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M Anantachar
Principal Investigator, Farm Machinery Testing Centre, Dept. of FMPE, CAE, UAS Raichur, Karnataka, India

Mareppa NB
Testing Engineer, Farm Machinery Testing Centre, Dept. of FMPE, CAE, UAS Raichur, Karnataka, India

Sushilendra
Assistant Professor, Department. Of FMPE, CAE, UAS Raichur, Karnataka, India

Sunil Shirwal
Assistant Professor, Department. Of FMPE, CAE, UAS Raichur, Karnataka, India

Correspondence
Mareppa NB
Testing Engineer, Farm Machinery Testing Centre, Dept. of FMPE, CAE, UAS Raichur, Karnataka, India

Development, testing and performance evaluation of push type cono weeder for wet land paddy crop

M Anantachar, Mareppa NB, Sushilendra and Sunil Shirwal

Abstract
A push type cono weeder for wet land weeding was designed and developed at the workshop of the Department of Farm Machinery and Power Engineering, University of Agricultural, Sciences, Raichur. The weeder consists of four parts namely float, cono with blades, main frame and handle. The cono weeder was evaluated for its field performance for long duration in paddy (Sona masuri) field. The type of weed observed was Cypruss, Cyndan, Dectylah and Rotendus. The weight of the push type weeder was 6 kg. The weeder was tested at the experimental field to evaluate its functional and economical parameters. The results were indicated that, the field capacity was in the range of 0.016 to 0.019 ha/h with a field efficiency in the range of 59.61 to 60.01 percent. The percent weeding efficiency was observed in the range of 72.16 to 85.5. The average effort required to push the cono weeder was 14.4 kgf. The average percent wear per hour on dimensional basis in the left and right weeding cones were observed in the range of 2.85 to 5.71 and 2.70 to 5.71 respectively.

Keywords: cono weeder, paddy, evaluation

Introduction
Rice (*Oryza sativa* L.) is the staple food for 65% population of India. The demand for rice is expected to rise due to increase in population increase (1.6% year^{-1}) and reduction in area under rice cultivation in next 15-20 years. Hence, there is a need to increase the productivity of (Anas *et al*. 2011) [1]. Paddy crop is the staple food for more than half of the world's population and generally grown under wetland condition. It may be grown in direct seeded or in transplanted condition. The high yielding rice varieties had been growing in transplanted condition since its innovation. Paddy crop is widely accepted cereal for food and 95 percent of world's paddy production by Asian countries only (Farahmandfar *et al*. 2009) [2]. Weeding in paddy is timely operation to be executed to get maximum yield otherwise weed will compete for the nutrients with crop. During early establishment, the weeds make 20-30% of their growth while the crop makes 2-3% of its growth (Moody 1990) [3]. Weeding accounts for about 25% of the total labour requirement of 900-1200 man-hours/hectare during a cultivation season (R. Yadav and S. Pund, 2007) [4]. The most common methods of weed control are mechanical, chemical, biological and cultural methods. Manual weeding is one of the time and energy consuming operation in rice cultivation and also labour cost increasing tremendously from the last decade. Manual weeding can give a clean weeding but it is a slow process (Biswas, 1990) [5]. Hence cost of cultivation is getting increased every day. The chemical weeding is one of the effective method but it leads to various environmental and health issues. Mechanical weeding either by hand tools mechanical weeders are most effective in both dry land and wet land (Gite and Yadav, 1990) [6]. Mechanical weed control not only uproots the weeds between the crop rows but also keeps the soil surface loose, ensuring better soil aeration and water intake capacity. Manual weeding can give a clean weeding but it is a slow process (Biswas, 1990) [5]. Hence there is need of low cost mechanical weeding to minimize the cost operation and execute timely operation to maximize the yield. Mechanical weeding equipment is available in the market, which are either costlier or effectively not suitable for weeding in rice. All these studies revealed that there is no versatile design of weeder. However, it is a region specific technology, the design of which differs from region to region to meet the requirements of soil type, crops grown, cropping pattern and availability of local resources. Therefore, the effort has been made to develop a weeder to meet the demand of farmers in Karnataka (India). Hence the study was undertaken evaluate the commercially available push type cono weeder for its performance in paddy field as per BIS codes relevant Indian standards and procedures at the College of Agricultural Engineering, Raichur.

Materials and Methods

This study was carried out in the experimental paddy field of the farmer's field during the rice-growing season of 2013. Single row conical weeder weeding methods were examined. The transplanted paddy varieties, namely Sona masuri which is local and high-yielding variety, were chosen in the experiment. The paddy field was prepared using conventional tillage practice, which is first plowing once followed puddling and harrowing twice under the flooding conditions by a tractor. To raise mat-type seedlings for transplanting, sprouted paddy seeds were sown uniformly over the plastic trays. The seedlings trays were covered with fine soils, stacked and covered with polyethylene sheet for germination process. After the germination stage was completed, the seedling trays were transferred to main nursery in the field for the greening and hardening stages. The mat seedlings were ready to transplant when they had 2 to 3 leaves and 20 days old with 15 cm height. Transplanting was done in rows at 30 cm fixed intervals. The average row spacing, hill to hill spacing and height of crop were found to be 30cm, 10cm and 38cm respectively. The average plant population of crop in square meter area was 32. The type of weed observed was Cypruss, Cyndan, Dectylah and Rotendus. The average height and population of weed in square meter area were 10 cm and 125cm respectively. Because of short hill spacing, the weeds between them were removed by labors and weeding machines were used in controlling weeds between the rows.

A push type cono weeder for wet land weeding was designed and developed at the workshop of the Department of Farm Machinery and Power Engineering, University of Agricultural, Sciences, Raichur. The weeder consists of four parts namely float, cono with blades, main frame and handle. A manually operated push type cono weeder evaluated to find its performance. The push type cono weeder consists of two weeding cones fixed at right and left side of the main frame. The front end of cono weeder is attached with a float to avoid sinking in the wet soil. The main frame is extended with a T handle with a provision to height adjustment. The schematic diagram of the push type cono weeder is presented in fig.1 and the detailed specification of the cono weeder is depicted in the table 1.

The specifications of the cono weeder were verified as per relevant clauses of IS: 14540-1998 and found satisfactory in construction of the cono weeder.

The cono weeder was evaluated for its performance in the paddy field for the duration of 10.5 hours at Farmers field, Raichur. The soil, crop and weed details are depicted in table 2.

The wear analysis for the two weeding cones was carried out on dimensional basis for the projected blades on the cones.

Table 1: Specification of the cono weeder

Sl. No	Particulars	Observed values
1	Type	Manually operated
2	Size, mm	2140 x 500 x 1070
3	Power sources as recommended	Manually operated
4	Length, mm	2140
5	Width, mm	500
6	Height, mm	1070
7	Working width, mm	140-160
8	Weight, kg	6
9	Number of cones	Two
10	Type of cone	metallic
11	Number of blades in weeding cone	Straight blade = 6 Serrated blade =6
12	Blade thickness, mm	1.6 to 1.8
13	Height of handle from the ground, mm	1070
14	Width of handle, mm	500
15	Float Length, mm	330
16	Float Width, mm	120
17	Float Height, mm	70

Table 2: Crop, Weed and Soil Parameters

Sl. No.	Parameters	Observed Values			
1.		**Test I**	**Test II**	**Test III**	**Test IV**
2.	Type of crop	Paddy	Paddy	Paddy	Paddy
3.	Variety of crop	Sona masuri	Sona masuri	Sona masuri	Sona masuri
4.	Maturity stage, days	28	29	30	30
5.	Average Row spacing of crop, cm	19	21	20	20
6.	Hill to hill spacing of crop, cm	11	8	9	12
7.	Average height of crop, mm	35	38	37	40
8.	Average plant population, no's/m^2	36	28	32	32
9.	Type of weed	Cypruss, Rotendus, Cyndan, Dectylah	Cypruss, Rotendus, Cyndan, Dectylah	Cypruss, Rotendus, Cyndan, Dectylah	Cypruss, Rotendus, Cyndan, Dectylah
10.	Average height of weed, mm	88	92	92	100
11.	Average weed population, no's/ m^2	116	129	125	127
12.	Type of soil	Black soil	Black soil	Black soil	Black soil

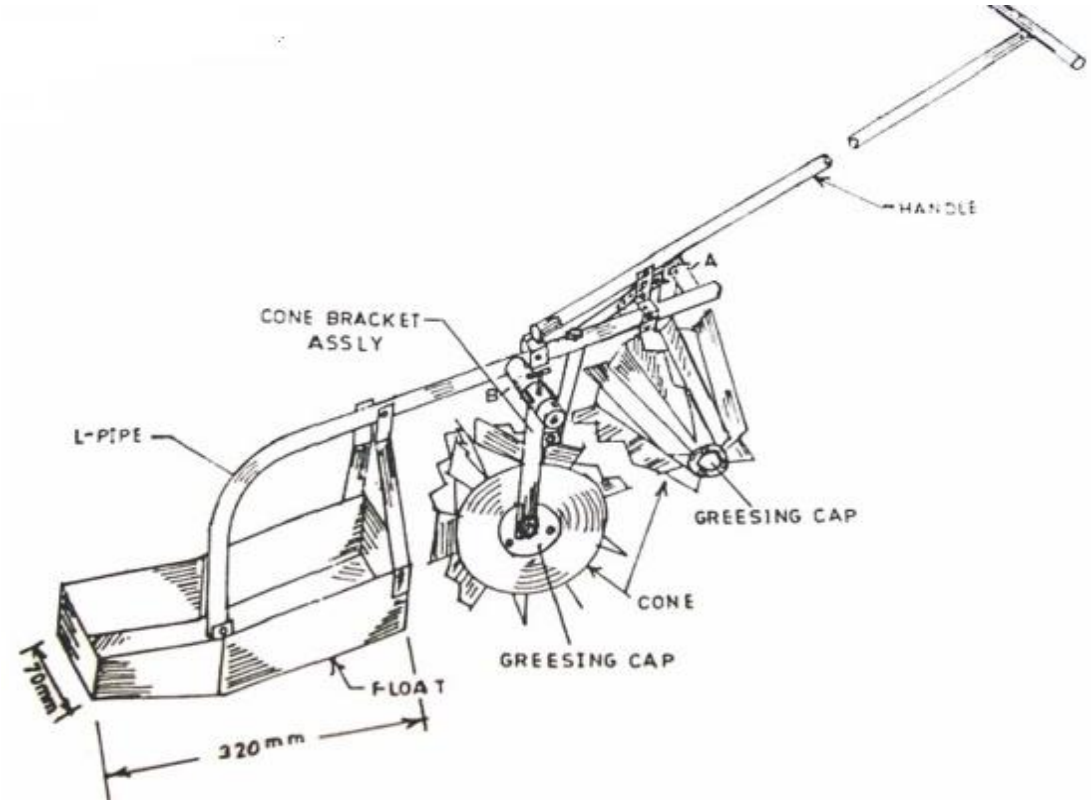

Fig 1: Schematic diagram of push type cono weeder

Results and Discussion

The performance of the push type cono weeder was evaluated in the field of paddy crop. The schematic diagram of the push type cono weeder is presented in fig. 2 and the comparison of [performance of cono weeder with manually method is presented in table. 3. The test was carried out in three series of short run tests. Selection of land was done according to RNAM (1983) test code. The test conditions such as Duration of test, Average travel speed, Average depth of operation, Average working width, Percentage of plant damaged, Area covered, Time required, Field efficiency, Weeding efficiency, Average implement draft and Power Requirement were taken into consideration.

The field performance results are depicted in fig. 3. The results indicated that the average area covered was observed to be 0.16 to 0.019 ha/h and the speed of operation was 1.66 to 1.99 Kmph in the black soil. The required for intercultural operation of one hectare area was recorded as 52.63 to 62.5 h. The average weeding efficiency for the push type cono weeder was recorded as 72.16 to 85.5%. This shows that the weeder is efficient. It was observed that, the weeding efficiency depends on shape of blade, moisture content of the soil at testing plot and cutting depth of the weeder blade. The weeding efficiency by traditional method was found to be 99.0% which is on par with cono weeder. The maximum weeding efficiency with traditional method was observed because of the capability of this hand tools to work between plant to plant spaces in a row. No plant damage was observed in traditional method whereas for cono weeder it was found to be 1.0%. The plant damage with cono weeder was occurred while working between plant to plant spaces.

The draft and power requirement are the important parameters for the development of weeder and they must be within the physical limit of the operator. The draft and power required to operate the cono weeder was measured as 14.4 kgf and 0.08 kW respectively, which is considered normal for one hour continuous operation by one unskilled labour. The power requirement was little bit higher because of higher width of cut. Further, it was concluded that if one want to reduce the power requirement, reduction in effective width of cut is needed which subsequently reduces the field capacity of the cono weeder.

The percent wear of blades of the two weeding cones was measured on dimensional basis and the results are depicted in table 4. The average percent wear per hour in the left and right weeding cones were observed in the range of 2.85 to 5.71 and 2.70 to 5.71 respectively.

Table 3: Field performance Data for weeding operation with manual weeding

Sl. No.	Parameters	Cono Weeder	Manual weeding
1.	Actual total area covered, ha.	0.019	0.050
2.	No. of Labour hours, man hour/ha.	120	245
3.	Type of soil	Black soil	Black
4.	Percentage of plant damaged, %	1.0	Nil
5.	Effective working width, mm	160	Nil
6.	Working depth, mm	32	25
7.	Field efficiency, %	60.71	99.0
8.	Weeding efficiency, %	85	99.0
9.	Average implement draft, kgf	13	Nil
10.	Power Requirement, kW (Ps)	0.08	Nil

Table 4: Wear analysis of the blade of the cono weeder

Sl. No.	Reference point	Percentage of wear			
		Left weeding cone		Right weeding cone	
		Total	Per hour	Total	Per hour
1	Height of the blade on the cone at left end	2.85	0.27	5.71	0.54
2	Height of the blade on the cone at centre	2.85	0.27	2.70	0.25
3	Height of the blade on the cone at right end	5.71	0.54	5.71	0.54

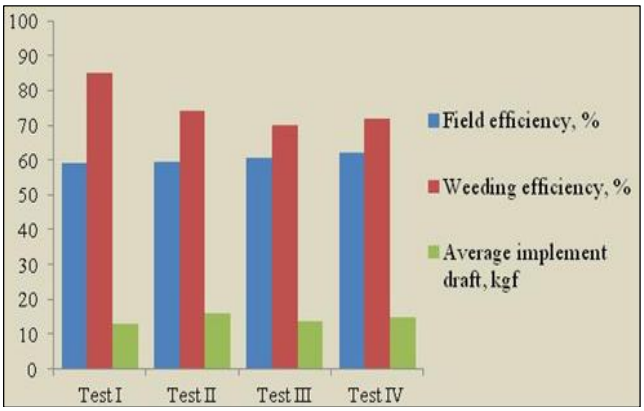

Fig 2: Schematic view field performance test results

Fig 3: Schematic view of weeding operation by push type cono weeder for paddy crop

Conclusions

The following conclusions were drawn from the results of this study:

1. The push type cono weeder can be easily fabricated by farmers themselves with low cost by using inexpensive materials.
2. The highest weeding efficiency and area covered recorded in the range of 72.16 to 85.5% and 0.16 to 0.019 ha/h respectively.
3. The percentage of plants damaged during the operation was recorded as Nil to 1.5 percent.
4. The draft required to operate the push type cono weeder was measured as 14.4 kgf, which is considered to be adequate for one unskilled labour.
5. The average percent wear per hour in the left and right weeding cones were observed in the range of 2.85 to 5.71 and 2.70 to 5.71 respectively.
6. Weeding cost in single row push type cono weeder less as compared to hand weeding method.
7. It can be operated easily by farmers or unskilled labours.
8. It is most economical viable and effective for marginal to medium farm holding farmers.

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