Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(3): 974-978
Received: 21-03-2020
Accepted: 24-04-2020

Samir Ranjan Biswal
Gandhi Institute for Technology, Odisha, India

Shubham Kumar Sarangi
Centurion University of Technology and Management, Odisha, India

Dr. PL Pradhan
Professor, Department of FMP, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha, India

Corresponding Author:
Samir Ranjan Biswal
Gandhi Institute for Technology, Odisha, India

Performance analysis of tractor operated multi row rotary Weeder and its comparison with manual weeding

Samir Ranjan Biswal, Shubham Kumar Sarangi and Dr. PL Pradhan

DOI: https://doi.org/10.22271/phyto.2020.v9.i3p.11420

Abstract
Excess harmful weeds are devastating problem in most of the part of India. If it is not controlled in the beginning, it will reduce the final yield as well as deteriorate in quality of the product. For this problem weeding through manual process is generally adopted. Weeding through rotary weeder is also practised now days for easy removal of weeds. In the present study a tractor operated multi row rotary weeder was considered for studying its performance on sugar cane field. The relation of row spacing with different components such as field efficiency, speed of operation, weeding efficiency and cost of operation was also studied.

Keywords: Weeds, yield, row spacing, field efficiency, multi row weeder

Introduction
Weeding operation in sugarcane crop in Odisha is mostly performed manually with hand tools. The manual method is not popular due to high labour cost and non-availability of human labour during the growing season. However in coastal Odisha, flood and cyclone during *kharif* season in recent years have compelled the farmers to take up *rabi* season as a major crop growing season of sugarcane. Therefore the scarcity of labour is felt during January and February due to harvesting, threshing and transplanting of paddy. The cost of weeding in sugarcane crop by manual method, even though very effective, has gone up to Rs. 5000/- per hectare. Therefore, multi-row tractor operated rotary weeder is proposed to be introduced in Odisha to find the adaptability of this machine among sugarcane and cotton farmers. The following paper is discussed with the objectives of

a. To evaluate the performance of tractor operated multi row rotary weeder.
b. To compare the performance of tractor operated rotary weeder with manual weeding.

Materials and Methods
The tractor operated multirow weeder was procured for conducting PFT in farmers' field in sugarcane growing areas of coastal districts. The performance of this machine was compared with manual weeding. The observation on speed of operation, fuel consumption, field capacity, weeding efficiency, crop damage, cost of operation were recorded. The economics of weeding in both the methods were studied by calculating the cost of operation per hectare area.

Table 1: Specifications of tractor operated multi-row rotary weeder

S. No.	Parameter	Description
1.	Length x Width x Height (mm)	2380 x 720 x 1225
2.	Number of rotary blade assemblies	Two
3.	Number of rotary units per blade assembly	One
4.	Number of flanges per unit	Two
5.	Number of blades per flange	Four
6.	Theoretical width of cut of each assembly, mm	700
7.	Gap between two units in each assembly, mm	510
8.	Diameter of blades, mm	455
9.	Outer width of cover of each assembly, mm	670
10.	Approximate minimum possible center distance of row crops for weeding, mm	1000
11.	Approximate maximum possible center distance of row crops for weeding, mm	1900
12.	Number of depth wheels	Nil
	Power transmission	
13.	Speed ratio (PTO to rotor shaft)	1:0.4

Crop: Sugarcane of variety SP80-1836, grown with the standard agronomic practices at village Mongooli, Jagatsinghpur during Rabi season was taken for the study.

Study area: Jagatsinghpur district of odisha, India.

Preparation of weeder for field test

Initial Preparations

- Check fasteners
- Lubricate the parts which require lubrication, and
- Operate the weeder for some time to get acquainted with the handling of the weeder under field conditions.

Selection of Test Plot

- **Size of Plot-**For uniformity of working, the minimum size of field may be fixed as 10 * 10 metres.
- **Type of Soil-**The rotary weeder should be tested in crop growing field to eliminate variations in test result due to soil factors. The type of soil should be determined on the basis of mechanical analysis of the test plot.
- **Depth of Standing water-**The depth of water to be allowed at the time of weeding may be 2.5 mm for facilitating the cleaning operation & effective elimination of weed.
- **Weed Population-**It is difficult to control the population of weeds but their average number per square metre may be recorded. One metre square frame may be used for measuring weed population. Counts from 10 random places should be taken and the average number should be determined.
- **Stage of Maturity-**The stage of maturity refers to the growth of the crop. Vigorous growth will hinder the effective use of sugarcane weeder.
- **Row Spacing Crop-**Row to Row & plant to plant spacing should be 1500 mm & 800 mm respectively.

Field Test

- **Effective Width of Weeding-**Measure the effective width of weeder which shall be the effective width of the weeding.
- **Field Efficiency-**Field efficiency is the ratio of effective field capacity to theoretical field capacity expressed as percent.

The Theoretical field capacity in hectares per hour can be calculated from the speed of weeding & width of weeding. It is the rate of field coverage that would be obtained if the weeder was operating continuously without interruptions. The speed of weeding should be obtained by following method:

a. Mark each end of row leaving allowance for starting the operation & measure the length of row.
b. Operate the weeder and make sure it is operating smoothly.
c. Record the time for the weeder to traverse the marked length of row.
d. Calculate the speed of travel in km/h.

Theoretical field Capacity (in ha/h) =Width of weeding(in metre) * Speed (in km/h) 10

The Effective field capacity is the actual average rate of coverage. It includes turning at the end of rows, chocking, making adjustments, etc. It is recorded in hectares / hour.

- **Power Requirement –** The power required to operate the weeder may be roughly measured with the help of average pull or push, the distance covered during each pull or push and the number of to and fro motions per unit time.
- **Weeding Efficiency –** The average number of weeds present per square metre area before weeding should be determined. In the similar manner the number of weeds left out per square metre can be counted after weeding. The difference of the two will give the number of weeds eliminated and the efficiency of weeder can be computed as follows –

Weeding Efficiency (in%) = Number of weeds eliminated per m^2 / Total number of weeds present per m^2*100

- **Cost Economics** – The total cost of the machine was determined based on fixed cost & variable cost of both tractor & multi row weeder.
  Fixed Cost includes –Depreciation, Interest on the capital, Housing, Insurance &Taxes Variable Cost includes - Operating Cost, Fuel Consumption, Lubricant, Repairs & Maintenance, Wages of workers.
- The cost of manual weeding with hand held tools was also calculated on the basis of labour engaged for manual weeding operation.

Results and Discussion

Performance of tractor operated two row rotary weeder for sugarcane crop was evaluated in the farmers' field in Jagatsinghpur district in an area of 8.4 ha.
Farmers` Name – Kartik Sahu & Ashok Sahu Soil types- Clay loam
Crop Variety-SP80-1836
Crop Duration – 60 Days
Tractor Model –John Deere 5045 D (Hp – 45 Hp)

Fig 1: Field Before weeding

Fig 2: Field After weeding

Fig 3: Field testing of tractor operated two row rotary weeder.

Table 2: Field performance multi row rotary weeder

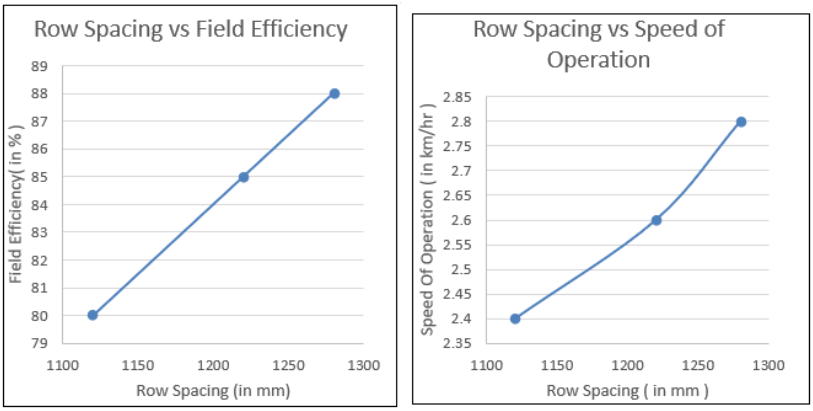
Sl. No.	Particulars	F-1	F-2	F-3	Mean
1	Plot size, m	60x30	60x30	60x30	60x30
2	Row spacing, mm	1220	1120	1280	1206.67
3	Crop height, mm	820	640	794	751.33
4	Working width, m	1.8	1.8	1.8	1.8
5	Speed of operation, km/h	2.6	2.4	2.8	2.6
6	Depth of operation, mm	152	90	112	118
7	Effective field capacity, ha/h	0.29	0.22	0.29	0.27
8	Theoretical field capacity, ha/h	0.34	0.27	0.33	0.31
9	Field efficiency, %	85	80	88	84.33
10	No. of weeds before operation per sq. m	43	36	34	37.67
11	No. of weeds after operation per sq. m	3	4	3	3.33
12	Weeding efficiency, %	92.23	92.09	93.19	92.5
13	Cost of operation, Rs/h Rs/ha	737/- 2541/-	737/- 3350/-	737/- 2541/-	737/- 2810/-

The multi-row rotary weeder could be used in the crops of row spacing between 110 to 190 cm. The width of multi-row rotary weeder is fixed and it cannot be changed according to the crop row spacing. The depth obtained from field tests of multi-row rotary weeder was in the range of 90-150 mm. It was found that, as the speed of operation increases the depth of operation decreases accordingly affecting the draft requirement of a weeder.

The effective field capacity was found in the range of 0.24 to 0.28 ha/h and the mean effective field capacity was 0.27ha/h. The row spacing of crop affects the effective field capacity. The effective field capacity was increased with increase in row spacing and the weeding efficiency decreased accordingly. The field efficiency for different field test of multi-row rotary weeder were in the range of 80 to 88 per cent and average field efficiency was found to be 84 per cent. The field efficiency increased with increase in row spacing. The maximum field efficiency of 88 per cent was obtained at a row spacing of 1280 mm and at a speed of 2.6 km/hr for which weeding efficiency was found to be 93 per cent and the minimum field efficiency 80 per cent was found at a speed of 2.4 km/hr, for which the weeding efficiency was observed 92 per cent.

In all the field tests the weeder was operated for speed of 2.4 to 2.8 km/hr. The average operating speed of the weeder was 2.6 km/h and fuel consumption was 3.8 l/h. The manual weeding requires nearly 144 man-h/ha for weeding operation resulting in very high cost of operation *i.e.* Rs. 4800 per ha. The total man hour requirement was found to be 3.7 for weeding operation by multi-row rotary weeder. Thus the saving in labour requirement is up to 97 per cent as compared to conventional method of weeding.

As far as the cost of operation is concerned the multi-row rotary weeder was always economical than conventional method of weeding. The cost of operation of the multi row weeder was calculated to be Rs.737/- per hour and Rs. 2810/- per hectare. The total man-hour required was only 4.0 man-hour/ha for multi-row rotary weeder and 144 man-hour/ha by conventional method of weeding. The multi-row rotary weeder reduced the human labour considerably which is otherwise the costliest source of power.



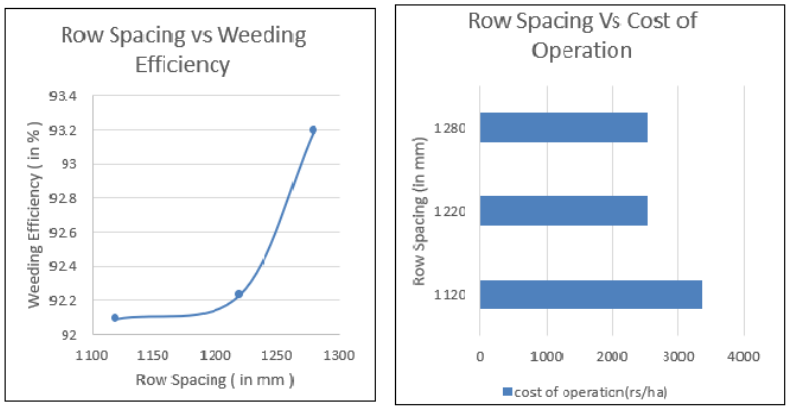


Fig 4: Characteristics curves between Row spacing and Field efficiency, Speed of operation, weeding Efficiency & cost of Operation.

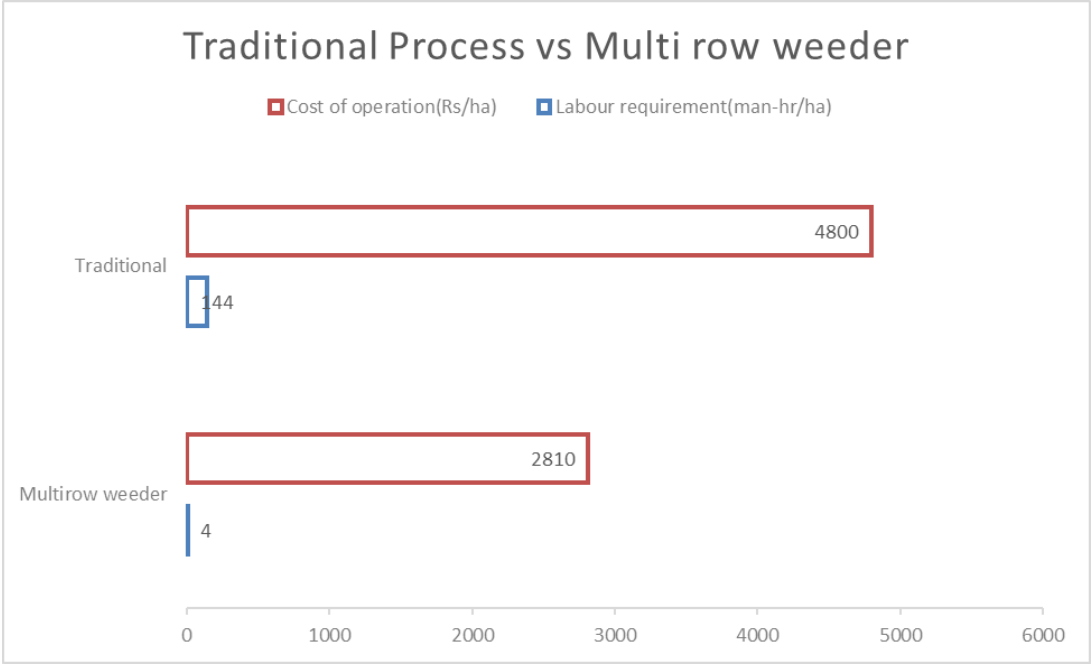


Fig 5: Cost of operation & Labour requirements in Traditional process & multi row weeder

Conclusion

The performance of the multi-row rotary weeder was evaluated in terms of field efficiency, weeding efficiency and cost economics. The field observations were analyzed which give the performance of multi-row rotary weeder. The type of soil was clay loam where the evaluation was conducted. The effective field capacity of multi-row rotary weeder was found to be 0.27 ha/h. The field efficiency and weeding efficiency was found to be 84.33 per cent and 92.5 per cent, respectively. The saving in cost and time were 41 per cent and 97 per cent, respectively as compare to conventional method of weeding. The tractor drawn multi-row rotary weeder relieved the farmer from fatigues work of weeding in sugarcane cultivation.

References

1. Anyawu AC, Anyawu BO, Anyawu AA. Agriculture for school certificate. Africana Education Publication (Nig.) in association with FEP Int. Ltd., 1976.
2. Arish S. A review of non-chemical weed control techniques. Biological Agricultureand Horticulture. 1990; 7:117-137.
3. Biswas HS. Performance evaluation and optimization of straight blades for shallow tillage and weeding in black soils, Agric. Mech. in Asia, Africa & Latin America. 1993; 24(4):19-22.
4. Fashina AB, Anumenechi G. A power operated inter-row weeder for the farmers in developing country. J. Research of Andhra Pradesh Agricultural University. 1991; 19(1):17-21.
5. Fogelberg F, Kritz G. Intra-row weeding with brushes on vertical axes-factors influencing in-row soil height. Soil & Till. Res. 1999; 50(2):149-157.
6. Gupta CP, Viswvanathan R. Power requirement of a rotary tiller in saturated soil. Transactions of ASAE. 1993; 36(4):1009-1012.
7. Hag KA, Islam MS. Performance of hand weeders in Bangladesh. Agric. Mechanization in Asia, Africa & Latin America. 1985; 16(4):47-50.
8. Hemeda MN, Ismail ZE. Developing a cultivator forinter-row cotton cultivation. Misr J Ag. Eng. 1992; 9(4):575-587.
9. Khurmi RS, Gupta JK. Text Book of Machine Design. 25thedition. Chand (S.) Co. Ltd, India. Chapter. 2005; 14:4-7.
10. Njoku PC. The Role of Universities of Agriculturei Appropriate Manpower Development for Weed Management in Agriculture. Nigerian Journal of Weed Science. 1996; 9:65.

11. Olaoye JO, Adekanye TA. Development and Evaluation of a rotary power weeder, Department of Agricultural and Biosysytems Engineering, University of Ilorin, Ilorin.
12. Hegazy RA, Abdelmotaleb IA, Imara ZM, Okasha MH. Development & evaluation of small scale rotary weeder.
13. Rajshekhar. Design and development of three row tractor mounted weeder. Tamil Nadu Agricultural University, Coimbatore, 2000.
14. Rathod RK, Munde PA, Nadre RG. Development of tractor drawn inter-row rotary weeder. Internat. J Agric. Engg. 2010; 3(1):105-109.