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EFFECT OF STAKING, MULCHING AND SEEDBED PREPARATION ON THE FIELD PERFORMANCE OF TWO YAM VARIETIES GROWN OFF-SEASON.

NDUBISI IGWILO

Institute of Agricultural Research and Development
University of Port Harcourt
P. M.B 5323 Port Harcourt
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ABSTRACT

The growth cycle of two yam varieties was changed from rainy season to dry season cycle using GA3 technique and were grown in the 1994/5 and 1995/6 dry seasons under irrigation. In both seasons, staking interacted with variety and mulching (P=0.01). the tuber yield of Obioturugo (*D. rotundata*) was not significantly increased by staking (5.8-6.4%) whether mulched or un-mulched. In the case of UM 680 (*D. alata*), staking increased tuber yield by 46.9-1415% when un-mulched and only 7.5-7.9% when mulched. Mulch, per se, increased the tuber yield of Obioturugo by 54.7-73.6% and Um 680 by 63.6-103.1%. planting on beds gave higher tuber yields than planting on mounds. The yield increased by mulching and beds were related to soil water conservation.

INTRODUCTION

In the rainy season yam crop in the rain forest zone, yam must necessarily be staked for good yields (Coursey 1967). It has been suggested that stakes serve to lift the yam vines away from the damaging effects of flood water (Igwilo 1989, Igwilo and Udeh 1987). It has been reported that mulching increased the tuber

yield of yams in the rain-forest zone during the rainy season cropping (Madukor 1985). It has also been reported that in the rainy season crop of yams, methods of seedbed preparation did not affect tuber yield (Lal and Hahn 1973, Igbokwe et al 1983). This study was designed to investigate the effects of these three factors at two levels each – staking (no staking), mulching (no mulching) and planting on beds (against planting on mounds) – on the field performance of two yam varieties – Obiaoturugo (D. rotundata) and Um 680 (D. alata) grown in the dry season.

MATERIALS AND METHODS

The experiment was sited in the University of Port Harcourt experimental farm in the High Rain-forest zone of Nigeria (05^0 10'N, 06^0 57^1 E, 7MSL). The soil is a sandy-clay loan containing 66.0% sand, 7.3% silt, 26.7% clay, 0.78% organic matter, 0.087% total N, 30.8 ppm P (Bray 1) as well as 0.25k 0.58 Ca and 0.10Mg in milli-equivalents/100g soil. The PH (1:1 H_20) was 5.5. Soil classification was Oxic paleudult.

Two Yam varieties, Obiaoturugo (D. rotundata) and Um 680 (D. alata) and two types of seedbed preparation (bed, mound). Mulching (mulch, no mulch) and staking (stake, no stake) were used As treatments. The experimental design and data analysis was a factorial arrangement with a split – plot layout in which yam varieties served as main plots and a factorial combination of seedbed preparation, mulching and staking served as sub-plots; there were three replicates. Sub-plot size was 1m long and 1.5m wide, with o.5m between subplots and between replicates. Four kilogrammes of lawn dry grass mulch was applied in each mulched sub plots (26.7t/ha). Height of stakes was 2.5m. Yam sett size was 25g (minisett) and six minisetts were planted per subplot. The yam tubers from where the minisetts were obtained had sprouts on them, their growth cycle having been change to dry season cycle by GA_3 technique (Igwilo et al. 1988). The minisetts were planted in the middle of October in both years.

In both seasons, watering commenced in the first week of December after the mini-

setts had sprouted. The plants were watered manually using 10 – litre watering cans at the rate of 4.0mm/day. The watering rate was obtained from Penman potential evapotranspiration estimates for south – eastern Nigeria during the dry season (Harmattan) period (Penman 1948, Igwilo 1982). Watering regularly was reduced as the rainfall started about the middle of February and was terminated after the third week of March.

For soil moisture content and bulk density determination, soil samples were taken from randomly selected two mulched and two un-mulched beds as for mounds, 24 hours after watering on 12 December 1996, 48 days after planting (48 DAP). The soil cores used were obtained with a soil auger to the depths of 0-15cm and 15-30cm. The soil samples were oven-dried to constant weight at 150°C.

Leaf area was determined by random sampling of one plant/plot at the peak of foliation. The leaves were detached and leaf discs were punched with cork borers 1.6cm diameter. The leaves were dried to constant weight at 70°C in ventilated oven. The relationship between the dry weight and leaf area of the discs was used to determine the leaf area of the plants. Harvest of tubers was at the end of May when all the yam vines had died.

RESULT

In both seasons (1994/5 and 1995/6), there were significant interactions (P= 0.05) between varieties, staking and mulching (Table 1a).

Um 680. Staking did not significantly increase the tuber yield of Obiaoturugo (*D. Rotundata*) whether mulched or not mulched (5.8 – 6.4%) whereas in Um 680 (D. alata)., tuber yield was increased by 46.9 – 141.5% (P = 0.01) when un – mulched but similar to Obioturugo (7.5 – 7.9%) when mulched. Mulch, per se, increased tuber yield of Obioturugo by 54.7 – 73.6 (P = 0.01) and of Um 680 by 63.6 – 103.1% (P = 0.01) in both seasons.

Planting on beds gave higher yield (P =0.01) than planting on mounds (Table 1b) – 37.6 – 111.9% in Obioturugo and 38.7 – 48.9% in Staking did not significantly increase the tuber yield of Obioturugo

Table 1 (a) Interaction between yam Variety, staking and Mulching in tuber yield (t/ha): 1994/5 and 1995/6

	1994/5						1995/6					
	Obioturugo			Um 680			Obioturugo			Um 680		
	Stake	No Stake	Mulch Mean	Stake	No Stake	Mulch Mean	Stake	No Stake	Mulch Mean	Stake	No Stake	Mulch Mean
Mulch	4.85	4.51	4.81	16.05	14.93	15.49	5.50	5.08	5.29	15.62	14.47	15.05
No Mulch	2.83	2.83	2.77	11.27	7.67	9.47	3.48	3.35	3.42	10.48	4.34	7.41
Stake Mean	3.83	3.62	3.73	13.66	11.29	12.48	4.49	4.22	4.36	13.05	9.41	11.23

(*D. Rotundata*) whether mulched or not mulched (5.8 – 6.4%) whereas in Um 680 (D. alata)., tuber yield was increased by 46.9 – 141.5% (P = 0.01) when un – mulched but similar to Obioturugo (7.5 – 7.9%) when mulched. Mulch, per se, increased tuber yield of Obioturugo by 54.7 – 73.6 (P = 0.01) and of Um 680 by 63.6 – 103.1% (P = 0.01) in both seasons.

Planting on beds gave higher yield (P =0.01) than planting on mounds (Table 1b) – 37.6 – 111.9% in Obioturugo and 38.7 – 48.9% in Um 680.

It is worthy of note that in 1995/6 season, even though the over-all yield of Um 680 was 2.6 folds the yield of Obioturugo, without stakes and mulch, the yields were similar – 3.35t/ha in Obioturugo and 4.34t/ha in Um 680 (Table 1a). Tuber yield/stand mirrored the effects of treatments on tuber yield/ha (Table 2).

In the 1994/5 dry seasons, staking ha no significant effect on the yield of Obioturugo (6.8% increase) mulching brought about tremendous increase in both varieties (83.5 - 110.2%, P = 0.01). In 1995/6 seasons, the results were similar to 1994/5. Staking had no significant effect on yield/ stand of Obioturugo (7.5%) but increased the yield / stand of Um 680 by 68.2 (P = 0.01. Mulching increased yield / stand by 148.9% (P = 0.05)

Table 1b: Interaction between Variety and seedbed preparation.

1994/5				1995/6			
Obioturugo		Um 680		Obioturugo		Um 680	
Bed	Mound	Bed	Mound	Bed	Mound	Bed	Mound
7.67	3.62	13.94	10.05	4.17	3.03	13.43	9.02

LSD (0.05 between treatment means	1994/5	1995/6
Yam variety	3.98	3.81
Sub-treatments (seedbed, staking or mulching	1.79	1.41
Within each sub-treatment in the same variety	2.08	2.00
Between varieties in the same or different levels of each sub-treatment	4.14	3.79
Two factor interactions	3.44	2.83
Three factor interactions	-	5.66

compared to mounds across the two yam varieties. Tuber size in both seasons varied with variety and mulching. In the 1994/5 seasons, tuber size in Obioturugo was 56.8g without mulch and 132.9g in the presence of mulch (P = 0.01). In 1995/6, it was 1-4.3g without mulch and 148.1g with mulch in Obioturugo. In Um 680, average tuber size was 108.6g without mulch and 216.0g with mulch and 208.7g with mulch (P = 0.01) and 1995/6. Number of tubers/ stand only varied between varieties – average of 1 in Obioturugo and 3 in Um 680 (P = 0.01). Other treatments had no effects.

In 1995/6, type of seedbed preparation, mulching and staking had no significant effect on plant height. Um 680 had average height of 2.6m being 22.4% (P = 0.05) taller than Obioturugo (1.9m tall). Treatment effects on the number of nodes/plant were similar to plant height. Um 680 had 37.9% (P = 0.05) more modes/ plant than Obioturugo. Similarly, number of leaves/plant was 66.4% larger in Um 680

Table 2 Tuber Yield/Stand (g)

	1994/5			1995/6		
Seedbed	Yam variety		Seedbed	Yam variety		Seedbed
	Obia	Um 680		Obia	Um 680	
Bed	126.5	478.5	302.5	163.1	422.0	292.6
Mound	136.6	406.9	270.8	109.8	311.4	210.6
Variety Means	130.5	442.7	286.7	136.5	366.7	251.6
(b) Staking			Stake			Stake
Stake	134.8	507.7	321.3	131.1	459.7	305.4
No Stake	126.2	377.7	252.0	212.8	273.7	197.8
Variety Means	130.5	442.7	286.7	136.5	366.7	251.6
(c) Mulch-ing			Mulching Means			Mulching means
Mulch	176.8	573.1	375.0	193.8	484.3	339.7
No Mulch	84.1	312.3	198.2	79.0	248.1	136.5
Variety Means	130.5	442.7	286.6	136.4	366.7	251.6

LSD (0.05) between treatments means	1994/5	1995/6
Yam variety	95.5	107.6
Sub-treatments (tillage, staking or mulching)	52.1	71.4
Between sub-treatments in the same variety	73.7	161.0
Between varieties in the same or different levels of each sub-	94.4	166.1
Two factor interactions	104.0	143.4
Three factor interactions	202.1	

(P = 0.01) than in Obioturugo. Um 680 had an average number of leaves/plant of 196.8 while Obioturugo had 118.3 leaves/ plant. Other treatments had no significant effects on number of leaves. Um 680 had an average leaf size of 31.6cm^2 while that of Obioturugo was 27.9cm^2, the difference being significant (p = 0.05). Leaf area/plant in Um 680 was 59.4dm^2 being 81.1% larger than Obiaoturugo (P = 0.01). Other treatments were not significant. The average leaf area index (LAI) of Um 680 was therefore 1.58 while that of Obiaoturugo was o.89. At the peak of foliation (129 DAP) it was observed in Um 680 that (Table 3a) mulching the beds reduced number of senescing leaves by 73.3% compared with mulching the mounds (P = 0.01) whereas in the absence of mulch, there was no significant effect of type of seedbed.

In Obioturugo, there were no such effects of treatment (Table 3a). Also there was significant interaction between yam variety and staking (P = 0.05). In Obioturugo, while staking reduced the incidence of premature leaf senescence by 35.6%, in Um 680 staking promoted leaf senescence by 31.4% (Table 3b It was observed that Um 680 matured one month earlier than Obioturugo.

On the average, mulched plots contained 15.2% more moisture than un-mulched plots and beds contained 3.3% more moisture than mounds (Table 4).

The deeper layers of the soil (15-30cm) contained more moisture than the upper layers (0-15cm). There was 60.9% more moisture in the deeper layers of mulched beds and 28.6% more moisture in the deeper layers of un-mulched beds than the upper layers. Correspondingly, there was 12.1% more moisture in the deeper layers of mulched mounds and 21.4% more moisture in the deeper layers of lkun-mulched mounds. Mulched plots gave 17.3% higher bulk density than mounds. There was an average bulk density of 1.61g/cm^3 in the upper layers (0-15cm) of the soil and 1.84g/cm^3 in the lower layers (15 – 30cm), 1.73g/cm^3 in mulched plots and 1.72gcm^3 in un-mulched plots; 1.78g/cm^3 in beds and 1.68g/cm^3 in mounds.

Table 3 : Percentage number of senescing leaves at the peak of foliation 129 DAP (a) Interaction between yam variety seedbed preparation and mulching.

	Obioturugo			Um 680		
Seed-bed	Mulch	No Mulch	Seed-bed Means	Mulch	No Mulch	Seed-bed Means
Bed	21.4	22.4	21.9	13.1	40.8	27.0
Mound	22.3	23.1	22.7	49.1	42.8	46.0
Mulch Means	21.9	22.8	22.3	31.1	41.8	36.5

3b Interaction between yam variety and staking

	Obioturugo	Um 680	Stake Means
Stake	17.5	41.4	29.5
No Stake	27.2	31.5	29.4
Variety Means	22.3	36.5	29.5

LSD (0.05) between treatment means:

Yam variety	7.2
Sub-treatments (seedbed. staking or mulching	7.7
Within each sub-treatment in the same variety	10.9
Between variety means in the same or different levels of each sub-treatment	26.2

DISCUSSION

Staking had no effect on the tuber yield of Obioturugo, (D. rotundata – Table 1a) whether it is mulched or not mulched. It has been noted that stakes increased the tuber yield of D. rotundata in the rainy season cropping (Coursey, 1967). Absence of significant effect of staking in the dry season cropping tends to support the view that stakes are necessary in the rainy season yam production in order to keep the yam vines from the damaging effects of flood water (Igwilo and Udeh, 1987, Nwankiti and Ahiara, 1983). This view is buttressed by the fact that staking had no effect on the tuber yield of Um 680 when mulched than when un-mulched (Table 1). This is because mulch tended to keep the yam vines of Um 680 from soil surface water. Therefore, by planting yams in the dry season, staking, a major cost item in yam production, is removed. Availability of stakes is dwindling in the rainforest zone of Nigeria, where stakes are used, because of dwindling bush lands due to infrastructural development. In the riverine areas and in the irrigated lands of Nigeria, therefore, yams can be grown in the dry season. This makes fresh yam tubers available in the market all the year round.

Mulching increased the tuber yield of yam varieties in the dry season as reported by Maduakor (1984). Effect of mulch was even more profound when used in the dry season in this study. Mulched plots conserved more soil moisture than un-mulched plots (Table 4). Beds increased tuber yields than mounds particularly in Um 680 because beds also conserved more soil moisture than mounds (Tables 1b and 4).

Conserving soil moisture by mulching and planting on beds when compared with their opposite treatments did not increase the growth of yam vines, especially number of leaves / plant and leaf size. This suggests that the increase in tuber yields might have been meditated through higher leaf photosynthesis (Ghuman et al; 1985).

At the peak of foliation, Um 680 had higher percentages of senescencing leaves than Obioturugo. Um 680 also matured about a month earlier than Obioturugo contrary to what prevails in the rainy season. It suggests that Um 680 is more sensitive to occasional

water stress than Obioturugo probably reminiscent of their origin. Obioturugo (D. rotundata) is a native of Nigeria and Um 680 (*D. alata*) originated in the heavy monsoon forests of South-east Asia (Onwuneme, 1978). Staked plants of Um 680 also had more senescing leaves than un-staked plants (table 3), suggesting that the sensitivity of Um 680 plants to any occasional water stress might be related to the plants' inefficient water transport system.

CONCLUSION AND RECOMMENDATION

Staking is a major cost item in yam production in the rain forest zone of Nigeria. When yams are grown in the dry season, stakes are not necessary, more so when mulched. Dry season yams should be planted on beds and mulched when mulch is available. Yams should be grown in the riverine areas (with moist soils in the dry season) and in irrigated lands so that fresh yam tubers will be available in the mark throughout the year.

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