Environment and Ecology 36 (4A) : 1133—1138, October—December 2018
Website: environmentandecology.com ISSN 0970-0420

Development and Evaluation of Different Components of Low Cost Weeding-Cum-Earthing-Up Equipment

Sunny Raina, J. P. Singh, Sushil Sharma, Sanjay Khar

Received 1 June 2018 ; Accepted 4 July 2018 ; Published on 21 July 2018

Abstract Every year in India, an average of 1980 crores of rupees is wasted due to weeds. Our country faces the total loss of 33% of its economy from weeds. The losses are due to some of the following reasons, total loss of 26% from crop diseases, total loss of 20% from insects and worms, total loss of 6% from rats. Shrinking farm lands, acute labor shortage, decreasing income per acre of cultivation, and economic frustration are some of the key factors hurting a farmer's confidence in continuing farming. Weeding control is done by mechanical weeding, thermal weeding, flaming, biological control, chemical control, and by farming pattern. It has always been a problem to successfully and completely remove weeds and other innocuous plants and also earthing-up the crop. Invariably, weeds always grow where they are not wanted. This work involved the design and construction of low cost weeding-cum-earthing-up equipment, which consists of two main units viz. first weeding unit and second soil cutting and earthing-up unit. A serrated blade and two discs were selected for weeding and earthing-up operations respectively.

Keywords Weeding, Earthing-up, Mechanical weeding.

Sunny Raina*
Advanced Center for Rainfed Agriculture, SKUAST-Jammu, India
e-mail: sunny.raina176@rediffmail.com

J. P. Singh
Division of Agricultural Engineering, SKUAST-Jammu, India
e-mail: jai12123@rediffmail.com

Sushil Sharma
Division of Agricultural Engineering, SKUAST-Jammu, India
e-mail: sk_sharma4@yahoo.com

Sanjay Khar
Division of Agricultural Engineering, SKUAST-Jammu, India
e-mail: sanjaykhar2007@gmail.com
*Corresponding author

Introduction

Majority of the Indian population depends on agriculture and agro-based industries and businesses. Lack of mechanization is one of the major problems to improving the productivity of agriculture. One of the major reasons for lack of agricultural productivity is weeds. The competitive abilities of weeds has serious negative effect in crop production and responsible for distinct losses in crop yield. Weed control is often the most important agricultural task facing farmers in developing countries. Weeding and interculture is one of the important management practice which has reasonable effects on crop yield. More than 33% of the cost incurred in cultivation is diverted to weeding operations there by reducing the profit share of farmers (Raut et al. 2013). Reduction in yield due to weed alone was estimated to be 16 to 42% depending on crop and location which involves one third of the cost of cultivation (Rangasamy et al. 1993). Depending upon the weed density, 20 to 30% loss in grain yield is quite usual which might increase up to 80% if

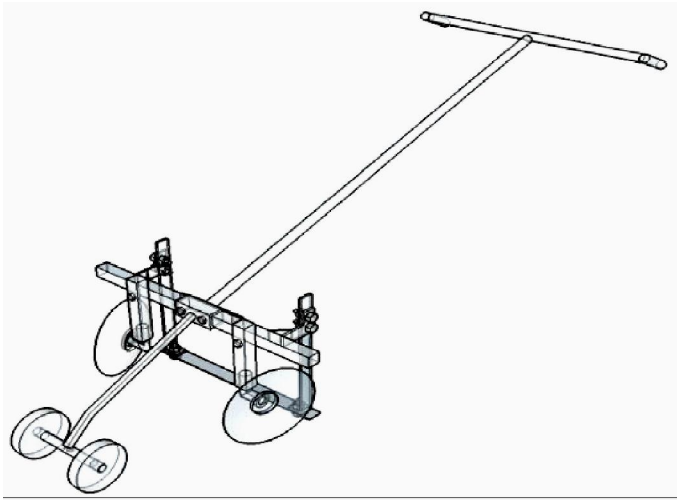

Fig. 1. Conceptual view of proposed prototype of weeding-cum-earthing-up equipment.

adequate crop management practice is not observed. Weeding and hoeing is generally done 15 to 20 days after sowing.

The most common methods of weed control are mechanical, chemical, biological and cultural methods. Out of these four methods, mechanical weeding either by hand tools or weeders are most effective (Alam and Singh 2003). In Indian agriculture, it is a very difficult task to weed out unwanted plants manually as well as using bullock operated equipments which may further lead to damage of main crops. Presently there are many types of weeders available from simple to complex and motorized weeders. Several innovative and cost effective designs were developed and experimented according to the requirements of the farmers and soil conditions. Efforts are still on to reduce the drudgery in weeding operation (Thiyagarajan et al. 2006).

Many farmers are unable to control the weeds effectively in their farms resulting in yield losses. The problem of weed control is very serious especially during *kharif* season. Due to the problem of weeds, cost of cultivation increases considerably and drastically reduces the crop yields. Mechanical methods of weed control are the most common control measures in India and traditional tools are mainly used for the purpose. If improved and efficient designs of manual, animal drawn and engine powered weeders are made available to the farmers, the problem of weed control can be effectively tackled and would result in timeliness of weeding operation, reduced cost of cultivation and higher crop yields. Saving of labor requirement (man-h/day) is achieved with the use of improved long-handle mechanical weeders like wheel hoes, animal drawn weeders (two to three rows) and engine-operated power weeders. Besides, saving of labor requirement and cost of weeding operation, the drudgery of weeding operation is also reduced with the use of improved mechanical weeding implements and machines because their operation is usually in standing posture to that of manual weeding in squatting posture or sitting posture.

Materials and Methods

It deals with the materials and methods employed for design of different components of low cost weeding-cum-earthing-up equipment.

Functional requirements

The weeding-cum-earthing-up equipment was designed to fulfill the following functional requirements : 1. To maximize the weeding efficiency, 2. To earthing-up the crop properly, 3. To minimize the weeding cost.

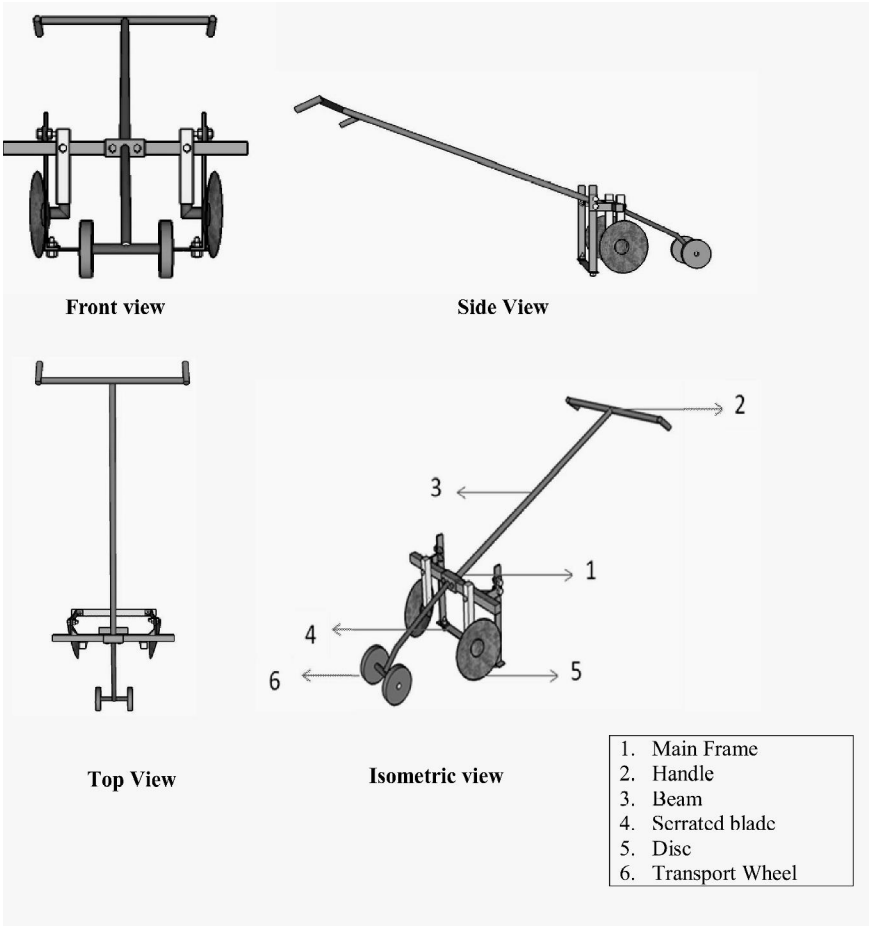

Fig. 2. Different views of weeding-cum-earthing-up equipment.

Design steps

The design of weeding-cum-earthing-up equipment consists of several steps and would require basic information about the following (Fig. 1) : 1. Determination of physical characteristics of soil for mechanized ridging, 2. Agronomic requirements of the crops, 3. Field condition during ridging, 4. Labor requirements for weeding operation, 5. Ease of operation, calibration and maintenance, 6. Safety and operation, calibration and maintenance, 7. Safety and operator's comfort, 8. Expected level of cost of machine and cost of machine operation, 9. Net benefit expected at farmer's level, 10. Fabricate the prototype, according to the design specifications, 11. Determine the performance of the prototype in laboratory and under actual field conditions with respect to row, plant damage, field capacity, field efficiency, 12. Modify the machine, if changes are required to achieve expected level of performance, 13. Development of prototype.

Selection of materials

Selection of proper materials for the manufacture of various components of weeding-cum-earthing-up is very important. Standard, common sizes, sections as well as semi-finished and finished items which are available in local market should be considered when specifying materials.

Table 1 gives the specifications of the materials for different components of a manually operated weed-

Fig. 3. Fabrication of different components.

ing-cum-earthing-up equipment. It is therefore, recommended to use standards for fabrication of machines. Selection of machine components should be made keeping in view that with their effectiveness and efficiency. This consideration applies to the uniformity of weeding and earthing up operations, less damage to standing crops. The cost and quality of work of developed weeding-cum-earthing-up equipment depends on several factors, among which are the costs of materials, the accuracy of the finished parts and the quality of workmanship.

Table 1. Selection of material for manually operated weeding-cum-earthing-up equipment.

Sl. No.	Parts	Material	Size, mm
1.	Frame	Angle Iron	450×50×50×5
2.	Handle	MS flat	450×50×3
	MS pipe	MS pipe	
	(Dia)	i. Diameter	30
		ii. Length	116
3.	Discs	MS sheet	
	(2 no's)	i. Diameter	300×2
4.	Weeding blade	Iron (Cerated)	400
5.	Ground	Rubber	
	wheel	i. Diameter	100

Development of equipment

A weeding-cum-earthing-up equipment was developed and fabricated for weeding as well as earthing-up operation simultaneously. The developed equipment is consisting of two units viz. Weeding unit and earthing-up unit as shown in Figs. 2, 3. Different views viz front view, side view, top view and isometric view of the developed equipment are shown in Fig. 4. The main components of weeding units are : main frame, handle, weeding blade and ground wheel. The earthing-up unit consisted of two no. of discs to cut and invert the soil. Fabrication of different components of weeding-cum-earthing-up equipment. The different components of the developed equipment are described below :

Main frame : The maine frame is made up of MS angle. The length, width, height and thickness of maine frame is 450, 50, 50 and 5 mm respectively.

Handle : A handle is fabricated for smooth operation of developed equipment. The handle was made of MS flat (450 × 50 mm) of 450 mm length and MS pipe (30 mm dia) having thickness 3 mm. A mild steel pipe of 1180 mm length was welded on the upper end at MS flat and lower end at the center of main frame.

Fig. 4. A view of developed equipment.

Weeding blade : A serrated blade is made of cast iron. It serves two purposes, first to minimize the root damage and second provide sliding action so root may not stick to the blade. The width and length of the blade are 40 mm and 400 mm respectively.

Ground wheel : Two ground wheels each of diameter 250 mm and made up of rubber were provided for smooth operation of developed equipment. Each ground wheel was kept at horizontal distance of 400 mm from main frame.

Disc : The disc is considered here as the main component which is used for the earthing-up operation in the crop and diameter of 300 mm was selected which was found suitable for manual operation.

Selection of diameter of soil cutting disc

A field trial was carried out at laboratory condition to overcome the problems of actual field conditions of maize crop to optimize the performance of the developed weeding-cum-earthing-up equipment as shown in Table 2. During the field trial three discs of different diameters viz., 250, 300 and 350 mm with proper spacing to cover the area between the two rows of maize crop and to avoid the plant damage through the implement were optimized. The selected discs were tested at disc angles of 25°, 35° and 45° and keeping tilt angle constant at 22.5° and it was observed that, with the increases in disc angle, depth of weeding increases but draft also increases as shown in Table 2 and the developed equipment was optimized with a disc having diameter of 300 mm, disc angle 35° and tilt angle 22.5°. Similar results were found by (Usman et al. 2004).

Table 2. Selection of different parameters of soil cutting disc.

Sl. No.	Diameter of disc. mm	Disc angle, °	Soil resistance kg/cm^2	Depth, cm	Draft, kg
1.	250	25	0.67	5	11.73
		35	0.67	6	16.08
		45	0.67	6.5	21.78
2.	300	25	0.67	7	23.45
		35	0.67	7.5	30.15
		45	0.67	8	34.84
3.	350	25	0.67	8.5	34.17
		35	0.67	8.5	37.02
		45	0.67	8.5	39.87

Table 3. Evaluation of different weeding mechanism.

Sl. No.	Type of weeding mechanism	Effective cutting width (cm)	Weeding efficiency, %
1.	Sweep blade	38	65.7
2.	Serrated blade	40	90.7
3.	Plane blade	40	78.4

Selection of weeding mechanism

During lab testing of the developed equipment, three different mechanisms were used i.e. Sweep blade type, serrated blade and Plane blade. It was also observed that weeding efficiency of serrated type blade was 12.3% and 25% higher as compared to Plane blade and Sweep blade respectively as shown in (Table 3).

Results and Discussion

1. Using the disc diameter of 300 mm, tilt angle 22.5°, disc angle 35° obtain maximum depth of weeding and was recorded as 1.3 cm, 2. The weeding efficiency of serrated blade was 12.3% and 25% higher as compared to Plane blade and Sweep blade respectively, 3. Less labor needed and it is more economical than hand weeding, 4. Here do not use any fuel and power, Hence maintenance cost is very less, 5. Improvement could be brought in their postures, thereby facilitating them to walk comfortably along the rows while weeding and earthing-up with this manual weeder.

Scope for future work

1. The weight of the weeding-cum-earthing-up equipment can be reduced by using lightweight materials, 2. Since the weeder was designed for low cost, the weeder was made manual but it can be made automatic by placing a motor, 3. The developed equipment can be evaluated in other wide spaced crops and type of soil.

References

Alam A, Singh G (2003) Present status and future needs of farm mechanization and agro-processing in India. Tech Bull 96. Central Institute of Agricultural Engineering, Bhopal, India, pp 48—50.

Rangasamy K, Balasubramanium M, Swaminathan KR (1993) Evaluation of power weeder performance. Agricultural Mechanization in Asia, Africa and Latin America, 24 (4) : 16—18.

Raut VD, Deshmukh BD, Dekate D (2013) Various aspects of weeders for economical cultivation. Int J Modern Engg Res 3 (5) : 3296—3299.

Thiyagarajan TM, Ranganathan CR, Bhaskaran A, Mathan KK, Karivaradaraju TV (2006) Trends in rice area, production and productivity in the different agroclimatic zones of Tamil Nadu. Madras Agric J 87 : 287—290.

Usman AM, Haque MA, Umar B (2004) Design, construction and evaluation of an animal drawn dusc harrow. Arid Zone J Engg, Technol Environ 4 : 37—44.