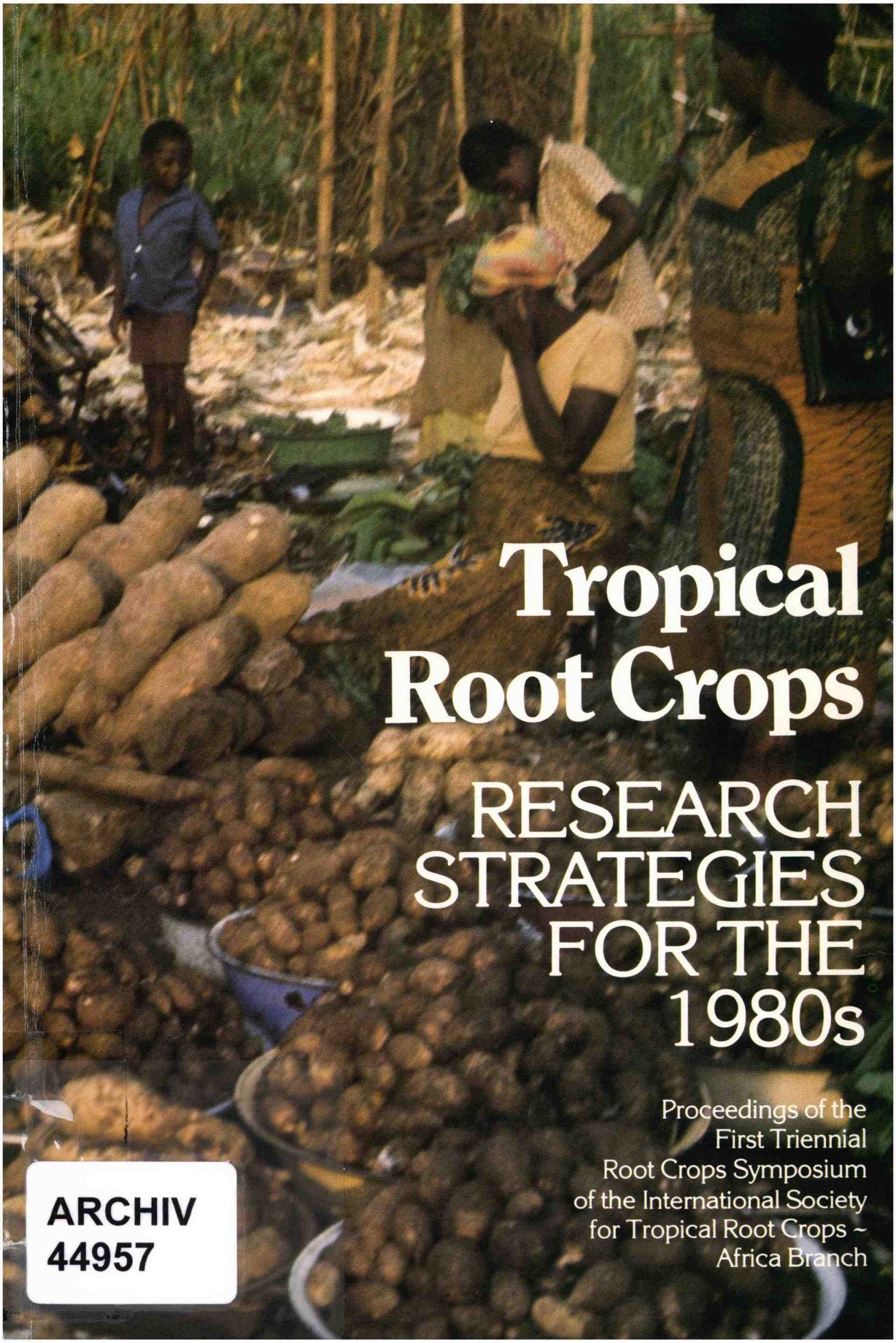

Tropical Root Crops

RESEARCH STRATEGIES FOR THE 1980s

Proceedings of the
First Triennial
Root Crops Symposium
of the International Society
for Tropical Root Crops ~
Africa Branch

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TROPICAL ROOT CROPS: RESEARCH STRATEGIES FOR THE 1980S

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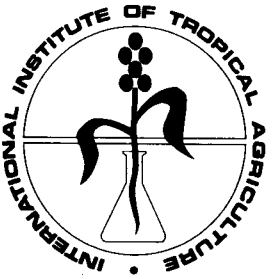

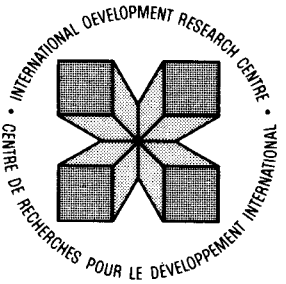

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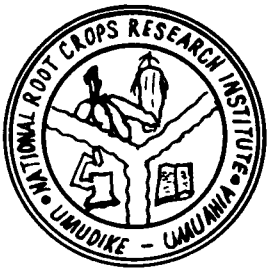

CONTENTS

YIELD AND NITROGEN UPTAKE BY COCOYAM AS AFFECTED BY NITROGEN APPLICATION AND SPACING

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Three amounts of N (0, 40, and 80 kg/ha) were tested on cocoyam, *Colocasia* spp. planted at 80, 60, and 40 × 100 cm at Umudike, Nigeria. Basal dressings of P, K, and Mg were given at 40, 75, and 20 kg/ha respectively. Averaged over all population means, application of N at 40 kg/ha increased yields of corms and cormels by 4.47 t/ha ($P = 0.05$). The largest yield increase of 8.99 t/ha due to N dressing was achieved with 40 kg/ha at a spacing of 100 × 60 cm. But when averaged over all N rates, the mean yields of corms and cormels with respect to the various spacings were not significantly different even though plant heights increased with population density. Observed significant increase in yield due to N was related to an extra 15.3 kg/ha taken up in the tuber when 40 kg/ha was given. This was equivalent to an apparent recovery of 38.3% of the applied N. Tuber yields were more related to the number of cormels than of corms at harvest.

Effets de 3 dosages de N (0, 40 et 80 kg/ha) sur des taros cultivés en plantation à Umudike, Nigeria, espacés de 80, 60 et 40 cm × 100 cm. Un traitement basal de P, K et Mg a été appliqué en quantités respectives de 40, 75 et 20 kg/ha. La production de tubercules et de bulbilles pour l'ensemble des peuplements a donné une augmentation moyenne de 4,47 t/ha avec la dosage de 40 kg/ha. Le rendement optimal de 8,99 t/ha a été obtenu avec le traitement de 40 kg/ha sur des plantes espacées de 60 cm × 100 cm. Cependant, la production moyenne de tubercules et de bulbilles pour l'ensemble des plantes, quel que soit l'espacement ou le dosage d'engrais, a été sensiblement identique sauf en ce qui concerne la hauteur des plantes qui a été plus élevée dans les peuplements à forte densité. L'accroissement du rendement chez les plantes amendées avec un dosage de 40 kg/ha de N s'est traduit par une augmentation de poids des tubercules de l'ordre de 15,3 kg/ha, ce qui signifie la récupération apparente de 38,3% de la quantité de N. La production de racines intéresse davantage le nombre de bulbilles que de tubercules.

The use of optimum spacing is necessary for the maximum exploitation of the factors essential for crop growth. Such exploitation can be accomplished when population density of a crop exercises maximum pressure on all production factors, such as solar radiation, soil nutrients, and water.

We believed, therefore, that it was necessary to assess the effects of spacing and nitrogen fertilizer on the yield and N uptake by one of our cocoyam cultivars locally called Ede ofe grown under the upland soil conditions at Umudike, Nigeria.

METHODS

Our experiment was conducted on sandy-loam soil derived from sandstone at Umudike, Nigeria, from May 1979 to February 1980. Some of the soil characteristics were pH 5.3, sand 76.4%, clay 6.8%, silt 16.8%, organic carbon 1.35%, total N 0.074%, available P (Bray P-1) 8.0; and exchangeable cations: Ca 1.87, Mg 1.25, K 0.24, and Na 0.06 me/100 g.

The experimental design was a randomized complete block with three replications. Four spacings, 100 × 80; 100 × 60; 100 × 40; and 100 × 30 cm (corresponding to 12 500; 16 666; 25 000; 33 333 plants/ha) were compared at three nitrogen rates (0, 40, and 80 kg/ha).

Basal dressings of 40, 75, and 20 kg/ha of P, K, and Mg, respectively, were given. Plant height was measured at 4.5 months after the planting, and crops were harvested after 8.5 months.

Soil pH was determined on a 1 : 2.5 soil, water ratio and texture by the hydrometer method. Organic carbon was by Walkley and Black's procedure, and available P was as described by Bray and Kurtz. Total exchangeable cations were leached with neutral normal ammonium acetate. Total N in corms and cormels and in soil was measured by the Kjeldahl method.

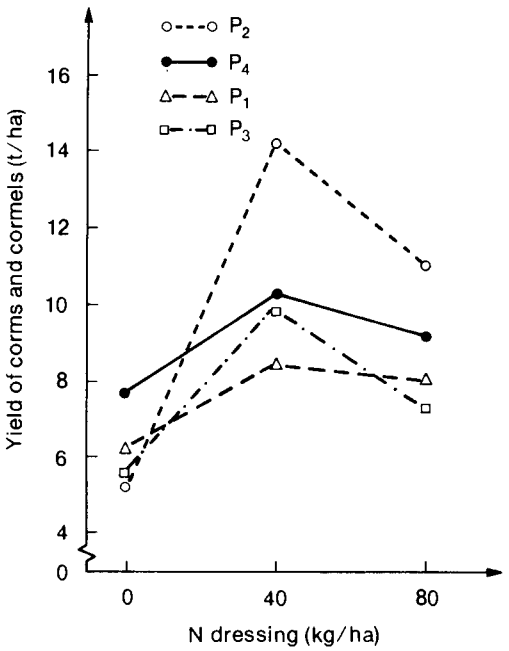

Fig. 1. *Yield of corms and cormels as influenced by spacing and N dressing.*

RESULTS AND DISCUSSION

YIELD OF CORMS AND CORMELS

Fig. 1 shows that, at all the population densities tested, the highest yields of corms and cormels were obtained with an application of 40 kg N/ha. Averaged over all N rates, the application of 40 kg N/ha increased yield of corms and cormels by 4.47 t/ha equivalent to 112 kg corm and cormel per kg N used ($P = 0.05$). At N applications of 80 kg/ha, yields were 2.69 t/ha larger than those from plots without N. The reason for this drop in yield is not clear but may be due to increased disease or lodging.

However, several multilevel N tests are necessary before the relationship between yield and N dressing can be described accurately. In our experiment only three rates of N were tested (0, 40, and 80 kg/ha). These are too few to show whether the corm/cormel yield N response curve is best fitted by a smooth curve or by two intersecting straight lines.

Of the various spacings we compared, 100 × 60 cm gave the largest mean yield (10.1 t/ha). The difference of 2.55 t/ha between the yield at this spacing and yield at the 100 × 80 cm spacing, which gave the least mean yield (7.57 t/ha) was not significant. However, the increased yield at 100 × 60 cm is in good agreement with the results of Arene and Okpala who obtained lowest rate of incidence of *Corticium rolfsii* in *C. esculenta* at a spacing of 60 × 100 cm as against high rates in spacings of 80 × 100 and 100 × 100 cm for shallow planting. They also obtained their best yield at 60 × 100 cm spacings.

N CONCENTRATION, UPTAKE, AND RELATIONSHIP WITH YIELD

Percentage of N in corms and cormels ranged from 1.39 to 2.1 (similar in crude protein to cereals) and was slightly higher (1.9%) at 80 kg N/ha than at 40 kg N/ha and in controls (1.6%). At 80 kg N/ha applications, the largest N uptake (45.9 kg/ha) occurred even though the overall yield was

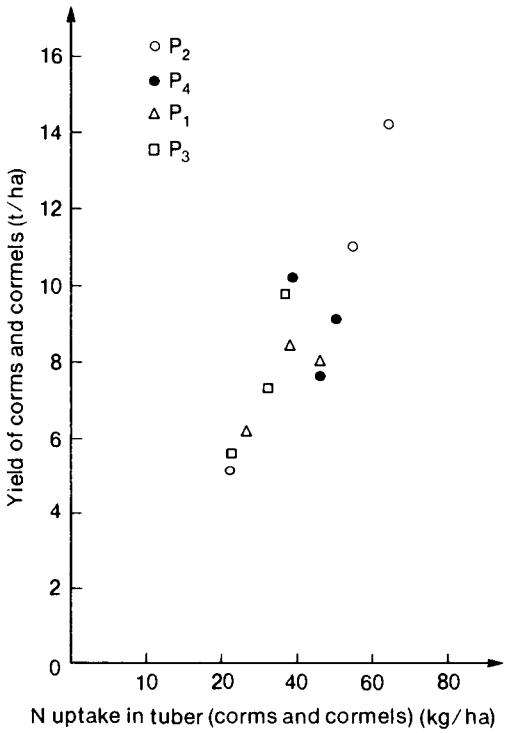

Fig. 2. *Relationship between yield and N uptake in corms and cormels of* Colocasia *sp.*

Table 1. Number of corms and cormels in relation to spacing and nitrogen (kg/ha) application.

Spacing (cm)	Corms			Cormels		
	N_0	N_{40}	N_{80}	N_0	N_{40}	N_{80}
100 × 80	33	27	29	212	223	241
100 × 60	18	52	40	172	314	421
100 × 40	34	37	40	181	369	327
100 × 30	66	42	38	289	261	254

Table 2. Effect of spacing and N application on height (cm) of *Colocasia*.

Spacing (cm)	*Colocasia* height (cm)			
	0 kg N/ha	40 kg N/ha	80 kg N/ha	Mean
100 × 80	55.8	78.8	82.5	70.3
100 × 60	60.5	81.0	72.6	71.4
100 × 40	66.0	82.5	70.8	73.1
100 × 30	78.3	80.0	77.1	81.4

1.78 t/ha less than that at 40 kg N/ha. Mean uptake of N by cocoyam with 40 kg N/ha dressing was 44.4 kg/ha, 15.3 kg/ha more than that when no N was given. This amounted to a net apparent recovery of 38.3 and 21% for application of 40 and 80 kg N/ha, respectively, in the corms and cormels. It is noteworthy that the treatment that gave the highest apparent recovery of N also produced the highest yield of corms and cormels (40 kg N/ha). Similarly for the population densities, N uptake was largest at a spacing of 100 × 60 cm (47 kg N/ha), which gave the largest yield.

Fig. 2 shows the relationship between yield of corms and cormels, and the N uptake of the tuber can be expressed by a linear model: $Y^1 = 1.91598 + 0.16725 \times Nc$ where Y^1 = yield of corms and cormels and Nc = uptake of N in corms and cormels (kg/ha).

The correlation coefficient (r) was 0.8706 and regression of yield of corms and cormels on N uptake accounted for 75.9% of the variance.

Number of Corms and Cormels and Relationship with Yield

Table 1 gives the number of corms and cormels as influenced by spacing and N dressing. Averaged over all spacings, N application had an increasing effect on the number of cormels but not on the number of corms.

The number of corms was only 14% of the total yield, 86% being accounted for by cormels. Cocoyam grown at a spacing of 100 × 60 cm had the largest number of cormels. In other words, the yield increments were largely attributable to the increase of cormels. Regression analysis of total yield showed that the cormels accounted for 43.6% of the variance, whereas the corms accounted for only 21.9%.

Plant Height, Flowering, and Deficiency Symptoms

Plant height measurements 4.5 months after planting showed that *Colocasia* spp. grew taller as intra-row spacing decreased. For example, at a spacing of 100 × 80 cm, plants grew to a mean of 70.3 cm, and at 100 × 30 cm, to 81.4 cm (Table 2). This finding was probably due to more competition for solar radiation. N also had an effect on plant height. *Colocasia* given 40 kg N/ha was 14.9 cm taller than that given no N (65.1 as compared with 80.0 cm). Thus, a symptom of deficiency of N was stunting as was general chlorosis of the leaves. The lower leaves died rather quickly.

Table 3. The effects of nitrogen application on the flowering of 12 plots of *Colocasia*.

Nitrogen (kg/ha)	Plots in which flowering was observed	Plants flowering	Mean (%)
0	6	17	4.3
40	11	47	11.8
80	8	29	7.3

Flowering was observed under field conditions to be more abundant on plots that received N than on plots without N. Spacing did not have any noticeable effect on flowering (Table 3).

As this work is preliminary, more detailed work is necessary on the combined effect of population and fertilizers for the different cocoyams under the Nigerian environment. Further investigation is especially important in the Southeastern zone where annual rainfall is often more than 2000 mm with consequent leaching of both applied and native N. The sandy nature of the soil with low organic matter, total nitrogen, and phosphate suggests that these nutrients among others will continue to be limiting.

The Director, National Root Crops Research Institute, Umudike, granted us permission to present this paper. Thanks are due to Dr Odurukwe for help with statistical analysis and to Mr Arene for helpful suggestions.