

Research Article

A high yielding downy mildew disease resistant pearl millet composite CO 10

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Abstract

A high yielding pearl millet variety, UCC 32 was developed as composite by mixing and random mating of five elite inbred lines with resistant to downy mildew disease at Department of millets, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore. It has been tested extensively in Tamil Nadu and in other states under MLT, ART, OFT and All India Co-ordinated programme for the past four years. It performed well both under rainfed and irrigated situations in Tamil Nadu. This variety is medium in stature (160 -180 cm) and in duration (85 - 90 days). It produces 4 - 6 productive tillers with mostly lanceolate shaped ears. The size of the grain is bold and is grayish yellow in colour. The variety UCC 32 is highly resistant to downy mildew under both normal and sick plot condition. This new variety recorded a mean grain yield of 3474 kg/ha under irrigated conditions, which are about 17 and 23 per cent increase over the checks CO (Cu) 9 and ICMV 221 respectively. The mean grain yield under rainfed conditions is 2916 kg/ha which is 15 and 24 per cent increase over CO (Cu) 9 and ICMV 221 respectively. The variety UCC 32 is medium in duration, high yielding, resistant to downy mildew, bold grain, compact ear head, non-lodging and fertilizer responsive. The protein content is high (12.07 %). It has acceptable cooking quality and suited for consumption.

Key words

UCC 32, composite, CO 10, medium duration, downy mildew resistance.

Introduction

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] commonly known as cumbu, belongs to family Poaceae. It is a cross-pollinating, diploid ($2n = 2x = 14$) tropical C_4 grass. Pearl millet is well adapted to drought prone areas, low soil fertility and high temperature situation. It also performs well in soils with high salinity or low pH (Singh and Saini, 2012). It is one of the best crop for marginal environments under arid and semi-arid harsh conditions because of its efficient utilization of soil moisture and higher level of heat tolerance compared to sorghum and maize. Pearl millet grain is nutritionally rich and contains higher protein content than many other cereals.

Pearl millet is a highly cross-pollinated crop and hence can be genetically improved by the population improvement breeding methods. In pearl millet, population improvement has been primarily to breed open-pollinated varieties (OPVs). Appreciable gains for grain yield in pearl millet have been realized by recurrent selection (Khadr, 1977; Govil *et al.*, 1982; Kapoor *et al.*, 1986). The vulnerability of hybrids to downy mildew shifted attention to open pollinated varieties (OPVs) development, making available some productive OPVs. OPVs have advantages over hybrids in situations (i) seeds of hybrids are not available both in adequate quantity and quality and (ii) sowing of pearl millet crop has to be done a number of times because of crop failure due to drought. This makes sowing with hybrid seeds either impossible or a costly affair and beyond the

means of the farmers living in areas with poor infrastructure.

With these objectives, breeding work was initiated and a new high yielding and downy mildew resistance composite variety viz., pearl millet composite CO 10 was developed to increase the production and productivity of this crop in the Tamil Nadu state.

Materials and methods

Five elite inbred lines PT6029, PT6033, PT6034, PT6039 and PT6047 with resistant to downy mildew disease were used for variety development at Department of Millets, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore. These lines are agronomically desirable and medium in plant height and maturity, and were composited during 2007 and allowed for random mating and selection (C_0) and the cycle was repeated from C_0 to C_6 cycles. Selection was made based on the characters, uniform plant height, uniform maturity, ear head shape, earhead length and compactness under open pollination. Seeds from selected earheads were mixed and the next cycle was raised.

The synthesized composite, UCC 32 was evaluated along with the checks CO (Cu) 9 and ICMV 221 in station trials from 2009 to 2011. Based on the performance, the composite UCC 32 was promoted and evaluated in Multi-location trial (MLT), station trial and All India Co-ordinated trial during 2011-2012. Then it was promoted to Adaptive

Research Trials (ART) and On Farm Trials (OFT) and evaluated during the years 2012-2014. Simultaneously, this composite was also screened for diseases viz., downy mildew, rust and ergot under both field and sick plot condition. Besides, the grain quality traits, viz., carbohydrate, protein, fat, phosphorous and iron were also analyzed following the standard procedures. Cooking quality and organoleptic evaluation were also carried out in UCC 32.

Results and discussion

The composite UCC 32 was tested in station trials from 2009-15 at Department of Millets, Centre for Plant Breeding and Genetics, TNAU, Coimbatore. It recorded an average yield of 4772 kg/ha over eleven season under irrigated condition. It was 19 and 30 per cent increased yield over the check varieties CO (Cu) 9 and ICMV 221 which recorded 4028 kg/ha and 3678 kg/ha respectively. Under rainfed condition, UCC 32 was evaluated in six seasons and it yielded 3595 kg/ha, while, the check CO (Cu) 9 and ICMV 221 recorded 3122 kg/ha and 2778 kg/ha respectively. It was 15 and 29 per cent higher than CO (Cu) 9 and ICMV 221 (Table 1). In earlier studies high mean grain yield was reported by Izge *et al.* (2007), Chotaliya *et al.* (2010) and Sumathi *et al.* (2012). The composite UCC 32 was also tested in multi-location trials, over eleven locations under irrigated and four locations under rainfed situations of the research stations of Tamil Nadu Agricultural University with the check CO (Cu) 9 and ICMV 221 (Table 2). The test variety recorded an average yield of 3076 and 3051 kg/ha under irrigated and rainfed conditions respectively. This was 16 and 21 per cent under irrigated and 13 and 20 per cent under rainfed condition higher than the checks CO (Cu) 9 and ICMV 221 respectively.

This composite UCC 32 was tested under 140 adaptive research trials during 2012-14 all over Tamil Nadu. The results revealed that the superiority of the variety in grain yield over the check CO (Cu) 9 by 15 per cent and ICMV 221 by 16 per cent, respectively (Table 3). Besides, composite UCC 32 was also tested under 57 locations on farm trials (OFT) at farmer's holding and it gave an average yield of 3301 kg/ha.

Similarly this composite also performed better under All India co-ordinated trials during 2011-12 under Initial Varietal Trial (IVT). It recorded an average yield of 2633 kg/ha over 17 locations and gave 11 and 12 per cent increased grain yield over the national checks ICMV 221 and ICTP 8302 Co. respectively. The overall mean yield of 3526 kg/ha was recorded by the composite under irrigated (112 locations) and 2923 kg/ha under rainfed conditions (134 locations). It was 18 and 25 per cent under irrigated and 16 and 26 per cent under

rainfed situations, over the check CO (Cu) 9 and ICMV 221 respectively (Table 4).

Disease reaction: Angarawari *et al.* (2008) reported that transfer of resistant to recipient parents by donor parents was highly possible. Shelke and Chavan (2010) reported that identification and selection of resistant parents is important for crossing programme involving in the development of high yielding hybrids with downy mildew resistance. This new composite, showed nil incidence for downy mildew and ergot disease under field condition, while the rust percent was very low of 4.2 per cent. While, the check varieties, CO (Cu) 9 and ICMV 221 recorded 8.5 and 9.0 per cent of rust and nil incidence of ergot respectively (Table 5).

Under sick plot conditions, the composite UCC 32 recorded 3.8 and 8.5 per cent of downy mildew and rust, respectively. Whereas, CO (Cu) 9 recorded 3.8 per cent of downy mildew and 10.5 per cent of rust incidences. ICMV 221 recorded 4.1 and 12.2 per cent of downy mildew and rust incidence respectively. All the three genotypes were resistant to ergot disease.

Grain quality: This variety was on par with the check variety ICMV 221 in carbohydrate, crude fibre and ash contents. It recorded high protein percentage of 12.07 which is higher than the check varieties (Table 6). This hybrid has acceptable cooking quality and has consumer preference due to its flavor, taste and keeping quality of the cooked preparations.

In morphological features of the composite UCC32, have erect plant type and grows up to a height of 160-180 cm. On an average it produces four to six tillers. It completes 50 per cent flowering in 47 to 50 days and matures in 85 to 90 days. This composite variety recorded 12 to 13 g of 1000 seed weight. Grains are grey brown, globular shaped and bold in size. Based on the above all desirable features, the composite UCC32 was released as pearl millet composite CO 10 by the Tamil Nadu Agricultural University during 2016 for cumbu growing regions of Tamil Nadu.

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Table 1. Performance of UCC 32 in Station trials (2010 - 2014)

Details	Grain yield kg/ha		
	UCC 32	CO (Cu) 9	ICMV 221
Irrigated			
<i>Kharif</i>			
2010	4952	4318	3876
2011	4550	3450	3350
2012	4486	3606	3420
2013	4827	4056	3800
2014	4835	4120	3825
Mean	4730	3910	3654
Summer			
2010	4995	4457	3889
2011	4509	3923	3576
2012	4528	3637	3596
2013	5058	4426	3925
2014	4866	4206	3589
2015	4925	4220	3630
Mean	4814	4145	3701
Mean (Irrigated)	4772	4028	3678
% increase over respective check		19	30
Rainfed			
<i>Rabi</i>			
2009	3725	3246	3051
2010	3457	2978	2673
2011	3750	3120	2755
2012	3620	3360	2840
2013	3500	3020	2650
2014	3520	3005	2700
Mean (Rainfed)	3595	3122	2778
% increase over respective check		15	29

Table 2. Performance of UCC 32 in Multi-location Trial (2011-12)

Seasons	No. of locations tested	(Grain yield kg/ha)		
		UCC 32	CO (Cu) 9	ICMV 221
Irrigated				
Kharif ' 2011	7	3005	2635	2505
Summer' 2012	4	3146	2687	2585
Over all Mean (Irrigated)		3076	2661	2545
% increase over respective check			16	21
Rainfed				
Rabi ' 2011	4	3051	2703	2538
% increase over respective check			13	20

Table 3. Performance of UCC 32 for grain yield in ART (2012-2014)

Details	No. of locations	Grain yield kg/ha		
		UCC 32	CO (Cu) 9	ICMV 221
Irrigated				
Kharif 1/ 2012-2013	40	2336	2063	2035
Kharif 1/ 2013-2014	31	2568	2170	2159
Summer 3 / 2012-2013	19	2268	1991	1939
Summer 3 / 2013-2014	10	2173	1857	1889
Rainfed				
Rabi 2/ 2012-2013	19	2535	2327	2289
Rabi 2/ 2013-2014	21	2272	1921	1891
Overall mean	140	2359	2055	2034
% increase over respective check			15	16

Table 4. Over all mean performance of UCC 32

Details	Grain Yield (Kg/ha)		
	UCC 32	CO (Cu) 9	ICMV 221
Irrigated			
Station trial (11)	4772	4028	3678
MLT (11)	3076	2661	2545
ART (29)	2221	1924	1914
OFT (44)	4034	3376	3186
AICPMIP (17)	2633*	-	2372*
Mean	3526	2997	2831
% increase over respective check		18	25
Rainfed			
Station trial (6)	3595	3122	2778
MLT (4)	3051	2703	2538
ART (111)	2478	2120	2094
OFT (13)	2568	2159	1873
Mean	2923	2526	2321
% increase over respective check		16	26

* Not included for the calculation of mean

Table 5. Disease reaction of UCC 32 under field condition and sick plot condition

Entries	Field condition			Sick plot condition		
	Downy mildew incidence (%)	Rust (%)	Ergot (%)	Downy mildew incidence (%)	Rust (%)	Ergot (%)
UCC 32	No incidence	4.2	No incidence	3.8	8.5	No incidence
Co (Cu) 9	No incidence	8.5	No incidence	3.8	10.5	No incidence
ICMV 221	No incidence	9.0	No incidence	4.1	12.2	No incidence
7042s						
(Susceptible check)	-	-	-	98	43	No incidence

Table 6. Grain quality characters of UCC 32

Quality characters	UCC 32	CO (Cu) 9	ICMV 221
Grain quality			
Moisture (%)	8.78	8.23	10.34
Carbohydrate (%)	69.75	71.80	69.78
Protein (%)	12.07	10.25	10.47
Fat (%)	4.99	5.23	5.14
Crude fibre (%)	2.68	3.13	2.67
Ash (%)	1.69	1.34	1.60
Calorific value (K calories/100g)	372.19	375.27	367.26
Cooking quality			
Initial weight (g)	100	100	100
Initial volume (ml)	120	120	120
Cooked weight (g)	260	230	240
Cooked volume (ml)	330	300	300
Water absorption (ml)	330	300	300
Time taken (min)	42	45	50
Organoleptic score			
Colour	8.7	8.2	7.9
Flavour	8.4	7.7	7.5
Texture	8.5	7.5	7.1
Taste	8.4	7.8	7.8
Overall acceptability	8.4	7.9	7.8