

Improving profitability of weeding technology in maize and sorghum production in Northern Nigeria

by

J O Olukosi¹ and A O Ogungbile²

¹ Interim Coordinator, West African Farming Systems Research Network

² Head, Farming Systems Research Programme

Institute for Agricultural Research, Ahmadu Bello University, PMB 1044, Zaria, Nigeria

Abstract

Maize and sorghum crops grown on land prepared by hand hoeing or ox cultivation were weeded using a hoe or herbicide. For both crops, ox cultivated plots required less weeding labour and gave higher returns per hectare and per labour-hour than hoe cultivated plots. Labour requirements in the months of June–August (the period of the weeding labour bottleneck) were reduced by 40% in maize and 59% in sorghum as a result of oxen use, and by 36% in maize and 27% in sorghum due to herbicide use. Ox cultivation has been found to be a better alternative to improving profitability of weeding technology than herbicide use.

Introduction

For a long time sorghum has been the most important cereal crop in Nigeria, in terms of cultivated land area and per capita consumption. This is followed by millet which is usually grown in mixture with sorghum in the drier north, while maize is grown together with sorghum in the wetter areas. Maize ranked third behind sorghum and millet as a major cereal crop in Nigeria; however, within the past decade or so, maize cultivation has been increasing in the sorghum areas as a result of the introduction of fertiliser, to which maize responds better than sorghum.

Weeding has been identified as the most limiting operation under the traditional farming systems (Norman, 1972; Olukosi, 1986). Hoe weeding is the most labour consuming of the pre-harvest operations either in maize or sorghum production under improved and traditional technologies (Norman et al, 1976a; b). It is therefore necessary to examine ways of improving weeding technology in the production of both sorghum and maize. Any intervention that will reduce the drudgery of hand-hoe weeding and save labour during the June–August peak labour demand period would be welcomed. However, the reduction in labour use should not be achieved at the expense of profitability.

The objective of this investigation was to determine the requirements and distribution of labour under

different modes of cultivation and weed control technologies in the production of maize and sorghum and to determine the profitability of each option.

Materials and methods

The experiments were conducted on farmers' fields at Nasarawa (11° 40' N, 7° 05' E) where maize or sorghum was the sole crop. The maize variety used was TZB while the sorghum variety was L.187. A total of 60 farmers were involved, 30 for maize and 30 for the sorghum trials. In each group of 30 farmers 15 owned and used ox-drawn implements for ridging and remoulding of ridges, while the remaining 15 used hand hoes. A 0.4 ha plot was marked out on each farmer's field and the plot was further split into two equal halves. One half was weeded by hand hoe while herbicide was applied on the other half.

For maize one sub-plot was treated with Primextra (atrazine and metolachlor in the ratio 1:2) at the rate of 2.0 kg/ha pre-emergence in about 12 litres spray liquid/ha using a controlled droplet low volume sprayer (Micron-Handy). Single superphosphate and calcium ammonium nitrate were applied at 100 kg N and 60 kg P₂O₅/ha to both the herbicide treated and hoe weeded plots two weeks after sowing.

For sorghum, one sub-plot was treated with Sorgoprim (propazine and atrazine mixture) at the rate of 1.8 kg/ha in 12 litres spray liquid/ha. The same Micron-Handy sprayer was used. Single superphosphate and calcium ammonium nitrate were applied at 65 kg N and 45 kg P₂O₅/ha as side dressing to both herbicide treated and hoe weeded sub-plots two weeks after sowing. Sprayers were calibrated by the researchers while the farmers mixed the chemicals and applied them to their fields. Supplementary hoe weeding was carried out on the herbicide treated plots as necessary.

Table 1: Labour requirements by operation for maize and sorghum with and without ox cultivation using hoe and herbicide for weeding (average of the two years 1989 and 1990)

Operation	Maize				Sorghum			
	Hoe cultivation		Ox cultivation		Hoe cultivation		Ox cultivation	
	Hoe weeding (hours/ha)	Herbicide weeding (hours/ha)	Hoe weeding (hours/ha)	Herbicide weeding (hours/ha)	Hoe weeding (hours/ha)	Herbicide weeding (hours/ha)	Hoe weeding (hours/ha)	Herbicide weeding (hours/ha)
Ridging	59	70	15	16	94	90	20	14
Weeding	102	23	72	19	139	61	112	30
Harvesting	145	215	250	240	189	211	84	122

The experiments were farmer managed while an enumerator stationed in the village throughout the growing period recorded the use of labour and other inputs. Information was recorded from each farmer at least once a week for the whole period. The yield estimates were obtained by weighing the total threshed grains from each plot.

The common species of weed found in the village farms were similar to those reported by Ogunbile and Lagoke (1986; 1989). The organic matter and clay contents of the soil were 0.5–1.3 and 7.2–18.5%, respectively.

Results and discussion

Weeding operations

For both sorghum and maize the highest value for weeding labour was recorded when land preparation and weeding were carried out using hoes while the lowest value was obtained when land was prepared using oxen and herbicides were used to control weeds. Ox prepared plots required less weeding labour than hoe prepared ones. As expected, the herbicide treated plots required less weeding labour. The result shows that ox cultivation enhances weed control and reduces weeding labour requirements (Table 1).

Monthly labour distribution

The peak period for weeding labour is from June to August (Norman et al, 1976a; b). The use of oxen for cultivation saved 40% of the total labour required for all operations during this peak for maize and 59% for sorghum under hoe weeding conditions. Herbicide use saved 21% of total labour required during this peak for maize and 56% for sorghum under hoe cultivation; 16% for maize, 22% for sorghum under ox cultivation. This implies that ox cultivation saves more labour at the peak period in sorghum than maize under hoe weeding conditions but this is reversed under herbicide use. Herbicide use, however, saves more labour at the peak period in sorghum than in maize and both hoe and ox cultivation conditions (Table 2).

Financial costs and returns

Tables 3 and 4 show the costs and returns involved in producing one hectare of sorghum and maize, respectively, under the different cultivation and weeding methods. Hired labour constituted between 46 and 58% of the total labour requirement for sorghum production and between 48 and 63% for maize production.

Table 2: Labour requirements for maize and sorghum production during critical monthly weeding periods (average of the two years 1989 and 1990)

	Maize				Sorghum			
	Hoe cultivation		Ox cultivation		Hoe cultivation		Ox cultivation	
	Hoe weeding (hours/ha)	Herbicide weeding (hours/ha)	Hoe weeding (hours/ha)	Herbicide weeding (hours/ha)	Hoe weeding (hours/ha)	Herbicide weeding (hours/ha)	Hoe weeding (hours/ha)	Herbicide weeding (hours/ha)
June	95	115	29	31	13	65	30	47
July	106	20	89	37	162	62	83	42
August	23	42	16	45	161	20	25	18
Total	224	177	134	113	336	147	138	107

Table 3: Costs and returns per hectare of sorghum, with and without ox cultivation, using hoe and herbicide for weeding (average of the two years 1989 and 1990)

Item	Hoe cultivation		Ox cultivation	
	Hoe weeding	Herbicide	Hoe weeding	Herbicide
Output kg/ha	1491	1596	1688	1658
Gross value (Naira)	2684	2873	3038	2984
Input costs (Naira)				
Seeds and seed dressing	86	86	86	86
Fertiliser	140	140	140	140
Herbicide	0	600	0	600
Depreciation	150	150	600	600
Labour (hired)	696	751	375	300
Labour (all)	1513	1295	723	613
Total cost (hired labour)	1072	1727	1201	1726
Total cost (all labour)	1889	2271	1549	2039
Returns (Naira)				
Hired labour	1612	1146	1837	1258
All labour	795	602	1489	945
	± 75	± 100	± 260	± 121
Returns per labour-hour				
Total labour	1.3	1.16	5.15	3.86
Family labour	2.4	2.16	10.72	7.56
June–August labour	2.4	4.19	10.80	8.80
Weeding labour	5.7	9.86	13.30	31.53
Yield required to cover cost (kg)	1049	1262	861	1133

Sorghum valued at 1.8 Naira/kg (1 Naira ≈ US\$0.12; US\$1 ≈ 8 Naira)

For both crops, yields were higher ($P < 0.05$) under ox cultivation and hoe weeding than under hoe cultivation and hoe weeding. For maize, the yield was higher ($P < 0.05$) under ox cultivation and herbicide than under hoe cultivation and herbicide.

For both crops, the net returns per hectare were higher ($P < 0.01$) under ox cultivation and hoe weeding than under hoe cultivation and hoe weeding, and higher ($P < 0.05$) under ox cultivation and herbicide than under hoe cultivation and herbicide.

When the labour inputs for the different systems were considered, the trends for both crops were similar. Generally, the systems gave a higher marginal return per hour than the marginal cost of labour. Viewed against the June–August peak period, the ox cultivated plots gave significantly higher returns ($P < 0.01$) than the hoe cultivated ones suggesting that using oxen to prepare land for the two crops is more profitable. Once the land is ox mechanised the superiority of using herbicide over the hand hoe is not very clear, especially as one supplementary hoe weeding was needed to support the herbicide treatment.

Summary and conclusion

The returns per hectare for both crops followed the same trend. Ox cultivation and hand hoe weeding treatment gave higher returns per hectare than ox cultivation and herbicide treatment, while the two are superior to the two hoe cultivation treatments. This shows that oxen technology is a better alternative for increasing profitability of weeding technology than the use of herbicide.

References

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Table 4: Costs and returns per hectare of maize, with and without ox cultivation, using hoe and herbicide for weeding (average of the two years 1989 and 1990)

Item	Hoe cultivation		Ox cultivation	
	Hoe weeding	Herbicide	Hoe weeding	Herbicide
Output kg/ha	2400	2631	2729	2957
Gross value (Naira)	4320	4736	4912	5323
Input costs (Naira)				
Seeds and seed dressing	86	86	86	86
Fertiliser	225	225	225	225
Herbicide	0	750	0	750
Depreciation	150	150	600	600
Labour (hired)	717	539	517	414
Labour (all)	1138	1068	1017	870
Total cost (hired labour only)	1178	1750	1428	2075
Total cost (all labour)	1599	2279	1928	2531
Returns (Naira)				
Hired labour	3142	2986	3484	3248
All labour	2721	2457	2 984	2792
	± 230	± 250	± 270	± 261
Returns per labour-hour				
Total labour	5.98	5.76	7.33	8.02
Family labour	16.20	11.70	14.90	15.30
June–August labour	12.10	13.90	22.30	24.70
Weeding labour	26.68	106.70	41.40	146.90
Yield required to cover cost (kg)	888	1266	1071	1406

Maize valued at 1.8 Naira/kg (1 Naira ≈ US\$0.12; US\$1 ≈ 8 Naira)

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