Plant Archives **Vol. 25, Special Issue (ICTPAIRS-JAU, Junagadh) Jan. 2025 pp. 413-422**
e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.SP.ICTPAIRS-060

DESIGN AND DEVELOPMENT OF ROTARY WEEDER FOR SMALL FARMING SYSTEM

Vaibhavkumar R. Dama[1]*, J.P. Singh[2], T.D. Mehta[1] and Nandan P. Delvadiya[1]

[1]Department of Farm Machinery and Power Engineering, CAET, Junagadh Agricultural University, Junagadh, Gujarat, India.
[2]Division of Farm Machinery and Power Engineering,
Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir, India
*Corresponding author E-mail : vaibhavkumardama8@gmail.com

ABSTRACT

This study focused on the design and development of a manually operated rotary weeder tailored for small-scale farming systems. The aim was to create a portable, lightweight, and cost-effective tool to reduce the labor-intensive nature of weeding and minimize environmental impact by reducing the reliance on chemical weedicides. The rotary weeder prototype was developed using locally available raw materials and fabricated at a workshop in Jammu, J&K. The prototype was tested and evaluated under field conditions at the Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu (SKUAST-J).

The development process involved designing a manual rotary weeder with considerations for agronomic requirements, such as row spacing and crop age. The rotary weeder was equipped with interchangeable rotor blades *i.e.*, plain, notched, and curved types each evaluated for their performance in terms of field capacity, field efficiency, draft, and power requirements. The experimental field used for the pre-study was a rectangular plot measuring 31.7 × 11 m². The soil type in the field was sandy loam, which is well-suited for cultivating various crops. Cauliflower was the crop selected for this study, with row-to-row spacing and plant-to-plant spacing maintained at 50 cm and 30 cm, respectively, to accommodate the weeding operations. The cauliflower crop was sown in the first week of January 2020. The weeding operations were conducted during the third and fourth weeks of January 2020 when the crop was 20 to 25 days old, ensuring that the crop was at an appropriate growth stage for the evaluation of the developed rotary weeder. Based on laboratory tests, the notched blade was selected for field performance evaluation due to its superior results in terms of field efficiency (82.23%) and effective width of cut (22.97 cm).

The notched blade provided the highest overall efficiency, balancing power requirements with minimal plant damage. The prototype demonstrated effective field capacity and improved weeding efficiency compared to conventional methods, reducing drudgery for small-scale farmers.

Cost economics were also evaluated, revealing a total cost of ₹ 1307 per hectare, making the rotary weeder an affordable solution for smallholder farmers. The study concluded that the developed rotary weeder significantly enhances weeding efficiency and reduces labor, making it a viable alternative for small-scale farming systems while promoting environmentally sustainable practices.

The findings contribute to the development of affordable agricultural machinery that can enhance productivity and sustainability for small-scale farmers.

Key words : Field capacity, Manual weeder, Mechanization, Plant damage, Rotary weeder, Weeding, Weeding efficiency.

Introduction

In Indian agriculture, weeding is a major and laborious task to weed out unwanted plants manually and as well as using bullock operated equipments, which may further lead to the damage of main crops and thereby affecting the agricultural productivity. In our country on an average most of small and medium scale farmers holds less than 2 hectare of land, which account for nearly 90% of the total number of farmers, who cannot afford the large machine like combine harvester, tractors, power tillers etc. to use due to their high initial and operating costs (Nikhade *et al*., 2020). Also, more than 33% of the cost incurred in cultivation is diverted to weeding operation alone and thereby reducing the profit share of farmers (Chavan *et al*., 2015). Weeding accounts for about 25% of the total labour requirement (900–1200-man hours/ hectare) during a cultivation season (Kumar *et al.*, 2014).

As weeds are the major yield limiting factors, proper weed management is of utmost importance for realizing increased crop productivity. By competing for light, water, space and nutrients, weeds can reduce crop yields and quality and can lead to billions of dollars in global crop losses annually. Because of their ability to persist and spread through the multiple reproduction and dispersal of dormant seeds/vegetative propagules, for this reason weeds are virtually impossible to eliminate from any given field (Verma *et al*., 2015). Weeds compete with crop plants for nutrients and other growth factors and remove 30 to 40 per cent of applied nutrients resulting in significant yield reduction about 45 per cent compared to diseases (20%), insects (30%) and pests (5%) (Gupta *et al*., 2014). India loses agriculture produce worth over around ` 77,027 crores (USD 11 billion), which is more than the centre's budgetary allocation for agriculture for 2017-18 annually to weeds according to a study by researchers associated with the Indian Council for Agriculture Research (ICAR) (Singh and Dubey, 2018).

Weed control methods encompass manual, chemical, biological, cultural and mechanical approaches. Manual weeding involves uprooting weeds using tools like the khurpi, particularly effective for young seedlings and established annual/biennial species in confined spaces. The chemical methods employ herbicides for agricultural weed removal, though excessive use can be environmentally harmful. Biological control utilizes insects, nematodes, bacteria, or fungi to manage weed populations. The mechanical weeding relies on manual, bullock-drawn, or power-operated weeders for efficient weed removal. The sustainable weed control integrates these methods, recognizing the importance of environmental impact and cost-effectiveness *i.e.*; crop rotation, delayed or early date of sowing, stale seedbed, plant density, planting pattern, method of fertilizers application, selection of quick growing varieties or using transplants, tillage, mulching and irrigation management with drip irrigation. In mechanical method of weeding manual weeders, bullock drawn and power operated weeders are mainly used (Rana and Rana, 2016). Out of these four methods, mechanical weeding either by hand tools or weeders are most effective (Manjunatha *et al*., 2014). Mechanical weeders range from basic hand tools to sophisticated self-propelled devices, which are commercially available in market. These machines are also quite costly and operate on diesel- or petrol-powered engines. Inter-row weeders are also available which removes weeds from multiple rows of crops at once. In India, different designs of hoes and weeders are available for weeding operations and the efforts are still on to increase the weeding rate with reduced cost and drudgery in weeding operations. There is a large demand to improve manually operated mechanical weeders and a clear need for an improved and optimized technology especially for small farming in India. Therefore, the various types of weeding equipment such as twin wheel hoe, dryland weeders, animal drawn blade hoe and power weeders are used for weeding or used for burying, cutting and uprooting weeds.

As far as the erstwhile UT of Jammu & Kashmir is concerned nearly 80% of the population is engaged in agriculture and allied sectors. The agro-climatic diversity of the area varying from sub-tropical in Jammu and temperate in Kashmir makes it ideal for varied cultivation. In the erstwhile UT of J&K about 94.78% of total numbers of farmers are marginal and small categories (Anonymous, Digest of Statistics, 2016-17). Since, the size of farm holdings of most of the farmers of Jammu region in J&K state is small to justify the use of big mechanical weeders due to their high initial and operating costs. Hence, the effective weeding technology can contribute to increase in production of small farmers through timely and good quality weeding operation by introducing the improved manual weeding equipment on their farms. Hence, keeping the above facts in view, an attempt has been made to develop a manually operated rotary weeder for small farming system and making it suitable for small scale farm holdings for weeding operations. The present study was carried out with an aim to design and develop a portable, light in weight, affordable and an efficient operated manual rotary weeder to overcome the drudgery of operations, reducing the environmental degradation by reducing the use of weedicide for small farmers.

Materials and Methods

This section outlines the procedures and methods adopted for the design, development, and evaluation of a rotary weeder tailored for small-scale farming systems. It covers key considerations in the prototype's development, including material selection, fabrication of various components and overall design principles. The rotary weeder was constructed using locally sourced raw materials, ensuring cost-effectiveness and accessibility. The fabrication process was carried out at the workshop of M/s G S Reen, located in Jammu, J & K. The performance evaluation of the developed prototype focused on key metrics such as field capacity, field efficiency, draft and power requirements. These evaluations were conducted at the research farm and experimental field of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, at the Main Campus Chatha, during the 2019-20 academic year. The results provided valuable insights into the operational effectiveness of the rotary weeder for small farming systems.

The methodology adopted in developing the prototype has been divided into the following sections.

- General Considerations for Development of Equipment
- Design and Development Considerations
- Selection of Materials
- Development of Various Components of Prototype
- Instrumentation used
- Functional Performance Evaluation of Developed Prototype during Pre-study
- Performance Evaluation of the Developed Prototypes
- Cost Economics of the Developed Prototype

General Consideration for Development of Equipment

The development of equipment was initiated either to provide an equipment for weeding and uprooting of weeds in the field, or to provide an improved equipment to overcome problems/defects of the existing practice of weeding operations. Basic specifications of the developed rotary weeder were derived from agronomic and operational parameters, source of power and labour requirements.

The type of blade on rotor was selected on the basis of performance of different types of blades mounted on rotor, such as; plain blade, notched blade and curved blade during laboratory test or pre study. The developed weeder was evaluated at field condition with three main different cutting blades i.e., i) Rectangular plain type with approach angle of 180^0, ii) Rectangular serrated type with approach angle of 180^0, iii) Sweep type with approach angle of 150^0 and with selected blade from pre-study with 4 nos., 6 nos. and 8 nos. of blade on rotor. The different observations were taken which includes soil parameters e.g., soil moisture content, soil bulk density, soil resistance and weeder performance parameters e.g., speed, draft, power requirement, field capacity, field efficiency, weeding efficiency, plant damage, performance index, cost of operation etc. during the experiment to evaluate the performance of developed prototype.

Functional requirements

The prototype for small farming system was developed and fabricated to fulfil the following functional requirements.

1. Light in weight and portable
2. Suitable for small farmers
3. Maximizing the weeding and minimizing the weeding cost

Agronomical requirements

As per the packages and practices of SKUAST-Jammu for Vegetable crops (Directorate of Extension SKUAST-J, 2016), following agronomical requirements were also considered for the design and development of the equipment;

1. Row to row spacing: 30 cm or more,
2. Age of the crop at the time of operation/ experiment: 25 to 30 days.

Economical consideration

1. The cost of the manual rotary weeder should be as low as possible so, that small farmers can afford to purchase the equipment.
2. The material of construction of different components should be easily and locally available.

Design and Development Considerations

The components of rotary weeder were designed and fabricated based on the parameters like functional requirements, engineering and general considerations. The assumptions made in the development of manual rotary weeder are as follow:

1. Determination of physical characteristics of soil for mechanized weeding,
2. Agronomical requirements and physiological parameters of crop plant,
3. Local availability of the materials,
4. Fabricate the prototype according to the design specification,
5. Ease of operations and maintenance,
6. Easily repairable, safety and operator's comfort,

7. Determine the performance of the prototype in laboratory study/pre-study under actual field conditions with respect to row to row spacing, plant damage, field capacity, field efficiency, draft requirement, power requirement, etc.
8. Reasonable space and weight requirement to allow moving it to the site,
9. Modify the equipment, if changes are required to achieve expected level of performance after laboratory study/pre-study,
10. Development of the prototype,
11. Performance evaluation of the developed prototype at field condition with different treatment combinations.

Selection of Materials

The selection of proper materials for the fabrication of various components of developed weeder was very much important. Standard, common sizes, sections as well as semi-finished and finished items which are available in local market was considered when specifying the materials. The specification of the materials for different components of developed were selected as given in Table 3.1. The selection of equipment's components was made keeping in view their effectiveness and efficiency. This consideration was applied for uniformity of weeding operation, less damage to the standing crop, quality of work, cost of materials, accuracy of the finished parts and the quality of workmanship.

Development of various Components of Prototype

A manual rotary weeder was developed and fabricated for weeding and uprooting of weeds. Two types of blades *i.e.*, rotor blades and cutting blade were used for weeding and gave forward motion for uprooting or cutting of the remaining weeds. The fabrication of whole assembly and different parts of the equipment done as shown in Fig. 3.1 and Plate 3.1, respectively.

Handle

The handle as shown in Fig. 3.2 and Plate 3.2, of the prototype was fabricated from the galvanized iron pipe having a circular cross section with 20 mm diameter and 2 mm thickness. The overall length of the handle was 432 mm. For comfort handling and to minimize sudden shocks rubber grips each of length 100 mm was provided at both ends of the pipe. The desired height of the handle from the ground surface was obtained with the adjusting support. The handle was joined to the main frame with the help of the handle pipe. The bolts used for the attachment of handle with that of frame of size 15 mm.

Beam

The beam was constructed with a galvanized iron

Table 3.1 : Selection of material for development of prototype.

S. no.	Parts	Material used	Size, mm
1.	Handle	Galvanized iron pipe	Diameter = 20 Length = 432
2.	Beam	Galvanized iron pipe	Diameter = 20 Length = 1194
3.	Frame i. Handle attached ii. Rotor ring attached	MS flat	 (l×b×t) = 305×25.4×5 (l×b×t) = 660×25.4×5
4.	Rotor ring	MS flat	(l×b×t) = 320×20×5 diameter = 102
5.	Rotor shaft	GI pipe	Diameter = 20 Length = 280
6.	Rotor blade	MS flat	(l×b×t) = 240×20×2
7.	Bush and cup (For free movement of the rotor) i) GI pipe ii) GI pipe		 Diameter = 20 Length = 25 Diameter = 24 Length = 25
8.	Cutting blade frame plates 2 nos.	MS flat	(l×b×t) = 200×20×5
9.	Support plate	MS flat	(l×b×t) = 180×20×5
10.	Cutting blade	MS flat	(l×b×t) = 300×25×5

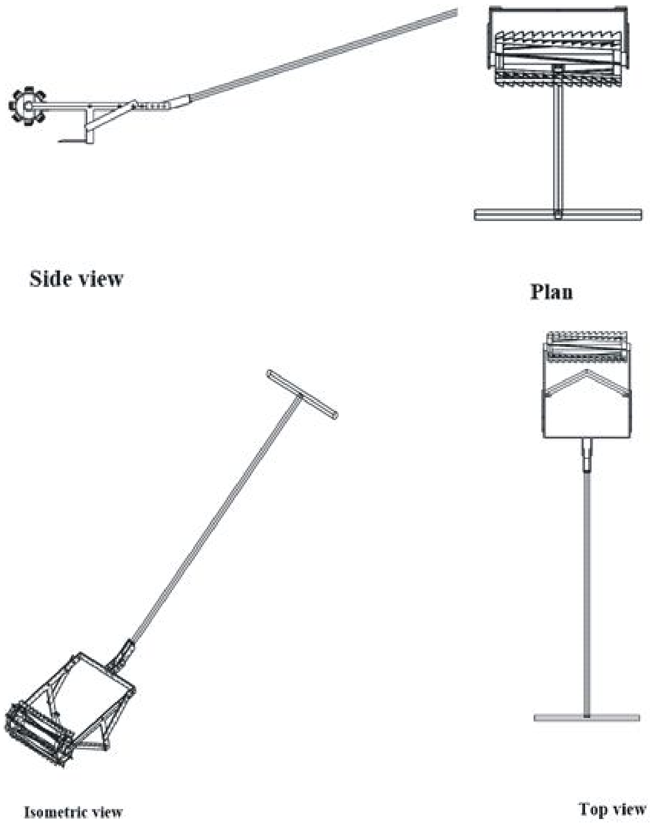

Fig. 3.1 : Different CAD view of the prototype.

Table 3.2 : Measured Weight of each component of prototype.

S. no.	Components/treatments	Weight (kg)
1.	Rotor 1 (N_1) 4 nos. of blades on rotor	1.40
2.	Rotor 2 (N_2) 6 nos. of blades on rotor	1.60
3.	Rotor 3 (N_3) 8 nos. of blades on rotor	1.76
4.	Sweep type cutting blade (B_1)	0.41
5.	Rectangular Plain type cutting blade (B_2)	0.31
6.	Rectangular Serrated type cutting blade (B_3)	0.10
7.	Handle + Beam	1.55
8	Main frame with nut-bolt and adjustment plates	2.18
9.	Treatment 1 (N_1B_1)	5.54
10.	Treatment 2 (N_1B_2)	5.44
11.	Treatment 3 (N_1B_3)	5.23
12.	Treatment 4 (N_2B_1)	5.74
13.	Treatment 5 (N_2B_2)	5.64
14.	Treatment 6 (N_2B_3)	5.43
15.	Treatment 7 (N_3B_1)	5.90
16.	Treatment 8 (N_3B_2)	5.79
17.	Treatment 9 (N_3B_3)	5.59

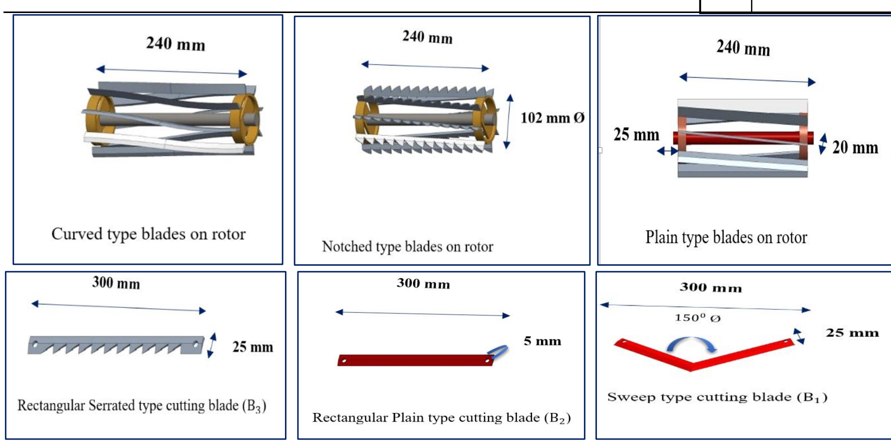

Fig. 3.2 : Views of different rotors and cutting blade of prototype.

pipe having a circular cross section of 20 mm diameter attached with handle in T-shape. The overall length of the beam was 1194 mm and the beam was further connected with the clamp with main frame by means of bolts of 15 mm size as shown in Fig. 3.2.

Main frame

The whole main frame consisting of two frames were attached to handle & beam pipe and another with rotor ring. The MS flats of different sizes were used to fabricate both frames of (length×breadth×thikness) 305×25.4×5 mm and 660×25.4×5 mm as shown in Figure 3.2.

Rotor ring

The rotor rings/rotors as shown in Fig. 3.3 and Plate 3.2 were made of MS flat of 320×20×5 mm size. The flats were twisted into circular shape of 102 mm diameter. There are two rings joined together by means of a shaft.

Rotor shaft

The rotor shaft was made from galvanized iron pipe as shown in Fig. 3.3 and Plate 3.2 of 20 mm diameter and 280 mm long with 2 mm thickness. It joined two rotor rings and gave forward movement to the rotor by means of bush and cup provided at the both ends of rotor.

Rotor blade

The different type of rotor blades such as plain type, notched type and curved type were mounted on the circumference of rotor rings parallel to each other as shown in Fig. 3.3 and Plate 3.2. Rotor blades are made of MS flat of 240×20×2 mm size.

Cutting blade

Three types of cutting blades i.e., sweep type, rectangular plain type and rectangular serrated type were fabricated with different approach angle as per the treatment combinations. The cutting blade was attached just behind of rotor mechanism, and bolted with support frame. The cutting blades were made of MS flat of 300×20×5 mm size as shown in Fig. 3.3 and Plate 3.3.

Cutting blade frame

Cutting blade frames were used to mount or attach the cutting blade made in size of 200×20×5 mm. It is bended 20 mm at the one end to provide nut, bolt and mounting the cutting blade at lower side and one end bolted with main frame.

Support plates

Support plates were used to adjust and for tighten main frame and cutting blade frame during operation. Support frames are made in size of (length × breadth × thickness) 180×20×5 mm size.

Bush and cup (for free movement of rotor)

Bush and cup were attached at the side end of rotor with the help of welding on a MS flat for free movement of rotor. It is further welded at the main frame MS flat and rotor. It was made of galvanized iron pipe (i) diameter = 20 mm, Length = 25 mm and (ii) diameter = 24, Length = 25. Here, bush was smaller in diameter than cup so it was easily filled in it and there was small clearance given to the rotor for forward movement as shown in Fig. 3.3 and Plate 3.2.

Condition of field, soil and crop during pre-study

(a) Size of plot: 31.7 × 11 m^2, rectangular.

(b) Type of soil; Soil type - *Sandy loam*

(c) Crop- Cauliflower

(e) Row to row spacing and Plant to plant spacing – 50 × 30 cm

(f) Date of Sowing- 1st Week of January 2020

(g) Date of Weeding- 3rd and 4th Week of January 2020

(h) Age of crop during Weeding- 20 to 25 days

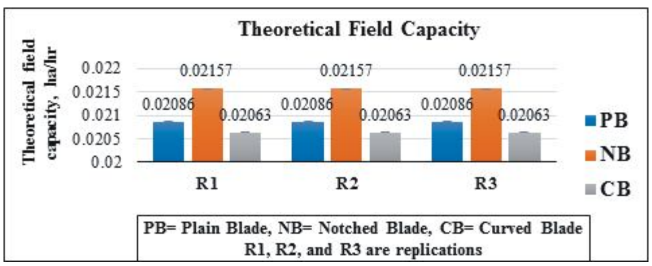

Fig. 3.3 : Effect of different rotors on theoretical field capacity.

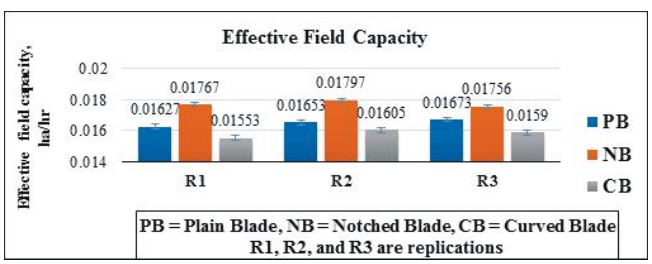

Fig. 3.4 : Effect of different rotors on effective field capacity.

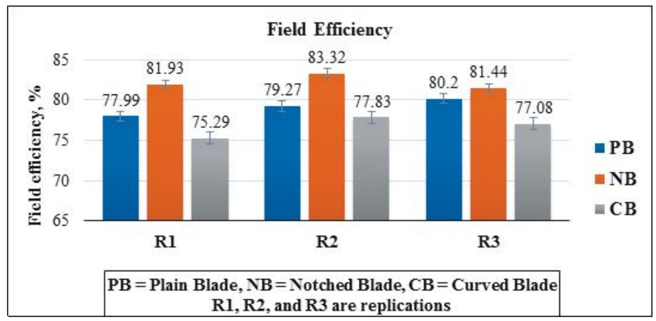

Fig. 3.5 : Effect of different rotors on field efficiency.

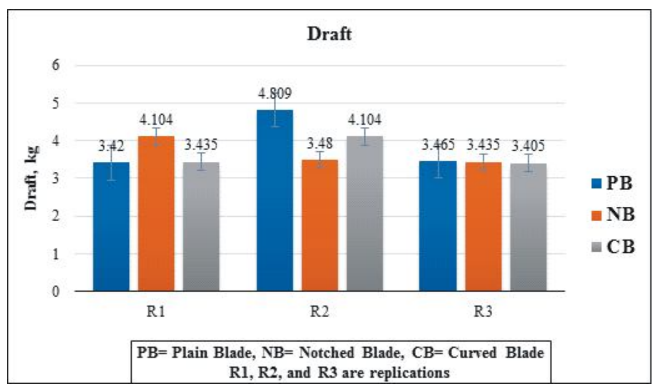

Fig. 3.6 : Effect of rotor blades on draft requirement.

Table 3.4 : Dependent and Independent variables selected for field evaluation.

Independent variables	**Dependent variables**	**Fixed parameters**
1) Plain blade	A. Total time taken to cover 1 hectare, h	a) Moisture content,
2) Notched blade	B. Effective Depth of weeding, cm	b) %
3) Curved blade	C. Effective width of cut, cm	c) Bulk density,
	D. Effective field capacity, ha/h	d) g/cm^3
	E. Field efficiency, %	e) Row to row
	F. Draft requirement, kg	f) spacing, cm
	G Power requirement, hp, etc.	g) Plant to plant
		h) spacing, cm
		i) Theoretical width, cm

Results and Discussion

The developed prototype was first tested to assess the performance and detailed specifications were recorded, as above presented in Table 3.1 and Condition of field, soil and crop during pre-study. The tests were carried out to study the following performance characteristics.

A) Soil Parameter

1) Soil moisture content, %

2) Soil bulk density, g/cc

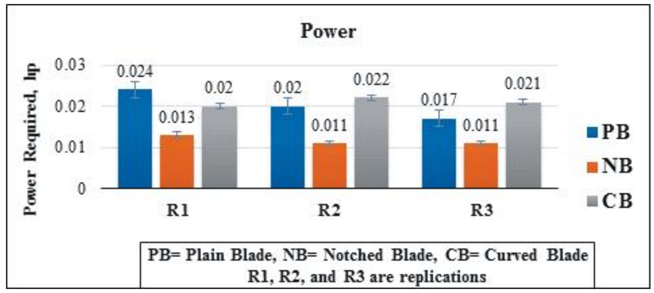

Fig. 3.7 : Effect of rotor blades on power requirement.

Table 3.5 : Effect of different type of rotor blades on Theoretical Field capacity.

Theoretical Field capacity, ha/hr					
S. no.	**Type of Rotor Blades**	**Replications**	**Theoretical width, m**	**Theoretical speed, kmph**	**Theoretical Field capacity, ha/hr**
1.	**Plain Blade**	**R_1**	0.24	0.87	0.0208
		R_2	0.24	0.87	0.0208
		R_3	0.24	0.87	0.0208
		Mean	0.24	0.87	0.087
2.	**Notched Blade**	**R_1**	0.24	0.89	0.0215
		R_2	0.24	0.89	0.0215
		R_3	0.24	0.89	0.0215
		Mean	0.24	0.89	0.0215
3.	**Curved Blade**	**R_1**	0.24	0.86	0.0206
		R_1	0.24	0.86	0.0206
		R_3	0.24	0.86	0.0206
		Mean	0.24	0.86	0.0206

Table 3.6 : Effect of different type of rotor blades on effective field capacity.

S. no.	**Type of Rotor Blades**	**Replications**	**Time taken (h/ha)**	**Effective Field capacity (ha/hr)**
1.	**Plain Blade**	**R_1**	61.46	0.0162
		R_2	60.47	0.0165
		R_3	59.76	0.0167
		Mean	60.56	0.0165
2.	**Notched Blade**	**R_1**	56.58	0.0176
		R_2	55.63	0.0179
		R_3	56.92	0.0175
		Mean	56.37	0.0177
3.	**Curved Blade**	**R_1**	64.38	0.0155
		R_2	62.28	0.0160
		R_3	62.28	0.0159
		Mean	62.98	0.0158

Table 3.7. Effect of different type of rotor blades on field efficiency.

Field efficiency%					
S. no.	**Type of Rotor Blades**	**Replications**	**Theoretical Field Capacity (ha/h)**	**Effective Field Capacity (ha/h)**	**Field Efficiency %**
1.	**Plain Blade**	R_1	0.0208	0.0162	77.99
		R_2	0.0208	0.0165	79.27
		R_3	0.0208	0.0167	80.20
		Mean	**0.0209**	**0.0165**	**79.153**
2.	**Notched Blade**	R_1	0.0215	0.0176	81.93
		R_2	0.0215	0.0179	83.32
		R_3	0.0215	0.0175	81.44
		Mean	**0.0216**	**0.0177**	**82.230**
3.	**Curved Blade**	R_1	0.0206	0.0155	75.29
		R_2	0.0206	0.0160	77.83
		R_3	0.0206	0.0159	77.08
		Sub Mean	**0.0206**	**0.0158**	**76.733**

Table 3.8 : Effect of different type of rotor blades on draft.

Draftkg					
S. no.	**Rotor Blade type**	**Replications**	**Effective Depth of Cut (cm)**	**Effective width of Cut (cm)**	**Draft (kg)**
1.	**Plain Blade**	R_1	0.5	22.8	3.42
		R_2	0.6	22.9	4.809
		R_3	0.5	23.1	3.465
		Mean	**0.5333**	**22.9333**	**3.8980**
2.	**Notched Blade**	R_1	0.5	22.8	4.104
		R_2	0.7	23.2	3.48
		R_3	0.5	22.9	3.435
		Mean	**0.5667**	**22.9667**	**3.6730**
3.	**Curved Blade**	R_1	0.5	22.9	3.435
		R_2	0.6	22.8	4.104
		R_3	0.5	22.7	3.405
		Mean			**3.6480**

Table 3.9 : Effect of different type of rotor blades on power required.

Powerhp					
S. no.	**Rotor Blade type**	**Replications and means**	**Draft (kg)**	**Actual Speed (kmph)**	**Power (hp)**
1.	**Plain Blade**	R_1	3.42	0.8946	0.02492
		R_2	4.809	0.8598	0.01968
		R_3	3.465	0.8532	0.01751
		Mean	**3.8980**	**0.8692**	**0.0207**

Table 3.9 continued...

Table 3.9 continued...

2.	**Notched Blade**	**R_1**	4.104	0.9013	0.01369
		R_2	3.48	0.8989	0.01158
		R_3	3.435	0.8959	0.01139
		Mean	**3.6730**	**0.8987**	**0.0122**
3.	**Curved Blade**	**R_1**	3.435	0.8542	0.01956
		R_2	4.104	0.867	0.02197
		R_3	3.405	0.8587	0.02165
		Mean	**3.6480**		**0.0211**

Table 3.10 : Soil moisture content measured during operation of different type of rotor at field condition.

Soil Moisture Content%					
S. no.	**Depth (cm)**	**Replication**	**Weight of wet soil (gm)**	**Weight of dry soil (gm)**	**Soil Moisture Content (%)**
1.	**0 to 5 cm**	**R_1**	117.83	103.17	14.12
		R_2	115.44	101.33	13.92
		R_3	107.49	95.23	12.87
		Mean			**13.63**
2.	**5 to 10 cm**	**R_1**	137.03	129.33	14.40
		R_2	117.31	101.18	15.94
		R_3	117.11	101.6	15.26
		Mean			**15.20**

Table 3.11 : Soil bulk density obtained during operation of different type of rotor at field condition.

Soil bulk density (g/cc)				
S. no.	**Replication**	**Weight of moist soil collected (gm)**	**Volume of core cutter**	**Soil bulk density (g/cc)**
1.	**R_1**	1608.14	1125.67	1.428
2.	**R_2**	1609.23	1125.67	1.429
3.	**R_3**	1607.28	1125.67	1.427
4.	**Mean**			**1.428**

B) Weeder Performance Parameters

1) Field efficiency, %
2) Effective width, cm
3) Effective depth, cm
4) Actual speed, kmph
5) Draft required, kg
6) Power required, hp

The experimental data of performance of developed rotary weeder for selection of type of rotor blade we got as given in Tables 5-11.

Conclusion

The study included the evaluation of the operational parameters of rotary weeder under local agro-climatic conditions. During field performance of the developed prototype different parameters were studied. In order to select the type of rotor blade mount on rotor, three types of rotor blades i.e., plain type, notched type and curved type was initially tested under laboratory conditions. The parameters like field capacity, field efficiency, draft and power requirements were determined under laboratory conditions for selection of the rotor blade. On the basis of the laboratory study, the notched type blade for mount on rotor was selected for the field performance of the prototype.

During performance evaluation of the developed prototype for selection of rotor blade soil parameters were recorded from three different locations in an experimental plot. The average soil moisture content was found at 13.63% and 15.20% (d.b) at depth of 0 to 5 cm and 5 to 10 cm, respectively and the soil bulk density was found at 1.428 g/cc at field condition. The average field efficiency was calculated as 79.153, 82.230 and 76.733% for plain type, notched type and curved type blade mounted on rotor, respectively. Where the highest theoretical field capacity (ha/hr), effective field Capacity (ha/hr) and field efficiency (%) found in notched type blade. The average draft required was found at 3.90, 3.67 and 3.65 kg in plain type blade, notched type blade and curved type blade, respectively. The average power required was found 0.0207, 0.0122 and 0.0211 hp in plain type blade, notched type blade and curved type blade, respectively. The draft (kg) and Power (hp) requirements were found highest in plain type blade followed by notched type blade and curved blade mounted on rotor.

Acknowledgement

I would like to express my sincere gratitude to the Division of Agricultural Engineering, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, main campus chatha, 180009 UT of J&K for providing me with the necessary resources and support to carry out my master's research. The access to the laboratory and agricultural fields was invaluable in enabling me to evaluate and conduct my study effectively. I am deeply thankful to the faculty, staff, and everyone involved for their guidance and assistance throughout this research journey.

References

Anonymous (2016-17). DES, *Statistical Digest of Jammu and Kashmir*. Directorate of Economics and Statistics. Department of Agriculture, Cooperation and Farmer's welfare. Ministry of Agriculture and Farmer's Welfare, Government of India.

Chavan, M., Sachin C., Ashutosh R., Piyush S. and Digvijay M. (2015). Design, development and analysis of weed removal machine. *Int. J. Res. Appl. Sci. Engg. Technol.*, **3(5)**, 526-532.

Kumar, N.T., Kumar S.A., Nayak M. and Ramya V. (2014). Performance evaluation of weeders. *Int. J. Sci., Environ. Technol.*, **3(6)**, 2160-2165.

Manjunatha, K., Sushilendra S.S. and Kumar V.P. (2014). Development and evaluation of manually operated sprocket weeder. *Int. J. Agricult. Engg.*, **7(1)**, 156–159.

Nikhade, S.R. and Gunaki A.S. (2020). Agricultural mechanization in India. *IJCRT*, **8(5)**, 2594-2605.

Rana, S.S. and Rana M.C. (2016). Principles and practices of weed management. Department of Agronomy, College of Agriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, 138 pages.

Singh, P.K. and Dubey R.P. (2018) Indian Council for Agricultural Research (ICAR), An Economic survey Published.

Verma, S.K., Singh S.B., Meena R.N., Prasad S.K., Meena R.S. and Gaurav (2015). A review of weed management in India: the need of new directions for sustainable agriculture. *The Bioscan: An Int. Quart. J. Life Sci.*, **10(1)**, 253-263 (Supplement on Agronomy).