

350

JIA 480

Indian J. Genet., 46(3) : 449-455

## VARIATION AND ADAPTATION OF PEARL MILLET GERMPLASM IN TAMIL NADU, INDIA

S. APPA RAO, M. H. MENGESHA AND C. RAJAGOPAL REDDY

*Genetic Resources Unit, ICRISAT, Patancheru 502 324*

(Received: February 2, 1985; accepted: June 24, 1986)

### ABSTRACT

Some 200 samples of pearl millet [*Pennisetum americanum* (L.) Leeke] collected from Tamil Nadu were evaluated at ICRISAT Center, Patancheru, for morphologic and agronomic characters. During the rainy season, most of the accessions flowered very late (100 days) and grew very tall (325 cm), while in the postrainy season, they flowered early (70 days) and had reduced plant height (145 cm) and spike size, indicating photoperiod sensitivity. The early and medium maturing types are less sensitive to day length. In Tamil Nadu, the crop duration seems to be associated with the pattern of rainfall distribution. Late-maturing types, which produce several asynchronous nodal tillers with very small grain, are grown in areas which receive most of their annual rainfall during the northeast monsoon. Early-maturing types, which produce synchronous basal tillers with large grains, are grown under lift irrigation.

**Key words:** Variation, adaptation, pearl millet, Tamil Nadu.

Tamil Nadu ranks seventh both in area and production of pearl millet [*Pennisetum americanum* (L.) Leeke] in India with an estimated area of 341,700 ha and production of 295,000 tonnes annually [1]. Seventy five accessions were assembled by the Rockefeller Foundation from Tamil Nadu [2]. These accessions when evaluated were found to be very tall and produced many tillers (21) with compact spikes [3]. Of these, only 51 accessions retained some of their original characters [4]. Later, pearl millet germplasm from Tamil Nadu was collected jointly by the Tamil Nadu Agricultural University (TNAU) and ICRISAT during April 1978. This paper describes the evaluation of this collection, narrates its adaptation in Tamil Nadu, and discusses its possible use in pearl millet improvement.

### MATERIALS AND METHODS

Details of the collection, the areas covered, route followed, and sampling procedures were described elsewhere [5]. Agronomic evaluation and characterization procedures were similar to those followed for the Uttar Pradesh collection [6]. The entire collection of 200 accessions was evaluated in the uniform nurseries at Patancheru in two contrasting seasons. The rainy and postrainy season nurseries were planted on June 20 and November 18, 1982, respectively. Various characters were recorded as per the pearl millet descriptors [7].

## RESULTS AND DISCUSSION

*Morphology of pearl millet.* The mean, standard error, and range for 13 characters are given in Table 1. Majority of the accessions grew very tall (325 cm), produced short (57.5 cm), narrow (27.7 mm) leaves, and thin (6.7 mm) stems. They produced several nodal tillers with sequential flowering resulting in asynchronous maturity. The spikes were thin, short, and cylindrical to fusiform. In all the medium and late-maturing types except *Arisi Combu*, the glumes completely cover the small grains and remain with the grain even after threshing. In all early-maturing types, except *Pokku cumbu*, the glumes partly cover the large grains. The grains were very small, obovate to cuneiform with corneous endosperm. Most accessions produced short bristles below the grain surface. In general, the variation for spike and grain characters was considerably less compared to the Uttar Pradesh [6] and West Africa [8-10].

Table 1. Range, mean and standard error (SE) of some morphological characters of pearl millet germplasm from Tamil Nadu

Character	Mean	SE	Range
Stem thickness (mm)	6.7	0.17	5-9
Total tillers	4.3	0.07	1-18
Productive tillers	2.7	0.04	1-11
Leaf number	12.0	0.29	9-15
Leaf blade length (cm)	57.5	1.24	47-74
Leaf blade width (mm)	27.7	0.68	23-37
Spike thickness (mm)	18.2	0.83	13-32
Spike exertion (cm)	6.8	0.07	6-14
Bristle length*	2.2	0.02	1-6
Grain shape*	2.8	0.03	1-6
Grain length (mm)	2.9	0.12	4-3.2
Grain width (mm)	1.8	0.48	1.3-3.0
Endosperm texture*	3.7	0.02	2-7

\* See Descriptors for Pearl Millet [7].

Based on flowering, plant height, spike length and grain size, the different landraces collected in Tamil Nadu were classified into 15 cultivar groups (Table 2).

*Variation within accessions.* Early-maturing types showed considerable variation for flowering and plant height, while the late-maturing types were uniform for these two characters. The photoperiod-sensitive *Kala cumbu* was remarkably uniform because it flowered only after the onset of the required day length. Variation was low for spike and

grain characters both within and between the accessions, probably because of strong selection pressure, or variation in the originally selected material was very low. This is in contrast to the West African material in which it is very common to find different spike and grain types within an accession [10], because new variation probably occurs due to introgression with wild types.

*Variation and adaptation.* Pearl millet collections from Tamil Nadu vary considerably for flowering (55-130 days), plant height (190-385 cm), spike length (16-31 cm), and spike thickness (11-31 mm) during the rainy season. They flowered early (62-86 days), accompanied by reduced plant height (96-149 cm), spike length (11-18 cm), and spike thickness (11-19 mm) in the postrainy season (Fig. 1).

Based on number of days from emergence to flowering during the rainy season, the landraces were classified as early, medium and late-maturing types.

*Early-maturing types.* Very primitive types like *Pokku cumbu*, which perhaps escape drought, are grown in low rainfall areas of Pudukkottai, Ramanathapuram and Tirunelveli districts. In these areas, the annual rainfall is 600-800 mm, most of which is received during northeastern monsoon. The early-maturing primitive types are grown with the onset of southwestern monsoon in June and harvested by September to facilitate a second crop during northeastern monsoon. They produce very thin stems and many asynchronous nodal tillers. The spikes are small and the small grains are completely covered by glumes. Some early types like *Kullan cumbu*, *Moonumoly cumbu* and *Arupathan cumbu*, with relatively high yield potential, are grown in garden land conditions under lift irrigation almost throughout the year. These are also grown in high rainfall areas on fertile soils where a second crop is taken.

*Medium-maturing types.* These are called by different names in different areas: *Aelumoly* around *Alangudi*, *Arisi* around Samayapuram, and *Mochai* around Pulivalam. They flower in about 75 days both during rainy and postrainy seasons (Table 2), indicating that they are less affected by day length and/or temperature. They are invariably grown under low rainfall conditions in areas which receive most rain during the southeastern monsoon. They are usually mixed with pulses or groundnut.

*Late-maturing types.* These are named differently in different areas: *Kattu cumbu* in Tudiyalur, Kovilapalayam and Mettupalayam; *Oong cumbu* around Pollachi and Udumalpet; *Valathi cumbu* around Vadachittoor; *Manavari cumbu* in Teni, Tirumangalam, and Usilampatti; *Mathura vellai* around Tenkasi; and *Perum cumbu* around Pollachi. They are invariably grown under rainfed conditions, usually mixed with a pulse crop. At Patancheru, they grew very tall, flowered very late, and produced several asynchronous tillers during the rainy season. During the postrainy season, they flowered early accompanied by reduced plant height and spike length suggesting quantitative day length and/or temperature sensitivity [11]. In Tamil Nadu these are usually grown in low rainfall areas that receive rain during both seasons. These are sown with the onset of southwestern monsoon in June-July, grow slowly during the dry spells, pick up growth with the northeastern monsoon rains in October, and mature after the rains stop in January. The photoperiod sensitivity of these types enables them to adapt to the bimodal rainfall patterns.

**Rainy**  
**Postrainy**

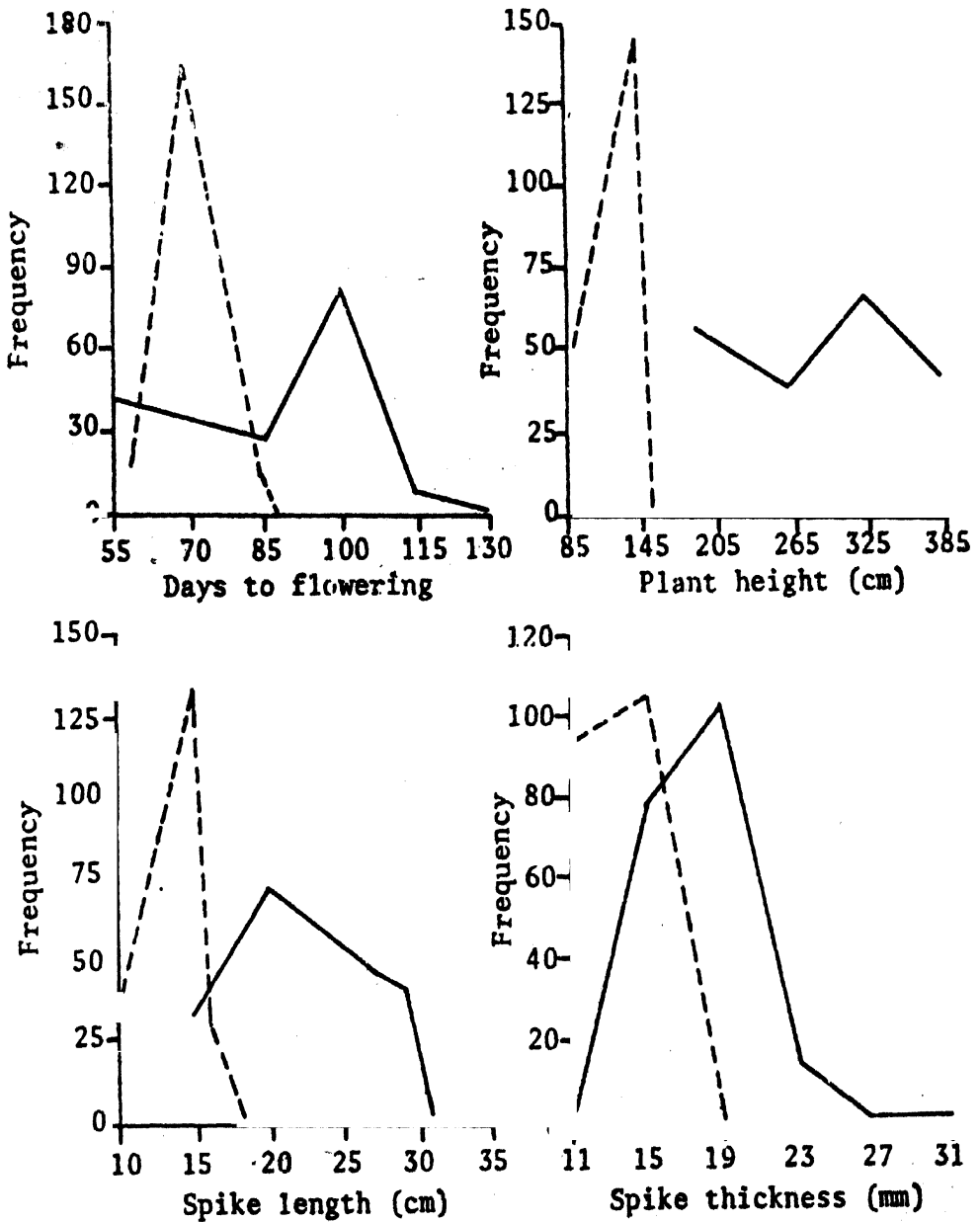


Fig. 1. Effect of two planting dates at ICRISAT Centre on days to 50% flowering, plant height, spike length, and spike thickness of pearl millet germplasm from Tamil Nadu.

Table 2. Characteristics of different landraces of pearl millet from Tamil Nadu

Cultivar group	Days to 50% flowering				Plant height (cm)				Spike length (cm)				1000 Gwt. (g)	
	rainy		postrainy		rainy		postrainy		rainy		postrainy		rainy	
	range	mean	range	mean	range	mean	range	mean	range	mean	range	mean	range	mean
<b>Pokku</b>	60-72	66.5	53-70	66.0	178-222	195.5	68-128	95.8	15.4-18.8	17.1	8.4-15.0	11.7	3.70-4.80	4.08
<b>Kullian</b>	61-119	70.3	57-95	71.7	160-246	190.0	106-160	126.5	16.1-22.6	18.1	11.4-16.4	14.8	4.40-8.26	5.83
<b>Moornumoli</b>	63-72	60.0	67-73	70.0	194-201	198.3	101-126	111.0	14.8-16.3	15.7	13.0-14.2	13.6	5.05-6.35	5.66
<b>Vellai</b>	60-98	75.0	58-74	68.5	219-246	223.0	91-174	132.0	13.8-23.3	18.3	10.2-15.6	13.0	4.65-6.05	5.46
<b>Arupathan</b>	53-56	55.0	59-65	62.0	180-240	210.0	130-150	140.0	13.0-19.0	16.4	13.0-19.0	16.0	6.81-8.83	7.45
<b>Aelumoly</b>	71-98	78.0	69-82	73.2	208-242	225.5	92-128	107.0	14.7-17.7	16.3	9.6-12.3	11.1	3.95-5.75	4.75
<b>Arisi</b>	65-100	79.0	56-90	75.5	176-339	250.3	87-170	126.8	16.1-21.6	18.8	11.8-15.4	13.3	4.50-6.65	5.27
<b>Mochai</b>	74-84	79.0	74-79	76.5	259-284	271.5	128-154	141.0	17.5-21.7	19.6	11.4-15.4	13.4	3.25-4.30	3.77
<b>Manavari</b>	81-116	97.0	55-82	64.4	308-388	342.9	99-155	121.9	24.1-29.9	26.8	11.8-20.2	14.5	4.55-6.15	5.50
<b>Mathuravellai</b>	89-107	98.9	70-81	74.2	336-416	385.0	117-150	135.6	22.3-30.3	26.5	10.6-19.3	15.9	4.10-7.60	5.56
<b>Podi</b>	65-105	95.2	70-77	73.3	328-392	362.6	137-168	148.9	24.0-34.4	30.5	13.6-19.8	17.8	4.90-8.15	6.14
<b>Kattu</b>	72-119	97.1	70-94	79.7	232-380	312.0	108-134	121.6	17.8-30.6	22.1	12.0-17.0	14.1	3.65-6.15	4.61
<b>Valvathi</b>	118-125	121.0	72-92	82.0	306-321	313.5	141-153	147.0	15.0-18.7	16.6	11.4-15.0	13.2	2.95-3.95	3.45
<b>Perum</b>	83-115	97.2	72-94	83.5	270-366	314.2	120-165	145.3	16.4-27.1	20.3	12.4-18.4	14.8	3.69-5.72	4.39
<b>Kala</b>	124-135	130.0	80-92	86.0	283-342	321.5	122-158	140.0	26.0-26.8	26.4	14.2-19.0	16.6	5.10-5.45	5.27

*Photoperiod-sensitive type.* Locally called *Kala cumbu*, it is grown around Tiruvengadam and Vandenallur where most of the rain is received from the northeastern monsoon. It is sown exclusively during September-October when the day length is less than 12 h. It is also grown as a garden crop during winter with lift irrigation. At Patancheru, it flowered in 120 days during the rainy season and in 86 days during the postrainy season, strongly indicating its qualitative photoperiod and/or temperature sensitivity. It is best suited for short days and low temperature conditions, which supports local farmers' belief.

Since the pearl millet types from Tamil Nadu are very tall, flower very late, produce several thin stems, and have small spikes, they appear different from others [8, 9, 12, 13]. The grain size is smaller (4-7 mg) compared to the large grain (8-18 mg) in the Ghana types [10]. These types might have evolved to adapt to the bimodal rainfall pattern in Tamil Nadu.

The variation in pearl millet from Tamil Nadu is low for most characters, except plant height and flowering. In Tamil Nadu, pearl millet is a dual purpose crop, grown both for grain and fodder. Hence, farmers might have selected tall types with high sugar content in the stems [13]. Crop season seems to be associated with the pattern of rainfall distribution. For instance, very late types that are mildly photoperiod sensitive are grown in areas with bimodal rainfall distribution. The photoperiod sensitivity enables them to flower after the northeastern rains. These types may have been selected by the farmers because they escape grain molds. Early maturing types are grown in those areas which receive rain only from southwestern monsoon or where a winter crop follows pearl millet. Selection by the farmers and specific farming practices lead to the evolution of cultivars with different morphologies [14]. Tamil Nadu pearl millet is good both for fodder and grain, and can be used to develop dual purpose cultivars. They are also a good source of high tillering and grain numbers.

#### ACKNOWLEDGEMENTS

Thanks are due to Professor R. Appadurai and his colleagues of TNAU for their help in collecting the germplasm; and to Drs. S. Sithanatham and V. Mahalakshmi for translating Tamil vernacular, checking the manuscript, and making suggestions.

#### REFERENCES

1. Directorate of Economics and Statistics, Govt. of India. 1982. Area and production of principal crops in India, 1980-81. New Delhi: 36-37.
2. K. O. Rachie. 1963. The systematic collection of sorghum, millets and maize in India. The Rockefeller Foundation, New Delhi (Mimeographed).
3. B. R. Murty, M. K. Upadhyay and P. L. Manchanda. 1967. Classification and cataloguing of a world collection of genetic stocks of *Pennisetum*. Indian J. Genet., 27: 313-394.
4. S. Appa Rao. 1980. Progress and problems of pearl millet germplasm maintenance. In: Trends in Genetical Research on *Pennisetums* (ed. V. P. Gupta and J. L. Minocha). Punjab Agric. Univ., Ludhiana: 279-282.

5. S. Appa Rao. 1978. Collection of landraces of pearl millet from Rajasthan, Tamil Nadu and Eastern Ghats of India. Paper presented at the National Symposium on Plant and Animal Genetic Resources, Indian Agric. Research Institute, New Delhi, December, 1978: 28-30.
6. S. Appa Rao, M. H. Mengesha and C. Rajagopal Reddy. 1983. Collection and preliminary evaluation of pearl millet germplasm from Uttar Pradesh, Indian J. Genet., **43**: 261-271.
7. IBPGR/ICRISAT. 1981. Descriptors for Pearl Millet. IBPGR Secretariat, FAO, Rome, Italy: 34.
8. M. Bono. 1972. Contribution a la morphosystematique des *Pennisetum* annuels cultives pour leur grain en Afrique Occidentale Francophone. IRAT, Paris: 140.
9. K. O. Rachie and J. V. Majumdar. 1980. Pearl Millet. The Pennsylvania State University Press, London: 307.
10. S. Appa Rao, M. H. Mengesha and D. Sharma. 1985. Collection and evaluation of pearl millet germplasm (*Pennisetum americanum*) from Ghana. Econ. Bot., **39**: 25-38.
11. C. K. Ong, and S. Everard. 1979. Short day induction of flowering in pearl millet (*Pennisetum typhoides*) and its effect on plant morphology. Exp. Agric., **15**: 401-410.
12. N. Krishnaswamy. 1962. Bajra, *Pennisetum typhoides* S & H. Indian Council of Agricultural Research, New Delhi: 94.
13. S. Appa Rao, M. H. Mengesha and V. Subramanian. 1983. Collection and preliminary evaluation of sweet-stalk pearl millet (*Pennisetum*). Econ. Bot., **36**: 286-290.
14. J. G. Hawkes. 1983. The Diversity of Crop Plants. Harvard Univ. Press, London: 184.