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Performance Evaluation of Different Models of Power Weeders for Pulse Crop Cultivation

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Abstract

The arduous operation of weeding is usually performed manually with the use of traditional hand tools in upright posture, inducing back pain for majority of labours. Weeding is the one of the labour intensive and tedious operation in pulse cultivation. This situation necessitates the introduction of suitable power weeders for pulse cultivation. With this objective to select the suitable power weeder for pulse cultivation a study was conducted at TNAU fields with 3 models of commercially available power weeders (Model A, B and C). In this case, to suit the power weeder the crop geometry was modified with 60 × 10 cm in pulse cultivation. The three models were compared with conventional method of hand weeding. The working width of the power weeders were 60 cm, 60 cm and 30 cm respectively for Model A, B and C. Manual weeding using hand hoe registered maximum weeding efficiency of 83.10 % (wet basis) and 82.5 % (dry basis). The weeding efficiency of Model A was 74.10 % (wet basis) and 73.45 % (dry basis), Model B recorded 63.49 % (wet basis) and 64.15 % (dry basis) and Model C recorded lowest weeding efficiency of 43.43 % (wet basis) and 43.13 % (dry basis). The saving in cost of weeding operation with three models when compared to manual weeding were 75.8, 72.5 and 54.8 % respectively for Models A, B and C. The saving in time of weeding operation using with the three models when compared to the manual weeding was 95.8, 94.6 and 89.8 % respectively for Models A, B and C.

Introduction

Pulse crops are grown on large scale in almost all tropical and subtropical countries of the world. The major pulse producing counties are India, china, Canada, Brazil, Australia, Nigeria, France, Myanmar, USA, Turkey, and Mexico. Among these, India occupies first position in acreage and production. The important pulse crops grown in India during Kharif are green gram, black gram, pigeon pea, horse gram and cow pea and during Rabi season chick pea, lentil, fababean and dry pea.

The area and production of pulses in India in 2005-06 was 22.39 million ha and 13.39 million tonnes, with a yield of 598 kg/ha. India is the key player with 25 % share in the global pulses basket. The area under pulses, production and productivity of total pulses in Tamil Nadu in 2005-06 was 0.53 million ha and 0.18 million tonnes and 337 kg/ha respectively. Tamil Nadu accounts for about 3 % of the total area under pulses and 2.5 % of total production in India.

The productivity of farms depends greatly on the availability and judicious use of farm power in pulse production. Agricultural machines increase productivity of pulse crop and reduce non availability of labours by meeting timeliness of farm operations and increase work output per unit time.

One third of the cost of cultivation is spent on weeding alone when carried out with manual labour. The arduous operation of weeding is usually performed manually with the use of traditional hand tools in upright posture, inducing back pain for majority of labours. Weeding is the one of the labour intensive and tedious operation in pulse cultivation. This situation necessitates the introduction of suitable power weeders for pulse cultivation.

Review of Literature

Hand weeding with or without

hoes can be an important and effective means of controlling weeds within the planted row if there is conducive soil moisture. The physiological demand in using weeders was relatively higher than that in manual weeding. However, the efficiency of the work in terms of area covered was significantly better with the weeder than with manual weeding. The energy demand in manual weeding is only about 27 % whereas for weeding with different weeders, the energy goes up to 56 %. The strain was relatively less in case of wheel hoe type weeder (Rajasekar, 2002).

According to Pullen and Cowell (1997), cutting action of the blade hoe is used most efficiently when operated at shallow depth and increasing the working depth does little to improve weed kill but a higher forward speed increases soil covering of weeds and may reduce their survival.

Padole (2007) reported that rotary power weeder works better in respect of working depth (5.67 cm) which is 16.67 % more than bullock drawn blade. Goel *et al.* (2008) reported that the plant damage increased with decrease in moisture content below 11.63 % and this may be due to the reason that with decrease in moisture content soil hardness increased and as a result weeder could not penetrate to desired depth and sometimes skid over hard surface and strikes the plant. Higher percentage of plant damage at 13.52 % soil moisture content was due to more softness of soil which allowed higher penetration of weeders inside soil surface that cause root damage and uprooting of some plants.

Rangasamy *et al.* (1993) evaluated the performance of power weeder and the field capacity of the weeder was 0.04 ha hr^{-1} with weeding efficiency of 93 for removing shallow rooted weeds and the cost of operation with power weeder amounted to Rs. 250 as against

Rs. 490 by dryland weeders and Rs. 720 by manual weeding with hand hoe per hectare. The saving in cost and time amounted to be 65 % and 93 %, respectively.

Material and Methods

With this objective to select the suitable power weeder for pulse cultivation a study was conducted at TNAU fields with 3 models of commercially available power weeders (Model A, B and C). In this case, to suit the power weeder the crop geometry was modified with 60 × 10 cm in pulse cultivation. The three models were compared with conventional method of hand weeding. Specifications of the three models of the power weeder are given in Ta 1. The operational view of po weeders are shown in **Fig. 1**.

The selected three weeders w used for weeding the pulse crop its performances were compa with the conventional metho weeding. In the conventional m od of weeding a pulse crop is formed by women labourers us hand hoe.

The treatments selected fo investigation were:

T_1: Conventional (Manual w ing)

T_2: Operation with self prope power weeder Model A

T_3: Operation with self prope power weeder Model B

T_4: Operation with self prope power weeder Model C

The weeders were evaluated its performance in terms of wee efficiency (wet and dry basis), d of operation and percentage of p damage. The moisture conte the soils during the evaluation 15.28 % on dry basis.

The cost of weeding using the ferent models of power weeder compared with the manual wee method.

Table 1 Specification of the power weeders

Particulars	Model A	Model B	Model C
Power, hp	5.5	4	1.6
Power source	Four stroke petrol engine	Four stroke diesel engine	Two stroke pe engine
Width of operation, mm	600 (Adjustable up to 800 mm)	450 mm	300 mm

Fig. 1 Operational view of the power weeders Model A, B and C

Table 2 Results of the performance evaluation of the power weeders in pulse crop

Particulars	Manual	Model A	Model B	Model C
Wet weight of weeds collected, gm/m²	436.70	400.40	305.30	184.83
Wet weight of weeds left out in the filed, gm/m²	88.80	140.00	175.50	240.77
Total wet weight of weeds, gm/m²	525.50	540.40	480.80	425.60
Weeding efficiency(wet basis)	85.1	74.1	63.49	45.43
Dry weight of weeds collected , gm/m²	237.27	155.78	119.64	71.28
Dry weight of weeds left out in the filed, gm/m²	50.33	56.32	66.86	93.98
Total dry weight of weeds, gm/m²	287.60	212.10	186.50	165.26
Weeding efficiency(dry basis)	82.5	73.45	64.15	43.13
No. of plants for 30 m long	109	104	98	118
No. of damaged plants	2	10	11	5
Percentage of damage	0.18	9.62	11.2	4.2
Depth of operation, mm	38	62	58	35

Results and Discussions

The performance evaluation results of the different models of the power weeder is shown **Table 2**.

The weeding efficiency for all the models is shown in **Fig. 2** and **Fig. 3**. It is observed that there was no significant variation between the weeding efficiency on wet basis and dry basis in all the treatments. Among the treatments Manual method registered the maximum efficiency of 83.1 % (wet basis) and 82.5 % (dry basis). The efficiency of model A and Model B are comparable. Model C had a lowest efficiency of 43.43 % (wet basis) and 43.13 % (dry basis).

The depth of operation in weeding for all the treatments are shown in **Fig. 4**. It was in inferred that the depth of operation was highest in Model A operation (6.2 cm) followed by Model B (5.8 cm). Owing to this maximum depth of operation the weeds were completely uprooted and the weight of the weeds collected per unit area was also maximum in Models A and B as seen from the

Fig. 2 weeding efficiency in wet basis

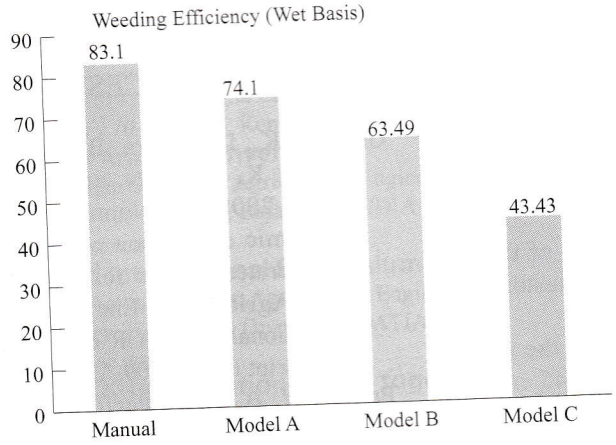

Fig. 3 weeding efficiency in dry basis

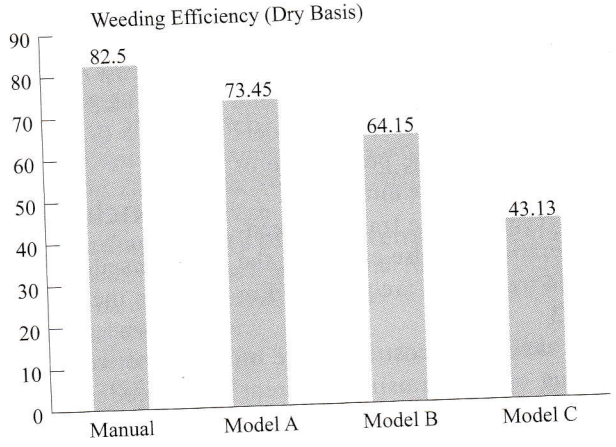

Fig. 4 Depth of operation of weeders

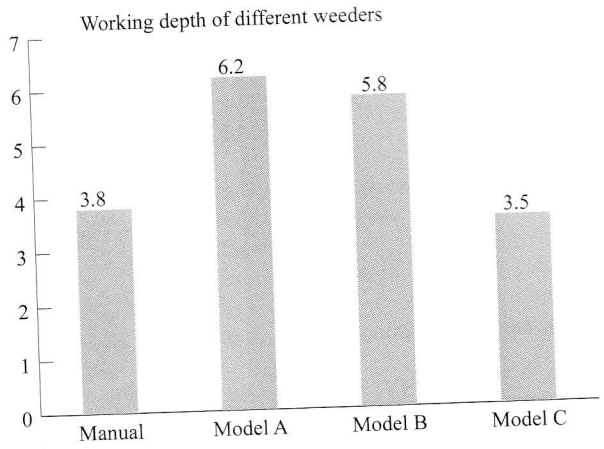

Fig. 5 Percentage of plant damage

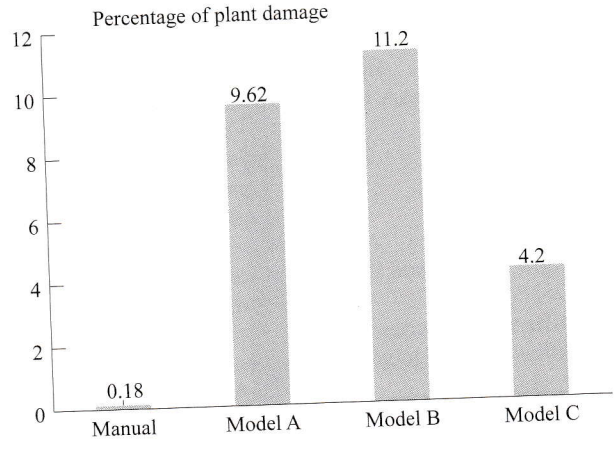

Table 3 Results of the evaluation of the power weeders in pulse crop

Particulars	Manual	Model A	Model B	Model C
Length of the field, m	-	50	50	50
Width of operation, m	-	0.600	0.450	0.300
Time taken to travel 50 m, sec	-	125.4	135.5	160.4
Forward speed, km/hr	-	1.43	1.32	1.12
Theoretical field capacity, ha/day	-	0.686	0.475	0.268
Size of the filed , m^2		$50 \times 15 = 750$		
Time taken to complete 750 m^2, min	440 hrs/ha	81.4	105.8	195.0
Actual field capacity, ha/day	-	0.44	0.34	0.18
Field efficiency, %	-	64.1	71.5	67.1
Cost of operation, Rs/hr	-	58.50	51.42	44.73
Cost of weeding, Rs/ha	4400	1064	1210	1988
Saving in cost when compared to manual method, %	-	75.8	72.5	54.8
Saving in time when compared to manual method, %	-	95.8	94.6	89.8

observations recorded in **Table 2**.

The percentage of plant damage in the trail field during the operation of the weeders is shown in **Fig. 5**. The percentage of plant damaged was greater in Model A and followed by Model B. This is due to the fact that wheels and the blade caused damage to the plants while passing through rows. With sufficient head land and training in operation of the weeders in between row the percentage of plant damage can be minimized.

The results of the trail for weeding operation in pulse crop with the selected treatments are presented in **Table 3**.

The savings in cost and time of weeding operation using different models of the power weeder are shown in **Fig. 6** and **Fig. 7**.

It is clearly reflected from the figure that all the treatments the saving in cost and time was maximum in Model A (75.8 % and 95.5 %) followed by Model B (72.5 % and 94.8 %). The Model C recorded the lowest cost of saving and time is 57.8 % and 88.8 %.

Conclusions

Based on the analysis of the results the following conclusions are drawn:

- The working width of the power weeders were 60 cm, 45 cm and 30 cm respectively for Model A, B and C.
- Manual weeding using hand ho registered maximum weeding ef ficiency of 83.10 % (wet basis) an 82.5 % (dry basis). The weedin efficiency of Model A was 74.1 % (wet basis) and 73.45 % (dr basis), Model B recorded 63.4 % (wet basis) and 64.15 % (dr basis) and Model C recorded low est weeding efficiency of 43.43 (wet basis) and 43.13 % (dry ba sis).
- The saving in cost of weeding op eration with three models whe compared to manual weedin were 75.8, 72.5 and 54.8 % re spectively for Models A, B and C
- The saving in time of weeding op eration using with the three mod els when compared to the manua weeding was 95.8, 94.6 and 89.8 % respectively for Models A, B and C.

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Padole, Y. B. 2007. Performance

Fig. 6 Saving in cost of weeding

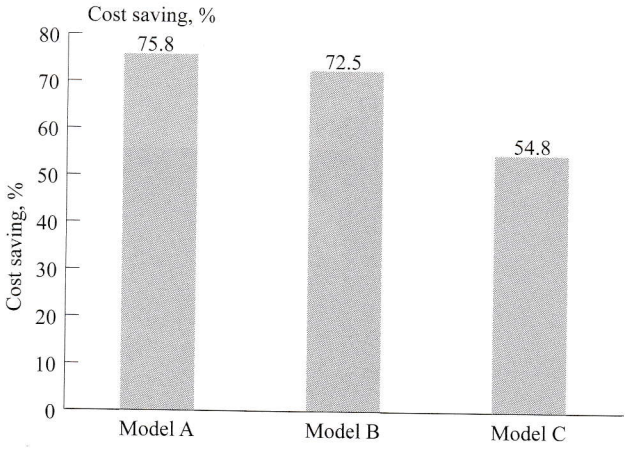

Fig. 7 Saving in time for weeding operation