SOME ASPECTS OF THE SWEET POTATO AND ITS AGRONOMY IN UGANDA

— *by* —

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Although the sweet potato is a crop of considerable importance in Uganda it has received only a little agronomic research attention. This paper presents a review of the existing knowledge pertaining to the growing of the crop in Uganda.

The importance of sweet potatoes in Uganda

Of the food crops grown in Uganda 75% of them, in terms of calories, are the perishable commodities, bananas, cassava and sweet potatoes. The position of sweet potatoes in relation to other food crops, both as acreages and total calorific values is shown in Table I. In 1959 the sweet potato acreage grown was sufficient to provide 890 calories per person per day, assuming an average production of three tons per acre.

As a food-stuff the sweet potato is grown almost entirely for its tuber. Few references exist of the sweet potato leaves being used as a spinach; however the leaves are used as food for *Tilapia* in fish ponds, occasionally fed to cattle and sometimes given to housed pigs. In those areas with a good rainfall distribution, such as the fertile crescent around the North-Western parts of Lake Victoria, the sweet potato is normally harvested piece-meal and eaten within one to three days after harvesting, but in those areas with pronounced dry seasons and less reliable rainfall, part of the crop is sliced, dried and stored.

The distribution of the sweet potato crop in Uganda has been described in detail by McMaster (1962). The crop is to be found over a wide altitude range extending up to 7000 ft. Of note in Uganda is the large acreage of sweet potatoes in South Kigezi (in the south west of Uganda), an area equal to one forty-fifth of Uganda but which has about a sixth of the total sweet potato acreage. The largest sweet potato acreage may be associated with land pressure problems and the fact that Kigezi is a high altitude area where cassava does not thrive.

The relative importance of sweet potatoes from an acreage viewpoint, is indicated in Table I; for 1959 the 712 thousand acres grown were equivalent to 8.1% of the total acreage under cultivation in Uganda, and equalled .11 of an acre per head of population. The acreage per head of population for the period 1923-1963 for Buganda, Eastern Region and Uganda is shown in Table II.

It is of interest to observe in Buganda that as the acreage of Robusta coffee per head of population increased, so the acreage of the perishable food crops, bananas, cassava and sweet potatoes declined. This is shown in Figure 1. It is possible to infer from this decline in acreage that there was a change in diet as more cash became available, but the more likely interpretation is that the increased cash earnings allowed the population in Buganda to be more independent of the vagaries of the weather (MacDonald 1963).

Table I. Food crop acreages (11) estimated yield per acre and total calorific values for Uganda in 1959

Crop	Acreage '000's	Yield/ acre**	Calories/lb F.A.O. values	Total calorific value (millions)
Beans	576.5	200 lbs	1565	180,444
Beans soya	5.0	200 "	1520	1,520
Cassava	676.1	5 tons	494	3,740,726
Grams	9.0	200 lbs	1565	2,817
Groundnuts (in shell)	426.8	800 "	1760	600,934
Maize	359.9	800 "	1615	464,991
Sorghum	705.2	600 "	1555	657,952
Finger millet	1270.5	600 "	1505	1,147,261
Bulrush	5.9	400 "	1580	3,729
Onions	2.0	2 tons	168	1.505
Pigeon peas	224.9	400 lbs	1565	153,307
Peas Field	31.4	200 "	1565	9,828
Plantains	1464.3	3 tons	320	3,148,830
Sweet potatoes	711.7	3 tons	440	2,104,354
Potatoes (Solanum)	9.6	3 "	317	20,450
Rice	7.4	600 lbs	1620	7,193
Sim-sim	235.0	200 "	2605	122,435
				12,368,276

° Census year
** Writer's estimate

Varieties

It is difficult to determine the exact number of varieties in use in Uganda, but it is likely that the number is well up in the hundreds. Nye (1938) recorded forty-seven varieties in one mutala in Buganda (the mutala was approximately one square mile in extent) and the writer has found twenty-seven varieties in the immediate vicinity of the University Farm at Kabanyolo.

Table II. Acreage per capita of selected crops for Uganda, Buganda and Eastern Region

Year	Uganda Pop in '000's	Uganda Total Acreage Per Head Of Pop.	Uganda Food Crop Acreage Per Head Of Pop.	Uganda Sweet Potato Acreage Per Head Of Pop.	Buganda Sweet Potato Acreage Per Head Of Pop.	Eastern Region Sweet Potato Acreage Per Head Of Pop.
1923	2975	.908	.763	.10	.20	.044
1924	3040	.993	.806	.15	.29	.048
1925	3107	.964	.765	.12	.20	.050
1926	3175	.978	.795	.13	.25	.047
1927	3245	.835	.668	.10	.12	.081
1928	3316	.938	.723	.11	.13	.104
1929	3389	1.121	.919	.13	.16	.104
1930	3464	1.115	.894	.11	.15	.074
1931	3536	1.224	.973	.16	.17	.136
1932	3605	1.327	1.022	.15	.21	.114
1933	3676	1.271	.966	.14	.21	.078
1934	3748	1.355	1.028	.13	.22	.071
1935	3821	1.349	.980	.13	.21	.079
1936	3896	1.354	.960	.11	.16	.060
1937	3972	1.408	.951	.11	.16	.073
1938	4050	1.389	1.002	.14	.15	.092
1939	4129	1.299	.976	.14	.09	.097
1940	4210	1.239	.914	.11	.08	.083
1941	4293	1.276	.957	.12	.09	.100
1942	4377	1.088	.848	.09	.05	.056
1943	4463	1.251	.954	.11	.09	.103
1944	4550	1.320	1.065	.11	.08	.123
1945	4639	1.284	1.002	.10	.08	.111
1946	4730	1.220	1.016	.11	.09	.117
1947	4823	1.354	.969	.10	.09	.096
1948	4918	1.390	1.002	.10	.09	.109
1949	5041	1.339	1.003	.10	.09	.108
1950	5167	1.327	1.005	.10	.07	.110
1951	5296	1.327	1.002	.10	.07	.114
1952	5428	1.286	0.971	.10	.07	.110
1953	5563	1.488	1.151	.11	.11	.119
1954	5702	1.508	1.152	.10	.09	.119
1955	5844	1.409	1.082	.10	.07	.118
1956	5990	1.350	1.028	.10	.06	.110
1957	6139	1.299	.959	.09	.06	.090
1958	6292	1.391	.922	.09	.06	.111
1959	6450	1.365	1.042	.11	.07	.183
1960	6611	1.282	.971	.09	.08	.094
1961	6776	1.456	1.063	.10	.06	.131
1962	6445	1.361	1.013	.09	.05	.110
1963	7119	1.381	1.007	.08	.06	.080

The characteristics that make a sweet potato variety acceptable have not been fully determined. Certainly yield per acre is not a dominating character; of a trial of fifty-five sweet potato varieties carried out in 1948/49 at the Government Research Station, Kawanda, the lowest yielders gave 5 tons per acre, whilst the highest yielders exceeded 11 tons per acre. The fact that the poorer yielders persist may be accounted for by consumer preferences in terms of palatibality and cooking characteristics, growth habit including length of growing period and disease and pest resistance features. Generally the consumer likes a red skinned variety, with a white flesh containing little fibre and, it is said by some consumers, a tuber which split exudes only a little latex. White skinned varieties are consumed, but are not so popular in the markets. The reason for this is said to be that some of the white skinned heavy yielding varieties are not so palatable, but they are indistinguishable from the palatable varieties. In general tuber shape is smooth or faintly ridged, although in Kigezi many of the varieties grown are deeply ridged and generally misshapen. Orange or yellow fleshed varieties are not so popular but do occur; Caroline Lea and Early Port are two such varieties although they are more virus susceptible than other varieties.

The peasant farmer rarely grows plots of sweet potatoes consisting of one variety and seems to prefer a mixture of several varieties; the reasons for this are variable.

Time of planting

In those parts of Buganda with a well distributed bimodal rainfall and reasonably fertile soils planting of sweet potatoes occurs in each month of the year:

No. of plots of sweet potatoes planted per month in Mukono Division (approx. 2,000 square miles in extend and situated in Buganda) Five year average (1952-1956).

Month	J	F	M	A	M	J
	1004	1287	1926	2174	1746	1513
	J	A	S	O	N	D
	1098	1183	1219	1065	1006	1787

In those areas with more marked dry seasons planting tends to be concentrated at the start of the rains, but there are also fairly extensive plantings around the swamps during the dry period both as a source of food and of planting material for the next season (Aldrich 1963).

Time of planting trials (unpublished report, Uganda Department of Agriculture) at Serere, a research station in the short grass area of Uganda, show that early planting gives the highest yields.

Place in the rotation

The sweet potato is a perishable crop and is often harvested piece-meal over a long period of time. This makes the sweet potato a difficult crop to include in arable rotation. Thus one finds the sweet potato being grown on small plots close to the dwelling place, outside the conventional arable rotation land. Sometimes the sweet potato is used as a closing crop in the rotation, but examples can

be found where it is used as an opening crop after the resting period. Although it is not normally an estate or large farm crop, the sweet poato is included in the rotation on the Makerere University College Farm at Kabanyolo.

	First Rains	Second Rains
1st year	Grass	Sweet potatoes
2nd "	Maize	Sorghum
3rd "	Groundnuts	Sorghum/or maize
4th "	Sweet potatoes	Grass
5th "	Grass	
6th "	Grass	
7th "	Grass	Sweet potatoes

Sweet potatoes were chosen as the opening crop in the rotation on the grounds of experimental evidence in Kenya (Boswinkle 1960) which showed that wheat yields were highest when the crop followed an opening root crop, in this case solanum potatoes; in the absence of evidence to the contrary it was assumed that the relationship between sweet poatoes and maize would be similar. It was also considered that opening with sweet potatoes would reduce the cultivation costs in breaking the grass ley, as a fine seed bed would not be necessary, and the sweet potato crop should give a better seed bed for the following maize crop. Sweet potatoes conclude the rotation, which has the advantages of (a) providing a good seed bed for the grass crop (b) allowing a longer harvesting period and (c) providing continuity of sweet potato tubers for sale and ensuring the provision of adequate planting material from season to season.

The rotation has now been followed for six years at Kabanyolo. Whilst the rotation has been generally successful, the inclusion of the sweet potato crop has created timing difficulties, particularly in harvesting and selling thirteen acre fields yielding 4-9 tons of saleable tubers per acre. However improved and quicker methods of breaking the grass leys have reduced the timing pressure.

Planting material

Usually wilted apical cuttings, 12"-8" in length are used, and for preference they are obtained from mature plants. Trials at Serere (unpublished report Uganda Department of Agriculture) showed that for five varieties, 750-1350 lbs of cuttings were needed to plant one acre; it was also observed that one acre of swamp edge sweet potatoes provided sufficient material to plant 10 acres.

Generally, care is taken to ensure that the planting material is virus free. However mistakes are made, particularly as plants with a primary attack do not necessarily show pronounced symptoms.

Method of planting and spacing

In Uganda sweet potatoes are grown on hills, mounds and ridges, but rarely on the flat. The Department of Agriculture recommends the use of ridges, especially on sloping land; however in experiments no differences were determined between the yields of sweet potato tubers when planted on hills 2', 3' and 4' apart or on ridges 2', 4' and 3' apart. In experiments at the Makerere University College Farm on ridges 4-5 feet apart with 2 rows of cuttings per ridge at spacings

24, 12, 8, 6, and 4.8 inches apart, i.e. with populations ranging from 48, 400 to 9,680 plants per acre, it was found by Aldrich (1961) that the spacing had relatively small effect on the total yields per acre, except at the lowest populations. However, there were considerable changes in the components of yield. Due to this ability to compensate there was relatively little change in the total yield per acre over a plant population range of 10,000-50,000 plants per acre, although when the population dropped to 5,000 plants per acre a significant reduction in yield occurred. Aldrich defined tubers as those with a diameter greater than 1 inch and his yields were of the order of 5 tons per acre.

In general the peasant cultivator in Uganda plants his cuttings by pushing them at an angle into the mound or ridge until more than 50% of the cutting is coverer; the drier the area the greater the percentage of the cutting that is covered by soil.

In 1963 a randomised block experiment was laid down by the writer, with the object of testing the adequacy of the planting methods used for sweet potatoes on the Makerere University College Farm. The experiment was designed to compare (a) planting on top of the ridge versus planting on the side of the ridge, (b) planting at 19,360 and 9,680 plants per acre and (c) comparing the conventional method of planting the vine cutting, i.e. pushing or drawing it into the ridge, versus having both ends of the vine cutting exposed.

The experiment consisted of five treatments:—

A. The normal planting method used on the Kabanyolo Farm, i.e. 4′ 6″ between ridge centres, with two rows of plants per ridge one row on each side of the ridge (about a third of the way down the ridge slope) and with one foot between plants in the row, giving a plant population of 19,360 plants per acre.

B. Planting on top of the ridge (4′ 6″ between centres) in one row with the individual plants being one foot apart i.e. a plant population of 9,680 per acre.

C. Planting on top of the ridge in one row, each plant being 6″ apart i.e., 19,360 plants per acre.

D. The same treatment as B, but in this case the cuttings were drawn through the soil so that both ends were protruding.

E. The same treatment as C, but with both ends of the cutting protruding.

The variety planted was Bitambi, a popular local type. The tubers recorded were assessed by eye as being saleable, but were not less than ounces in weight. The harvested plots were 3 x 6 yards in size.

The results (Table III) of this experiment showed that there were no significant differences between the treatments in terms of yields of tubers, although there is a strong indication, nearly approaching significance, that the 9,680 plants per acre population is too low and causing a depression in the yield. There are, however, highly significant differences in the number of tubers produced per treatment. These findings confirm Aldrich's findings that the sweet potato has "a considerable capacity for compensating for low plant populations by higher yields per plant" (Aldrich 1963). Such findings may be of importance to a farmer who plants large acreages of sweet potatoes all at the same time, but who wishes to stagger the harvesting i.e. he could use wider spacings for that part of the field to be harvested first.

Table III. Analysis of Yields obtained from a planting method trial, Kabanyolo 1963.

Treatment	Average yield per plot of tubers in lbs	Average yield in tons/ acre of tubers	Tubers/ plot	Average tuber wt. in lbs	Average wt. of tubers per plant
A. Normal planting	106	12.7	137**	.77	2.94
B. Planting on top of the ridge 1' apart	91	10.9	87	1.05	5.06
C. Planting on top of the ridge 6" apart	109	13.1	138**	.79	3.03
D. Planting on top of the ridge 1' apart with both ends protruding	91	10.9	97	.94	5.06
E. Planting on top of the ridge 6" apart with both ends protruding	100	12.0	137**	.73	2.78
S.E.	6.8 lbs		4.9		

It was thought that if the planting material was drawn across the ridge with both ends protruding i.e. more or less horizontal, rather than the normal vertical or sloped planting angle, then a greater number of tubers might be initiated on a larger number of nodes. The results show that there is neither advantage or disadvantage in drawing the planting material through the soil and leaving both ends protruding when using the variety Bitambi.

The other observation on this trial was that the farm labourers, who assisted in the harvesting of the plots, found it easier to harvest tubers from the plants that had been planted on the top of the ridge compared to those planted on the side of the ridge. As there is no significant difference in yield, whether the vines are planted on the top or the side of the ridge, then it would seem that planting on top of the ridge has the advantage, in view of the reduced harvesting effort.

Cultural operations during the growing period

The normal practice is to give the crop two or three weedings during the growing period, at which time the ridges, mounds or hills may be reshaped. As the sweet potato plots are normally situated near the dwelling places and in the care of the women folk the standards of weeding are in general good.

Ochse (1931) suggested that, in Malaya, sweet potatoes, which were prevented from rooting at the nodes of the creeping vines, increased their yields. An experiment conducted by the writer at Kabanyolo in 1964 to test this suggestion gave significant negative results when using the sweet potato variety Bitambi (Table IV).

Under the Kabanyolo conditions and using the variety Bitambi there was a highly significant decrease in yield when the plants were not allowed to root freely at the nodes. Whether this result is applicable to all sweet potato varieties is not known. Presumably there might be a difference between those varieties that produce tubers only from the nodes of the original planting material, and those that produce tubers at the nodes of the new vine growth.

Table IV. Yields obtained from a rooting at the nodes trial Kabanyolo 1964

Treatment	Yields per plot in lbs of saleable tubers	Yields per acre in tons of saleable tubers
A. Creeping vines disturbed weekly	15	2.9
B. Creeping vines disturbed bi-weekly	18	3.5
C. Creeping vines disturbed monthly	19	3.7
D. Undisturbed	27**	5.3**
S.E. 1.44		

Manures and fertilizers

Little work has been done on the manuring aspects of sweet potatoes. As the crop is normally grown nearby the dwelling place and as this is the area in which most of the household waste is deposited then this may account for the reasonable yields often quoted for this crop in Uganda i.e. 5-7 tons of tubers per

acre. Biggs (1940) states that, 'manuring with cattle manure has shown considerable increase of yield, and were this crop to be used in rotations it could with advantage be the crop to receive the manurial dressing.'

Working at Kabanyolo Aldrich (1968) found that applications of 450 lbs of sulphate of ammonia resulted in a highly significant reduction in yield and although smaller applications had less effect they also tended to give yield reductions. Aldrich also found that muriate of potash gave a significant decrease in the dry—matter content of the tuber.

In 1962 a trial was laid out by the writer at Kabanyolo to test the response of the sweet potato variety Bitambi to applications of compost, which contained farm yard manure. The applications were at 0, 2½, 5, 7½ and 10 tons per acre on a latin square lay out with each plot being 1/73 rd of an acre. The records taken were of the yield of tubers greater than 2 oz and the fresh vines. Although there were no significant differences (Table V), due to the variability within the experimental area and possibly because of the high yield level, there were indications that there were in fact responses to the application of F.Y.M./compost. The yield of fresh tops is recorded and could be of interest where livestock is integrated with arable cropping.

Table V. Results of a F.Y.M./compost trial Kabanyolo 1962

Treatment	0	2½	5	7½	10	S.E.
Yield tons/ac/ tubers	12.86	13.43	13.79	14.65	13.50	.46
Yield fresh vines in tons/acre	8.79	8.22	8.79	9.71	10.52	.68
Yield vine dry matter in tons/acre	1.31	1.22	1.30	1.38	1.55	

Harvesting

Under peasant cultivation conditions the wife normally harvest the sweet potato tubers piece-meal; the mature tubers being removed individually and the plant being allowed to continue growing.

Where the sweet potato is incorporated into a rotation and grown on a large field scale, as on the Makerere College Farm, which grows twenty six acres of sweet potatoes per year, then harvesting problems can cause timing problems. The market is not over flexible and cannot absorb a sudden release of large quantities of tubers; in order to increase the harvesting period at Kabanyolo part of the crop is often harvested before it is fully mature.

Farm workers using spade hoes are expected at Kabanyolo to harvest between 400-800 lbs of tubers per task depending on the crop yield and soil conditions; about 1,200 lbs per task is considered the maximum.

Pest and diseases

The main pests and diseases are:—

1. Virus diseases
2. Spiny caterpillar (*Acraea acerata*),
3. Weevils (*Cylas* spp)

Little work has been done on control measures, with reliance being put on normal crop hygiene measures to control any outbreaks.

Farm Scale Costings

It is difficult if not impossible to determine costings for sweet potatoes grown on a peasant scale. The following data provides some of the costings which occurred in growing 9.5 acres of sweet potatoes at the Makerere University College Farm during the first rains of 1966.

	Total cost
Ploughing @ Shs 41.50 per hour	394.25
Discing @ shs 24.50 per acre	232.75
Ridging @ shs 30.00 per acre	285.00
Collecting vines – 37 mandays*	158.25
Carting vines	25.00
Planting vines – 44 mandays*	136.00
Gapping	60.00
Weeding – 67 mandays*	201.00
Weeding @ shs. 30.00 per acre	285.00
Harvesting – 106 mandays*	359.00
Carting	166.00
Total cost for 9.5 acres – Shs	2,302.50
Cost per acre – Shs	242.36

*Costs per man day vary depending on whether the labourers are permanent or casual.

Analysis of costings

Gross yield	– 119,168 lbs	– 12,544 lbs per acre
Gross revenue @ 6cts per lb	– Shs 7,150.00	– Shs 752.60 per acre
Gross cost	– Shs 2,302.50	– Shs 242.36 per acre
Profit	– 4,847.50	– Shs 510.26 per acre.

Summary

The paper presents a review of the existing knowledge pertaining to the growing of the sweet potato crop in Uganda. Figures, both total and per head, illustrating the importance of the crop, are given for the period 1923-1963 with an estimate of the calorific production. Reference is made to varieties, the consumer's preference and tuber shapes. Some details are given of time of planting and the place of the crop in rotations. The planting material used, methods of planting, spacing and post planting cultural operations are discussed and the results of trials at Kabanyolo Farm are given. Manures and fertilizers harvesting problems and pests and diseases are also mentioned. The paper concludes with some costings of growing the crop on a farm scale.

Acknowledgements

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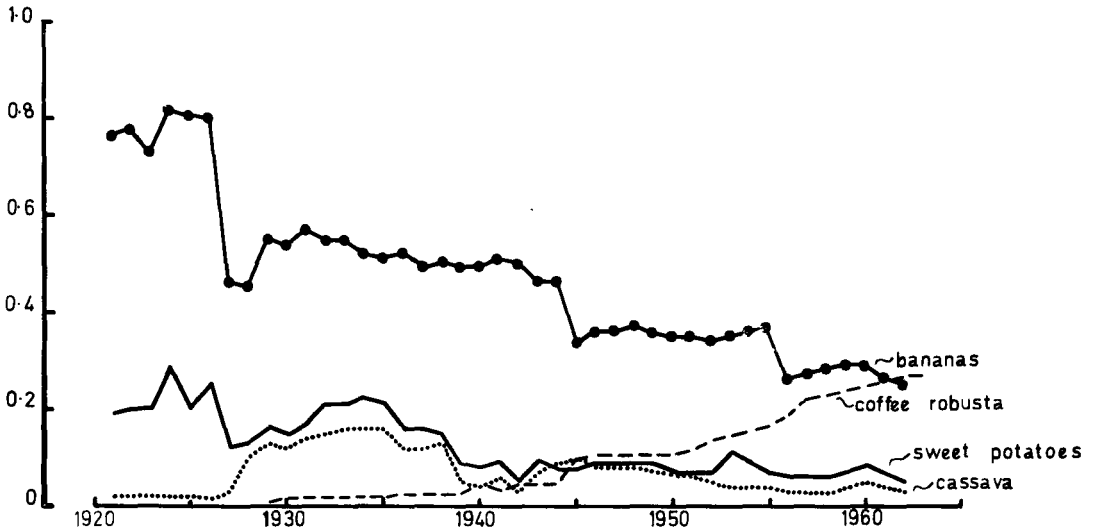
FIGURE 1



ACREAGE PER HEAD OF BANANAS, SWEET POTATOES, CASSAVA AND COFFEE ROBUSTA IN BUGANDA

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