The Races of Sorghum in Africa

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From the world point of view, sorghum is the most important of the African domesticates. Many millions of people in Africa and Asia depend on it as a source of food. It has become a major feed grain of the United States and is being used more and more in Latin America, replacing maize in the drier regions. Sorghum is much more drought-resistant than maize and has proved to be one of the really great cereals that feeds the world.

The Crop Evolution Laboratory, University of Illinois, has been conducting studies on the origin and evolution of sorghum for several years. The extensive collection of cultivated sorghums at Kew has been carefully analyzed. Other herbaria with useful materials are Paris, Brussels, Florence, Nairobi, and Pretoria. In addition to these, some twenty-five small herbaria have been visited across Africa. Approximately ten thousand head samples have been obtained from the world sorghum collection for study and analysis. Professors de Wet and Harlan have made extensive field studies in most of the sorghum-growing countries of Africa.

We found in our studies that it was necessary to devise a new and simplified classification for the cultivated sorghums. The system developed by Snowden is basically sound, but we found it too difficult when thousands of samples were being studied. A simplified classification has been published (Harlan and de Wet 1972) and will not be treated in detail here. When a large number of sorghum samples was classified by the new method and plotted on a map of Africa, it became apparent that the distribution patterns were remarkably precise and clear. We feel these distributions to be so consistent that they must be based upon
some historical sequence of events. This paper is an attempt to interpret
the distributions of the races of sorghum in Africa.

THE RACES

The classification adopted involves five basic races: bicolor, guinea,
kafir, caudatum, and durra; and ten intermediate races consisting of
all combinations of the five basic races taken two at a time (Table 1).

Table 1. The races of sorghum according to Harlan and de Wet

<table>
<thead>
<tr>
<th>Basic races:</th>
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<tbody>
<tr>
<td>Race (1) bicolor</td>
<td>(B)</td>
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<tr>
<td>Race (2) guinea</td>
<td>(G)</td>
</tr>
<tr>
<td>Race (3) caudatum</td>
<td>(C)</td>
</tr>
<tr>
<td>Race (4) kafir</td>
<td>(K)</td>
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<tr>
<td>Race (5) durra</td>
<td>(D)</td>
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<table>
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<tr>
<th>Intermediate races: (all combinations of basic races)</th>
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<tr>
<td>Race (6) guinea-bicolor</td>
<td>(GB)</td>
</tr>
<tr>
<td>Race (7) caudatum-bicolor</td>
<td>(CB)</td>
</tr>
<tr>
<td>Race (8) kafir-bicolor</td>
<td>(KB)</td>
</tr>
<tr>
<td>Race (9) durra-bicolor</td>
<td>(DB)</td>
</tr>
<tr>
<td>Race (10) guinea-caudatum</td>
<td>(GC)</td>
</tr>
<tr>
<td>Race (11) guinea-kafir</td>
<td>(GK)</td>
</tr>
<tr>
<td>Race (12) guinea-durra</td>
<td>(GD)</td>
</tr>
<tr>
<td>Race (13) kafir-caudatum</td>
<td>(KC)</td>
</tr>
<tr>
<td>Race (14) durra-caudatum</td>
<td>(DC)</td>
</tr>
<tr>
<td>Race (15) kafir-durra</td>
<td>(KD)</td>
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</tbody>
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The bicolor race is the most primitive and least specialized of the
major races. It has an open head, somewhat resembling the wild sor-
ghums; the spikelets have long glumes; the seed is elongate, more or
less symmetrical dorsoventrally, and usually covered by the glumes.
All of these characteristics are considered primitive in comparison to
the highly specialized spikelets of the other four races.

Bicolor is found on a minor scale almost everywhere that sorghum is
grown in Africa; consequently, we have not shown the distribution on
maps. In India and the Far East it is relatively more important. While
the race has primitive morphological features, some of the bicolor
materials are recent evolutionary products. Bicolor morphology can be
recovered from hybrids between wild sorghum and almost any
cultivated race. Such derivates have been detected in Nigeria, Chad,
Sudan, Ethiopia, Uganda, and South Africa and are widespread else-
where in Africa. In Asia there seems to be little interaction between

wild and cultivated sorghum except in Burma, Thailand, and the Indo-
China region.

The guinea race also has an open head with relatively long glumes.
However, the spikelets are highly specialized, and there is nothing like
them in any of the wild races of sorghum. They are distinguished at
maturity by widely gaping glumes that roll inward, and the seed is
twisted almost 90 degrees between them.

The kafir race is distinguished by small, roundish, well exposed
seeds, more or less symmetrical dorsoventrally, although the glumes
are of variable length. The head is usually semicompact.

The caudatum race is characterized by asymmetrical seeds which
are flattened on the lower side. In extreme cases the lower side may
be even somewhat concave and the upper side rounded and bulging,
producing a sort of beak at the tip. The seeds are well exposed and
the head type is extremely variable ranging from loose, open heads
to semicompact types.

Durra is perhaps the most specialized race of all. The head types
are frequently very tight, forming a nearly round ball. The spikelets
are highly specialized; the seed is obovate, widest slightly above the
middle, very large and rounded above, and wedge-shaped below. The
glumes often have a transverse crease.

DISTRIBUTION

The distributions of the principal races in Africa are shown in Maps
1 through 4. Each dot represents one to several collections either in
herbaria or from the world collection. It is impossible, of course, to
show all of the collections on the maps, but the number of specimens
is substantial. Map 1, for instance, dealing with the guinea race and
its intermediate forms, was based on over 1,000 collections available
to us. Our sampling, however, is far from uniform. Some of the
countries in Africa are very poorly collected, and others are well
represented.

It will be noted from the maps that guinea is primarily a West
African sorghum. It is the dominant race and occurs in its purest
form there. It also occurs in East Africa where it is often modified by
hybridization with other races. The guinea race also occurs in India
on some scale. The caudatum race is primarily a race of Central
Africa and occurs in its purest form in Chad and Sudan. Kafir is
entirely a race of southern Africa. We have no authentic collection
Map 1. The guineas and half-guineas of Africa

Key:
- Solid circles: guinea
- Open circles: guinea-kafir
- Solid bottoms: guinea-caudatum
- Solid tops: guinea-durra

Map 2. The caudatums and half-caudatums of Africa

Key:
- Solid circles: caudatum
- Open circles: durra-caudatum
- Solid bottoms: guinea-caudatum
- Solid tops: kafir-caudatum
Map 3. The durras and half-durras of Africa

**Key:**
- Solid circles: durra
- Open circles: durra-caudatum
- Solid bottoms: durra-guinea

Map 4. The kafirs and half-kafirs of Africa

**Key:**
- Solid circles: kafir
- Open circles: guinea-kafir
- Solid bottoms: kafir-caudatum
of it north of the equator. The dura race, on the other hand, is found abundantly in Ethiopia, Sudan, and along the fringes of the Sahara. We have not found authentic collections of dura south of the equator. Durra is essentially the only race of sorghum in the Near East from Turkey through Syria, Iran, Pakistan, and into India where it is estimated that four-fifths of the sorghums are dura. Intermediate races occur at the expected locations where two major races overlap.

The distributions are so precise in detail that some explanation is called for. We shall attempt to reconstruct the sequence of events that probably took place during the origin and evolution of sorghum.

RECONSTRUCTION OF EVENTS

1. Sorghum was First Domesticated in the Area Designated "Early Bicolor" on Map 5. The justification for this statement is more fully amplified in the paper by de Wet (this symposium) and in de Wet and Harlan (1971). Briefly, it is based on the idea that agriculture originated in Africa south of the Sahara and north of the equator. Archaeological evidence would seem to indicate that agriculture was practiced much later south of the equator than north of it. West Africa is ruled out because of the lack of a wild sorghum adapted to the savanna zone. The wild sorghum of West Africa is a forest race and grows in habitats where the crop is not well suited. We have, therefore, outlined the area in which the most massive stands of wild sorghum occur north of the equator and on the east side of the continent. 

Negative: Past distributions of wild sorghums may have been different from the present ones. It is our feeling, however, that changes in climate would have shifted the indicated zone either northward or southward, and it is unlikely that it would have moved to West Africa.

2. Early Sorghum Resembled the Bicolor Race. This race has the most primitive features of any of the cultivated sorghums and is most nearly like the wild forms. It is generalized in comparison to the other four basic races and could probably give rise to any of them. The other races, on the other hand, are so specialized that it is unlikely that one could produce another.

Negative: We see no argument against this statement.

3. Early Bicolor was Distributed at an Early Date to West Africa Where the Guinea Race Evolved. We consider the guinea race the earliest of the specialized races because of its distribution not only in West Africa, but also in East Africa and India. No other race except the generalized bicolor has so broad a distribution. Guinea is the dominant and most characteristic sorghum of West Africa and almost certainly evolved there. Elsewhere it appears in slightly modified forms.

Negative: The only other alternative that we see would be an independent domestication in West Africa. We consider this unlikely for reasons given above. It is true that the guinea race is better suited to high rainfall than any of the other races of sorghum, and it is possible that this adaptation was introduced from the forest arundinaceum race. We do not consider it likely, however, that arundinaceum
was the progenitor of guinea because of their differences in ecological amplitudes.

4. Early Bicolor was Distributed to the Sind-Punjab Region Before 1000 B.C. At some time sorghum became an important food plant in India. We do not know when the first introduction was made. Archaeologically, in the excavations conducted so far, sorghum dates only from Roman times. We do have evidence, however, of other African crops at about 1000 B.C. Pearl millet and finger millet have been found in Rangpur and Hallur respectively (Rao 1963; Nagaraja Rao 1967). If other African crops were being imported, we assume that sorghum came with them. Sorghum was apparently not very important for some time, however, because there is no Sanskrit word for it.

Negative: The only alternative would be for the durra race to have evolved in Africa and later to have been transported to India where it became the dominant race of the region.

5. The Durra Race Evolved in India. The distribution of the durra race in Africa suggests that it is intrusive. It is found abundantly east of the plateau in Ethiopia, in parts of Sudan, and only as an occasional culture along the fringes of the Sahara to the west. In India durra reaches its most extreme forms with creases on both glumes, while in Africa it is often modified through hybridization with other races.

Negative: An alternative explanation would be the evolution of the durra race in eastern Ethiopia from whence it was later transported to India, or perhaps even more likely, an evolution in both India and eastern Ethiopia with sea transport exchanging germ plasm over a long period of time.

6. Early Bicolor was Distributed to Southern East Africa Where the Kafir Race Evolved. Kafir is the characteristic race of southern Africa and is not found elsewhere. It seems most likely to have evolved in the region indicated in Map 5.

Negative: The only alternative would be an independent domestication in southern Africa from local populations of the wild verticilliflorum race.

7. Guinea Moved Out of West Africa and Down the East African Savanna to South Africa. Guinea is found up and down the agricultural zones of eastern Africa but is seldom a major race there. In Malawi and Swaziland, however, there are local areas in which it is dominant. The guineas of East Africa are somewhat different morphologically from those of West Africa and, in general, tend to resemble guinea-kafirs in morphology.

Negative: There is no question that guinea reached eastern Africa, but there may have been alternative routes and times other than those indicated.

8. The Guinea Race was Introduced Directly to India by Sea Trade Across the Indian Ocean. There is no trace of guinea between southern Ethiopia and India. The race is not well suited to arid agriculture, and the most likely means of distribution seems to be transport from the East African ports to the Malabar Coast of India. This sea trade was flourishing at least 2,000 years ago. Apparently the kafir race was not taken to India. Therefore, it would seem most likely that northern ports such as Mombasa and Zanzibar were used.

Negative: There is no question that the guinea race reached India, but the time and route may not be as indicated. The lack of kafir in India might be due to its lack of adaptation on the Malabar Coast, while guinea is better suited to the higher rainfall of the Western Ghats. It may also be that the kafir race is very recent and had not evolved at the time that guinea sorghum was transported by ocean to India.

9. The Caudatum Race Evolved in or near the Region of Initial Domestication. Caudatum is important in eastern Nigeria, Chad, Sudan, and Uganda, and it is a minor race in Ethiopia. Caudatum has never spread much beyond this limited distribution, and, therefore, we suppose it to be a relatively new race. It has produced intermediate races with durra, guinea, and kafir. The occurrence of durra-caudatum in Uganda would indicate materials introduced from the north since durra has not been detected in Uganda. Intermediates with the kafir race are found to the south as expected.

Negative: We find no argument against this statement.

10. The Durra Race Returned to Africa. If our interpretation of an Indian evolution of durra is correct, then durra returned to Ethiopia and Sudan and spread westward along the fringes of the Sahara. The fact that sorghum is mentioned by Greek and Roman writers as having come from India would suggest that durra was introduced into Africa approximately 2,000 years ago. It is probable, however, that the distribution to the west was accomplished in Arab times.
Negative: An alternative evolution of durra has been suggested above.

11. **The Kafir Race Expanded Throughout Southern Africa.** We presume that the distribution of kafir is closely associated with the migrations and movements of Bantu agriculturalists.

12. **Meanwhile, Early Bicolors Spread Eastward to Burna and Indonesia and Northward into China Where the Kaoliangs Evolved.** Archaeological finds of sorghum have been reported in China dating to early or middle first millennium B.C. A word for sorghum does not appear in Chinese literature, however, until the fourth century A.D., and the crop was not important until after the Mongol conquest. The Chinese word *shu-shu* indicates “a millet from Szechuan.” It has been suggested, therefore, that it was introduced originally from India by an overland route. The kaoliangs are morphologically related to bicolor and appear to represent a Chinese variant of some early bicolor race.

We realize that our reconstruction may extend beyond the safe limits of our evidence. The consistency of the distribution patterns, however, demands an explanation which cannot deviate very much from the one offered.

It has been our observation that the races of sorghum are intimately associated with the cultivators who grow them. At the edge of the Konso tribal area in southern Ethiopia, one may find two villages side by side with a completely different array of sorghums. A Konso village will grow sorghums peculiar to Konsoland, and the neighboring Galla village will grow an assortment of durras. In western Ethiopia enclaves of caudatum are grown by immigrants from Sudan. From Ethiopia westward to the Atlantic the same pattern holds. Particular peoples have an affinity for particular races or subraces of sorghum.

Perhaps, as a result, there is a crude general correspondence between the distribution of the basic races of sorghum and the distribution of the major language groups of indigenous Africans. Guinea is a sorghum of the Niger-Congo family, kafir a Bantu sorghum. Durra follows the Afro-Asian family fairly closely, and caudatum seems to be associated with the Chari-Nile family of languages. The correspondence is far from precise, but a more detailed study of minor variation in sorghums may prove revealing with respect to human history.

In addition to the broad regional patterns of the basic races, we can detect small areas with rather unusual assemblages of sorghums. One such region is in southern Ethiopia (shown in black on Map 6). The region has not been sampled adequately for us to draw any real conclusions, but we feel that the complexity of the sorghum array is associated with ethnographic complexities. A similar situation may exist in northern Cameroon, but we have not yet studied the materials in detail.

So far, our studies are really preliminary in nature, but they do suggest that a thorough analysis of crop variation could reveal a great deal about the people of Africa and that thorough ethnographic studies might help agronomists understand African crops. A closer cooperation between various specialists should be of great benefit to all who are interested in African plant domesticates.
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Biographical Notes

J. DESMOND CLARK was born in England in 1916. He received his B.A. and Ph.D. in Archaeology from Cambridge University in 1937 and 1950. He served during the war in Africa and was Director of the Rhodes-Livingstone Museum in Zambia from 1937 to 1961. Since then he has been Professor of Anthropology at the University of California at Berkeley. His archaeological fieldwork has been extensive; he has worked in most parts of central and southern Africa, Angola, Syria, the Sahara (Niger), and the Sudan. A Fellow of the British Academy and of the American Academy of Arts and Sciences, he is also a Member of the Permanent Committee of the Pan-African Congress on Prehistory and Quaternary Studies and, in 1971–1972, was a Guggenheim Fellow. Some 200 papers by Dr. Clark on archaeological subjects have been published in scientific journals in Africa, Britain, and the U.S.A. Books include: The Kalambo Falls prehistoric site, The prehistory of Africa, The atlas of African prehistory (compiler), Background to evolution in Africa (edited with W. W. Bishop), and volumes on the prehistory of Zambia, the Horn, Angola, and southern Africa. Dr. Clark is currently editor of the first volume of the Cambridge history of Africa.

D. G. COURSEY (1929— ) was born and studied in London. He joined the Colonial Agricultural Service and worked in Nigeria (1951–1964), most of his research being concerned with yams and cassava. His work was continued at the University of Ghana (1964–1966), where he extended his interests in root crops from the purely agricultural to the sociological and prehistorical aspects. In 1966 he returned to England, where he now works for the Ministry of Overseas Development and is mainly