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Design and development of weeding-cum-earthing-up equipment

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■ **ABSTRACT :** Every year in India, an average of 1980 Cr of rupees is wasted due to weeds. Our country faces the total loss of 33 per cent of its economy from weeds. Shrinking farm lands, acute labour 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. In order to overcome these problems weeding-cum-earthing-up equipment was developed. 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. The weeding efficiency and cutting width of developed equipment was found 90.7 per cent and 35 cm, respectively.

■ **KEY WORDS :** Weeding, Earthing-up, Working width, Weeding efficiency

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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 per cent 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 per cent 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 per cent loss in grain yield is quite usual which might increase upto 80 per cent if adequate crop management practice is not observed. Weeding and hoeing is generally done 15 to 20 days after sowing. The weed should be controlled and eliminated at their early stage. Competition in the early stage of growth and failure to control weeds in the first three weeks after seeding, reduce the yield by 50 per cent (Gunasena and Arceo, 1981).

Saving of labour requirement (man-h/day) can be 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. Typical work rate of hand tool (*Khurpi*), hand chopping hoe, push / pull type or push-pull weeder and animal drawn weeding implement varies between 300-

500, 200-300, 100-125 and 6-20 manh/ha, respectively resulting in saving in cost of weeding approximately from Rs. 4000-5000 per ha (manual weeding) to Rs. 1500-2000 per ha in case of improved mechanical weeders (Singh *et al*., 2000 and Alam and Singh, 2003). Besides, saving of labour 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.

The recent trend toward restricting weedicide/ herbicide due to rising cost and concern over potential health and environmental risk have intensified in search for alternate weed control strategies. (Alexandrou and Coffing, 2001) reported that consumers in the United States are alarmed from reports on the consequences of herbicides/weedicides on health and have supported the idea of organic farming where the use of chemical herbicides are prohibited. Since the size of farm holdings of the J&K farmers is too small to justified the use of big mechanical weeders on their farms. The effective weeding technology can contribute to increase production of small farmers through timely and good quality weeding operation by introducing the improved weeding technology on the farm.

METHODOLOGY

Developed weeding- cum-earthing-up equipment consisting of components, especially the weeding unit, and earthing-up unit.

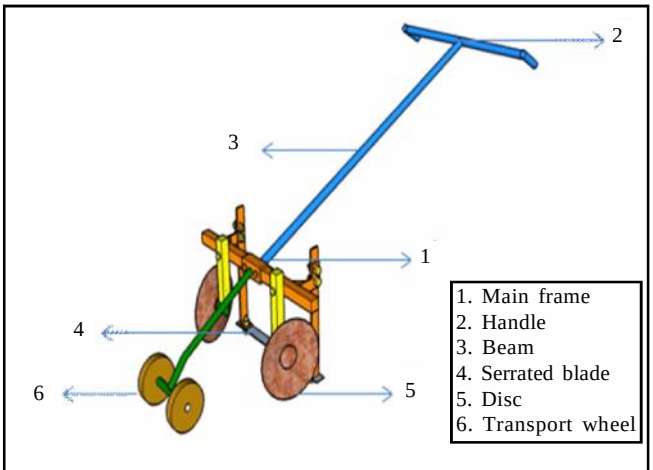

Fig. A : Developed equipment

Design and development of weeding-cum-earthing-up equipment :

The self propelled weeder was designed and developed by considering agronomic and machine parameters. The agronomic parameters likes crop, variety, row spacing and others parameters like weeding interval and physical properties of soil. Crop variety is an important parameter, which influence the mechanical weeding operation.

The soil properties relevant to the design of tool for weeding were identified as soil type, moisture, bulk density. The types of soil influence on the design of weeding tool. A soil resistance varies with type of soil. Moisture content of soil affects the draft required for weeding tool of the weeder and slip of cage wheel. Soil having more moisture content gives more slip. Optimum soil moisture is needed at time of weeding to minimize the field losses and energy input. Bulk density of soil is the measure of a compaction of soil condition which influences draft required for weeding.

Based on crop and weed parameters, it was proposed to develop self propelled weeder for 90 cm row spacing crop. Considering the draft limitations of weeder and ensure good maneuverability. Walk behind type self propelled weeder was designed and developed.

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 of two units *viz.*, Weeding unit and earthing-up unit as shown in (Fig.1).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. 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. Number of holes was drilled at a uniform spacing in the frame to accommodate the different desired spacing adjustment.

Handle :

The handle considered the main component and determines the working position of the operator. The handle was made of MS flat (450 x 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 centre of main frame.

Weeding blade :

Blade was selected and fabricated after comparing with two types of blades *viz.*, Plane blade and sweep 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. It is selected to work in the soil under the interaction of different weeds. Therefore, the serrated type blade was selected and is strong enough to sustain the prevailing forces. The serrated blade can cut the weeds easily.

Selection of disc :

The three numbers of discs of diameter 250,300 and 350 mm made up of MS sheet fitted with a bush in order to rotate the disc along with the movement of the operator and the discs were sharpened at the edges so that it can cut the soil properly and pulverise it. The sharpened discs were then tested preliminary in the field and after evaluation of all the three discs, diameter of 300 mm was selected which was found suitable for manual operation.

Table A : Components of weeding-cum-earthiong-up equipment

Sr. No.	Parts	Material	Size, mm
1.	Frame	Angle Iron	450x50x50x5
2.	Handle	MS flat	450 x 50x3
	MS pipe (Dia.)	MS pipe	
		Diameter	30
		length	116
3.	Discs (2 no's)	MS Sheet	
		Diameter	300x2
4.	Weeding blade	Iron(Cerated)	400
5.	Ground wheel	Rubber	100
		Diameter	

RESULTS AND DISCUSSION

Developed weeding-cum-earthing-up equipment has been evaluated on the following parameters:

Speed:

Speed to cover an area of 9 m^2 by developed equipment with 4 different areas (Table 1).

Table 1 : Speed to cover an area of 9 m^2 by developed equipment with 4 different areas

Area	Time taken (sec)	Speed (Km/hr)
A_1	60	1.20
A_2	67	1.08
A_3	53	1.35
A_4	80	0.90

Weeding efficiency of developed equipment (Table 2).

Table 2 : Weeding efficiency of developed equipment

Area	No. of weeds before weeding	No. of weeds after weeding	Weeding efficiency
A_1	3660	335	90.8
A_2	3825	340	91.1
A_3	3870	385	90.1
A_4	3785	353	90.7

Effective field capacity :

Field capacity of developed equipment to cover an area of 9 m^2 with 4 different areas (Table 3) (Thiyagarajan *et al.*, 2006).

Table 3 : Field capacity of developed equipment to cover an area of 9 m^2 with 4 different areas

Area	Speed (Km/hr)	Effective field capacity (ha/r)
A_1	1.20	0.054
A_2	1.08	0.049
A_3	1.35	0.061
A_4	0.90	0.041

Conclusion :

– The working width of the developed equipment was maximum among the other existing manually operating weeders and was 35cm.

– Less labour needed and it is more economical than hand weeding.

– Here do not use any fuel and power, hence maintenance cost is very less.

– 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.

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