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CHAPTER 4

MAIZE

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Introduction

Maize, also called corn in the United States of America, is a monoecious plant which bears the male organs, the stamens and the female organs, the pistil, in separate flowers on the same plant. The endosperm is the food storage organ and is soft and mealy in flouring types, hard in flint types and harder in popcorns. Maize is the most efficient plant for capturing the energy of the sun and converting it to food. Maize therefore provides a major source of calories in Nigeria as well as other parts of the world.

Global maize utilization in 1996 totaled 579 million tonnes with 387 million tonnes used for animal feed. Use of maize for direct human consumption has remained stable at about 100 million tonnes per

CHAPTER 9

FONIO MILLET (*Acha*)

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Introduction

Acha (fonio millet, *Digitaria exilis* stop) is a small grain cereal crop grown mostly in the rocky areas of the Savanna in West Africa. A member of the grass family, *graminae*, it is an annual crop that grows to about 150 cm in height and produces numerous seeds generally cream in colour. Acha is the common house name in most parts of Northern Nigeria. It is called hungry rice is most West Africa countries (Dogget, 1986), this might be due to it's feeling, the gap between last available major cereal like sorghum, maize or millet had been exhausted and the first harvested crop of the acha.

In Nigeria acha is grown in the southern parts of Kaduna state, Bauchi, Plateau, Kebbi and Niger States. It is usually sown in April, May, June and even July depending on the maturity period of the variety. (Table 9.1)

It matures been 70 to 120 days. The total land area grown to "Acha" is about 15,000 hectares. Up to 3% of

the farm land is sometimes devoted to "Acha" in the major growing areas (Ndoye and Nwasike, 1991). Yields vary from 600 - 800 kg ha^{-1} to cover 1000 kg ha^{-1} on favorable soils, while on poor soils, yields may be reduced to about 150 - 200 kg ha^{-1} (Purseglove, 1975).

Breeding.

Not much work has been done in terms of the genetic improvement of "*Acha*" in Nigeria. The use of exotic germplasm to increase genetic variability and possible heterosis has increased the knowledge of all plant characters in sorghum (Lukhele, 1981). Several workers have reported the variability present in various plant traits. Different researchers in different places have shown that genetic variability exists in finger millet (*Elensine coracana*) a closed relative of fonio millet (Prasad and Sundaresan, 1989) and also in sorghum (*Sorghum bicolar* Kambal, 1962; Kambal and Webster, 1965). Not many studies have been done on the variation that exist on "*Acha*" cultivars, even though its cultivation has been long. Different types of fonio millets exist. For example the weedy, *Bracharia deflexa* (animal fonio) is cultivated on the Fouta-Djalon high lands of West African savanna (Chevalian, 1933; Porters, 1951). It differs from the wild *Brachiaria deflexa* only in having spikelets, which are disarticulate tardily at maturity. Another type is Black fonio, *Digitaria ibura* is grown by the hausa tribe of Nigeria and occurs sporadically across most of semi-arid west Africa (Porteres, 1955; Clayton, 1972) often planted between rows of sorghum or pearl millet, the black fonio, *Digitaria ibura* is drought tolerant and often produces a harvest where other major cereals it accompanies fail to survive. True fonio, *Digitaria exiles* on the other hand is widely grown across the west African savanna, differing from *Digitaria ibura* which has both glumes conspicuously shorter than the spikelets.

A survey of fonio millet growing areas was carried out in year 2001 the table below 9.1 is showing the most important areas of production in four states in Northern Nigeian.

Agronomy

"Acha" *Digitaria exilis* is known to have great adaptability for dry soils and it is this condition that has necessitated in cultivation is the semi-arid tropics, usually under extremely harsh environmental condition. It is cultivated in areas of marginal and erratic rainfall with a short growing period. The plant has to withstand high air and soil temperatures, sand storm, high intensity rains and does tolerate poor soils with low level of fertility (FAO, 1990). In most of the areas where it is grown, most or all of the farmers indicate that they do not apply any fertilizer to the crop. Because of its adaptability to rocky areas it is assumed that the soils are alluvial in nature with some mineral nutrients available. Like the gero millet, it can survive in areas with 300 mm and even below a seasonal rainfall due to it's strong and deep roofing system an efficient utilization of available moisture. Also it can grow on light, well-drained soils that are poor in organic matter.

The seeds are usually broadcast on either a freshly

prepared flat land or on ridges at a seed rate of between 45 - 55kg ha^{-1} (Audu, 1993). Weeding is done at least twice in the season. Weeds are carefully hands pulled to avoid destroying the young seedlings that may be mistaken for weeds. This is quite laborious and requires patience in order to be able to carry out the task. The weedier must be conversant with the morphology of the young seedling in order to do a good job. No fertilizer is applied.

Harvesting

Fonio millet (Acha) is a low crop and can easily be harvested using a sickle to cut it down into bundles. This is the common way of harvesting it, but in Tafawa Balewa in Bauchi state, the seed is scrape into a calabash leaving the plant standing. When one sees a field that has been harvested that way you 'll. not know that there is no seed in the panicle (head) except you go near to it, you then find out that the panicles are empty. Bundles of acha crop are place on the surface of rocky or cemented floors or tarpaulin or dry ground then beaten with sticks to remove the seeds. The hay from the plants is carefully shaken and removes. The seeds are then winnowed to remove the chaff and stones and the seeds collected into a basin or big calabash.

Table 9.1 Fonio millet producing areas in Kaduna, Plateau, Bauchi and Kebbi.

State	Location	Local name	Comments
1st October. 1997 PLATEAU	Bukuru		Striga haemontheca infesting a fonio millet field. Read type/var. Early maturing.
1.	"		Phyloidy observed in one field, stem borer attack on the var.
1 (55)	Kuru Janta Kanyam Chinkus	Kuru Janta Kanyam Chinkus Chinye Chungum Chinkop Daddama	Head smut observed - White Early - White medium - Black medium - White late - White late - White, high yielding medium maturing.
	Rahol	Boot	White, planted in fadama, ratooned high yielding
		Garugyand	White, small seeded
		Nding	White, small seed
1	Rokwat	Chum	White. serious head smut, planted in fadama, it can ratoon. Early maturing'.
		Garosyang	White, planted in April as in (1) above no disease, no fertilizer.
		Aburu	Tall, large seeded, late type – plant May, high yielding, white seeded.

Table 9.1 cont'd

	Panksin	Acha	While seed
		Chikaray	Planted in May harvested in September
			Plant in May. harvested in November all are white seeded.
	Bokos	Nyamat (female)	Black glumes, white seeded planted in May harvested in November.
	Bokos	Njapalak	Brown glumes, pests, white disease resistant use fertilizer from maize, seeded. White black glumes Planted in May harvested in November No. Fertilizer application. No disease or insect pests. Black, planted in April/May and harvested in September/November
		Wanka (Famara) Male	Brown glumes, white seeded. Planted in May harvested in November. No fertilizer application. No disease or insect pests
			Black, planted in April/May and Harvested in September/November.
		Uding	Black
		Njarab	Planted in mixture with maize, uses fertilizer from the maize, no disease or pests.
	Bokos	Tamba (Finger Millet)	

Table 9.1 cont'd

1		Tamba	
2		"	
3		"	
		"	Striga haemonthica attacking millet.
3			
3	Riyom	Komtuwo	Also grown here.
3	L.G.A.	Dandupu	
		Achi amutu	Large grain
		Tamba	Small grain
		Panarai	Planted in May/June harvested
	R. A. Hoss	Danasurai	September. White grain
1		Achiamuli	Black, planted in May/June harvested in October. Late maturing. Photosensitive.
2			
		Ndai	No fertilizer
3		Kohorok	Same
		(Abum) (Achi amuli)	Large grain
		Gindiri)	Planted iin April and harvested in Augus Very Early maturing (photoinsensitive?).
	Dantsun	Chun shello	Red, early maturing
	Miden	(Wuyai)	Planted in April harvested in September.
		Chun rei	Black, late maturing planted in April/May *harvested in November later maturing.* Planted in Fadam and fertilizer is applied.
			Also grown
	Dakwak Kuru	**Tamba**	Ground is plastered with cow dung before use in beating the Acha.
	Hoss/ Malera		

Table 9.1 cont'd

BAUCHI STATE 2/10/97	T/Balewa	Wandai	White late maturing
		Chitfayali	White late maturing
		Chit. Kasung	Red glumes, white seeded. Early maturing type. Fertilizer is apply because the soils are exhausted.
		Lat (Iburu) (Dat)	Large seeded. red glumes white seeded *susceptible to striga haemontheca. attack by termites (*all types*). Planted mostly by the Sayawa tribe.
			-Grown in very small holdings, useual mixed crioped wutg itger cereals.
		Tamba (Damisum)	White – planted in June - harvested in September - Early maturing.
	Dandore	Biyama	**White** – planted in June - harvested in August - Very early maturing
		Chale Badama	Planted in April, harvested in September/October.
			Susceptible to striga haemontheca.
		Gundiri	Their long head types Thick short head types *Intermediate types*

Table 9.1 cont'd

KADUNA STATE 1	Fadan Karshi	Iburu	
2	Tudun – Waca	Akhirk	
	Samban-Gida	Buel	
		Fari Acha	While glumes, white seded planted in June harvested in October Late maturing
		Iburu	Red glumes – plant in July -harvested October While seeded. Black lype not available with the [illegible] now . Not collected.
	Jimdi Toto L.G.A	Tamba	Same types as in the above.
	3/10/97	4 Acha types Chale	
1	T/wada Chori	Yea	Planted in April and harvested in September. Medium maturing No fertilizer.
		Niyat	Planted in April harvested Nov./October. Planted in April and harvested in Nov/Dec.
		Aburu (Yyar)	Late maturing Planted in May/June harvested in Nov./Dec.
		Ngban	Also grown
		Tamba	Planted April, harvested June
		Buel	Extra early.

able 9.1 cont'd

		Zigla (Jangorozo)	Planted May. harvested in Nov./October. No fertilizer.
		Patagyus (Acha rani)	Could be Aburu
		Gyar (Kyar)	Planted May and harvested in September.
	Sabongari T/Wada Kuri	Wun Zero	Planted May, harvested August.
		Sabana Saburo	Resistant to diseases? White, planted May harvested Nov/Oct. No. Fertilizer
	Nock	Wun	Early, planted in July harvested in Nov/Oct. Late.
		Zea	All white seeded. Planted in April harvested Aug. Sept.
	Samban Daji	Yea	Planted April harvested in November Planted in May/June harvested October
		Kyar (Aburu)	No fertilizer Termite attack
		Nyat	Ants attack Rodden problem
		Pafibure	Planted in May/June harvested September./October.
		Ndua-yea	Seeds from discard of yea variety.
KEBBI STATE	Tugar Maji	Ontoya	Planted in April/May harvested in September Panicle finger – 2 – 4 Stem erect, tillers, thin, stem green in colour Plant height 30 – 35cm. Glume colour is white Leaf – very thing, 6 – 7 cm Nodes 2 – 5 Peduncle – comparatively long in proportion to the plant height.
	Rigiya Mai	Buntu	Height – 35 cm Panicle fingers 3 – 4 Stem, erect, tillers, Nodes 2 1 Leaf tiny 2 4 cm long Disease free Stem green.

Table 9.1 cont'd

	Acha baka	Kangiwa	Planted in April/May – harvested **October** Tillers stem brown, very thin Nodes – 5 – 6 Leaves very small, 2 4 cm Blast Panicle fingers – 3 –5 Peduncle is long 2 1/3 of plant height Glume colour brown.

Diseases and Pests of fonio millet.

No diseases of economic value have needed identified, but a few are known to affect the vegetative part of the plant, of some of the varieties identified. *Digitaria ischaemum* (schreb) Muhls (smooth crab grass). Diseases recorded on this specie include, leaf spot or blast caused by *Pricularia grisea, Piricularia Orgzae* cav: loose smut, caused by *ustilago valenhorstiana* Kueh and Mosiac caused by the virus *Mormor Saccharia* Homes and *Saccharum*. *Digitaria Sangunalis* (L) sap (Hairy crab grass) Diseases recorded on this variety include: anthracnose, caused by *Colletotrichum graminicola* (ces) wils, leaf mould caused by *Curverlaria trifolia* (Kauff) Boed; stem nematod, *Ditylenchus dipsaci* (kuehn) filip; leaf sports caused by *Helninthosporium lencostylum* Drecha; and *Helminthosporium saliuum* pam, King and Bakke; and many other leaf diseases *Digitaria violascens:* Link (Purple crab grass). Diseases recorded included - rust caused by *Curvullaria* sp. Head mould, caused by *Fusarium heterosporum* Nees, Blast caused by *Piricularia grisea* and *piricularia orgzae* cav. Loose smut caused by, *Ustilago rabenhostiana* Kaeh and many other leaf

diseases.

Var 4. *Digitaria serotina* (watt) Michx (Blanket crab grass). Diseases recorded include - Blast, caused by *Piricularia oryzae* cav, nest caused by *Puccinia Oahwensis* and *PucciniasSulotriata* EU and Barth.

Four foliage diseases, two of which were caused by fungi, one caused by a virus and one caused by a bacteria were identified on the foliage of field grown "Acha" no inflorescence diseases were discovered.

Processing and Utilization of Acha

Importance of Acha and Food nutrients.

Acha is utilised in various forms. The dehulled grain is used for the preparation of many palatable dishes, such as *tuwon* acha (a dough serve with thick soup), *gusgus* (jollof form of acha), pate (a thin porridge) and *Nburo* (a stiff dough mixed with beans). It can be used for making puddings serve with milk and sugar, kunu (a thin dish) could be made from acha. Iit is grounded and mixed with soyabean and use as a weaning food.

In some areas, acha is used for locally brewed beer. during the colonial days, Europeans used acha as a good substitute for semolina. Dalziel (1937).

Acha is a light food that has been found to be nutribtionally superior to rice. It is also believed that acha makes a good diet for diabetic patients because of its law sugar content compared to most energy giving foods. The proximate food composition of acha (per 100g) is as follows: protein 8.3%, fat 3.5%, mineral 3.8%, fiber

8.5%, carbohydrate 73.6%, calcium 3.0%, phosphorus 170g, thiamine 300g).

The strave of the plant is used for hay making, silage, and also it serves as a good fodder for livestock. The straw is also used as stuffing's for locally made mattresses. It is mixed with clay as a binding agent in the making of mud-blocks or bricks. The ash of the burnt plant serves for making local potash. It is believed that the filtrate of the ash can be taken as local medicine to neutralise stomach acidity. It can be used to soften meals like beans and to cook mest infested with tapeworms.

Processing.

There is little or no technology for processing acha compared to other cereals. Processing of acha involves conversion of the commodity from its raw form to a more acceptable forms. The objective is to enhance, preserve the product and add to the product utility. Thus the utilimate aim is to remove the husk which is rough and is of no significant food value.

Acha processing involves threshing which means removing the grains from the stalk which is mostly done by trampling with the feet on hard surface to loosen the grains or beating with a stick before it is dehulled and stored for future use.

Dehulling involves removing the hull from the grains. It is processed traditionally using a mortar and pestle which involves pounding the grains until the hull is

removed the grain. It is winnowed to remove the chaff. The pounding and winnowing take several operations to produce clean grains for food preparation.

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CHAPTER 10

POST-HARVEST AND PROCESSING TECHNOLOGIES OF CEREAL CROPS

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Introduction

Cereals are those members of the grass family which have edible starchy seeds. They are the most important source of plant food for man and usually provide the bulk of his staple diet. The provessing of cereal grains is usually by traditional or modern methods. This study is aimed at providing relevant information available on the post-harvest and processing technologies of cereal crops which should serve as basic information, scientific and technological data to all those working or interested in the field (Bencini, 1991).

Nigeria does not produce enough to feed its population. Self-sufficiency in crop production cannot be achieved solely by increasing production; prevention or reduction of post-harvest losses is also necessary. This means that