Sorghum for Special Uses

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Summary

Sorghum is used for various special purposes such as popping, roasting, chewing, malting, and flavoring. Germplasm accessions known for these uses are presented with their geographical origin and taxonomic status. Germplasm accessions from India (3682) were screened at ICRISAT and 36 lines that exhibited superior popping quality were identified. Empirical selection for sweet stalks among 7000 accessions of the World Collection resulted in the identification of 253 lines for chewing purposes. Landraces preferred for malting, cooking like rice, and Basmati *sorghums for flavoring are indicated.*

Sorghum (*Sorghum bicolor* L. Moench) is used in the semi-arid tropics primarily for human consumption. It is used in the preparation of porridges and both leavened and unleavened bread (Vogel and Graham 1979). In addition, sorghum is used in the preparation of several snacks and for popping, chewing, and malting. Literature on the use of sorghum for special purposes is limited (Ayyangar 1939; Damon 1962; Rachie 1970). At ICRISAT, specific efforts were made to collect germplasm and information on the special uses of sorghum during the collection expeditions in India and African countries and through correspondence with various sorghum scientists. Traditionally, farmers have consciously selected landraces of sorghum for these special purposes. Our surveys have indicated that although these sorghums were still in use, with growing urbanization and changed market demands, the area cultivated with the special-purpose sorghums has dwindled and is restricted to the remote areas.

The objective of this paper is to document and describe the land-races known for various special uses and to present data on those that were investigated in detail.

Popping Sorghums

A broad survey of the geographical distribution of popping sorghums available in the World Collection showed that a majority of them originated in India. Popped sorghum grains are consumed in several states of India by the poor as well as rich as a snack food and as a delicacy. Popping is done by putting small quantities of grain in a hot pan kept over a steady fire. The popped grains are removed immediately after they are formed. Popped sorghum is considered to be superior to popped corn as they are tender, have less hull, do not clog the space between the teeth, and cause less noise when eaten. Besides, the popped sorghum grains have been found to have as much flavor and be as nutritious as popcorn (Subramanian 1956). Popped sorghum grains are used in the preparation of sweet snacks, which are commonly sold in the state of Maharashtra (India). It was reported that popping varieties of sorghum belong to the *Talavirchina* group (*S. roxburghii* var *hians*) characterized by small grain with a dense and corneous endosperm (Ayyangar and Ayyer 1936). *Pelalu jonna* belonging to the Snowden species *S. membranaceum* was considered to be good for popping (Reddy 1957). During our recent germplasm collection trips to the Karnataka and Andhra Pradesh states in India, landraces with names *Allinajola* and *Dholijaki* belonging to durra (*S. membranaceum*) and *Pelalu jonna* and *Allu jonna* belonging to guinea (*S. roxburghii*) were collected as superior popping cultivars. Damon (1962) reported that in Ethiopia, *Fendisha* sorghums were popped like popcorn besides being used for making *injera*.

Since most of the pop sorghums are identified in the Indian subcontinent with various colloquial

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names, it was felt desirable to screen the germplasm originating from India for popping quality. Grain samples chosen for popping studies were drawn from the ICRISAT cold store (regularly maintained at 4° C and 40% RH). They had a moisture content of 9 to 10%. A 10-g sample of the grain without pretreatment was placed on an open steel pan maintained at 300-324° C and stirred briskly. The number of completely puffed grains per sample were recorded after 1½ min and expressed as percent popping. Of 3682 accessions screened, 36 accessions showed 80% or more popping. The identity, physical grain quality characteristics, and taxonomic classification of the superior popping sorghums are presented in Table 1. Most of these exhibited small grain size, white color, medium thick pericarp, a breaking strength of about 7 kg, and a hard corneous endosperm. This conformed with the observations of Doggett (1970). Popping sorghums have a very low germ/endosperm size ratio and the embryo is located at a corner in the hilar region. The germ remains unaffected during popping. The availability of sorghum cultivars whose grains exhibit superior popping quality without any pretreatment should be of significance to food technologists and breeders. Utilization of these popping sorghums in breeding programs aimed at improved popping quality might be rewarding (Murty et al. 1981b).

Roasting or Parching Sorghums

In several parts of Africa and India there is a practice of roasting sorghum heads at the dough stage and eating the threshed grain as a delicacy. The cultivars most suitable for roasting have a sweet endosperm that is dimpled at maturity. *Vani* sorghums (durra group) of India are especially popular in this respect. Rachie (1970) reported that roasting *Vani* type sorghums during the crop season was common in some areas of Gujarat. The whole earheads were harvested at the dough stage and brought to the roasting pits. They were buried in hot coals and ashes for several minutes to be cooked, following which the light green seeds were lightly beaten off the heads and hand winnowed. A similar practice exists in the state of Maharashtra where this snack is called *Hurda*.

The practice of eating sorghum at the dough stage either raw or roasted exists also in Ethiopia and Sudan. Dimpled red grain sorghums *Wotet beguncha* (IS-11758), *Red merchuke* (IS-11167) cultivated in the Wollo province of Ethiopia were stated to be specially suited for this purpose. The other varieties utilized for this purpose are *Bsenga* and *Muyera* (Damon 1962). The two landraces IS-11758 and IS-11167 are also known to be high lysine sources (Rameshwar Singh and Axtell 1973). *Maleek*, a half broomcorn type (IS-22383, durra caudatum), cultivated in the backyards in the Kassala province of Sudan, is used for roasting.

Sweet Stalk Sorghums/Chewing Sorghums

Sorghum landraces possessing sweet stalks are sparsely distributed in the sorghum-growing areas of Africa and India. The green stalks are often chewed in a manner similar to sugarcane, particularly in dryland areas. The grain yield of these sorghums is poor and hence they are grown only as special types in the backyards or in small patches.

A study of the sorghum World Collection maintained at ICRISAT and accessions collected in recent ICRISAT expeditions showed that sweet stalk sorghums exist in collections from Botswana, Cameroun, Chad, Ethiopia, India, Kenya, Malawi, Niger, Nigeria, Somalia, South Africa, Sudan, Thailand, Uganda, USA, Zambia, and Zimbabwe. In Ethiopia, sweet stalk sorghums were used for a confection besides chewing (Damon 1962). *Fendisha*, *Keyila* and *Eja Saa* cultivars possess sweet stalks. *Tinkish* is the common Ethiopian name for sweet stalk sorghums (Mengesha personal communication, 1981).

In Sudan, sweet stalk sorghums are cultivated in patches and are called *Ankolibs*. These belong to the intermediate race durra-bicolor with poor grain quality. *Ankolibs* could be the *Sorghum ankolin* Stapf. described by Snowden, the distribution of which is stated to be North East Africa including Sudan (Snowden 1935). Stems are very sweet and farmers chew them like sugarcane.

In Malawi, sweet stalk sorghums are grown in maize fields or in the backyards. These are locally called *Misale* in the southern region and *Njiho* in the northern region. These are mostly grown for domestic consumption but at times they are sold in the market (Appa Rao 1979). In Zambia, different landraces are grown for chewing purpose. These are known as *Kamutu halli* (Chama area) and *Misale* (Petanke area) (Appa Rao 1980). In

Table 1. Grain quality characters and taxonomic distribution of selected popping sorghums from India.

Genotype	Origin[a]	Classification[b]	Grain			
			Corneousness[c]	Weight (g 100 grain)	Breaking strength (kg)	Popping (%)
White grain types						
IS-1192	A.P.	G(R)	1	2.77	7.9	80
IS-1199	T.N.	G(R)	1	2.11	8.5	80
IS-2205	U.P.	D(M)	3	2.38	5.6	80
IS-4596	Mah.	G(R)	1	1.66	6.6	82
IS-4939	Mah.	D	2	3.02	7.4	82
IS-5111	A.P.	G(R)	1	1.87	8.2	91
IS-5112	A.P.	G(R)	1	1.80	5.2	87
IS-5113	A.P.	G(R)	1	1.75	6.4	87
IS-5115	A.P.	G(R)	2	1.49	5.5	87
IS-5116	A.P.	G(R)	2	1.96	7.4	87
IS-5285	A.P.	D(M)	2	2.25	6.1	91
IS-5418	T.N.	G(R)	1	1.89	6.9	85
[illegible]-5484	Kar.	D	2	2.37	6.0	82
[illegible]-5566	Kar.	D(M)	3	2.43	6.1	90
IS-5604	Kar	D(M)	2	2.46	5.6	98
IS-5638	Kar.	D(M)	2	2.19	6.9	97
IS-5648	Kar.	D	3	2.27	5.3	85
IS-5653	Kar.	D(M)	2	2.38	7.5	96
IS-5655	Kar.	D	2	2.40	5.8	96
IS-5665	Kar.	D	3	2.51	.0	90
IS-5726	Bihar	G(R)	1	1.36	7.1	85
IS-5732	Bihar	G(R)	1	1.71	7.5	82
IS-5741	Bihar	G(R)	1	1.72	8.7	90
IS-5849	M.P.	G(R)	1	1.74	7.9	86
IS-5910	M.P.	G(R)	1	1.99	8.2	82
IS-6243	W.B.	G(R)	1	1.80	6.3	80
IS-6248	W.B.	G(R)	2	2.63	8.6	92
IS-17903	A.P.	G(R)	1	2.01	6.1	80
IS-18363	Mah.	D	2	3.08	7.3	80
IS-18488	A.P.	D	2	3.31	8.5	82
Red grain types						
IS-2185	Mah.	D	3	2.63	7.6	92
IS-4803	Guj.	D	3	2.97	7.0	90
IS-5646	Kar.	D	3	2.27	4.2	94
[illegible]S-5651	Kar.	D	2	2.80	7.0	96
[illegible]S-8347	Mah.	G(R)	1	2.47	7.8	88
IS-17860	A.P.	G(R)	2	2.17	6.4	85

a. A.P. = Andhra Pradesh; T.N. = Tamil Nadu; U.P. = Uttar Pradesh; Mah. = Maharashtra; Kar. = Karnataka; M.P. = Madhya Pradesh; W.B. = West Bengal; Guj. = Gujarat

b. G(R) = Guinea (*S. roxburghii*); D = Durra; D(M) = Durra (*S. membranaceum*)

c. 1 = Completely corneous; 2 = Corneous; 3 = Partly corneous

Zimbabwe, a variety known as *Iowa* is grown for chewing and sweet stalks are commonly sold in the market.

In Nigeria, the *Takanda* group of sorghums is sweet stemmed and are chewed like sugarcane. They are quite distinct from the popular guinea race and can be distinguished by their persistent pedicelled spikelets. The grains are small, brown or grey, with a brown testa, and are less exposed. *Takanda* flowers before the main crop and is thus maintained as a distinct variety. The *Takanda* variety of sorghum is not confined to any particular zone (Curtis 1967).

Most of the sorghums grown in India are found to be dual-purpose varieties providing grain for human consumption and fodder for livestock. Sweet stalk sorghums are planted sparsely mixed with cultivated sorghums. In a recent collection expedition to the Karnataka state of India one cultivar, *Kareguni* (IS-22122), was collected that possessed sweet stems and desirable agronomic characteristics (Prasada Rao and Gopal Reddy 1980). Although the sweet stalk sorghums are used in the traditional sorghum-growing areas for chewing or for confectionary purposes, their importance is increasing because of their potential use in the production of sugar, syrup, and alcohol. In view of their growing importance in the developed and developing countries, a part of the sorghum germplasm (about 7000 accessions) was tested for stalk sweetness by chewing a stem sample. About 250 lines were identified as very sweet. The geographic and taxonomic distribution of these lines are presented in Table 2. It was observed that more than half of the lines belonged to the race caudatum followed by those of durra and are mainly from the Sudan, Cameroun, Ethiopia, USA, and India. Studies on the techniques of evaluating sweetness are under way in collaboration with physiologists and biochemists and it would be useful to rescreen the gemplasm through rapid objective tests.

Sorghums for Cooking Like Rice

The boiling of dried sorghum grain with water is practiced in several parts of the semi-arid world. There is a special type of sorghum variety called *Kyaram* in West Africa that is usually cooked like rice. This variety belongs to the race guinea and subrace margaritiferum (de Wet et al. 1972). *Kyaram* is distinguished from other guinea sorghums by its very small flinty grains. The grain is either freely exposed at maturity or it remains cupped in the lower glume. In both cases the seed is readily shed at harvest. de wet et al. (1972) opined that margaritiferum (IS-7818) with its small white flinty grain seemed to have originated in the West African forests as a selection for cooking in the same way as rice, a cereal commonly grown in the forest. There are some World Collection accessions belonging to margaritiferum from Japan (IS-8064) and Sri Lanka (IS-19467). In the Abobo area of Ethiopia, another special type of preparation was found to be made by boiling green sorghum grain with water and salt (Prasada Rao and Mengesha 1981).

Malting Sorghums for Nonalcoholic Drinks

It is widely known that most of the red and brown grained sorghums of Africa are used for the preparation of a variety of alcoholic drinks. Novellie (1981a,b) reviewed the information available on fermented sorghum porridges and beverages. Nonalcoholic porridges of sorghum are made by souring the grain overnight and cooking it in the morning. Such preparations are diluted and consumed as a thin gruel (Novellie 1976). In the highlands of southern Uganda extending into Rwanda, there is a practice of malting the dark brown sorghums for preparation of *Obushera*, a thin porridge, in addition to the usual practice of making *ugali*. The dark brown sorghum grain, which has a bitter taste due to tannins, is germinated in a mixture of wood ash and water. After sprouting, the grain is sun dried, pounded to remove the sprouted radicals, and then ground. The flour is mixed with water and kept overnight to obtain a delicious drink, which is not intoxicating (S. Z. Mukuru personal communication, 1981). By malting and treating with wood ash the grain is less bitter and forms a delicious drink fit to be consumed by children.

Scented Sorghums

The existence of sorghums with a special aroma or scent was reported as early as 1919 (Kottur 1919). *Ambemohor*, a rainy season variety of the Maharashtra state (India) ripening in 4.5 months was reported to contain a special flavor like

Table 2. Geographic and taxonomic distribution of sweet stalk sorghums (identified from 7000 accessions of the World Collection).

	Basic races[a]					Intermediate races[b]										
Country	B	G	C	K	D	BG	BC	BK	BD	GC	GK	GD	CK	CD	KD	Total
Cameroun	-	-	33	-	5	-	1	-	-	-	-	-	-	3	-	42
Chad	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Ethiopia	-	1	10	-	12	-	-	-	1	1	-	-	-	-	-	25
India	-	-	1	-	10	-	-	-	1	-	-	-	-	1	1	14
Kenya	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
Nigeria	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	2
Niger	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Somalia	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
South Africa	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
Sudan	4	-	107	-	7	-	1	-	-	10	-	-	5	1	-	135
Thailand	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Uganda	-	-	3	-	-	-	1	-	1	1	-	-	1	-	-	7
USA	-	1	6	1	3	-	1	-	-	-	-	-	5	-	-	17
Zimbabwe	-	-	3	-	1	-	-	-	-	-	-	-	1	-	-	5
Total	4	2	167	1	39	-	6	-	3	12	-	-	13	5	1	253

a. B = Bicolor; G = Guinea; C = Caudatum; K = Kafir; D = Durra

b. BG = Bicolor-guinea; BC = Bicolor-caudatum; BK = Bicolor-kafir; BD = Bicolor-durra; GC = Guinea-caudatum

c. GK = Guinea-kafir; GD = Guinea-durra; CK = Caudatum-kafir; CD = Caudatum-durra; KD = Kafir-durra

Ambemohor rice (*Ambemohor* = mango inflorescence). This variety was specially cultivated by the farmers as a delicacy. A variety of sorghum from Tanzania named *Kinungapembo* belonging to *S. conspicuum* var *conspicuum* Snowden has been reported by Ayyangar (1939) to have scented grains. The scent was somewhat similar to scented rice. Seedlings were stated to emit scent and also the adult leaves when crumpled. Unfortunately, both of these scented sorghums are not available in the World Collection. Neither do they seem to exist in the place of their origin.

In a recent ICRISAT germplasm collection trip to the remote hilly areas of Central India, head and seed samples of three sorghum landraces, IS-19907 (KEP-472), IS-19910 (KEP-475), and IS-19912 (KEP-477), with the local name *Basmati* were collected in the Karri and Sarwa villages of Chattarpur District (25° N, 79° E, altitude 300 m). These samples belong to the race durra and had white seeds with a floury endosperm (Prasada Rao and Murty 1979). The grains and the crumpled leaves emitted a mild scent typical of *Basmati* rice. The stiff porridge (*sankati*) made from the *Basmati* grain was distinctly scented. The simple KOH technique devised originally for the scented rice was used on sorghum to detect the scent released (Prasada Rao and Murty 1979). A distinct and strong aroma was noticeable a few minutes after adding KOH to the *Basmati* samples. In crosses with nonscented varieties, the scented grain character proved to be a monogenic recessive (Murty et al. 1981a).

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