ROOT CROPS IN GHANA

—*by*—

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Cassava, (*Manihot esculenta,* Crantz,) Yams, (*Dioscorea* spp.) Cocoyams, (*Xanthosoma sagittifolium,* Schott., and *Colocasia antiquorum,* Schott.) and Sweet potatoes *(Ipomoea batatas, Poir)* provide the main source of carbohydrates to a large proportion of the population of the tropics, especially the inhabitants of the wetter tropics, including Ghana. When cereals are in short supply, as they occasionally are, these root crops supply the sole source of carbohydrates.

Generally, they are not grown on a large scale. Nevertheless, they are of immense importance, and in every garden or small holding throughout the tropics one or more of these crops are grown. The total annual production must therefore be considerable.

These crops are as important as the Irish potato is to the European as constituents of the daily diet. They can be grown on a variety of soils and as a rule, require or receive little attention. They are therefore relatively cheap to produce, but they yield very heavily. Cassava may yield up to 12 tons or more per acre, Yams, about 5 tons or more. Cocoyams about 5 tons or more and Sweet potatoes about 6 tons or more on peasant farms. All these crops could certainly yield much more with better management and the planting of proven varieties. At the moment, perhaps with the exception of cassava and yams, varieties do not generally play any major role in the cultivation of these root crops in Ghana.

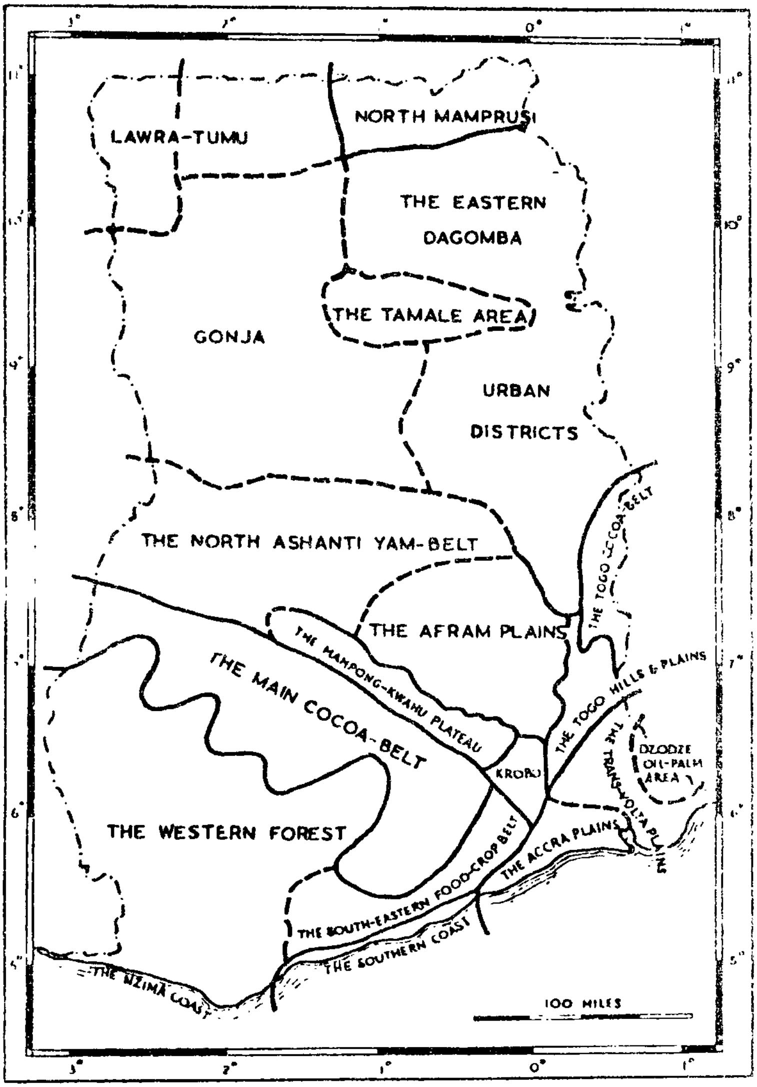
In contrast with these tropical root crops, to obtain high yields (about 10 tons per acre) with Irish potatoes (which have been and are still being grown in Ghana) under temperate climatic conditions, a very high level of soil fertility ensured by heavy manuring is required in addition to frequent cultivations to check competition by weeds.

While diseases do not generally appear to be a major problem in the cultivation of the tropical root crops, they are the major problem with the cultivation of Irish potatoes everywhere in the world, be it in the temperate regions or at high or low altitudes in the tropics.

Many disease of the Irish potato are well known because intensive research has unearthed these diseases together with their control measures. On the other hand, diseases of tropical root crops appear to be of minor importance, probably because the depth and scope of researches on these crops in the tropics do not come anywhere near to what has been done on the Irish potato in temperate regions. The havoc done by disease to tropical root crops is therefore not really known and would appear at the present, at least, that the growing of Irish potatoes is a more specialised and expensive business than the growing of any of our tropical root crops.

Of course, yams, and sweet potatoes have their storage and sprouting problems but so also has the Irish potato. Cassava has its virus diseases, Mosaic

GHANA: PROVISIONAL AGRICULTURAL REGIONS



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and Streak, (the latter not present in Ghana) and Cocoyams their root rot, but these would appear to do less havoc when compared with the havoc done to the Irish potato by Late Blight, Wart, Potato viruses X and Y, to mention only a few diseases.

ROOT CROPS IN GHANAIAN AGRICULTURE

The importance of Cassava, Yams, and Cocoyams in terms of their distribution, acreages and total annual production would be seen by glancing through Tables 1 and 2, respectively. Sweet potatoes do not appear in the tables because they are unimportant. (Wills 1962).

Cassava:

Cassava used to be grown only in Southern Ghana, particularly, the non-forested areas which still produce about 50% of the total crop. The crop is now being increasingly cultivated in the forested and savanna areas in other parts of the country also. Even as far north as Tamale, one often sees cassava growing in small gardens here and there.

It is generally the last crop to be planted in rotation when the land is left to fallow. This, however, is not the general practice, and may be confined only to areas where the rainfall is adequate and more reliable, thereby making it possible for good crops of maize to be taken.

In the drier eastern part of the coastal plains where comparatively little maize is grown, one often sees crop after crop of cassava being grown on the same piece of land year after year, generally but not always, in mixed culture with legumes, i.e., groundnut (*Arachis hypogea.*) bambara nuts (*Voandzeia subterranea*) and cowpeas, (*Vigna unguiculata*) and occasionally with vegetables—tomatoes, peppers, okroes and garden eggs.

Yams :

The yam is a crop of the savanna area where it grows well and gives good yields (Torto 1956). Its cultivation is centred around Northern Ashanti, Brong Ahafo, Krachi and along the main roads leading to Wa, Tamale and Yendi in the North. Unlike cassava, great care is exercised in the choice of fertile land for yam growing. According to Torto (1956) land rested for about 6 years is known to produce tubers of good size, whereas lands cultivated more frequently yield poorly. New uncultivated lands in the savanna are very extensive and growers continue to open up more land for planting. The crop is usually interplanted with various crops, i.e., cowpeas, upland rice, vegetables, etc.

D. rotundata and *D. alata* are also produced in the forest areas and even as far south as the Coastal Scrub and Thicket zone, the latter area being where they were first encountered and described by the early European traders and explorers. Production in these areas, however, seem to have declined considerably. Farms here are smaller and fewer ; mounds and yields are also smaller than those of the savanna areas.

Though the types of crops being grown in the Northern (Interior) savanna areas were not known at the time the early European explorers were describing those being cultivated on the Coastal areas, it would appear that the yam has moved northwards where it found a more favourable environment than the south. Only a few areas (Kpandu, Asesewa, Bawjiase and Mankessim) are left in the forest zone where *D. rotundata* is cultivated on a commercial scale. Around Akim Oda where some yams are also grown, the quality is poor and are only occasionally offered for sale. According to Torto (1956) the climate of the forest areas is too humid, and the soils unsuitable for yams. There is also not a well organized system of seed supply as in the savanna areas where some farmers specialize in seed yam production on a commercial scale.

Cocoyams :

Both *Colocasia* and *Xanthosoma* cocoyams are cultivated throughout the forest zone. There are four varieties of the former, and one of the latter. (Wright 1930b).

In the past, Cocoyams were planted almost everywhere after clearing virgin forest for farming. Today, whenever a piece of secondary forest is cleared, cocoyams spring up all over the cleared area, these plants having arisen from old pieces of tubers which for years had been lying dormant in the soil after the old farm had been abandoned and the forest had rejuvenated. It is not known how long such tubers remain viable, but Wright (1930b) cites an interesting example in the Aburi gardens when in 1930 part of a Funtumia plot was cleared after 34 years of growth and within a month cocoyams sprung all over the cleared area. Presumably cocoyams had been growing on the site before the Funtumia was established but due to shading, weed and root competition, etc., they had apparently died out. Over these three decades, however, some of the tubers had retained their viability and had sprouted when suitable conditions for growth were created. These tubers produced healthy plants.

In the cultivation of cocoyams, these plants which spring up on clearing secondary forest are thinned out when growing too thickly in places, and gaps filled by pieces of seed consisting of portions containing buds of the old rhizome. When mixed cropping is practised, which is the usual practice, gaps are not filled with seed cocoyams after thinning, but with other crops such as maize, plantains, beans, etc.

When the mature crop is dug up and the cormels of a plant removed, the central corm is trimmed down and the remaining stump planted in the same soil, if not at the same spot, from which the plant has just been harvested, or it is covered with soil to serve as a seed for the next generation.

The cormels which this seed produces are smaller than those of the previous generation, and vary in shape, being from round to oval, instead of flask shaped. These are harvested in a similar manner ; the old stumps being trimmed again to serve as seed.

This process may go on generation after generation till such time that yields and quality of the crop so deteriorate that the farmer gives up the farm for another, and the entire process starts again in the new farm. Meanwhile, the abandoned farm gradually becomes over-grown into secondary forest.

Sweet Potato:

Sweet potatoes are mainly grown in the interior and coastal savanna zones, and in other parts of the country, all on a small scale. It is not yet an important root crop compared with the others. There appears to be two main varieties with several gradations in between. (1) A white-tubered, (white fleshed) variety commonly cultivated in the coastal areas, and (2) A purple-violet-tubered, (white-fleshed) variety more common in the North.

Acreages and production of various crops, not excluding root crops, have increased tremendously since independence (1957), and though the figures in Tables 1 and 2 may not be correct now, there is reason to believe that compared. with the other crops, the same percentages in terms of acreages and yields have been maintained.

Table 3 is compiled from a countrywide survey of the distribution of expenditure within the group "local foods". From it, it would be seen that the root crops together with their products account for *21.28%* of the expenditure on local foods (i.e. 15.82 + 5.46). All the cereals and their products taken together account for *17.00%* (i.e. 10.45 + 6.55%). Meat and Poultry account for *14.00* and Fish *18.53%*.

The importance of root crops in Ghanaian agriculture and in the Ghanaian diet cannot therefore be over-emphasised. More is spent on them than any other foodstuff. Cassava alone with its products account for 12.27% (6.81% + 5.46%), Yam 6.89%. Cocoyam 2.07% and Sweet Potato only 0.05%. The relative importance of the individual root crops is thus indicated.

ROOT CROP INVESTIGATIONS IN GHANA.

Despite their importance, and the fact that they have been cultivated in Ghana for a very long period, (the most recent introduction, *X. sagittifolium* having been cultivated for over a hundred years) with the exception of cassava and perhaps yams, these root crops have not and are not receiving the research attention they deserve.

Research into all these crops which was started round about 1930 by the then Department of Agriculture has not been kept going for all the crops. In fact, research work on sweet potatoes and cocoyams ceased as far back as the early 1930's and the early 1940's respectively, and has not since been revived. Active research on yams also ceased during the 1930's but has had to be revived recently (i.e. since 1958) primarily because of the great damage being done to the crop by the yam tuber beetle in the main growing areas. The work on cassava has been the least interrupted. Except for a 6-year break from 1948 to 1954, it is still being continued.

Sweet Potato :

The only investigations on Sweet potatoes in Ghana on record were the testing of introduced varieties at Kpeve Station (Anon 1931) and (Anon 1933) in 1931 and 1932. The mean yields of these introduced varieties over a period of two years are given below :—

(1) Six weeks	5,174	lbs/acre	(6) Red Vine	1,800	lbs/acre
(2) Brook's Seedling	3,995	,,	(7) Palime	1,737	,,
(3) Trinidadian	3,070	,,	(8) White Sealy	1,637	,,
(4) Jackson	2,840	,,	(9) Brook's Gem	1,576	,,
(5) Caroline Lee	2,521	,,	(10) Red Nut	1,151	,,

palatability tests found Red Nut and Brook's Gem, the poorest yielders, to be among the best in flavour.

More varieties were introduced to Aburi Gardens in about 1933 from the New South Wales, Australia (6). These were (1) Wannop, (2) Puerto Rico, (3) Pierson, (4) Nancy Hall, (5) Yellow Strasburg, (6) Southern Queen, (7) Ashburn, (8) Vineless and (9) Triumph. No record of their performance is available.

It is not clear what happened to these introductions. It is not on record whether or not the best varieties among them were maintained and given out to farmers, though it is likely this might have been done. However, with the passing of time, they have all become mixed and disappeared together with any useful information that might have been accumulated about them. The present position is that though many varieties of sweet potatoes are grown on a small scale in the country, their names, yields and other qualities are not widely known. Farmers grow what they like or what they can get hold of. It would however appear that a variety whose tubers have a white skin and a white flesh, said to be of "local" origin, is the most popular and most widely grown around the coastal areas, and another, with purple or violet skin and white flesh is the most popular and widely cultivated in the Northern and Upper Regions.

Clerk (1961) observed virus-like symptoms on Sweet potatoes in the Akim Abuakwa district. This was later confirmed to be a virus disease and was named Vein Clearing Virus, after the nature of the symptoms.

It was said to superficially resemble a virus disease of Sweet potatoes found in parts of East Africa, Congo Leopoldville, and Ruanda Urundi. The vector in Ghana was found to be the Aleuroid fly *Bemisia tabaci* Genn.

The extent, distribution and damage to the crop has not yet been studied, probably because the crop is not so important at present. I would indeed be very surprising to some one from the West Indies or the Southern United States where so much sweet potatoes are cultivated and eaten in various forms that no research work whatsoever is being done on this crop, and that such a small amount is cultivated in Ghana.

Cocoyams :

Research work on cocoyams was mainly to find the causal organism and the control of a disease known as root rot. Wright (1930b) reported that the late stages of the disease was first observed at Wankye near Oda in 1925 by Dade, who in the absence of any other demonstrable organism capable of causing the disease, suspected nematodes to be the probable cause.

The disease takes the form of a wet root rot, wilting of leaves and the inability to form tubers, followed, in severe cases, by death and putrefaction of the entire plant. It may appear any time after planting. The sprouting "seed" may never push a shoot above the soil ; plants may make an extremely stunted growth or may die off, after having become well established. In well established plants, symptoms are a flaccid appearance and yellowing of leaves. Chlorotic patches appear and often the leaves become attacked by leaf spotting fungi, e.g. *Cladosporium* colocasiae, *Phyllosticta colocasiae* and by woolly aphids and scale insects. Roots exhibit a dying back accompanied by a blackening necrosis and wet rot. Decaying corms are usually coated with a typical mycelial felt of *Sclerotium rolfsii.*

In 1926 Wright (1930b) found the early stages of the disease in other parts of the forest zone and after several investigations concluded that the disease was physiological, caused by a deficiency of Potassium and that all organisms found attacking the tubers were soil saprophytes and only became capable of attacking the roots when the plant was in a debilitated state. He recommended the following control measures :

(1) Cocoyams should be established on virgin soils not previously used for root crops.

(2) Bush should be burnt off and not only cut down and cleared away and the crop be liberally manured with all available wood ash.

(3) The health of the crop should be given a bit more attention by weeding more frequently, with a more thorough bush clearing since the crop likes sunshine.

(4) The practice of cropping till the soil became exhausted should be modified by reducing the number of times a crop was taken from the same farm.

(5) The custom of planting "seed" in exactly the same soil from which the previous crop had just been taken must be avoided as well as the use generation after generation of the same old stumps as "seed" since this practice was bound to result in seed degeneration.

This disease investigation work was followed up by Posnette (1945) who found inter alia, that :

(1) Application of wood ash did not reduce the incidence of the disease.

(2) Rogueing of all "wild" cocoyams immediately after bush clearing and then planting healthy setts delayed the on-set of the disease so that a crop might be obtained.

(3) Once infected, plants might carry the disease and infect the soil.

(4) The disease might be carried by corms which had been surface sterilized and all roots removed.

(5) It might be transmitted by gently rubbing an extract of apparently healthy roots from diseased plants with carborundum powder on the roots of healthy plants.

(6) It might also be transmitted through leaf petioles grafted together.

He therefore suggested that for further investigation, the primary pathogen might be considered to be a virus which alone caused lesions on the roots and rendered the plant susceptible to a variety of weak parasites often present in the soil.

So far, as the author is aware this line of the work has not been followed up in Ghana since the publication of Posnette's paper. The economic importance of the disease itself is not very well known. It is not very likely that it has declined in its severity and is no longer of economic importance.

In his earlier work, Wright (1930b) showed that none of the then available cocoyams varieties was resistant to the disease. New introductions were therefore made in 1937 and 1938 from Hawaii, Sierra Leone, Nigeria, Trinidad, Puerto Rico, and the Panama Canal Zone. Almost all these introductions succumbed to the disease. However, one species *X. violacceum* var. Yautia Palma proved to be very resistant, but unfortunately it was not edible. Two other varieties, Conbiche and Morado proved more tolerant than the local types, but their tolerance was not sufficiently high to be of economic value.

Meanwhile, single plants of local varieties had sometimes been observed to stand unaffected while the rest of the farm succumbed to the disease. On the assumption that bud mutations were not uncommon in this species (since many varieties are known though true seed is rarely formed) Posnette (1945) carried out trials with 30 plants propagated from uninfected cormels and concluded that individual plant selection among local varieties had possibilities. This line of work also has not been followed as yet.

Posnette (1945) also investigated the possibility of producing true seed for hybridization purposes. When grown under light shade, he found that the local cocoyams flowered freely but none of the spathes set seed. A considerable amount of hand pollinations both of self and cross—was done without success. None of the introduced ones flowered.

While investigating the disease, Wright (1930b) also studied the local varieties. He found five different types of which four were varieties of *X. sagittifolium*, and one, a variety of *C. antiquorum*. All these he described some details.

The names of the sagittifolium varieties are given in Twi as :

(1) Amankani Pa or Amankani Kokoo—With purple petioles and pink tubers. The most common variety said to possess all the desirable cooking qualities of texture, taste, etc.

(2) Amankani Fufuo —Very similar to Amankani Pa, but with pale purple petioles and white tubers.

(3) Amankani Fita —Above ground parts resemble Amankani Fufuo, but the plant is smaller and more delicate. The tubers are white and the cormels have several constrictions.

(4) Amankani Antwibo —Petioles very pale green and cormels pink unconstricted. The central stem of this variety is edible.

The variety of *C. antiquorum* is known as Kokoo in Twi. Its peltate leaves are supported by pale, green petioles. The tubers are white and smaller than the Amankani varieties. The central stem is edible. At one time this was the favourite variety, but is now seldom eaten except in cases of scarcity. Because it is very soft, it is preferred by old men and women, and on account of its poisonous properties, it has to be boiled for about 12 hours before it becomes edible as compared with the 20 minutes or so required for cooking the Amankani varieties. Also unlike the Amankani varieties, it is not suitable for fufu.

Yams:

Research work on yams started round about 1928 at Ejura Station, (de Graft 1960) with the collection and classification of cultivated varieties in Northern Ashanti and what is now Brong-Ahafo and the Production of seed yams from elite varieties for distribution to farmers.

A very large collection, amounting to several hundred varieties was made and classified. About 80 *rotundata* and 133 *alata* varieties were classified. These varieties are still being maintained at Ejura station but with the passing of time some of them have disappeared. The remaining varieties in the collection were planted at Kwadaso, the main research station in 1961 so as to facilitate further observations on them.

Varietal and other trials involving mainly *rotundata* varieties were conducted on several Agricultural stations in the country about this time. The stations included Ejura, Wenchi, Tamale and Asuansi.

Variety Trials. In 1932, trials involving 15 local *rotundata* varieties were conducted at Ejura. (Anon 1931c). The varieties were found to differ greatly as regards yield and taste. Yield ranged from 1½ tons to 4½ tons per acre. Pasadjo, Lilia and Zon the most commonly grown varieties, all yielded 4½ tons per acre. Brofo and Zugulamgbo which were of the worst quality as regards taste, yielded 3 tons and 2 tons per acre, respectively, but both stored better. The best varieties in respect of taste, Asobayere and Lareboko also yielded only 1½ tons and 2 tons per acre, respectively.

The other variety trial on record was conducted at Ausansi station (Anon 1936) involving 6 varieties. Yields which were given per set, (and not per acre) ranged from 7.95 lbs. to 6.80 lbs. The results were by no means conclusive since this was not a full scale trial, and plot size was small in addition to many gaps between plants.

Planting on mounds vs. planting on ridges: Trials were conducted at Wenchi and Ejura stations comparing the yields of yams planted on ridges with those planted in the traditional way, on mounds. (Anon 1933). Large disc ploughs were used to make ridges of similar size and spacing as the mounds.

Mounds or ridges at 6' apart were found to give the best yields.

The problem of staking becomes acute with mechanical cultivation. All trees are felled and stumped and stakes have to be provided whereas in the traditional way of clearing, farmers leave some live stakes in the form of unfelled trees. However, since the ridges are straight, an overhead line above the ridge supported only by a few stakes at intervals is all that would be required. The vines could then be trained on the line.

In these trials yields from ridges staked as described were as good, if not better, than those of farmers, and labour was considerably reduced. This method of planting yams on ridges is still being practised at Ejura and other agricultural

Staking Trials comparing staked and unstaked yams were conducted at Tamale (Anon 1931a) and Kumasi (Anon 1934).

Treatments ranged from no staking to stakes of 12' high. In both experiments overall yields as well as individual tuber size increased with height of stake: from 3,605 lbs/acre for no staking on Labaco at Tamale, to 10,568 lbs/acre—the average yields of 6 varieties at Kumasi for 12' stakes —, and 11,278 lbs/acre for 6' stakes on Dapam at Tamale.

There was a strong indication that the profitable limit of height of supporting stake was not reached since it appeared possible that still greater yields could be obtained by using higher stakes. Brown (1931) has also reported similar results. He suggested that weed competition might be more severe on unstaked yams, hence their lower yields.

Sexes of yam plants: About 290 plants of 6 varieties, were planted for observation at Asuansi station, (Hinson 1934). 54 produced no flowers, 11 had abnormal flowers, the sex of which could not be determined. Three varieties, Batafu, Ayirbil and Lilia, were entirely female varieties, producing no male flowers. Puna was probably a male variety and Unnamed and Akokoa produced a mixture of male and female flowers.

It is very unlikely that farmers had selected plants by examining flowers, the sole interest being in the tuber and other characters such as earliness or lateness in maturity, leaf size, presence or absence of prickles, etc. If this hypothesis is true, then it would mean that male and female plants might have produced different characters hence selection by farmers had resulted in either pure male or female plants. Where the influence of sex had no effect on plant characters of value in selection, a variety producing both male and female plants had resulted. Hinson (1934) observed that male plants produced less foliage than female plants, in the variety Unnamed.

Unfortunately no male plant produced pollen and no female seed germinate at this time. However, later germination experiments with true yam seed by Waller (1958) suggested that seeds might require a dormancy period before germinating. Though it was not stated how long this dormancy period would last, it was suggested that pricking the seed and dipping it in alcohol for a brief period would enhance germination.

Summarising the results of preliminary investigations on yam seed germination in Nigeria, Waitt (1956) has suggested that when the seed was harvest ripe, it was not germination ripe, i.e. the embryo was immature. The harvested seed would require certain conditions of type and duration of storage before germination could take place. The best germination percentages were obtained for *D. rotundata* and *D. dumentorum* seed (% germination figures were not stated) planted on the surface of charcoal.

Waitt (1957) again reported later that a storage period of more than three months was required during which the rudimentary embryo at harvest would become mature. Storage under dry conditions was found to be better than storage either under room conditions or under low temperatures.

Recent work (Doku 1965) on two *rotundata* varieties confirmed the embryonic immaturity hypothesis of Waitt, but found that at least for the varieties concerned, a storage period of two months at room temperature was required. "Satisfactory" germinations (between 35% and 51%) lasted for 6 months after which there was a sharp decline in germination. Germination temperatures of 30°C to 35°C might not only enhance germination but also prolong the period of "satisfactory" germination.

Seedlings obtained from these tests produced only small tubers after about 9 months. These were used as "seed" yams for planting in the normal way. The resulting plants and tubers resembled the parents from which the true seed was collected, though the tubers were still slightly smaller.

The biology of flowering and pollination in yams as a whole need urgent study. Our knowledge in this field is very scanty indeed, and if we are to effect any improvement through breeding, then such knowledge would be indispensable.

Fertilizer Trials : Trials throughout Ghana on various crops indicated that gains of 5% to 20% in yield could be obtained on yams with Sulphate of Ammonia at rates ranging from 60 lbs per acre to 120 lbs per acre depending on the district (Torto 1956 and Evans 1961). A more recent recommendation is 1 oz. per yam mound of Superphosphate and Sulphate of Ammonia in a 1 :1½ mixture applied at planting in a drill around the mounds halfway down. (Willis 1962).

Studies on the Yam tuber beetles : Work on the Yam tuber beetle started round about 1958 (Buahin personal communication). The species involved is *Heteroligus meles*. Billb. equal *H. claudius*. klug. The adult beetles feed on the yam setts and growing tubers in the soil. The feeding holes are generally about big enough to accommodate the insect, but where the damage is great the holes are deeper. When many beetles attack a single tuber, the feeding holes coalesce and the resulting tuber is unfit for eating.

The beetles emerge from their breeding areas around water sources during late March to May. They enter the mounds, feed on the tubers, mature and then leave the mounds in late October and November to breed away from the yam fields. The eggs are laid in October-February.

In laboratory observations, the eggs were laid singly in the soil, and a single female could lay about 200-250 eggs during a life time. Incubation period was from 14-18 days and larval period, 70 to 160 days during which time moulting occurred thrice. The pupal period varied from 7 to 26 days.

A search for control measures has established that seed yams treated with 0.3% Aldrin are well protected against beetle damage but it appears the residual effect does not last long enough. Setts treated and sown in March are well protected, but setts sown in December-February should be treated in March, by opening up the mound and spraying the setts and the soil around with 0.3% Aldrin. This method though tedious is effective.

The economics of Yam Production : Some research has been made into the economics of yam production in Ghana. (Bray 1958). This crop is one of the few fully commercialized crops in Ghana. In the major producing area, farms are large, the average farm size of about 20 acres, ranging from 15 to 30, is very large by tropical standards.

From 50% to 90% of the gross farm income is derived from the sale of farm products, yams being the major crop, and others like maize, and rice are grown as supplementary crops both by interplanting and as a succession crop. Much of the work is done by hired labour, though a farmer's family may also help on the farm. Labour is paid for partly in kind and partly in cash. The average rate of a hired labourer is £35 a man year (230 days of 7 hours each). The mean family income from yam production is estimated at approximately £150 for a family input of labour on the farm of 4/5 of a man year. Some of the farm produce is, of course, consumed and this is difficult to estimate.

Average yields are estimated at 5 tons per acre and the disposal of yam is estimated as follows :—

Small useless tuber	15%
Used for extra seed (otherwise unsaleable)	15%
Stolen or otherwise disposed of	10%
Coverage for losses in transit	10%
Failure to sprout	5%
Damaged in harvesting	5%
Total unsaleable	60%
Saleable	40%

Thus 600-700 mounds planted to the acre would produce 240-280 saleable yams per acre.

Cassava :

Like Cocoyams, research work on Cassava in Ghana was started to find or breed varieties resistant to a virus disease, Cassava Mosaic, first observed near Accra in 1926, and had spread throughout the main cassava growing areas by 1930.

Cassava had been in cultivation in Ghana for over 200 years and because many varieties flower and set seed, numerous local varieties had been developed through selection by farmers.

Almost all these old varieties yield well over 5 tons per acre, have good food qualities (fufu and ampesi) and a safe level of HCN (i.e. less than 50 mg. per kg. fresh root), though some varieties may excel others in these characters probably because there were different emphasis in selection by farmers in different areas. Unfortunately, all these varieties went down heavily with the virus disease. It therefore, became necessary not only to find or breed varieties resistant to the virus, but also to combine this resistance with the high yields and good food qualities of the old varieties.

As a preliminary to breeding, a large collection of local, and of exotic varieties from Trinidad, British Guiana (now Guyana), Mauritius, Java, Kenya, Sierra Leone and the Cameroons was made. These were inter-planted with a susceptible variety in field trials on Agricultural Stations, for the assessment of their resistance. Susceptibility of seedlings was assessed by grafting buds of infected plants on to seedlings, or grafting seedlings on to infected plants.

Mechanical inoculation was not successful. It was realized that grafting gave absolute results, but was no real guide to field performance. Apart from the intrinsic ability of a plant to resist infection, there were other external factors controlling natural infection which the artificial methods did not cater for. Since, however, the element of chance was greater in natural field infection, the grafting method was used as a check on field performance when a variety's behaviour was inconsistent.

As a result af several crosses and field tests, two hybrids namely C50 and C282A were recommended as being high yielding, of good taste, and highly resistant to mosaic. C50 later went down with the disease and was replaced by Mauritius 9, a selection from an introduction from Mauritius which was later named Ankra in 1935. C282A was also later named Queen. The varieties Gari and Williams, also selected from crosses, were later added to the recommended list. Unfortunately, the parents of most of these hybrids cannot be traced.

Gari had the highest mosaic resistance and was also the highest yielder, producing very large but unpalatable tubers high in starch content. It was recommended specificially for Gari and starch production.

Queen was an all purpose type, highly resistant to mosaic with moderate yields and palatable tubers.

Williams, named after the breeder, was the most palatable variety with a fair amount of mosaic resistance and moderate yields.

Ankra was also very palatable, high yielding with a high mosaic resistance. Several cuttings of this variety were extensively distributed to all parts of the country and other parts of Africa, i.e., Nigeria, East Africa, and the Firestone rubber plantation in Liberia. (de Graft 1960, Lloyd-Williams 1957). (Yield and Resistance figures not given).

These varieties are still being grown by farmers but are very mixed, probably as a result of accidental hybridizations with other varieties. Because of this breakdown in varietal purity, or an increase in the virulence of the mosaic virus as it became more widespread through the country, all these varieties became very susceptible to the disease to such an extent that they are now used as spreaders of the disease in field trials. Ankra, by far the most popular and widely grown variety in the country today, however, still maintains a relatively high yield of between 7 to 10 tons per acre or probably more.

With the death of T. Lloyd-Williams (Plant Breeder) in 1942, A. C. de Graft, his assistant, had to continue his valuable work alone till 1948 when the latter was given a new assignment. Work on cassava was therefore discontinued till 1954 when a new Plant breeder was appointed.

By this time, results of work in East Africa where breeding had been concentrated on resistance to two virus diseases, mosaic and brown streak (the latter is not present in Ghana) were beginning to be known. It has been established there that no variety of *M. esculenta* was completely resistant to the mosaic virus. Resistance was found in other species which lacked the tuberous roots of *M. esculenta* and successful inter-specific crosses combining resistance with the desirable characters of *M. esculenta* had been obtained.

Resistance, however, was not a simple presence or absence factor, but ranged from very high resistance to susceptibility with all grades in between. (Jennings 1963). There was also a strong suggestion that the ideal of immunity might not be reached, but that highly resistant clones which would be satisfactory in respect of other desirable characters could be developed.

The mosaic virus was also found to exist in several different strains and there was always the possibility that resistance, even in a highly resistant clone, might break down and hence a high yielding, susceptible but tolerant variety might be a better proposition.

There was again a strong indication that a more virulent strain of the virus was at work in East Africa since all resistant varieties from the West Coast immediately went down with the disease when sent to East Africa. It was therefore decided to obtain some resistant material from that part of Africa to improve the resistance of Ghanaian varieties. (McEwen 1955).

Open-pollinated seeds from resistant clones (hybrids between *M. glaziovii* and *M. esculenta*) were therefore obtained from the East African Agricultural and Forestry Research Organization at Amani, Tanganyika. Selections from seedlings raised from these clones form the basis of recent breeding work in Ghana, which involves hybridizations between selected clones from the East African material, and between local varieties and the East African material, to combine high yields and good food qualities with high resistance to mosaic.

As a result of direct selections from the East African material, the following outstanding clones have been obtained namely *K.357, K.162, K.680 and K.491. *K.357* was selected in 1957. It is the most resistant clone so far, its percentage resistance ranging between 70 and 90. Its yield is rather low, about 3 tons per acre. The tubers are very palatable but of poor cooking quality *K.162* was also selected in 1957. Its resistance to mosaic is between 40% to 60% and yields about 5 tons per acre. The tubers are moderately palatable but of poor cooking quality. *K.680* was selected in 1957 from a cross between two clones raised from East African hybrid seed. Its mosaic resistance is between 15% to 25%. It is very vigorous and high yielding; yielding up to 15 tons per acre, with very palatable and good cooking tubers. This is now one of the recommended varieties in Ghana. (Ankra is the other). *K.491* is an open pollinated selection from "Tree" cassava *M. wrighti.* Its mosaic resistance is between 5% to 15% and yields up to 10 tons per acre. The tubers are moderately palatable and of a very good cooking quality.

The palatability and cooking qualities of the variety Ankra are still the standard by which other varieties are rated. Only K. 491, and K. 680 come near to Ankra in these qualities.

A hybridization programme to combine the resistance of K. 357 and K. 162 with the high yields and other qualities of K. 680 and Ankra being undertaken by the Crop's Research Institute at Kwadaso, Kumasi, is now well under way. Unfortunately K. 491 does not flower and can not be used in this programme. Results have so far, been very encouraging, and high yielding, disease resistant clones may be obtained in the very near future.

***K — Kwadaso Number.**

It has been known for a long time that resistance to mosaic is strongly linked genetically with low yields. In fact, many decades of attempts to combine high yields with high resistance have not proved very successful. This combination lasts for a few years only, after which the varieties become susceptible and probably, go down in yields as well. On the other hand, in Ghana at least, there are many high yielding but very susceptible local varieties, the most outstanding among them being Ankra.

Investigations into plant characters associated with yield have indicated that at least, in some varieties, the ability to retain a large number of leaves and a large green stem area during the most favourable season of the growing period may be more important than high disease resistance per se in bringing about high yields. (Doku 1965). This work needs following up to find out how these plant characters could be incorporated into the breeding programme to combine high resistance with high yields and good food qualities.

The yield of starch of varieties in Ghana has also been considered. Local varieties are almost entirely of the sweet type and are lower in starch content as compared with the high yielding, bitter varieties of Latin America and the Far East which are mainly grown for the commercial production of starch. It may well be that only the sweet types were brought from Brazil to the West Coast of Africa. In fact, *Captain Philip Beaver in 1792 mentioned in his "African Memoranda" that he found only sweet cassava on the Island of Bulama (on the West Coast of Africa.). This made a profound impression on him because he had found no sweet cassava in the West Indies. It is also likely that over the years, in selecting for palatability, farmers had concentrated only on the sweet types.

The yield of starch is closely related to the overall yield (fresh weight) of tuber, as well as to its moisture content. The ideal variety must be high yielding, producing tubers of very low moisture content. For, if the yield of tuber is low even if the starch content is high, the yield of starch per acre is bound to be low. Similarly, if the yield of tuber is high, and the moisture content also high, the yield of starch will again be low.

Trials of Kwadaso with over 200 varieties, clones, and hybrids have suggested that there might be no relationship between yield and starch content, and between yield and moisture content. The relationship between moisture and starch content might, however, be significantly negative. That is to say, a variety stored water in its tuber at the expense of starch and vice versa. Yield (fresh weight) of tuber, however, was not affected whether more starch or more water was stored.

However, since the moisture content of many local varieties appeared to be more or less the same, i.e. between 50% to 60%, it would appear that another tuber characters, apart from moisture content might be responsible for variations in starch content. A tuber, minus its outer and inner skins, is made up largely of water, starch and fibre. In the course of tuber development, an internal meristem, centripetally proliferates parenchymatous cells (in which the bulk of the starch is stored) studded irregularly with vascular bundles of various sizes. These bundles which determine the fibre content of a tuber are also largely responsible

* Beaver, Philip (Captain) An African Memoranda relative to the attempt to establish a British settlement in the Island of Bulama on the West Coast of Africa, Printed for C. & R. Baldwin, 1805.

for supplying the tuber with water. Many varieties may have the same moisture content and the same concentration of starch per unit tuber volume, but different amounts of fibre, depending on the sizes and numbers of these bundles. Some may have large numbers of smaller bundles, others a few large bundles, and so on. A few large bundles make up a smaller fraction of the overall tuber weight than numerous small bundles. Therefore, if the composition of tubers is equal in every respect except in fibre content, one would expect the tuber with the least weight of fibre to have a higher starch content and vice versa.

It is interesting to note that these same bundles to a large extent, determine the cooking qualities of a tuber, many bundles giving rise to "stringy" tubers. A tuber with fewer bundles should therefore be preferred. It might therefore be expected that tubers of local varieties with good cooking qualities should also be relatively high in starch content. This has been clearly borne out in trials at Kwadaso. Of 255 varieties, clones and hybrids on which determinations were made, 67 had percentage starch content values of 10% and above. Of these, the already established (good cooking) varieties were among those with the highest values. E.g. Nkani, 11.0%, Ankra, 15.5% and Calabar red tuber 16.5%.

In addition to breeding for high yields mosaic resistance and good food qualities, it is necessary to develop high starch yielding varieties for the commercial production of starch and alcohol. This line of work needs urgent attention now.

Some work has been done on the mechanisation of the crop at the Pokoase Agricultural Station by Evans (1957). Trial plantings were done by two persons sitting on a low platform behind a tractor with a load of cuttings. At pre-determined intervals (3 feet) marked by the tractor, each person inserted a cutting into the soil at the point marked. Two ridges at a run (each person planting a ridge) were planted in this way. This is a quick and easy method which could be widely used. Trial harvesting was also done with a mid-mounted disc plough, digging under a ridge, loosening the earth, and exposing the tubers to be picked up later by hand. This operation presented some difficulties. First of all, tall cassava stems had to be cut short to make it easier for both driver and tractor to operate. Secondly, most of the tubers were cut through by the discs since they were not only at different depths but also of different shapes and sizes. The lower portions of the cut pieces were often left to rot in the soil because they were not always seen by the pickers. Yields were therefore reduced as a result.

In later trials at Pokoase in 1962 by Kumar (1962), the cassava sticks were first cut by a mid-mounted mower instead of by hand. It was also found that the mid-mounted Disc-Terracer could harvest an acre in 2½ tractor hours for which five man-days were normally required. The planting unit was also modified so that six ridges could be ridged and planted at the same time, after the field has been ploughed and harrowed. The average time taken to ridge and plant one acre in one operation was 2 hours and 10 minutes as compared to 4 man-days per acre for planting alone. Losses due to damaged or incompletely dug out tubers were not mentioned. The advantages of mechanization particularly when large acreages are involved are obvious nevertheless.

As soon as cassava tuber is cut through it must be used immediately or else it will start to deteriorate. The possibilities of harvesting cassava mechanically are therefore remote at the present time when there are no mechanized processing plants to handle large harvests at a time. Moreover, we are far yet from developing varieties with the right tuber shape and size amenable to mechanical harvesting—more rounded than elongated. However, there are a number of dwarf varieties such as Poe and Kromho whose stems need not be out back before harvesting. Short or round tubers may have to be developed from these. How long this will take cannot be predicted. All indications are that it may not be an easy task since these dwarf varieties may be poor yielders.

The Irish Potato (Solanum tuberosum)

It would appear that before 1898 Irish potatoes were being cultivated in Ghana. In his book "Gold Coast Past and Present" George MacDonald (1898) then Director of Education writes (page 51) . . . . "In other parts, the people gave their attention to the cultivation of Corn, Yams, Potatoes, Plantain, Bananas and the preparation of Palm oil. It would be very difficult to find at the present day a potato grown on the Gold Coast ; rice is now very largely imported but much attention is still given to the cultivation of the yams, cassava and the sweet potato."

It is not clear whether MacDonald's observation on the disappearance or the potato was his own experience or whether he was relying on what others had told him. Though MacDonald distinguished between the potato (Irish) and sweet potato, others did not always do so. Indeed, very few writers distinguished between *S. tuberosum* and *Ipomoea batatas* in those early days. They merely mentioned "the potato." Most of them were merchants and traders not botanists or agriculturists interested in crops *per se*. It is therefore, not unlikely that MacDonald might have relied on information obtained from one of those people who could not, or did not care to distinguish between the different species of potato.

Cofie (1949) who genuinely believed MacDonald and thought that Irish potatoes were being widely cultivated in the country prior to 1898, cities the results of two rather inconclusive experiments, his own, Cofie (1949) and that of Glover (1947), to support this belief. No yield figures are given in the report by Cofie which covered a two-year period (1942-1944) of trials conducted at Amedzofe, 2,400' above sea level and Gbefi (near Kpandu) 500' above sea level. He concludes :

1. "For good yields a heavy and well distributed rainfall is required from planting to tuberization. Thereafter, and up to maturity, that is until the tops commence to die, rainfall need not be so heavy, but it should be well distributed."

2. "Comparison between yields at places of low elevation and of high elevation should be relative and not absolute. With good rainfall satisfactory yields should be obtained at places of low elevation."

Cofie, thus admits however reluctantly, that yields at lower altitudes are lower than those at higher altitudes.

Though Glover (1947) also concluded that potatoes grown at 3,000' and 600' above sea level on latitude 5°S in Tanganyika from Kenya grown commercial seed, could give yields of ware similar to English yields provided (a) the soils were manured on a scale comparable to that of moderate English practice and (b) the plants received water throughout life, yet it was only the yields of ware obtained from well manured plots at the higher altitude which came nearer to English yields. Here he obtained 6.1 to 7.5 tons per acre in the relatively dull season and 6.5 to 9.6 tons in the hot bright season.

The overall mean yield obtained from the lower elevation was only 3.5 tons per acre. This is certainly poor by English standards, yet Glover thought this figure was "surprisingly large because most of the plants died of drought before reaching maturity."

Since the trials were not repeated, and we are not told what the yields would have been under favourable conditions at the lower elevation, too much reliance should not be placed on Glover's conclusions. Knowing fully well that the growing of Irish potatoes at lower elevations in the tropics had always been a problem, he could have made his report more convincing, had the results justified his doing so. Obviously he could not.

Again in support of MacDonald, Cofie (1949) writes. . . "It is difficult to believe that the cultivation of potatoes (Irish) was then (i.e. prior to 1898) confined to places of high elevation. It would be interesting to know why its cultivation was abandoned. Bad husbandry, incidence of disease with consequent low and unprofitable yields suggest themselves as the chief reasons. At the present time wherever the potato has been tried by the department of Agriculture, Leaf roll —a virus disease, and Sclerotium have shown up in the plots and caused appreciable losses in yield."

If one agrees with MacDonald (1898) and Cofie (1949) then one might conclude that the first attempt to grow Irish potatoes in Ghana was a complete failure. One should, however, bear in mind that it is also possible that the crop had not been introduced by that time since there is no corroboration from any other source regarding the authenticity of MacDonald's observation.

One could be very certain, however, that by the early 1940's Irish potatoes were being planted by the Department of Agriculture at various places in the country. (Blane 1951 and Manser 1962) — all at high altitudes, e.g. Mampong, Ashanti 1,300' above sea level and Amedzofe 2,250' — 2,400' above sea level, primarily to augment the war time shortage of importations into the country. But since it was largely held (and it is still held) that the Irish potato was nutritionally more superior, especially in protein content, than all the tropical root crops, so much was done on the Irish potato, that within the short span of a decade and a half (i.e. 1940-1955) a large number of experiments was conducted on this crop almost to the neglect of the tropical root crops. (Sekyere 1965, Blane 1951, Cofie 1948 and 1949, Miller 1962, Manser 1962 and Anon 1936).

The following trials summarised by Sekyere (1965) were some of those carried out during this period, mainly at Mampong Station 1 Variety trials, 2 Generation trials, 3 Seed treatment trials, 4 Time of Planting trials, 5 Application of Mulch and Farm yard Manure and 6 Storage trials.

Yields in all these trials were very low not only by European standards for Irish potato but also compared with the average yields obtainable for the important tropical root crops, i.e., Cassava, Cocoyams and Yams. The highest yield obtained were 5.8 tons per acre. Indeed, yields of the order of 5 tons per acre were very rare, except in the heavily Mulched and Farmyard Manure trials where such yields occurred more frequently, the highest yield being 5.7 tons per acre when manured with 7½ tons per acre of Farmyard Manure and 10 tons per acre of Mulch.

Moreover, most of the trials were either "observations" from small plots sometimes of less than 1/100th acre, or not properly designed. Results of these experiments, therefore, should not be relied on too much. In all probability yields per acre were inflated by the smallness of the plots.

The failure of this attempt to grow Irish potatoes in Ghana is borne out by the fact that by the end of 1958, the Department of Agriculture had ceased to be enthusiastic about the crop, and that the farmers' co-operatives organized to grow the crop in the Mampong Ashanti district had long ceased to function, obviously because they were not making profit; the war having come to an end and cheaper potatoes were being imported again from abroad.

To conserve the drain on our foreign currency reserves, The State Farms have since 1963 embarked on large scale potato cultivation with seed imported from Western Europe. An observation from the previous trials was that two-thirds of the cost of growing potatoes was due to the cost of imported seed. (Cofie 1948). It is, however, too early yet to comment on this new large scale potato enterprise, though experience of previous plantings should normally make one less optimistic about its success. Naturally most people in the tropics are eager to eat Irish potatoes because of the old belief that it is more superior nutritionally than most of our tropical root crops. That this belief is deep-rooted and dates far back would be seen by an article entitled "Potato for the Tropics," from the Gold Coast Farmer (1937) *6*, 216, culled from the Crown Colonists of November, 1937. The relevant portion is quoted. ". . . . Among research projects of particular interest that are being financed is a search for new varieties of the potato (Irish) suited or capable of adoption to tropical conditions. Such a foodstuff it is believed would be of the greatest importance to the Colonial Empire in view of the nutritional superiority of the potato over many of the tropical root crops. A free grant of £100 is, therefore, being made to the government of Jamaica so that a special officer can be attached to a scientific expedition which is being sent to Peru."

Another article entitled "Potato breeding and Research,—South American Tropical Species,"—which appeared on page 48 of the same volume of the Gold Coast Farmer and which was culled from the Imperial Bureau of Plant Genetics, *8*. 633491, will throw more light on what should have been done to obtain potato varieties suitable for the tropics, particularly areas of lower elevation. It reads :—

"Hitherto it (the Irish Potato) has been regarded as a temperate climate crop capable of growing in countries with conditions like those of Northern Europe. It now appears that the vast majority of potatoes in their native home belong to the tropical belt and are adapted to all the conditions including the short photoperiod found in the tropics. Most of them occur in mountainous areas but one specie. *S. Phureja* is found in hot valleys at low latitudes and forms tubers in humid hot, sub-tropical conditions. It is characterized by a low starch content (8-10%) but very high in protein (14%). Potato breeding in Kenya, India and other countries near the equator should therefore be based on this Andean material rather than on types obtained from Scotland, etc. as has been the practice; a great extension of potato cultivation in the tropical and sub-tropical countries may be foreseen as a result."

There is no record of any breeding work in Ghana involving *S. Phureja* types as suggested. Miller (1962) mentioned that a consignment of seed and seed tubers of other solanum species and crosses was received at Mampong from Cambridge but they all failed to germinate or sprout. Apparently no further attempt was made to obtain fresh material. In fact, it appears no serious attempt anywhere in the tropics has been made to breed potatoes adopted to lowland tropical conditions and it is high time something was done about this. For, it appears we must either grow the right types of Solanums or not at all. Moreover, in Ghana, had half the time spent on experimenting with imported potato seed from Western Europe been devoted to experiments on cocoyams and sweet potato, we would obviously have obtained better varieties with higher yields than we have today. At present we have lost in both fields of endeavour.

Nor is the Irish potato as nutritious we have been made to believe. The following table, (Table 4) shows that is not. From it, it would be seen that the Irish potato contains the same amount of protein as yams and cocoyams. Yam flour, in fact, contains more protein than the Irish potato, whose protein content is only 0.5% higher than cassava flour (kokonte) and sweet potato. As regards Minerals and Vitamins, Irish potato is lower in calcium and iron than all the tropical root crops except fresh yam with which it has the same calcium content. Sweet potato and yam (fresh) contain considerably higher quantities of vitamin A than Irish potatoes. The Thiamin content of Irish potato is the same as that of the tropical roots except cassava whose thiamin content is lower. The Riboflavin content of Irish potatoes is almost the same as the tropical roots. Its nicotinamide content is slightly higher whilst its ascorbic acid content is only slightly lower than that of fresh cocoyams and yams.

The Net Protein Utilization (N.P.U.) values of all the tropical roots are very low, that for Irish Potato, I am reliably informed, (Oracca-Tetteh Personal) is of the same order. They are all inadequate for health and must be supplemented by protein rich foods, i.e. fish, meat, eggs, etc. Europeans themselves have never regarded the Irish potato as a complete food, but mainly as a source of carbohydrates, just as the tropical roots are regarded.

We should therefore, eradicate this "Potato" mentality and concentrate more on the improvement of our root crops. They have all the advantages of yield, adaptation, and ease of cultivation over the Irish potato. Besides, they are the already established staples. It is not only their roots which are eaten but other parts of the plants as well, e.g. the tender leaves of the cocoyams are a valuable spinach in Ghana eaten almost daily by the majority of the people. The young leaves of the cassava also serve the same purpose in other parts of West Africa. The many products prepared from cassava roots are well known everywhere. What is not so well known, perhaps is that the peel of cassava is a valuable feed for sheep, goats and pigs in West Africa.

Clonal selection in yams and cocoyams could result in better varieties than those being grown at present. Research into methods of inducing flowering and seed setting in these crops should also be vehemently pursued. Fortunately the problem of flowering and seed setting does not appear to be very serious in cassava and sweet potatoes. It is indeed strange that more breeding work has been done on sweet potatoes in the temperate regions where seed setting is more difficult than in the tropics. These temperate workers have shown that sweet potatoes grown from seed, exhibit great diversity in their characters, and whenever the problems of seed production are overcome, the breeding potential of the plant may be considerable. (MacDonald 1963). Prolific seed production has been reported in Kivu, (Congo Kinshasa), Bunganda, and parts of Hawaii. Working Hawaii, Poole, (quoted by MacDonald 1963) produced two unique plants with 75 and 65 tubers weighing 20.5 lbs and 27.5 lbs respectively. It is high time Ghanaians started being interested in this crop. We should not forget that Carver (1936) the famous American Negro agriculturist, reported 118 different, attractive products made from this crop.

If, inspite of the many advantages of the tropical roots we must, for other reasons, grow Irish potatoes in the tropics, it should not be by imported seed from the temperate regions. We must first of all turn to such species as *S. phureja* and *S. rybinii* which are known to grow well under condition of high temperature and humidity and start a comprehensive breeding programme to obtain varieties capable of growing and producing well under our conditions.

It will not be an easy task, but a long and arduous one. It will also be a challenge which must be taken up by breeders in the tropics. Taking their inspiration from what has been done on other crops elsewhere, e.g. Maize in the U.S.A., Wheat, Barley and Oats in Western Europe—all crops originating from climates different from that of Europe — they should press on and demonstrate to the world once and for all whether or not tropical solanum varieties could be bred, capable of yielding as well as the other tropical root crops.

*Table I. *Estimates of Acreages of Main Staples (Thousand acres).*

Crop	Northern Territories (Now Northern and Upper Regions)	Ashanti (Now including Brong/Ahafo	*Colony (Now Southern Ghana) Forest	*Colony (Now Southern Ghana) Non-forest	Togoland Ho District (Now Volta Region)	Total
Maize	79.5	66.7	87.0	100.1	21.0	354.3
Millet	432.0	—	—	—	—	432.0
Sorghum	332.5	—	—	—	—	332.5
Rice	20.5	6.5	5.5	8.6	6.2	49.0
Plantain	—	67.9	231.3	—	16.5	314.0
Cassava	1.5	45.7	56.8	92.5	8.2	204.7
Cocoyam	—	45.4	144.9	5.5	4.0	199.8
Yam	59.5	58.4	15.3	6.4	9.4	149.4
Groundnut (seed)	11.5	21.9	—	—	—	—
Pulses	39.0	—	—	—	—	—
	*1,076.0	312.5	540.8	213.1	69.2	2,111.6

*From Annual Report. Dept. of Agriculture, Gold Coast, 1950-51 (1952) p. 23.

*Table II. *Estimates of Production of Main staple (Thousand tons)*

Crop	Northern Territories (Now Northern and Upper Regions)	Ashanti (Now including Brong/Ahafo	*Colony (Now Southern Ghana)		Togoland Ho District (Now Volta Region)	Total
			Forest	Non-forest		
Maize	29.0	33.4	43.6	50.0	10.5	166.5
Millet	97.0	—	—	—	—	97.0
Sorghum	78.0	—	—	—	—	78.0
Rice	9.5	3.0	2.5	—	7.5	22.5
Plantain	—	271.6	925.2	34.6	24.8	1,256.2
Cassava	4.5	119.9	149.1	209.1	21.6	504.2
Cocoyam	—	115.8	369.6	14.1	10.1	509.6
Yam	204.0	175.2	45.7	19.2	29.5	473.6
Groundnut (seed)	22.5	6.0	—	—	—	29.5
Pulses	31.5	—	—	—	—	31.5
Total	476.0	724.8	1,535.7	327.0	105.0	3,168.5

*From Annual Report. Dept. of Agric. Gold Coast 1950-51 (1952) p. 23.

*Figures of production and acreages are taken from the 1950-51 Annual Report by the Department of Agriculture and are only estimates. However, they more or less agree with what is generally known through observations.

Table III. —Proportionate Distribution of Expenditure within the Group "Local Foods" All items equal 100.00.

Commodity	Sub-group %	Item within Sub-group %
Cereals (Grain)	6.55	
Corn-whole/shelled	—	2.83
Guinea Corn	—	0.20
Millet	—	0.35
Rice	—	3.17
Cereals (Prepared)	10.45	—
Corn (Maize)	—	—
Dough or Ground	—	0.93
Kenkey, Akple, Koko, Abole	—	7.91
Krakro, Togbei, etc.	—	0.61
Bread (from home ground grain)	—	1.00
Rice and Beans or stew, twuo	2.75	2.75
Roots and tubers	15.82	—
Cassava	—	6.81
Cocoyams	—	2.07
Sweet potato	—	0.05
Yam	—	6.89
Cassava (prepared)	5.46	—
Dough	—	0.91
Kokonte	—	2.28
Gari, Yakayaka	—	0.10
Agbli kakro	—	0.17
Nuts	1.85	
Oils and vegetables	3.00	
Fruits	7.67	
Pulses	0.55	
Vegetables	9.02	
Fish	18.53	
Shell Fish	0.57	
Meat and Poultry	14.00	
Livestock	0.90	
Miscellaneous	3.50	

From Economic Bulletin (1962): 6, No. 4.

Table IV. *REPRESENTATIVE VALUES PER 100 gm EDIBLE PORTION*

	WATER (ml.)	CALORIES	PROTEIN (g)	FAT (g)	CARBOHYDRATE (g)	FIBRE (g)	CALCIUM (mg)	IRON (mg)	VITAMINS A. Potency (I.U.)	Thiamine (mg.)	Riboflavin (mg.)	Nicotinamide (mg.)	Ascorbic Acid (mg)	Waste % of food as purchased
Cassava Fresh (M. esculenta)	60 (49-74)	153	0.7	0.2	37	1.0	25	1.0	0	0.07	0.3	0.7	(0-50) 30	15
Cassava Flour	12 (11-15)	342	1.5	0	84	1.5	55	2.0	0	0.04	0.04	0.8	0	0
Irish Potato (S. tuberosum)	80 (70-85)	75	2.0	0	17	0.4	10	0.7	0	0.1	0.03	1.5	(5-50) 15	15
Sweet potato (I. batatas)	70 (60-80)	144	1.5	0.3	26	1.0	25	1.0	100	0.1	0.04	0.7	30	15
Yam, fresh (Dioscorea spp.)	73 (54-84)	104	2.0	0.2	24	0.5	10	1.2	20	0.1	0.03	0.4	10	15
Yam flour	18 (13-19)	317	3.5	0.3	75	1.5	20	10.0	0	0.15	0.1	0.1	0	0
Cocoyam (X. Sagittifolium)	65 (58-78)	133	2.0	0.3	31	1.0	20	1.0	0	1.1	0.03	0.5	10	20
Cocoyam (C. Antiquorum)	70 (60-83)	113	2.0	0	26	0.5	25	1.0	0	0.1	0.03	1.0	5	20

0 — Contains none
0 — Contains too small a quantity to be significant in dietary evaluation.

From tables of representative values of foods commonly used in Tropical countries. London H.M. Stationery Office, 1963.

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