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Folk classification of sorghum landraces and its ethnobotanical implication: a case study in north-eastern Ethiopia

S. Benor[1], L. Sisay[2]

[1]Department of Plant Sciences, College of Agriculture, Debub University, P.O. Box 5, Awassa, Ethiopia; [2]Institute of Biodiversity Conservation and Research, Collection and Exploration Division, P.O. Box 30726, Addis Ababa, Ethiopia.
solomonbenor@yahoo.com

Abstract. Ethiopia is one of the centers of origin and diversity for a number of crop species, among which sorghum has a wide range of distribution in the country. Farmers' knowledge about sorghum crop, such as types, names, uses, cropping systems, cultivation methods, and so on, has been handed down intergenerationally, primarily through oral tradition. A sorghum landrace collection was conducted in Ethiopia to document farmers' indigenous knowledge, take conservation measures, and incorporate potential landraces into future breeding programs. The collection strategy incluted farmers and their rich indigenous knowledge and experience into the collection team. Farmers refer to discrete sorghum types by different names, which vary for several characters. The wealth of genetic diversity in the explored area consisted of drought-tolerant, striga-tolerant, and bird-resistant species. Pot and field experiments were conducted to corroborate the indigenous knowledge of such tolerance. We recommend that the pest-tolerant landraces confirmed by these experiments be incorporated into breeding programs.

Key words: Collection, Genetic diversity, Landraces, Local name, Sorghum

Resumen. Etiopía es uno de los centros de origen y diversidad de diferentes especies de interés agrícola, entre los que se encuentra el sorgo, con una amplia distribución por el país. Los conocimientos de los agricultores acerca de nombres, variedades, usos, métodos de cultivo y cosecha de dicha planta han sido transmitidos de generación en generación de manera oral. Una misón de colecta de variedades agrícolas del sorgo fue realizada en el noreste del país, teniendo como objetivos principales la documentación del conocimiento de los agricultores, los cuales tomaron parte en el equipo de catalogación aportando su conocimiento y experiencia. Los agricultores llaman a las diferentes variedades por nombres diferentes que varían en varios caracteres. La abundancia de diversidad genética en el área estudiada abarca resistencias a la sequía, y tolerancia a striga y a la avifauna. Para confirmar tales resistencias, experimentos en macetas y en campo han sido realizados. El resultado de tales experimentos ha demostrado que tales variedades son resistentes a plagas, y por lo tanto podrían incorporarse a programas de mejora.

Palabras clave: Colección, Diversidad genética, Nombre local, Sorgo

Introduction

A number of crops have originated, or have been domesticated, in Africa, including sorghum, pearl and finger millets, coffee, cow pea, African rice, *Digitaria* spp., sesame, castor, oil palm, yam, and others (Simmonds 1979; Anishetty & Perret 1981; Mooney 1983; Paroda & Arora 1991). The continent also is a center of crop diversity, including durum wheat and barley. Ethiopia is the diversity center for 11 crops (Zohary 1970) and some 38 species are connected with Ethiopia as a primary or secondary gene center (Vavilov 1951). Vavilov and other scientists identify Ethiopia as the established center of origin and diversity for sorghum, coffee, durum wheat, barley, castor, teff, sesame, mustard and chat.

The greatest variability of the wild and cultivated sorghum crops occurs in the northeast quadrants of Africa, especially in the Ethiopian and Sudanese parts of East Africa (Dogget 1965). Thus, Ethiopia has a wealth of crop genetic diversity in both cultivated and wild forms. This immense wealth is the result of the rugged terrain, wide range of agro-climatic conditions, broad diversity of ecological habitats, and primarily a consequence of agricultural populations interacting with the crop plants in those habitats. The wide range of environmental conditions under which sorghum is growing in Ethiopia has given rise to a tremendous range of genetic variability in the country (BERHANE 1981). Ethiopian sorghum germplasms have contributed a great deal to identifying resistant lines in the World Sorghum Improvement Program. For example, SCO 326, derived from IS 3758, is resistant to zonate leaf spot, rust, sooty stripe, and leaf blight. Among the pests, midge has been a major problem, but SCO 175, derived from IS 1266 ex Ethiopia, is providing a good source of resistance. In addition, a number of midge-resistant lines exist, primarily those derived from Zera Zeras of the Ethiopia-Sudan region: SC 052, SC 063, SC 239, SC 319, SC 414, and SC 574 (DOGGET 1968).

In Wollo Region, sorghum (*Sorghum bicolor* (L.) Moench) is the first stable food crop in terms of area coverage and production (MENGESHA 1975). According to Agricultural Sampling Survey estimates for the 1997/98 cropping season (CSA 1998), using total area cultivated as the reference point, sorghum is the number one crop in Wag-Himra and Oromia, number two in South Wollo, and number three in North Wollo. Sorghum lines IS 11758 and IS 11167 identified from Wollo region are highly prized throughout the world for high lysine content (HOUSE 1985). Farmers' knowledge about sorghum crop, such as types, names, uses, cropping systems, cultivation methods, and so on, has been handed down intergenerationally, primarily through oral tradition (BENOR & SISAY 1999).

A number of general collecting missions have been undertaken throughout Africa, but the fast-changing environment (e.g., due to global warming, habitat destruction, and drought) will necessitate more rescue missions for wild and weedy types as well as domesticated races (HOUSE 1985; MOSS 1990). The broad range of genetic diversity that exists in Ethiopia, particularly in primitive and wild gene pools, is currently subject to serious genetic erosion and irreversible losses (WOREDE 1991). Many attempts have been made to characterise threats to plant diversity in wild and cultivated populations, among which MUCHIRU (1985) and PUTTER (1994) identifies habitat loss, overexploitation, introduced species, indirect effects, and,

Table 1 - Selected landraces with promising characteristics collected from Wollo region.

Collection No.*	Vernacular name	Ear compactness	Grain color	Special use/Remark
SSGM022	*Kindibe-Tikur Cherekit*	Semi-compact	White	Striga-tolerant
SSGM037	*Minchiro*	Loose	Reddish-brown	Striga-tolerant
SSGM132	*Woitezera*	-	White	Striga-tolerant
SSGM131	*Alaila*	-	White	Striga-tolerant
SSGM050	*Kindibe-Nech Cherekit*	Semi-compact	White	Striga-tolerant
SSGM063	*Mera*	Semi-compact	White	Striga-tolerant
SSGM033	*Mog-Ayfere*	Compact	Red	Striga-tolerant
SSGM019	*Ahyo*	Very compact	Reddish-brown	Striga-tolerant and bird-resistant
SSGM031	*Wof-Aybelash*	compact	Dark-red	Bird-resistant
SSGM001	*Abula-Gorad*	Very compact	White	Drought-tolerant/General purpose
SSGM051	*Rejimu Nech-Jamoye*	Semi-loose	White	Drought-tolerant/General purpose
SSGM028	*Key-Ganseber*	Compact	Reddish brown	Highly preferred for local beer
SSGM046	*Shilime*	Compact	Red & white	Red and white colors in same panicle
SSGM003	*Chibte-Watigela*	Compact	Red	Many nodal tillers
SSGM057	*Gogobsa-Tinkish*	Semi-compact	Red	Many nodal tillers
SSGM107	*Enkoylel-Zengada*	Semi-compact	Red	Large head size, high land sorghum
SSGM039	*Key-Marchuke*	Semi-compact	Red	Subject to genetic erosion
SSGM054	*Wotet-Begunche*	Semi-compact	White	Milky taste, subject to genetic erosion
SSGM092	*Hawaye*	Semi-compact	Yellow	Sweet-stalk/in a state of genetic erosion
SSGM078	*Yejib-Murt*	Semi-compact	Reddish brown	Sweet-stalk/in a state of genetic erosion
SSGM011	*Tikur-Kilo*	Very loose drooping panicles	Black	Wild type/used as animal feed
SSGM017	*Gubete*	Semi-compact	Brown	Highly needed for roasting purpose
SSGM053	*Key-Jiru*	Compact	Yellow	High-yielding
SSGM096	*Keyo-Amarica*	Compact	Yellow	Early maturing type
SSGM038	*Mar-Beshenbeko*	Loose	Reddish brown	Sweet-stalk
SSGM036	*Necho-Yegenfo-Ehil*	Compact	White	Highly needed for porridge purpose
SSGM058	*Yikir-Mindaye*	Very loose	Red	Roasting purpose
SSGM024	*Enat-Gorad*	Very compact	White	High yielding

* Letters correspond to initials of collectors' names (Solomon, Samson, Getachew, Mekonnen).

Fig. 1 - Map of the study area

as a discrete factor, agricultural development.

The objectives of this paper are, therefore, to report on farmer's indigenous knowledge on the use and classification of sorghum and to assess the extent of genetic erosion in the study area.

Materials and Methods

Collections were made during the 1998 and 1999 cropping seasons in collaboration with Sirinka Agricultural Research Center and the Ethiopian Institute of Bio-Diversity Conservation and Research. While collecting, information about the samples was gathered using the standard collection data format Performa developed by the International Board for Plant Genetic Resources and the International Crop Research Institute for the Semi-Arid Tropics (Ibpgr & Icrisat 1993). Each sample has a unique collection form on which are recorded a collection number, first initial of the collector's name, vernacular name, date of collection, description of site and crop sample, and other observations (Table 1). Soils were sampled at each collection site and pH values were determined using a field pH meter. Cloth bags were employed to collect sorghum fruiting heads, to allow free circulation of air.

Farmers included in the collection teams imparted their own indigenous knowledge. Checklists were prepared to record information on sorghum germplasms and their threat to genetic erosion. The model developed by Goodrich (1987) was used to estimate the threat of genetic erosion that a particular taxon (wild or cultivated) faces in a defined area. The model is based on scoring a variety of factors (biological, environmental, and socioeconomic) and summing the factors.

Table 2 - Sorghum collection undertaken by Sirinka Agricultural Research Center and the Institute of Bio-Diversity Conservation and Research, 1998.

Area explored	Major landraces	No. of samples collected
South Wollo	Tengele, Gorad, Cherekit, Jamyo, Ahyo	78
North Wollo	Jigurti, Degalit, Jamyo	12
Wag Himra	Quancha, Amsale, Aliqua	8
Oromia	Cherekit, Ahyo, Kilo, Minchiro, Mera, Jigurti, Mog-Ayfere	10

Results and Discussion

The collection covered areas of altitude ranging from 1420 m (Oromia zone) to 2400 m (Wag-Himra zone) above sea level (Figs. 1 and 2). Latitude and longitude values ranged from 100 21' 09 N (Oromia zone) to 120 30' 42 N (Wag-Himra zone) and 380 55' 73 E (North-Wollo) to 400 00' 96 E (Oromia zone), respectively. The soil pH ranged from 5 to 8.

Farmers who participated as identifiers imparted their own rich local knowledge and experience and in this way assisted the team in discerning one farmer's variety from the others. Further, the farmers identified samples that had different names but were types already collected. The average landrace types collected from areas other than Fontenina were three, but in Fontenina (South-Wollo) the team was able to collect more than 65 landraces from two farmers' fields (Table 2). In Fontenina, Hara, and surrounding locales farmers grew mixtures of different morphological types of sorghum in the same field. Considerable variations were found for plant height (more than 4 m in the case of *Key Rejimu Minchiro*), panicle length (ranging from very small in *Chibte* to very large in *Jamoye* and *Enkoylel-Zengada*), and ear compactness (ranging from very loose in *Kilo* and *Minchiro*

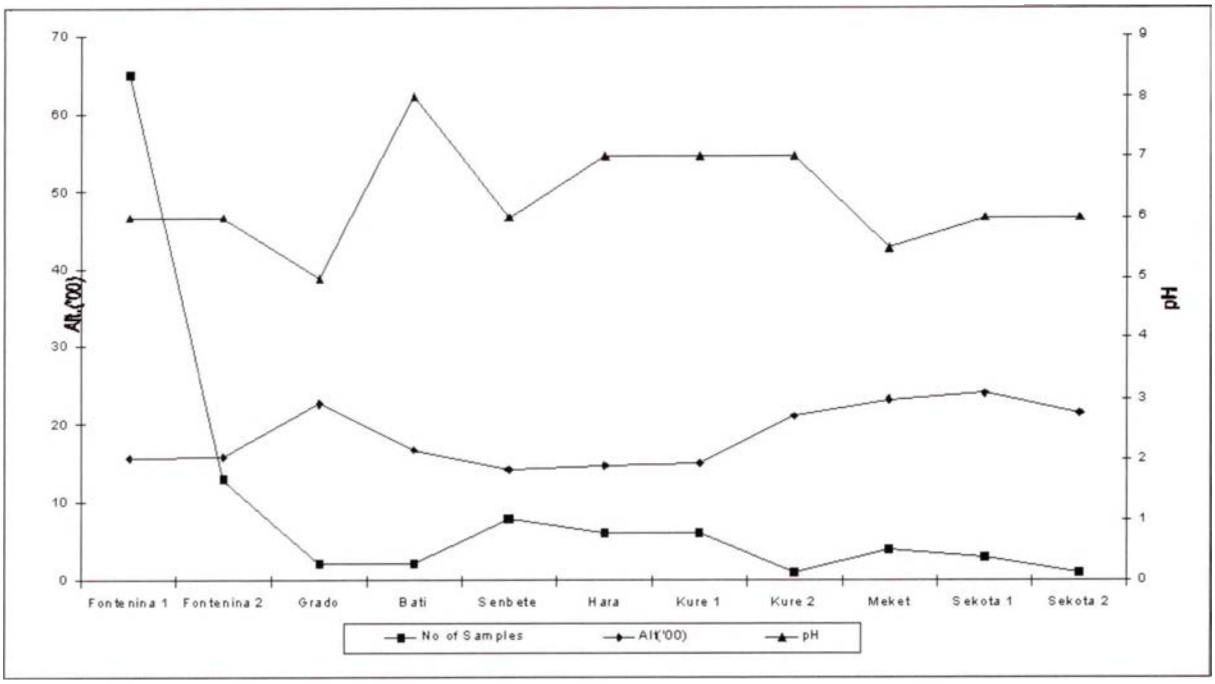

Fig. 2 - Number of sorghum populations collected with their respective location, altitude and pH.

to very compact in *Chibte*, *Gorad*, and *Tengele*). The grain color varied from white to brown, red, black, and yellow (Table 1). Surprisingly, one landrace, Shilime, contained both red and white colors in a single panicle, and in a single seed. Farmers suggested that this was a result of cross between Gorad and Wogere, which have white and red colors respectively. Further investigation will be

Table 3 - Comparison of striga-tolerant sorghum collected landraces with improved commercial varieties.

Identification	Plant Ht. (cm)		Striga count	Oven dry sorghum shoot biomass (g)	
	TD*	UT**	SQUARE ROOT	TD*	UT**
Kindibe-Tikur-Cherekit	86	105	3.91	63	67
Mogn-Ayfere	104	140	4.06	61	93
Minchiro	55	91	4.44	39	58
Kindibe-Nech-Cherekit	100	102	4.11	66	64
Mera	69	87	4.25	46	60
Ayfere-Delanta	126	164	4.04	71	88
Ayfere-Asfachew	2	108	2.74	75	71
P-9401[1]	72	74	1.05	48	43
P-9403[1]	81	46	2.26	35	49
SRN-39[1]	74	69	1.52	41	64
Wotere	27	76	2.66	81	93
Merar	55	46	5.24	38	51
Jigurti[2]	48	55	4.93	56	65
Degalit[2]	66	94	5.24	52	76
Key # 8574[3]	51	76	6.41	23	45
Mean	68	89	4.05	53	66
LSD 5%	41	75	2.97	30	27
CV	48	51	6.43	45	25

*TD: treated with striga; **UT: untreated with striga; [1] released commercial varieties; [2] local check; [3] susceptible check; others from collection.

Table 4 - Causes for genetic erosion of sorghum landraces in Wollo region.

Vernacular name	Zone	Causes for genetic erosion	Growing period
Aliqua	Waghimra	Drought, stalk borer	April-December
Shiula	Waghimra	Drought, striga	April-December
Waliya	Waghimra	Drought, stalk borer	May-December
Minaba	Waghimra	Drought, stalk borer	March-December
Awunawuna	Waghimra	Drought, stalk borer	May-December
Kuchbiye	Waghimra	Drought/lack of rain in *belg**	June-November
Wondaybelash	Waghimra	Stalk borer	June-December
Debala	Waghimra	Drought, stalk borer	June-December
Zengada	In both zones	Drought/lack of rain in *belg*	March-December
Chirqua	Waghimra	Drought/lack of rain in *belg*	April-December
Witezera	Waghimra	Drought/lack of rain in *belg*	May-December
Degalit	In both zones	Drought/lack of rain in *belg*	April-December
Alaila	Waghimra	Drought/lack of rain in *belg*	June-December
Yikirdemewoze	Waghimra	Drought/lack of rain in *belg*	March-December
Fechifecha	Waghimra	Drought/lack of rain in *belg*	March-December
Key marchuke	South & North Wollo	Man made	May-December
Wotet Begunche	South Wollo	Man made	May-December
Degalit	In both zones	Drought/lack of rain in *belg*	April-December
Hawaye	North Wollo	Drought/ stalk borer	May-December
Yejibmurt	South Wollo	Man made, stalk borer	May-November
Kolobo	North Wollo (Gobye)	Drought/lack of rain in *belg*	May-November

* A rain shower season in dry months of Ethiopia.

important to establish how such seed colors are transmitted from generation to generation.

The result of this collections mission indicated that Fontenina (South-Wollo) and Hara (North-Wollo) and their surrounding areas are the sorghum belts where the most genetic diversity for sorghum is found (Fig. 2). Variations for morphological characters were more apparent as well in Fontenina (South Wollo) and Hara (North Wollo). Farmers identify different sorghum types by different names, which vary for several characters (Table 1). Most of the names for each landrace indicate its unique characteristics. For instance, the name *Chibite* designates a sorghum with a compact head; *Wotet-Begunche* indicates seeds with milky taste; *Ahyo* designates tolerance to bird and striga (a parasitic weed of sorghum and maize); *Cherekit* indicates white seed color; *Minchiro* designates loose, drooping panicles; *Wof-Aybelash* connotes bird-resistant; *Marchuke* and *Mar-Beshenbeko* mean full of honey; *Ayfere* refers to striga-resistance; *Shilme* connotes a fruiting head that contains seeds of different colors; *Gubete* invokes the softness of the roasted seed. The observation of reddish brown and dark red accessions of *Ahyo* and *Wof-Aybelash*, in which not a single grain was damaged by birds, is consistent with the view of IBPGR (1987) that reddish-brown and dark red grained sorghums are bird-resistant because of tannins in the sub-coat. Farmer's varieties that are believed to be striga-tolerant were evaluated through an experimental pot methodology in 1999 (Table 3), and the results indicated the striga-tolerance value of few sorghum landraces is close to that of the standard released varieties (BAYU *et al.* 2001).

In most parts of Fontenina and Hara, sweet-stalk sorghums were grown for chewing, much like sugar cane, and also were marketed near urban areas. More than 23 types of sweet-stalk accessions were collected during this mission. Several striga-tolerant sorghums were collected as well, e.g., *Mera*, *Mogn-Ayfere*, *Ahyo*, *Minchiro*, *Kindibe-Tikur Cherekit*, and *Kindibe-Nech Cherekit*.

Among the collected farmers' varieties those which are severely threatened by genetic erosion are *Marchuke*, *Wotet-Begunche* (due to roasting at soft and hard dough stages), and many of the sweet-stalk sorghums, such as *Zergataw-Watigela*, *Amelse-Tinkish*, *Necho-Tinkish*, *Tuba-Tinkish*, *Mali-Tinkish*, *Jofa-Tinkish*, *Sererge-Tinkish* (Tables 4-7). Results of the farmers' interviews indicated that these varieties are becoming very scarce in the collection area.

Table 5 - Assessment of sorghum landraces of Wollo Region for genetic erosion using GOODRICH (1987) Model.

Factor	Standard score	Survey score
Taxon distribution (For sorghum landraces listed in Table 4)		10
Rare	10	10
Locally common	5	
Wide spread/abundant	0	
Drought		
Known to have occurred in 2 or more consecutive years	10	10
Occurring on average 1 or more times every 10 years	5	
Occurring less than once every 10 years		0
Flooding		
Area known to be very flood prone	10	10
Area not known to be flood prone	0	
Area under the crop		
Decline rapidly	10	10
Increasing or static	0	
Modern cultivar of the crop		
Available and used by >70% of the farmers	15	
Available and used by 50-70% of the farmers	10	
Available and used by < 50% of the farmers	5	
Not yet available, but introduction planned	2	
Not yet available	0	0
Mechanization		
Tractors used by >30% of the farmers	10	
Animal traction used by >50% of the farmer	5	
Manual labor used by >50% of the farmer	0	0
Distance to major road		
<10 km	10	
10-30 km	5	
>30 km	0	0
Extent use of the target species		
Industrial exploitation	15	
Exploitation by surrounding farmers	10	
Local exploitation	5	5
Protected or not used	0	
Distance to major population center		
<20 km	10	
10-30 km	5	
>30 km	0	0
Extent of wild habitat within the study area		
Very restricted (<5%)	15	15
Restricted (5-15%)	10	
15-50%	5	
Extensive (>50%)	0	

CONCLUSION

The objective of the collection program described here has been to cover the major sorghum growing areas of Wollo. One hundred eight sorghum accessions were collected. A wide diversity of sorghum in Wollo has been located to Fontenina (South-Wollo) from 100 58' 33 N latitude to 390 46' 20 E longitude, and from 1420 m to 1580 m elevation above sea level, at pH value of 6.0.

Sorghums indicated by local farmers' knowledge to be bird-, striga-, and drought-resistant/tolerant will be tested in the breeding program. Farmers' varieties with higher yields and pest-resistance shall also be included in variety trials through a landrace improvement program. It should be emphasized that re-collection exercises are necessary for farmers' varieties in Ethiopia where genetic erosion is common, primarily due to natural disasters. This would prevent loss of such potentially useful genetic resources. More targeted collections and re-collection also can help to prevent or disturb the process of evolution, which could be a long-term problem for plant genetic resources stored in gene banks. For the sake of future generations, we must collect and study the wild and weedy relatives of our cultivated plants as well as the domesticated races.

Table 6 - Distribution of households by main causes of crop failures in the Amhara region*

Causes	Response	
	No. HHS	%
Uneven distribution of rainfall/drought	821	43.7
Locust	62	3.3
Army worms	86	4.6
Hail storm	143	7.6
Heavy rain fall	208	11.1
Frost	67	3.6
Weeds	53	2.8
Decline in soil fertility	206	11
Others	231	100
Total	**1877**	**100**

*Source: Sustainable Agriculture and Environmental Rehabilitation Program (SAERP 1996)

Table 7 - Distribution of households by major drought/famine occurrence observed*

Occurrence observed	No. of HHS	%
Once	282	16.3
Twice	697	40.2
More than two times	754	43.5

*Source: Sustainable Agriculture and Environmental Rehabilitation Program (SAERP 1996)

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