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NEW RESULTS IN YAM MULTIPLICATION

L. DEGRAS and P. MATHURIN
Station d'Amelioration des Plantes,
Centre de Recherches Agronomiques des Antilles et de la Guyane
(CRAAG) Institut National de la Recherches Agronomique (INRA,
Guadeloupe.

SUMMARY

Tubers of two cultivars of *D. alata* and a cultivar of *D. trifida* have been cut in setts of ¼, 1/8, 1/16 and 1/32 in such a way that longitudinal heterogeneity could be expressed in germination and yield potential. Proximal end is generally earlier but and interaction with size of setts is obvious. There was a tendency for a higher yield towards distal tuber end. This study is part of a research programme still in progress.

INTRODUCTION

A previous publication (Mathurin, Degras, 1974) has given the background of this research. We list here the general objectives:

1. Verify yield and physiological potential gradients in tubers of recently released varieties of yam.
2. Study their optimal propagation systems.
3. Explore tuber internal heterogeneity as a possible source of genetic variation.

A second year of observations is reported here. A third one is in progress.

VARIETIES AND METHODS

Varieties

Two varieties used in the first year (Mathurin, Degras, 1974) have been used again: *D. alata* cultivar "Pacala Station" and *D. trifida* cultivar "INRA 25" an original hybrid.

D. alata cultivar "Lupias" was added in the second year. We introduced it in Guadeloupe from Lifu Island (New Caledonia, Oceania) (Degras, Arnolin, Poitout, 1972). It idffers from cv "Pacala" mainly by its tuber shape more ovoid with harder skin which makes it better suited to mechanised planting and harvesting.

Methods

All tubers were maintained from harvest to planting in a stocking room at about 16 - 19°C and 85 p 100 relative humidity. These conditions are known to prolong dormancy.

Six types of cut pieces were obtained in each variety (see figure 1):

A	-	4	horizontal sections
B	-	8	sections by a vertical and median cutting of A
C	-	8	horizontal sections (treatment added this second year)
D	-	16	sections by a vertical and median cutting of B
E	-	16	horizontal sections (treatment added this second year)
F	-	32	sections by another vertical cutting in D perpendicular to the first one.

Due to availability of material and variation in varietal characters we had different seed pieces weight for an equivalent treatment of different varieties and also a limitation of the replications. One series at uniform spacing was set on for each variety and two series for "INRA 25" and "Lupias" in modulated spacing, giving a constant weight per square meter for each variety (Table 1.)

RESULTS

Many observations have been gathered: germination earliness, growth and maturity indices, flowering, number and weight of tubers at harvest.

We will consider only, here, germination earliness and weight of harvested tubers.

GERMINATION EARLINESS
(Tables 1, 3, 4)

Notation referred to the time of 50% bursting buds over the seed pieces of a treatment.

1. Effects of number of cuttings (and size of seed pieces)

In each variety germination earliness is more or less affected by the number of cuttings.

The less affected is "Lupias", the treatment E only being out of the general delay. It is the one with the thinner slice of tuber (1/16 in transversal section).

In "INRA 25" also this treatment is markedly the latest one.

In "Pacala" the lateness of treatment F is partly due to a re-seeding necessitated by a lack in normal water circulation. Treatment E is the least early among the others.

Figure 2 shows the correlation between successive years in germination of sizes of seed pieces (of course treatments E and C are not included).

Roughly it can be admitted that the biggest seed pieces are the earliest and the smallest one the latest. But if a regular decreasing gradient is seen in "Pacala" both "Luipas" and "INRA 25" have the latest germination in treatment E (partition in 16 sections).

2. Effects of origin level of seed pieces

There is a general tendency towards earlier germination of proximal end. The gradient is quite linear in "Pacala" variety this year. It was such also for "INRA 25" last year. It fits a curve with the earliest germination just out of a proximal end of "INRA 25" this year, or with the latest germination just out of distal end of "Pacala" last year. The intermediate behaviour in "Lupias" is devoid of uniform direction.

It can be said that an heterogeneity is always expressed in earliness by different origins of a given tuber but no internal gradient extends, in all situations, the constant advance in germination of proximal end over distal end.

3. Interaction between size and level of origin of seed pieces

For the three varieties it can be seen that when the size goes from ¼ to 1/32 the earliest section goes from proximal end to intermediate section, the distal end becoming earlier than the distal one for two varieties.

WEIGHT HARVESTED

The two systems of field density will be considered separately.

Uniform spacing of plants

Half the data of the treatments in "Pacala" is accidentally lacking. A comparison between the remaining results with those of the first year permits some conclusion. The total weights of each treatment are given in Table 5 and indicate that:

- 1/16 section is still the highest in yield
- 1/32 gives a higher yield than ¼
- The apparent superiority of distal end observed the first year given way to a superiority of intermediate proximal section. But distal and proximal end yields remain of the same order.

A comparison of equivalent data for "INRA 25" is possible with Table 5, it follows that:

- this year the 1/16 section yield climbs at the level of 1/32 one which was the highest the first year.
- distal end becomes by far the best yielder section, while it was not significatively different from others
- however the absolute superiority of distal end over proximal end confirms the difference observed between them the first year.

As for "Lupias" the unique crop observed gives best yield with 1/32 sections, and a regular gradient towards the yield superiority of distal end.

Modulated spacing (uniform weight density by variety)

Table 6 permits the comparison of uniform spacing yields and modulated spacing yields for "INRA 25" and "Lupias".

Common features within varieties are:

The superiority of distal end yield over the proximal end yield, in both types of spacing

The variation between treatments of each variety is, as expected, less within modulated spacing than within uniform spacing, with the exception of the effect of size of setts in "INRA 25".

These two varieties differ in their behaviour regarding the relative rank of size of setts in yield. For example 1/32 falls below ¼ in "INRA 25" while it outpasses it in "Lupias".

DISCUSSION

This report is given as a complement to the quoted publication (Mathurin and Degras, 1974) in order to establish the limitation of such studies when they consider one species among the wide *Dioscorea* genus, one variety among a given species, or, with several cultivars.

A comprehensive deduction can be made after the third year experimentation which is in progress. But some particular point can be underlined here.

First of all a regular supply to the plants, from germination to harvest, of phytosanitary protection, in water, manure and light is highly necessary to avoid bias in results. For instance, we cannot assume that the poor yield obtained with "INRA 25" in many treatments does not result from more parasitic influence than we thought remaining after a disinfection soaking of all setts. The beginning of growth suffered from a severe drought. It accounts for the high level or mortality in 1/32 and 1/16 section and perhaps for the higher yield of latest germinated pieces.

Experiment in the third year will emphasise dormancy, floral behaviour and the possibility of a clonal selection in material of different origin.

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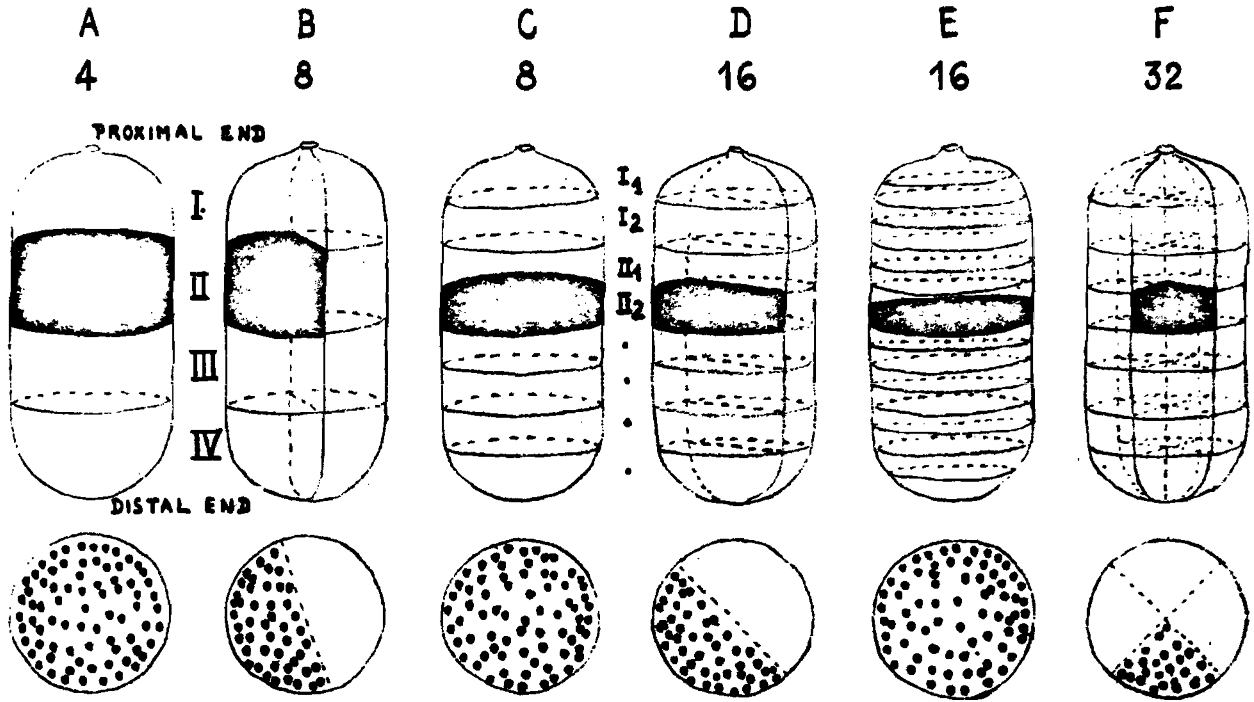

Fig. 1. Fragmentation Techniques of Yam Tubers.

TABLE 1. Initial data of the experimental design

Treatments (see fig. 1) Varieties		Number of seed pieces	Weight of seed pieces (g)	Uniform (no replication)	Density (g/m^2) from spacing on the ridge (117 cm between ridges)			
					Modulated (2 replications)			
				50 cm	120 cm	60 cm	30 cm	15 cm
D. alata cv. Pacala	A	4	250	427				
	B / C	8	125	213				
	D / E	16	62	106				
	F	32	31	53				
D. alata cv. Lupias	A	4	200	306	142			
	B / C	8	100	153		142		
	D / E	16	50	75			142	
	F	32	25	32				142
D. trifida cv. INRA 25	A	4	40	67	28			
	B / C	8	20	33		28		
	D / E	16	10	17			28	
	F	32	5	8				28

TABLE 2. Germination delays of *D. alata* cv. "Pacala Station" (Number of days from first sett germination i.e. 5/28/75).

LEVELS	DELAYS (with grouping in B, C, D, E, F)							8 LEVELS DELAYS		
Cuttings	4A	8B	8C	16D	16E	32F	Mean		16D	16E	32F
Proximal end											
I	1.0	8.5	6.0	10.0	15.0	55.0	16.7	I_1	5.0	13.5	60.0
								I_2	15.0	17.0	50.0
II	8.0	11.0	10.0	14.0	11.0	46.0	17.6	II_1	9.0	10.5	46.0
								II_2	18.5	12.0	46.5
III	13.0	11.0	10.0	11.0	10.5	49.0	18.4	III_1	9.5	10.0	49.0
								III_2	12.5	11.5	49.0
IV	12.0	10.5	10.0	14.0	18.0	49.0	19.8	IV_1	15.5	12.0	52.5
Distal end								IV_2	13.0	24.0	46.0
Mean	8.5	10.1	9.0	12.2	13.8	49.8			12.2	13.8	49.8

TABLE 3. Germination delays of *D. alata* cv "Lupias" (Number of days from first sett germination i.e. 5/28/75)

LEVELS	DELAYS (with grouping in B, C, D, E, F)							8 LEVELS DELAYS		
Cuttings	4A	8B	8C	16D	16E	32F	Mean		16D	16E	32F
Proximal end											
I	3.5	9.0	11.0	10.7	30.5	15.7	13.4	I_1	10.0	22.7	14.7
								I_2	11.5	38.5	14.2
								II_1	14.5	37.7	13.7
II	9.2	12.5	12.0	14.2	43.7	13.5	16.7	II_2	14.0	39.2	13.2
								III_1	16.0	29.0	12.0
III	11.5	14.0	13.5	15.2	35.5	11.2	14.4	III_2	14.2	42.0	11.5
								IV_1	17.7	40.2	14.7
IV	19.2	11.0	15.0	12.2	34.2	16.2	17.9	IV_2	12.0	28.2	18.0
Distal end											
Mean	10.8	11.6	12.8	13.1	34.1	14.3			13.1	34.1	14.3

TABLE 4. Germination delay of *D. alata* cv. "INRA 25" (Number of days from first sett germination i.e. 5/28/75).

LEVELS	DELAYS (with grouping in B, C, D, E, F)								8 LEVELS DELAYS		
Cuttings	4A	8B	8C	16D	16E	32F	Mean		16D	16E	32F
									24.2	(24.0)	23.2
Proximal end I	13.7	19.5	19.0	22.0	(49.5)	27.0	21.9		28.0	50.0	31.0
									14.0	(21)	17.5
II	14.7	19.2	16.7	15.0	(24.5)	21.2	18.9		17.5	24.0	24.0
								III_1	18.5	(19.0)	21.2
III	13.0	19.7	24.7	19.7	(44.0)	20.0	23.5	III_2	15.0	44.5	19.5
								IV_1	14.0	29.0	20.0
IV Distal end	36.2	34.5	21.5	18.5	36.0	20.5	27.7	IV_2	19.5	44.0	21.0
Mean	19.8	23.2	20.4	18.8	(38.8)	22.5			18.8	(38.8)	22.5

N.B. Some data are calculated from initial notes which are more precise than numbers simplified here for presentation in this preliminary note

TABLE 5. Weight (g) of harvested tubers from one mother-tuber for two years with uniform spacing.

a *D. alata* cv. "PACALA STATION"

YEAR	TOTAL WEIGHT FOR PARTITION			TOTAL WEIGHT FOR LEVEL (+)			
	4A	16D	32F	Proximal end	Intermediate Prox.	Intermediate Dist.	Distal end
1974	9850	24600	13280	17300	17030	15580	16300
1975	9470	39690	18560	14500	20010	18210	15020

b *D. trifida* cv. "INRA 25"

YEAR	TOTAL WEIGHT FOR PARTITION				TOTAL WEIGHT FOR LEVEL (++)			
	4A	8B	16D	32F	Proximal end	Intermediate Prox.	Intermediate Dist.	Distal end
1974	8060	5020	5640	13860	5900	8370	9320	8210
1975	11400	16320	27840	27560	17840	30460	28980	43430

(+) 8 B is included in 1974

(++) 8 C and 16 E are included in 1975

TABLE 6. Weight (kg) of harvested tubers from one mother-tuber of D. *alata* "Lupias" and *D. trifida* "INRA 25" with two systems of spacing.

A/ Total weight for partitions

	4 A	8 B	8 C	16 D	16 E	32 F
INRA 25						
Uniform space	11.400	15.040	16.320	27.840	9.890	27.560
Modulated space	15.970	2.470	5.970	11.160	16.750	6.740
LUPIAS						
Uniform space	9.740	16.160	1.723	33.180	32.600	58.800
Modulated space	27.335	29.830	25.935	19.290	34.235	32.105

B/ Total weight for levels

	Proximal end	Intermediate proximal	Intermediate distal	Distal end
INRA 25				
Uniform space	17.840	30.460	28.960	43.430
Modulated space	14.890	16.590	10.870	17.680
LUPIAS				
Uniform space	37.180	38.490	43.910	51.730
Modulated space	40.730	40.350	40.890	46.760

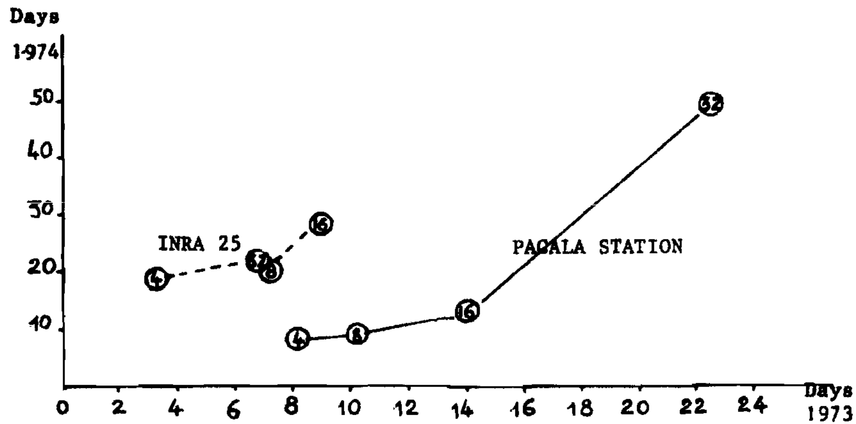

Fig. 2. Germination delays (number of days after 1st germination) for two yam varieties under four sizes of setts over two years.