Effects of Weeds on the Profitability of Millet (*Pennisetum glaucum*) and Groundnut (*Arachis hypogaea*) Crops in Mixed Cropping Systems

[1]A.T. Yahaya, [1]K.M. Baba, [1]U.B. Kyiogwom, [2]A. Singh
[1]Department of Agricultural Economics and Extension,
[2]Department of Crop Science
Usmanu Danfodiyo University, Sokoto, P.M.B. 2346, Nigeria

ABSTRACT: Samples of 80 respondents were randomly selected from 8 villages in Tambawal and Sabon-Birni Local Governments Areas (LGA) of Sokoto State to examine the cost of controlling weeds in arable farms. The data collected through structured questionnaire were analysed using farm budgeting technique. The results showed the cultivation of millet/sorghum/cowpea and groundnut/millet/cowpea mixtures as the most widely used biological measures of controlling weeds. Most of the land was zero tilled and manually weeded. For manual control measure, about 77 man-days/ha and 46 man-days/ha were used for weeding sole millet and sole groundnut equivalent respectively, indicating more labour was needed for weeding millet than groundnut crop. The high cost of weeding groundnut farms despite the low amount of man-days used was attributed to drudge nature of its manual weeding method and market prospect of the crop. Average total cost of weeding millet was ₦11, 057.16/ha and ₦ 17,139.32/ha in groundnut production, representing about 40% of the total cost of production of each crop. Average net-farm income was ₦27, 258.7/ha and ₦ 67,488.5/ha for millet and groundnut production, respectively. When the cost of weeding was excluded, a net- loss of ₦10,822.14/ha and ₦19,565.72/ha were recorded for millet and groundnut production, respectively. This shows that the cost of weeding increased production cost by 40%, while unchecked weeds depressed farm profit by about 500% and 400% in millet and groundnut production, respectively. Therefore, there is a need to reduce the cost of weeding through government support services so that the profit of farmers can be increased. This will make farmers enjoy the fruit of their labour better.
Keywords: Weeds, Profitability, Millet, Groundnut, Mixed Cropping,

INTRODUCTION

A weed is a plant that grows where it is considered undesirable (Adu, 2005). Therefore, any plant can be a weed as long as it exists where it is not wanted. Weeds are of economic importance because of their ability to reduce yield through competition, interference with harvest and through harbouring pest and diseases.

Uncontrolled weeds have been reported to course yield reduction by34-55% in maize, 28 – 100% in rice, 40 – 67% in grain legumes, 52% in oil fibre crops (sun flower) and 65 - 91% in root and tuber crops (Akobundu, 1987). An estimate of total annual crop loss due to *Striga spp.* alone in Africa was found to be 7 billion US dollars (Adu, 2005). The loss may even reach 100% in heavily infested fields, causing farmers to abandon their fields (Lagoke, 1999). In economic sense, this effect outweighed any possible benefit associated with weeds.

Weeds survive over generations in association with crop and compete not only for water and nutrients but also reduce farmers' disposable income, since part of their farm expenses must be spent on weed control measures to ensure profit. In modern farming, the weeds may be controlled chemically by use of herbicides. Although, these herbicides are labour saving innovations, they are hardly used in traditional farming. Traditionally, the labour requirement for weed control is supplied by the family or it is hired. However, the amount of labour supplied by the family depends on the size and the composition of the family. The greater size of the family, the more land is fragmented among heirs. This discourages mechanization. Thus, generating a large family for the purpose of using family labour for crop production does not make much economic sense. Similarly, hired labour is often not only available at the time of peak-labour demand but also makes production cost high. If labour is cheap and available then, it is possible for a farmer to cultivate a large area using a family or hired labour. In recent time, labour has become scarce and expensive. This has restricted the farmer to little area that he alone can weed

(Egunjobi, 2005). Thus, weed control has set a limit to the size of land a farmer can cultivate.

In Nigeria, most of food and cash crops are produced by peasant farmers who largely depend on hand weeding to keep their farms free from weeds. The method is very drudgery and labour intensive. For instance, Ikuenobe *et al*. (2005) showed that weed control requires the highest man-hour in food crop production than all other operations. Therefore, the current methods of weed control adopted by peasants are unsustainable and can lead to food insecurity (Egunjobi, 2005). Hence, it must be made easier in traditional agriculture for increasing farmers' productivity. This will in turn increase farm profits.

In view of the problems associated with weeds, large amount of literature on the effects of weeds on crops exist in the study area. However, the information have hardly any impact on labour resource management for weed control. This is because many studies have only shown over utilization of labour resource in major key operations (Ogunfowora *et al*. 1976, Osuntogun, 1980 and Alimi, 2000), but failed to give numerical decrease in farm revenue resulting from unchecked weeds in crop production. Hence, this study provides base line information on how the cost of weeding affects profitability of millet and groundnut crop production with a view to suggesting ways of avoiding high cost of production. Hence the objectives of the study were to determine:

a) The methods of weed control in mixed crop farms,
b) The amount and cost of manual labour used in millet and groundnut weeding,
c) The level of profit with and without considering the cost of weeding.

MATERIALS AND METHODS

The survey was conducted during 2003/2004 cropping season in two (2) Local Government Areas (LGAs) of Sokoto State namely; Sabon-Birni and Tambawal LGA. Four villages and 10 respondents were randomly selected from an established list of all the villages in each LGA and the list of households in each village, respectively. This gave a total sample size of 80 respondents. The data generated by the use of questionnaires were administered fortnightly by well trained enumerators during the production period. Since weed control in the area was mainly manual, labour use was given prime consideration. The time devoted to farm operations by both family and hired labour was measured using prayer time. Since work performance of individuals varies with sex, age and physical strength, the weight suggested by Upton (1996); 1 for adult male, 0.67 for adult female and 0.33 for children were used to aggregate different categories of labour into man equivalent. Family labour was also valued since farmers must pay for it if not supplied (Baba, 1989). Since the crops were mainly grown in mixture, proportions based on the cropping patterns were used to arrive at the cost of each operation per respondent.

The cost of fixed assets used was valued by using straight line method of depreciation. Since the assets were used for crops grown in mixture, the depreciated value of each asset was shared between the crops in each combination based on proportion of the area occupied by each crop.

Revenue generated without considering the cost of weeding was determined on the assumption that 87% reduction in yield has been recorded when the plots were not weeded. Available evidence showed that yield losses due to unchecked weeds in Nigeria is between 10-87% in most crops (Onazi, 1983). Whereas, average net farm income, was determined by using farm budgeting technique. The model is of the form;

NFI= GI- (VC+FC)
Where:
NFI = Net Farm Income
GI = Gross Income (₦),
VC = Variable Costs (₦),
FC = Fixed Costs (₦)

RESULTS AND DISCUSSION

Types of Weeds Identified in the Area

It appeared from the Table 1 that the weeds found in millet and groundnut farms were grasses that are perennial in nature. The respondents said the most devastating weed in millet production in the area is *Striga hermonthica*, perhaps this could be due to its ability to attach its self to the root of host and extract nutrients for its own growth (Renard and Kumar, 2001). The respondents further

elaborated that in severe cases of infestation, no millet heads are produced. The result corroborates the finding of Kolo and Adamu (2006) who also considered *Striga hermonthica*, as the most important biological constraint to production of many cereals in West Africa. In Nigeria, Gressel *et al*. (2004) reported that approximately 9 million hectares are infested with this weed.

Table 1: Major Types of Weeds in Millet and Groundnut Farms

Millet Farms	Groundnut Farms
Striga hermonthica	*Eleusine indica*
Cyperus rotundus	*Rottboellia spp*
Cynedon dactylon	*Euphoibia spp*
Andropogan spp	*Digitaria sp*
Digitaria spp	

Source: Field survey, 2003/2004.

In groundnut production, the most damaging effects of weeds reported by the respondents occur during the first weeks after emergence. They emphasized on the danger associated with weed control when the crop started flowering since any interference at that stage reduces yield thorough damage caused to vegetative parts. This supports the contention that any extra weeding of groundnut after flowering leads to decrease in yield (Onwueme and Sinha, 1991).

Methods of Weeds Control

The characteristic features of weeds enable them to survive in competition with planted crops. This necessitates farmers to take physical, chemical and biological measures with view to freeing the land and the crops of them.

Physical method is perhaps, the oldest method of weed control because it has been in use since ancient time. The method involves the use of hand hoe and hand picking. Cutlasses and matches are also used to clear the land at the time of land preparation. Physical measures used by the respondents in millet and groundnut farms are presented in Table 2.

Table 2: Distribution of respondents according to physical methods of weed control used in the study area by crop enterprises

Control methods	Millet farms		Groundnut farms	
Land cultivation:	Frequency	Percentage	Frequency	Percentage
Zero tillage	68	85.00	51	63.75
Animal traction	27	33.75	64	80.00
Tractor power			2	2.50
Fire	75	93.75	77	96.25
Total	80	100.00	80	100.00

Source: Field survey, 2003/2004.

The Table 2 indicates that 85% of the respondents used zero tillage for millet, while 80% of the respondents cultivated groundnut using animal traction technology. Only few respondents used tractor power in groundnut production and none in millet production. This shows that the use of machine in land cultivation is rare, possibly because of the cost of hiring and small sizes of farm holding. Although IFAD (1992) acknowledges the importance of soil cultivation in weed control, root and moisture penetration in Sokoto State, it however showed that any delay in planting in order to cultivate land often results in decline in yield. According to its finding, yield losses were found to be closely correlated with relative delay in planting resulting from the three (3) systems, which outweigh any benefit from cultivation. This might explained why most of the millet farms were zero tilled and groundnut farms were cultivated using animal power at first stage and subsequent operations by using manual labour.

Hand-hoes and other hand farm implements were mainly used for manual weeding and land clearing for both crops. Use of fire to destroy residue and other vegetative plants that were removed during land clearing was also widely practiced.

Despite the Importance of herbicides in modern farming system, the study revealed that no one used these chemicals for both crops. This could partly be due to lack of awareness of the existence of herbicides and how to apply them or due to rekindled interest of farmers in organic farming. The low level of income of

farmers coupled with their low literacy level will make the use of herbicides more difficult even if farmers are aware with the existence of these herbicides (Engunjubi, 2005). However, it was observed that the respondents used crop mixtures as a means of increasing crop productivity. This practice can be regarded as biological measure because the plant population density is manipulated with the aim of achieving favourable crop competition with weeds (Onwueme and Sinha, 1996). In this context, crop combinations used by the respondents with a view to giving the composition of crops planted in millet and groundnut farms are given in Table 3.

Crop Mixture Used in Millet and Groundnut Production

The results in Table 3 indicate three types of mixture each in millet and groundnut farms. Millet/sorghum/cowpea mixture was the most popular in millet based farms. While, groundnut/millet/cowpea was the most widely used mixture in groundnut based. Sole millet and groundnut were not common. S.A.D.P. (2003) reported only 9.6% and 8.4% of the total plots cultivated by farmers in the State were devoted to sole millet and groundnut, respectively. This could be due to the argument that mixed cropping lead to economy of labour use. In northern Nigeria mixed cropping has been found to yield high return at peak labour demand than sole cropping (Norman, 1969). Cereals-legumes mixtures were also reported to produce greater total yields than each crop grown alone (Onwueme and Sinha, 1996). In such mixtures, there will be complete utilization of soil moisture and nutrients and that, legumes offer no competition to companion crops for soil nitrogen. However, it will be very difficult to any weed scientist to recommend single herbicide that can be tolerant to all crops planted in mixed farms (Engurjobi, 2005). Thus, where mixed cropping is practiced as a biological method of weed control, the adoption of herbicides is impeded.

Table 3: Distribution of respondents according to combination of crops grown

Millet farms			Groundnut farms		
Method	Frequency	%	Method	Frequency	%
Millet/sorghum/cowpea	37	46.25	Groundnut/millets/ Sorghum/cowpea	9	11.25
Millet/cowpea	6	7.50	Groundnut/millets/ cowpea	25	31.25
Millet sole	2	2.50	Groundnut	1	1.25

Source: Field survey, 2003/2004.

Level of Input Used

Analysis of the results gives an average farm size of 6ha per household. Whereas, average area put into millet and groundnut production per household were 2.6ha and 3.2ha, respectively. Average seed input was 24.2 kg/ha and 27 kg/ha for millet and groundnut production, respectively. Most of the respondents used more manure than inorganic fertilizer. Average manure used was 2310.8 kg/ha and 1326.45 kg/ha for millet and groundnut, while average inorganic fertilizer used were 42.48 kg/ha (NPK) and 45.27 kg/ha (SSP), respectively.

Level of Labour Used

In crop production, there are usually seasonal peak periods of labour demand during each operation. Particularly, when most farmers planted at the same time, at each operation, it will be difficult then for farmers to save labour. This compels farmers to use any available family or hired labour. The use of labour was far greater in millet than in groundnut production. The number of labour used decreased after second weeding in both crops (Table 4). The table shows that hand hoe weeding accounted for 76.84 man-days/ha in millet production and 46.10 man-days/ha in groundnut production. This shows the use of more labour in millet farms. Only 8.20 and 5.50 man-days/ha were used at third weeding in millet and groundnut production, respectively. This implies that lower amount of labour was used for weeding as farm operations progressed. More hired labour was used for weeding compared to family labour in both millet and groundnut farms. The shift of

farmers from the use of family labour, which is readily available, to hired labour in weeding corroborates the finding of Alimi (2000) who reports that food crop farmers are not efficient in the use of family labour but are efficient in the use hired labour. He argued that less contribution of family labour is needed to attain optimum level in food crop production. Similarly, Abdu *et al*. (2001) reported the use of more hired labour than family labour in wheat production. The use of more family labour was mainly observed in land preparation. Therefore at the time of weeding, wage rates are high. This increases the cost of production, which consequently reduces farmers' profit.

Level of Output Obtained

When all the farms were weeded, average yield obtained were 1011.39 kg/ha and 429.5 kg/ha for millet and groundnut, respectively. On the assumption that, 87% yield is lost due to unchecked weed (though it could be up to 100% in extreme cases), yield loss per hectare was estimated to be 879.91 kg/ha in millet and 373.67 kg/ha in groundnut production. This means that only 131.48 kg/ha and 55.8 kg/ha will be realized in millet and groundnut production, respectively.

Cost Return Analysis

The cost of weeding consists of fixed and variable costs. Fixed costs consist of depreciation on hoes and cutlasses. While variable cost is made up of cost of manual labour, animal and machines hired during land cultivation. The weeding was carried out manually, and the amount of labour used was either supplied by he family or hired. Average cost of weeding was lower in millet than in groundnut production (Table 5).

The results showed the dominance of variable cost over fixed cost. The level of fixed cost used in both millet and groundnut production was negligible, indicating that less fixed capital investment is needed for weed control in mixed farms. The average total cost of weeding took the highest proportion of the production cost, accounting for about 40% of the average total cost of production in both millet and groundnut production. Both millet and groundnut farms were weeded up to 3 times. First weeding nearly recorded the highest cost, about ₦3000and ₦5000 in millet and groundnut production respectively. The cost of labour used decreased to ₦862.74/ha and ₦ 1669.25/ha at third weeding in millet and groundnut production, respectively. This implies that the wage rate and the number of man-days spent during weeding decreases as the season progresses. The cost of weeding groundnut crop at each stage was generally higher than in millet crop despite the high amount of man-days that were used in millet farms. Perhaps, because the groundnut crop is exclusively produced for market or due to drudge nature of its manual weeding method. This makes production cost high thereby reducing farmer's profit. Table 6 depicts how cost of weeding affects the net farm income of farmers.

Table 6 indicates average net-farm income of about ₦2700/ha and ₦ N6700/ha in millet and groundnut production, respectively. When the cost of weeding is taken in to consideration, groundnut production is more profitable than millet production. But when the cost of weeding was ignored, the net-farm income decreased to net loss of ₦ 10,822/ha and ₦ N19, 565.72/ha in millet and groundnut production, respectively. This means that profit of farmers decreased by about 500% in millet production and 400% in groundnut production (Table 6). This signifies that lack of weeding decreased farm profit more than the cost of weeding. Hence, the contribution of weeding cost to farm revenue is more important than its opportunity cost. However, the production of both crops will be more profitable if the cost weeding is reduced or saved since it cannot be avoided.

Table 5: Cost structure in millet and groundnut production (₦/ha)

Cost item	Millet farms		Groundnut farms	
	Average Cost	% of Total	Average Cost	% of Total
Variable cost of weeding				
Land clearing	-	-	2376.86	-
Manual labour	-	-	-	-
1st weeding	3141.57	-	4789.21	-
2nd weeding	2569.23	-	4889.39	-
3rd weeding	862.74	-	1669.25	-
Animal traction	1448.78	-	1645.39	-
Machine traction	1493.81	-	1493.89	-
Total	10779.15	42.18	168663.99	39.04
Fixed Cost for Weeding				
Depreciation on cutlasses	278.01	1.09	275.33	0.64
Total cost of weeding	11057.16	43.27	17139.32	39.68
Other computed variables costs				
Seeds	657.20	2.57	2828.31	6.55
Planting	1710.63	6.67	2737.13	6.34
Fertilizers	2692.81	10.54	4054.50	9.39
Fertilizers application	863.00	3.38	1734.17	4.01
Manure	2437.16	9.54	2966.54	6.84
Insecticides	933.27	-	253.58	-
Harvesting	2556.63	10.00	8669.34	20.07
Transportation	1287.47	5.04	1321.80	3.06
Total variable cost production	23,917.32	94.68	41429.32	95.88
Other computed fixed costs				
Depreciation on sickle	96.94	0.38	-	-
Depreciation on ropes	243.13	1.00	-	-
Depreciation on planters	-	-	67.62	0.16
Depreciation on sacks	-	-	450.90	1.04
Rent on land	1020.39	4.0	974.97	2.26
Total fixed cost of prod	1638.47	6.47	1768.82	4.10
Total cost of production	25,555.79	100	43, 198.16	100

Source: Field survey, 2003/2004.

Table 6: Average net-farm income with and without the cost of weeding (₦/ha)

Cost	Millet production		Groundnut production	
	Including weeding	Excluding Weeding	Including Weeding	Excluding Weeding
Total variable cost	23917.32	13138.17	41,429.32	24565.33
Total fixed cost	1638.47	1360.46	1,768.82	1493.50
Total cost	25,555.79	14498.63	43,198.14	26058.83
Gross revenue	28,281.80	3676.63	49,947.00	6493.11
Gross margin	4364.48	-9461.54	8,517.68	-18072.22
Net-farm income/Net loss	2726.01	-10822.00	6748.86	-19,565.72
Percentage net-loss		-497%		-390%

Source: Field survey, 2003/2004.

CONCLUSION & RECOMMENDATIONS

Weed control constitutes a major proportion of the total cost of production in arable farms than any other operation. It increases the cost of production by 40% and decreases farmers' net farm income by greater than or equals to400% in arable crop production. However, incurred cost of weeding is more important than its opportunity cost. Therefore there is the need to develop a technology that will reduce the cost weeding through proper use of labour and other labour saving innovations such as biological measures since all the respondents interviewed do not used chemical methods. This calls for the need to educate farmers on organic farming through aggressive extension work. In order to reduce the cost of weeding, the following recommendations were made;

1. Farmers should make all efforts possible to prevent high population of weeds than incurring the cost of weeding. This could be achieved through farm sanitation.
2. The cost of weeding should always be considered against expected losses resulting from weeds before incurring any cost,
3. The amount of labour to be used in weed control should always be determined by the density of weeds,
4. Farmers should be enlightened on how to source and use other biological measures for weed control such as crop rotation and cover cropping.

REFERENCES

Abdu, Z., Bello, H.M. and Kushwaha, S. (2001). Efficiency of rural resource utilization for sustainable irrigated agriculture in Nigeria. *Rural Resources Development and Sustainability*. A Proceeding of the 9th Annual National Conference of the Nigeria Rural Sociological Association held at Usmanu Danfodiyo University, Sokoto, Nigeria. 5th -8th March, 1996.

Adu, I.F. (2005). Food security in Nigeria: The challenge to weed scientists. *Nigeria Journal of Weed Science.* **18:** 73-77.

Alimi, T. (2000). Resource use efficiency in food crop production in Oyo State of Nigeria. *Journal of Agriculture and Environment.* **1(1):** 1-7.

Akobundu, I.O. (1987). *Weed Science in the Tropics Principles and Practices*. John Willey and Sons, Chi chester, 522p.

Baba, K.M. (1989). Economics of Resource use in irrigated Agricultural: A case study of Pump system in Western zone of the Bauchi State Agricultural Development Programme, Nigeria Unpublished M. Sc. thesis Department of Agric., ABU, Zaria. P84.

Egunjobi, J.K. (2005). Effective weed control for enhanced food security. *Nigeria Journal of Weed Science*. **18:** 79-80.

Gressed, J. Hanafi, A., Head, G., Marasas, W., Obilana, A.B., Ochanda, J., Souissi, T. and Tzotzos, G. (2004). Major heretofore intractable biotic constraints to African Food Security that may be amenable to novel biotechnological solutions. *Crop Protection.* **23:** 661-981.

IFAD (International Fund for Agric. Development) (1992).An appraisal report of World Bank on Sokoto State Agric. And CommunityDev. Project. Working Papers 1-7.

Ikuenobe, C.E. Fadoyomi, O., Adeosun, J.O., Gworgwor, N.A., Melifonwu, A.A. and A.O. Ayeni (2005). State of adoption of improved weed control technologies by farmers in three agro-ecological zones of Nigeria. *Nigeria Journal of Weed Science*. **18:** 1-9.

Kolo, M.G.M. and Adamu, S.U. (2006). Rotation of food legume trap crops with maize for *striga hermonthica* (Del) Benth management at Gwagwalada, *Nigeria Journal of Weed Science*.**19:** 49-55.

Lagoke,S.T., Parkinson, O.V. and Agunbiaden, R.M. (1999). Parasitic weed control; in Africa, in: Kim (ed) *Combating striga in Africa* Proc. of an International Workshop Organized by IITA, ICTISAAT IPRC at IITTA Ibadan, Nigeria 22nd -24th August, 1999, p.3-14.

Norman, D.W. (1969). Labour inputs of farmers: A case study of the Zaria province of the North Central State of Nigeria. *Nigeria Journal of Econ. and Social Std.* **2:** 3-14.

Ogunfowora,O., Essang, S.M. and Olayide, S.O. (1976). Resource productivity in traditional agriculture: A case study of Agricultural Division in Kwara State, Nigeria. *Nigeria Journal of Rural Econ. Dev*. **9 (2):** 119-131.

Onazi, O. C. (1983). *Agricultural Science* Macmillan Publishers, P. 88.

Onwueme,I. C. and T. D. Sinha (1991).*Field Crop Production in Tropical Africa*. CTA Wageningen, Netherlands. 480 pp

Osuntogun, A. (1980). A study of resource productivity in cooperative group farming in Imo State in Nigeria. *Canadian Journal Agricultural Economics*. **28(3):** 80-85.

Rennard C. and Kumar, K.A. (2001). Pearl millet *pennisetum galaucum* (L.) R. Br. In: *Crop Production in Tropical Africa*. R. H. Raemaekers (eds) DGIC (Directorate General for International Cooperation) Belgium, p.46.

S.A.D.P. (Sokoto Agric. Dev. Project) (2003). Preliminary Report of the Field Record for Agronomic Details, yields and stands (FRADAYS) Survey, Unpublished, 43pp.

Upton,M. (1996).*The Economics of Tropical Farming System, Great Britain, Cambridge* University Press, London. pp. 55.

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