CASSAVA CULTURAL PRACTICES

Proceedings of a workshop held in Salvador, Bahia, Brazil, 18-21 March 1980

Editors: Edward J. Weber, Julio Cesar Toro M., and Michael Graham

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Cassava Planting Systems in Africa

H.C. Ezumah and B.N. Okigbo

The target of research on cassava planting systems in Africa continues to be the small farmer who plants fewer than 2 ha, often at scattered locations, and who cultivates and weeds using hand tools. In Africa, cassava is generally grown in combination with other crops. As the last crop in an intensive cropping system that may involve 2–4 years of land utilization with crops such as vegetables, legumes, tree crops, etc. before cassava is finally introduced, cassava may be harvested from fields that have attained various stages of fallow. The planting practices, land preparation, and bush clearance methods are influenced by soil–water relations, consideration for which crop is intercropped with cassava, and the cropping history of the land.

Among the important factors resulting in low root yields in Africa are late planting (10% root yield reduction for every month’s delay), untimely and inadequate weed control, and high incidence of diseases and pests. The enormous drudgery involved in land preparation and weed control, lack of a ready and sure market for the fresh roots, and transportation and processing problems combine to limit the scale of cassava-growing operations in Africa.

Scientific research aimed at confirming, modifying, or completely changing traditional cropping systems used by peasant farmers in tropical Africa is just beginning, but it has been widely recognized that these systems are based upon results of centuries of trial and error, given a particular socioeconomic environmental setting. A system once developed becomes more or less an integral part of the life system of the society and fulfills certain socioeconomic goals. With their limited resources, which must be shared among many other needs, subsistence farmers cultivating fewer than 2 hectares of land are usually reluctant to embark upon innovations that mean increased investment. Unless economically attractive, innovations that entail drastic changes in the farmers’ way of life will probably fail to be adopted, even with intensive extension work.

A typical African cassava farmer grows the crops in mixtures. Methods of land preparation, crop combination, patterns of planting, population and spacing may vary with soil type and other ecological factors such as rainfall regimes. This paper reviews work on cultural practices used in cassava production in certain parts of Africa.

Environmental Adaptation

Cassava is adapted to diverse environmental conditions and systems of cultivation. Neither is it limited to well-defined harvesting periods nor does it require special skills in production (Coursey and Haynes 1970). It is grown in areas ranging from humid (more than 2000 mm annual rainfall) to semi-arid (500–750 mm) in tropical Africa, between latitudes 15°N and 15°S. Though grown at altitudes ranging between 500 and 2000 m in East Africa, the most suitable range is 1500–1800 m (Okigbo 1978). It is grown mainly at altitudes less than 1000 m in West Africa (Onwueme 1978b). These facts suggest that varieties are adapted to different altitudinal ranges.

Cassava also grows in a range of soil types. Well-drained sandy loams, preferably rich in the essential nutrients, are required for high yields of good quality roots, although reasonable returns may be obtained from soils usually regarded as poor and infertile (Godfrey-Sam-Aggrey and Bundu 1972; Onwueme 1978b). Various levels of fertilization have been recommended for different areas, and critical nutrient levels have been reported. In general, improved, newly developed cultivars are more responsive to fertilization.

1International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.
Local cassava varieties exist in adverse growing conditions, and their tolerance to high soil acidity may be related to generations of adaptation to the highly leached, acid soils common in tropical Africa (Edwards and Kang 1978; Rogers and Appan 1972). Indeed, Doku (1969) reported that 50% of the cassava grown in Ghana is in the forest zone where it is usually mixed with maize and cocoyam after a fallow of secondary forest has been cleared. Throughout Africa, cassava is grown in combination with another crop, which varies with ecological regions. Usually, cassava is the last crop in a rotation of crops that is continuous and covers 1—4 years, at which time the field is left fallow.

**Land Preparation**

Land preparation for cassava is basically the same as for most other arable crops. In the forest areas, it consists of bush clearing and some tillage. The amount of work required varies with the dominant vegetation and soil type. In the savanna, the field is simply set on fire before plot preparation, whereas in the forest zone the bush and some big trees must be cut and allowed to dry before being burned. The stumps may be removed. Preplanting cultivation is done with hand tools and entails ridging, mounding, or tillage on the plot. How a field is prepared (ridges, mounds, flat tilled or no tillage) depends upon soil type and drainage. Drainage conditions often determine size of ridges or mounds and location of crops on them. Thus Okigbo (1978) illustrated the placement of different crops on large mounds in the hydromorphic areas of Southeastern Nigeria. There, cassava is usually planted on the side of ridges near the top, and the yams and legumes are planted on top. Crops tolerant to a high water table such as cocoyams (C. esculenta) and rice (Oryza sp.) are planted close to the base of ridges (cocoyam) and in the water-logged, flat intermound spaces (rice). In a study in the sandy-clay-loam soil in Zaire, the yield advantage in net yield from ridges as compared with flat or untilled plots where the field is mulched. Lowest yield occurred in unmulched, untilled fields (Table 1). In highly leached, low-fertility, clay-loam soil (Kimpese), ridging had no yield advantage over untilled plots, which produced the poorest yield, whether mulched or unmulched. No standing water was observed in either location. Okigbo (1979b) observed no effects of land preparation on root yield of cassava grown on flat ground, ridges, mounds, or untilled land. It would be worthwhile to conduct more trials on various soil types and in various ecological conditions. The extent of bush clearing may be unrelated to the land-preparation needs of a particular crop. Complete stumping for cassava culture may be done in forest areas prone to root rot caused by *Fomes lignosus*, for which several trees are alternate hosts.

**Mafuku Method of Mound Preparation**

A variant mound found in Central Africa, particularly Zaire, is called mafuku. Heaps of dry organic matter (grasses, broad leaves — any weeds) are partially buried with soil and set on fire. Part of the organic matter burns completely providing ash, whereas the deeply buried portion burns only partially because of the near anaerobic conditions. Mounds are constructed by the addition of fresh soil. Maize, peanuts, beans, melons, gourds, and vegetables are planted on the center of the heap close to the partly burned residues, whereas cassava and sweet potatoes are planted further away but close to the ashes. Some 7—12 cassava stakes have been observed growing on a mafuku heap spaced 2.0 × 1.5 m (i.e. population of 40 000—67 000/ha). This high population would only be realized if the hectare had been systematically planted, and this is hardly the case in Bas-Zaire where random checks of eight farms revealed considerable gaps

<table>
<thead>
<tr>
<th>Cultivation treatment</th>
<th>Yield (fresh roots, t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Site 1 (Mpalukidi)</td>
</tr>
<tr>
<td></td>
<td>Mulch</td>
</tr>
<tr>
<td>Flat</td>
<td>21.8</td>
</tr>
<tr>
<td>Ridge</td>
<td>17.4</td>
</tr>
<tr>
<td>No till</td>
<td>20.7</td>
</tr>
<tr>
<td>Mean</td>
<td>19.9</td>
</tr>
<tr>
<td>L.S.D. (0.05)</td>
<td>2.3</td>
</tr>
</tbody>
</table>
Although a peasant farmer's field may seem overpopulated, the gaps result in populations approaching those recommended in conventional planting. In the mafuku practice, a farmer concentrates the organic matter, together with its nutrient contents, which would serve a large area, into a much smaller area and, to compensate for loss in area, increases the number of plants on the heap. The position of a mafuku is usually shifted from year to year so that areas between mounds in one season will be the mounds in the next season. In other words, the mafuku land preparation system practiced by the Bakongos of Central Africa more or less constitutes a built in method of crop rotation.

**Time of Planting**

Time of planting depends upon many factors, the most important of which is the onset of rains. The associated crop in an intercrop also determines the time of planting of cassava, which may be planted late (June–August in northern hemisphere, March–April in southern hemisphere) or early (March–May in northern hemisphere, September–November in southern hemisphere). Higher yields are usually obtained from crops planted early because they are exposed to more months of rain (Nwosu 1973; IITA/PRONAM 1978; IITA 1977). In a study of the effects of delayed planting on root yield in southern Nigeria, average cassava dry root yield was reduced 11.0, 35.0, and 56% for respective delays of 1, 2, and 4 months (Table 3). On the other hand, in Zaire, planting very early when rainfall is not yet certain may result in poor establishment of plants and subsequent reductions in yield (Table 4). Given that November is the optimum planting time, one can expect average reductions in root yield at 1, 2, or 3 months delay to be 4, 29, and 34% respectively for a first-season crop. In Western Tanzania, Scaife (1968) reported a decline in root yield from 20 t/ha to only 5, 75% by a delay in planting from December to March.

In South Western Zaire, first-season planting is usually from late September to January. October–December planting is usually recommended, and the common practice is to plant cassava early in combination with maize, peanuts, vegetables, and sometimes melons. Late-planted cassava (February–April) is in as-

---

**Table 2.** Cassava population on mafuku heaps in Bas-Zaïre in 400 m² sample areas.

<table>
<thead>
<tr>
<th>No. of heaps</th>
<th>Plants/heap (average)</th>
<th>Population/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>9.0</td>
<td>11700</td>
</tr>
<tr>
<td>44</td>
<td>8.0</td>
<td>8800</td>
</tr>
<tr>
<td>38</td>
<td>11.5</td>
<td>10925</td>
</tr>
<tr>
<td>48</td>
<td>8.5</td>
<td>10200</td>
</tr>
<tr>
<td>46</td>
<td>7.0</td>
<td>8050</td>
</tr>
<tr>
<td>48</td>
<td>7.0</td>
<td>8400</td>
</tr>
<tr>
<td>56</td>
<td>6.5</td>
<td>9100</td>
</tr>
<tr>
<td>50</td>
<td>8.0</td>
<td>10000</td>
</tr>
</tbody>
</table>

---

**Table 3.** Effect of delayed planting on root yield (dry weight, t/ha) of late season cassava in southern Nigeria (adapted from IITA 1977).

<table>
<thead>
<tr>
<th>Month planted</th>
<th>Cassava alone</th>
<th>% of June yield</th>
<th>Maize/ cassava</th>
<th>% of June yield</th>
<th>Cassava/ melon</th>
<th>% of June yield</th>
<th>Avg</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>June</td>
<td>10.81</td>
<td>100</td>
<td>9.53</td>
<td>100</td>
<td>11.19</td>
<td>100</td>
<td>10.51</td>
<td>100</td>
</tr>
<tr>
<td>July</td>
<td>9.72</td>
<td>90</td>
<td>8.94</td>
<td>94</td>
<td>9.38</td>
<td>84</td>
<td>9.35</td>
<td>89</td>
</tr>
<tr>
<td>Aug</td>
<td>6.91</td>
<td>64</td>
<td>6.54</td>
<td>69</td>
<td>7.04</td>
<td>63</td>
<td>6.83</td>
<td>65</td>
</tr>
<tr>
<td>Sept</td>
<td>6.70</td>
<td>62</td>
<td>8.14</td>
<td>85</td>
<td>7.91</td>
<td>71</td>
<td>7.58</td>
<td>78</td>
</tr>
<tr>
<td>Oct</td>
<td>4.48</td>
<td>41</td>
<td>4.71</td>
<td>49</td>
<td>4.38</td>
<td>39</td>
<td>4.52</td>
<td>44</td>
</tr>
</tbody>
</table>

---

**Table 4.** Effect of time of planting on root yield (fresh roots, t/ha) of early cassava in pure and mixed culture in central Africa, Zaire, (adapted from IITA/PRONAM 1978).

<table>
<thead>
<tr>
<th>Month cassava planted</th>
<th>Cassava yield</th>
<th>Cassava yield when mixed with maize</th>
<th>Avg yield as % of Nov yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct</td>
<td>11.50</td>
<td>12.03</td>
<td>-</td>
</tr>
<tr>
<td>Nov</td>
<td>20.44</td>
<td>10.80</td>
<td>100</td>
</tr>
<tr>
<td>Dec</td>
<td>17.68</td>
<td>12.17</td>
<td>96</td>
</tr>
<tr>
<td>Jan</td>
<td>13.85</td>
<td>8.42</td>
<td>71</td>
</tr>
<tr>
<td>Feb</td>
<td>9.90</td>
<td>10.60</td>
<td>66</td>
</tr>
</tbody>
</table>

*In all cases maize was planted in October.*
Stakes, usually 25–30 cm long, are arranged in different patterns on ridges, mounds, flat or untilled plots. The use of disease-free planting material, preferably 12–18 months old (Godfrey-Sam-Aggrey and Bundu 1972) is recommended. Other observations are: (1) the older the stakes are, the higher the root yield and the better the plant establishment (IITA/PRONAM 1978; IITA 1974; Enyi 1970); (2) stakes are normally two-thirds buried with the older end in the soil; (3) optimum length of stakes is 20–40 cm, though longer ones do not result in yield losses (Nestel 1973); (4) root yield and plant establishment are significantly reduced when stakes are planted upside down (Onwueme 1978b), though this finding has not been established as fact (Nestel 1973); (5) given optimum soil moisture and soil temperature conditions, young stakes become established more readily than do stumps and primary stems. They also dehydrate and die more quickly in adverse conditions, e.g. moisture stress or water-logged conditions (IITA/PRONAM 1978).

Variations in planting methods include upright placement, horizontal, and, most common, slanted planting, in which two-thirds of the stake is buried old-end first, at an angle of 30–45° to ground surface. Effects of the different methods of planting on root yield are conflicting. Some results show no differences for the varieties studied (IITA/PRONAM 1978); others indicate improvement in root yield for different varieties in a slanted position (Umanah 1977); and still others note a significant increment in leaf yield and number of stems per plant as well as reduced lodging for horizontally planted stakes compared with those planted in an inclined or vertical position (IITA/PRONAM 1978). Onochie et al. (1973) have speculated that cassava planted vertically would be less favourable for mechanical harvesting than cassava planted in a horizontal or slanted position because of increased depth of rooting. The mould board plow or ridger used in their study could not easily reach the roots without damaging them.

The most primitive planting pattern and method is on a flat field, at random, with the planter usually moving up the slope or sideways and spacing often being determined by the length of the planter’s stride or machete, or plans for intercropping. Populations of 10 000–28 000 plants per hectare have been observed at random in fields in forests and derived savanna areas of Zaire.

Cassava may be planted on mounds, ridges, or on flat, tilled, or untilled fields. Size and spacing of mounds vary with tradition, soil–water relations, and crop combination. When mixed with other crops, cassava stakes (2–16 per mound) are usually planted on the sides of the mounds. The number of stakes planted varies with location, number of crops per mound, size of mound, and soil–water relations. The size of mound may vary from 1.3 x 1.3 m in Abakalaki, southeast Nigeria (Okigbo 1978), to 1.0 x 0.8 m in Okigwi (personal observation 1976). Oversized heaps, 2 x 1.5 m, have been observed in Bas-Zaire. Up to 11 different crops per mound (including cassava) have been observed by Okigbo (1978). The range was 5–11.

On the basis of research, no spacing has been found to be universally applicable because spacing should vary with cassava variety, the rate of development of leaf cover, branching habit, dominant weeds, and soil moisture conditions (Enyi 1972; Akobundu 1980). Some reports show highest root yield at wide spacings 1.5 x 1 m (6600 plants/ha) (Ekandem 1967 in Okigbo 1979b), whereas others show highest yields at 1 x 1 m (10 000) and 1 x 0.67 m (15 000) (IITA 1974; Umanah 1977). In the forest zone of Ghana, Gurnah (1973) reported highest yield at 18 500 plants/ha. In general, a population of 10 000–15 000 plants/ha is economic and gives a good crop of cassava.

Planting arrangement may vary from 0.9 to 1.5 m between rows, the within-row spacing being adjusted to bring population to 10 000–15 000 plants/ha. A common variation in Zaire is double-row cassava planting — two rows of cassava spaced about 50 cm apart on ridges, 1 m apart. Plant spacing on each ridge is 1–1.5 m. Root yield from this arrangement is comparable with that from 1 m x 1 m spacing, but the double-row pattern tends to favour peanut productivity, especially at high peanut populations.


Systems and Sequence of Cassava Culture

Cassava is generally grown in mixtures with other crops, including yams, maize, cocoyams, plantain, sugarcane, beans, peanuts, melons, bananas, sweet potatoes, and assorted vegetables. Tree crops such as oil palm and cashew (E. Africa, Okigbo 1978) have also been observed in association with cassava, as has elephant grass (Nwosu 1973). Cassava is usually the last crop in a rotational system. Because cassava matures last and is usually harvested after the other crops, some observers surveying areas erroneously assume that cassava is being grown alone. Timing of such surveys is, therefore, important.

Cassava is increasingly being grown alone in large plantations; however, large operations contribute only a small percentage of total cassava production in Africa and are likely to continue to do so for awhile. Thus, the target in cassava improvement is still the small farmer.

Cropping combinations that involve cassava under various ecological conditions in Western Africa based on Okigbo (1978), Nwosu (1973), and Godfrey-Sam-Aggrey and Bundu (1972), include: (1) imperfectly developed monoculture based on cassava; (2) yam/cassava or pineapple/cassava; (3) yam/maize/cassava; (4) cocoyam/plantain/yam/cassava; (5) yam/cocoyam/maize/cassava; and (6) yam/cocoyam/pigeon pea/cassava.

Commonly observed combinations in Central and Eastern Africa include: (1) plantain/Phaseolus/cassava; (2) plantain/sweet potato/cassava; (3) sweet potato/cassava; (4) maize/peanut/cassava; (5) maize/beans/cassava; (6) beans or peanut/cassava; and (7) cassava as a monocrop in the Kalahari Sand areas.

Okigbo (1977b) observed best yield of cassava and maize and best returns per ha when both crops were planted at the same time or cassava was planted through maize after 1–2 months but not later. In Bas-Zaïre, a preliminary observation was that yield reduction of cassava planted through maize 3 and 4 months later was 31% and 12%, respectively. Reduced insolation and sub-optimum temperatures under the maize canopy at 3 months are suspected as the main causes of yield reduction (IITA/PRONAM 1978). It is more profitable to intercrop cassava with other cash crops. The yield of peanuts planted at the same time as double-row cassava, or cassava planted at 75 × 100 cm or 100 × 100 cm spacings, depended more upon the peanut population than upon the cassava planting system, though double-row association was generally superior to the others. Intercropping produces maximum benefits when the cropping sequence and choice of crop minimize interplant competition for the limited environmental resources (light, water, nutrients, space, etc.) during critical periods of growth and development.

Because cassava has minimal demands for resources, it is commonly planted last in a sequence of crops, and the number of crops in combination with cassava decreases with increasing distance from the farmer’s homestead (Nwosu 1973; Okigbo 1978). The farther away the field is located, the less likely it will be fertilized with refuse, etc., and the less demand will be put on it by the farmer.

Among the major cropping sequences involving cassava identified by Okigbo (1978) is a system of 3 years of heavy cropping with maize, vegetables, and other crops followed by early and late cassava mixed with legumes and vegetables in the 4th and 5th years. Whether alone or intercropped, cassava is usually harvested from fields that have been fallow.

Effect of Culture and Ecology on Scale of Operation

Because in Africa cassava is generally grown by low-income peanut farmers, there are understandable limitations on its production. Among the important factors that limit cultivation are:

1. Plot preparation with simple tools. Using only simple hand tools and human power, a family can usually cultivate only a small area. Although some families draw on help from extended families, child labour, and, in rare cases, hired labour, plots rarely reach 5 ha per family. To spread the risk and diversify their crops, farmers sometimes own patches of intercropped cassava plots at several locations; for instance they may have cassava mixed with yams, cocoyams, maize, and vegetables in the more fertile forest zones; peanuts, pigeon peas, and beans in the dry sandy areas; yams, cocoyams, rice, and vegetables in the hydromorphic areas. The availability of the type of terrain needed for specific purposes, a factor related to population pressure and availability of labour for land preparation, may also limit the scale of operation.

2. Weed competition. The most common method of weed control in cassava growing areas in Africa is hoeing. Cassava usually needs to be weeded at a time when there is a high demand on
the farmer's time for other farm operations such as harvesting peanuts and maize, preparing plots for bean and cocoyam cultivation, and maintaining compound farms. For good cassava root yield, weeding must be frequent and timely, especially during the first 12 weeks (Akobundu 1980; Moody and Ezumah 1974). Most farmers fail to weed early enough, and their losses are high. To be economic and meaningful, large-scale cassava production requires that weeds be controlled. Hoeing is too expensive, demanding about 41% of the time spent in cassava production. Excellent herbicides that have proved effective against weeds associated with cassava in forest zones of Nigeria have been identified by Akobundu (1980). The plots where such herbicides were applied produced root yield as good as weed-free plots. Again, the utility of the herbicides is limited by the mixed cropping system of cassava.

Choice of cassava variety may be helpful in controlling weeds. Akobundu (1980) has noted that TMS 30395 developed at IITA grows fast, produces extensive branches and leaf cover within 3 months of being planted, and thus has some natural means of weed control. Lal et al. (1979) identified some legumes and grasses that can be grown as cover crops, killed as sods with contact herbicides such as paraquat, and have maize, cowpeas, and cassava planted through them in untilled plots. Cassava produced well in this system, which, if perfected, may provide an answer to weed control in mixed cropping. In contrast, mulching (with organic matter), though suppressing weeds and improving root yields, is not practical because of the lack of available mulching materials, a problem recognized by Lal et al. (1979).

(3) Diseases and pests. In Africa, cassava is attacked by many diseases and pests, among which are African mosaic, cassava bacterial blight, and cassava anthracnose. Prevalent insect pests are the cassava mealybug, the green spider mite, and Zenocerus sp. Each of these diseases and pests causes considerable losses in root yield (IITA/PRONAM 1977; Nyira 1978) and reduces the scale of production and operation.

(4) Transportation of planting materials. Cassava stakes are heavy and difficult to carry given the resources of peasant farmers. This feature obviously limits the extent to which they can be conveniently moved. As most cassava diseases and pests are transmitted via stakes, there are stringent quarantine regulations that limit the dissemination of disease-resistant cultivars and, hence, their introduction in areas where they are badly needed.

Conclusions

Cassava-planting systems differ throughout Africa but are similar in that they are part of subsistence operations. The scale of cassava production is limited by drudgery in plot preparation and weeding, diseases and pests, transportation and difficulty, and obstacles to widespread adoption of scientific innovations in mixed cropping systems. A disturbing view expressed by Hahn et al. emphasizes the place of cassava in the diet. "Since it is a reserve food, 90% of which is consumed by humans in Africa, it is generally harvested when needed and when more attractive food crops are out of season or are destroyed by drought. Unless the trend is such that demands other than human consumption make production more attractive, the potential increase in production may be retained in the ground." Industrial demands for cassava, more efficient and faster processing methods, more easily accessible processing facilities, and a more affluent population, coupled with demands for cheap food by an ever-increasing population, are likely to increase the trend toward larger commercial cassava farms such as those gaining ground in Nigeria and other West-African countries, and in Zaire.