

2

**ORIGIN, EVOLUTION AND SYSTEMATICS OF
MINOR CEREALS**

J M J de Wet

The Poaceae includes an estimated 8,000 species belonging to some 600 genera. Grasses occur on all continents, and in all habitats that support growth of flowering plants. They serve man in many ways, but it is their use as cereals and feed for livestock that make them essential for human survival. The caryopses of most grasses are edible, and at least 300 species were harvested during historical times as wild cereals by nomadic hunters and herders, and by farmers during times of scarcity. Thirty five species belonging to 20 genera are known to have been domesticated. Their cultivated races rely on man for seed dispersal (sowing), and for a suitable habitat to reproduce successfully (cultivated field).

Cereals are globally planted on an estimated 730 million hectares, and yield an estimated 1,800 million metric tons of grain annually. Wheat, maize and rice account for approximately 80 per cent of grain produced in the world. These cereals are followed in importance by barley, sorghum, oats, rye and pearl millet which together represent another 19 per cent of the world's cereal production. The remaining cereals account for about 1 per cent of the foodgrain produced in the world today. These minor cereals are not important in terms of world food production, but essential as food crops in their respective agro-ecosystems. They are mostly grown in marginal areas, or under agricultural conditions where major cereals fail to consistently produce an acceptable harvest.

MINOR CEREALS OF THE AMERICAS

Wild cereals played an important role in the diets of native Americans until recent historical times (Palmer, 1871, Ball, 1884). Fifty species were extensively

harvested, but only six species were domesticated as cereals. Maize (*Zea mays* L.) is the only New World cereal of commercial significance. *Setaria geniculata* (Lam.) P. Beauv. (brittle grass) from arid Mexico (Callen, 1965), and *Phalaris caroliniana* Walt. (may grass) of the southeastern United States (Chomko and Crawford, 1978) are known as cultivated cereals only in an archaeological context. Brittle grass was grown for at least a millennium (Callen, 1967), but was replaced by maize as a cereal some 4000 years ago (Mangelsdorff, MacNeish and Gallinat, 1967). Two minor cereals, mango (*Bromus mango* Desv.) in Chile and sauwi (*Panicum sonorum* Beal) in Mexico were important crops until recent historical times. American wild rice (*Zizania aquatica* L.) is a recent domesticate in north central Canada and adjacent regions of the USA (de Wet and Oelke, 1979).

Molina (1782) recorded that the Araucano Indians in Central Chile grew a kind of rye that was called el Mango, and a kind of barley that was called Tuca. Tuca probably refers to *Bromus unioloides* HBK., a wild grass that is extensively harvested as a cereal on the highlands of South America (Ball, 1884). El Mango (*Bromus mango*) was cultivated. Gay (1865) recorded that it was a biennial crop, grown with peppers and beans. Florets were roasted to facilitate removal of the lemma and palea, and the grains were ground into flour to make bread or a fermented drink called chicha. Cruz (1972) cited an unpublished manuscript by Arturo Fontecilla Larrain, a professor of agronomy at the Catholic University of Santiago in Chile during the early twentieth century, who recorded that plants of el Mango produced 40-50 culms, each bearing an inflorescence with 70-100 grains. It required eighteen months to mature, however, and el Mango was replaced during the last half of the twentieth century by wheat for making flour and by apples to make cider (Brucher, 1979).

Sauwi (*Panicum sonorum*) is native to arid western North America. It formed an important part of the Sonoran desert agriculture of northwestern Mexico (Nabhan and de Wet, 1984). It was widely grown well into the twentieth century by Indian tribes who lived along the Colorado river delta (Gifford, 1931). Today it is grown only in southeastern Sonora and adjacent Chihuahua. Although little known outside this area, sauwi is a promising cereal for the semi-arid tropics of Africa and Asia. It is drought tolerant, and has acceptable yield potential under adverse conditions. Plants produce several tillers, each of which produce an inflorescence with as many as 2,500 fertile florets.

The only New World minor cereal of present-day economic importance is American wild rice. This is not a true rice. It belongs to the genus *Zizania* rather than *Oryza*. American rice is commercially harvested as a wild cereal (Dore, 1969), and since the late 1960's planted on a commercial scale. *Zizania aquatica* is the only grass species successfully domesticated as a cereal in historical times (de Wet and Oelke, 1979). It is grown in paddies as is rice. Paddies are flooded and seeded in late fall. Germination is rapid in spring and the water level is maintained until August when the crop matures. Fields are

then drained and harvested with a modified rice combine. Since the cultigen retains some degree of natural seed dispersal, no subsequent sowing is needed. Spikelets and straw are worked into the wet soil after harvest, where the caryopses lie dormant until the soil thaws in the next spring. Natural populations rarely yield more than 100 kg ha⁻¹, while yields of 1000 kg ha⁻¹ are obtained in planted paddies. Yields of at least 3000 kg ha⁻¹ are possible from fully non-shattering cultivars.

MINOR CEREALS OF AFRICA

At least 60 grass species were extensively harvested in Africa as wild cereals until recent historical times (Busson, 1965, Jardin, 1967). The widely distributed *Brachiaria deflexa* (Schumacher) C. E. Hubbard, *Oryza barthii* A. Chev., and *Paspalum scrobiculatum* L. were extensively collected in West Africa. *Stipagrostis pungens* (Desf.) de Winter, and *Cenchrus biflorus* Roxb. were harvested by nomadic tribes in the Sahara. These species are often still encouraged as weeds in cultivated fields where they are harvested as wild cereals.

In West Africa, *Oryza barthii* Chev. gave rise under domestication to the cultivated *O. glaberrima* Steudel (Porteres, 1976). Tef, *Eragrostis tef* (Succ.) Trotter, is an important cereal in the Ethiopian highlands and was probably derived from *E. pilosa* (L.) P. Beauvois (de Wet, 1977, Costanza, de Wet and Harlan, 1979). The weedy *Brachiaria deflexa* (animal fonio) is cultivated on the Fouta Djallon highlands of the west African savanna (Chevalier, 1933, Porteres, 1951). Animal fonio differs from wild *B. deflexa* only in having spikelets that disarticulate tardily at maturity.

Two other minor cereals are important crops in the west African savanna. Black fonio, *Digitaria iburua* Stapf is grown by the Hausa tribe of Nigeria, and occurs sporadically across most of semi-arid west Africa (Porteres, 1955, Clayton, 1972). It is often planted between rows of sorghum or pearl millet, and commonly as a mixture with *Digitaria exilis* (Kippist) Stapf (true fonio). Black fonio (*D. iburua*) is drought tolerant and often yields a harvest when the major cereal it accompanies fails to survive. True fonio (*D. exilis*) is widely grown across the west African savanna. It differs from *D. iburua* which has both glumes conspicuously shorter than the spikelet, in having the upper glume at least as long as the spikelet. Fonios are sown in west Africa during May or June, and harvested in September. Harvested inflorescences need to be protected from moisture since the grains become agglutinated to the lemma and palea when they get wet. Threshed grains are parched or dried in the sun before the chaff is removed by pounding in a wooden mortar. Fonio is used in stews, or the boiled grains are eaten as rice with butter or palm oil.

The most important minor cereal in Africa is finger millet, *Eleusine coracana* (L.) Gaertner. It was domesticated in Africa, but is also widely grown in south

