

PEARL MILLET (*Pennisetum americanum*) GERMPLASM
FROM SENEGAL

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ABSTRACT

The pearl millet, *Pennisetum americanum* (L.) Lecke, germplasm from Senegal assembled at the ICRISAT Center in Patancheru includes 258 cultivated, 43 intermediate, and 3 wild accessions. Farmers of Senegal call pearl millet cultivars by different names like *souna*, *sanio* and *thiotande*. The early-maturing *souna* type is adapted to low (350-600 mm) rainfall regions of the north, while the late-maturing *sanio* is adapted to the high (900-1200 mm) rainfall regions of the south. The *thiotande* type which produces large grains with starchy endosperm is generally grown in backyards. The *souna* and *thiotande* flowered in long days also, while *sanio* flowered only in short days. All the cultivated accessions were classified into seven cultivar groups based on phenology, aristation and spike shape, and a key was developed to identify them. The Senegal germplasm is a good source for long spikes, grain density and grain size, besides long bristles.

Key words: Pearl millet, germplasm, Senegal.

Pearl millet [*Pennisetum americanum* (L.) Leekel] is an important crop in Senegal, covering an estimated 800,000 ha annually [1]. It is a staple food in the western and northern regions and is preferred over sorghum and maize for greater palatability and better nutrient value [2]. Senegal falls within the area of pearl millet domestication [3], where wild, weedy and cultivated forms occur in abundance. Realizing the need for conserving this diversity, pearl millet germplasm was collected by Office de la Recherche Scientifique et Technique d'Outre-Mer (ORSTOM) during 1976 [4]. All the samples collected in Senegal were introduced to the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, during 1978. The material was evaluated, characterized and classified to facilitate its use for pearl millet improvement. The purpose of this paper is to describe the variation observed, and to classify this variation into suitable cultivar groups and to constitute germplasm pools for conservation and utilization.

Pearl millet is by and large a rainfed crop of sandy soils in areas receiving ca 1000 mm rainfall. Long duration types are grown in the higher rainfall regions of the south, and early types in the drier north. It is sown to coincide with the advent of the rainy season. Early maturing pearl millet is usually sown in April or May, and late types in June or early July. Seeds are generally sown in hills at 45×45 cm to 100×100 cm. If mixed with other crops, the spacing may be increased to 150×150 cm [5]. This practice may reflect the need to speed up operations during the optimum soil moisture time, while sowing is often done by hand.

MATERIALS AND METHODS

Seeds of individual accessions multiplied by the cluster-bagging method [6] were used for evaluation. The entire collection was evaluated in the uniform nurseries at the ICRISAT Center, Patancheru, in two contrasting seasons differing in day length and temperature. Agronomic evaluation and characterization procedures followed were reported elsewhere [7].

RESULTS AND DISCUSSION

AGRONOMIC EVALUATION

All the accessions were evaluated at the ICRISAT Center, Patancheru ($17^{\circ}27'N$) as per the pearl millet descriptors [8]. Considerable variation was observed for all the characters studied, especially for flowering and spike length, as was previously reported [9]. During the rainy season, flowering commenced 52 days after sowing with bimodal distribution (Fig. 1). The first peak (75 days after sowing) represents the *souna*, while the second and third peaks (105 and 125 days after sowing) represent *sanio*. The second peak coincided with the commencement of short days (12 h 10 min), suggesting the photoperiod sensitivity of *sanios*. Based on the number of days taken for flowering during the rainy season at the ICRISAT Center, Patancheru, all those accessions which flowered within 78 days were grouped as *souna*, and those that flowered after 95 days as *sanios*. Accessions which flowered between 78 and 95 days are possible hybrids between the two groups.

During the postrainy season, the number of days from sowing to flowering of *sanio* was drastically reduced as compared to the rainy season (Fig. 1). Moreover, all the *sanio* types flowered earlier than the *souna* types. The differential

expression of these two types during the two contrasting seasons is due to differences in day length and temperature. As the *sanio* types flower only in short days, during the rainy season at Patancheru they flower in October with the onset of short days. During the postrainy season they flower early because the days are already short. The delay in flowering of the *souna* types during the postrainy season is due to low temperature.

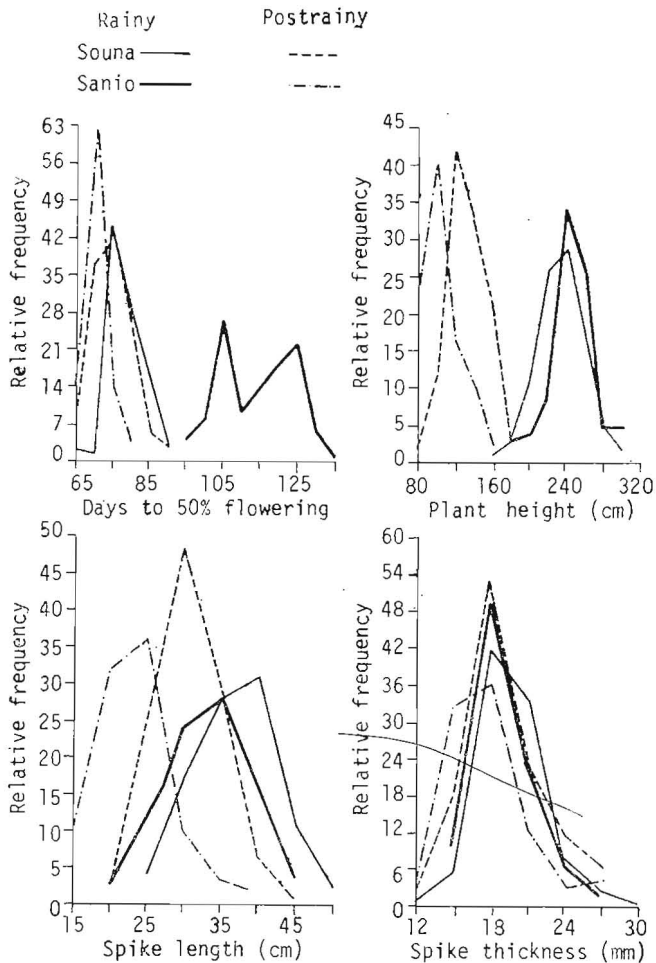


Fig. 1. Comparison of *souna* and *sanio* types of pearl millet germplasm from Senegal evaluated during the rainy and postrainy seasons at ICRISAT Center in Patancheru, A.P., India.

In pearl millet, a considerable reduction in the number of days to flowering due to short days was reported earlier [10, 11]. The strong photoperiod sensitivity

delays flowering in June plantings and enables the cultivars to fully utilize the scanty rainfall received over a long time. Based on flowering, aristation and spike characters all the cultivated accessions were classified into seven groups and a key was developed to identify them (Table 1).

Table 1. Key to identify different cultivar groups of pearl millet from Senegal

1. Flowering only during short days (day length less than 12 h 10 min).	
Leaf blade glabrous.....	<i>Sanio</i> .
2. Spikes bristled	
3. Spikes cylindrical.....	<i>Karang</i>
3. Spikes conical to spindle-shaped.....	<i>Casamance</i>
2. Spikes nonbristled	
4. Spikes cylindrical.....	<i>Casamance</i>
4. Spikes conical to spindle-shaped.....	<i>Samckouta</i>
1. Flowering irrespective of day length. Leaf blade coarse.	
5. Spikes conical to spindle-shaped.....	<i>Thiotande</i>
5. Spikes candle-like or cylindrical.....	<i>Souna</i>
6. Spikes candle-like.....	<i>Sine Saloum</i>
6. Spikes cylindrical.....	<i>Ferlo</i>

VARIATION AND ADAPTATION

Souna. The *souna* type is early maturing, and it flowers earlier than the *sanio* type when grown during long days and is well adapted to the low (350-600 mm) rainfall regions of the north (Fig. 2). The local farmers have selected a number of *souna* types of differing maturity depending on the rainfall and soil type. The *souna* types grown in the fertile alluvial soils of the Senegal river basin produce very long (70-85 cm) candle shaped spikes but mature early because of low rainfall and high temperature. In the high rainfall areas of the Casamance province, the late maturing *souna* types are grown.

None of the *souna* types has bristles (Fig. 3). As they mature during peak rainfall, long bristles may prevent rapid drying leading to the development of grain moulds. Farmers deliberately exclude the bristled forms for seed purpose [4]. The most common spike shape is almost cylindrical with maximum

thickness at the base, and gradually tapering towards the tip. However, candle-shaped types are not uncommon in the north, and so are the conical types in the south. The spikes are very compact and the grey grain is bold, with corneous endosperm.

Sanio. The *sanio* types are usually grown in the high rainfall (900-1200 mm) regions of the south (Fig. 2). Because of their photoperiod sensitivity,

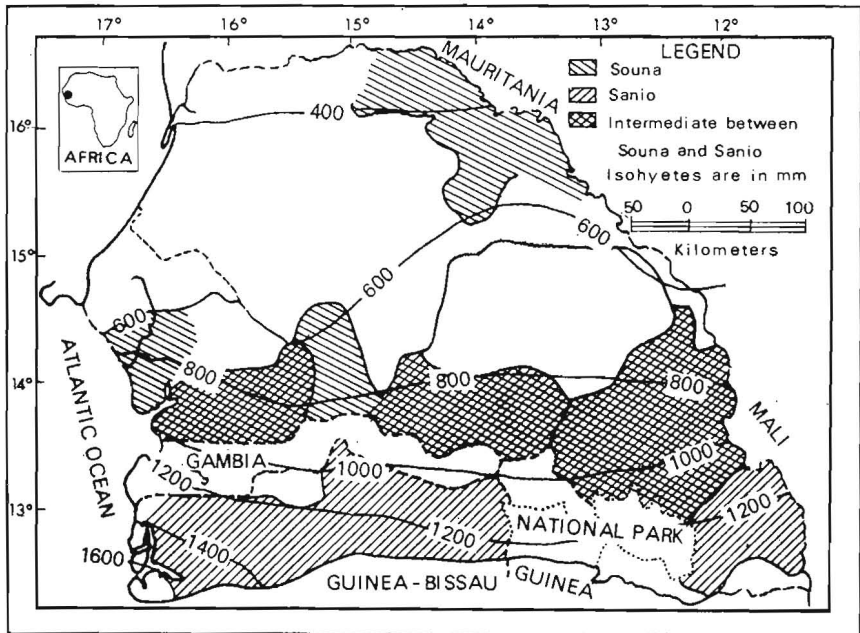


Fig. 2. Distribution of *souna*, *sanio* and possible intermediate types in relation to rainfall distribution in Senegal.

they flower in October and mature in November. Photoperiod sensitivity probably contributes to drought resistance, and enables them to mature after the cessation of rains [12]. The *sanio* types commonly produce long (45 cm) candle-shaped spikes, often with dense long red bristles (Fig. 3). The *sanio* types are found along the Senegal river, Ferlo, Boundou and Sine-Saloum areas. In the eastern region, short, cylindrical types with very dense long bristles are found. The crop matures later than in the north because of lower temperatures.

The short-bristled types with short spikes were collected from Casamance and in the eastern region. Three types can be distinguished: short (30 cm) cylindrical with very compact spikes, thin long cylindrical spikes with

characteristically rounded tip, and spindle-shaped stout spikes with sparsely filled grains at both extremities.

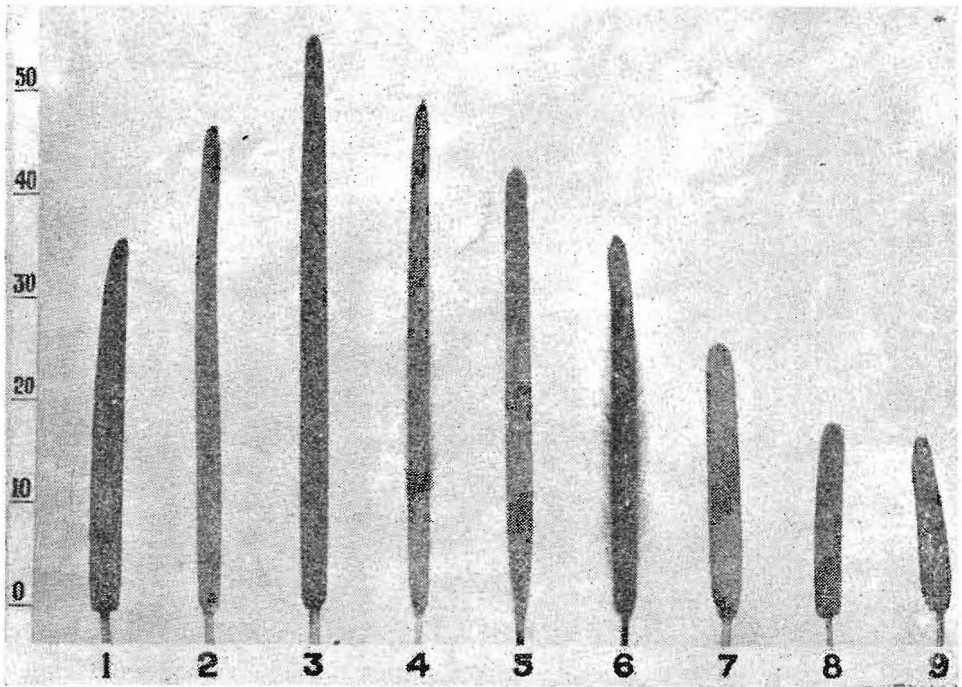


Fig. 3. Spikes of *souna* (1-3), *sanio* (4-6), and *thiotande* (7-9) groups of pearl millet from Senegal.

Thiotande. The *thiotande* group of pearl millet is cultivated under receding flood water conditions almost throughout the Senegal river valley from Bakel to St. Louis. It is particularly common around Madan Podor and is grown in small plots in backyards. As the crop matures on residual soil moisture, it flowers very early (within 55 days) and matures early. The spikes are conical, very short and stout, and the grains are large and globular. The starchy endosperm is specially used for culinary preparations, and served to guests, on festive occasions, and after fasting (Bilquez, personal communication).

The pearl millet cultivars grown in Senegal are traditionally classified into two broad groups by the farmers [13, 14]. The early maturing form is called *souna* and the late maturing form *sanio*. Though *thiotande* is also early maturing, it is different from *souna* and farmers consider it as a special type. While the *souna* type flowers whatever be the day length, the *sanio* type flowers

only during short days (less than 12 h 10 min). However, both types were found to be day length sensitive [15]. Considering the shape of caryopsis, cultivars from Senegal were combined as race *globosum* [3].

WILD AND WEEDY FORMS

Six of the 32 perennial *Pennisetum* species in the section *Penicillaria*, considered to be ancestors of cultivated pearl millet [16], occur in West Africa including Senegal. These as well as wild annual relatives of pearl millet have been treated as separate species and four of the cultivated species were found in Senegal [17]. The 155 Senegalese cultivars were divided equally into the species *Pycnostachyum*, *gambiense* and *nigritarum* [18]. Since all these mentioned taxa are interfertile with pearl millet, they have been merged with pearl millet into a single species [3, 19]. In current usage, *Pennisetum americanum* (L.) Leeke includes a wide array of cultivated pearl millets (subsp. *americanum*), the wild progenitors (subsp. *monodii*), and the intermediate mimetic weeds (*stenostachyum*).

The wild progenitor of cultivated pearl millet, *Pennisetum americanum* subsp. *monodii* formerly *P. violaceum* (Fig. 4), was found near the Senegal river, Ferlo, Boundore and Sine Saloum [4]. Intermediate weedy forms occur abundantly in many cultivated fields. These are reported to be derivatives of natural hybrids between the wild and cultivated forms [3], or offsprings or off-types from the cultivated races [20] occurring abundantly in many cultivated fields. They are usually eliminated at the time of transplanting of the *sanos*. Various tribes such as the *Serer*, *Toucouleurs* and *Wolof* often try to eliminate *shibra* forms at harvest when they select spikes while the *Ferlo* do not separate them. Though various farmers try to eliminate the weedy forms at various stages, they perpetuate themselves as weeds in the fields, and since the crop is cross-fertilizing, the genes for shattering persist in the nonshattering forms. The weedy forms are sometimes harvested for food as they mature early, before the maturity of the main crop, particularly during adverse weather conditions. The weedy forms were observed both in *souna* and *sanio* types but not in *thiotande*.

GENETIC EROSION

High yielding dwarf cultivars of pearl millet with increased harvest index (40–50%) and early maturity (75–100 days) were developed [21, 22]. Improved cultivars, such as GAM 75, developed by incorporating the dwarf gene *d2* into *souna* background, are becoming increasingly popular. Farmers call such

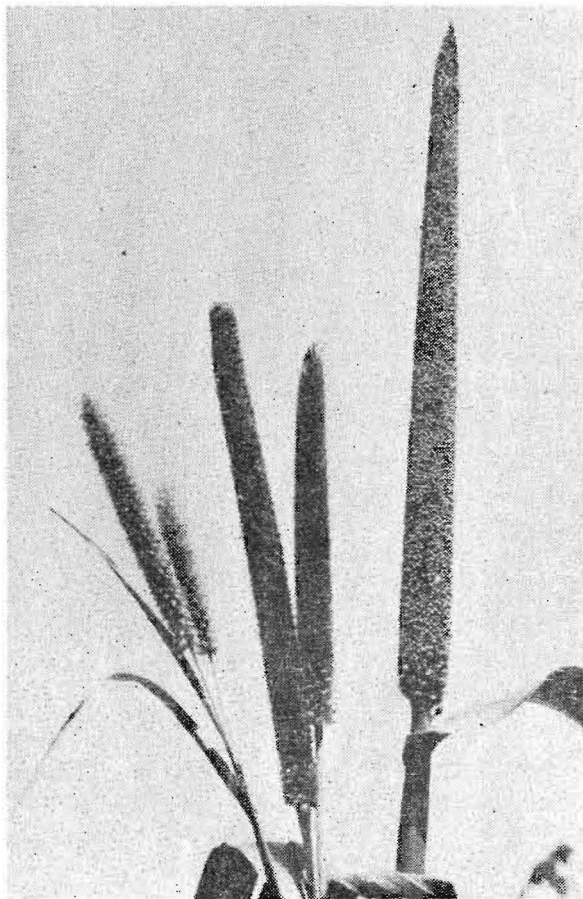


Fig. 4. The wild form (left) and intermediate form (middle) produced after introgression between the wild and cultivated (right) forms.

cultivars "mill Senghor," "souna Bambey," or "Cooperative distribution" [4]. The *sanio* types have practically disappeared from the low rainfall areas because of frequent crop failures. Farmers have a tendency to grow early and drought resistant sorghums. However, the spread of exotic introductions is limited because of the local preference for the vitreous grain of local pearl millet. In Eastern Senegal, farmers are gradually switching over from pearl millet to rice cultivation. The *thiotande* type has almost disappeared from *decrue* cultivation, probably because the decrease in floods resulted in the reduction of cultivable land after the floods.

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