Effects of seedbed types on yield of White Guinea Yam (*Dioscorea rotundata*) minisetts in Makurdi, Nigeria

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ABSTRACT

The effect of seedbed types on yield of yam-minisetts was studied in field trials at the University of Agriculture, Makurdi research farm in 2000 and 2001 cropping seasons. The results indicated that the raised flattened top beds improved yam-minisett emergence count by 22%, establishment by 23%, total tuber number by 24% and yield of minisetts by 21% over the ridge system. Generally, higher number of ware yams (401-3000g) were obtained from ridges. On technical grounds, the raised flattened top bed was superior to the ridge system.

Key words: White Guinea Yam, *Dioscorea rotundata*, Minisetts, Seedbed types, Nigeria.

INTRODUCTION

Yams are Nigeria's leading crops both in terms of land under cultivation and preferred major staple food crops contributing immensely to rural and regional economies (Agboola, 1979). The South-Guinea savanna zone of Nigeria is a major yam producing area. The yams are the most important food crops in the zone (Onwueme, 1978). The tuber crop has the greatest sink capacity amongst other crop plants thus enhancing its capacity to store food reserves.

Recent studies in the zone have shown a high potential and suitability of the use of (*D. rotundata*) as minisetts in rapid seed yam multiplication (Kalu and Erhabor, 1992; Kalu and Ortese, 1993). Although, the minisett technique has been developed for the rapid production of seed and ware yams, from preliminary studies, Kalu (1986) showed that a larger proportion of ware yam could be produced from 2 meter ridges than from narrower ones. This he claimed had the disadvantage of decreasing plant population density by more than 45%.

An alternative production system involving only a modified seedbed, while maintaining the recommended plant population density of 40,000 stands per hectare was considered necessary. Igwilo and Ene (1982) in their study on the yield effect of planting minisetts on ridges, mounds and flats in the rain forest zone, concluded that there were no significant yield difference between the different seedbed preparations.

Since different ecological zones have different environmental patterns, such effects would be expected to differ from zone to zone. The objective of this study was therefore to determine the effects of seedbed types (ridges and raised flattened top beds) on the yield of yam minisetts (*D. rotundata*) with the view to evolving an additional technological package that would enable yam growers to produce both marketable ware yams and seed yams simultaneously from minisetts in quantity.

The importance of good seedbed structure in raising crops has been evaluated by research scientist (Nelson and Fencer, 1983, Nicou, 1973). Recommendations on the most suitable type of seedbed have been based on prevailing weather and soil conditions of the location of study. Yield responses among other factors may be controlled in part by the method of seedbed preparation. Onwueme (1979) has shown that planting yams on ridges is excepted in regions of heavy rainfall and where water logging is likely. Joy and Wibberly (1989) recommended the use of bulky ridges where rainfall is heavy and erosion problem very likely.

It has been reported in Nigeria that planting on ridges, mounds and occasionally on flat cultivated land are used uncritically by farmers as standard procedures in annual crop husbandry (Aina, 1979). Kalu (1989) in his trial on the yield of yam-minisetts under different production systems concluded that planting minisetts on beds resulted in significant improvements in both emergence and plant stand establishment percentages compared with planting on ridges.Onwueme (1978) also emphasized that uniformly shaped tubers are produced from ridges although it is subjected to frequent soil wash of the ridge tops.

Igbokwe and Ene (1982) compared the effect of planting on ridges, mounds or flats on the performance and yield of yam minisetts. Although no significant yield differences were recorded for mounds, flat and ridges respectively, it was observed that establishment count was less and harvesting more difficult in plots planted on the flat. Igbokwe et al,(1983) included planting on the bed in a comparison, again there were no significant yield differences between the different seedbed preparations.

MATERIALS AND METHODS

The experiment was carried out during the rainfall cropping seasons of 2000 and 2001 at the Research Farm of the University of Agriculture, Makurdi, Benue State, Nigeria. The location falls within the Southern Guinea savanna agro-ecological zone. A randomized complete block design with three replications was used. The cultivar of white Guinea yam (*D. rotundata*), local cultivar Dan-Onicha was used. Dan-Onicha, local cultivar of white yam is grown extensively on a greater acreage. It is high yielding and when used as minisetts, gives a high number of seed yams (IITA, 1983).

The experimental field was ploughed, harrowed and then divided into two main treatment plots, each measuring 10 m × 10 m. Treatments were represented by planting on ridges and on raised flattened top beds.

The first treatment plot consists of 10 rows of ridges 1 m apart while the second treatment plot consists of 10 rows of raised flattened top beds 1 m apart. The ridge and raised flattened top bed construction were done manually using the native hoe. Intact tubers weighing about 400 grams apparently free from bruises and rot were selected from the previous years harvest stored from January- May of each year of study.

Minisetts weighing about 25 grams were cut from the ware yam tuber (about 400 grams). The yam-minisetts cut for planting were treated with Apron-plus chemical (100 minisetts to 20 grams of Apron-plus) to prevent fungal attack and minisetts rot and cured for 24 hours.

Minisetts were planted about 6 cm deep and at 25 cm interval in single rows on ridges and on raised flattened top beds to give a plant population density of 400 stands per treatment plot (equivalent to 40,000 stands per hectare). The seedbed types were adequately mulched with locally available dry grass after planting.

In each year (2000, 2001) planting was done in mid-May (a time of year when rains were steady).

Emergence and establishment counts were recorded daily from 30 days after planting (DAP) until no new sprouts were observed. The date for days to 50% emergence and establishments were also recorded.

The presence of two expanded leaves on vine was used as an indication of stand establishment (Kalu and Erhabor, 1992).

The leaf area of established minisett stands was measured at 60 days interval starting from 60 to 180 days after planting. The plots were manually weeded at 4 weeks interval from the date of planting. The recommended rate of fertilizer for yams: 50 kg N/ha, 20 kg P/ha and 40 kg K/ha was applied (Ekpete, 1976). These translated to 22.5 grams/stand. The fertilizer was applied twice at 8 and 16 weeks after planting. The number and weight of harvested tubers classifying as seed yams (less than 400 grams) or ware yams (401-3000 grams) were taken and recorded.

The yield of yam-minisetts per plot was obtained. The yam plots were harvested manually in December for each year of study.

Analysis of variance was carried out on each of the observations recorded for each year of study, followed by combined analysis over the two years. The least significant difference (LSD) test was used for detecting differences between means.

RESULTS AND DISCUSSION

The meteorological information of the area of study is presented in Table 1. Rainfall was observed to be regular from the months of May to October for the two years of study. With a corresponding high relative humidity. The month of September has the highest number of rainy days. It was observed that rainfall was moderate during the growing period with a little bit of drought in the month of July 2001. the intensity of rain increased as the season progressed for both years of study. during the growing period with a little bit of drought in the month of July 2001. The intensity of rain increased as the season

Table 1. Meteorological information for Makurdi during the two years of study (2000, 2001)

Average monthly Rainfall (mm)		Average monthly temperature (°c)		Average relative humidity (%)
2000		**Max**	**Min**	
May	133.4(8)*	33.7	25.2	73.5
June	231.0(12)	31.2	23.3	76.5
July	201.1(13)	31.1	21.4	77.3
August	276.2(17)	30.1	23.4	78.7
September	242.1(19)	28.7	22.7	78.6
October	76.2(8)	30.4	21.3	74.3
November	0(0)	23.1	16.6	53.3
December	0(0)	16.2	15.4	47.6
2001				
May	97(12)*	33.0	24.7	76.5
June	152.4(12)	31.7	24.1	76.7
July	85.3(10)	31.4	23.6	75.4
August	146.3(12)	31.5	24.0	76.3
September	236.4(14)	32.3	23.3	76.3
October	237.3(6)	33.4	24.4	75.3
November	0(0)	34.3	17.7	53.4
December	0(0)	35.2	16.4	44.3

*Values in parenthesis indicate number of rainy days.
Source: Meteorological Station, Air Force Base, Makurdi

during the growing period with a little bit of drought in the month of July 2001. The intensity of rain increased as the season progressed for both years of study. The effect of seedbed types on emergence count, days to 50% minisett emergence, establishment count and days to 50% minisetts establishment are shown in Table 2. The result indicated that raised flattened top bed system improved emergence count by 22% over planting on ridges. The significant improvement in emergence count of yam-minisetts from the raised flattened top beds might be attributed to the fact that the raised beds could have provided more favourable conditions for better moisture

Table 2. Effects of seedbed types on yam-minisett emergence count, days to 50% yam-minisett emergence, establishment count, days to 50% yam-minisett establishment.

Seedbed types	Emergence count (No.)	Days to 50% emergence (No.)	Establishment count (No.)	Days to 50% establishment (No.)
Ridge	420.5	63.2	419.1	69.9
Bed	425.0	56.1	423.5	62.4
LSD 0.05	4.30	ns	3.3	ns

Table 3. Mean leaf area index (LAI) of establishment stands of yam-minisetts on ridges and beds at 60, 120 and 180 days after planting (DAP)

Seedbed types	Leaf area index 60 DAP	Leaf area index 120 DAP	Leaf area index 180 DAP
Ridge	0.11	2.99	0.37
Bed	0.23	4.09	0.76
LSD	ns	0.98	0.13

retention.

The result agreed with that of Kalu (1989) and Iwueke (2001) that planting minisetts on beds resulted in significant improvement in emergence count. However, Igwilo and Ene (1982) in an experiment carried out at Umudike in the rain forest zone of Nigeria, reported that emergence count were less in plots where minisetts were planted on flat, compared to the ones planted on ridges. These conflicts in results could be due to the unidentical situation in the seedbed configuration and also to the prevailing weather and soil conditions of the location of study.

Although the seedbed types did not significantly influence the days to achieve 50% emergence and establishment, the bed system improved establishment count by 23% over planting on ridges. The significant improvement in establishment count of yam-minisetts from raised flattened top beds might also be linked to the fact that the bed system could have provided more favourable conditions for better moisture retention.

At 120 and 180 days after planting (DAP), the leaf area index (LAI) was larger under the bed system compared to the ridge (Table 3.) the length of time of canopy retention was observed to be longer with the bed than with the ridge system. This could be due to the fact that the bed system might have had its supplied nutrients securely in place without experiencing any soil nutrient wash that was more pronounced on ridges. At 120 days after planting, the yam-minisetts were in the tuberization phase thereby justifying a larger leaf area recorded.

The frequency of twinning was not affected by the seedbed types. However, the bed system improved total tuber number by 24% compared to ridges. The highly significant total tuber number produced from raised flattened top beds compared to ridges (Table 4) could be attributed to the seedbed structure and its ability to retain moisture and nutrient.

The raised flattened top beds not only providèd ample depth of loose, fertile soil for tuber root penetration but also the flattened top surface was less readily washed away by rain during the course of the season compared to ridges. Onwueme (1975) pointed out that the major difficulty often encountered in ridge

Table 4. Effects of seedbed types on frequency of twinning, total tuber number and yield of yam-minisetts

Seedbed types	Frequency of twinning	Total tuber number (no.)	Yield of yam minisetts (tn/ha)
Ridge	1.31	20.2	1.30
Bed	1.33	25.0	1.57
LSD	ns	4.42	0.26

plantings, is the gradual wash down of the ridge tops during the rains thereby decreasing the height of ridges, exposing tubers and influencing total tuber number.

The raised flattened top beds produced significant higher yields compared to the ridge system. This could be linked with the reason stated earlier that the nutrients applied were securely in place on raised flat beds and did not experience any soil wash.

The roots could have appropriately absorbed the nutrients thereby enhancing the weight of tubers. However, this result contradicted the earlier findings of Igbokwe *et al.*, (1983) and Madukwe *et al*,(2000) in which they reported no significant yield difference from planting on ridges, mounds or flats. The conflict in result could be attributed to the differential environmental pattern of the zones and the unidentical seedbed structure used.

Higher percentages of seed yams (50-400 grams) were recorded on the ridge system while higher percentages of ware yams tubers (401-3000 grams) were recorded on the raised flattened top beds (Table 5). In earlier reports (Kalu and Erhabor, 1992) attributed the differences in weight categories to differences in seedbed structure which in case of the wide and flattened top beds provided favourable conditions for better soil moisture retention compared to the conical (pointed crest) nature of the ridges.

CONCLUSION

The result from this study suggests that the ridge system can be embarked upon if the farmers' preference is to obtain more of seed yams than ware yams, while the raised flattened top beds can also be used if the farmers' preference is to obtain more of edible ware yams than seed yams. However, the raised flattened top bed was

Table 5. Number (×100) of harvested tubers per hectare classifying as seed or ware yams from two seedbed types.

	2000		2001		Mean	
Weight classes of tubers	Ridge	Bed	Ridge	Bed	Ridge	Bed
Seed yams						
50-100 grams	32	16	42	21	37	18.5
101- 200 grams	65	32	35	48	50	40
201- 400 grams	164	52	151	49	157.5	50.5
Total seed yams	261(81)+	100(27)+	228(70)	118(29)	244.5(75)	109(28)
Ware yams						
401- 600 grams	53	92	69	64	61	78
601- 800 grams	7	39	27	70	17	54.5
801-1000 grams	1	56	2	45	1.5	50.5
1001- 3000 grams	1	80	1	109	80.5(25)	
277(32)						
Total ware yams	62(19)+	267(73)+	99(30)	288(71)	325	386.5
Total tuber number	323	367	327	406	569.5	495.5
Significance	*		*		*	

+ Values in parenthesis indicate percentage contribution from seed or ware yams to total tuber number.
* Significant difference (P=0.05) between ridge and bed and gross weight classes.

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