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EFFECTS OF MULCHING, STAKING AND TILLAGE ON WEED GROWTH IN YAM PLOTS DURING THE DRY SEASON

NDUBISI IGWILO

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ABSTRACT

The effects of two levels each of mulching (mulch, no mulch), staking (stakes, no stakes) and tillage (bed, mound) on weed infestation were studied in the 1994/95 and 1995/96 dry seasons. Data collected at the peak of yam foliation and at tuber maturity showed that mulching had no significant effect on the total fresh weight of weeds. Whereas mulching depressed the fresh weight of some grass weeds, it caused an increase in the fresh weight of some broad-leaf species. Some weed species were not affected by mulching. Bed tillage increased the fresh weight of broad-leaf species in the dry seasons of both years. Staking had no significant effect on the fresh weight of weeds.

KEYWORDS: Weeds, dry season yam crops.

INTRODUCTION

Most seed yams break their dormancy in the month of February. In the upland areas, these seed yams are planted after the rains are regular in late March/April. But in the riverine areas, farmers plant yams in December/January. In February, these seed yams break their dormancy in the ground, the sprouts emerge and begin to grow and develop because there is adequate residual moisture in the soils to support yam growth in the dry season. The farmers harvest these yams in July as the rivers begin to overflow their banks. The ware tubers are not fully mature at harvest. Studies have shown that the growth cycle of yams can be changed such that the riverine farmers plant sprouted seed yams about October/November when the flood is receding and harvest mature ware tubers around April/May when the supply of ware yams is declining in the market (Igwilo et al., 1988; Igwilo, 2001). Once the growth cycle of yams is changed from rainy season to dry season cycle, it remains permanent.

Weeding is a major cost item in yam production, accounting for about 40 man-days per hectare (Onwueme 1978). The effect of weed infestation on the yield of yams during the rainy season has been reported (Onochie 1974, Unamma and Akobundu 1989). Mulching also suppressed weeds in the rainy season (Maduakor et al, 1984) but the effect of mulching on weeds in the dry season has not been reported. In the dry season, dry grasses and dry leaves of palms, plantain/banana and cocoyams are readily available to serve as mulch for the peasant farmers. It will be of interest also to know the effects of unstaked yams covering the soil surface and seedbed preparation on weed infestation in a yam crop during the period.

In this study, the effects of mulching, staking and tillage on weeds is reported for yams grown in the dry season.

MATERIALS AND METHODS

Two levels each of tillage (bed, mound), mulch (mulch, no mulch) and staking (stakes, no stakes) were factorially combined and used to raise two yam varieties – 'Obiaoturugo' (*D. rotundata* Poir) and Um 680 (*D. alata* Linn) – during the 1994/95 and 1995/96 dry seasons. The sixteen treatment combinations were laid out in a split-plot design with yam varieties in the main plots and the eight factorial combinations of seedbed, mulch and staking as sub-plots. There

NDUBISI IGWILO, Institute of Agricultural Research and Development, University of Port-Harcourt, Port Harcourt, Nigeria

were three replicates. Sub-plot size was 1.Om long and 1.5m wide. The main-plots and sub-plots were 0.5m apart.

Four kilogrammes/plot of dry lawn-grass were used as mulch. There were six mounds, 0.5m apart, in each sub-plot with mound treatment. The mounds and the beds were 30cm high. Yam sett size was 25g (minisett) and six minisetts were planted in each sub-plot, one sett/mound in the mounded plots and six setts/bed in the bedded plots, the minisetts being 0.5m apart. Yam stakes were 2.5m high.

Before field preparation, the site was under a three-year fallow dominated by *Chromolena odorata* and *Panicum maximum*. Before tillage, there was clearing of the bush and uprooting of the underground stems (rhizomes) of the grasses especially guinea grass (*Panicum maximum*). The minisetts were planted on 5th October 1994 for the1994/95 trial and 10th October, 1995 for the 1995/96 trial. Immediately after planting, all the plots were sprayed with primextra (atrazine/metalachlor) at 2.5kg a.i/ha mixed with paraquat at 0.5kg a. i./ha to control early weed emergence (Unamma and Melifonwu, 1986). After herbicide spraying, the sub-plots were staked and mulch was applied in the appropriate plots. On sprouting, the yam vines were directed to the stakes with piassava (raphia fibres) in staked plots or left to trail in the plots without stakes. Watering with tap-water started in the first week of December of each year at the rate of 4mm/day (Penman, 1948; Igwilo, 1982) applied three times a week using 10-litre watering cans. All weeds/plot were harvested.

In the 1994/95 dry season, weeds were uprooted by hand on 20 January, 1995 107 days after planting, (DAP) at the peak of yam foliation (peak of leaf area index). Grasses (including sedges) and broad-leaved weeds were separated and weighed fresh. In the 1995/96 season, the weeds were harvested on 21 January (103 DAP) at the peak of yam foliation as well as on 22 April, 1996 (196 DAP) at the yam tuber maturity. The weeds were separated into species before they were weighed fresh in 1996. Weed species less than 2g/plot were grouped as others. Keys to weeds (Akobundu and Agyakwa, 1987) were consulted; soils of mulched and un-mulched beds and mounds were sampled with soil auger and dried in a ventilated oven at 105°C.

RESULTS

1994/95 Data

Mulching depressed the fresh weight of grasses by 47% (P = 0.05) and increased the fresh weight of broadleaves by 132% (P = 0.05). There was a significant interaction (P = 0.05) between mulching and seedbed preparation in increasing the fresh weight of broadleaves (Table 1). Mulching increased the fresh weight of broadleaves more on beds than on mounds. Beds, on the average, increased the fresh weight of broadleaves by 15.4% (P = 0.05) when compared with mounds. The overall effect on both grasses and broadleaves was that the treatments had no significant effects on the total weight of weeds and there were no significant interactions (Table I).

1995/96 Data

In the 1995/96 season, data collected 103 DAP showed that mulching reduced the fresh weight of grass weeds by 36.1% (P = 0.05) as shown in Table 2. Other treatments and interactions showed no significant effects. Mulching rather increased the fresh weight of broadleaves by 87.0% (P = 0.05), while beds compared with mounds increased the fresh weight of broadleaves by 68.0% (P = 0.05). Other main effects and interactions were also not significant. Total fresh weight of weeds/plot showed no significant effects of treatment and interactions.

In the second weed harvest (194 DAP), mulching reduced the fresh weight of grasses by 43. 1% (P = 0.05) as shown in Table 3. Other main effects and interactions on grass weeds were not significant. On the contrary, mulching increased the fresh weight of broadleaves by 188.4% (P = 0.05). Other main effects and interactions on broadleaves were also not significant. Again, main effects and interactions had no significant effects on total fresh weight of weeds (Table 3).

TABLE 1: EFFECT OF MULCHING AND TILLAGE ON THE FRESH WEIGHT OF WEEDS/PLOT (g), 1994/5 DATA.

	Grasses			Broad Leaves			Weeds Total		
Tillage	Mulch	No Mulch	Tillage Means	Mulch	No Mulch	Tillage Means	Mulch	No Mulch	Tillage Means
Bed	576.3	1238.5	907.4	1619.3	639.9	1129.6	2195.7	1878.4	2037.1
Mound	686.9	1142.8	917.0	1157.6	554.6	856.1	1844.1	1695.7	1769.9
Mulch Means	631.6	1190.7	912.2	1388.5	597.3	992.9	2019.9	1787.1	1903.5
$LSD_{(0.05)}$ between mulch or tillage means	193.7			166.7			N.S.		
$LSD_{(0.05)}$ for mulch x/tillage interaction	N.S			333.3			N.S.		

TABLE 2: EFFECT OF MULCHING AND SEEDBED ON THE FRESH WEIGHT OF WEEDS/PLOT (g) 103 DAP, 1995/6 DATA

	GRASSES		BROAD LEAVES				WEED TOTAL
	MULCH	NO MULCH	MULCH	NO MULCH	BED	MOUND	
	905.3	1416.4	942.1	503.9	902.9	543.1	1870.4
$LSD_{(0.05)}$	129.6		320.3		320.3		N.S.

TABLE 3: EFFECT OF MULCHING ON THE FRESH WEIGHT OF WEEDS/PLOTS (g) 194 DAP. 1995/6 DATA

	GRASSES		BROAD LEAVES		WEED TOTAL
	MULCH	NO. MULCH	MULCH	NO. MULCH	
	1046.1	1838.8	1680.0	582.3	2573.7
$LSD_{(0.05)}$	536.3		486.0		N.S.

The effects of mulching on the fresh weights of the major weed species 103 DAP and 194 DAP are shown in Tables 4 and 5. Among the twelve major grass weeds harvested 103 DAP, five species were significantly depressed, three were significantly promoted, while four species were indifferent to mulching (Table 4). With the eighteen major broadleaves, one species was depressed, twelve were promoted and five were not significantly influenced by mulching. Among the ten major grass species harvested at 194 DAP (Table 5), five species were significantly depressed, four were significantly promoted and one species was indifferent to mulching. With sixteen broadleaf species, two were significantly depressed, nine significantly promoted and five indifferent to mulching. *Panicum maximum* constituted 64 1 –

84.2 percent of the grass weeds, while *Commelina* constituted 42.9 – 55% of the fresh weight of the broad-leaf species (Table 6). There was a pronounced increase in the population of *Richardia* from 0.5% at 103 DAP to 9.3% at 194 DAP. There were more weeds at 194 DAP than at 103 DAP, an interval of 91 days. Mulched beds contained 16.11% moisture, un-mulched beds 14.13%, mulched mounds 15.23% and un-mulched mounds 13.56%.

DISCUSSION

Weeds have been reported to reduce the yield of yams (Unamma et al, 1980; Unamma and Akobundu 1989). Mulching increases the tuber yield of yams when compared with no mulch treatments (Maduakor et al, 1984). In this study,

Table 4 **Fresh Weight Per Plot (g) of Weed Species as affected by Mulching, 103 DAP, 1995/6 Data**

	GRASESS	*Mulch*	*No Mulch*	*LSD(0.05)*	*Remarks*
1	*Panicum maximum*	541	1414	242.5	Depressed by mulch
2	*Panicum laxum*	3	5	1.6	Depressed by mulch
3	*Eleusine indica*	6	30	5.4	Depressed by mulch
4	*Paspalum orbiculare*	7	24	4.8	Depressed by mulch
5	*Brachairia sp.*	5	14	3.3	Depressed by mulch
6	*Cyperus sp.*	10	5	2.8	Promoted by mulch
7	*Killinga sp.*	10	5	2.9	Promoted by mulch
8	*Setaria barbata*	17	2	3.3	Promoted by mulch
9	*Axonopus compressus*	38	40	N.S.	Indifferent
10	*Digitaria horizontalis*	11	12	N.S.	Indifferent
11	*Mariscus alternifolius*	4	4	N.S.	Indifferent
12	*Erogrostis tremula*	4	5	N.S.	Indifferent
	TOTAL	**656**	**1560**		
	BROAD LEAVES				
1	*Ageratum conyzoides*	34	56	3.1	Depressed by mulch
2	*Commelina sp.*	696	98	48.8	Promoted by mulch
3	*Synedrella nodiflora*	140	94	30.8	Promoted by mulch
4	*Calapogonium sp.*	93	65	21.4	Promoted by mulch
5	*Cleome sp.*	11	7	3.2	Promoted by mulch
6	*Aspilia africana*	6	3	2.1	Promoted by mulch
7	*Cyanthula prostrata*	16	3	3.3	Promoted by mulch
8	*Celosia sp*	15	10	4.1	Promoted by mulch
9	*Tridax procumbens*	4	2	1.7	Promoted by mulch
10	*Emilia sp.*	6	2	2.0	Promoted by mulch
11	*Asystasia gangetica*	16	2	3.2	Promoted by mulch
12	*Richardia braziliensis*	5	2	1.9	Promoted by mulch
13	*Ipomoea involucrata*	18	15	N.S.	Indifferent
14	*Sida sp.*	4	3	N.S.	Indifferent
15	*Urena lobata*	5	7	N.S.	Indifferent
16	*Plastostoma africana*	4	4	N.S.	Indifferent
17	*Vernonia cinerea*	4	3	N.S.	Indifferent
	TOTAL	**1077**	**376**		

Table 5: Fresh Weight per plot (g) of Weed Species as affected by Mulchs. 194 DAP, 1995/996 Data

		Mulch	No Mulch	LSD(0.05)	Remarks
	GRASESS				
1.	*Panicum maximum*	448	1400	229.3	Depressed by mulch
2.	*Panicum laxum*	2	11	2.6	Depressed by mulch
3.	*Paspalum orbiculare*	22	138	21.7	Depressed by mulch
4.	*Mariscus alternifollius*	15	25	6.9	Depressed by mulch
5.	*Brachairia* sp.	19	71	13.1	Depressed by mulch
6.	*Axonopus compressus*	163	104	34.8	Promoted by mulch
7.	*Cyperus* sp.	80	15	13.2	Promoted by mulch
8.	*Kyllinga* sp.	28	6	6.2	Promoted by mulch
9.	*Eleusine indica*	78	38	16.2	Promoted by mulch
10	*Digitaria horizontalis*	46	44	13.2	Indifferent
	TOTAL	**901**	**1847**		
BROAD LEAVES					
1.	*Ageratum conyzoides*	26	51	11.5	Depressed by mulch
2.	*Ipomoea involucrata*	18	30	7.9	Depressed by mulch
3.	*Commelina* sp.	651	320	121.2	Promoted by mulch
4.	*Synedrella nodiflora*	492	16	52.4	Promoted by mulch
5.	*Aspilia africana*	34	15	8.0	Promoted by mulch
6.	*Cyanthula prostrata*	25	15	6.9	Promoted by mulch
7.	*Tridax procumbens*	17	4	4.6	Promoted by mulch
8.	*Emilia* sp.	10	4	3.7	Promoted by mulch
9.	*Oldelendia* sp.	16	5	4.6	Promoted by mulch
10.	*Vernonia cinerea*	11	3	3.7	Promoted by mulch
11.	*Richardia braziliensis*	93	16	27.9	Promoted by mulch
12.	*Calapogonium* sp.	12	15	N.S	Indifferent
13.	*Cleome* sp.	25	24	N.S	Indifferent
14.	*Celosia* sp.	8	5	N.S	Indifferent
15.	*Sida* sp.	3	2	N.S	Indifferent
16.	*Chromolena odorata*	3	3	N.S	Indifferent
	TOTAL	**1544**	**528**		

mulching suppressed the growth of grasses and promoted the growth of broadleaved weeds (Table, 1 – 3), Guinea grass (*Panicum maximum*), a fast-growing and highly competitive weed (Tables 4 – 6) was the dominant grass species (64 – 84) percent. Guinea grass has an aggressive root system like maize (*Zea mays*) which when intercropped with yam (*Dioscrorea* sp) substantially reduces the tuber yield of yam, physically, through root competition for soil pore spaces and perhaps through increasing the soil resistance to yam tuber growth (Igwilo, 1994; Russell, 1973). It is therefore likely that the favourable effect of mulching on yam tuber yield is mediated through reduction in the population of grass weeds. This view is buttressed by the fact that mulching caused compensatory increases in the fresh weight of broadleaved weeds simultaneously as it reduced grass weeds (Table 1 – 3). Indeed, most of the stolons and adventitious roots of *Commelina* sp. which constituted the dominant broadleaf species (45 – 55 percent) were located above ground in the mulch. It is therefore the presence of grass weeds that causes yield reduction. Mulching materials are available in good quantities during the dry season and are within the reach of the peasant farmers who are the major producers of yam in Nigeria.

The favourable effects of beds over mounds on the infestation of broadleaved weeds was consistent in the two seasons (Tables 1-3) probably because of more efficient soil water conservation in the beds than in the mounds. Staking of yams had no significant effect on weed infestation suggesting that the canopy of trailing, unstaked yams had not adverse shading effects on the emergence and early growth of weeds. The increased harvest of weeds in the second half of the 1995/95 season (Tables 2 and 3) may be due to the more favourable water supply through the rainfall.

In Nigeria, increases in yield due to dry grass mulching have been reported with other crops such as maize (Adeoye, 1990) and plantain (Salau *et al.*, 1992) and the control of grass weeds by the mulches might have been the cause.

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REFERENCES

Adeoye, K. B., 1990. Effects of amount of mulch and timing of mulch application on Maize at Samaru. Northern Nigeria. Samaru Journal of Agric. Research. 7: 57 – 66.

Akobundu, I. O. and Agyakwa, C. W., 1987. A Handbook of West African Weeds, I. I. T. A., Ibadan.

Table 6 Percentage Composition by fresh Weight of the Weed Species 1995/6 Data

		103 DAP	194 DAP
GRASSES			
1.	*Panicum maximum*	84.2	64.1
2.	*Axonopus compressus*	3.4	9.3
3.	*Paspalum orbiculare*	1.3	5.5
4.	*Eleusine indica*	1.6	4.0
5.	*Cyperus* sp.	0.7	3.3
6.	*Digitaria horizontalis*	1.0	3.1
7.	*Brachairia* sp.	0.8	3.1
8.	*Mariscus alternifolius*	0.3	1.4
9.	*Kyllinga* sp.	0.6	1.0
10.	*Setaria barbata*	0.8	-
11.	*Others*	5.4	5.2
	BROAD LEAVES		
1	*Commelina sp.*	55.0	42.0
2	*Calapogonium sp*	10.9	1.2
3	*Ageratun Cornyzoides*	6.2	3.4
4	*Synednella nodiflora*	16.2	22.5
5	*Cleome sp.*	1.2	2.2
6	*Ipomoea involucrate*	1.6	2.1
7	*Celosia sp.*	1.7	0.6
8	*Asystacia gangetica*	1.2	0.5
9	*Aspillia africana*	0.6	2.2
10	*Richardia braziliensis*	0.5	9.3
11	*Others*	4.9	10.5

Igwilo, N., 1982. Effect of climatic changes on the growth and yield of two cowpea varieties in South-eastern Nigeria. (i) Climatic changes, yield and seed quality. Nigerian Agricultural Journal. 17/18: 243 - 260.

Igwilo, N.; Mbanaso Ada E. N.; Onyia, G. O. C. and Atu, U. G., 1988. Inhibition of sprouting by gibbellic acid in the preservation of seed and ware yam. Beitrage zur tropischen landwirtshaft und Veterinarmedizin, 26, H. 2, 145 - 154.

Igwilo, N., 1994. Effect of staking and population of yam and removal of maize leaf and ear in a yam/maize intercrop. (ii) Dry matter production and the mechanism of maize interference with yam yield. Nigerian Agricultural Journal 27: 73 – 82.

Igwilo, N., 2001. Effects of staking, mulching and Seedbed Preparation on the Field Performance of Two Yam (*Dioscorea* sp.) varieties grown off-season: Nigerian Agricultural Journal (in press).

Maduakor, H. O., Lal R. and Okpara – Nadi O. A., 1984. Effects of Seedbed Praparation and Mulching on the Growth and Yield of White Yam (*Dioscorea rotundata*) on an ultisol in South-eastern Nigeria. Field Crops Research 9: 119 – 130.

Onochie, B. E., 1974. Critical Period of Weed Control in Yam Plots. *Nigerian Agricultural Journal* 11 (3), 13 – 16.

Onwueme, I. C., 1978. The Tropical Tuber Crops. John Willey and Sons, Chichester, 62pp.

Penman, H. L., 1948 Natural Evaporation from Open Water, bare soil and grass. Proceedings of Royal Society, Series A. 193: 120 – 145.

Russell, E. W., 1973. Soil Conditions and Plant Growth, London, Longmans, 10th Edition, pp. 492 – 511.

Salau, O. A., Okpara – Nadi O. A. and Swennen R., 1992. Effects of Mulching on Soil Properties, Growth and Yield of Plantain on a Tropical Ultisol in South-eastern Nigeria. Soil and Tillage Research 23: 73 – 93.

Unamma, R. P. A., Akobundu I. O. and Fayemi A. A. A., 1980. Weed Interference in White Yam, in Tropical Root Crops Research Strategies for the 1980's. Proceedings of First Triennial Root Crops Symposium of ISTRC Africa Branch, Ibadan, Nigeria. 1980 (Eds. E. R. Terry, K. A. Oduro and F. Caveness), pp. 203 – 207.

Unamma, R. P. A. and Akobundu I. O., 1989. Effects of Tropical Weeds on Yield of White Yam (*Dioscorea rotundata* Poir). Weed Research 29: 1 – 6.

Unamma, R. P. A. and Melifonwu A. A., 1986. Herbicides for 'seed' yam production from 'minisetts' in the forest zone of Nigeria. Weed Research 26:115 – 120.