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# PERFORMANCE AND EVALUATION OF DEVELOPED MANUALLY OPERATED WEEDER

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**Abstract:** India is vast country having agriculture sector as the backbone of its economy. Majority of the population is employed under agriculture sector. In agricultural operations weeding is the important but it is time consuming and requires man power. Manually operated weeder that can be operated by single man was developed but it is necessary to evaluate the performance of weeder. In this study the developed manually operated weeder is evaluated based on the performance indices such as field capacity, weeding efficiency, plant damage, suitable speed of operator and moisture content of the field. Two fields were selected for conduction of field experiments. The results showed that highest weeding efficiency of 81.8 % with minimum of 4.39 % plant damage was obtained. The result of this study concluded that weeding efficiency of field is depending on speed of operator when speed of operator is a increases then weeding efficiency is decreases.
**Keywords:** Field capacity, Moisture content, Weeding, Weeder, Weeding efficiency.

## Introduction

Manual weeding requires huge labour force. Weeding is important but equally labour intensive agricultural unit operation in world. All crops are mostly affected due to weeds. Weeding accounts for about 25 % of the total labour requirement (900–1200 man-hours/hectare) during the cultivation season (Nag and Dutta, 1979). Delay and negligence in weeding operation affect the crop yield up to 30 to 60 per cent (Singh, 1988). In India, about 4.2 billion rupees are spent every year for controlling weeds in the production of major crops. At least 40 million tonnes of major food grains are lost every year due to weeds alone (Singh and Sahay, 2001). The reduction of yield due to weed was 11.8 % of the total yield in Asia. This operation is mostly performed manually with cutlass or hoe that requires high labour input, very tedious and it is a 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. Often several weeding operation are necessary to keep the crop weed free. Reduction in yield due to weed alone was estimated to be 16 to 42 % depending on crop and location which involves one third of the cost of cultivation (Rangasamy *et al.,* 1993).

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Weeds are unwanted and undesired plants which grow among the field crops. It interfere and compete with main crop for their existence, causing serious yield loss by share in land, water, nutrients, sun light, and available $CO_2$ for main crop (Rao, 1999). Weeds waste excessive proportions of farmer's time, thereby acting as a brake on development. Presently in India, weeding with simple tools such as cutlass, hoe etc is labour intensive and time consuming. Thus, there is a need for the design of manually operated weeder for intensive and commercial farming system in India. One of the major problem in crops and vegetables production is poor weed control; hence there is a need of mechanical weeder to increase the crop production. The cost for employing labour force when using simple tools is very high in commercial farming system. This can be reduced using mechanical weeder. Therefore, objective of this project is to evaluate the performance of developed manually operated weeder.

**Material and methods:**

After developing manually operated weeder how it actual work is described here,

**Experimental site**

The study was conducted at Research Farm Jalgaon (Jamod). The field was carefully selected for conduction of the study. Developed manually operated weeder is operated for cutting of weed.

**Material required**

The following material is used for determining the different methods.

**1. Measuring tape:**

The long measuring tape is required for measuring the different dimension of developed weeder.

**2. Stop watch:**

Stop watch was required for calculating the speed of operator and also required to calculate theoretical speed of operator. Because the speed of operator is also affected by the weeding efficiency.

**3. Weighing balance:**

Weighing balance was required to record observations of weight of soil for calculating moisture content of soil.

**4. Moisture boxes:**

The aluminum moisture boxes were used for calculating the moisture content of soil.

**5. Electric oven:**

Electric oven is required for calculating moisture content of soil. It is important to calculate moisture content because it is affected by weeding efficiency.

**Performance and evaluation of manually operated weeder**

**1. Moisture Content**

Moisture content for soil sample is computed on dry basis. For measurement of soil moisture, take core samples of wet soil from at least three different locations randomly selected in the test plot. Record the weight of wet soil sample. Place the sample in hot air oven maintained at 105$^{o}$ C for at least 24 hrs. At the end of 24 hrs, place the sample for cooling in the in desiccators and note the observations of weight again. Calculate the soil moisture using the following formula (Veerangouda *et al.,* 2010).

$$Soil\ moisture\ \%\ (dry\ basis) = \frac{Wieght\ of\ wet\ soil\ sample\ (g) - Weight\ of\ dry\ soil\ sample(g)}{Weight\ of\ dry\ soil\ sample(g)} \times\ 100$$

**2. Speed of operator:-**

Speed of operator was calculated by putting two pole at two end of the field, opposite in direction. The operator travelled from starting point to end point. The observation of time required and distance travelled was recorded. The speed of operator was calculated by ratio of distance travelled to time required (Olaoye *et al.*,1990).

$$S = \frac{d}{t}$$

Where,

S = Speed of operator (m/s)

d = Distance travelled by operator (m)

t = Time required to travel (sec)

**3. Actual field capacity**

The actual field capacity is the actual rate of coverage by the implement. The total time required to complete the operator was recorded and actual field capacity was calculated as followed by (Kumar *et al.,* 2014).

$$Actual\ field\ capacity = \frac{A}{T}$$

Where,

A = area covered by machine, m$^2$

T = time taken by machine to cover area A, s

**4. Theoretical field capacity:-**

The theoretical field capacity is the rate of field coverage that would be obtained if implement were performing its function 100% of the time at the rated speed and always covering 100% of its rated width. Field capacity was calculated by following expression (Kumar *et al.*, 2014).

$$\text{Theoretical field capacity} = \frac{S \times W}{10}$$

Where,

W = Width of Machine, m

S = Speed of operator, m/s

**5. Field efficiency**

Field efficiency is the ratio of actual field capacity and theoretical field capacity. It is expressed in percentage by following expression (Kumar *et al.*, 2014).

$$Field\ efficiency = \frac{\text{Actual field capacity}}{\text{Theoratical field capacity}} \times 100$$

**6. Weeding index:-**

Weeding index is the ratio between the numbers of weeds removed by a weeder to the number of weeds which were present in one unit area before starting operator (Goel *et al.*, 2008).

$$\text{Weeding index} = \frac{\text{W1} - \text{W2}}{\text{W1}} \times 100$$

Where,

W1 = Number of weeds before weeding

W2 = Number of weeds after weeding

**7. Plant damage:-**

Plant damage was calculated by counting the number of injured plants in sample plot to the total number of plants in sample plot. Plant damage was calculated by following expression (Kumar et al., 2014).

$$\text{Pd} = \frac{\text{A}}{\text{B}} \times 100$$

Where,

Pd = plant damage, %

A = No. of injured plants (cut or damaged) in sample plot

B = Total no. of plants in sample plot.

**Findings and analysis:**

This experiment was conducted at the Research Farm of C.A.E.T Jalgaon (Jamod). The observations were recorded at field conditions. Experiment was conducted by plotting number of field for noting the observations for speed of operator, actual field capacity, theoretical field capacity, field efficiency, moisture content of soil, bulk density, weeding efficiency. The above observations were analysed and results were computed. From the results suitable conclusions were drawn and are discussed in the following sections.

**1. Moisture content of soil**

The test was carried out in two different field (A &B). Soil sample is collected from the field and kept in the digital electrical oven for calculating the moisture content of soil sample. The result of this is shown in table 1

**Table 1:** Moisture content of soil in field A and field B

| Sr no. | A (%) | B (%) |
|---|---|---|
| 1 | 13.40 | 11.15 |
| 2 | 13.13 | 11.88 |
| 3 | 12.37 | 11.34 |
| 4 | 13.86 | 11.11 |
| 5 | 12.25 | 11.11 |
| **Average** | 13.00 | 11.15 |
| **Total average =** 12.25 | | |

From the Table 1, it is observed that the average moisture content of field A is 13 % and the field B average moisture content is 11.15 %. This infers that the field A has high moisture content than field B. The total average moisture content of soil is 12.25 %.

**2 Performance and evaluation of manually operated weeder**

**Table 2:** Effect of moisture content on speed of operator and field efficiency for field A

| Sr no. | Moisture content (%) | Speed of operator (m/s) | Field efficiency (%) |
|---|---|---|---|
| 1 | 13.40 | 0.40 | 66 |
| 2 | 13.13 | 0.43 | 62.85 |
| 3 | 12.37 | 0.47 | 61 |
| 4 | 13.86 | 0.39 | 73.84 |
| 5 | 12.25 | 0.49 | 58 |
| **Average** | 11.50 | 0.44 | 64.34 |

**Plate 1.** Performance and evaluation of manually operated weeder

The relationship between moisture content, speed of operator and field efficiency is presented in the table 2. The result shows that average speed of operator in field A is 0.44 m/s and field efficiency in field A is 64.33%. From the above table it is observed that when the speed of operator was increased, the field efficiency decreased. This states that the relation between the speed of operator and the field efficiency is inverse. When the moisture content of soil increases then speed of operator decreases and vice versa. But when moisture content of soil increases then field efficiency is increases due to decrease in speed and vice versa.

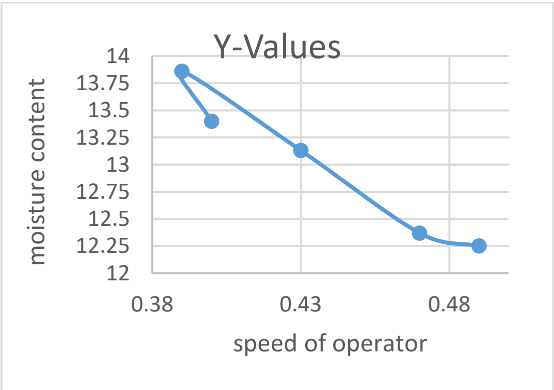


**Fig 1:** Effect of moisture content on speed of operator in field A

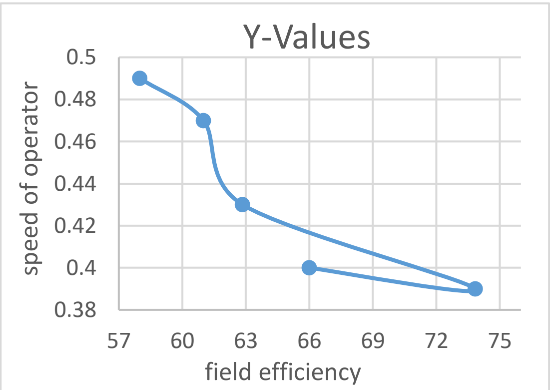


**Fig 2:** Effect of speed of operator on field efficiency in field A

**Table 3:** Effect of moisture content on speed of operator and field efficiency in field B

| Sr. No. | Moisture content (%) | Speed of operator (m/s) | Field efficiency (%) |
|---|---|---|---|
| 1 | 11.15 | 0.57 | 60 |
| 2 | 11.88 | 0.51 | 66 |
| 3 | 11.74 | 0.55 | 64 |
| 4 | 11.11 | 0.58 | 58 |
| 5 | 11.65 | 0.54 | 65 |
| **Average** | 11.50 | 0.55 | 62.6 |

From Table 3, it is seen that the speed of operator decreased when field efficiency was increases and also depicted in fig 4. The average speed of operator in field B is 0.55 m/s and average field efficiency in field B is 62.6 %. The highest field efficiency 66 % obtained at 11.88 % moisture content. Hence, in field B, 11.88 % moisture content is best for weeding efficiency.

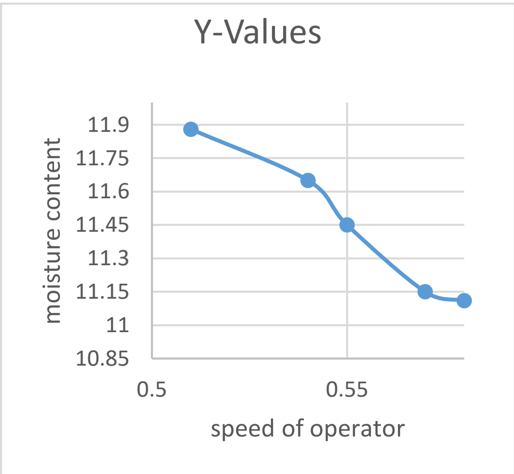


**Fig 3:** Effect of moisture content on speed of operator in field B

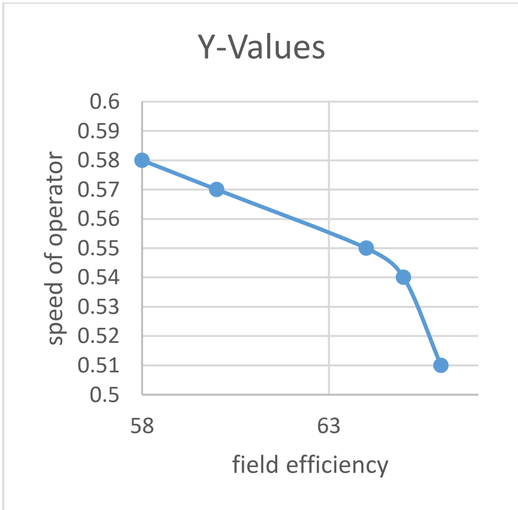


**Fig 4:** Effect of speed of operator on field efficiency in field B

**Table 4:** Effect of moisture content on speed of operator and weeding efficiency in field A

| Sr no. | Moisture content (%) | Speed of operator (m/s) | Weeding efficiency (%) |
|---|---|---|---|
| 1 | 13.40 | 0.40 | 84 |
| 2 | 13.13 | 0.43 | 81 |
| 3 | 12.34 | 0.47 | 79 |

| | | | |
|---|---|---|---|
| 4 | 13.86 | 0.39 | 88 |
| 5 | 12.25 | 0.49 | 77 |
| **Average** | 13 | 0.43 | 81.8 |

From the table 4 it is observed that when moisture content in field A is decreased the speed of operator is increases and vice versa. But when moisture content in field increases then weeding efficiency was observed to be decreased due to increase in speed of operator and due to some other reason. The average speed of operator in field A is 0.43 m/s average weeding efficiency of field A 81.8 % and 13.40 % moisture content of soil gives best condition for weeding efficiency.

**Table 5:** Effect of moisture content on speed of operator and weeding efficiency in field B.

| Sr. No. | Moisture content (%) | Speed of operator (m/s) | Weeding efficiency (%) |
|---|---|---|---|
| 1 | 11.15 | 0.57 | 76 |
| 2 | 11.88 | 0.51 | 68 |
| 3 | 11.74 | 0.55 | 71 |
| 4 | 11.11 | 0.58 | 79 |
| 5 | 11.65 | 0.54 | 74 |
| **Average** | 11.50 | 0.55 | 73.6 |

When moisture content in field B is increased then speed of operator is observed to be decreased and vice versa as shown in Table 5. The average speed of operator in field B is 0.55 m/s, average of weeding efficiency is 73.6 %. It is found that the weeding efficiency is decreased when speed of operator is increased and vice versa. The highest weeding efficiency 79 % is obtained at 11.11 % moisture content. Hence 11.11 % moisture content is the best condition for weeding efficiency in field B.

**Recommendations and Conclusion**:

The moisture content of soil in field A was 13 % and moisture content of 11.5 % in field B. In field A, the highest speed of operator was 0.49 m/s and average speed of operator was 0.044 m/s whereas in field B highest speed of operator was 0.58 m/s and average was 0.55 m/s. Total average of speed of operator in field A and B was 0.49 m/s. Highest actual field capacity in field A was 0.11 m/s and average field capacity was 0.096 ha/hr. In field B average field capacity was 0.092 ha/hr and the total average actual field capacity in both A and B field was .081 ha/hr. In field the 13.86 % moisture content is best field efficiency, because at 13.86 %

moisture content the highest field efficiency 73.84 % was obtained. The 13.86 % moisture content was also suitable for weeding efficiency because at 13.86 % moisture content the highest weeding efficiency 88 % was obtained. The highest field efficiency is 73.84 % and the average field efficiency of field was 64.34 % and for field B was 62.6 %. The total average of both field A and B was 63.47 %. The average plant damage was 4.39 % and in field B it was 4.43 % but the total average plant damage in both field A and B was 4.41 %. The highest weeding efficiency was 88 %. The average weeding efficiency in field A was 81.8% and for field B was 73.6 % but the total average weeding efficiency in both field A and B was 77.7 %. Therefore, weeding efficiency of field is depending on speed of operator when speed of operator is a increases then weeding efficiency is decreases.

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