Food, Fuel and Fields

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The movement of cultivated plants between Africa and Indiain prehistory

Abstract

Many cultivated plants are common to India and Africa and in particular plants of African origin seem to be well established in Indian agrarian systems, although their introduction and early use is nowhere documented. Although proposals for the prehistoric transmission of cultivated plants between Africa and India have a long history, there have also been claims that the archaeobotanical material from India does not stand up to scientific scrutiny and that only more recent dates should be accepted. New evaluations of the evidence has concluded that some early dates are justified, suggesting that similar dates may be appropriate for species so far not found in the archaeobotanical record. Proposals that Arabia represented a key staging post in this trade have been dropped in the absence of reliable archaeobotanical evidence. The paper enumerates all the crop species that may have been transmitted in both directions and suggests the possible route (either sea or land). Excluded are recent Indian Ocean introductions such as the sweet orange and the diploid bananas. It concludes with a number of ‘mystery’ species for which there is presently no evidence as to the time, place or direction of their spread.

Key words: Africa, India, crops, transmission routes, prehistory.

1. Introduction

1.1. Background

The transfer of cultivated plants between Africa and India in both prehistory and historic times has been mooted since De CANDOLLE (1886), but the evidence is extremely scattered and much depends on the presumptions of botanists rather than on ‘hard’ archaeobotanical data. A conjunction of the much better-known flora of India and earlier compilations of data on its economic plants (e.g. WATT 1889-95) suggested to an earlier generation of scholars that cultivated plants found in both continents were transferred from India to Africa. Indeed, older botanical names often reflect this view, for example Tamarindus indica or Sesamum indicum. With apparently high levels of diversification on both sides of the Indian Ocean suggesting thousands of years of establishment, determining the region of domestication of these crops is not always easy, especially since early ‘escapes’ rapidly take on the appearance of wild forebears. In more recent times this topic has been discussed by POSSEHL (1986, 1998), DOGGETT (1989), WIGGLESWORTH (1996), BOWLEY-CONNOLLY et al. (1997), WEBER (1998) and FULLER (2000a. This volume. In press a).

It may be that with modern laboratory-based techniques using mitochondrial DNA, as well as the study of co-associated pathogens and biotrophs, it will prove possible to resolve the present debates. However, this type of historical archaeobotany is a low priority in laboratories with these capabilities and, in the meantime, much can be deduced from existing archaeological and botanical data. KAULE (1991) and FULLER (2000a. This volume) represent recent comprehensive reviews of Indian archaeobotanical data, but African material remains scattered.

The movement of cultivated plants
2.1. The nature of the evidence

Assigning dates and routes for the transfer of cultivars faces a number of key problems:

a) Archaeobotanical evidence is very slight for many species, especially those that reproduce vegetatively.

b) Access to dates is difficult since many locally published reports, notably in India, are not easily available elsewhere. Dating is often not very secure and older dates and identifications are often criticised in more modern literature.

c) Research on modern-day plants, both phenotypic and genetic, is driven by their economic importance rather than their historical significance.

d) Historical documentation is lacking for ‘minor’ plants and climatic descriptions are often inadequate.

e) Post-Columbian movements of plants cannot always be distinguished from earlier movements, especially in the case of ‘tolerated weeds’.

The overland movement of crops, especially to and from India, cannot always be distinguished from sea-routes, and indeed some crops may have travelled both routes. In addition, the rapid movement of the Portuguese around the world in the sixteenth century was responsible for the introduction of what are now called ‘vavtropical species’, particularly those which colonise wastelands and are occasionally cultivated. Some of these have adapted so rapidly to their new environments that their exact region of origin remains unknown. Further genetic work could probably resolve some of these problems, but for obvious reasons, plant geneticists do not see minor green vegetables as a priority.

An independent source of evidence that has barely been exploited is linguistic data. The use of names of cultivated plants to trace their likely routes of introduction has been employed successfully within West Africa (see COLOMBEL 1985, 1997; BLENCH 1997, 1998; BLENCH et al. 1997). For example, plants introduced by the Arabs into West Africa in the early Medieval period without exception still bear recognisable versions of their North African name: SOUTHWORTH (1976, 1988) has attempted to derive a chronology of Indian crops from linguistic reconstructions of plant names. Cultigens transmitted across the Indian Ocean in the Medieval period still bear recognisably Arabic or Hindi names on the East African coast. The analysis of cultigen names for crops transmitted at an earlier period is more complex and no work of this nature has yet been undertaken.

2.2. Historical stratification of routes to and from India

Historically, there seem to have been three important trade-routes between Africa and India:

a) From Egypt to the Near East, across Iran to Northwest India.

b) The Sabaean Lane, along the Red Sea, along the southern edge of the Arabian peninsula and then either coasting along the southern edge of Iran or perhaps crossing the open sea.

c) The open ocean crossing between the west coast of India and East Africa.

The first route was initially favoured by many historians and botanists, often because it involved known peoples with writing systems and substantial archaeological macro-remains, at least for Egypt and the Near East. Although some cultivated species were indeed transmitted along this route, the absence of many plants in the archaeological and epigraphic record shows that it was only one avenue for the exchange of plants between continents. BLENCH (1991) considered the evidence for the Nile Valley route but omitted plants for which there was no evidence. The very full records of Ancient Egypt, textual, iconographic and archaeological, allow some weight to be assigned to negative evidence. In other words, if a major economic species is apparently absent from Egypt, then it is a reasonable assumption that it was not transmitted from Africa via the Nile Valley.

The Sabaean Lane is a name given to a shipping route that joined, Africa, Egypt, Oman and India. The name and the idea that it was a corridor for cultivated plants goes back at least to SCHWEIN-
FURTHER (1572-73) who argued that the cow pea, Vigna sesquipedalis, must have been transmitted along this route while ANON (1894) speculated on the movement of the cultivated Colus spp. from Africa to India. Although there is very little textual evidence for such a route, archaeological remains would appear to confirm its importance (e.g. BOWER & ALBRIGHT 1958). The earliest evidence for ships sailing down the Red Sea, along the southern coast of the Arabian peninsula and across to India, either coasting the Iranian coastline or perhaps sailing across open seas is ca. 4000 BC. POSEIDON (1990) describes the Akkadian literature on Meluhha, now generally identified with Harappa, and suggests that material culture is evidence for a Middle Asian interaction sphere still to be recovered. Diodorus Siculus and Pseudo-Callisthenes refer to ships passing along this route (KORISCHANOV 1965). Representations of reed boats appear on rock engravings and remains of such reed boats have been recovered from Oman (COSTANTINI 1990). As maritime technology improved, this route expanded and included excursions down the East African Coast, eventually to be recorded in the Periplus of the Erythraean Sea (HUNTINGFORD 1980).

Present knowledge of the evolution of maritime technology does not yet allow us to say precisely when it became possible to cross the open ocean from India to East Africa, but presumably the development of island settlements such as Shanga off the Kenyan coast reflect an intensive Arab and Persian trade (HORTON 1997). There is evidence for trade between the Aksumite kingdoms and India and possibly also China (MUNRO-HAY 1996). BLENCH (1996a) describes the ethnographic and textual evidence for Austronesian incursions on the East African coast.

In the complex history of cultigen exchange between Africa and India, plants exist which neither passed up the Nile Valley corridor, nor were carried by the dhow trade, but which were carried at times unknown along the Sabaean Lane. This paper examines the evidence for individual plants and suggests that the African cultigens reaching India may have played a role in the development of dryland agriculture.

3. Plants of African origin reaching India at an early period

3.1. General

The development of the trade in India in its initial phases seems to have been driven from the west, since the primary flow appears to be of significant economic plants to India. Many species are either not recorded at all from African archaeological sites or only with relatively recent dates. For major cereals such as sorghum and millet this has been seen as problematic and in need of explanation. Table 1 shows the plants considered to be of African origin that have either been recorded archaeologically in India or are well established within its agricultural system. The order of presentation reflects the detailed discussion below.

There is an opposing view in the literature which essentially assumes that only written or ultra-secure archaeobotanical evidence can be accepted, and in their absence, only late dates can be adopted. The most extreme version of this is WIGBOLDUS (1996), who appears to think that the diffusion of millet, finger millet and sorghum is medieval and that all Indian archaeobotanical data which contradict this are to be discarded. The apparently similar views of BOWLEY-CONWAY et al. (1997) on sorghum are given below in more detail. This paper tackles the opposing view that if cultural, biological and linguistic forms of evidence are not given equal weight then an extremely Eurocentric view of prehistory must emerge. Reviews of the archaeobotany by WEBER (1998) and FULLER (2000) support some of the early dates and thus reach conclusions similar to those set out here.

3.2. Cereals

Sorghum [guinea-corn, kaffir-corn]
Sorghum bicolor (Linn.) Moench.

The primary studies of the evolution of sorghum are SOWDEN (1936), DOGGETT (1985), HARLAN

1. A pyramidal term found in earlier literature and regretfully enshrined in some current terminology.
<table>
<thead>
<tr>
<th>English name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td></td>
</tr>
<tr>
<td>finger millet</td>
<td>Earsine comosus (Linn.) Gaertn.</td>
</tr>
<tr>
<td>ditch millet</td>
<td>Psophium siccifolium L. var. frumentaceum</td>
</tr>
<tr>
<td>sorghum</td>
<td>Sorghum bicolor (Linn.) Moench.</td>
</tr>
<tr>
<td>(Bicolor, caudatum and guinea races)</td>
<td></td>
</tr>
<tr>
<td>bulrush millet</td>
<td>Pennisetum glaucum (L.) R. Br.</td>
</tr>
<tr>
<td>Tubers</td>
<td></td>
</tr>
<tr>
<td>date</td>
<td>Pluchea esculenta NE Br.</td>
</tr>
<tr>
<td>Hausa potato</td>
<td>Solanum tomentosum rotundifolius (Poir.) JK Morton</td>
</tr>
<tr>
<td>Vegetables</td>
<td></td>
</tr>
<tr>
<td>okra</td>
<td>Abelmoschus esculentus L. Moench.</td>
</tr>
<tr>
<td>spiderflower</td>
<td>Celosia argentea L. var. cristata</td>
</tr>
<tr>
<td>Indian mustard</td>
<td>Brassica juncea (Linn.) Coss</td>
</tr>
<tr>
<td>Pulses</td>
<td></td>
</tr>
<tr>
<td>cow pea</td>
<td>Vigna angustifolia (L.) Welp. (1842)</td>
</tr>
<tr>
<td>hyacinth bean</td>
<td>Lablab purpureus (L.) Sweet (1827)</td>
</tr>
<tr>
<td>velvet bean</td>
<td>Mucuna pruriens (L.) DC. var. utilis (Wall ex Wright) Bak. ex Burch.</td>
</tr>
<tr>
<td>cluster bean [guar]</td>
<td>Cyamopsis tetragonoloba (L.) Taub. (1894)</td>
</tr>
<tr>
<td>Oilcrops</td>
<td></td>
</tr>
<tr>
<td>castor bean</td>
<td>Ricinus communis Linn.</td>
</tr>
<tr>
<td>niger seed</td>
<td>Gongora abyssinica Coss.</td>
</tr>
<tr>
<td>Fibres</td>
<td></td>
</tr>
<tr>
<td>kenaf</td>
<td>Hibiscus cannabinus Linn.</td>
</tr>
<tr>
<td>jute</td>
<td>Corchorus triterus Linn.</td>
</tr>
<tr>
<td>Managed trees</td>
<td></td>
</tr>
<tr>
<td>tamarind</td>
<td>Tamarindus indica Linn. (1753)</td>
</tr>
<tr>
<td>silk cotton</td>
<td>Celos pentandra (L.) Gaertn. var. pentandra</td>
</tr>
</tbody>
</table>

& STEMLER (1976), OLLITRAULT et al. (1989) and DOCCETI & PRASADA RAO (1995). All these studies concur that sorghum indeed originated in Africa and identify the original region of domestication of sorghum as a band stretching from SW Ethiopia to Lake Chad. Hypotheses about the domestication and diffusion of sorghum in Africa are based almost exclusively on the distribution of modern races, since the evidence from archaeology remains so evasive.

Sorghum certainly has a history of early dates within Africa that have been discounted following more detailed examination. WASILIKOWA & DAHLBERG (1999) show that the carbonized sorghum grains found at Nabta Playa in southern Egypt at ca. 8000 bp are exclusively wild. Archaeological evidence for sorghum in West Africa is relatively late. KLEE & ZACH (1999: 87f) report domestic sorghum only appearing very late in the mound at Mege in NE Nigeria. It is not recorded at Dhar Tichitt, Kuyakata and Galganna although it appears at Nianli, in Guinea in the 8th century and at Daime in Northeastern Nigeria in the 9th-10th centuries (CONNHA 1981). This must almost certainly be an artefact of excavation, since the complexity and diversity of sorghum phenotypes in West Africa argues for a more ancient establishment. At Iryanga in Zimbabwe, and in Zambia there are records of sorghum, at roughly the same period (SHAW 1976).

Cultivated sorghum presents one of the more perplexing problems in African agrarian history. It is found in archaeological sites in Kordofan and India millennia before confirmed archaeological

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Table 2. The earliest archaeological records of domesticated sorghum.

<table>
<thead>
<tr>
<th>Region</th>
<th>Country</th>
<th>Site</th>
<th>Date(s)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>Sudan</td>
<td>Jebel Tomat</td>
<td>245 ± 69 AD</td>
<td>CLARK &amp; STEMLER (1975)</td>
</tr>
<tr>
<td></td>
<td>Sudan</td>
<td>Meroe</td>
<td>20 ± 127 BC</td>
<td>ROWLYN-WONFY (1991)</td>
</tr>
<tr>
<td></td>
<td>Nigeria</td>
<td>Dalma</td>
<td>800 AD</td>
<td>CONNASI (1981)</td>
</tr>
<tr>
<td>India</td>
<td>India</td>
<td>Hulas</td>
<td>2200-1500 BC</td>
<td>SARASWAT (1993)</td>
</tr>
<tr>
<td></td>
<td>India</td>
<td>Tuljepur Garhi</td>
<td>1200 - 900 BC</td>
<td>KAJALE (1988)</td>
</tr>
<tr>
<td>East Asia</td>
<td>Korea</td>
<td>Hunsanji</td>
<td>3000 BP</td>
<td>CHO (1982) [doubtful]</td>
</tr>
</tbody>
</table>

finds in Africa. Table 2 presents selected African and Eurasian records for archaeological sorghum; Fuller (this volume) presents data and evaluations of the Indian material in much greater detail.

BURKILL (1937: 118) may have been the first author to clearly state that African sorghum reached India in prehistory. Sorghum is widely grown in India today and races bicolor, guinea and caudatum are all present, suggesting strongly both early and repeated introductions. Reports of sorghum in Oman with dates of 3500 calBC (POTT'S 1993) and Yemen at 2000 calBC (COSTANTINI 1990) were originally taken as evidence of the 'Saharan Lane' transmission via Arabia. How- ever, Tengberg (pers. comm.) notes that all the Arabian finds depend on dubious identifications none of which have been subsequently validated and that if a sea-route was used it did not include stops on the Arabian peninsula. ROWLEYN-WONFY et al. (1997, 1999) have reviewed all the African and some of the extra-African evidence, taking a robustly positivist approach and casting doubt on the dates of all early finds outside Africa. None-\textemdash the re-evaluations of FULLER (2000a). This volume. In press a) suggest that some sorghum was reaching India as early as 4000 bp and that this cannot be the case unless comparably early sorghum is present in Africa. So the question becomes, where is the missing African evidence?

YOUNG & THOMPSON (1997) explore this question from the geochemical perspective and sug- gest that the paucity of macro-botanical remains can no longer be attributed to an absence of research and that poor preservation may reflect wet tropical soils. HALLAND (1996, 1999) invokes a 'cultivation without domestication' scenario to explain these lacunae. Cultivation, the resowing of wild seed in convenient locations, is contrasted with 'domestication' where selection induces morphological change in the seed. She argues that wild sorghum would have been cultivated in the Chad-Ethiopia belt from 6000 bp onwards, but that domestication took place outside Africa, perhaps in Arabia, but most likely in India.

The following rather speculative historical sce- nario is synthesised from HARLAN & STEMLER (1976), MANN et al. (1983), DE WIT (1983), DEU et al. (1994) and DOGGETT & PRASADA RAO (1995) to account for the synchronic distribution of sorghum races:

a) Sorghum bicolor is the least specialised race of sorghum, and the source of the other cultivated races, deriving from Sorghum sect. Sorghum ssp. verticilliflorum. This evolved through disruptive selection in the semi-arid zone between the Nile tributaries and Lake Chad before 54000 bp. This conclusion was in part anticipated by CHEVALIER (1952: 864f) who pointed to the diversity of wild sorghums in this region.

b) S. bicolor, developed into the 'guinea' race, in turn divide into subraces Roxburghii and guineense. Roxburghii has been retained in Ethiopia, but also spread southwards and was carried to South Asia, SE Asia and the south coast of China. Roxburghii also spread south- wards, and through back-crossing with S. verti- calliflorum produced the kafir sorghums typical of 'Southern Africa'.

c) the durra sorghums evolved in Ethiopia, per- haps as a result of introgression of weedy Sorghum spp. The former idea that these developed outside Africa and were re-introduced has now been generally rejected. DOGGETT (1988) noted that sorghums reached Iran and

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south-western Asia from further east and that they only arrived in Egypt in the Ptolemaic period (see also GERMER 1985:227f.). PLINY (Nat.Hist. XVIII,10), writing in the 1st century AD, noted that a new 'black' millet had been introduced during the previous decade. The Chinese kaoliang sorghums appear to arise from a crossing of the wild S propinquiun and dura sorghums. CHEVAUER (1932: 85ff.) points out that sorghum in northern Saharan oases is usually of the dura type.

d) The caudatum sorghums, with their resistance to flooding, drought and parasites, may have been the last to evolve, probably in Ethiopia. Their dark grains contain polyphenols that make the flour bitter and thus resistant to birds. The caudatum sorghums spread both to West Africa and into East Africa. They have freely crossed with other races and stable dura and guinea 'half-caudatum' are found across Af- rica. Caudatum has largely replaced the original bicolor in many places because they are adapted to the same climatic regime.

HARLAN & STEMLER (1976: 475ff.) argued for the sea transport of the guinea sorghums to India on the grounds that there are no residual landraces in the intervening territories. However, the traffic to India was by no means all in one direction; in the case of the brachinch bean (see below), there is evidence for reverse traffic. By the early tenth century, travellers such as Abu Zaid and al- Mas'udi were reporting that black sorghum was an important food on the East African coast. WATSON (1983: 14ff.) points out that Indian varie- ties were re-imported, perhaps through Pemba, as these 'new' cultivars are known as 'Pemba rice' in some languages.

Pearl millet [bulrush millet, curioo millet] Pennisetum glaucum (L.) R. Br.

The wild relatives of pearl millet are found on the southern edge of the Sahara (CHEVAUER 1952: 488ff. BRUNKEN et al., 1977) and it is usually considered that this was its locale of domestication (DE WET 1965a. TOSTAIN 1989, 1994, 1998). GILL et al. (1997) have recently summarised the modern-day distributional evidence and provide an up-to-date bibliography on pearl millet. The levels of Dhur Tichitt in Mauritania provide the most detailed sequence of wild and cultivated Pennisetum. Re-examination of the ceramics from Dhur Tichitt and Oualata revealed that domesti- cated Pennisetum was grown at least as early as 3500 BP (AMBLARD & PERNES 1989. AMBLARD 1996). A sherd with impressions of Pennisetum has been directly dated to 3500 ± 100 BP (1996- 1683 calBC, Pa-1157) and thus provides the oldest evidence for pearl millet (AMBLARD 1996). Agri- culture was practised from the beginning of the occupation, correlated with well-developed set- tlement structures including granaries (AM- BLARD-PISON 1996). A find of comparable age (3460 ± 200 BP (1980-2320 calBC, TO-8172) has been reported from the site of Birrim in NE Ghana (D'ANDREA et al. 2001; D'ANDREA & CASEY in press). Slightly later is the dune site Tin Akof in Burkina Faso where grains of domesticated Pennisetum have been found, directly dated to 2840 ± 49 BP. In Galigurum in Nigeria, domesticated Pennisetum occurs used as pottery temper in Phase IIIb dated to 2930 ± 60 BP (1261-1034 calBC, UC-2329) (NEUMANN 1999). In the ear- liest phase, there is only a single grain of Pennisetum, but more occur in Phase IV. Al- though it is recognisably cultivated in subse- quent phases, its role cannot be easily deduced in the early period. There is no certain evidence for pearl millet in Ancient Egypt and earlier identifications of millet in intestines were prob- ably sorghum (DAHAN et al. 1977: 484ff. GERMER 1985: 224ff.).

PORTERIS (1976: 433ff.) provides a detailed over- view of the subtypes of pearl millet in Africa and argues that the morphological evidence strongly supports early transmission to India. The absence of finds in the Nile Valley and the Near East support a sea-route. Although the cultivation of Pennisetum millet is well-established in many parts of India (WATT 1889-93: P. 384'), the ar- chaeological record is frankly weak, with grains dated by context rather than directly. However,

2 References to the Dictionary of the Economic Products of India give the entry number (proceeded by P.) rather than the volume and page.
recent reviews of the evidence have confirmed that at least some records can be considered well-founded (FULLER 2000a. This volume). Table 3 summarises the present evidence for archaeological millet in Africa and India.

Much work remains to be done on the historical and morphological relations between African and Asian pearl millet.

Kodo (birds' millet, ditch millet)

Paspalum scrobiculatum L. var. polygalatum Stapf.

Indian kodo, Paspalum scrobiculatum L. var. frumentaceum, remains a major staple for ordinary subsistence farmers in many parts of the subcontinent (WATT 1989:95. 332ff.). It is highly varietally diversified in different regions, suggesting considerable depth of establishment (DE WIT et al. 1978). The outer husk or pericarp can be toxic and must be removed in the milling process (see PORTERES 1976: 432ff. for references on poisoning outbreaks). The principal archaeological record is in Kurnool district, Veeraparum, Andhra Pradesh where seeds dating to 5-300 BC have been recovered (KAJALE 1991: 166ff.).

A very similar cultivated cereal also exists in Africa, Paspalum scrobiculatum L. var. polygalatum

Stapf. Wild forms of this plant are found in low-lying places across Africa and Asia giving rise to the name 'ditch millet'. The only source for the use of kodo as a crop is PORTERES (1976: 429ff.); no mention of its existence appeared before 1959. Although this cereal is also gathered, like many other Paspalum spp. among the Khasi and Kuranko of southern Guinea, it is transplanted into rice paddies or else encouraged to invade eroded upland rice patches (NATIONAL RESEARCH COUNCIL 1996: 339ff.).

The similarities between these two plants and existence of wild forms in Africa, led Porteres to observe that they are indeed the same plant and that kodo millet must originally have been carried from Africa to India. Since there are no records of even pseudo-cultivation in the East African region, this may have been as a 'promising' wild plant.

Finger millet [ragi]

Eleusine coracana (Linn.) Gaertn.

The exact area of domestication of finger millet has remained controversial. Because it shows the greatest varietal diversity in India, earlier sources suggested a homeland there and VAVILOV (1951)

<table>
<thead>
<tr>
<th>Region</th>
<th>Country</th>
<th>Site</th>
<th>Date(s) BP</th>
<th>Date(s) calBC/BC</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>Mauritania</td>
<td>Dhar Tichitt</td>
<td>2840 ± 49 BP (UcC-4906)</td>
<td>1936 ± 1683 calBC 1881 ± 1527 calBC</td>
<td>AMBLARD (1996)</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>Tin Akof</td>
<td>2400 ± 70 BP (UcC-5425)</td>
<td>1980 ± 1520 calBC</td>
<td>NEUMANN et al. (1996), KLEE et al. (2000)</td>
<td></td>
</tr>
<tr>
<td>Niger</td>
<td>Kuranakata</td>
<td>2290 ± 70 BP (TO-8172)</td>
<td>1035 ± 916 calBC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mali</td>
<td>Ga,</td>
<td>3460 ± 200 BP</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asia</td>
<td>India</td>
<td>Rangpur</td>
<td>ca. 1800 - 1200 BC</td>
<td>HERMAN (1997)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Narber</td>
<td>ca. 1200 - 1000 BC</td>
<td>SARASWAT et al. (1994)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hallur</td>
<td>7220 - 1800 BC</td>
<td>FULLER (1999. This volume)</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 3. The earliest archaeological records of domesticated pearl millet.

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proposed in 1926 the grassy uplands as its true source. PORTÈRES (1951) inclined to an African origin on the basis of a study of terms in African languages, a view supported by MENHA (1962, 1963) on botanical grounds. Portères later changed his mind and reverted to the hypothesis of Indian origin (PORTÈRES 1976: 417ff.). However, HARLAN et al. (1976: footnote, 417ff.) point out that this was to ignore the existence of Eleusine africana, a wild tetraploid that crosses freely with cultivated finger millet. This assertion of an African origin for *Eleusine* appears to have been generally accepted (HILL & DE VET 1976, 1977; HILL et al. 1979. DE VET 1990b, HILL 1995). In southern and eastern Africa, there is a record of cultivated *Eleusine* at Inyanga, in modern-day Zimbabwe, where carbonised seeds are associated with late Iron Age pottery (SUMMERS 1958).

Finger millet has been recorded from numerous Indian sites but it appears that many reports are misidentifications of foxtail millet (*Setaria*) caryopses or even *Eleusinopsis* (RULLER 2000; this volume). Only one site, Hallur (7 1000 BC) appears to have a single trustworthy caryopsis and even the dating of this is still uncertain. Despite this, finger millet is both extremely widespread and diverse in India today. If other finds confirm the apparent indication of Hallur, then finger millet probably travelled in the same ships as sorghum and pearl millet.

3.3. Tubers

Hausa potato (*Fadina* potato, turnaka)

*Solanum penniridius* (Poir.) JK Morton

This is the most widespread of the cultivated Labiatae, found throughout Africa, on Madagascar and in Java and Sri Lanka (CHEVALIER 1953). According to CHEVALIER & PERRON (1905) this was first noted by Rumphius in Volume 5 (p. 372) of *Herbarium Ambrosianum* (published in 1750 but apparently compiled in 1695). A specimen collected in the Transvaal in 1884 was successfully grown in Paris and then redistributed by Tholozon in the Western parts of Equatorial Africa in the 1890s, leading to some confusion about the true distribution of the various races (CODO 1975). The first proposal that the Indian *Cenosis* species were related to those in Africa appears to date back to ANON (1894). Its cultivation is not recorded in any intervening locations between East Africa and India.

3.4. Vegetables

Okra (*gumbo, ladies’ fingers*),

*Abelmoschus esculentus* L. Moench. (formerly *Hibiscus esculentus*)

Although okra was previously considered to have been domesticated in South or SE Asia (CHEVALIER 1940; RUSSELL 1965: 294ff.), FRANCE (1976: 232ff.) took the alternative view, now generally accepted, that its origin was in West Africa, confirmed by research on the gmelinales (HARMON & VAN SLoten 1989, BURKIE 1997: 5ff.). The wild *okra* in India is generally thought to be subspecies. Although okra only occurs in North Africa in a cultivated state and is grown in all the oasis of the Sahara (CHEVALIER 1932: 854ff.) there is no incontrovertible evidence for its presence in Ancient Egypt (DARBY et al. 1977: 695ff., GERMER 1985: 122ff.), as the first reference to it in Cairo is as late as 1234 (MAINY 1953: 720ff.). These late dates suggest that it was carried to India at an early period along the sea-lanes.

Spider-flower (*lizard bean, Lagos spinach, quail-grass*),

*Celosia argentea* L. var. cristata

Spider-flower is both cultivated and found as a weed of cultivation throughout the Old World. The exact region of domestication of spider-flower is disputed. BURKIL (1985: 33ff) argues that it must be an Asian domesticate on the shaky grounds of its early appearance in Chinese medical texts. However, other authors describe it as native to a broad area of humid tropical Africa (RAPONGA-WALKER & SELANS 1961: 49ff., EEFEN-HUISING 1978: 43ff.). It appears in Egyptian grave-gardens of the Graeco-Roman period from the Necropolis at Hawara and was presumably brought into Egypt from the upper reaches of the Nile (GERMER 1985: 33ff.).
Indian mustard [leaf-mustard]
Brassica juncea (Linn.) Cos. ( Cruciferae)

Despite its vernacular name, this plant appears to be indigenous to Africa (EPHENHUISSE 1978: 40f. BURKILL 1985: 560fl.). The main centres of diversification are India and China, suggesting that the plant must have spread to India at an early date (OCHSE & BAKHUIZEN VAN DEN BRINK 1980: 163fl.). Mustard-seed has been recovered from Charhu-daro, a Harappan site in Sind (RANDHWA 1989: 179fl.). In the East Asian literature, B. juncea is known as B. campestris ssp. nipponica, and there is some evidence for its early cultivation in China (CRAWFROD 1992: 28fl.).

Roselle [sorrel]
Hibiscus sabdariffa L.

The original place of domestication of roselle is disputed. Curiously, it was thought to be an American plant earlier in the twentieth century and is known in Dutch as Amerikaans Zuur (OCHSE & BAKHUIZEN VAN DEN BRINK 1980: 475fl.-477fl.). RUSSON (1965: 259fl.) claims that H. sabdariffa was domesticated in India and spread to Africa, but this is probably only true of the karkadle forms, those with calices that are deep red when dried and are used to make a drink. Generally speaking, roselle has green calices and is used as a pothoer, leves and all, and in that form is most likely to be indigenous to West-Central Africa (RAFONDA-WALKER & SELANS 1961: 274fl.). The principal agents of dispersal of the red-caliced form were the trans-Saharan traders, as it is still found mainly in Islamised regions of Sahelian West Africa (CHEVALIER 1992: 83fl.).

Melon
Cucumis melo L. var. cheir (L.) Naud. ex Bois.

The wild ancestor of the Mediterranean sweet melon grows along the southern margins of the Sahara, in the Sudan and the Nile Valley and may stretch to the Near East (CHEVALIER 1992: 89fl). BATES & ROBINSON 1995: 67fl.). Distinguishing between feral and truly wild specimens is highly problematic, hence the uncertainty about the natural range of C. melo. However, the greatest phenotypic diversity is in Southern and Eastern Africa. The earliest evidence for its use in Ancient Egypt is considered to be pictorial representations in the Old Kingdom, although the identification of these has been questioned (GERMER 1985: 128fl.). It must have been developed into a desirable fruit in the Near East at an early date, to judge by the lookings of the inscriptions leaving Egypt (BARRE, Numbers, Book 12, verse 5). The first uncontroversial find of seeds of C. melo is in Egyptian tombs from the Graeco-Roman period. India and China both represent secondary centres of diversification supported by abundant archaeobotanical remains. VATS (1940) reports melon seeds at Harappa and Kate (1988) observes that melon was probably present from the Maurya period (1700-1500 BC). CRAWFORD (1992: 27fl.) notes that over 5000 seeds have been recovered from Japanese sites, in one case final Jomon or 2500 calBP.

3.5. Pulses

Cow pea [black-eyed bean]
Vigna unguiculata (L.) Walp. (1842)

The cow pea is indigenous to West-Central Africa (CHEVALIER 1992: 855fl.; BUSSON 1863: 24fl.; FARKES 1945: 21; WAKU 1975: PARELLA at et al. 1992, NC 1995), although its long-established presence in India was until recently considered as evidence for an Asian domestication, PARELLA at al. (1993) proposed another locus of domestication in Botswana but the late inception of agriculture is this region makes this unlikely. The wild Vigna subsp. divaricata var. divaricata is generally considered to be the progenitor of the domestic cow pea. The cow pea must have been transmitted to Egypt from Sub-Saharan Africa early, for specimens were identified by Schweinfurth among offerings in Firth Dynasty tombs, and Künzer noted small faunia models of the plant (DABREY at el. 1977: 62fl.; GERMER 1985: 87fl.). Finds of cow peas are reported at Kintampo in south-central Ghana dated to 3500 BP but their domestic status remains debatable (STAHLE 1983). ALPERT et al. (2003: 343fl.) record cow pea from the site of Oursi in Burkina Faso as Age de Fer ancien for which they

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give a date of 1869-1870 caBP. In south-central Africa, the first record of cultivated cow peas is in Central Zambia where seeds have been recorded from the 2nd century AD (PHILLIPSON 1993: 132f.). Carboonised seeds have been recorded in a late Iron Age context at Iyangaying, in modern-day Zimbabwe (SUMMERS 1958). They are widely cultivated in Ethiopia (WESTPHAL 1974: 213ff. HEDBORG & EDWARDS 1989: 174ff.). BLENNCH (1990b) notes that a root for 'cow pea' can be reconstructed to Proto-East Bantu-Congo, supporting the idea of domestication in the Nigeria-Cameroon borderland. Long-podded varieties were developed for grain and carried further east to SE Asia where the very long *anqueyalus* cultivars evolved (OCHE & BAKUHIZE VAN DEN BRINK 1980: 435ff.).

Although NG (1995: 330f.) states that cow peas were carried to India by sea at 2200 bp, he presents no evidence for this. Nomadic cultural confusion has not been helpful in clarifying Indian archaeological material but it is now generally accepted that at least two early records are genuine (Daimabad ca. 1700-1500 calBC and Hulas 2200-200 BC) (see FULLER 2000: fn. 2. This volume). The lack of any convincing records of cow peas in intermediate sites strongly supports the sea-route but at a date far earlier than that proposed by Ng. Hulas is a remote site almost in the foothills of the Himalayas and it is difficult to imagine the cow pea left East Africa later than 4000 BP.

Hyacinth bean (dolique de Chine)

*Labeodolus purpurascens* (L.) subsp. *anqueyalus* Sweet (1827)

The hyacinth bean is now thought to have originated in East Africa (SMAKHT 1990, LIU 1996) although its cultivation is known primarily from India, where it has developed considerable agrobiodiversity (FOOD AND AGRICULTURE ORGANISATION 1988: 337ff.). It was carried to Malaria at an early but unknown date (SILLOTO 1983: 9ft.). Hyacinth bean has been reported from many sites in India with reliable illustrated finds from as early as 1800 BC (FULLER, this volume). As with the cow pea, a lack of Arabian sites suggests a sea-route, with rather similar dates. Unlike cow peas, there are no archaeological reports of *Lambab*

in Sub-Saharan Africa. Although conventional wisdom is that it is a widespread early cultigen in West-Central Africa (BUSON 1965: 239f.), the lack of vernacular names (or in the case of Hausa, names suggesting it was brought from Egypt, or even by 'white men' may imply it is quite a recent introduction (BURKILL 1995). Hyacinth bean has been reported sporadically throughout Ethiopia and especially in Gamu Gofa (WESTPHAL 1974: 213f. HEDBERG & EDWARDS 1989: 179f.) and it is known but not widely cultivated in Eastern and Southern Africa. Indian cultivation systems have been introduced back into Africa and are contributing to its spread in traditional farming systems (FOOD AND AGRICULTURE ORGANISATION 1988: 337ff.).

Bambara groundnut

*Vigna subterranea* (L.) Verdc. (1980) (formerly *Voandzeia subterranea*)

Bambara groundnut is an annual prostrate herb grown for its edible seeds throughout most of sub-Saharan Africa and on Madagascar (BUSON 1965: 250f.). It is native to West Africa and was presumably domesticated in the region of the Bantu near the present-day Nigeria/Cameroon border (HARRIS 1912. HEPPEL 1963). ALBERT et al. (2000: 343f.) record the Bambara nut from the site of Ouari in Burkina Faso as *Age de Fer ancien* (Couteau 1938) dated to ca. 1300 BP. In south-eastern Africa, the first record of cultivated Bambara groundnuts is at Iyangaying, in modern-day Zimbabwe where carbonised seeds have been recorded in a Late Iron Age context (SUMMERS 1958). The Bambara groundnut is widely cultivated in India and Java, although the date and route by which it reached Asia is unknown (OCHE & BAKUHIZE VAN DEN BRINK 1980: 439ff.). However, its undoubted domestication in Africa and its absence in the Near East strongly suggest the sea-lanes.

Velvet beans [cow-itch < Hindi kowach]

*Mucuna pruriens* (L.) DC. var. *wiltii* (Wall. ex Wight) Bak. ex Burck

A climbing herb with pods to 9 cm found wild in many parts of Africa, although cultivated in
the Wellega region of Ethiopia (HEDBERG & EDWARDS 1989: 164ff.). The pods are covered in hair, that give a painful sting, but a variety without stinging hairs, var. utilis, is widespread in India and may well have evolved there (BURKILL 1995: 406ff.). Macuna is widely used for cover-crops, fodder-crops and vegetables and in this form has been widely re-introduced back to Africa in recent times.

Cluster bean [guar]
Cyamopsis tetragonoloba (L.) Taub. (1894)
Guar is a bushy annual grown for its edible young pods and seeds, cultivated in Keren in Eritrea which appears to be a native of Africa (HEDBERG & EDWARDS 1989: 138ff.). Although widely grown throughout India, it has no in situ wild relatives, although there are no archaeological finds to indicate the antiquity of its introduction (KAZALE 1991: 174ff.).

3.6. Oil seeds
Castor bean
Ricinus communis Linn.
The original region of domestication of the castor bean appears to have been West-Central Africa but it must have spread early to Egypt, for seeds are found in pre-dynastic sites (GERMER 1985: 104ff.). LORET (1902) reviewed all the records of castor oil in Egypt. Castor is both wild and cultivated in Egypt today, and the seeds of the earliest finds are so reduced in size that they may well be sub spontaneous. The earliest reference to castor oil in Egypt is in Herodotus, fifth century BC (DARBY et al. 1977: 78ff.). In south-eastern Africa, the first record of castor beans is at Inyangwa, in modern-day Zimbabwe where carbonised seeds have been recorded from the eighth century. The earliest archaeobotanical castor in India is at the Harappan site of Hulas, dated at between 1800-1300 BC (GA-RASWAT 1993).

Niger seed [noug]
Guizotia abyssinica Cass.
Niger seed is an erect leafy herb cultivated as an oil seed both in Eastern Africa and throughout India (WATT 1889-93: G. 386. BURKILL 1985: 474ff.). It is found throughout much of Africa as a plant of waste lands and as a casual in Europe. It appears to have been domesticated in the highlands of Ethiopia (BAAGOE 1974) but to have been carried early to India. RILEY & BELAYNEH (1989: 399ff.) note that 'Niger gene pools in Ethiopia and India have been separated for several thousand years'. A closely related plant, Guizotia scabra (Vie.) Chiov, is cultivated in Nigeria, Ethiopia and Sudan but there are no reports of its presence in India.

3.7. Fibre plants
Kenaf
Hibiscus cannabinus Linn.
Kenaf is cultivated principally for its fibres, but the young leaves, as with most of the Hibiscus spp., can be used as a potherb (CHEVALIER 1932: 834ff.). Apparently domesticated in West Africa, it spread to India at an early period, where there has been a considerable development of cultivars (BURKILL 1985: 294ff.).

Jute [Jews' mallow]
Corchorus olitorius Linn.
The original homeland of jute is debated. Jute was used in India very early as a fibre plant, but it appears to grow wild in West Africa (FRANKE 1976: 398ff.; BURKILL 1985: 461ff.). Whether this plant was cultivated in ancient Egypt remains disputed but seeds of the cultivated plant have been found in tombs of the Graeco-Roman period at Kom Oushar (DARBY et al. 1977: 671. GERMER 1985: 118ff.). Al-Umari mentions that Jews' mallow as growing wild in West Africa (LEVITZON & HOPKINS 1981: 263ff.).

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3.8. Managed trees

Tamarind [Indian date, sour tumbler] *Tamarindus indica* Linn. (1753)

The tamarind is now generally considered to be of West African origin, despite its scientific name (*< tamar hind, > date of India in Arabic*) but to have spread to India at an early date (MORTON 1958; BURRELL 1965: 262ff.; LEFFYREY 1971; BURKILL 1997: 164ff.). Charcoal from a tamarind tree has been identified from Narhan site in the middle Ganges at some 1300 BC (SARASWAT et al. 1994). SALLEH et al. (1998) note that it is referred to in the Brahmasamhitā scriptures (1200-200 BC) and in Buddhist sources from around 650 AD. Indian ocean traders are considered to have carried the tree from India to SE Asia in the medieval period (OCHSE & BAKUZIJN VAN DEN BRINK 1980: 431ff.; COATES-ZALGRAVE 1988; GUNASENA & HUGHES 2000). An absence of Egyptian finds suggests that the tamarind may have travelled along the Sudanian Lane.

Silk-cotton [kapok] *Ceiba pentandra* (L.) Gaertn. var. pentandra

BAKER (1965) argues that the cultivated kapok was introduced from West Africa to south-western Asia by the Arabs. However, kapok is very widely spread through insular SE Asia and is found through much of Africa as an anthropic species, so it may also have been carried directly across the Indian Ocean (OCHSE & BAKUZIJN VAN DEN BRINK 1980: 79ff.).

<table>
<thead>
<tr>
<th>English name</th>
<th>Scientific name</th>
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<tbody>
<tr>
<td>aerial yam</td>
<td>* Dioscorea bulbifera* Linn.</td>
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<tr>
<td>mask mallow</td>
<td>* Abbeambraeia moluca* Medik.</td>
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<tr>
<td>pigeon pea</td>
<td>* Ceiba pentandra* (L.) Milap.</td>
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<tr>
<td>sesame</td>
<td>* Sesamum indicum* Linn.</td>
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<td>jujube</td>
<td>* Zizyphus mauritiana* Lam.</td>
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<td>7 horse-raddle tree</td>
<td>* Morus oleifera* Lam.</td>
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Tab. 4 Plants of South Asian origin apparently reaching Africa at an early date.

4. Plants of South Asian origin reaching Africa at an early date

A suite of cultivated plants of South Asian origin apparently reaches Africa at an early date to judge by their establishment within African farming systems. A summary of these is given in table 4.

Aerial yam *Dioscorea bulbifera* Linn.

Aerial yams are cultivated widely through the Pacific (BARBAU 1956), SE Asia (OCHSE & BAKUZIJN VAN DEN BRINK 1980: 246ff.) and India as well in much of Africa. In Africa, aerial yams are spread from Senegambia to Kefa in SW Ethiopia (MARKIN 1974, WESTPHAL 1975: 151; BURKILL 1989: 657ff.; HAMON et al. 1995: 46ff.). There appear to be wild forms in both Africa and India, and both BURKILL (1911) and CHEVALIER (1916: 524ff.) argued that it was domesticated independently in both continents. CHEVALIER (1916, 1912) claims that the Indian type, *D. bulbifera* var. birmanica, were brought to the East African coast by the Arabs and to the West African coast by the Portuguese and would presumably have crossed with or supplanted the indigenous African aerial yam.

Pigeon pea *Cajanus cajan* (L.) Millsp. (1900)

The pigeon pea is a shrub cultivated for its edible seeds and for the browse provided by the leaves now cultivated throughout the tropics (BENSON 1965: 236ff.; OCHSE & BAKUZIJN VAN DEN BRINK 1980: 370ff.; HEDBERG & EDWARDS 1919: 181ff.). Although originally thought to be indigenous to Africa (PURSEGLOVE 1974; YANKE 1976: 139ff.), it is now generally considered to be South Asian in origin and to derive from *Cajanus ceiba* (formerly *Atylosia*) (VAN DER MAASEN 1986. 1996). Indian finds are scarce but the pigeon pea seems to have begun to spread in the mid-2nd millennium BC (FULLER in press a). Pigeon peas were in the Near East at a very early date, as Schweinfurth recorded them in a 12th Dynasty grave at Dra Abu el-Naga, although GERMER
(1985: 94ff) does not accept this as proof that the pigeon pea was cultivated. No archaeobotanical evidence from Africa is available, but the relatively high level of embedding in agriculture in East Africa suggest an early date (ROOD AND AGRICULTURE ORGANISATION 1988: 130ff) in contrast to the virtual absence of pigeon pea throughout much of West Africa (BURKILL 1997: 296ff).

Sesame [Beniseed, girngelly, sesame, simsim] Sesamum orientale Linn. (formerly Sesamum indicum)

The original homeland of S. orientale is the subject of some debate. Earlier authors saw West Africa as its homeland since a preponderance of wild relatives of sesame are found there (e.g. NAYAR & MEHRA 1970). However, during the 1980s, Bedigian proposed that its progenitor was the Indian Sesamum orientale var. malabaricum which today grows wild on granite outcrops and is found in a weedy form all over the subcontinent (BEDIGIAN & HARLAN 1985). BEDIGIAN et al. (1985). More recently, HIREMATH & PITAL (1991) have advanced a strong case for S. malagatum also occurring in India, vindicating the argument of IHLENFELDT & GRABOW-SIEDENSTICKER (1979).

Archaeological evidence for sesame in ancient India is sparse; Sesamum is present during the Mature Harappan period at Mohenjo-Daro, 2600/ 2500-2000 calBC (PULLER & MADELLA 2001). Sesame in China is exceptionally early; HO (1977) reports seeds from a site at Chien-shan-yang dated to 4567 ± 100 bp. Although most authors identify the faba bean as the Bumeranians as sesame, there is no archaeobotanical proof for this; it is at least possible it referred to another oil seed (BEDIGIAN & HARLAN 1986). Evidence for sesame in Egypt places it earlier than the generally accepted 18th Dynasty date (DARBY et al. 1977: 497ff; 785. GEIMMER 1983: 171ff). PLNY (Nat.Hist. 18.22.96) also refers to sesame as an import from India, a trade confirmed by the 'Ptolemaic of the Erythraean Sea'.

If S. malagatum is indeed the ancestor of S. orientale then it was probably carried to Africa perhaps both via the Nile Valley and the Sabean Lane. However, West Africa has at least two other domesticated sesames not found outside the region, S. alatum and S. radiatum. The common use of domesticated sesames in West Africa is as mucilaginous potherbs, not oil seeds. It may therefore be that the white-seeded types domesticated in India later outcrossed with indigenous West African sesames to produce the mucilaginous and oil seed varieties grown there today.

Jujube Ziziphus mauritiana Lam.

The jujube was apparently domesticated at an early period in India (PULLER 2006) and brought to sub-Saharan Africa via the Near East at an unknown period (ZOHARY & HOFF 1993).

Musk mallow Abelmoschus moschatus Medik. (formerly Hibiscus abelmoschus)

The exact origin of this plant remains disputed, although CHEVALIER (1940) argued that it was domesticated in the Pacific region, spreading early to India and thence to Egypt and Sub-Saharan Africa. It is widespread in Africa and shows no sign, culturally and linguistically, of not being anciently established (BUSON 1969: 295. BURKILL 1997: 11f). It may thus have reached sub-Saharan Africa both via the sea-lanes and down the Nile corridor.

Cordia africana Wight & Arn.

A relative of jute, domesticated in India but also widely cultivated in Ethiopia and East Africa, and recorded in gardens in the Gambia (BURKILL 1985: 97ff). Nothing is known about the date or route by which it reached Africa.

Horse-radish tree, ben-ool tree, drumstick tree Moringa oleifera Lam.

The origin of the horse-radish tree is disputed; either it is indigenous to West Africa, but reached

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India at an early date, or the reverse (Bisson 1965: 204ff. BURKILL 1997: 221ff.). Although recorded in Egyptian tombs, no early record has been published and GEMMER (1985: 59ff.) notes that botanical remains are not easy to distinguish from those of Moringa oleifera. COLOMBEL (1997: 307ff.) sets out the vernacular terms for Moringa oleifera in Central Chadic languages, many of which seem to have been borrowed from Arabic. It seems that the tree was brought across the desert to sub-Saharan Africa in the medieval period.

Appendix: Some queries

The plants listed in this section are of Asian origin but have been recorded in cultivation in Africa. Nothing is known of the dates and routes by which they arrived.

Moth bean

Vigna aconitifolia (Jacq.) Maréchal (1969)

A hairy annual with trailing branches from an erect stem, cultivated for its edible pods and seeds. Domesticated in Asia, it is recorded from Eritrea, although its period of introduction is unknown (HEDBERG & EDWARDS 1989: 177ff.).

Asystasia gangetica (Linn.) T. Anders with Asystasia myosheris

An annual or perennial semi-woody herb found throughout tropical Africa and also in India and SE Asia (BURKILL 1985: 3ff.). Occasionally cultivated but more often the leaves are collected from wasteland (SCHIPPERS & BUDD 1997: 137ff.).

Oasis carrot

Daucus carota L. var. saharianus A. Chev.

An unusual type of carrot is cultivated in the oases of the Central Sahara with long, thin white roots. CHEVALIER (1952: 864ff.) notes that it resembles the carrot types cultivated at the oases of Turkestan, described by Vavilov.

5. Conclusion: the impact of African crops in India

This paper highlights the hypothesised major movements of cultivated and semi-cultivated plants between Africa and India, especially those that may have passed along the Sahel Line. The basis for the majority of these claims is either archaeological or textual but the synchronic distribution and cultivar diversity of crops present in both locations, combined with botanical evidence on the original locus of domestication. In some cases, doubt remains about the identity of plants in different continents and whether apparent wild relatives are in fact escapes, as with sesame. India is rather better known than Africa archaeobotanically and plants such as the hyacinth bean are known from Indian archaeological contexts but so far remain unrecorded in Africa. Nonetheless there may be other reasons for the absence of specific cultivars from African sites, if Haaland’s ‘cultivation before domestication’ hypothesis is adopted.

The evidence points to a considerable traffic in ‘promising plants’ from Africa to India and rather less in the opposite direction. The logic of this is simple: if the Indian dates of ca. 4000 bp attributed to cereals and pulses are correct, at that date much of the East African coast would have been populated only by pastoralists and foragers whose interest in new cultivars would have been rather limited. Only Ethiopia, and then only the highland populations, would have been the willing recipients of new crops. Once Bantu farmers began reaching the East coast around 0 AD, a population more receptive to both trade and agricultural exchange would have been present. From this perspective, Indian Ocean traders would have had several thousand more years to observe and transport potential cultivars from Africa to India, hence the greater numbers of plants travelling west to east in the later period.

There is a powerful tradition of scepticism about early dates for African cultivars in India. Nonetheless, recent re-evaluations of archaeobotanical claims of early dates for major grains and pulses in India of African origin have confirmed their presence, even after discarding doubtful finds and
insecure dating. Both linguistic evidence and the degree of secondary diversity of many crops in India seem to confirm these claims. However, of all the plants that probably passed along this route, only a very few have yet made an appearance in the archaeological record. Moreover, as the claims for finds in the Arabian peninsula have collapsed, it appears there was little interaction between the sea-traders and the coastal populations.

POSEHOL (1986) was one of the first writers to suggest that African cultivars played a role in the expansion of Indian agriculture into drier, dryland areas. The argument is that Harappan agriculture was based primarily around winter crops familiar from Europe such as wheat, barley and peas. As a result, despite its early date in the northwest, agriculture did not spread into the monsoon-dominated regions of India for several thousand years after its establishment. With the advent of sorghum, millet, finger millet, pulses and oil seeds, it became possible to take advantage of arid regions with concentrated summer rains and thus agriculture took off in these regions. WEBER (1998), FULLER & MADELLA (2001) and FULLER (in press b) have recently questioned this, suggesting that summer cropping based on indigenous millets was already in place and that the introduced cereals and pulses gradually supplanted them because of yield advantages. Probably only a higher density of sites and dated material will be able to resolve this issue conclusively.

Nonetheless, it is surprising that a traffic so such a significant scale has left so little trace, both archaeologically and textually. This paper does not deal with domesticated animals but the principal gift of India to Africa was probably not a crop but zebu cattle, a species that came to dominate the pastoral economy of Africa. The prehistory of the Indian Ocean trade has tended to rely on text-based analysis and the archaeology of direct finds, but the botanical evidence suggests that "invisible" voyages can have highly tangible effects.

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