Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(1): 1264-1266
Received: 21-11-2017
Accepted: 22-12-2017

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Modification of power operated single row rice weeder for dry field condition

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Abstract
Weeding is an important agricultural unit operation. Delay and negligence in weeding operation affect the crop yield up to 30 to 60 per cent. Weeders are used for all the intercultural operations performed in the field among which power weeders are mostly used nowadays and are also one of the most important intercultural machines for small or marginal agricultural field/crop famers. It is also more economical machine as compared to other manual or mechanical weeders. The present study deals with the design modification of existing power weeder and making it suitable for dry field condition. This research work was carried out in Department of Farm Machinery and Power Engineering, IGKV, Raipur (C.G.). The existing power weeder works well in wet land conditions but by modifying some parts of weeder and adding few parameters such as “C” type Blade, Removable extension shaft and transport wheel it performs well in dry field conditions and even it also works more effectively when compared with wet land conditions. Overall, the machine was found satisfactorily and was best suited to opt in both conditions of land i.e. dry and wet.

Keywords: Weeding, weeding efficiency, field capacity, mechanical weeders, yield, power weeder

1. Introduction
India is an agricultural country where 75% of the population lives in the village and whose life depends only on sources of income which are available from agriculture. During the plant growth, the weeder is best usable intercultural machines for any crop it cuts the weeds to a certain depth which in results increases our production and productivity [1].
In rice cultivation, weeding is important but equally labour incentive agricultural unit operation. Weeding accounts for about 25% of the total labour requirement (900-1200 man-hr/ha) (Yadav and Pund, 2007). Modified power weeder helps to build up the soil organic matter and subsequently large and diverse microbial population thus it facilitates the process of aeration. In India this operation is mostly performed manually with khurpi or trench hoe that requires higher labour input and is also very tedious and time consuming process. Moreover, the labour requirement for weeding depends on weed flora, weed intensity, time of weeding and soil moisture at the time of weeding and efficiency of worker [2].

Materials and Method
Description of Power weeder
Existing components before modification
Power unit: The power for prime mover used for weeding operation was calculated as 2hp with all major factors taken into account as speed; soil resistance etc. (Sirmour *et al*, 2016) [1].The power required for weeding condition is about 2 hp per row. Hence, a single cylinder, 2- stroke petrol engine of 2 hp, with side valve and air cooled engine was used as a prime mover in modified power weeder.
Transmission: A lightweight aluminum gear box was connected vertical with the engine. The power from the single central vertical rotor was transmitted to the rotor by means of worm and worm gear arrangement. The rotary wheels were rotated by the power transmission system of the engine. The bottom of the weeder is provided with the wheel. The forward speed of the machine was having a speed ratio of 34:1 from engine to rotor shaft.
Rotary blades: In rotary weeders, blades are attached to a flange mounted on a rotating shaft usually by nuts & bolts commonly three types of blade geometries are used as blades for weeders and tillers namely, L-shaped blades, C-shaped blades and J-shaped blades.
The C-shaped blades are used here due to its greater curvature, so that they can penetrate in hard field and performs well in heavy and wet soils.

Handles: Handles was made of MS pipe with 19.2 mm, outer diameter 20 mm MS rectangular frame of length 40 mm and width 18 mm with plastic grip fitted at the ends. The overall length of handle 1090 mm with two bends from point of attachment and have a height of 760 mm from ground level. With help of handle, the machine can be steered. A throttle lever is provided on right side of the handle to control the engine speed.

Mud flap: To avoid throwing of mud and stones towards operator and as a safety, a mud flap is provided covering the upper and rear side of the blades of the rotary cutting units. Upper side is made up of plastic sheet and the rear side is covered by rubber sheet.

Floating mechanism: The floating mechanism is important part of the machine, as it helps the machine to float in muddy conditions without sinking. The floats reduce the ground reaction due to buoyancy effect. The size of float is 860×170 mm and it is made of plastic material with the total weight of float is 1.2 kg.

Throttle lever: A hand operated throttle lever was provided for controlling the speed of the machine and is attached to right hand side of the handle.

Details of Modified machine components

Removable tail wheel

In the dry field condition the transport wheel is better for preventing the jerking in undulated fields and smooth field operation, traction wheels was made by using nylon of 180×23 mm diameter as inner and outer ring diameter. It is bolted to rear brackets. The wheel provides better traction and stability during dry field operation.

Rotary blade

The rotary blades work under uneven miscellaneous forces of cyclic loading effect of soil parts at the cutting edge (Jeevarathinam *et al*, 2014). Due to the cyclic loading condition the fatigue strength and life of the blade will be affected. In order to improve the fatigue strength of the blade the design of the blade will be modified. There are 8 rotor blades on either sides of rotor flange is bolted on each sides made up of EN 24 APA having thickness of 2.2 mm.

Removable extension shaft

The removable extension shaft is fixed to the main axle shaft. The two extension shaft are joined on both side by means of nut and bolt for setting of complete cutting unit and are fixed to the rotary shaft as depend upon the field condition and row spacing.

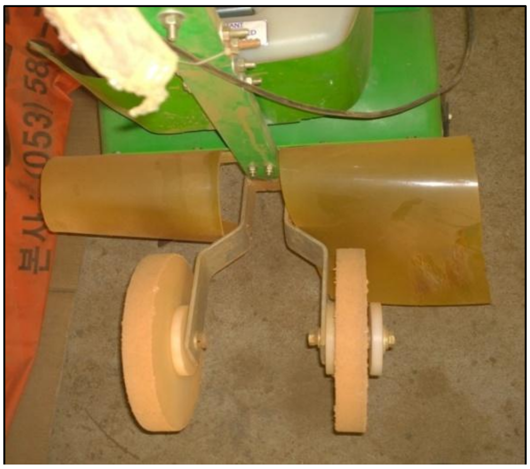

Fig 1: Removable tail wheel along with support plate

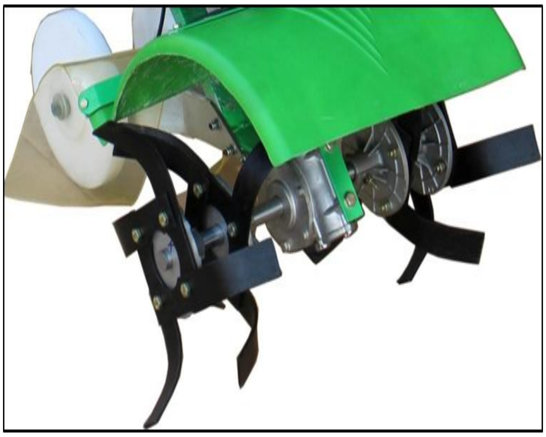

Fig 2: Modified ''c'' type rotary blade

Fig 3: Removable extension shaft

Fig 4: Modified power weeder

The following field tests were carried out in the research fields to evaluate the performance of the power weeder for weeding operation using different number of blades as 4, 6, and 8 respectively. The field tests were carried out to ascertain the following performance parameters.

Weeding efficiency

The weeder is tested on the same field to determine weeding efficiency. It is calculated by using equation.

$W = (W_1 - W_2)/W1 \times 100$

Where,

W_1 = number of weeds before weeding

W_2 = number of weeds after weeding

W= weeding efficiency

Field efficiency

The field efficiency is the ratio of the effective field capacity to the theoretical field capacity and it is expressed in percent.

$$\text{Field efficiency} = \frac{\text{effective field capacity}}{\text{theoritical field capacity}} \times 100$$

Plant damage

Plant damage was calculated by counting the number of injured plants in sample plot and total number of plants in sample plot. The plant damage was calculated by following expression.

$$P_d(\%) = \frac{A}{B} \times 100$$

Where,
Pd = plant damage, %
A = No. of injured plants (cut or damaged) in sample plot
B = Total No. of plants in sample plot.

Results and Discussion

Weeding efficiency

The weeding efficiency of modified power weeder was found maximum in 8 blade with 73.25%, followed by 68.21% and 65.46% with 6 and 4 blade respectively due to large no. of blade as compared to 6 and 4 blade. In wet land field condition weeding efficiency was observed maximum in 8 blade with 70.12%, followed by 66.28% and 62.1% with 6 blade and 4 blades respectively as shown in graph.

Field efficiency

Field efficiency of the modified power weeder was 75.07% at 8 blade followed by 70.35% and 65.15 of 6 blade and 4 blade respectively. At wet field condition, field efficiency was more as compared to dry field condition due to the low resistant force of soil, loose soil, friction in wet field. Maximum field efficiency was observed 85.17 in 8 blade, which followed by 78.42% and 75.32% of 6 blade and blade respectively.

Plane damage

The plant damage caused by the modified power weeder was minimum observed in 1.85% in 4 blade while maximum plant damage was 4.74% in 8 blade weeder. In wet field condition maximum plant damage was observed in 6.18 in 8 blade while minimum was 1.65%.

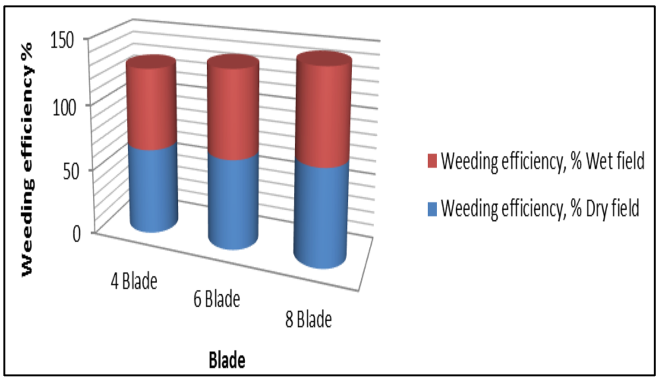

Fig 5: Weeding eff. of modified weeder in dry and wet field with different blades

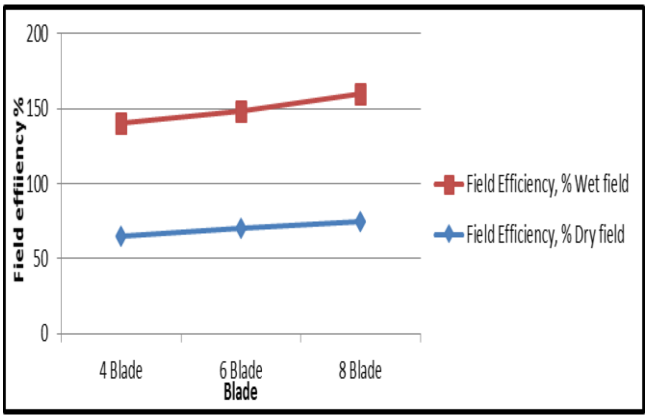

Fig 6: Field efficiency of modified weeder in dry and wet field with different blades

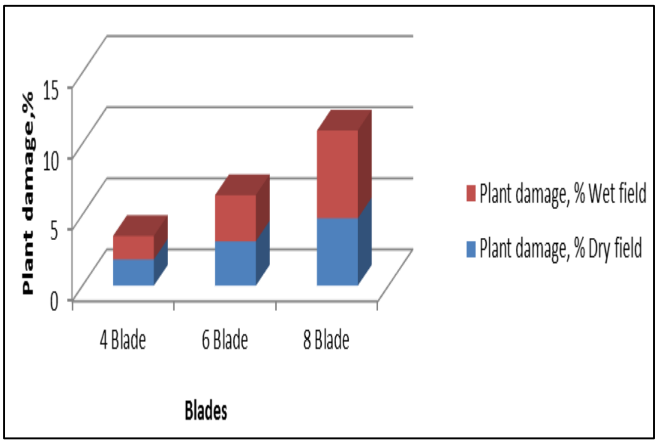

Fig 7: Graph shows plant damage of modified weeder in dry and wet field with different blade

Cost of operation

The cost of operation of modified power weeder was calculated as Rs 1800/ha. The cost of operation of power weeder was found more than other intercultural tools or machines such as wheel hoe, grubber, ambika paddy weeders and cono weeders etc. which might be due to its high cost of the machine and lower annual use which were responsible for increasing the fixed cost of power weeder.

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