Economic Evaluation of Cultural Control of *Tithonia diversifolia* (Hemsl. A Gray) in South Western Nigeria

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Abstract: Field experiments were conducted during the rainy season of 1999 and 2000 at the Teaching and Research farm of Ladoke Akintola University of Technology, Ogbomoso, Nigeria to assess the economics of the control of *Tithonia diversifolia* by mulching in Okra production. There were five treatments namely; plastic mulch, grass mulch, wood shavings mulch, Hoe weeded and an unweeded and unmulched plots which constituted the control treatments. The experimental design was the Randomised complete block while partial budgeting was the instrument of economic analysis. Weed control method significantly affected Okra fruit yield (P=0.05) with highest resulting from plastic mulch followed by hoe weeding, grass mulch, wood shavings and unweeded control in that order. The economic profitability of the control methods measured by the net change in profit was in the order; hoe weeding (N263,630) > Panicum mulch (N253,950) > plastic mulch (N201,000)> wood shavings (N195,000). The established long term effect of grass mulch as it affects soil fertility and sustainability however makes grass mulch better than the other control methods.

Key words: Economic, partial budgeting, mulching, tithonia control, okra

INTRODUCTION

The significance of weed in agriculture especially in crop production is both positive and negative. However, as crop producers, man is often quick to highlight crop losses due to weeds resulting from competition, allelopathy, adulteration of farm produce and inflation of cost of production among others (Akobundu, 1987 and Lavabre, 1991). Therefore, for a profitable crop production, the bulk of labour requirement goes into weed control. The estimated total labour for weed control as a percentage of the total labour requirement for production including harvesting have been put at 36% and 37% respectively for maize and sorghum (Akobundu, 1987). For fruits and vegetables, Usoroh (1995) reported that weeding alone accounted for between 30-45% of the total cost of production in Nigeria. The frequency and hence the total cost of weeding had been linked to weed type and crop concerned (Olabode *et al*., 1999 and Akobundu, 1987). Higher frequency and total cost of weeding is required for aggressive weeds such as *Tithonia diversifolia* (Olabode *et al*., 1999) and *Amaranthus hybridus* (Chivinge and Schweppenhauser, 1995) compared with less aggressive weeds such as *Acalypha segetalis* (Ogunyemi *et al*., 2001). Similarly, the cost of weed control is directly related to the weed control method(s) adopted and frequency of weeding required (Akobundu, 1987).

The effectiveness of mulching as a weed control method had been reported (Akobundu, 1987). However, Opara-Nadi (1993) reported differences in the weed control efficiencies of

different mulch types. *Tithonia diversifolia* (Hemsl.) A. Gray, member of the family Asteraceace and native to Mexico and Central America (Carter, 1978) has become a problem in Nigeria. Though the route of introduction of this weed into Nigeria is unknown, it has become a significant agronomic and economic factor to optimum arable crop production especially in the southern guinea savanna zone (LordBanjou, 1991). A major fruit vegetable in this region is okra which is grown for its nutritive fruits and leaves. Due to the slow juvenile development of okra, early and repeated hoe weeding is usually adopted to reduce the competitive effects of Tithonia on the crop. Repeated hoeing with the attendant accumulation of labour cost eventually reduces farmers' net income.

The objective of this study therefore is to evaluate the economics of the control of Tithonia by mulching in okra production in comparison with the traditional control method of hoe weeding.

MATERIALS AND METHODS

Field experiments were carried out at the Ladoke Akintola University of Technology, Ogbomoso Teaching and Research farm in southwestern Nigeria. The experiments were sited on a Tithonia infested field (Akobundu, 1991) during the rainy seasons of 1999 and 2000. The soil characteristic and climatic data for the experimental site are presented in Figure 1 and Table 1.

Table 1: Soil physico-chemical properties of the experimental site

Properties	**1999**	**2000**
pH (H_2O)	6.00	6.30
Organic Carbon (%)	1.90	1.60
Total N (%	0.26	0.18
Available P (ppm)	4.93	5.98
Exchangeable K (Meq/100g)	0.42	0.38
Sand (%)	87.00	88.00
Silt (%)	9.00	10.00
Clay (%)	4.00	2.00

Source: Department of Agronomy, Ladoke Akintola University of Technology, Ogbomoso.

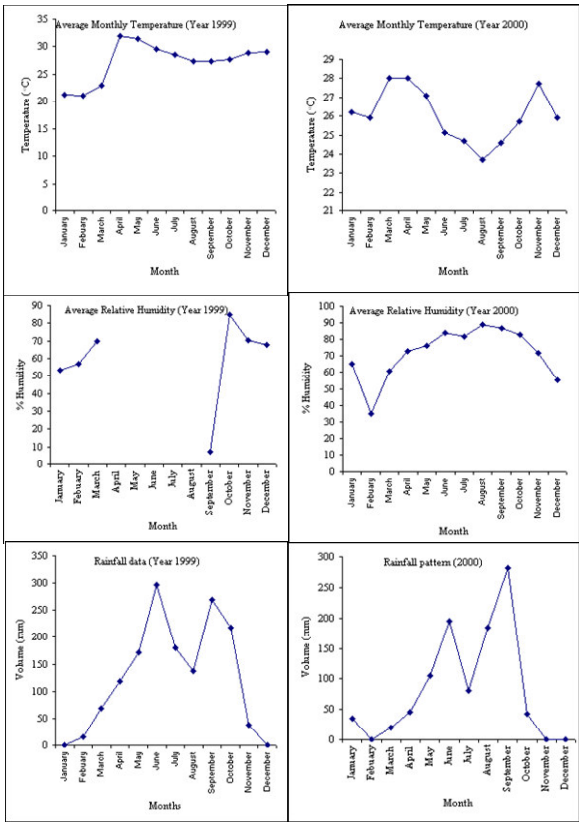

Fig1: Weather records of the study area for year 1999 and 2000

The site was manually cleared, tilled and levelled before laying out plots. The experimental design was a randomized complete block (RCB) with four replications. There were five treatments namely: plastic, grass, wood shavings mulching, hand hoeing and no weeding + no mulching. Each treatment plot size was 3 m x 3 m and the block size was 19 m x 3 m. each treatment plot and block plot were separated by an alley of 1m respectively, such that the total experimental plot size was 19 m x 15 m.

The plastic mulch 0.25m thick black-grey polythene sheet was obtained from the International Institute of Tropical Agricultural (IITA) and the grass mulch was sourced from slashing of *Panicm maximum* collected from adjacent fallow areas. The wood shavings from *Tectonia grandis* were collected from a local sawmill in Ogbomoso. The mulches were applied to rain fed soils. The plastic mulch was laid with the grey side up and plantings made through holes at marked points. Both the grass and wood shavings were laid to a thickness of 3cm. The grass mulch was augmented at four weeks after the first application due to rapid decomposition. Weeding was done twice as hoe was used for weeding plots thereby receiving two weeding exercises at 2 and 4 weeks after planning (WAP); while the weedy plot was maintained leaving the plot unweeded from planting. Seeds of Okra V. 35 characterised with large alternative cordate leaves with 3 to 5 smooth edged lobes and short pods used for trial were obtained from the National Horticultural Research Institute (NIHORT) Ibadan, Nigeria. Plantings were done on 10th of May and 20th of May respectively for 1999 and year 2000 trials.

Cypertex, an insecticide containing 100mg/ml of cypermethrin was applied weekly to protect the crop from *Podagrica* sp attack (from the second WAP to fruiting). Data were collected for dry matter yield of Tithonia by oven drying (at 80^0C for 48 hours) weeds collected from three randomly placed 0.25cm^2 quadrats and weighing on a Metler balance.

Okra fruit yield was estimated from cumulative fresh weight, per plant of okra harvested at 5 days interval. Data means were compared using Duncan's multiple range test (DMRT). The instrument of economic analysis was partial budgeting as described by Ronald (1986).

RESULTS

The dry matter yield of Tithonia was significantly affected by mulch types (Table 2). The highest weed dry matter yield apart from the

unweeded control occurred on plots mulched with panicum while plastic mulched plots had the least. The order of weed control was plastic mulch> wood shavings mulch> hoe weeding> panicum mulch.

Table 2: Effect of mulch type *Tithonia diversifolia* biomass on Okra plot at flowering in the two seasons (1999 and 2000).

Weed Control Method	**Weed Biomass {dry weight (g/m^2)} within Okra plot.**	
	1999	**2000**
Plastic mulch	28.4e	0.00d
Panicum mulch	98.5b	104.0b
Wood shaving mulch	87.7c	90.5b
Hoe weeding	62.5d	57.6c
Weedy plot	263.0a	220.4a

Values with the same letter for each year along the significant different at 5% level of probability by Duncan Multiple Range Test (DMRT).

The yield of okra was significantly ($P<0.05$) affected by weed control methods in the two years (Table 3). Okra fruit yield followed the trend plastic mulch> hoe weeding> panicum mulch wood shaving> unweeded plot. The economic implications of the various weed control methods are presented in Tables (4 -7). The economic profitability of the control methods measured by the net change in profit was in the order; hoe weeding (N263,630.40)> panicum mulch (N253,950.40> plastic mulch (N201,110.40)> wood shaving (N195,150.40).

Table 3. Effect of mulch type on Okra yield and yield parameters in the two seasons (1999 and 2000)

Weed Control Method	Number of Fruit/plant	Weight of Fruit/plant (g)	Estimated Fruit Yeild (Kg/ha)
1999			
Plastic mulch	12.11a	173.41a	11560.55a
Panicum mulch	8.67b	99.73bc	6648.60b
Wood shaving mulch	4.54c	77.20c	5146.62c
Hoe weeding	7.85bc	104.00b	6933.26b
Weedy plot	0.00d	0.00d	0.00d
2000			
Plastic mulch	10.12a	190.67a	12711.00a
Panicum mulch	6.33b	101.38b	6759.00b
Wood shaving mulch	6.00b	81.85c	5456.00c
Hoe weeding	5.78b	102.29b	6820.00b
Weedy plot	1.56c	28.38d	868.00d

Values with the same letter for each year along the significant different at 5% level of probability by Duncan Multiple Range Test (DMRT).

Substituting panicum mulch for hoe weeding led to an additional cost of N251, 800 as against an additional income of only N185,080 (Table 5). By replacing hoe weeding with wood shaving mulch, there was a 33% reduction in the cost of production. However, apart from no accruing extra income, the total income fell by 26% (N71,480) (Table 6). Panicum mulch reduced cost of production by 31% and total income by only 4% (N11,360) (Table 7) when substituted for hoe weeding.

Table 4: Farm income statement per hectare of Okra

Control Plot: Hoe Weeding	N. K
a) **Income**	
Yield: 6,933.26 Kg @ N 40.00/Kg	**277, 330. 40**
b) **Variable Cost**	
Land Preparation: 6 *MDL, Weeding: 10 MDL, Spraying (for Insect Control): 3 MDL, Harvesting: 5 MDL, Transportation: 2 MDL	
Total MDL and Cost for field =26 @ # 300.00/MDL	7,800.00
Cost of Hoe:8 hoes @ #150.00 each	1,200.00
Seed: 4 Kg @ #350.00/Kg	1,200.00
Cypertex: 3 Litres @ #850.00	2,550.00
Sub -Total	12,950.00
c) **Overhead Cost**	
Rent on Land 1ha @ #750.00	750.00
d) **Total Cost of Production/ha**:- b + c	**13,700.00**
Gross Margin/ha:- a – b	**264,380.40**
Net Profit :- a – d	**263,630.40**

*MDL = Mandays labour.

Table 5: Partial Budgeting for Okra production with Plastic Mulch
Proposed Change: Plastic Mulch

Additional Cost:	N K
10,000m^2 plastic mulch @ #25/m^2	250,000. 00
Fixing of the plastic mulch - 4 MDL @ #300.00/MDL	1,200. 00
Cost of Harvesting: 2 MDL @ #300.00/MDL	1,200. 00
Sub Total	**251,800. 00**
Reduced Income	**Nil**
Additional Cost + reduced income	**251,800. 00**

Additional Income:	N. K
Yield increase over the Control plot = (11,560 – 6,933) kg = 4,627 Kg @ #40.00/Kg =	**185,080.00**
Reduced Cost	
10 MDL of weeding @ #300.00/MDL =	3,000.00
Cost of 8 hoes @ #150.00 each =	1,200.00
Sub Total	**4,200.00**
Additional Income + Reduced Cost = 185,080 + 4,200 =	**189,280**

Net change in profit = # (189,280 – 251,800)
= **- #62,520.00**

*MDL = Mandays labour.

Table 6: Partial Budgeting for Okra production with shaving mulch
Proposed Change: Wood shaving Mulch

Additional Cost:	N. K	*Additional Income:*	#. k
Cost of packing and Transportation	300. 00	*Reduced Cost*	
Cost of mulch application -		10 MDL of weeding @ #300.00/MDL	
4 MDL @ #300.00 /MDL	1,200. 00	=	3,000.00
Sub Total	**1,500. 00**	Cost of 8 hoes @ #150.00 each	
		=	1,200.00
Reduced Income		Cost of harvesting: 1 MDL	300.00
Yield reduction below the control		Sub Total	**4,500.00**
(6,933 – 5,146)Kg			
= 1,787.00 Kg @ #40.00/Kg =	71,480.00		
Additional Cost + reduced income	**72,980.00**		
Net change in profit = # (4,200 – 72,980)			
= - #68,480.00			

*MDL = Mandays labour.

Table 7: Partial Budgeting for Okra production with Panicum mulch
Proposed Change: Panicum mulch

Additional Cost:	#. k	*Additional Income:* Nil	#. k
Cost of cutting and packing		*Reduced Cost*	
5 MDL @ #300.00 /MDL	1,.500 00	10 MDL of weeding @ #300.00/MDL	
Cost of mulch application -		=	3,000.00
3 MDL @ #300.00 /MDL	900. 00	Cost of 8 hoes @ #150.00 each	
Sub Total	2**,400. 00**	=	1,200.00
		Sub Total	**4,200.00**
Reduced Income			
Yield reduction below the control		Additional Income – Reduced Cost	
(6,933 – 6649)Kg		=	4,200.00
= 584 Kg @ #40.00/Kg =	11,360.00		
Additional Cost + reduced income	**13, 760.00**		
Net change in profit = # (4,200 – 13, 760)			
= - #9,560.00			

*MDL = Mandays labour.

DISCUSSION

The performance of various control methods conforms to the pattern earlier reported by Stapleton (1990). The variation in Okra yield from the different plots is attributable to the effectiveness of the control methods except for wood shavings mulch. Reduced yield under wood shavings inspite of good weed control had been reported (Opara-Nadi, 1993, Adetunji 1990) as being the resultant of a number of factors ranging from Nitrogen (N) immobilization to phytotoxicity of some wood materials to seedlings.

Mulching brought about a change in the cost of production compared with hoe weeding. The high increase in the cost of production under plastic was due largely to the cost of plastic material. Panicum and wood shavings mulches reduced the cost due to no cost of purchase. Though there was a significantly higher yield of Okra under plastic, the additional income from the increase could not offset the additional cost and hence a reduced net income. Apart from a reduced cost of production, the yield under panicum mulch was similar to those of hoe weeding (Table 3) and

thus a similar net income. The gains from reduced cost of production under wood shavings mulch could however not offset the loss in income due to depressed yield which could have resulted from release of phytotoxins into the soil (Opara-Nadi, 1993). This study had shown that plastic mulching in okra production is better left for experimental purposes rather than commercial production.

However, Panicum mulch could be adopted for commercial purposes. Apart from the economic aspect, grass mulch (organic) had been recommended for improved soils productivity and sustainability (Obatolu and Agboola, 1993) as against the tendency of hoe weeding to expose the soil to agents of erosion and destroy the structure of the soil. High carbon/nitrogen ration requiring longer period of degradation does not make wood shavings beneficial for yield improvement in a short duration crop like okra

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