Animal-powered reduced tillage and weed control methods in Zimbabwe

by

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Abstract

Low cattle numbers and poor cattle condition at the start of the rainy season increase the time taken for land preparation, resulting in delayed maize establishment and hence low yields, particularly for farmers who do not own draft animals. The use of a ripper tine in combination with a herbicide was found to increase maize yields in Mangwende Communal area of Zimbabwe. Although the use of a herbicide was economical, lack of cash to buy the herbicide limited the adoption of this technology. A tine in combination with a cultivator with two weeding regimes—at emergence and at 30 days after emergence; and at 14 and 30 days after emergence—was tried as an alternative to herbicide. The results showed that there was no significant yield difference between using the herbicide or the cultivator at the two weeding regimes.

Introduction

The Farming Systems Research Unit (FSRU) of the Department of Research and Specialist Services in the Zimbabwean Ministry of Agriculture was established in 1984 after an increased interest in research in Communal Area farming systems. It was given the mandate to carry out research in two areas, Mangwende and Chivi, which are representative of high and low rainfall areas, respectively. Mangwende communal area, located about 80 km north-east of Harare, receives an annual average rainfall of 800–1000 mm; annual average rainfall at Chivi, which is 350 km south of Harare, is 300–600 mm.

Draft power problems

According to a survey by FSRU in these areas, low cattle numbers and poor cattle condition at the start of the rainy season result in insufficient draft power (FSRU, 1985). This has contributed to low crop yields, particularly for non-cattle owners. According to Spear (1968), maize yields are reduced by 1–3% per day when planting is delayed until mid-November. In a trial conducted at the Grasslands Research Station in Marondera, the yield of groundnuts was halved by delaying planting from mid-November to mid-December (Shumba, 1985). Work carried out by the Gesellschaft für Agrarprojekte mbH (GFA) in several communal areas of Zimbabwe indicated that cattle owners usually obtained higher maize yields per hectare than non-cattle owners. This was attributed to timely crop establishment and other operations like weeding, and the ability of such farmers to apply manure (GFA, 1987).

The other constraints that were found to affect crop yields were labour bottlenecks during planting and weeding. It was also established from these surveys that some farmers winter-plowed their fields: that is, they plowed soon after harvesting when moisture was still available.

Trials and methods

To capitalise on existing winter-plowing practices, a trial was initiated in which a ripper tine was used directly on winter-plowed land and compared with the conventional method of plowing the land before planting. The use of a herbicide compared with hand weeding was superimposed on this trial. The trial was conducted at eight sites in Mangwende in the first season, 1983/84. (Mangwende was chosen because it has high rainfall which can quickly wash away the residual effects of the herbicide.) The eight sites were divided into three groups according to rainfall patterns (Table 1).

Results

The tine treatment significantly outyielded the conventional tillage treatment in rainfall group 1; the yield increase was not significant

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Table 1: Rainfall distribution in three group trial sites in Mangwende in the 1983/84 season

	Average rainfall (mm)						
Sites	*October*	*November*	*December*	*January*	*February*	*March*	***Total***
Group 1 (3 Sites)	28.3	55.0	126.6	40.0	123.3	100.8	**474.0**
Group 2 (2 Sites)	12.5	47.5	97.5	58.7	178.5	160.0	**554.7**
Group 3 (3 Sites)	18.5	52.5	119.5	109.2	156.2	98.5	**554.4**

Source: FSRU (1985)

in groups 2 and 3. Because the tine was associated with deeper root penetration it was concluded that this enabled the crop to cope better with the dry period in January. Planting for both the tine and conventional plow was carried out on the same day at two sites in group 1, so that the increase in yield could not be attributed to differences in planting date. Herbicide use significantly increased yield at the sites in rainfall groups 2 and 3. At one of the sites in group 1 it failed to work because it was applied in dry conditions.

The results of an economic analysis carried out on the pooled data showed the highest net returns to labour for the treatment involving the ripper tine plus herbicide treatment; use of the ripper tine and hand weeding gave the lowest returns. Based on these results it was considered that it might be appropriate for farmers to adopt the tine and herbicide technology as this would involve less labour and draft power.

Follow up trials and implications

After running the trial for six seasons a survey was carried out at Mangwende in 1990 to see how farmers were taking to the ripper tine and herbicide technology. It was found that farmers were very interested in the tine and did not see any problems in using it. Some farmers noted that they might have problems in using the herbicide. A major problem was lack of cash for buying sprayers and herbicide. Some farmers expressed the wish to have credit to buy sprayers and herbicide.

To overcome the problems associated with herbicide use it was considered that it might be more practical if farmers could use an ox-drawn cultivator in combination with the tine for weed control. This would reduce the labour required for weeding and could enable more farmers to adopt the technology.

In 1990/91, a trial was run to compare the use of a herbicide with an animal-drawn cultivator. Two weeding regimes were employed:

- weeding at emergence and 30 days later
- weeding at both 14 and 30 days after emergence.

The results of this trial are shown in Table 2. There were no significant yield differences between the treatments, suggesting that farmers could use either method, depending on the most limiting factor for them.

Results of economic analyses of the data are shown in Table 3. Use of the tine plus weeding at emergence and 30 days later required less labour than weeding at 14 and 30 days after emergence. This was because there was no need for hand weeding when cultivation was done at emergence. However, an informal discussion with farmers revealed that, although cultivation at emergence required less labour, farmers preferred to cultivate at 14 days after emergence as most of the planting was then

Table 2: Main effects of weed control methods on maize grain yield in Mangwende, 1990/91

	Yield (t/ha)			
Treatment	*Zihute*	*Musami*	*Muchinjike*	*Mean*
Herbicide (Atrazine)	4.40	5.06	3.23	4.23
Cultivator at emergence and 30 days later	5.55	3.80	3.27	4.20
Cultivator at 14 and 30 days after emergence	5.43	4.55	3.63	4.55
Significance (NS = not significant)	NS	NS	NS	
CV%	15.7	12.6	13.7	

Source: FSRU, 1991

Table 3: Economic analysis of the three weeding methods after ripper tine cultivation

Criteria	*Herbicide*	*Ox weeding 0 and 30 days*	*Ox weeding 14 and 30 days*
Yield of maize grain (t/ha)	4.23	4.20	4.55
Variable costs (Z$)			
Cost of 2.5 litres/ha herbicide (Z$)	49	–	–
Labour for applying herbicide (Z$)	2	–	–
Cost of hiring sprayer (Z$)	5	–	–
Cost of ox cultivating (Z$)	–	154	154
Cost of hand weeding after cultivating (Z$)	–	17	34
Total variable costs (Z$)	**56**	**171**	**188**

The prices used to compile the partial budget were as follows: Cost of Atrazine = Z$ 19.65/litre Labour for applying the herbicide = Z$ 5/day; Time for herbicide application = half day/ha Hiring sprayer = Z$ 5/day; Cost of cultivating = Z$ 77/ha; Weeding (after cultivating) = Z$ 16/ha US$1 ≈ Z$5 (1991)

completed and there was less demand for draft power for land preparation to plant other crops.

Another study carried out in the same area showed that the use of a ripper tine for planting greatly reduced the time taken to plant a hectare of maize (Table 4). This allowed a large area of maize to be planted on time, leaving time for planting other crops. With this system, non-cattle owners should find it easier to gain access to draft power at the optimum time.

Conclusion

The trials were run successfully for two seasons and the same results were obtained. The technology should be further investigated, perhaps in fully farmer-managed trials where the farmers are supplied with seed and fertiliser and carry out all the operations themselves.

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