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Performance Evaluation of Power weeder, Star weeder and Wheel hoe

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ABSTRACT

Performance evaluation of intercultural implements such as power weeder, star weeder and wheel hoe was conducted in the Agricultural college farm, Bapatla during the year 2012-13. Three weeders were initially evaluated in the dry land planted with maize with a plot size 20 m × 10 m. Power weeder was also evaluated in the wet land (paddy field) at the plant age of 30 days which was maintained with a crop row to row spacing of 20 cm and average plant to plant spacing of 18cm. Actual field capacity, theoretical field capacity, field efficiency, weeding efficiency, plant damage and cost of operation were considered to evaluate the performance of three weeders.

Actual field capacities and theoretical field capacities of power weeder, wheel hoe and star weeder were 0.0494 ha/h, 0.022 ha/h, 0.021 ha/h and 0.060 ha/h, 0.030 ha/h, 0.026 ha/h respectively. Whereas field efficiencies of power weeder, wheel hoe and star weeder was found to be 82.33%, 73.66%, 80.76% respectively. Power weeder has more field efficiency than other two weeders. Plant damage observed for power weeder, wheel hoe and star weeder were 11.10%, 2.20%, and 1.17% respectively. Weeding efficiencies of power weeder, wheel hoe and star weeder were found as78.4%, 74.0%, and 75.4% respectively. Power weeder has more weeding efficiency than other two weeders. Cost of operation of power weeder, wheel hoe and star weeder was Rs.2532.71/ha, Rs.1696.5/ha and Rs.1785.37/ha respectively. Operational cost is more for power weeder and less for wheel hoe, star weeder compared to power weeder. Actual field capacity, theoretical field capacity, field efficiency, weeding efficiency of power weeder in wet land were 0.0439 ha/h, 0.072 ha/h, 60.9 %, 69.65% respectively. Plant damage observed in paddy field weeding was 8.34%.Cost operation of power weeder in wet land (paddy) field is Rs.2658.20 /ha. The weeding efficiency and cost of operation were more for power weeder under wet land weeding.

Key words : Field capacity, Plant damage, Power weeder, Star weeder, wheel hoe.

A weed is essentially any plant which grows where it is unwanted. Weeds are major pests in upland as well as shallow low land rice (Biswas *et al*). The labour availability during the operation is scarce and the cost of operation in high (Pardia B.C). Timeliness of operation is not maintained, it results in reduced yield and loss to farmers. Beside manual and chemical methods of weeding are costlier. Today the agricultural sector requires non-chemical weed control that ensures food safety (Mallikarjun Reddy *et al*).

Delay and negligence in weeding operation affect the crop yield up to 30 to 60 per cent. Uncontrolled weeds growth reduces the returns from the overall investments in the production of crops. Various types of cutting blades are used for manually operated weeder. Where weeders are continuously pushed, V-shaped sweep is preferred and tool geometry of these cutting blades is based on soil-tool plant interaction. The objectives of the present study is to evaluate the performance of power weeder, star weeder and wheel hoe in dry land (maize field), to estimate the cost of operation of power weeder, star weeder and wheel hoe and to evaluate the performance of power weeder in wet land.

MATERIAL AND METHODS

The present study was conducted on the Performance evaluation of power weeder, star wheel and wheel hoe. Performance of three weeders (Power weeder, Star weeder and Wheel hoe) was conducted in Agricultural College Farm, Bapatla (2012-13), located at an altitude of 15°58' N latitude and 80° 28' E longitude. The three weeders were evaluated in dry land (maize crop). The maize crop was divided into number of plots of sizes 20 m x 10 m. The row to row and plant to plant spacing maintained was 60 cm and 15 cm respectively. Weeding was done in field at the plant age of 25 days.

Power weeder was also evaluated in the wet land (Paddy field) in Agricultural College Farm, Bapatla. The paddy crop was planted in a row spacing of 20 cm and average plant to plant spacing of 18 cm. The weeding was done at the plant age of 30 days. Cost of operation for three weeders was calculated to know the efficient and low cost weeder for weeding.

Work Plan

Initially the three weeders were evaluated for its performance in dry land (maize crop). The following parameters had been considered.

Effective working depth

The depth of weeding was measured by measuring with scale in different rows at different places. Average of five observations was taken as depth of weeding and it is expressed in cm.

Speed of operation

Operational speed of weeders was calculated by fixing two poles, 20m apart in the test plot. The time required to travel the 20 m distance was recorded to calculate the average value of time. From this time the effective field capacity has been estimated.

Actual field capacity

Time consumed for real work (t_p) and that cost for other activities such as turning at headlands, blade cleaning when clogging with weeds (t_c) was measured by stopwatch and recorded for calculation.

$$a = \frac{A}{(t_p + t_c)}$$

Where,

a = actual field capacity (ha/h)

A = area covered, ha

t_p = Productive time, h

t_c = Unproductive time, h

Theoretical field capacity

Theoretical field capacity is the rate of field coverage of implement, based on 100 percent of time at the rated speed and covering 100 percent of its rated width.

$$f = \frac{(W \times S)}{10} \quad f = \frac{(W \times S)}{10}$$

Where,

f = theoretical field capacity (ha/h)

W= Width (m)

S= Speed of operation (km/h)

Field efficiency

Field efficiency is the ratio of effective field capacity to theoretical field capacity. It was determined by the formula.

$$Effeicency = \frac{\text{Actual field capacity}}{\text{Theoretical field capacity}} \times 100$$

Fuel consumption

The fuel consumption has direct effect on economics of the power weeder. It was measured by Top fill method. The fuel tank was filled to full capacity before the test was conducted. After completion of test operation, amount of fuel required to top fill again is the fuel consumption for the test duration. This observation was used for computation of fuel consumption in L/h.

Weeding efficiency

It is the ratio between the numbers of weeds removed by a weeder to the number present in a unit area and is expressed as percentage. The spots where such counts are taken were randomly selected and a square metallic frame covering area of 1 m^2 was used for sampling. The weeding efficiency was calculated by the following formula.

$$e = \frac{(W_1 - W_2)}{W_1} \times 100$$ Where, e = weeding efficiency, percent, W_1 =Number of weeds/m^2 before weeding, W_2 =Number of weeds/ m^2 after weeding.

Plant damage

It is the ratio of the number of plants damaged in a row to the number of plants present in that row. It is expressed in percentage. Plant damage in percentage is given by

Table1. Technical specification of weeders

Parameters	Power weeder	Star weeder	Wheel hoe
Total length (cm)	120	138	169
Handle length (cm)	51	54	61
Wheel width(cm)	17	6	4
Cutting width (cm)	25	17.5	20.5
Wheel diameter (cm)	14	16	32
Weeder height (cm)	80	93	135
No. of blades	2	-	-

Table2. Speed of operation.

Trail	Trail 1	Trail 2	Trail 3	Average speed (kmph)
Power weeder (kmph)	2.42	2.25	2.57	2.41
Star weeder (kmph)	1.40	1.55	1.57	1.50
Wheel hoe (kmph)	1.41	1.61	1.46	1.49

Table 3. Calculation of actual field capacity of power weeder.

Trail	Area of the plot (Sq. m)	Time taken to cover an area of 200 sq. m (min)	Actual Field capacity (ha/h)
1	200	24	0.0495
2	200	24	0.0500
3	200	25	0.0487
Average	200	24	0.0494

Table 4. Calculation of actual field capacity of star weeder .

Trail	Area of the plot (Sq. m)	Time taken to cover an area of 200 sq. m (min)	Actual Field capacity (ha/h)
1	200	60	0.020
2	200	54	0.022
3	200	57	0.021
Average	200	57	0.021

$$q = \left\{ \frac{n_1}{n_2} \right\} \times 100$$

n_1= Number of plants damaged in a 10 m row length after weeding

n_2= Number of plants in a 10 m row length before weeding

RESULTS AND DISCUSSION FOR MAIZE CROP (DRY LAND WEEDING)

Three weeders (Power weeder, wheel hoe and star weeder) were evaluated for its performance in maize field. The results obtained in calculating the parameters such as actual field capacity, theoretical field capacity, field efficiency, plant damage, weeding efficiency, and cost of operation under three replications are tabulated below.

Speeds of operation of three weeders were calculated by noting down the time required to cover 10 m of weeding length. Speed was calculated by calculating the average of three trails as shown in Table.2. The speed of operation of power weeder was more compared to star weeder and wheel hoe, because it was provided with petrol run engine which tills the soil with high rotating blades. Wheel hoe and star weeders are having almost same speeds of operations.

ACTUAL FIELD CAPACITY

Actual field capacity is the ratio of area covered and time taken to cover total area Actual Field capacity was calculated in a plot size of 10 × 20 m. Experiment was conducted in three replications. The actual field capacity varied from 0.049 to 0.050 ha/h with an average of 0.0494 ha/h.

Actual field capacity of star weeder was calculated in the plot size of 10 x20 m. the total time taken to weed the entire area was noted. Field experiment was conducted in three replications. The actual field capacity of star weeder varied form 0.020 ha /h to 0.022 ha/h with an average filed capacity of 0.021 ha/h.

Actual field capacity of wheel hoe is given in Table5. The time taken to cover the area of 200 m^2 was noted down in three replications. The average of the three replications was taken as actual field capacity. The filed capacity varied form 0.022 ha/h to 0.022 ha/h with an average of 0.022 ha/h.

Form the above three tables, the actual field capacity of power weeder was 0.0494 ha/h, which is more compared to wheel hoe and star weeder. This is due to the cutting blades of power weeder propels the weeder to move forward.

PLANT DAMAGE

The plant damage with the power weeder is 11 %, which is more compared to star weeder and wheel hoe. Wheel hoe is having highest plant damage when compared to star weeder.

WEEDING EFFICIENCY

Weeding efficiency was calculated by counting the number of weeds in 1 m^2 area before

Plate.1 Weeders selected for performance (1. Star weeder 2. Wheel hoe 3. Power weeder).

Table 5. Calculation of actual field capacity of wheel hoe.

Tail	Area of the plot (Sq. m)	Time taken to cover an area of 200 sq. m (min)	Actual Field capacity (ha/h)
1	200	55	0.022
2	200	54	0.022
3	200	54	0.022
Average	200	54	0.022

Table 6. Calculation of plant damage.

Weeders were evaluated for its plant damage in maize field in various trails. The average number of weeds before and after inter cultivation is tabulated below.

Types of weeders	Number of plants before weeding	Number of plants after weeding	Plant damage (%)
Power weeder	180	20	11.10
Star weeder	170	2	1.17
Wheel hoe	180	4	2.20

Table 7. Weeding efficiency of power weeder.

Weeding efficiency of power weeder in three different trails were given below.

Replication No	Area of plot (sq.m)	Number of weeds before weeding in an area of 1 m^2	Number of weeds after weeding in an area of 1 m^2	Weeding efficiency (%)
1	1	45	8	82.22
2	1	40	10	75
3	1	50	14	72
Average	1	45	10.66	76.40

Table 8. Weeding efficiency of star weeder.

The weeding effeciecy of star weeder in three different trails were given below.

Replication No	Area of plot (sq.m)	Number of weeds before weeding in an area of 1m^2	Number of weeds after weeding in an area of 1m^2	Weeding efficiency (%)
1	1	36	9	75
2	1	40	11	72.5
3	1	33	7	78.7
Average	1	36.34	9	75.4

Table 9. Weeding efficiency of wheel hoe.

Weeding efficiency of wheel hoe in three different trials were given below.

Replication No	Area of plot (sq.m)	Number of weeds before weeding in an area of 1m^2	Number of weeds after weeding in an area of 1m^2	Weeding efficiency (%)
1	1	40	12	70
2	1	39	11	77
3	1	36	9	75
Average	1	38.33	10.66	74

Table10. Field parameters observed in dry land (Maize crop) with weeders.

Type of weeder	Theoretical field capacity (ha/h)	Actual Field capacity (ha/h)	Field Efficiency (%)	Weeding Efficiency (%)	Plant damage (%)	Cost of operation (Rs/ha)
Power weeder	0.060	0.0494	82.33	78.4	11.10	2533.07
Star weeder	0.026	0.0210	80.76	75.4	1.17	1785.37
Wheel hoe	0.030	0.0221	73.66	74.0	2.20	1696.50

Table 11. Calculation of the speed of operation of power weeder in paddy filed.

Trail	Trail 1	Trail 2	Trail 3	Average speed (kmph)
Power weeder (kmph)	3.1	2.8	2.8	2.9

Table 12. Actual field capacities of power weeder in paddy field.

Trail	Area of the plot (Sq. m)	Time taken to cover an area of 400sq. m (min)	Field capacity (ha/h)
1	400	55	0.0436
2	400	52	0.0461
3	400	57	0.0420
Average	400	54.66	0.0439

Table 13. Calculation of the field efficiency of power weeder in paddy field.

Type of weeder	Theoretical field capacity(ha/h)	Actual field capacity (ha/h)	Field efficiency (%)
Power weeder	0.072	0.0439	60.9

Table 14. Weeding efficiency of power weeder.

Replication No	Area of plot (sq.m)	Number of weeds before weeding in an area of 1 m^2	Number of weeds after weeding in an area of 1 m^2	Weeding efficiency (%)
1	1	50	12	76
2	1	40	15	62.5
3	1	44	13	70.45
Average	1	38	13.33	69.65

Table 15. Comparison of field parameters in dry land and wet land with power weeder.

Parameter	Dry land weeding	Wet land weeding
1.Field efficiency (%)	82.33	60.9
2.Weeding efficiency (%)	78.4	69.65
3.Plant damage (%)	11.10	8.34
4.Fuel consumption (l/h)	1.02	1.1
5.Cost of operation (Rs/ha)	2533.07	2658.20

and after weeding. Weeding efficiency of power weeder is estimated to be 76.4 % (Table.7), which is more compared to star weeder efficiency of 75.4 % and wheel hoe efficiency of 74 %. (Table. 8, Table.9).

Average theoretical field capacities were calculated as 0.026, 0.030 and 0.060 ha/h for star weeder, wheel hoe and power weeder respectively. The field efficiency of power weeder was 82.33 %.

From table 10, it is evident that cost of operation of power weeder is Rs. 2533.07 /ha, Wheel hoe is having less cost of operation, where as drudgery is more in wheel hoe compared to power weeder and star weeder.

FOR PADDY FIELD (WET LAND WEEDING)

A paddy field of one acre was selected which was located at the Agricultural College Farm, Bapatla. The crops were planted in rows with row spacing of 20 cm and plant-to-plant spacing of 18 cm. power weeder is tested in this field for weeding purpose.

The speed of operation of power weeder in paddy field is conducted in three trails. The average speed was 2.9 Kmph.

ACTUAL FIELD CAPACITY

Table 12. Actual field capacities of power weeder in paddy field

Actual field capacity was calculated in three replications ranges from 0.0420 ha/h to 0.0461 ha/h with an average field capacity of 0.0439 ha/h.

Field efficiency

Field efficiency of power weeder was observed in an experimental plot. The results are presented in Table 13. Filed efficiency of power weeder is estimated to be 88.8 % in paddy fields. Average weeding efficiency of power weeder was 69.65 per cent, which was calculated from the average of three replications which is tabulated in Table 14.

Field efficiency, plant damage and weeding efficiency were found to be more with power weeder in dry land weeding. Whereas cost of operation and fuel consumption were more in wet land as shown in Table. 15.

SUMMARY AND CONCLUSIONS

1. Actual field capacities of power weeder, wheel hoe and star weeder in dry land (Maize field) were 0.0494 ha/h, 0.022 ha/h and 0.021 ha/h respectively.
2. Theoretical field capacities of power weeder, wheel hoe and star weeder dry land (Maize field) were 0.060 ha/h, 0.030 ha/h and 0.026 ha/h respectively.
3. Field efficiencies of power weeder, wheel hoe and star weeders in dry land (Maize field) were 82.33%, 73.66%, 80.76% respectively. Power weeder has more field efficiency than other two weeders.
4. Plant damage observed for power weeder, wheel hoe and star weeders in dry land (Maize filed) were 11.10%, 2.20%, and 1.17% respectively. More plant damage is observed in power weeding operation than other two weeding operations. Plant damage observed in paddy field was 8.34%.
5. Weeding efficiencies of power weeder, wheel hoe and star weeder are 78.4%, 74.0%, and 75.4% respectively. Power weeder has more weeding efficiency than other two weeders.
6. Cost of operation of power weeder, wheel hoe and star weeder are Rs.2533/ha, Rs. 1696.5/ha and Rs.1785.37/ha respectively. Operational cost is more for power weeder and less for wheel hoe, star weeder compared to power weeder. Cost operation of power weeder in wet land (paddy) field is Rs.2658.20 /ha.

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