Original Research Article

Performance Evaluation of VNMKV Developed Power Weeder

P. A. Munde*, R. T. Ramteke and S. N. Solanki

Department of farm Machinery and Power Engineering, CAET, VNMKV, Parbhani, India

*Corresponding author

ABSTRACT

Weeding is tedious and labour consuming operation in Agriculture. More than 33 percent of the cost incurred in cultivation is diverted to weeding operations thereby reducing the profit share of farmers. Power weeder was developed and its performance was at Department of farm Machinery and Power, college of Agricultural Engineering and Technology, VNMKV, Parbhani. The weeding efficiency was 83.60 and 84.48 percent for soyabean and turmeric respectively with plant damage percentage of 4.6 and 6.7 percent. The effective field capacity, field efficiency of developed weeder was 0.45, 0.47 ha per day and 84.28 percent and 81.42 percent respectively. The fuel consumption for weeding in both crop was 0.61 and 0.58 lph respectively for soyabean and turmeric crop. Operation cost by developed weeder is less than other two methods. It saves 35.50 percent and 20.00 percent over the manual weeding and weeding with the help of bullock hoe respectively. The energy required for weeding the one hectare by traditional human power with the help of kurpi is 328.52MJ/ha, by traditional bullock hoe is 660.82MJ/ha and by developed weeder is 524.86MJ/ha.

Keywords

Power Weeder, Energy requirement in weeding, performance evaluation

Article Info

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Introduction

A weed is essentially any plant which grows where it is unwanted. Saving of labour requirement (man-h/day) is achieved with the use of improved long-handle mechanical weeder like wheel hoes, animal drawn weeder (two to three rows) and engine-operated power weeders. Typical work rate of hand tool (Khurpi), hand chopping hoe, push / pull type or push-pull weeder and animal drawn weeding implement varies between 300-500, 200-300, 100-125 and 6-20 man-h/ha respectively resulting in saving in cost of weeding approximately from Rs. 4000-5000 per ha (manual weeding) to Rs. 1500-2000 per ha in case of improved mechanical weeder (Singh et al., 1999-2000, Alam and Singh 2003).

Mechanical weeding is one of the oldest, but the most common methods of weed control in upland crops. Although it has undergone a spectacular advancement, yet hand weeding with simple weeder is common. These simple weeder are cheap, more efficient and suitable for farmer’s situation to reduce the cost of crop production and improve crop yield to a great extent. It is not only safe to the environment, but also safe to the user. The physiological demand in using weeders was relatively higher than 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 per cent where as for weeding with different weeders, the energy goes up to 56 per cent. The strain was relatively less in case of wheel hoe type weeder (Rajasekar, 2002).

**Materials and Methods**

The power weeder consists of following components or systems.

1) Engine 2) Main frame 3) Weeding assembly 4) Ground wheel 5) Front wheel 6) Control system 7) Power transmission system 8) Fuel tank 9) Light system 10) Cover.

i) A engine operated blade weeder had a adjustable operating width to adopted row spacing. The depth of operation was adjustable to 2 cm to 7 cm.

ii) Power transmission system

Chain and sprocket system was used to transmit the power of engine to ground wheel. Sprocket used was made up of high carbon steel. Such sprockets has a maximum load transmission ability without breakage.

iii) Material of blade

Blade was the soil working tool for machine. Spring steel was used for blade after heat treatment.

The power operated weeder was operated in the field of AICRP on soyabean, and vegetable VNMKV, Parbhani. The field test was carried out as per RNAM test code procedure for weeder. The weeder was evaluated for the actual field capacity, theoretical field capacity, weeding efficiency, fuel consumption etc

**Calculation of energy**

Source-wise energy consumption was calculated for each source used for the operation. Energy equivalents were used as mentioned in the table.1.

**Co-efficient for various sources of energy**

Energy coefficient for various sources of energy taken into all forms of energy input to their production has been worked out, Mittal & Dhawan (1988). The energy equivalent used in the study is shown in table.2.

**Results and Discussion**

The developed weeder was evaluated for its performance in the field of AICRP on Vegetables and AICRP on soyabean.

The field condition at both the farms are given in table 3. Black cotton soil is present in the both fields and planting method in the fields was Ridges and furrows for vegetable field while in soyabaen field it was BBF planting.

The results obtained in the field confirms with the results obtained for the field performance evaluation. The weeding efficiency was 83.60 and 84.48 percent for soyabean and turmeric respectively with plant damage percentage of 4.6 and 6.7 percent.

The effective field capacity, field efficiency of developed weeder was 0.45, 0.47 ha per day and 84.28 percent and 81.42 percent respectively. The fuel consumption for weeding in both crop was 0.61 and 0.58 lph respectively for soyabean and turmeric crop.

**Energy requirement for Weeding**

The energy used in weeding with different methods was calculated as discussed in the
materials and methods. For calculating the energy supplied from various sources like human, bullock and mechanical and converted into energy by using the conversion factor the details of calculations are given in appendix and the energy requirement is shown in table 5.

It shows that the energy required for weeding the one hectare by traditional human power with the help of kurpi is 328.52MJ/ha, by traditional bullock hoe is 660.82MJ/ha and by developed weeder is 524.86MJ/ha.

Cost economics of turmeric digger

Adaptability of any machine depends of its performance, cost economic. The cost of weeding for all three types of operation i.e. weeding by manually, bullock weeder and developed weeder was calculated. It is clear from the table that operation cost by developed weeder is less than other two methods. It saves 35.50 percent and 20.00 percent over the manual weeding and weeding with the help of bullock hoe.

Table 1: Specification of Engine Weeder

| Sr. No. | Particular            | Specification                                  |
|---------|-----------------------|------------------------------------------------|
| 1.      | Name of machine       | Engine Operated Weeder                         |
| 2.      | Make                  | MAU, Parbhani.                                 |
| 3.      | Model                 | Prototype                                      |
| 4.      | Type of machine       | Blade type (straight)                          |
| 5.      | Overall length of machine (mm) | 1820                           |
| 6.      | Overall height of machine (mm) | 1020                          |
| 7.      | Overall width of machine (mm) | 640                |
| 8.      | Overall weight of machine (Kg) | 45                           |
| 9.      | Ground clearance (mm)  | 180                                            |
| 10.     | Width of blade (mm)    | 25 or 42.5 (as per requirement)                |
| 11.     | Turning space diameter (mm) | 2000                                    |

Table 2: Energy equivalent MJ/Unit

| Sr.No | Items                                                | Energy equivalent MJ/Unit                  |
|-------|------------------------------------------------------|-------------------------------------------|
| 1     | Human labour                                         |                                          |
|       | Male                                                 | 1.96 MJ/male hr                          |
|       | Female                                               | 1.57 MJ/female hr                        |
| 2     | Bullock with a body weight (350-450 kg/bullock     | 10.10 MJ/pair                            |
| 3     | Diesel                                               | 56.31 MJ/lit                             |
| 4     | Machinery                                            |                                          |
|       | Prime mover other than electric motor including self| 54.8 MJ/kg                               |
|       | Farm machinery other than propelled ones             | 62.7 MJ/kg                               |
| 5     | Electric motor                                        | 11.93 MJ/kWh                             |
Table.3 The field conditions at both the centres were as follows:

| Particulars         | AICRP on vegetable | AICRP on soyabean |
|---------------------|--------------------|-------------------|
| Type of soil        | Black cotton soil  | Black cotton soil |
| Moisture content of soil | 16.5 percent      | 18.6 percent      |
| Planting method     | Ridges and furrows | BBF               |
| Age of crop         | 45 days            | 30 days           |

Table.4 Performance evaluation of developed digger in the field:

| Sr.no | Particulars                | Soyabean | Turmeric |
|-------|----------------------------|----------|----------|
| 1     | Working width (mm)         | 390      | 415      |
| 2     | Depth of operation (mm)    | 39       | 42       |
| 3     | Speed of operation (km/h)  | 1.8      | 1.90     |
| 4     | Theoretical field capacity (ha/day) | 0.54 | 0.58 |
| 5     | Effective field capacity (ha/day) | 0.45 | 0.47 |
| 6     | Field efficiency (%)       | 84.28    | 81.42    |
| 7     | Plant Damage %             | 6.7      | 4.6      |
| 8     | Fuel consumption lph       | 0.61     | 0.58     |
| 9     | Weeding efficiency (%)     | 83.60    | 84.48    |

Table.5 Comparative table for Energy requirement for weeding:

| Sr.No | Type of energy consumed | Traditional Hand Weeding | Traditional Bullock Hoe | Developed weeder |
|-------|-------------------------|--------------------------|-------------------------|------------------|
| 1     | Human being E= Energy equivalent × man’s hours | 165*1.96=323.40           | 22.67*1.96 =44.96       | 1.96 * 18 = 35.28 |
| 2     | Energy from machine     | 0.031*165=5.115          | 22.67*62.70*40/240=236.90 | 64.8 x 40 x 18/320 = 145.8 |
| 3     | Energy from petrol /Bullock | 14.07*22.67=318.96      | 0.396× 48.23× 18 = 343.78 |
| Total | 328.51 MJ/ha            | 600.82 MJ/ha             | 524.86 MJ/ha            |

Table.6 Comparative table for cost of weeding with different methods:

| Sr.no | Particulars                              | Cost of operation |
|-------|------------------------------------------|-------------------|
| 1     | Weeding with traditional human (Kurpi)   | Rs.3600/ha        |
| 2     | Weeding with traditional Bullock Hoe     | Rs.2900/ha        |
| 3     | Weeding with developed weeder            | Rs.2322/ha        |
It is clear from the table that operation cost by developed weeder is less than other two methods. It saves 35.50 percent and 20.00 percent over the manual weeding and weeding with the help of bullock hoe.

In conclusion the developed weeder was operated for row spacing 375 to 450 mm with 39 to 42 mm depth. The weeding efficiency was 83.60 and 84.48 percent for soyabean and turmeric respectively with plant damage percentage of 4.6 and 6.7 percent. The effective field capacity, field efficiency of developed weeder was 0.45, 0.47 ha per day and 84.28 percent and 81.42 percent respectively. The fuel consumption for weeding in both crop was 0.61 and 0.58 lph respectively for soyabean and turmeric crop. Energy requirement in developed weeder is less than that of the traditional operation carried out with bullock hoe. The effective field capacity of developed weeder is more than both the traditional methods. The time and cost required for the operation with developed weeder is less than other two methods.

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