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Performace Evaluaton of Self Propelled Inter-Row Cultivator for Rainfed Crop

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Abstract

Weeding operation is one of the important intercultural operation which control unwanted plants between the rows which consume more fertilizers and reduce the crop yield. Controlling weed is one of the serious, problems faced by the farmers. Day by day bullock power is reducing due to it's maintenance and tractor are not suitable due to tire size and soil compaction occurred in the row crops. To solve, weeding problem, self propelled inter-row cultivator developed at Department of Farm Power and Machinery, Dr. PDKV, Akola and evaluated for its performance at University field and farmer fields. The performance evaluation of self propelled inter-row cultivator was carried out as per standard testing procedure mentioned in test code. The equal depth of cut was observed due to gauge wheel and four bar linkage mechanism irrespective of any soil type and moisture. The actual field capacity was found 0.21 to 0.27 ha/h with 80 to 83 per sent field efficiency. The weeding efficiency was 91 to 97 per sent. The operation cost was found as Rs.225 to 290 per hectare. The overall saving in cost of operation was observed in the range of 25 to 29% over the traditional method.

Keywords: Intra Row Cultivator, Performance Evaluation, Self Propelled.

Introduction

The reduction in the yield due to weed alone is estimated about 30-60 per cent depending upon the crop and location, and one third of the cost of cultivation is being spent for weeding alone Rangasamy *et al.* (1993). Interculture operation needs precision & timely operation. It also needs large scale labour and bullock power. Traditional bullock drawn inter row cultivation is fatigue prone operation. At present, small capacity power weeder are available in market whose field capacity normally 0.07 ha/hr, (Veerangouda *et al.,* 2010) which is greater than bullock operated weeders having field capacity is 0.058 ha/h (Manian *et al.,* 2004). Due to narrow row spacing tractor cannot be used for this purpose. If wide row spacing is suitable for tractor but soil compaction will more in the rainy season. Some crops are of long or some of them short duration grown in region, hence inter row cultivation has a great importance in weed management of these crops. Because of the present equipment available for intercultural operation the inter row cultivation could not be started immediately after germination of crop. The cotton crop is grown with a wide row spacing hence intensive weed control is needed. Similarly, short duration crops like green gram, soybean needs inter culture operations within 30 to 35 days. In initial stage of the crop the available soil moisture is less hence the precision inter row cultivation needed such that it could save the soil moisture by retaining the dry top layer of soil on the top it and should not expose the soil moisture to sunlight. In crop like cotton, more time cover the soil by its canopy. During the precipitation the open soil surface get compacted, which is unfavourable to crop production and hence needs immediate inter row cultivation. Continuous rain fall in later stage of crop, the growth stagnated and looses the crop health ultimately looses the field. Sometimes the continuous heavy rain fall the soils become hard and inter row cultivation becomes difficult and due to lack of aeration crop loos its health.

Keeping the above point in view, the present investigation was undertaken with the objectives to test the self propelled inter -row cultivator for the various crops and to assess the feasibility of self propelled inter row cultivator in terms of adoptability & acceptability by the farmers and workout the cost economics of self propelled inter row cultivator.

Review of Litrature

The Self propelled inter-row cultivator has been a subject of interest for many scientists since the last five decades. The related review of evaluation and cost of cultivator have been reviewed.

Muzumdar (2006) imported Oleo make power weeders and its performance was evaluated at TNAU and found its field capacity was 0.05

ha per day. The unit was evaluated for weeding in cotton crop and compared with long handled weeder and conventional method of weeding with hand hoe. The weeding efficiency of self-propelled power weeder was 73.4 per cent (wet basis). Manual weeding with hand hoe registered the maximum efficiency of 94.8 per cent (wet basis).

Tajuddin (2006) tested engine operated weeder and he concluded that 0.4 kW diesel engine power weeder with rotary blade weeding could be done in the between standing row crops like cotton, tapioca and grape. Whose row to row, spacing more than 450 mm, more area (Ground 1 ha) could be covered in day using only one operator. The weeder had the field capacity 0.1 ha/ hr.

Dixit and Sayed (2008**)** evaluated the field performance of power weeder for rain-fed crop in Kashmir valley. The time input for the power weeder was about 157 h/ha less than tanggroo (local tool). The power weeder achieved the lowest weeding time (10 h/ha), maximum coverage area (0.1 ha/h) over the traditional practice.

Kathirvel *et al.* (2009) studied the economics of three weeders and concluded that the saving in cost with TNAU-Varun, Oleo and Balram power weeders was 21.5, 16.2 and 23.1 per cent, respectively, when compared with manual weeding. The saving in time with the TNAU-Varun, Oleo and Balram power weeders was 59.8, 58.6, and 59.8 per cent, respectively.

Material and Methods

To achieve the typical shape and proper angle to blades a dies were developed for cutting and for providing proper shape to a sheet metal of 4 mm thick sheet for the half & full sweeps. A square section stalks were provided to the half & full sweeps with angle adjustment provision. Suitable mounting frame was developed to mount these stalks of the sweeps with vertical & horizontal adjustment. A four bar linkage mechanism was developed by forming the links from sheet metal and providing the bushes at both ends. A gauge wheel was provided to this four bar linkage mechanism. The fixed link of this mechanism was the fore arm which was provided for individual row and was mounted on the cross frame with the help of special brackets. Two such sets were mounted on the cross frame and adjustable for the any row spacing. This cross frame made from hallow square section was welded to the main frame to mount to the hitch of the self propelled toll bar. On the main frame the arrangement was provided for additional weight if required for balancing the machine in the field.

Testing of Inter Row Cultivator

The inter row cultivator was tested on the University fiend and farmer field in kharif and rabi season in intercultural operation. The arms of the cultivator were set on 60 cm the half sweeps were mounted on the frame from crop row side the full sweep was set in the centre of these half sweeps. The effective width of these sweeps were kept as 48 cm.

RNAM test code and test procedure (1983) followed for field testing. The operating speed of self propelled inter row cultivator was maintained at the rate of to prevent fatigue.

During the test trials various parameters like condition of field, weed parameters and soil parameter etc were recorded. The various measures of the machine like effective field capacity, field efficiency, depth of operation, weeding efficiency and fuel consumption. During test, the time taken to traverse the length of the field was recorded to determine the average speed of operation in the field. The instrument like steel tape, core cutter, cone penetrometer, stop watch etc were used. During the field operation of the machine, all the operational and adjustment difficulties were recorded to assess the handling characteristics.

The operational cost of self propelled inter-row cultivator was determined as per specification of BIS. Operational cost of machine was compared with traditional method.

Result and Discussion

Due to four bar linkage mechanism guided by the gauge wheel mounted on one link of the mechanism. Hence, the set depth was maintained of all the trials. Similarly, orientation of the angle of the sweep depend on the fixed link of the mechanism. Proper setting and orientation of sweep achieved by the seeps when the fixed link was perpendicular to the soil surface. The cut of soil was also nearer to the row without disturbing the row and crop root. The speed of operation was observed 2.80 to 3.5 km/h. which was moderate for maximum efficiency and drudgery free to the operator. The detail result of test carried out in various crops is depicted in Table 2. The self propelled inter-row cultivator in field operation shown in plate 1.

The actual field capacity of was found to be 0.21 to 0.27 ha/hr with field efficiency from 80 to 83%. These findings are close agreement with the result reported by Nkakini *et al*., (2010). Similarly, the weeding efficiency in between the rows was 91 to 97%. This was due setting of sweeps in between the row with row clearance of 5 cm. These findings are close agreement with the result reported by (Kankal U. S., 2011). The weeding was 100% done in the setting of the sweep no any weed was left without removing as it happen in traditional method due to sticking of weed to blades. Inspite of quality work the cost of operation was also less than traditional hoe. The equal depth of cut was observed due to guage wheel and four bar linkage mechanism irrespective of soil type and moisture content. Over traditional method saving in operation cost of cotton was 29 per cent where as in case of other crops was 25 per cent. These findings are in close agreement with the result reported by (Tajuddin 2009 and Veerangouda *et al.,* 2010)

Conclusions

The self propelled intra-row cultivator has been developed at Deptt. of Farm Power and Machinery. The test trials were carried out at the University farm and farmers fields. From study on the field test result conclusions could be drawn

1. Because of the shape and arrangement on four bar linkage mechanism the operation could be start immediately after the germination of seed which is not possible in traditional hoe.
2. Depth of cut set prior to operation in all cases was observed more the set depth. The equal

depth of cut gives complete removal of weed without skipping at blade over weed irrespective of soil moisture, weed intensity and height of weed.

3. The speed of operation was found from 2.85 to 3.6 km/hr which was most suitable for operator and was drudgery free operation.
4. The actual field capacity was found 0.21 to 0.27 ha/hr with 80 to 83% field efficiency.
5. The weeding efficiency was 91 to 97%.
6. The operation cost of developed cultivator was found as Rs.225 to 290 per hectare. Saving in operation cost of cotton was 29 per cent where as in case of other crops was 25 per cent

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Table 1
Interculture Operation in Various Crop by Self Propelled Inter-Row Cultivator

S. N.	Name of crop	No. of Operation at Different Crop Stages	University field area (ha)	Field test	Farmers field area (ha)	Name of the farmers and village
1	Cotton	4	2	Cotton project CRS	2	Mr. Sharad Patil, Gorwha, Akola
2	Soybean	2	3	Malkapur Block CRS	2	Mr. Arun Pagrut, Ghusar Akola
3	Greengram	2	1.3	Malkapur block, CRS	2	Mr. Ramkrishna Gawande, Kumbhari Akola
4	Black gram	2	2	Malkapur block CRS	2	Mr. Arun Pagrut, Ghusa Akola
5	Sorghum	2	4	Babulgaon block CRS	2	Mr. V. P. Thokad, Washimba, Akola
6	Seasamum	2	1	Babulgaon block CRS	2	Mr. Arun Pagrut, Ghusal Akola
7	Sunflower	2	2	Babulgaon block CRS	3.5	Mr. S. G. Kambe, Kamalni, Akola
8	Groundnut	3	1.8	Babulgaon block CRS	NA	NA

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Table 2
Test Results of Self Propelled Inter Row Cultivator in Various Crops

S. N.	Parameters	Cotton	Green Gram	Black Gram	Soybean	Groundnut	Sorghum	Seasamum	Sunflower
1	Area ha	4	3.3	4	5	1.8	6	3	5.5
1	M.C. of soil db %	20	22	23	19	20	25	20	25
2	Crop & Variety	PKVhy^2, bt	Kopargaon	T9	TAMS 38	TAG 24	CSH 9	N-8; AKT 64	Modern
3	Row spacing, cm	60	45	45	45	45	45	45	45
4	Plant spacing, mm	45	10	10	10	15	10	10	10
5	Age of crop, days	i. 7 ii 25 iii 45 iv 60	i 8 ii 27	i 10 ii 30	i 6 ii 30	i 10 ii 28 iii 45 (earthing up)	i 12 ii 30	i 15 ii 36	i 12 ii 27
6	Plant height, cm	i. 10 ii 22 iii 35 iv 50	i 5 ii 30	i 7 ii 35	i 6 ii 32	i 5 ii 15 iii 25	i 8 ii 60	i 5 ii 40	i 15 ii 40
7	Effective width of coverage, cm	120	90	90	90	90	90	90	90
8	Speed of operation, km/h	2.8	3.5	3.3	3.0	2.9	3.4	3.2	2.8
9	Field capacity, ha/h	0.27	0.26	0.24	0.22	0.21	0.25	0.236	0.21
10	Field efficiency,%	80	82.5	80	83	80.5	81.7	81.9	83
11	Fuel consumption, l/h	0.19	0.75	0.8	0.8	0.8	0.75	0.8	0.75
12	Weed intensity before operation, g/m^2	98	120	123	120	115	118	101	119
13	Weed intensity after operation, g/m^2	3	6	7	6	6	5	7	5
14	Weeding efficiency %	97	93	91	93	93	94	93	94
15	Percent plant damage %	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
16	Labour man-h/ha	3.7	4	4	4.5	4.7	4	4.5	4.7
17	Cost of operation, Rs/ha	247	225	254	268	290	230	255	277
18	Crop yield, kg/ha	1600	1000	950	1300	1050	2800	800	1200

Plate1: Self Propelled Inter Row Cultivator in Operation