

DEVELOPMENT OF MANUALLY OPERATED WEEDER FOR GROUNDNUT CROPS

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ABSTRACT

Weeding is an important operation for increase the productivity of farm. For small land holdings and considering economic condition of Indian framers, manual operated weeder is most suitable. Groundnut is the major crop of Saurashtra region. In groundnut weeding operation is done manually by hand sickle or khurpi. Manual weeding is precise but requires about 250 man-hours to cover 1 ha of land. Due to acute shortage of labour in peak seasons, weeding operation is difficult to carry out within short stipulated period. With regard to this, a manually operated weeder was developed and tested. The weeding blades were made from cast iron and V-shape with an angle of 125°. The width and length of the blade are 60 mm and 200 mm respectively. The blade is attached to the prong at an angle of 140°. Handle of weeder is fabricated from the galvanized iron pipe of 700 mm length and 20 mm outer diameter. It is bent from both the sides with 180 mm at an angle of 40°. Rubber grips are provided at both the ends of pipes for comfort handling. The desired height of the handle from the ground surface is obtained with the adjusting support. The developed groundnut weeder was tested on average travelling speed is 25.17 m/min. The developed weeder can work up to 4.0 cm depth of operation with field capacity of 0.0285 ha/h. Higher weeding efficiency was obtained (i.e. up to 80.42%). The draft requirement was 34.4 kg for 20 cm width of the weeder. During weeding operation, the peak heart rate of the subjects was found to range from 142 to 150 beats per min. In case of heavy work and dense grass infested field, the rest pause of 14 min was required by the subjects to come to the normal heart rate. The overall performance of the weeder found promising.

KEY WORDS: Groundnut, weeder, weeding

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is major oil seed crop of Saurashtra. It is sown at row spacing 45 to 60 cm for bunch and spread type varieties, respectively. In *kharif* season, weeds are major problem in

production of groundnut. The qualitative and quantitative crop production depends upon the effectiveness and timeliness of weeding; as weeds are biggest crop enemy which causes 45% of annual yield loss as compared to the disease as

20%, insects as 30% and pest as 5%. The weeding operation consumes 25% of the labour for crop cultivation. There are various methods of weed control viz., chemical, mulching, mechanical, sterilization, crop rotation, etc. with their own merits and demerits. Among all the method, the mechanical method of weed control proves to be better. It is reported that the mechanical method keeps the soil surface loose; resulting in better aeration and moisture conservation. Weeds causes about 45% yield loss in the crops which is highest as compared to other factors (Mungale, 2007).

Groundnut weeding is done manually by hand sickle or khurpi in Saurashtra region. Manual weeding is precise, but requires about 250 man-hours to cover 1 ha land. Due to acute shortage of labour in peak seasons, weeding operation cannot be carried out within short duration. Moreover, the operation is cumbersome causing drudgery due to awkward posture of working to the operator. It induces back pain and may lead to musculoskeletal disorder. Manually operated weeders are not suitable for them or require modifications. Therefore, V shape blade weeder used for groundnut crops and it operates by push and walking type implement.

Animal power also plays an important role in mechanical control of weeds in Indian agriculture. Traditional animal drawn harrow made by the village artesian are widely used due to their simplicity of construction and lower in cost. Shallow tillage and weeding operation are practiced repeatedly in black soils with animal drawn straight blade harrow to remove the weeds during monsoon. The maintenance of the pair of bullock has also become costlier nowadays. So, the use of animals in agriculture is declining day by day. Tractors are used

for inter-culturing and other light operations like spraying, dusting, etc. in the standing crops. Many times they are not suited for such operations due to higher weight and large turning radius which results in compact the soil and damage the standing crops.

Under RNAM programme, Biswas (1980) identified a set of upland weeders and evaluated them at Central Institute of Agricultural Engineering, Bhopal to test their suitability for popularization and suggested that they are suitable for Saurashtra region. Gill and Kollar (1983) reported that grain yield was reduced to 20 to 30% because of weeds. It can be increased up to 50% if adequate crop management practices were adopted. The inter-culturing operations are performed with a view to break the crust formed and make the soil friable, which helps in conservation of moisture and to remove the weeds and other unwanted plants growing along the main crop in the farm.

MATERIALS AND METHODS

The main components of the manually operated weeder are: ground wheel, blade, prong, mainframe and handle. There are two ground wheels, fabricated from mild steel bar of 12 mm diameter. The diameter of each ground wheel was kept 250 mm. The spokes are provided in the wheels for attaching the hub of 35 mm diameter with the help of washers with inner diameter of 35 mm and outer diameter of 95 mm. It is made of mild steel bar of 9 mm diameter and 160 mm length. The threads are provided on both the ends to fix the main frame. Working blade is made of cast iron. It is V-shape with angle of 125° . It serves two purposes first to minimize the root damage and second provide sliding action so root may not stick to the blade. The width and length of the

blade are 60 mm and 200 mm respectively. The blade is attached to the prong at an angle of 140° (Figure 1) The desired height of the handle from the ground surface is obtained with the adjusting support. The height and angle can be adjusted as per the

need of the operator to suit its posture. The handle is joined to the main frame with the help of handle pipe. The average weight and stature of weeder operator was 55.25 kg and 163.12 cm, respectively.

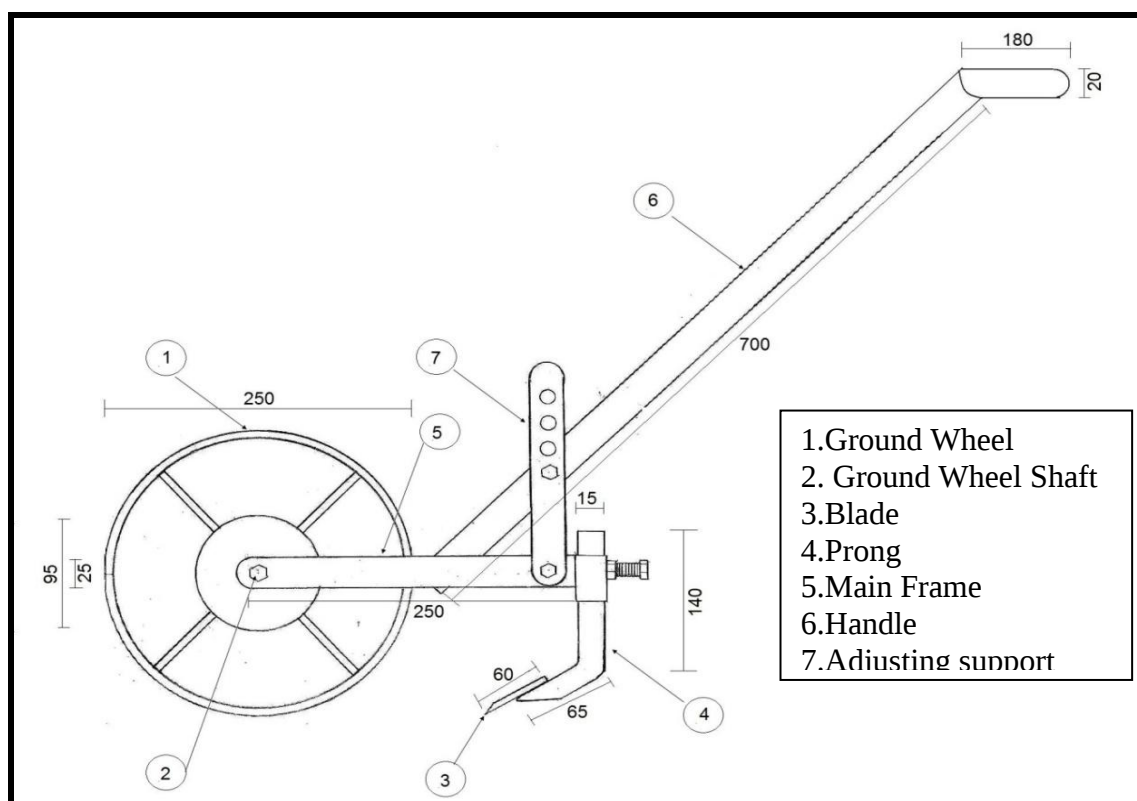


Figure 1: Sketch diagram of manually operated weeder for Groundnut

Prong of the weeder is made of mild steel square bar and size of the bar is $200 \times 15 \times 15$ mm. The blade is fixed at the one end of the prong and on the other end marks are provided at 10 mm, 25 mm, 40 mm and 55 mm from the top of the prong on back side to fix the nut so that desired depth can be obtain. Main frame is fabricated from two mild steel flat of $250 \times 25 \times 5$ mm. It is bent in such a way that the outer end of frame is kept at 110 mm and inner end is kept at 35 mm. At the outer end, main shaft is bolted and at inner end, provision of handle and

adjusting support is made. Handle of weeder is fabricated from the galvanized iron pipe of 700 mm length and 20 mm outer diameter. It is bent from both the sides with 180 mm at an angle of 40° . The desired height of the handle from the ground surface is obtained with the adjusting support.

RESULTS AND DISCUSSION

The designed manually operated weeder is tested in groundnut crop at Junagadh Agricultural University, Junagadh. The test field was identified at Mechanized Commercial Farm (MCF), which has

clay loam soil and moisture content was 8.74 % at the testing time. Three plots, each of 1 m² area were selected. The groundnut crop was about 25 days old at the time of weeding from the date of sowing. The groundnut crop has row to row spacing of 50 cm. The average plant population per square meter area was 25 nos. and the average height of the plant was 20 cm. Weed root zone depth play an important role in manually weeding, since it decides the power needed to take out weed, weeding time and consequently the field performance of the weeder. It was observed that root zone depth differs for different type of weed. It shows minimum root zone depth of 2 cm for “Jungli Gobi” and maximum depth of 5 cm for “Nut grass”.

Field Performance

The field performance of the developed weeder was evaluated. The test was conducted by selecting certain fixed distance say 150 m and the time was noted to travel this distance. Travelling speed is also depends on the operators condition like weight of the operator, height of the operator and physique of the operator. The developed weeder was easy to operate at the speed of 25.17 m/min.

Field capacity

The field capacity of developed weeder was calculated by selecting a respective three plots of size 150 × 2 m. The theoretical field capacity of the developed weeder was calculated about 0.0285 ha/h. Field capacity is directly affected by cutting width and the physique of the operator. If the effective cutting width is reduced than field capacity is also reduced.

Weeding efficiency

The average value of the weeding efficiency was found to be

80.42%. It can be concluded that the weeder is efficient because efficiency is more than 80% and also easy in operation. Weeding efficiency differs in every test plots located in the field. It depends on the root zone depth of weeds, shape of the blade, moisture content of soil and cutting depth of the weeder blades. Draft is an important parameter of the developed weeder and it must be within the physical limit of the operator. The average draft obtained is 34.4 kg. Depth of weeding 4 cm was maintained during the testing. In the field, maximum weed root zone was found within 3-5 cm. If we reduce the depth, then weeding efficiency can also be reduced and on the other side the weeding will not be proper because of less depth covered.

The average power requirement for developed groundnut weeder was estimated to be 0.19 hp. After going through all detail tests, the performance index was prepared to know the overall performance of the weeder. It is the function of weeding efficiency, field capacity, power input and plant damage. During field test, no plant damage was observed. The performance index of the developed weeder was calculated and it was about 1210.53.

The developed manually operated groundnut weeder is easy to operate and suitable for shallow weeding up to the depth of 4.0 cm. the developed weeder is not only suitable for groundnut crop but it can also be used for other crops as row spacing can be adjusted. As far as physiological aspect, one can operate it easily as handle height and angle can be adjusted as per operators requirement.



Figure 2: Complete view of the developed weeder

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The average weight and stature of the operators was found to be 55.25 kg and 163.12 cm respectively. The inside grip diameter and instep length was found to be 5.07 and 17.99 cm respectively. The results revealed that after 8 min of start of work, the peak heart rate was found to be 143, 142 and 150 beats/min for subjects S1, S2 and S3, respectively. The rate was found to stabilize around the peak heart rate. After 18 min of work the rest was given to the subjects, and it was found that rest of 14 min was required by each of the operator to come to the normal position. Thus, the fatigue of the operator is avoided by giving the

rest pause of 14 min. After 8 min of work, the heart rate of the subject stabilizes in the range of 125 – 150 beats/min, the work can be rated as heavy type of work.

CONCLUSION

To increase the productivity per unit area of small land holdings of farmers and considering their economic condition it is quite necessary to have suitable agricultural implements by which farmers can use them and also allow custom hiring. With regard to this an attempt was made to develop a weeder for groundnut and assess functional suitability and weeding efficiency. Test result indicated a clear view for adopting this design of manually operated groundnut weeder, because it is easy to operate and outcome of weeding efficiency is also satisfactory. The outcome revealed that:

- 1.The developed weeder can work up to 4.0 cm depth of operation with field capacity of 0.0285 ha/h.
- 2.Higher weeding efficiency was obtained (i.e. up to 80.42%)
- 3.The performance index of the

developed weeder was obtained 1210.53.

4. The draft requirement was 34.4 kg for 20 cm width of the weeder
5. The average weight and stature of the operators was found to be 55.25 kg and 163.12 m respectively.
6. The inside grip diameter and instep length was found to be 5.07 and 17.99 cm respectively.
7. The peak heart rate was found to range from 142 to 150 beats per min.

The weeding performance of the weeder was achieved satisfactory under the following conditions:

- a. Plant population: 25 – 30 per sq. m.
- b. Moisture content of soil: 8.74 %
- c. Effective width of cut : 20 cm

d. Speed of travel : 25.17 m/min.

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