.80	3.40	3.00
Grain thickness (mm)	1.09	0.98	0.95
Sensory evaluation (hedonic rating)	Good taste and highly Preferred (appearance)	Dull appearance, less taste	Dull appearance
Milling percent	70	64	64
Whiteness percent	32.40	24.20	25.00

Table 4: Composition of nutrients

Nutrients	Grain		Raw rice		Parboiled	
	ACM 10145	CO(Kv) 2	ACM 10145	CO(Kv) 2	ACM 10145	CO(Kv) 2
Fat (%)	5.5	5.2	3.6	3.5	3.9	4.2
Crude fibre(%)	10.1	9.8	6.8	6.7	7.5	7.8
Protein (%)	11.8	11.6	9.5	9.26	10.2	9.8
Ash (%)	4.4	4.6	2.2	2.5	2.5	2.6
Iron (mg/100g)	17.5	16.6	11.5	13.3	16.0	15.0
Zinc (mg/100g)	5.9	6.3	4.9	5.0	5.5	5.4

Table 5: Fodder quality.

Nutrition (%)	ACM 10145	Co(Kv)2
Crude protein	7.6	8.3
Crude fibre	23.0	25.0
Ash content	12.0	12.0
Fat	2.0	1.6

Annexure I

Performance of ACM 10145 - AICSMIP – BAVT trial – Grain yield (2013)

Sl. No	Location	Season	ACM 10145		CO(Kv)2	
			Days to maturity	Grain yield (kg/ha)	Days to maturity	Grain yield (kg/ha)
Andhra Pradesh						
1.	Vizianagaram	*Kharif*	92	1449	76	1072
Bihar						
2.	Dholi	*Kharif*	99	1358	84	988
Karnataka						
3.	Bangalore	*Kharif*	92	1862	77	2040
Madhya Pradesh						
4.	Rewa	*Kharif*	96	1926	84	1111
Tamil Nadu						
5.	Coimbatore	*Kharif*	91	3093	79	1157
6.	Madurai	*Kharif*	97	1630	90	2272
7.	Chettinad	*Rabi*	93	1146	89	543
Uttarakhanad						
8.	Almora	*Kharif*	110	1314	85	2104
	Mean		96	1722	83	1411
Percentage increase over regional check				**22.0**		

CONCLUSION

The new culture ACM 10145 is found to be unique in having 1000 grain weight, high milling percent, white rice recovery and also coupled with higher yield. This culture is different from local check CO (Kv) 2 and national check VL 172. Hence the culture, ACM 10145 has been recommended as a suitable variety for all the districts of Tamil Nadu.

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