AGRONOMIC STUDIES ON EDIBLE YAM IN THE GRASSLAND PLATEAU REGION OF THE UNITED REPUBLIC OF CAMEROON

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SUMMARY

Root and tuber crop cultivation and production in Cameroon is outlined. A collection of 109 accessions of yam species and cultivars has been screened. Three promising cultivars, one from each important species are being tested for optimum planting period, size of planting setts, population density, staking, fertilizer responses and storage characteristics.

The earliest planting date (January) tried gave the highest yield, but even earlier dates are being tried. Setts of 375-500 grams are best for ware yams, setts of 125 grams are best for rapid multiplication; best spacing is 100 cm x 66 cm giving 15,000 plants per hectare. Tall stakes were best, and 80 kg/ha of N and 40 kg/ha of K fertilizers gave economic responses.

RESUME

La culture et la production des plantes à racine et à tubercule ont été soulignées. Une collection de 109 variétés d'espèces et cultivars d'igname a été sélectionnée. Trois cultivars à caractéristiques désirables issus de chaque espèce importante sont en cours d'essai pour déterminer la période optimale de plantation, la dimension des boutures, la densité de peuplement, le tuteurage, les réponses aux engrais et les caractéristiques de conservation.

La date de semis la moins tardive essayée (janvier) a donné le rendement le plus élevé et on essaie méme des dates de semis encore moins tardives. Les boutures de 375-500 grammes sont les plus valables pour le marché, celles de 125 g pour la multiplication; l'espacement de 100 cm x 66 cm donne la meilleure densité, soit 15,000 plants à l'hectare. Les treillis longs sont les plus staisfaisants. 80 kg/ha d'engrais K sont également les plus satisfaisants du point de vue économique.

RESUMEN

Se reseña el cultivo y producción de raíces y tubérculos en Camerún. Se ha seleccionado una colección de 109 especies y cultivares de ñame. Se están probando tres cultivares prometedores, uno de cada especie importante, en cuanto período óptimo de siembra, tamaño de "estacas" de siembra, densidad de población, estacado, respuesta a los fertilizantes y características de almacenamiento.

La fecha de siembra más temprana que se probó (Enero) dió el más alto rendimiento pero aún se están probando fechas mas tempranas. Las "estacas" de 375-500 gramos son las mejores en ñame para venta, las "estacas" de 125 gm son las mejores para la multiplicación rápida; el mejor espaciamiento es 100 cm x 66 cm dando 15,000 plantas por hectarea. Los estacados altos fueron los mejores 6 80 kg/ha de N 6 40 kg/ha de K como fertilizantes, dieron la respuesta económica.

INTRODUCTION

Investigations have been carried out mainly in the North West Province of Cameroon. The landform comprises a broad mainly rolling low lava plateau from 700 – 1400 m above sea level surmounting which there is a more rugged chain of high lava mountains with peaks from 1400 m to over 2500 m. The main vegetation is grassland savannah dominated at lower altitudes by *Hyparrhenia* spp and at higher levels by *Sporobolus* spp. These provide good cattle grazing pastures but are liable to dry season fires. Savanna trees, raffia palms and elephant grass (*Pennisetum purpureum*) compete in the narrow valleys and stream banks.

The climate is cool with temperatures ranging between 14° C and 25° C. Annual rainfall is between 200 and 300 cm occurring between mid-March and mid-November with a single peak around July or August. There is a marked dry season with strong dusty winds preceding the return of the rains (hamattan).

The soils mainly have volcanic parent material such as trachyte lavas and tertiary basalt. They are humic with a wide carbon/nitrogen ratio (16-20 in the surface layers), acidic (pH from 4.2 in alluvium to 5.5 in the high lava humic soils). The cation exchange capacity of surface layers is high (10-28) with low total exchangeable bases, the combined figure for calcium, magnesium and sodium seldom exceeding 1-4 me/100 g of soil. These soils are usually deficient in the main nutrients, mainly as a result of leaching, burning and erosion which constitute serious problems. Fertilization and conservation should therefore, be important considerations in their management.

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Cameroon is an agricultural country and will for some time remain so. Table 1 gives production figures of the main food crops of the Republic and the target tonnages for 1976.

Until the creation of the West Cameroon Yam Scheme[2] in 1962, almost all yams were imported from neighbouring Nigeria at prices ranging between 290 U.S. dollars to 387 U.S. dollars per ton. The Government then decided on a policy of self-sufficiency for this commodity by assisting farmers to produce it. Between 1962 and 1965 Government purchased and sold to farmers over 167,000 setts of 'Ogoja' yams from the former Eastern Nigeria. Later, attention turned to the Central South Province of Cameroon where the 'Mban' cultivar of white yam (*Dioscorea rotundata*), though smaller in tuber size and lower in yield, was a satisfactory substitute, especially in the hot lowlands.

Root crops are generally the first on newly opened land. Yams are usually planted during the dry season (November to January) on ridges or mounds and mulched with grass. Natural or artificial stakes are used. In the yam valleys of North Cameroon short stakes (about 1 m) are preferred and intercultivation with other crops is unusual. Generally, trifoliate yam (*Dioscorea dumetorum*) is not staked.

The practice of 'topping' to produce 'ware' yams and a subsequent crop of 'seed' yams is used by the Ejagham tribe bordering Nigeria and by the growers in North Cameroon and by the Oshei farmers in North West Province.

Staking and harvesting of yams are among the most costly operations in their production. The 'tonkey', a digger made in North Cameroon is regarded as an efficient harvesting tool.

With increasing production and the desire of farmers to benefit from higher prices in the off-peak season, storage problems require urgent consideration. At present, prices fluctuate from 97 dollars during peak harvest to 290 dollars when scarce. There is also a poor infrastructure in the main areas of production for transportation and marketing.

Yams in Cameroon are not a staple even among the communities producing them. They are a cash earner and their potential in this respect compares favourably with that of any other food crop. There is therefore a need to provide technical guidance to growers whose experience with this crop is comparatively limited.

For this reason yam research started in 1970 in the North West Province.

GERMPLASM COLLECTION

A start was made by collecting local material for classification. Preliminary study and screening at Bambui Plain (1330 m) of eighty nine accessions from eight species has been completed. In addition, twenty cultivars from three species have been imported from the Caribbean. The accession list is summarized below:

Local accessions

Dioscorea alata L.	16 accessions
D. bulbifera L.	11 "
D. cayenensis Lam.	18 "
D. dumetorum (Kunth.) Pax.	16 "
D. esculenta (Lour.) Burk.	3 "
D. liebrechtisiana de Wild	2 "
D. rotundata Poir	17 "
D. schimperiana Hochst.	6 "

Exotic accessions

D. alata	6 "
D. cayenensis	4 "
D. trifida	10 "

Three local accessions (Table 2), 'Oshei', 'Jakiri' and 'Batibo' have showed promise in nearly all the ecological areas involved and have provided the material basis for the agronomic tests discussed below.

MATERIALS AND METHODS

The investigations began in 1970 and are still continuing. They include varietal yield tests (9 trials), cultural techniques (10 trials), fertilizer trials (2 trials), storage (2 trials), and simple chemical analysis. Trials were at sites in the following ecological zones, representative of the whole province

Bambui Plain	1330 m above sea level
Babungo	1100 m above sea level
Befang	700 m above sea level
Santchou (W. Province)	700 m above sea level.

The designs used have been simple or split-plot randomized blocks with a minimum of six replications in any trial. Plot size ranged between 20-40 plants, sown at a metre square along ridges, giving a density of 10,000 plants per hectare. With the exception of fertilizer trials, all other trials received either the same fertilizer application of 80 kg of N, 50 kg P and 120 kg of K per hectare, or 15 tons of farm yard manure or compost per hectare if fertilizers were not available. N and K fertilizer applications were split into two equal applications applied by incorporation into the top soil 60 days and 120 days after planting.

Planting was in February and early March, no mulch was applied and a weight of setts (uniform in any given treatment) between 375-500 g was used. Wooden stakes of about 3 m, each supporting four plants, were used. Except for 'time of planting' trials, replanting of any stands that failed to emerge was done with pre-sprouted material of the same source about 5-6 weeks after planting. Hand weeding was done three times, and moulding up of ridges took place around the middle of the growing season.

RESULTS AND DISCUSSION

Varietal yield comparisons

Table 3 provides data comparing the performance of four popular local varieties of white yams (*D. rotundata*) at Babungo and Santchou. 'Oshei' is now recommended for the highlands. The tuber is long and cylindrical, usually tapering to a tip. It is slightly hairy and the tuber shape varies considerably with soil type. Tuber skin is thin and flesh colour temporarily becomes dull grey on exposure to air. Another shortcoming is its susceptibility to anthracnose disease (*Glomerella cingulata*) which was severe in Bambui in 1972 and early 1973. 'Bonankanda' is a lowland type and has good eating qualities.

Four common yellow yam (*D. cayenensis*) types were tested in Babungo and Bambui Plain (1330 m). Two of them, 'Balikumbat' and 'Batibo' did well, yielding 24.2 tons and 21.4 tons per ha respectively. Batibo has commercial potential, having a better tuber size and shape and better eating quality. It is now recommended to growers in both zones. However, its growing cycle is long (280-315 days) and it is often attacked by the yam beetle. Multiplication of this clone is in progress.

Trifoliate yams (*D. dumetorum*) are popular among peasants who usually sell them already cooked in local markets, hence the name 'traveller's yam'. There is much variation but little commercial potential because they harden on exposure to the atmosphere and so cannot be satisfactorily stored. If this storage problem could be solved, this species might become the most popular yam in Cameroon.

Two accessions of trifoliate yams were superior in the yield trials. 'Jakiri' has a palatability score of 66%. Clonal production is already under way. 'No. 45 ex-Dschang' has a yield range of 22.5-32 t/ha, a growing cycle of 210-240 days and acceptance rating of 60%.

Aerial yams (*D. bulbifera*) are only cultivated in a few isolated communities and have little commercial value. Two accessions, No. 17 ex-Dschang (7.8 t/ha) and No. 21 ex-Dschang (6.2 t/ha) have consistently performed better than the rest.

Yield trials have not been carried out on water yams (*D alata*) whose performance in the zones tested has been very poor. The crude protein content however (11-13%) of some accessions is the highest recorded in our analysis.

Improvement of production techniques

The effects of staking yams:

Treatments and results are summarized in Table 4.

'Topping' of white yams (*D. rotundata*) to increase planting material:

Yam setts may cost up to 600 to 750 U.S. dollars to plant one hectare. Topping of Oshei, Mbam and Ogoja yams was done 8 weeks and four weeks before maturity. In some plots the tubers were harvested and in others tubers were left to mature in the soil. There were three controls, one in each of the harvesting periods.

A higher yield of setts (yam tops) resulted from topping 8 weeks before harvest (30% of yield), but the total yield of ware yams plus setts was depressed by about 8%. Production of setts was much less by topping only 4 weeks before the main harvest (2% of total yield) but there was no depression of total yield.

Topping 8 weeks in advance may therefore be useful if the value of setts is high enough in relation to the value of ware yams to make this economically advantageous.

Land preparation, spacing and fertilizer trial on 'Oshei' yam:

Ridges were compared with planting on flat land using four population densities; 5,000, 10,000,

15,000 and 20,000 plants per hectare. Some plots received fertilizers (usual dose mentioned earlier), others were not fertilized. Results are summarized in Table 5.

The difference between ridged and flat plot yields was not significant, but the latter produced poorly shaped yams and 7.2 percent of the tubers were exposed causing greening and drying. The yield of the two higher plant populations were significantly higher than the others, and the effects of fertilizers were also significant. This trial is being repeated.

Optimum size of yam setts:

Treatments and results are given in Table 6. Sett weight and yield were correlated and heads of tubers did better as setts than the rest of tuber. The greatest margin of profit per kilogram of material invested was obtained from 125 g setts (Fig. 1). This is therefore the best sett weight for production of further yam setts if land is not the limiting factor, whereas 375-500 g sett weight is best for ware yam production.

Optimum time of planting 'Oshei' yams at Banbui Plain:

Planting dates between January 15th and May 30th were compared. January 15th gave, by far, the highest yield, with a substantial regular reduction of yield as planting date was later. The trial has been repeated starting from the middle of October.

Fertilizer trials

Factorial trials of nitrogen, potassium and phosphate on the yield of Oshei (*D rotundata*), 'Batibo' (*D. cayenensis*) and 'Jakiri' (*D dumetorum*) yams were carried out at Rambui Plain (1330 m) in a low humic soil.

Treatments were:

N: 0, 80, 160 kg/ha (Urea, 45%)
P: 0, 100, 200 kg/ha (single superphosphate*, 18%)
K: 0, 120, 240 kg/ha (potassium chloride, 60%)

N and K were applied in two equal doses 60 days and 120 days after planting, while P was applied as a single dose at planting.

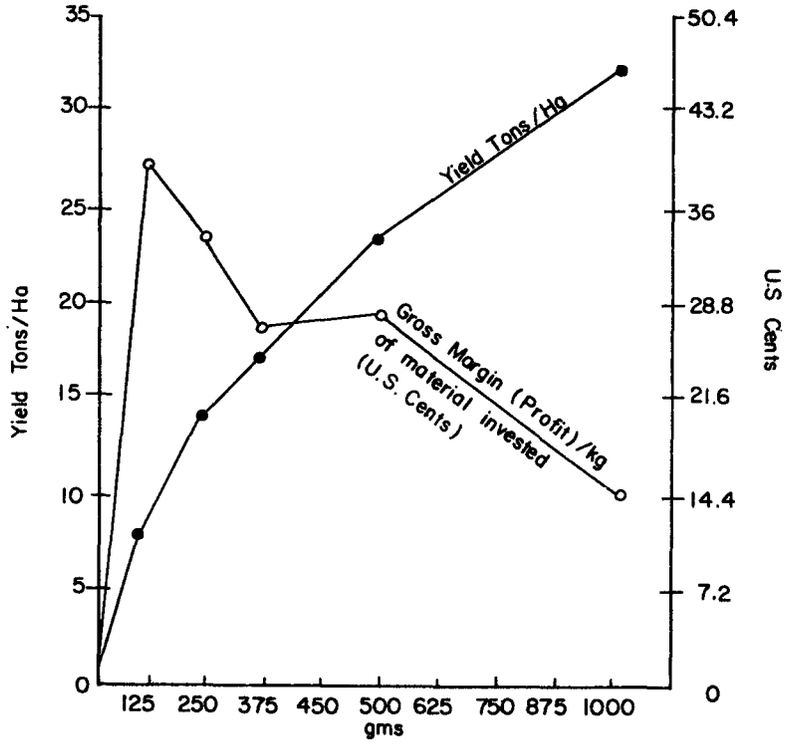

Figure.1. Graph contracting yields with gross profit per kilograms of planting material invented (U.S. Cents).

*Any results attributed to P may be partly due to S whenever single superphosphate is used.

There was a response to both N and K and a positive interaction between them, but not to P. This agrees with previous findings.[3] The economic levels of N and K are currently under investigation.

Preliminary tuber storage trials

The effects of fertilizers (NPK) on the keeping quality of 'Batibo' yam (*D. cayenensis*) were tested under room ambient temperature in wooden trays (50 kg/tray). Results were inconclusive.

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TABLE 1

Production data and targets for food crops in Cameroon.

Commodity	1963-64	1970-71	Target for 1975-76	% increase per annum
Millet and sorghum	381	455	540	37.4
Maize	210	265	290	18.9
Rice	14	34	50	9.4
Wheat	-	-	6	-
Yams	148	185	203.7	2.0
Cocoyams	620	695		
Cassava	433	460		
Sweet potato	101	105	1,349.8	1.3
Solanum potato,	2.7	7		
Melon seeds	8.3	11.6		
Groundnuts	88	120		
Beans	38	50		
Fresh vegetables	171	207		
Plantains	746	850	1161.2	7.3

TABLE 2

Characteristics of yams used in the experiments

Scientific name	Local name	Days to mature	Yield (t/ha)	Crude protein (% dry matter)
D. rotundata	'Oshei'	250-270	22-30	9.0
D. dumetorum	'Jakiri'	210-240	30-45	10.2
D. cayenensis	'Batibo'	270-290	12-18	7.8

TABLE 3

Variation in performance of four popular local varieties of white yams

Variety	Babungo(1100m) t/ha.	Maturity (days)	Santchou(700m) t/ha.	Maturity (days)	Crude protein % day matter
'Oshei'	27.6	(258)	19.1	(199)	9.0
'Mbot'	25.3	(264)	15.9	(197)	5.9
'Banakanda'	16.2	(230)	22.6	(185)	9.3
'Mbam'	7.8	(233)	15.6	(183)	6.2

TABLE 4

Effect of methods of staking on yields of 3 yam species

Staking methods	Mean yield (t/ha)
Tall wooden stakes (3 m)	20.3
Tall wire lines (3 m)	17.7
Short wire lines (1.5 m)	17.4
Short wooden stakes (1.5 m)	16.7
Control (no staking)	15.3
Yam species	
D. cayenensis (Yellow Yam)	24.2
D. rotundata (Oshei Yam)	17.7
D. dumetorum (Trifoliate Yam)	10.7
Standard Error	0.83

TABLE 5

Effect of seed bed preparation, plant population and fertilizer on yam yields

Treatments	5,000 plant/ha	10,000 plant/ha	15,000 plant/ha	20,000 plant/ha
	t/ha	t/ha	t/ha	t/ha
Flat plots, fertilized	8.40	14.28	20.60	22.06
Flat plots unfertilized	8.88	12.39	18.19	20.75
Ridges, fertilized	8.48	13.54	19.72	22.03
Ridges, not fertilized	8.00	11.26	18.83	17.88

Mean of flat plots = 15.69
Mean of ridges = 14.98
Mean of fertilized plots = 16.14
Mean of unfertilized plots = 14.52
General mean = 15.33

TABLE 6

Effect of sett size on yam yields

Treatment	Yellow yam Mean (heads and rest)	Trifoliate Mean (heads and rest)	White Yam Mean (heads and rest)
	t/ha	t/ha	t/ha
125 g.	16.1	13.9	8.1
250 g.	19.1	21.5	14.7
375 g.	22.7	26.1	17.4
500 g.	27.9	32.4	23.5
1000 g.	31.7	44.6	30.6
Standard error	1.1	0.7	-
Mean yields of tops	26.7	30.4	not
Mean yields of rest	20.3	25.0	differen-tiated.