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**CARIBBEAN
FOOD
CROPS SOCIETY**

*SOCIETE CARAIBE
POUR LES PLANTES ALIMENTAIRES*

25

Twenty fifth
Annual Meeting 1989

25^e CONGRES ANNUEL

Guadeloupe

Vol. XXV

MANAGEMENT OF THE BINUGAS YAM (DIOSCOREA ALATA) IN PUERTO RICO

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ABSTRACT

The Binugas yam has an extraordinary yielding potential. However, it often produces large-sized and off-shaped tubers which make the product unattractive and difficult to market. Two experiments were conducted to determine the effect of cultural practices on marketable yield and uniformity in size and shape of tubers. In the first experiment ridged and flat rows with and without vine support were evaluated. All plants were spaced .30 m in rows and 1.52 m between rows. In the second experiment the following planting systems were tested : ridged and flat rows with vine support, in-row spacings of .15 and .30 m with a distance between rows of 1.52 m, and three sett sizes averaging 56, 112 and 224 g each. The Binugas yam planted in flat rows with and without vine support has a yielding potential of 60,000 to 72,500 kg/ha of marketable tubers. Premium marketable yields of 45,800 kg/ha were obtained when medium size setts (112g) were planted in flat rows spaced at .30 m within the rows. Under these management conditions 85 % of the tubers were of uniform shape and desirable marketable size.

RESUME

CONDUITE DE LA CULTURE DE L'IGNAME BINUGAS (DIOSCOREA ALATA) A PORTO RICO

L'igname Binugas a un potentiel de rendement extraordinaire. Toutefois, il produit souvent des tubercules volumineux et malformés qui rendent sa production peu attirante et difficile à commercialiser. Deux expérimentations ont été conduite pour déterminer l'effet des systèmes de plantation, de l'espacement et la densité de peuplement et de la taille du plant de semence sur la récolte commercialisable et sur l'uniformité et la forme des tubercules. Dans la première expérimentation quatre systèmes de plantation ont été

évalués : des billons avec et sans tuteur et des rangs à plat avec et sans tuteur. Les plants étaient à 0,30 m sur le rang et 1,52 m entre rangs. Dans la seconde expérimentation les traitements suivants ont été essayés : rangs à plat et billons avec 0,15 et 0,30 m sur le rang et 1,52 m entre, d'où 43.170 à 21.585 pl/ha, respectivement et trois poids de semence, 56,112 et 224 g. L'igname Binugas à plat a un rendement potentiel de 60,170 sans tuteur et 72,476 t/ha avec tuteur. Des rendements de qualité commerciale supérieure de 45,800 t/ha ont été obtenus avec 112 g, à plat à 0.30 m. Dans ces conditions 85 % des tubercules sont uniformes et de la taille commerciale souhaitable.

INTRODUCTION

In Puerto Rico, the true yam (*Dioscorea spp.*) is a demanding food staple. In 1986, consumption was about 14,000 metric tons, 15 % more than the local production (Anonymous, 1986).

Most of the yam production is located in the humid uplands on steep and clayey soils. Under these conditions yields are low, and most cultural practices are labor intensive, particularly land preparation, bed raising, staking and harvesting.

During the late 1960's the Federal Experiment Station at Mayaguez introduced from South-East Asia and the South Pacific eight high yielding *D. alata* cultivars (Martin and Delpin, 1978). The plants develop vigorous vines, are shallow setting, and produce semi-rounded tubers which make easier and less expensive the harvest operation specially on clayey soils. More recently it has been reported that these yams possess field resistance to foliar diseases and viruses (Hepperly and Vázquez, 1989).

However, because of the frequent production of large-sized and off-shaped tubers, acceptability of these yams among local farmers has been slow. The large and distorted tubers often are difficult to market and usually demand lower prices at the farm gate. In yams, the individual tuber size is affected by the size of the seed piece used. The shape, although primarily under genetic control is also influenced by the soil structure (Coursey, 1967 ; Onwueme, 1978).

Among these cultivars, Gunung (P.I. 390102), has been successfully treated with ethephon for the production of greater number of uniform tubers per plant (Goenaga, et al., 1989). This study reports on the yielding potential of the Binugas yam (P.I. 390072) and recommends cultural practises to

improve tuber uniformity.

MATERIALS AND METHODS

Two yam experiments were planted April 30, 1985 and June 27, 1988 at the AES-UPR Corozal Substation. The Substation is located in the humid north-central uplands at an elevation of 200 m. Mean annual rainfall is about 1,800 mm and pan evaporation of 1,400 mm. Average monthly minimum and maximum temperatures are 19.5 and 30.5° C, respectively. The soil is a red-acid Corozal clay (Ultisol) with a pH of 5.2 and a exchangeable base capacity of 10.9 meq/100 g of soil.

In the first experiment ridged and flat rows with and without vine support were evaluated in a split-plot design with 8 replications. The plants were spaced .30 m in the row and 1.52 m between rows.

In the second experiment two planting systems (ridged and flat rows with vine support), two in-row plant spacings (.15 and .30 m with a distance of 1.52 m between rows, about 43,170 and 21,585 plants/ha, respectively) and three sett sizes (56,112 and 224 g each) were tested in a split-split-plot design with 5 replications. Main plot size for both experiments was 6.1 by 9.2 m.

The soil was tractor-plowed to about 25 cm depth and disc-harrowed twice. Because of a 12 % steepness the ridged rows were raised by hand to about 30 to 38 cm in height. To provide vine support, single wire trellises were prepared using 2.1 m long wooden posts spaced 4.6 m in the row and connected in the top with a gauge # 10 galvanized wire. The trellises were spaced 3 m apart.

Tubers of the Bigunas cultivar were used as planting material. In the first experiment unselected tubers of different sizes and shapes were sectioned into pieces weighing 84 to 168 g per sett. In the second experiment only fairly uniform semi-rounded tubers were used as planting material. Before planting all setts were submerged for 15 minutes in a solution containing 15 and 30 cc of Vydate-L and Mertect 340-F, respectively per 3.81 of water. One week after planting, Temik 10-G was applied on the top of the row at the rate of 34 kg/ha. As a preventive measure against foliar disease outbreaks, the plants were sprayed 3 times during the growing cycle with Benomyl at the rate of 1 kg/ha.

All plants received 2,200 kg/ha of a 10-5-20-3 (N, P₂O₅, K₂O, MgO) fertilizer divided into equal applications 1 and 4 months after planting.

Weed growth was suppressed with a pre-emergence application of Ametryne at the rate of 4.5 kg/ha and occasional hand weeding.

Eight months after planting the two middle rows of each plot were harvested. On the basis of size, the tubers were classified into marketable and non-marketable. Small tubers weighing 230 g or less were classified as non-marketable. In the second experiment the marketable tubers were further sub-divided into two categories : tubers of uniform size showing semi-rounded to ovate shapes with no more than two prominent lobes, and deformed and large sized tubers fused together forming irregular clusters. Number of tubers and their weight were recorded.

RESULTS AND DISCUSSION

In the first experiment, the planting systems of flat rows with trellises was the highest yielder with a production of 72,476 kg/ha of marketable tubers (table 1). Although yield differences from ridged rows with vine support were not significant, the flat row planting reduces production cost, particularly on steep land where hand-bed-raising is expensive and difficult to perform. Tuber weight differences between flat and ridged rows without vine support also were non-significant. On the other hand, flat rows with trellises outyielded ridged rows without trellises by 19,035 kg/ha.

In the second experiment, there was no significant interaction between planting systems, in row plant spacings and sett sizes for number of tubers. However, acting independently, these cultural practises affected some of the yield parameters. The flat row planting produced significantly greater number of tubers/ha than the ridged row system (table 2). The increase in weight was 8,366 kg/ha but the differences were not statistically significant. Flat row planting also tended to produce the heaviest individual tubers.

The in-row plant spacing of .15 m produced significantly higher number of tubers/ha from the wider spacing of .30 m (table 2). However, this increase was associated with a substantial reduction in mean tuber weight. Therefore, marketable weight was about the same, an average of 44,062 kg/ha.

Large and medium size setts produced significantly higher number of tubers and marketable weight/ha over small propagating setts (table 2). The average weight increase was 15,956 kg/ha or about 32 %. There were no significant differences between large and medium size setts. Mean tuber weight tended to increase with and increase in the size of the propagating material.

Table 1 : Effect of planting systems on the yield of the binugas yam, experiment 1

TREATMENT	MARKETABLE WEIGHT
	kg/ha
Flat rows with trellises	72, 476.0 ^a 1/
Ridged rows with trellises	61, 489.9 ^a b
Flat rows without trellises	60, 169.5 ^a b
Ridged rows without trellises	53, 440.8 ^b

1/ Mean values in the same column bearing unlike letters differ significantly ($P < 0.95$).

Table 2 : Effect of management systems on the marketable production of the Binugas yam, experiment 2

TREATMENT	TUBERS	WEIGHT	MEAN TUBER WEIGHT
	No/ha	Kg/ha	Kg
Planting system :			
Flat row	40, 040.8 ^a 1/	48, 244.8 ^a	1.22 ^a
Ridged row	34, 156.6 ^b	39, 878.5 ^a	1.16 ^a
In row spacing :			
. 15 by 1.52 m	43, 987.5 ^a	44, 615.0 ^a	1.01 ^b
. 30 by 1.52 m	30, 210.0 ^b	43, 508.2 ^a	1.44 ^a
Sett size :			
Large (224g)	43, 000.8 ^a	52, 590.7 ^a	1.24 ^a
Medium (112 g)	39, 287.4 ^a	46, 169.5 ^a	1.18 ^a
Small (56g)	29, 008.1 ^b	33, 424.6 ^b	1.15 ^a

1/ Within each management practise mean values in the same column bearing unlike letters differ significantly ($P < 0.95$).

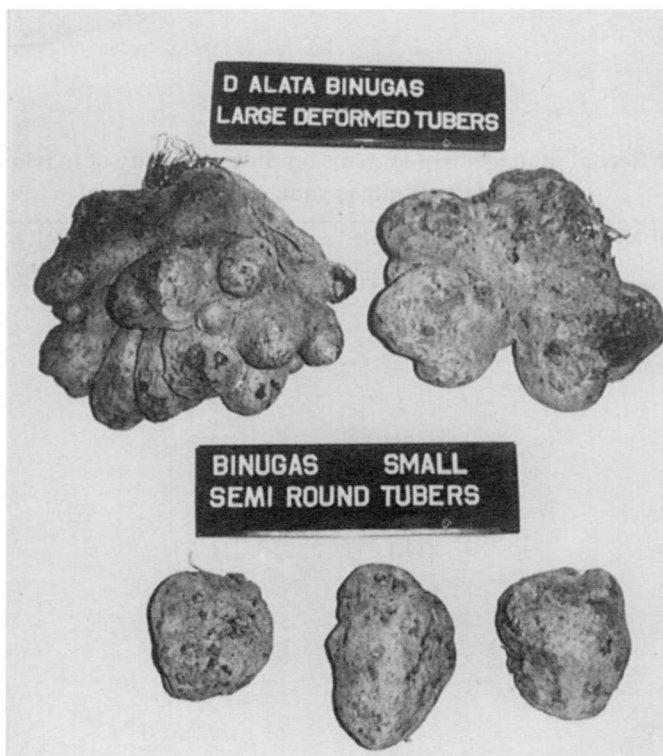


Figure 1 : Classification of yam tubers in two categories : large and distorted tubers, and uniform ovate premium tubers

table 3 : Effect of management systems on the uniformity of marketable tubers of the Binugas yam, experiment 2

TREATMENT	OVATE OR SEMI-ROUNDED TUBERS	PREMIUM WEIGHT	MEAN TUBER WEIGHT
	No/ha	Kg/ha	Kg
Planting systems :			
Flat rows	34, 049.1 ^{a1/}	33, 628.1 ^a	1.01 ^a
Ridged row	26, 083.9 ^b	22, 462.1 ^b	.86 ^a
In row spacing :			
. 15 by 1.52 m	37, 314.1 ^a	31, 284.2 ^b	. 84 ^b
. 30 by 1.52 m	22, 818.9 ^b	24, 806.1 ^b	1.09 ^a
Sett size :			
Large (224 g)	35, 197.2 ^a	34, 791.8 ^a	1.00 ^a
Medium (112 g)	32, 344.9 ^a	29, 567.0 ^b	. 94 ^a
Small (56 g)	22, 657.6 ^b	19, 776.5 ^c	. 87 ^a

1 / Within each management practice values in the same column bearing unlike letters differ significantly (P < 0. 95) .

All marketable tubers were further classified into uniformed and deformed on the basis of tubers size and shape (fig. 1, table 3).

In the flat row planting about 85 % of the total marketable tubers were of uniform size and shape, averaging 1 kg/tuber, and contributing to a significant weight increase of 11,166 kg/ha over the ridger row system (table 3).

The in-row closer spacing of .15 m also contributed to the production of significantly higher number of uniform tubers/ha from the wider spacing of .30 m (table 3). However, the individual tuber size was drastically reduced and the closer spacing required and additional 4,835 kg/ha more of planting material.

Optimum yields in terms of number of uniform tubers and marketable premium weight per hectare were obtained from the propagation of medium size setts (table 3). Although maximum marketable weight per hectare in the large size setts was superior from the medium size setts, the increase in yield only compensate for the additional propagating material needed to establish a similar planting. Tuber deformataion was always associatec with tuber size.

ACKNOWLEDGEMENTS

This paper covers work carried out Cooperatively between the Agricultural Research Service-USDA, TARS, Mayaguez, and the Agricultural Experiment Station, University of Puerto Rico (AES-UPR), Rio Piedras, Puerto Rico.

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