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A New Cumbu (Pearl Millet) Hybrid X-4 for Tamil Nadu

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UCH 4, a hybrid combination between MS 5141A and PT 1921, an inbred of African origin, is high yielding with a recorded mean grain yield of 2531 kg/ha as against 2136 and 2131 kg/ha recorded respectively by the presently popular hybrids KM 1 (BJ 104) and KM 2 (BK 560) under irrigated conditions. This hybrid has recorded grain yields exceeding 3500 kg/ha at ten centres out of a number of location tests conducted in Tamil Nadu and outside. This indicates its high yield potential. As a rainfed crop it registered a mean grain yield of 958 kg/ha which was a marginal increase of 7.5 per cent over KM 1 and 1.1 per cent over KM. 2. UCH. 4 has long compact panicles with bold grains and is resistant to downy mildew. It has a wide adaptability. The grains contain 10.3 per cent protein with a digestibility of 91.65 and a biological value of 82.30.

In view of its high yield, resistance to downy mildew and wide adaptability, this hybrid was released as X-4 for general cultivation in Tamil Nadu.

Cumbu (*Pennisetum americanum* (L) Leeke) is one of the important millet crops of India. Exploitation of hybrid vigour and commercial seed production in cumbu was made possible by the development of cytoplasmic genic male sterile lines. The commercial hybrids popular in our country during 1970s which involved the male—sterile line Tift—23A, developed by Burton (1958) however become highly susceptible to downy mildew after a few years of cultivation. The new male-sterile line MS 5141A developed at the Indian Agricultural Research Institute, New Delhi being resistant to downy mildew is presently used in making crosses.

The hybrids BJ 104 and BK 560 involving cytosterile MS 5141A are being cultivated widely at present. In order to develop new high combining pollinator lines conferring resistance to downy mildew, breeding work was initiated at the Millets Breeding Station, Coimbatore and the results are reported in the present paper.

MATERIAL AND METHODS

Evaluation of the gene pool maintained at the Millets Breeding Station resulted in the identification of a line MS 7625 an African introduction as a source of resistance to downy mildew. By further inbreeding and selection in this line, a downy mildew resistant restorer genotype PT 1921 was developed. Crosses were effected with MS 5141 A using PT 1921 as pollen parent. This

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TABLE I Morphological description of X-4 and its parents

Characters	MS 5141 A	PT 1921	X4
Origin	Donor 1587 Indian parent, derived from Baroda 4 through backcrosses to Tift 23 A	Africa	MS 5141 A x PT 1921
Plant height (cm)	140—150	160—190	150—160
Days to flowering	50— 60	60— 65	50— 55
Days to maturity	85— 90	90— 95	80— 85
Tiller number	3— 5	3— 5	4— 7
Panicle thickness	1.8—1.9	3.0— 3.5	2.1—2.6
Panicle length (cm)	21— 23	25— 30	25— 35
1000 grain wt (gm)	7.0—7.5	9.0— 10.0	8.0—9.0
Distinguishing characters	Bold grains, leaf and sheath with dense hairs, nodal hairs prominent, ear rod shaped with distinct tip, anther colour pink	Bold grains, leaf and sheath sparsely hairy leaves yellowish green, spindle shaped panicles compact with good seed set, anther colour purple or yellow, light grey grains	Bold grains leaf and sheath sparsely hairy, nodes ciliated with moderately dense hairs, light purple nodes compact panicles of conical shape, anther colour purple or yellow

Note : For raising a seed production plot of the hybrid the male parent has to be sown 7—10 days in advance for synchrony of flowering.

combination designated as UCH 4 along with twenty other hybrids was tested in 17 replicated trials under irrigation and seven trials under rainfed conditions at the Millets Breeding Station, Coimbatore. Apart from this, the hybrid was subjected to multilocation tests in 133 centres, viz. 40 adaptive research trials in the Districts 60 All India Coordinated trials and 33 minikit trials (Table II). Under the District trials the hybrid was tested in Coimbatore, Tirunelveli, Pudukkottai, South Arcot, Salem and Trichy Districts and in the All India Coordinated Trials covered the states of Gujarat, Haryana, Rajasthan, Maharashtra, Tamil Nadu, Madhya Pradesh and Punjab.

The hybrid was tested for its reaction to downy mildew, ergot and rust at various places. The nutritional quality of the grain was ascertained in terms of

TABLE II Yield Performance of X4 (UCH 4)

Nature of Trials		No. of trials	Irrigated (Mean yield kg/ha)					No. of trials	Rainfed (Mean yield kg/ha)				
			UCH 4	KM 1	KM 2	% on KM 1	% on KM. 2		UCH 4	KM 1	KM 2	% on KM 1	% on KM 2
Research Station Trials	1976—77	9	2938	2101	—	139.8	—	3	713	539	—	132.2	—
(Replicated)	1977—78	4	2193	1492	—	146.9	—	2	861	731	—	117.8	—
	1978—79	5	2790	2413	—	115.6	—	1	715	393	—	181.9	—
Mean of Station trials			2731	2053	—	133.1	—	—	762	579	—	131.8	—
District trials	1976—77 (Summer)	3	2923	2633	—	111.1	—	6	830	754	848	110.8	98.1
	1977—78							18	967	905	—	106.9	—
								9	1082	—	1089	—	99.4
	1978—79							4	981	885	923	110.9	106.3
Mean of District Trials			2923	2633		111.1	—	—	978	870	978	112.4	100.0
All India Trials	1978—77	8	1936	1796	1841	107.8	105.2	—	—	—	—	—	—
(Replicated)	1978—79	26	2179	1953	2007	111.6	108.6	—	—	—	—	—	—
	1979—80	26	2176	2022	—	107.7	—	—	—	—	—	—	—
Mean of All India Trials			2147	1955	1968	109.3	107.8	—	—	—	—	—	—
Minikit trials	1978—79							33	937	911	918	102.9	102.1
Total Trials		81						76					
Mean of all Trials			2531	2136	2131	118.5	118.8	—	958	891	948	107.5	101.1
Mean of summer season			2640	2379	—	110.9	—						
Mean of Monsoon season trials			2333	1963	1968	118.9	118.6						
Mean duration in days			85	80	80				85	80	80		
Per day production (kg) (Based on mean of all trials)			29.78	26.70	26.64				11.27	11.14	11 75		

TABLE III Disease reaction under artificial conditions of UCH 4 in comparison with other cultivars

Name of entries	Downy mildew in percentage of plan s infected		Ergot incidence in % of florets infected		Rust intensity in mean grade	
	1977	1978	1977	1978	1977	1978
UCH 4	5.0	6.8	18.3	43.5	4	4
KM. 1	6.7	8.1	20.7	50.6	4	4
Co. 6	0.0	2.2	9.0	26.5	3	3
Check HB. 3	85.0	100.0	27.5	48.6	4	4

TABLE IV Evaluation of UCH 4 for fungal diseases (1978–'79) All India Trials

Centre	Rust (Grade)			% of downy mildew			% of Ergot florets		
	UCH 4	BK 560	BJ 104	UCH 4	BK 560	BJ 104	UCH 4	BK 560	BJ 104
Akola	NA	4	2	–	—	0	NA	20	20
Aurangabad	4	3	4	0	1.7	6.8	65.3	48.2	59.4
Coimbatore	4	4	4	0	0	0	20.0	10.0	10.0
Delhi				0	0	8.8	0	12.5	30.0
Duragapura	5	5	5	0	2.0	0	10.0	5.0	30.0
Hyderabad	0	5	1	9.0	11.0	3.0	1.0	0	0
Hissar	2	2	2	2.0	2.5	5.5	40.0	70.0	70.0
ICRISAT (sickplot)				22.8	28.0	68.3	NA	70.0	74.0
Jamnagar				0	4.9	4.8	100.0	100.0	83.0
Jodhupur				5.9	6.7	3.6	—	—	—
Ludhiana				0	4.1	7.0	60.0	50.0	72.0
Bangalore				—	–	—	1.7	3.5	3.7
Mean	3.0	3.8	3.0	3.97	5.54	9.80	37.0	38.92	45.21

(Based on mean of all trials)

protein content, digestibility, biological value and net protein utilisation value in comparison with Co.6.

RESULTS AND DISCUSSION

The performance of the hybrid in comparison with KM.1 and KM 2 in various trials is shown in Table.II. It could be seen that UCH.4 recorded 33.1 and 31.7 per cent higher yield over KM.1 under irirgated and rainfed conditions respectively. In the District trials underirrigated conditionsUCH4 recorded 2923 kg/ha which was 11.1 per cent increase over KM. 1. and under rainfed conditions UCH. 4 recorded 12.4 per cent higher yield than KM.1.

The performance of UCH 4 in All India Coordinated Trials conducted over 60 locations in three years (Anon, 1977, 1977, 1980) revealed the adaptability of the hybrid over a wide range of environments. Grain yield exceeding 3500 kg/ha was realised from this hybrid in ten centres of All India trials indicating its potentiality for high yield. On an average UCH 4 yielded 2147 kg/ha against 1965 kg/ha recorded by KM 1 and 1968 kg/ha by KM. 2. It is also note-worthy that this hybrid ranked first among the entries during 1978-79, KM. 1 and KM.2 holding the 11th and 9th positions respectively (Anon, 1979). In the 1979-'80 Coordinated trials, UCH4 was the third best hybrid against KM.1 which held the 15th position (Anon, 1980). At the 1979-'80 Annual Workshop Meeting the hybrid was recommended for All India pre-release multiplication because of its high yield potential and stability in performance.

The reaction of the hybrid to diseases is given in Table III. The hybrid was resistant to downy mildew with a mean infection percentage of 5.9 against 92.5 in HB 3 under artificial epiphytotic conditions, in two years. In All India Coordinated trials during 1978 79 downy mildew was recorded under natural condition in 10 centres and under artificial conditions at ICRISAT. Out of the former 10 centres, there was no incidence of the disease in six centres. A mean percentage of infection of 3.97 over all the centres was recorded by UCH 4 as against 5.54 by KM.2 and 9.80 by KM. 1.

Varietal diversity is one of the recently advocated strategies to combat disease. In regionus of disease epidemic cultivation of a single genotype over vast areasis conducive for the appearance of new races of pathogen. We have witnessed the case of HB.3 cumbu suddenly becoming susceptible to downy mildew due to continued extensive cultivation in Tamil Nadu and outside. Another example elsewhere is the southern corn leaf blight of maize in hybrids possessing Texas male sterile cytoplasm. Van der plank (1968) considers that a host pathogen system operates in the successful management of vertical resistance in crop plants. This may hold good in cumbu also.

TABLE V Results of the biochemical analysis of the grain

Variety	Protein content %	Digesti-bility	Biological value	Net Protein Utilization
UCH 4	10.30	91.65	82.30	74.10
Co 6	9.37	89.04	80.50	74.60

Hence growing of UCH 4 in addition to KM. 1 and KM.2 will be advantageous in terms of controlling downy mildew because UCH. 4 possesses resistance from a different source.

The reaction of UCH 4 to ergot and rust is similar to that of KM.1 and KM. 2. UCH. 4 was reported to be tolerant to shootfly and ergot (Bala subramaniam *et al.* 1980).

This hybrid possesses bold grains with a 1000 seed weight of 7.8 g. A biochemical analysis of the grains indicated that the grains contain 10.3 per cent protein and the protein content, digestibility and biological value are superior to Co. 6 (Table V).

Thus, the hybrid UCH4 was released as X 4 for general cultivation in Tamil Nadu in view of its high yield potential, wide adaptability and resistance to downy mildew. It also satisfies the need for diversification of hybrids.

The morphological characters of the parents and hybrid are presented in Table I.

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