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EFFECTS OF SETT SIZE, SETT TYPE, MULCHING AND STAKING ON TUBER YIELD PRODUCED FROM YELLOW YAM (*DIOSCOREA CAYENENSIS* L.) MINISETTS

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ABSTRACT

The value of Jamaican yellow yam (*Dioscorea cayenensis*) exported in 1992 was US$9.9m. These yams are produced in a traditional system where all yams are staked and planted on individual mounds. The traditional system of production contributes to soil erosion on the hillsides where most of the crop is grown. Based on the importance of the crop, the minisett system of production was introduced to improve the system of production. Four on-farm trials were conducted to determine the effects of sett type. sett sizes, staking and mulch on tuber yield from yellow yam minisetts. It was found that sett size and type did not affect total tuber yield. A quantitative assessment of the number and weight of marketable tubers produced in defined weight categories showed that tuber size was influenced by staking and mulching. Experimental yields from 17.7 t/ha to30.9t/ha were higher than national average yield of 12t/ha.Agronomic implications were discussed.

INTRODUCTION

In 1992 the value of yams (*Dioscorea spp.*) exported from Jamaica was US$9.9m (Planning Institute of Jamaica, 1993). Yams are grown for local consumption but a growing export market has facilitated the expansion of production and farmers are interested in producing tubers for export. However, the production of yam forms part of a very diversified system on small farms where proper proportioning of farm labor to meet the demand of all the enterprises has resulted in management inefficiencies (Payne, 1976). Rankine (1974) found that labor represented 30-60% of the total cost of producing the crop and that the farm family provided 52% of the labor required. All yams are planted on individual mounds spaced 2m x 2m to 3m x 3m apart with two to three setts weighing between 0.5kg and 4kg on each mound (Ferguson, Rankine and Bennett 1985). The portion of the tuber which is proximal to the vine and referred to as the"head" is the normal planting material. The vines are supported with poles 3m to 7m long. Between 4.5t/ha and 10.2t/ha of heads are planted to produce average yields of 12t/ha (Payne 1976).

The minisett system of production was introduced to Jamaica in 1985 to improve the system of production. The system which was developed in Nigeria, involves the cutting of whole tubers into setts weighing approximately 25g and planted at high densities, however, due to the low percentage sprouting of 25g minisetts of yellow yam a modified technological package using 120g setts was introduced to farmers with the objective to produce marketable tubers in one growing season. The modified minisett production system involves the use of pre-sprouted setts, planting on continuous mounds and mulching with plastic. Kalu, Norman, Paland Adedzwa (1988), found that under African savanna conditions,more marketable tubers were produced from *D. alata* and *D.esculenta* than *D. rotundata* and *D. cayenensis* when minisetts of the same size were used. Onwueme (1981) described a non-staking system of producing yams which was less laborious and yielded as much as the traditional system. It has been suggested that yam production should move towards mechanized operations and reduced requirements for stakes (Wilson 1982).This paper evaluated the effects of sett characteristics (type and size) and agronomic practices (mulching and staking) on the production of marketable tubers within the modified minisett technological package for producing yellow yams in Jamaica.

MATERIALS AND METHODS

Four on-farm trials were conducted in the Guys Hill area of St. Catherine at an elevation of 1000m and on soil type classified as Wirefence Clay Loam in the Jamaican soil classification. Dormant tubers were cut into setts weighing 120g and dipped in a mixture of 20g fungaflor and 150ml oxamyl solution in 80l of water. The setts were air dried for 1 day and then presproutedin moist saw dust. To reduce variability due to differences in physiological maturity in the planting material, only setts that sprouted at the same time were selected for the experiments which allowed each experiment to be planted out in one day. Setts were prepared from the proximal (head), middle and distal(tail) portions of the tuber. In all the experiments except formulched double row plantings, the sprouted setts were transplanted 30cm apart along the row on ridges spaced 90cm apart. The ridges were covered with plastic mulch after a rainfall event.

The first experiment compared two sett sizes, 120g and 200g. Each plot was 3.5m x 3.6m. The experiment was planted on May 15, 1991 and harvested on February 24, 1992. A randomized block design with four replicates was used. In the second experiment head, middle and tail setts which sprouted at the same time were transplanted into separate plots based on sett type. Each plot was 3.3m x 3.6m with four rows of 11 plants each. Theexperiment was planted in December 1990 and harvested in August 1991. A randomized complete block design with three treatments and three replicates was used. The third experiment, examined the effect of staking on yield. One month after planting the minisett vines in the staked treatment were supported with poles 1.2m long. A randomized block design with staked and unstaked treatments and three replicates was used. Each plot was 4.5m x3.6m and comprised of four rows of 15 plants. The plot was hand-weeded twice during the life of the crop. The experiment was planted in January, 1991 and harvested in October, 1991. In the fourth experiment, a split-plot design with three replicates, and having single and double row production systems as the main plots, and mulch and no mulch subplot treatments was used. For single row plantings, the setts were spaced 30cm in a single row on ridges spaced 90cm apart. In the double row planting, two rows of setts were planted 30cm along the row on each ridge; the ridges were spaced 1.5m apart. Each plot was 9mx 5m. The experiment was planted on December 14, 1990 and harvested on October 3, 1991.

In light of the fact that marketable tuber size can change, aquantitative assessment was made of tubers in different size categories. Marketable tuber yield was analyzed for two market categories. Market 1 consisted of tubers with a minimum size of 0.3kg and market 2 consisted of tubers weighing more than 1.3kg. The data were analyzed using analysis of variance and chisquare.

RESULTS

There was wide variation in the tuber size produced from minisetts in all the experiments. Variation in tuber size within plots was sometimes greater than the variation between plots. Tuber size ranged from 0.1-3kg with a large proportion of the tubers in the size range 0.3-1.3kg (Figs.1-4). There was no significant difference ($p>0.05$) in total tuber yield due to sett size (Table I), sett type (Table II) and mulching (Table IV). Total tuber yield was 52% higher ($p<0.5$) for minisetts with vines that were staked than for those which were not staked (Table III). For both markets, market 1($p<0.01$) and market 2 ($p<0.001$) proportionately more marketable tubers were obtained from the plots that were staked(Table VII). Although a larger number of marketable tubers was produced from 200g setts than from 120g setts the difference was not significant (Table V) ($p>0.05$). The number of marketable tubers was not influenced by sett type (Table VI). There was interaction between row and mulched plots with the highest number of large tubers produced from single row mulched treatments for both market 1 ($p<0.01$) and market 2 ($p<0.1$)(Table VIII).

DISCUSSION

It was demonstrated that staking increased the total tuber yield of yellow yam minisetts which is in keeping with earlier reports. In Jamaica yields from plots where large yam heads were planted and staked with long poles were generally superior to plots where shorter poles were used (Payne, 1973). Increased yield from staked minisetts in this study was attributed to the production of a larger number of tubers weighing more than 1.3kg which is advantageous to the farmer since the market for tubersless than 1.3kg has not been developed.

This study was comprised of simple experiments and placed great emphasis on reducing variability in the planting material as a means of providing reliable results. Given that the experiment shad few degrees of freedom, any detectable difference was likely to have significant implications for farmers. Based on these it is recommended that minisetts be staked for the production of larger tubers. Staking may have increased the photosyntheticability of the plant through increasing leaf exposure or reduced the competition between vines of neighboring plants.

It was found that the size and type of sett did not affect total yield, thus all portions of the tuber can be used for planting. In previous reports, the effect of sett type was not always marked and since these experiments were planted with setts that sprouted at the same time, the difference in results may be due to the use of setts that sprouted at the same time while earlier studies tended to compare yield from setts of different physiological age and which were planted out over a period of time depending on the time of sprouting.

In studies on-farm with yams, Gooding (1971), found that simple experiments were capable of yielding a considerable amount of information from which trends can be deduced. Examination ofthe tuber population at harvest emphasized the presence of relatively large proportions of small tubers. It was observed that the variability in tuber size was sometimes greater than the variability between plots. A more detailed study of tubersize distribution revealed that there were differences in the number of marketable tubers due to the effects of staking and mulching. A larger number of marketable tubers was produced from staked minisetts and in plots which were established with single rows and mulched than plots established with double rows. It seemed that plants in double row unmulched plots established an adequate crop cover which acted as a mulch and produced yields that were similar to mulched plots. Ferguson (1973) and Oriuma and Onwueme (1980), found that at high plant densities, there was no marked increase in tuber size in D. alata which suggested that the effect of mulching was restricted at the closer spacing. This could explain the significance ininteraction of mulch and spacing in the experiment. These results suggested that the main benefit of plastic mulch was weed control. On the other hand staking increased yield and facilitated other methods of weed control such as hand weeding and the use of herbicides. Total tuber yield was high compared to national average yield of 12t/ha, however, it should be possible to increase marketable yield by increasing the acceptance of tubers weighing less than 1.3kg but are in excess of 0.3kg.

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TABLE I: THE EFFECT OF SETT SIZE ON TOTAL AND MARKETABLE TUBER YIELD (T/HA) FROM YELLOW YAM MINISETTS

	Yield tonnes/hectare		
Sett size	Total	Market 1	Market 2
120g	25.62	23.88	13.14
200g	30.65	27.01	18.92
SED	8.8	15.1	9.1
CV	44.2%	32.9%	21.1%

TABLE II: THE EFFECT OF SETT TYPE ON TOTAL AND MARKETABLE TUBER YIELD (T/HA) FROM YELLOW YAM MINISETTS

	Yield tonnes/hectare		
Sett type	Total	Market 1	Market 2
Head	18.3	14.9	7.0
Middle	19.2	16.5	8.3
Tail	19.7	16.3	7.1
SED	2.48	2.35	1.84
CV	15.8%	18.1%	30.3%

TABLE III: THE EFFECT OF STAKING ON TOTAL AND MARKETABLE TUBER YIELD (T/HA) FROM YELLOW YAM MINISETTS

	Yield tonnes/hectare		
Treatment	Total	Market 1	Market 2
Stake	30.9	28.1	22.3
No stake	21.1	16.9	9.4
SED	1.92	2.31	3.44
C.V.	9.0%	12.6%	26.6%

TABLE IV: THE EFFECT OF MULCHING ON TOTAL AND MARKETABLE TUBER YIELD (T/HA) IN TWO PRODUCTION SYSTEMS FOR YELLOW YAM MINISETTS

Treatment	Yield tonnes/hectare		
	Total	market 1	market 2
Double row mulch	17.86	14.61	7.09
Double row no mulch	21.25	18.31	10.37
Single row mulch	30.67	28.15	16.01
Single row no mulch	22.36	18.35	8.85
SED Row	0.37	2.08	5.55 SED
Mulch	0.82	2.18	4.17
SED Interaction	0.90	3.01	6.94
CV Row	8.3%		
CV Mulch	18.4%		

TABLE V: THE EFFECT OF SETT SIZE ON NUMBER OF MARKETABLE TUBERS FROM YELLOW YAM MINISETTS

Sett size	Number of tubers				
	market 1 Umkt	Mkt	market 2 Umkt	Mkt	Total
120 g	75	109	147	37	184
200 g	73	111	131	53	184
Total	148	220	278	90	368

$X^2 = 0.045$ $X^2 = 3.765$

TABLE VI: THE EFFECT OF SETT TYPE ON NUMBER OF MARKETABLE TUBERS FROM YELLOW YAM MINISETTS

Treatment	Number of tubers				
	market 1 Umkt	Mkt	market 2 Umkt	Mkt	Total
Head	63	45	93	15	108
Middle	62	57	104	15	119
Tail	56	63	105	14	119
Total	181	165	302	44	346

$X^2=2.888$ $X^2=0.232$

TABLE VII: THE EFFECT OF STAKING ON NUMBER OF MARKETABLE TUBERS FROM YELLOW YAM SETTS

Treatment	Number of tubers				
	market 1		market 2		
	Umkt	Mkt	Umkt	Mkt	Total
Staked	80	102	118	64	182
Unstaked	108	75	157	26	183
Total	188	179	275	90	365

X^2=8.286 X^2=21.573

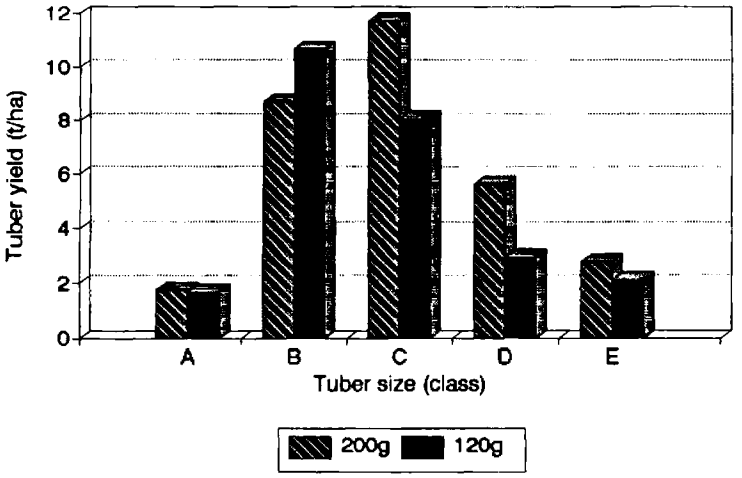
TABLE VIII. THE EFFECT OF MULCHING ON NUMBER OF MARKETABLE TUBERS IN TWO PRODUCTION SYSTEMS FOR YELLOW YAM

Treatment *	Number of tubers				
	market 1		market 2		
	Umkt	Mkt	Umkt	Mkt	Total
Double row mulch	93	65	139	19	158
Double row no mulch	67	74	114	27	141
Single row mulch	67	123	148	42	190
Single row no mulch	96	78	156	18	174
Total	323	340	557	106	663

X^2 =23.256 X^2 =12.315

* Double row mulch -mulched ridges 1.5 m apart planted with two rows.
Double row no mulch - ridges 1.5 m apart planted with two rows (no mulch).
Single row mulch - mulched ridges 0.9 m apart planted with two rows.
Single row no mulch - ridges 0.9 m apart planted with two rows (no mulch).

Fig. 1. Effect of sett size on yield (t/ha) from yellow yam minisetts.



A = 0 - 0.45 kg
B = 0.46 - 0.91 kg
C = 0.92 - 1.36 kg
D = 1.37 - 1.82 kg
E = 1.83 - 2.27 kg
F > 2.27 kg

Fig. 2. Effect of sett type on yield (t/ha) from yellow yam minisetts.

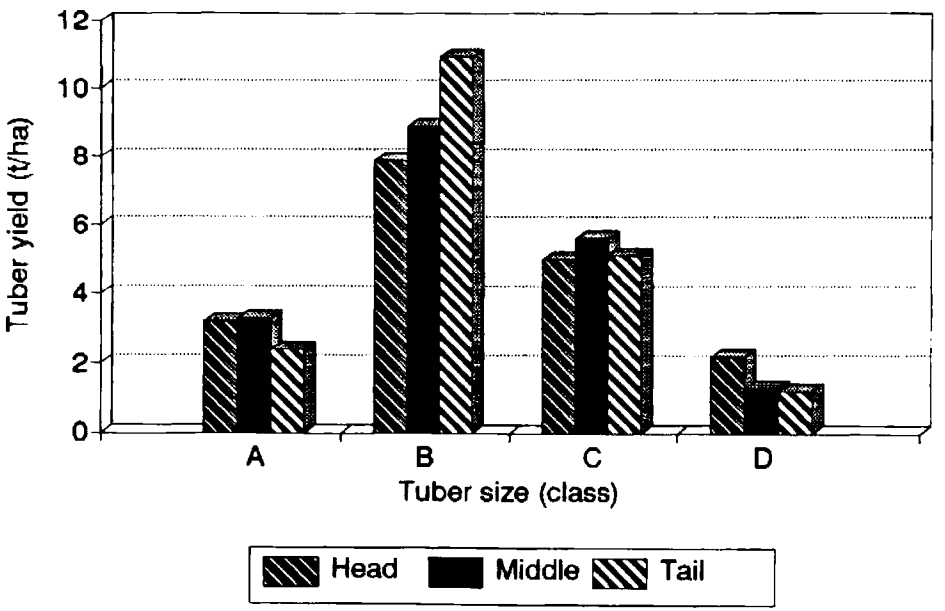


Fig. 3. Effect of staking on tuber yield (t/ha) from yellow yam minisetts.

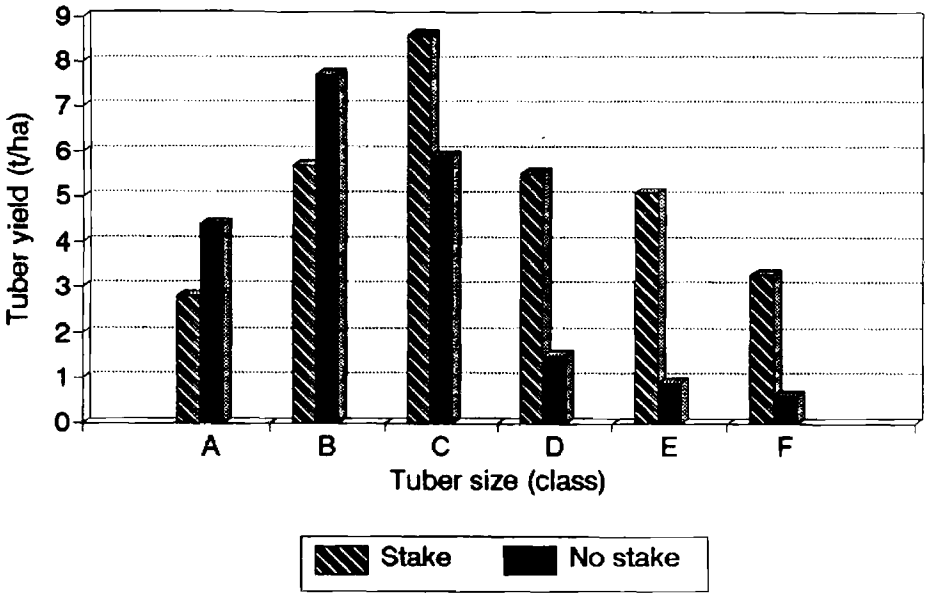


Fig. 4. Effect of mulching on yield (t/ha) in two yam planting systems.