Economic assessment of manual and chemical control of thorny mimosa in cassava in Nigeria

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Abstract

The economic assessment of manual and chemical methods for controlling thorny mimosa (*Mimosa invisa)* in cassava established at 10,000 plants/ha was investigated at the Institute of Agricultural Research and Training, Ibadan, Nigeria (7? 22.5' N, 3? 50.5'E), a humid tropical environment. Six weeding regimes were compared with an unweeded control. Removal at 4, 7, and 11 weeks after planting (WAP) consistently gave the highest net benefit and marginal rate of return. In a herbicide trial, net benefit and marginal rate of return was highest when thorny mimosa was hand-weeded in cassava. Only atrazine [6-chloro-N-ethyl-1-methylethyl)–1,3,5-trianzine-2,4-diamine] + metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy–1-methylethyl)acetamide] at 0.82 + 1.68 kg/ha had net benefit and marginal rate of return that were close to hand-weeding.
Abreviation: N = Nigerian currency, Naira. In 1995 to 1996 1$ = N80. In 1996 to 1997 1$ = N84.

Media Summary

Manual removal of thorny mimosa in cassava is more economical than herbicide treatments in Nigeria. Mimosa was best removed at 4, 7 and 11 weeks after planting cassava.

Keywords

Hand weeding, time of weeding, herbicides, total cost, net returns.

Introduction

Thorny mimosa or giant sensitive plant (*Mimosa invisa* Mart), one of the invasive leguminous weeds in Nigeria, is a native of Brazil (Holm *et al.*, 1977). It has recently become a threat to the production of cassava and other long season crops in Nigeria (Akobundu and Agyakwa, 1998; Alabi *et al*., 2001). The weed causes up to 85% yield loss in cassava (Alabi *et al*., 2001), the crop for which Nigeria is the world's leading producer (FAO, 2000).

Manual removal of weeds is the major traditional method for weed control in cassava in the tropics (Akobundu, 1987). Manual weed removal needs proper timing but many farmers do not adhere to this. Thus, the benefits from manual weeding are not fully realized. In Nigeria, weeding is recommended at three times in cassava within the first 3 months after planting (MAP), but opinions vary as to the best time to apply the these. Onyengoli (1975) and IITA (1990) recommend weed removal at 4, 8, and 12 WAP.

Not many herbicides have been identified for effective control of thorny mimosa in cassava. Alabi *et al*., (1999) recommended atrazine + metolachlor at 0.82 + 1.68 kg/ha for controlling thorny mimosa in cassava. The objectives of this study were to determine the economic implications of timing of manual removal of thorny mimosa in cassava, and to compare some herbicides with hand weeding in controlling thorny mimosa in cassava.

Materials and Methods

The investigation was conducted at the Institute of Agricultural Research and Training (IAR&T), Moor Plantation, Ibadan (7^{o}22.5' N, 3^{o}50.5'E), Nigeria in 1995 to 1996 and repeated in 1996 to 1997. Thorny mimosa population was estimated at 630,000 to 680,000 plants/ha during the cropping seasons.

Two experiments were set up after the land was prepared with a tractor and disc implement. Plot size was 5 m by 5 m and the area harvested was 4 m by 4 m at the centre of each plot. Cassava variety, 'TMS 30572' was planted on a ridge at a spacing of 1m by 1m on April 28, 1995 and May 7, 1996 for the first experiment, and April 29, 1995 and May 8, 1996 for the second experiment.

Experiment 1 had thorny mimosa manually removed in cassava plots three times within the cropping season at (1) 2, 5 and 9; (2) 3, 6 and 10; (3) 4, 7, and 11 and (5) 6, 9 and 13, WAP. In 1996 weeding was also done at 3, 8 and 12 WAP, which is the standard regime recommended by the (Nigerian) National Advisory Committee on Weed Control (NACWC, 1994). Thorny mimosa was manually removed with hoe to a depth of 3 to 5 cm. There was also an unweeded control treatment.

Experiment 2 had nine herbicide treatments: mixtures of atrazine + metolachlor (Primextra^{R}) applied pre-emergence at 0.82 + 1.68, and 1.15 + 2.35 kg/ha; pendimethalin [N-(1-ethylpropyl)-3,4– dimethyl–2,6-dinitrobenzenamine] + linuron [N(3,4-dichlorophenyl)-N-methoxy-N-methylurea] (Panter^{R}) at 0.72 + 1.28, and 1.08 + 1.92 kg/ha; bentazon (3-(1-methylethyl)-(IH)-2,1,3,-benzothiadiazin – 4(3H)–one 2,2-dioxide] + propanil [N(3,4-dichlorophenyl) propanimide] (Basagran PL 2^{R}) at 1.12 + 2.38, and 1.44 + 3.06 kg/ha; oxadiazon {3-[2,4–dichloro-5-(1methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3H)-one} (Ronstar R) at 1.5 and 2.0 kg/ha; and a tank mixture of acetochlor [2-chloro-N-(ethoxymethyl)-N-(2-ethyl-6-methlphenyl acetamide] + atrazine at 0.92 + 0.63 kg/ha. Unweeded and a hand-weeded control plots were also established. Thorny mimosa was removed 3, 8, and 12 WAP in the hand-weeded control.

Cassava was harvested 12 MAP in both experiments. The yield data were subjected to ANOVA and significantly different means separated with Duncan's multiple-range test at 5% level of significance. Partial budgets involving the analysis of variable input costs and benefits were drawn for all the treatments. Items considered were the gross benefit (N/ha) calculated as yield of cassava (tons/ha) multiplied by field price (N/ha), total cost (N/ha) of all inputs and labour used, and the net benefit (N/ha) calculated as gross benefit less total cost. The marginal rate of return (MRR) was the net benefit divided by total cost.

Results and Discussion

Cassava storage root yield: Among the weeding regime treatments, storage root yield in cassava was highest when thorny mimosa was removed 4, 7, and 11 WAP or 5, 8 and 12 WAP in the 1995 to 1996 cropping season (Table 1). In the 1996 to 1997 planting, the highest root yield occurred when thorny mimosa was removed 4, 7, and 11 WAP.

In the herbicide trial, the hand-weeding control gave the highest root yield in both cropping seasons (Table 2). The yield from both atrazine + metolachlor treatments was statistically comparable to the hand-weeded control in both cropping seasons. These results confirm earlier reports that atrazine + metolachlor at a combined dosage of 2-3 kg/ha controlled weeds in cassava and was favourable for good root yield (IITA, 1990; NACWC, 1994).

Economic assessment:

In the 1995 to 1996 planting, treatments where thorny mimosa was removed 4, 7, and 11 WAP and 5, 8 and 12 WAP had net benefits and marginal rates of return that were similar (Table 2). Every N1 expended in this treatment yielded N4.06 as profit. In the 1996 to 1997 cropping season, the highest net benefit and marginal rate of return was recorded in the treatment where thorny mimosa was removed 4, 7, and 11 WAP. For every N1 expended in this treatment, N1.17 was gained. Net benefit and marginal rate of return from treatment weeded at 3, 8, and 12 WAP, the standard weeding time recommended for weed control in cassava in Nigeria (IITA, 1990; NACWC, 1994) were far lower than in the treatment weeded 4, 7 and

11 WAP. Imeokparia and Okunsanya (1997) also had shown that the time of weed removal in rice is important. Rice plants hand-weeded once at 30 days after transplanting had higher grain yield than plants hand-weeded once at 14 days after transplanting.

In the herbicide trial, in the 1995 to 1996 cropping season, total cost of operation was lower with hand weeding than all herbicide treatments (Table 3). Net benefit was highest in hand weeding which also gave the highest marginal rate of return in both years. With these results, hand weeding was more profitable than herbicide treatments. This conclusion is subject to availability and relative cost of labour from country to country. This finding is similar to that of Imeokparia and Okusanya (1997) in Nigeria who indicated that hand weeding twice gave higher net benefit and marginal rate of return than herbicide treatments in transplanted rice. Among the herbicide treatments, only atrazine + metolachlor, 0.82 + 1.68kg/ha had net benefit and marginal rate of return that was close to that of the hand weeding.

Table 1. Effect of herbicide treatments of thorny mimosa on storage root yield in cassava 12 MAP[1]

Treatment	Rate (kg/ha)	Storage root yield (t/ha)	
		1995 – 1996	1996 - 1997
Oxadiazon	1.5	2.5c[3]	NA[3]
Oxadiazon	2.0	6.3bc	NA
Bentazon + propanil	1.12 + 2.38	5.9bc	7.3e
Bentazon+ propanil	1.44 + 3.06	8.0bc	8.4e
Atrazine + metolachlor	0.82 + 1.68	23.3a	25.0ab
Atrazine + metolachlor	1.15 + 2.38	19.8a	23.0bc
Pendimenthalin + linuron	0.72 + 1.28	10.0b	15.9d
Pendimethalin + linuron	1.08 + 1.92	10.5b	17.4cd
Acetochlor + atrazine	0.92 + 0.63	NA	22.5bc
Hand weeded	3, 8,12 WAP	24.9a	31.0a
Unweeded		2.5c	4.9c

[1]MAP, months after planting; WAP, weeks after planting;
[2]. NA, Not applied

[3]. Means followed by the same letter(s) within a column are not significantly different (Duncan's Multiple-range test; P = 0.05).

Table 2. Storage root yield and economic assessment of timing of thorny mimosa removal in cassava.

Removal timing (WAP)	Storage root yield (t/ha)		1995 -1996			1996 - 1997		
	1995-1996	1996-1997	Total cost (N/ha)	Net benefit (N/ha)	MRR[2]	Total cost (N/ha)	Net benefit (N/ha)	MRR
3, 8, 12 (Standard)	NA[3]	13.1bc	NA	NA	NA	14,750	4,900	0,33
2, 5, 9	24.4ab[4]	13.8bc	8,750	27,850	3.18	14,750	5,900	0.40
3, 6, 10	22.1b	14.5bc	8,750	24,400	2.79	14,750	7,000	0.48
4, 7, 11	29.5a	21.3a	8,750	35,500	4.06	14,750	17,200	1.16
5, 8, 12	29.5a	16.4b	8,750	35,500	4.06	14,750	9,850	0.67
6, 9, 13	21.0b	10.9c	8,750	22,750	2.60	14,750	1,600	0.11
Unweeded control	0.8c	1.3d	6,050	-4,850	-0.80	9,350	-7,400	-0.79

[1] MAP, months after planting; WAP, weeks after planting;
[2] NA, Not applied
[3] Means followed by the same letter(s) within a column are not significantly different (Duncan's Multiple-range test; P = 0.05).

3. Economic assessment of herbicide treatments for thorny mimosa control in cassava.

Treatments	Rate (kg/ha)	1995 - 1995			1996 - 1997		
		Total cost (N/ha)	Net benefit (N/ha)	MRR[1]	Total cost (N/ha)	Net benefit (N/ha)	MRR
Oxadiazon	1.5	11,910	-8,160	-0.69	NA[3]	NA	NA

Oxadiazon	2.0	13,810	-4,360	-0.32	NA	NA	NA
Bentazon + propanil	1.12+2.38	13,070	-4,220	-0.32	17,505	-6,555	-0.38
Bentazon+ propanil	1.44+3.06	15,030	-3,030	-0.20	19,755	-7,155	-0.36
Atrazine + metolachlor	0.82+1.68	9,910	25,040	2.53	13,580	24,820	1.83
Atrazine + metolachlor	1.15+2.38	11,390	18,010	1.58	15,160	19,340	1.28
Pendimenthalin + linuron	0.72+1.28	11,810	3,190	0.27	15,590	8,260	0.53
Pendimethalin + linuron	1.08+1.92	14,610	1,140	0.08	18,570	7,530	0.41
Acetochlor + atrazine	0.92+0.63	NA	NA	NA	13,161	20,589	1.56
Hand-weeded	3,8,12 WAP[2]	8,750	28,600	3.27	14,750	31,750	2.15
Unweeded		6,050	-2,300	-0.38	9,350	-2,000	-0.21

[1]. MRR = Marginal rate of return
[2]. WAP = Weeks after planting
[3]. NA = Not Applied.

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