Economics of Organic Weed Management In Maize Production In Jalingo, Taraba State, Nigeria.

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ABSTRACT

The high cost of organic weed management has limited the adoption of organic crop production in North-Eastern Nigeria. Thus field experiments were conducted between 2007 and 2009 at the Taraba State College of Agriculture Teaching Farm, Jalingo, Nigeria to assess the economics of organic weed management in maize production using three cover crops: akidi (*Vigna unquiculata sub-sp sequipedalis*); a local vegetable cowpea, melon and sweet potato . There were 11 treatments replicated three times in a randomised complete block design. The treatments included 20,000, 30,000 and 40,000 stands/ha of Akidi (A_1, A_2, A_3), Melon (M_1, M_2, M_3) and Sweet potato (S_1, S_2, S_3), in addition to hand-weeded (C_1) and unweeded (C_2) controls. The results show that net profits/ha from organic weed management using S (₦217,660.00) and A (₦131,670.00) were greater than hand-weeded control (C_1) (₦117,570.00). Therefore akidi or sweet potato is recommended for profitable organic weed management in maize.

Key words: organic weed management, economics, maize, cover crops, benefit

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INTRODUCTION

Maize (*Zea may* L.) is a cereal crop of great importance for food, feed and industrial processing (Brewbaker, 1985) in sub-Sahara Africa. Among the various problems limiting maize production, weed appears to have the most deleterious effect (Mennan *et al.,* 2009) causing yield reduction between 40 and 100% (Akobundu, 1987). Organic crop growers cite weed control as their greatest difficulty in crop production because they are not permitted the use of chemical herbicides (Gianessi and Reigner, 2007). They substitute hand weeding, cover crops and cultivation for herbicides at a greatly increased cost and with reduced effectiveness.

The choice of cover crops for organic weed management (Akinyemi and Tijani-Eniola, 1997) has been limited because the crops normally used, have little or no food or cash value (Chikoye, 2004) making adoption by farmers difficult. The potentials of cowpea, melon and sweet potato to suppress weed in maize have been reported (Akinyemi and Tijani-Eniola, 1997; Okpara, 2000; Michael and Tijani-Eniola, 2009).However, the economics of these cover crops as tools for organic weed management has not been adequately investigated in north-eastern Nigeria. Thus field experiments were conducted to determine the profitability of using akidi, melon and sweet potato for managing weeds in maize.

MATERIALS AND METHODS

The Experimental site: Field trials were conducted at the Teaching farm of Taraba State College of Agriculture (08^0 50' N, 11^0 50' E), Jalingo, in the Northern Guinea Savannah ecological zone. Jalingo has a wet and dry tropical climate with rainy season of about 150 days and an average annual rainfall of about 700 mm – 1000 mm. Mean annual temperature of Jalingo is about 28^{o}C.

Experimental design and layout: There were 11 treatments replicated three times in a randomized complete block design. The treatments included 20,000, 30,000 and 40,000 stands/ha of Akidi (A_1, A_2, A_3), Melon (M_1, M_2, M_3) and Sweet potato (S_1, S_2, S_3), in addition to hand-weeded (C_1)(3 + 6 WAP) and unweeded (C_2) controls. Each plot measured 4m x 4m with 1m space between plots and 2m border separating blocks.

Planting and agronomic practices: Maize seeds, of an early maturing variety 95-TZEE-W1 were collected from International Institute for Tropical Agriculture (IITA), Ibadan. This was the test crop in all the plots and planted at 25cm x 100cm spacing, to give a population of 40,000 plants/ha. Cover crops

were planted within 24hrs of planting maize (4/hole for akidi and melon, 2-3 sweet potato vines/hole), spaced 50 cm x 100 cm and latter thinned to give the required population densities of 20,000; 30,000 or 40,000 plants/ha. All cover crop treated plots were weeded once at 3 Weeks After Planting (WAP) to allow them establish and suppress weeds. Manual weeding was carried out twice at 3 and 6 WAP on hoe-weeded control plots. Fertiliser was applied to maize at the recommended rate of 120 kgN/ha. Maize cobs were harvested dry at 14 -16 WAP.

Data collection: Maize grain yield and yields of cover crops were estimated from 10 tagged plants selected from the middle rows, exempting the border plants, in each plot and expressed in Kg/ha. There were no harvestable yields of melon during the investigation.

Data analysis: Crop Enterprise Budget Technique (Wesley *et al.,* 1993) was used for the economic analysis of maize production under each of the organic weed management treatments yearly. The pooled average for each cover crop treatments are presented in this report. The cost of inputs, various farming operations and crop prices were the average prices prevailing in the study area during the experimental periods. The budget preparations included calculation of the:

(i) Average yield of maize (t ha^{-1})

(ii) Gross benefit (₦/ha) = (yield of maize x price) + (yield of cover crop x price)

(iii) Total variable cost (₦/ha) for each treatment which comprised of cost of land preparation, planting materials and labour (for planting, weeding, harvesting and processing).

(iv) Net benefit (₦/ha) = Gross benefit – Total variable cost.

(v) Marginal Rate of Return (MRR)

$$= \frac{\text{Extra benefit from weed management}}{\text{Extra investment in the weed management}} \times \frac{100}{1}$$ (CIMMYT, 1998)

(vi) Relative profitability was assessed with :

(a) Net benefit relative to hand-weeded control (C_1) ($NBRC_1$)

$$NBRC_1 = \frac{\text{Net benefit from a given weed management treatment}}{\text{Net benefit from hand-weeded control } (C_1)}$$

(b) Net benefit relative to the unweeded (C_2) ($NBRC_2$)

$$NBRC_2 = \frac{\text{Net benefit from a given weed management treatment}}{\text{Net benefit from the unweeded control } (C_2)}$$

(c) Percentage Net Benefit Gain (%NBG)

$$\%NBG = \frac{\text{Net benefit from a given weed management treatment - Net benefit from unweeded}}{\text{Net benefit from the unweeded control } (C_2)} \times 100$$

RESULTS AND DISCUSSION

The cost of production and gross benefit for using akidi, melon or sweet potato to organically manage weeds in maize production is shown in Table1.The total cost of production was almost the same throughout the experimental period under each organic weed management treatment. Cost of production was higher in S treated plots (₦83,320.00), compared with A (₦56,040.00) and M (₦53,140.00). The total cost of production was highest for the sweet potato treated plot and the least for melon.

Generally, the gross benefit was greatest in 2008, (₦222,491.00) being, 18.1% and 27.5% greater than gross benefits in 2007 and 2009 respectively. Averaged over the 3 years, the gross benefit was in the order S (₦300,970.00) > A (₦187,720.00) > C_1 (₦173,330.00) > M (₦151,330.00) > C_2 ((₦52,830.00).

Table 1: Cost and gross benefits of organic weed management in maize production

Treatments	2007		2008		2009		Average	
	CP (₦' 000)	GB (₦' 000)	CP (₦' 000)	GB (₦' 000)	CP (₦' 000)	GB (₦' 000)	CP (₦' 000)	GB (₦' 000)
Akidi	53.56	153.83	59.09	236.28	55.48	173.03	56.04	187.72
Melon	51.49	123.83	54.36	171.67	53.57	158.50	53.14	151.33
Sweet Potato	81.79	347.98	85.00	320.68	83.16	234.25	83.32	300.97
Hand-weeded	52.86	125.00	57.45	201.50	56.97	193.50	55.76	173.33
Unweeded	41.59	70.50	40.96	60.00	39.04	28.00	40.53	52.83
T mean	59.54	188.40	63.07	222.49	61.15	174.44	61.25	195.11

CP = Cost of Production GB = Gross Benefit

The net profit followed similar order as the gross benefit (Table 2).

Averaged over the 3 years, all the organic weed management plots except M treated plots had net profits that were greater than C_1 (₦117,570.00). A deficit of ₦11,040.00 was incurred in C_2 during the 2009 season. The marginal rate of return indicated that for every ₦1.00 investment in using various cover crop to manage weed in maize ₦2.56, ₦2.32, ₦1.84 were respectively realised from S, A and M on the average. However, not weeding maize resulted in loss of ₦0.28 for every ₦1.00 in vested in 2009.

Table 2: Net benefit and marginal rate of returns of organic weed management in maize production

Treatments	2007		2008		2009		Average	
	NB (₦' 000)	MRR	NB (₦' 000)	MRR	NB (₦' 000)	MRR	NB (₦' 000)	MRR
Akidi	100.28	1.87	177.19	3.00	117.55	2.12	131.67	2.33
Melon	72.34	1.40	117.31	2.16	104.93	1.96	98.19	1.84
Sweet Potato	266.19	3.25	235.68	2.77	151.09	1.82	217.66	2.61
Hand-weeded	72.14	1.36	144.05	2.51	136.53	2.40	117.57	2.09
Unweeded	28.91	0.70	19.04	0.46	-11.04	-0.28	12.30	0.29
T mean	128.86	2.16	159.42	2.53	113.29	1.85	133.86	2.18

NB = Net Benefit MRR = Marginal Rate of Returns

Table 3 shows the relative profitability of each organic weed management treatments in comparison with the recommended hand weeding (C_1) practiced by farmers or the unweeded plot (C_2). Using akidi and sweet potato were 1.12 and 1.85 times more profitable than using the farmers' practice of hoe weeding. However, melon treated plot was less profitable when compared with the farmers practice. The A, M and S treated weed management system and C_1 were 10.70, 7.98, 17.70 and 8.56 times more profitable when compared with the unweeded plot respectively. Sweet potato treated plot has the highest percent net gain (1670.0%), followed by akidi (970.0 %) while the least was in melon treated plot (698.0%).

Table3: Relative profitability of organic weed management in maize

Treatments	NB(₦' 000)	$NBRC_1$	$NBRC_2$	%NBG (x100)
Akidi	131.67	1.12	10.70	9.70
Melon	98.19	0.84	7.98	6.98
Sweet potato	217.66	1.85	17.70	16.70
Hand weeded control (3+ 6 WAP)	117.57	1.00	9.56	8.56
Unweeded control	12.3	0.10	1.00	0.00

NB = Net benefit. $NBRC_1$ = Net benefit relative to C_1 $NBRC_2$ = Net benefit relative to C_2 %NBG = Percentage Net Benefit Gain

The generally higher economics value recorded in 2008 could be as a result of higher maize grain yields in all the treatment as a result of the nutrient and fertility enhancement from associated cover crops. According to Jeranyama *et al,* (1998), though intercropped legume is not likely to directly benefit the companion maize crop, but has potential to increase the yield of a subsequent maize crop. This was confirmed in this study. The least cost of production, gross revenue, net benefit, marginal rate of returns and relative profitability recorded in melon treated plot could be attributed to a number of reasons. The cost of melon seeds was the lowest. Though melon plants grew to suppress weeds, but no harvestable yields were obtained throughout the experimental periods when compared with akidi and sweet potato. This is in line with Anuebunwa (1991) who reported that *egusi* melon (*Colocythis citrillus*. L) at 40,000 stands/ha in association with yam in Umudike produced high leaf biomass with no pod formation.

Conversely, sweet potato system had the highest production cost, because the cost of propagules, planting and harvesting were higher as it requires more time and energy which increased labour cost. However, the substantial tuber yields of sweet potato obtained in the S plots resulted in higher gross and net benefit, as well as higher marginal rate of return and relative profitability. This confirms the report of Zuofa and Tariah (1992) working on maize reported that generally, the highest net income was achieved with maize and sweet potato weeded once. The high rainfall which favoured sweet potato growth and production was also to the disadvantage of akidi and melon, causing them to produce little or no harvestable yields. The additional grain yield of akidi also gave such system a better profit than melon. This is in line with Okpara, (2000) who reported that yield advantages were gained by growing maize and vegetable cowpea together in Umudike.

CONCLUSION

From this experiment, organic weed management in maize using akidi or sweet potato is profitable.

REFERENCES

Akinyemi, S.O.S. and Tijani – Eniola (1997). Effect of Melon Population Density intercropped with plantain on weed control and intercrop productivity. *Nigeria journal of Weed Science*. 10:27-34.

Akobundu, I.O. 1987. Weed Science in the Tropics: Principles and Practices. John Wiley and Sons Limited. 522pp.

Anuebunwa F.O. (1991). Weed control in yam/maize/cassava Intercrop for resource limited Farmers. *Nigerian Journal of Weed Science* 4: 63 – 69.

Brewbaker, J.L. 1985. The Tropical environment for maize cultivation. Breeding strategies for maize production improvement in the tropics. A Brandolini and F. Salamini ed). FAO and Inst. Agron. L.'Oltremare, Firenze, Italy. Pp 44-47.

Chikoye D. (2004) Winning the war against speargrass, *Imperata cylindrica:* Problems and opportunities *Nigerian Journal of Weed Science* 17: 91-100

Gianessi L. P. and N. P. Reigner (2007) The Value of Herbicides in U.S. Crop Production. *Weed Tech.* 21(2):559-566.

Jeranyama, P., O.B. Hesterman, and C.C. Sheafer (1998) Medic Planting date effect on dry matter and Nitrogen accumulation when clear - seeded or intercropped with corn. *Agron. J*. 90: 601- 606.

Mennan H., M. Ngouajio, E. Kaya, and Dogan Isık (2009) Weed Management in Organically Grown Kale Using Alternative Cover Cropping Systems *Weed Tech*. 23(1):81-88. 2009

Michael G. C. and H. Tijani-Eniola (2009) Assessment of status, perception of weed infestation and weed control methods adopted by farmers in Taraba State, Nigeria. *Nigerian Journal of Weed Science* 22: 31-42.

Okpara, D.A. (2000). Growth and yield of maize and vegetable cowpea as influenced by intercropping and nitrogen fertiliser in the lowland humid tropics. *Journal Sustainable Agricultural Environment* 2(2): 188 – 194

Wesley, R.A., L. A. Smith and S. R. Supurlock (1993). Economic analysis of irrigation and deep tillage in soybean production systems on clay soil. *Soil and Tillage Research* 28: 63-78.

Zuofa K. and Tariah N.M. (1992). Effects of weed control methods on maize and inter crop yields and net income of small holder farmers, Nigeria. *Tropical agriculture* 69(2): 167 – 170.