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# EFFECTS OF DIVISION LEVELS OF SEED TUBERS ON YAM (D. alata, D. trifida) GERMINATION AND YIELD

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## INTRODUCTION

Yam cultivation rests essentially on tuber cutting for propagation. Only some small tubers bearing species (*Dioscorea esculenta*, *D. trifida*, in the West Indies) are regularly cultivated from whole tubers. Even with these species cutting may be practiced at times.

A number of authors have discussed the effects of cutting (see COURSEY, 1967) We quote here some of them.

As early as 1921, KINMAN showed in the West Indies (Puerto-Rico) the advantage of top setts (cuttings from near the stem) over middle and lower setts of *D. cayenensis* (forma *rotundata*) in yield although middle setts gave more tubers at harvest.

SAWADA (1952) showed with *D. batatas* that germination was polarized according to the tuber-mother structure : first germination point appeared or prevailed on sett part facing the tuber-mother top. He discovered that tuber initiation was exogen in large setts and endogen in small ones. With bulbils he observed that cuttings as small as 0.5 gram could grow.

MIEGE (1957), in Ivory Coast, with *D. alata* and *D. cayenensis*, explored the heterogeneity of tubers. He found a gradient in starch granule distribution, with raphids when present mostly in the top part. Here also top setts were the best in earliness of germination as well in yield, over middle or lower setts, the latter outyielding the middle setts. Level of yield depended also on tuber-mother weight (lighter better than heavier) and some optimum weight existed from each variety.

FERGUSON, HAYNES and SPRINGER (1969) studied cutting of tubers of *D. alata*, *D. esculenta* and *D. trifida* in a study of limiting experimental and random variations in yam growing. Top sett earliness was confirmed, but no yield significative differences existed between level of cutting of setts. In some cases origin of the setts influenced number of stems and tubers. Overall, their studies confirmed the high variance heterogenity in yam propagation material, and thus the inadequacy of simple statistical comparisons in experiments in this crop.

In Guadeloupe, the Plant Breeding Station (INRA) set up several trials in 1965 which established:

- the clear superiority of head and decline in yield toward the tail with *D. alata* cv. Couleuvre;
- the net superiority of head over other parts with *D. alata* cv. Tahiti;
- a variation of head yield when comparing setts from second harvest tuber (usual seed sett) with setts from first harvest tuber (usual market tuber), the last giving higher yield, with *D. cayenensis* cv. IGNAME JAUNE

Recent experiments aim at the following points:

- verifying yield and physiological gradient in tubers of recently released varieties
- studying optimal propagation conditions for these slones
- exploring tuber heterigeneity as a possible source of genetic diversification

The first year of experimentation here reported attempted to verify yield and physiological gradient in some controlled conditions which may justify drastic limitation in sampling, one tuber being taken for each treatment.

## MATERIAL AND METHODS

The cvs. were PACALA STATION of *D. alata* and INRA 25 of *D. trifida*.

PACALA STATION is a selected clone of a desirable commercial type, with fair tolerance against disease (FOURNET et al., 1974) and good production, cooking and keeping abilities.

INRA 25 is an hybrid clone from a Cush-cush crossing (DEGRAS, ARNOLIN, POITOUT, 1971) of high productivity and good cooking ability.

Four tubers of each varieties were divided into 4, 8, 16 and 32 setts respectively. Their origin are indicated in gigures 1 where levels are I to IV from head (or top) toward growing point when tubers are divided into 4 and setts.

Tubers of PACALA weight about 800 grams each, those of INRA 25, 160 g. These weights are normal commercial tuber weights from each variety. All setts were placed on 5.22.73 in a humid frame in individual pots filled with soild mixed with vegetable mould and regularly watered till germination. They were then planted in the field at a uniform spacing of 0.50 m between setts. These procedured gave the experimental combinations which follow:

| SETTS NUMBER/TUBER | | 4 | 8 | 16 | 32 |
|---|---|---|---|---|---|
| PACALA | sett weight (g) | 200 | 100 | 50 | 25 |
| | field weight/m2 (g) | 800 | 400 | 200 | 100 |
| INRA 25 | sett weight (g) | 40 | 20 | 10 | 5 |
| | field weight/m2 (g) | 160 | 80 | 40 | 20 |

Treatments (16) for PACALA and (4) for INRA are more or less common field densities.

PACALA was harvested on 1. 7. 73, INRA 25 on 2. 18. 73, which represents respectively 228 days and 268 days from planting.

## RESULTS

Tables I to IV summarise the results. We have lost 8.3% setts of INRA 25 by decay before germination and 3.1% between germination and harvest. On account of ditribution of these losts, which occur mostly among size 1/16 and size 1/32 upper setts, we think that peduncle fungus diseases related to Penicillin oralicum attacks (RICCI, ARNOLIN, 1973) may be the main factor.

Germination earliness

In tables I and II, setts of both varieties show

- maximum earliness towards head setts,
- maximum earliness with heavier setts.

Seemingly, interactions exist. Their values are difficult to estimate considering FERGUSON's (1969) data. At least the following points are of interest:

- no simple head-tail gradient of germination in PACALA, where IV level and III level are similar
- no simple gradient of germination in relation with INRA 25 setts weight : the 1/32 sett size, on a mean, is not inferior to 1/16 sett size as in PACALA case.

There was wide range of earliness among setts from the same level when cut into 32.

Harvested tuber yield

Table III and IV show

- a clear but slight variation of tuber yield in relation to level
- a clearer and greater variation of tuber yield in relation with the setts weight.

The most striking difference is between 1/4 and 1/8 setts of INRA 25. On the contrary no difference is observed between 1/16 and 1/32 sett type of either cv., nor between 1/4 and 1/8 sett types of PACALA.

It is worth noting the rate of propagation permitted with each sett type of each variety (sett weight in $g/m^2$ in parenthesis):

| Sett type | 1/4 | 1/8 | 1/16 | 1/32 |
|---|---|---|---|---|
| PACALA | 12 (200) | 23 (100) | 30 (50) | 17 (25) |
| INRA 25 | 50 ( 40) | 30 ( 20) | 37 (10) | 87 ( 5) |

The greatest efficiency in cumulated harvested weight is obtained in PACALA with 8 setts and in INRA 25 with 32 setts (table III and IV), though absolute yield per m is higher with 4 setts in both varieties.

Origin levels of setts give small differences with a superiority of "tall" over "head", more regular in PACALA than in INRA 25 where maximum yield appears with level II (upper middle level).

**Number of tuber harvested**

In PACALA in all cases but one (level III, type 1/32, where two tubers was harvested) each sett gave one tuber.

In INRA 25 which normally give several tubers per plant, a clear difference appears both with level of origin of setts and with sett size. Only this latter is considered, the former being in accordance with the harvested tuber weight.

Variation with size of setts results in the following data for harvested tubers:

| | | | | |
|---|---|---|---|---|
| Number/sett | 1/32 | 1/16 | 1/8 | 1/4 |
| Number/mother-tuber | 10.3 | 7.5 | 11.0 | 28.2 |
| Tuber mean weight (g) | 329.6 | 120.0 | 88.0 | 112.8 |

## DISCUSSION AND CONCLUSIONS

1. Longitudinal heterogeneity of yam tubers in physiology and yield potential is confirmed.

Earliness of germination shows the known gradient from head to tail. though some interaction may be found with size of setts.

Both with PACALA and INRA 25 earliness of germination differences between head and tail are smaller when sett size is smaller; mean earliness is lower also (an exception could be in the case of INRA 25 from 1/16 to 1/32). Two process may account for this:-

- slower initiation of new buds when tissue are less important
- an inhibition correlation stops fewer buds when setts are smaller so that the leading bud is less able to realise its potential.

2. A transverse heterogeneity of yam tubers may account for the wide dispersal of earliness in germination from a particular level (size 1/32), but this may not be entirely random. The regular occurrence of the latest germination at all levels in PACALA 1/32 raises some doubts.

3. Yield results along a head-tail gradient conflict with published results and with our previous observations on the effects of level of setts. FERGUSON, HAYNES and SPRINGER (1969) reported only the better performance of tail sett for number of stems and number of tubers, this last point being in accordance with KINMAN's (1921) observation. We think that the field density could be a cause of interaction, but further observations are needed.

4. As for the sett size effect, interaction with field density precludes any conclusion, but the higher propagation rates found in each variety for a limited size setts remain of interest.

Further experiments will examine the following:

- uniform density and uniform spacing
- 2-3 mother-tubers by treatment
- a more systematic division into setts
- numbering of setts for testing transverse heterogeneity
- dormancy observations after harvest
- a first "vegetative genealogy" for search of "progenies" diversity.

We hope that breaking the bud inhibitions of a wider area of the mother-tube will show possible "somatic" mutations as well as phenotypic "variants" representing different balances of explored in classical breeding needs more attention in the selection of vegetatively reproduced tropical plants.

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