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Performance Evaluation of Draught Animal Power Cultivator

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ABSTRACT

This performance evaluation was conducted to pave the way for making use of Draught Animal Power Cultivator and cosequently possibilities of adaptation in our local condition between 2010 and 2011 in the Jimma zone two districts of southwestern Ethiopia on the farmers' field to evaluate energy requirement. To improve weed management at the small holder farmers level, animal-drawn cultivating equipment is now available, with very little technical information available to the farmer on their performance, commonly used in different countries. Sets of intercultural equipment had been evaluated on farmers' fields to assess energy requirement. The average crop height, plant population and average weed population ranged from 200-450 mm, 1.66 plants/m 60-350 weed/m2- respectively. The average effective field capacity of three-tine cultivator, five-tine cultivator and traditional Plow were 0.05,0.08 and 0.03 (ha/h) respectively. The saving in the cost of operation of three-tine cults, five-tine-cults, and traditional Plow were 78.64, 47.48 and 133.00 (Birr/ha) respectively. In labor requirement, saving were 19.66, 11.87 and 33.25 (man-h/ha) respectively. The three-tine cultivator had been preferred by farmers because of its light weight over the five-tine cultivator. Therefore, it had been recommended for popularization in any row planted crops as it gave better field capacity (0.05 ha/h) and higher saving in the cost of operation (78.64 Birr/ha) over the traditional Plow.

Key words: Cultivator, Weed controlling, Traditional Plow

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INTRODUCTION

The greatest demands for mechanical energy in smallholder farmers crop production operations are for land preparation and weed control, either, or both of these can limit the output of a smallholder farmers. For land preparation, the limit is due primarily to the intensity of the energy demand, whilst for weed control; the duration of demand is likely to be more restricted. The maximum rate of working (i.e.) a power developed) that may be expected of a smallholder would be applied rather inefficiently through the use of a simple hand tools, typically hoes of various designs; although cultivating had been associated with a lower power demand than land preparation, the time available may be inadequate to complete the task. This contributes to the drudgery of long hours of cultivating, a burden borne mainly by women who must accommodate cultivating within their schedule of domestic tasks.

Poor weed control on Ethiopian farms can reduce yield by 30% (MOA, 2005) or more the use of animal-drawn implements can reduce labor demand in cultivating considerably. In our country, the weed problem is acutest in the rainy season during June to August. Sometimes cultivating is incomplete or delayed. It is estimated that millions of tons of food grains are lost annually due to weed lowering yield. Weeding by manual methods requires extra labor force for a farmer. This resulted in a loss of time gives a low field capacity to these traditional implements.

To improve weed management, animal-drawn cultivating equipment such as three and five-tine cultivator are now available, with limited technical information available to farmers and extension agents in their performance. To popularize improved animal-drawn cultivating tools, the above-mentioned tools had been evaluated for feasibility in farmers' fields. The implements had been evaluated on the basis of the quality of work and comparative evaluation with the traditional animal-drawn plow.

OBJECTIVES

General objective

To pave the way for making use of Draught Animal Power Cultivator and cnsequently possibilities of adaptation in our local condition.

Specific objective

To increase agricultural productivity of smallholder farmers at the individual farm household level by providing access to a simple farm implement.

To save farming labor by minimizing tedious cultivating by hand.

MATERIAL AND METHODS

Two sets of each implement a three-tine cultivator, and five-tine cultivator had been evaluated on farmers' fields (Table I). Farmers in the villages of Waktola and Kitinbile districts of Nada and Karsa respectively participated in an evaluation in the Jimma zone during the 2010/2011 cropping season. Pairs of bullocks were used to provide animal power. The climate at each site is characterized by a rainy season from April to June when moderate of the rainfall. The intercultural equipments had been evaluated on maize crop sown in rows. The cultivating operation was carried out by three and five-tine cultivator.

The trial was laid out in an on fully randomized design; each plot was 50 m wide by 50 m long without replication at each site. The site was uniformly spring plowed using a standard ox-drawn traditional plow.

Maize hybrid BH 660 test crop was planted in 0.7m rows at both sites during the third week of April 2008. cultivating operations were planned to be undertaken after two and six weeks of plant emergence, with supplemental hand weeding within the crop row after each animal drawn cultivating operation.

During each cultivating operation, the speed of operation had been measured by observing the time taken to travel over 50m. The Depth and width of soil disturbance for each cultivator had been recorded (two measurements per plot). Total time spent on each cultivator had been measured, crop records included maize plant population and the number of barren plants to check if there was any serious crop damage during the each operation, hiring charge of a pair of bullocks with labor was Birr 20/day and without labor was Birr 10/day. The weeding efficiency was determined by collecting weed samples before and after the cultivating (Sample size $1m^2$, two repetitions per plot.) Samples had been dried, and weeding efficiency was calculated by the relative difference between total dry matter of weed before (m1) and after (m2) weeding treatment.

Weeding efficiency (%) = (m1-m2/m1) x100

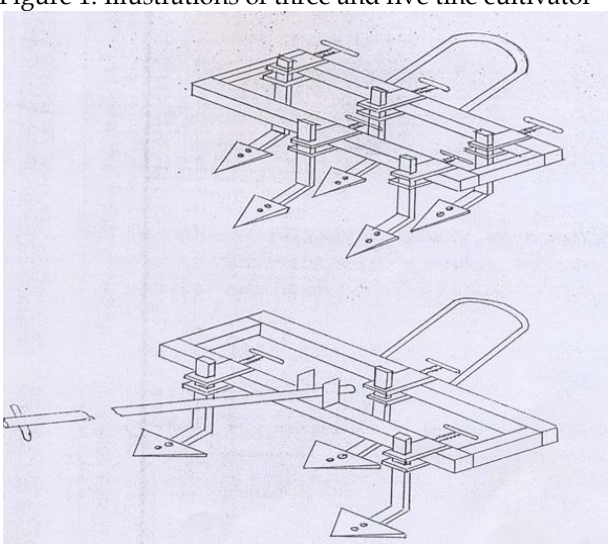
Table I. Brief specification of different intercultural tools and implements

Particulars	Three time cultivator	Five tine cultivator	Traditional plough
Number of Pass in one row	2	1	3
Width of coverage (mm)	2X400	550	3X250
Depth of intercultural (mm)	100	100	250
Filed Capacity (ha/h)	0.05	0.08	0.03
Mass of the equipment	12.5	16.5	-

The following observations were collected /recorded from farmers' fields during intercultural operation.

- Field Observation: location, size and shape of the field, the last crop grown and stubble /weed present in the field area coverage crop type and row-row-spacing.
- Operating conditions: width of coverage, operating depth, speed of travel, time required to complete the operation and labor requirements.

Figure 1: Illustrations of three and five tine cultivator



RESULT AND DISCUSSION

The performance of each implement had been discussed below.

Performance of the three-tine cultivator on farmers' fields:

The three-tine cultivators had been evaluated in Maize crop in intercultural operation on farmers' fields. The weeding operation was carried out at the crop age 25 days and 45 days after sowing (Table II). The mean crop height, plant population, average weed population, weeding efficiency, depth and width of working, average speed of operation had been measured. The effective field capacity, plant damage, the cost of operation and labor requirement had been calculated. The results had been given in Table II. Three-tine cultivators were given to the farmers for evaluation in maize crop in intercultural operation at their farms. The weeding operation was carried out at an average crop age of 25 and 45 days after sowing. Results for the various measured and calculated parameters had been also given in Table II.

Performance of the five-tine cultivator on farmers' fields:

The five-time cultivators were evaluated in the Maize crop in the intercultural operation of farmers' fields in a similar way to the three tine cultivator and were also tested by the farmers in their crops of maize. The results of trials had been given in Table II.

Table II. Comparative Performance of intercultural tools

No	Particulars	Three tine cultivator	Five tine cultivator	Traditional plow
1	Area covered (ha)	0.5	0.5	0.5
2	Test duration (h)	9.83	5.93	16.62
3	Row-row spacing (mm)	700	700	700
4	Age of the crop (days)	25/45	25/45	25/45
5	Mean plant spacing (mm)	600	600	600
6	Mean plant population (No/row)	83.33	83.33	83.33
7	Mean plant height (mm)	200/450	200/450	200/450
8	Plant damage (%)	-	12	-
9	Mean weed population (No/m^2)			
	- Before cultivation	350	350	350
	- After cultivation	65	60	95
10	Weeding Efficiency (%)	81.43	82.86	72.86
11	Depth of operation (mm)	100	100	250
12	Working width (mm)	400	550	250
13	Mean speed of operation (m/s)	0.4	0.33	0.3
14	Effective field capacity (ha/h)	0.05	0.08	0.03
15	Labor requirement (Man-h/ha)	19.66	11.87	33.25
16	Cost of operation (Birr/ha)	78.64	47.48	133.00
17	Length of the row (m)	50	50	50

CONCLUSION AND RECOMMENDATIONS

The overall performance of the intercultural tools was found satisfactory in weeding operation of maize crops in farmers' fields. The average effective field capacity of five-tine cultivator, three-tine cultivator and traditional plow were 0.08,0.05 and 0.03 ha/h respectively.

The following conclusions had been drawn from the results presented above.

Even though the five-time cultivator gave a better field capacity (0.08 ha/h) and higher saving in the cost of operation and labor requirement over the others many farmers were unwilling to use because of its heavy weight and plant damage, further more very difficult

to control on the soil particularly when the soil moisture content is high. Due to these reasons it has less scope for adoption under maize-based cropping systems.

The three-tine cultivator had been recommended for popularization in any row planted crops as it gave a better field capacity (0.05 ha/h) and higher saving in the cost of operation and labor requirement over the traditional plow.

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