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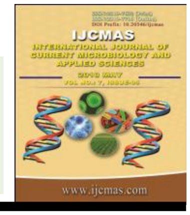

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Performance Evaluation of Prototype Ride on Type Paddy Weeder

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A B S T R A C T

A study was conducted for performance evaluation of prototype ride on type paddy weeder in wetland field, Tamil Nadu Agricultural University, Coimbatore, India. The experimental site is geographically situated at 11^o North latitude and 77^o East longitude and at an altitude of 427 m above MSL.Weed is inevitable part of farming. SRI system of rice cultivation naturally weed growth is more in the fields because there is no stagnated water. So, it is very necessary to use proper weeding implements to reduce drudgery and cost of cultivation. Performance evaluation of prototype ride on type paddy weeder was done in the paddy field. In field evaluation the of developed ride on type paddy weeder the following evaluated parameters were wheel slip 15%, effective field capacity 0.03004 hah^{-1}, theoretical field capacity 0.0375 ha h^{-1}, field efficiency 80.35 %, plant damage 3.33% and weeding efficiency 84.04% and fuel consumption of the weeder was 0.6 lit h^{-1}.

Introduction

Rice is an important staple food for about 50 per cent of the world's population providing 66-70 per cent body calories intake to the consumers (Barah and Pandey, 2005).The world paddy production was 614.65 million tonnes covering an area of 153.51 million hectare with an average yield of 3.87 tonnes per hectare. India has the largest area under rice in the world which comprises about 44 per cent of the total area under cereals in India and its production reached to a record high of 104.32 million tonnes in 2011-12. Weed is inevitable part of farming. Ever since man started growing crops, he had come up with the problems of weed. Farmers and researchers have been putting up a combined front to tackle the menace of weeds. Weeds are serious threat to all crops. Weeds, instead of harbouring insects, compete with the crop for water, light and plant nutrients and adversely affect the microclimate around the plant. Weeding is an important but equally labour intensive agricultural unit operation. Weeding accounts for about 25 per cent of the total labour requirement during a cultivation season (Nag and Dutta, 1979). In developing countries it is estimated that reduction in yield due to weeds alone is 20 to 30 per cent depending on the crops, weed infestation intensity and location, which might increase up to 50 per cent if adequate crop management practices were not observed. Human energy is predominantly used in most of the rice farming operations starting from seedbed preparation to threshing. It is estimated that nearly 145 man-days are required per hectare of rice. Among these crop, care is highly labour intensive operation accounting for 24.3 per cent of total human power requirement (Fig. 1). Hand weeding is the most common method of weed control in rice but it requires high labour input. Normally two or three manual weeding is done in rice per crop.

Among various farm operations in rice cultivation i.e. growing of seedlings, transplanting of seedlings, weeding, harvesting etc are labor intensive operations and one of the major laborious and time consuming operations in rice cultivation is weeding. The yield loss ranges from 10-50 % in transplanted rice depending on the extent of weed infestation (Pathak *et al.,* 1976).

In Transplanted paddy cultivation, Traditional seedbed-based rice cultivation consumes higher energy for weed management in India (15.3 -23.7 %) compared to stale seedbed because traditional farmers give their higher priority to hand weeding (Chaudhary *et al.,* 2006). It is very clear that the estimates of time and cost for hand weeding are variable and dependent on weed flora, weed intensity, cropping season, labour availability and efficiency of weeding methods.In SRI system of rice cultivation naturally weed growth is more in the fields because there is no stagnated water. So, it is very necessary to use proper weeding implements to reduce drudgery and cost of cultivation. Performance evaluation of prototype ride on type paddy weeder was done in the paddy field.

Materials and Methods

The developed prototype ride on type paddy weeder was evaluated in M-4 plot of wetland field, Tamil Nadu Agricultural University, Coimbatore, India. The experimental site is geographically situated at 11^{o} North latitude and 77^{o} East longitude and at an altitude of 427 m above MSL. The soil of the experimental site was sandy clay loam as per the textural classification (USDA).Weeding was done on 25th DAS. The spacing of paddy was 25 × 25cm. The field trials were carried out at a soil moisture content of 37 %. The size of the plot was 0.25 acre. The performance of the machine was evaluated in terms of wheel slip, weeding efficiency, plant damage, field capacity, field efficiency and fuel consumption and Specification of ride on type paddy weeder has given Table 1.

Wheel slippage

Wheel slip for power weeder was measured by monitoring the number of revolutions of the wheel over a specified distance under load and zero load conditions. The slip was calculated by using the following formula.

$$S' = \frac{n_1 - n_0}{n_0} \times 100 \qquad (1)$$

Where,

S' = wheel slip, per cent

n_1 = number of revolution of wheel under load conditions for specified distance.

n_o = number of revolution of wheel under no load conditions for specified distance

In most of the cases the tool has no effect of slip at different levels of forward speed but fuel consumption increases considerably.

Effective field capacity

The weeding machine was operated in the different test fields. The area covered during the test was calculated. The effective field capacity was calculated by using following formula

$$\text{Effective field capacity (ha/h)} = \frac{\text{Area covered (ha)}}{\text{Time required (h)}} \quad (2)$$

Theoretical field capacity

It is always greater than actual field capacity. The theoretical field capacity was calculated by using following formula.

T.F.C. (ha h^{-1}) = (3)

Where,

T.F.C. = Theoretical field capacity, ha/h.
W_t = Theoretical width of operation, m.
S = Speed of operation, km/h.

Field efficiency

The field efficiency was calculated from theoretical and effective field capacity by using following formula.

$$\text{Field efficiency (\%)} = \frac{\text{E.F.C.}}{\text{T.F.C.}} \times 100 \quad (4)$$

Where,

E.F.C. = Effective field capacity, ha h^{-1}.
T.F.C. = Theoretical field capacity, ha h^{-1}.

Weeding efficiency

The developed weeder was operated in the experimental plot. Before operation of the weeder the numbers of weeds in the plot were counted. After the operation the number of weeds left in the plot was also counted. This procedure was repeated at different depth. The forward speed was maintained at constant in all the field tests. Weeding efficiency was calculated by the following expression.

$$E = \frac{W_1 - W_2}{W_1} \quad (5)$$

Where,

E = weeding efficiency, %

W_1 = number of weeds counted before operation in square metre area

W_2 = number of weeds counted after operation, in square metre area

Plant damage

The quality of work done is the measure of damage on crop during weeding operation. It is calculated using the following expression (Remesean *et al.*, 2007).

$$DF = \frac{Q_2}{Q_1} \times 100 \quad (6)$$

Where,

DF - Damage factor, per cent

Q1 - Number of plants in 10 m row before weeding

Q2 - Number of plants damaged in 10 m row after weeding

Fuel consumption

The fuel consumption has direct effect on economics of the weeder. It was measured by Top fill method. The fuel tank was filled to full capacity before the testing at level condition. After completion of test operation, amount of fuel required to top fill again is the fuel consumption for the test duration.

Table.1 Specification of ride on type paddy weeder

S. No.	Particular	Specification power weeder
1.	Name of machine	Self-propelled ride on type paddy weeder
2.	Make	TNAU Coimbatore
3.	Model	Prototype
4.	Type of machine	Self-propelled
5.	Overall length of machine (mm)	1500
6.	Overall height of machine (mm)	950
7.	Overall width of machine (mm)	250
8.	Overall weight of machine (Kg)	52
10.	Width of blade (mm)	15
11	No. of blades on wheel	28
12.	Diameter of weeder (mm)	600
13.	Weight of float (kg)	6
14.	Length of float (mm)	850
15.	Width of float (mm)	150

Table.2 Field capacity and efficiency of ride on paddy weeder

Observations	Area of field in (m^2)	Ride on paddy weeder	
		Effective field capacity	Field efficiency (%)
1	300	0.03064	81.73
2	300	0.02998	79.95
3	300	0.0295	79.39
Average	**300**	**0.03004**	**80.35**

Table.3 Weeding efficiency of weeder at 22 DAS

Observation	Ride on type paddy weeder		
	Number of weeds in 1 sq.m area		Weeding efficiency %
	Before weeding	After weeding	
1	123	21	82.93
2	131	23	82.44
3	140	19	86.43
4	151	23	84.77
5	132	26	80.30
6	127	19	85.04
7	119	21	82.35
8	163	20	87.73
9	134	21	84.33
Average			**84.04**

Table.4 Plant damage by weeder at 22 DAS

Observations	Ride on type paddy weeder		
	Number of plants in 10 m row length		Plant damage %
	Before weeding	Plants damaged after weeding	
1	40	2	5.0
2	40	1	2.50
3	40	1	2.50
4	40	1	2.50
5	40	1	2.50
6	40	1	2.50
7	40	2	5.0
8	40	1	2.50
9	40	2	5.0
Average			**3.33**

Table.5 Performance evaluation of prototype ride on type paddy weeder

S. No.	Parameters	Values
1.	Wheel slip, %	15
2.	Weeding efficiency, %	84.4 %
3.	Plant damage, %	3.33
4.	Field capacity, ha h^{-1}	0.0306
5.	Field efficiency, %	80.35
6.	Fuel consumption, lit h^{-1}	0.6

Fig.1 Labour requirement in rice farming

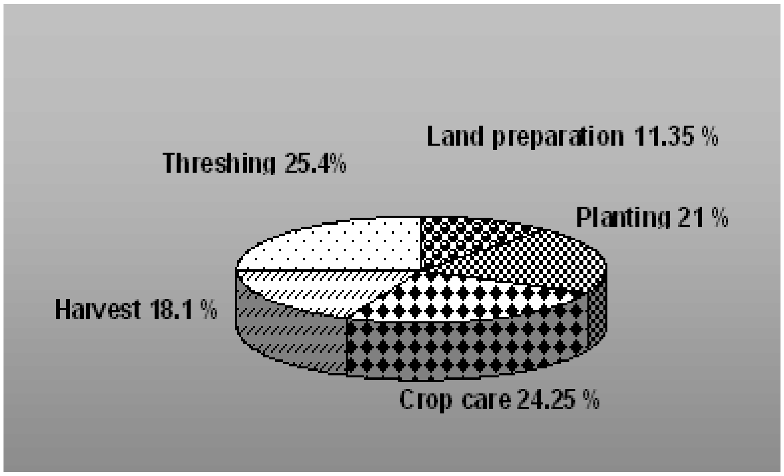

Fig.2 Field view of ride on type paddy weeder

Fig.3 View of the field before weeding

Fig.4 View of the field after weeding

This observation was used for computation of fuel consumption in L/h.

Results and Discussion

Field evaluation of ride on type paddy weeder

The developed prototype self-propelled ride on type paddy weeder was evaluated in paddy field having cone index 0.14 to 2 kg cm^{-2}.

Wheel slippage

Wheel slip for power weeder was measured by monitoring the number of revolutions of the wheel over a specified distance under load and zero load conditions. Number of revolutions of wheel in 10 m row under no load was 11. Number of revolutions of wheel in 10 m row under load was 13.

$$S' = \frac{n_1 - n_0}{n_0} \times 100 \quad = \quad = 15\ \%$$

The determined wheel slip of the prototype ride on type paddy weeder was 15%.

Effective field capacity

The effective field capacity of the self-propelled ride on type weeder obtained from the experiments varied between 0.03 ha/h to 0.0306 ha/h and the average effective field capacity of the weeder was 0.03004 ha/h. The results are presented in Table 2 and Field view of paddy weeder shown in Figure 2.

Theoretical field capacity

It is always greater than effective field capacity

Width of weeder is 0.15 m and speed of operation is 2.5 kmh^{-1}

$$\text{T.F.C. (ha h}^{-1}) = \frac{W_t \times S}{10} = \frac{0.15 \times 2.5}{10} = 0.0375 \text{ha h}^{-1}$$

Field efficiency

The field efficiency was calculated from theoretical and effective field capacity by using following formula.

$$\text{Field efficiency (\%)} = \frac{\text{E.F.C.}}{\text{T.F.C.}} \times 100 = \frac{0.03004}{0.0375} = 80.35\ \%$$

The field efficiency of the prototype weeder was 80.35 % and effective field capacity and field efficiency of the weeder is given in Table 2.

Weeding efficiency

The weeding efficiency of developed self-propelled weeder was determined and presented in Table 3. Weeding operation of the experimental plot shown in Figure 3 and 4.

Plant damage

The plant damage was measured in paddy field and furnished in Table 4.

Fuel consumption

Fuel consumption of the weeder was calculated by "topping method". It was observed that the fuel consumption of the self-propelled ride on type paddy weeder varied between0.557 L/h to 0.635 L/h and the average fuel consumption was 0.6 L/h and given Table 5.

In field evaluation the of developed ride on type paddy weeder the following evaluated parameters were wheel slip 15%, effective field capacity 0.03004 hah-1, theoretical field capacity 0.0375 ha h-1, field efficiency 80.35 %, plant damage 3.33% and weeding efficiency 84.04%. Fuel consumption of the weeder was 0.6 lit h^{-1} and cost of operation of developed weeder was Rs. 2741.11 ha^{-1}.From performance evaluation of ride on type paddy weeder found better than hand weeding and power operated paddy weeder in rice cultivation.

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