

Evaluation of three tyne wheel hoe for reducing drudgery in vegetable crops

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■ **ABSTRACT** : Women constitute a major task force in agricultural operations in India. Therefore, it becomes necessary to study the ergonomics of women operators involved in weeding. Weeding is a main drudgery prone activity mostly performed by farm women and to resolve this problem Krishi Vigyan Kendra, Banavasi conducted front line demonstrations on the performance of improved weeder that is three tyne wheel hoe in reducing drudgery among women engaged in weeding activity in vegetable crops. Twenty farm women were selected randomly for the study. The results showed that the overall discomfort rate of hand hoe and three tyne wheel hoe was 8.1 and 4.7 (Table 4) *i.e.* more than moderate and light discomfort, respectively. Musculo-skeletal problems were decreased with improved weeding tool induced moderate to light discomfort/pain in shoulders, hands and arms compare to traditional method. Moderate drudgery index score of 53 per cent was recorded compare to traditional practice 72 per cent recorded as maximum. In the recommended weeding practice *i.e.* with three tyne wheel hoe, the same amount of work could be done in almost half of the time and work efficiency was increased by 93.3 per cent than normal weeding. Improved technologies for weeding activity for farm women is recommended so they can increase their efficiency, reduce the drudgery with time saving while performing weeding activity.

■ **KEY WORDS** : Drudgery, Wheel hoe, Weeding

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Women in India are the major workforce in the house- hold activities as well as Agriculture which gave them double the workload. Most of the field operations like seed sowing, nursery management, seed treatment, weeding, digging, transplantation, winnowing, harvesting, cleaning and preparation and much more are done by farm women with the use of traditional types of equipment. During this activity their body gets tired and their efficiency reduces. Verma *et al.* (2013) (Gite and Singh, 1997) found that during the farm activities women adopt an unnatural body posture due to which their physiological

workload increases and also they face many types of muscular-skeletal problems, as a result, the efficiency of women to work decreases to a greater extent. Traditional method of weeding takes longer. Women generally adopt squatting and bending posture while doing the activity and maintain it for long hours, which cause musculo-skeletal problems (Sharma, 1999).

Further, timely weeding can be achieved by using mechanical weeders which perform simultaneous job of weeding and hoeing, thus reduce the time spent on weeding, cost of weeding and drudgery involved in manual weeding (Goel *et al.*, 2008). Behera and Swain (2005)

reported that manually operated weeders have found acceptability due to their low cost.

Ergonomics is the scientific study of the relationship between man and his working environment that includes ambient conditions, tools, materials, methods of work and organization of the work. The performance of man – implement system may be poor, if ergonomic aspects are not given due attention. It may also cause clinical or anatomical disorders and will affect worker’s health. Proper attention to ergonomics aspects in design and operation will help in increasing the man implement system efficiency and also in safeguarding the workers’ health (Gite and Singh, 1997). The main aim of this study was to reduce drudgery, increasing the working efficiency of farm women and also reduce the cost of weeding operation to farmers by introducing three tynewheel hoe in comparison to the traditional method of weeding.

METHODOLOGY

The study was carried out in the adopted village, Venkatapuram and Ragimandoddi of KVK Banavasi, Andhra Pradesh, India. Twenty farm women who had good experience at the control and operating traditional hand hoe were selected randomly. They were healthy and had no physical ailment. The grading of health status of women was done on the basis of BMI. The BMI scores were interpreted as per the classification given by Garrow (1987). Following parameters were calculated to know the efficiency of the implement when compared to farmers’ practice *i.e.* hand hoe.



Fig. A: Three tyne wheel hoe and hand hoe

Over all discomfort (ODR):

Overall discomfort rating (ODR) was used which was developed by Corlett and Bishop (1976) for the assessment of it. It consisted of a 70 cm long graduated scale with its left marked as 0 and its right ends 10 which are representing ‘no discomfort’ and ‘extreme discomfort’, respectively. A sliding pointer was provided on the scale to mark the level of discomfort. At the end of each trial, subjects were asked to mark their overall discomfort rating on the scale. The overall discomfort ratings given by each of the twenty subjects were averaged to get the mean rating. Drudgery was operationalized as physical and mental strain, fatigue, monotony and hardship experience by farm women while

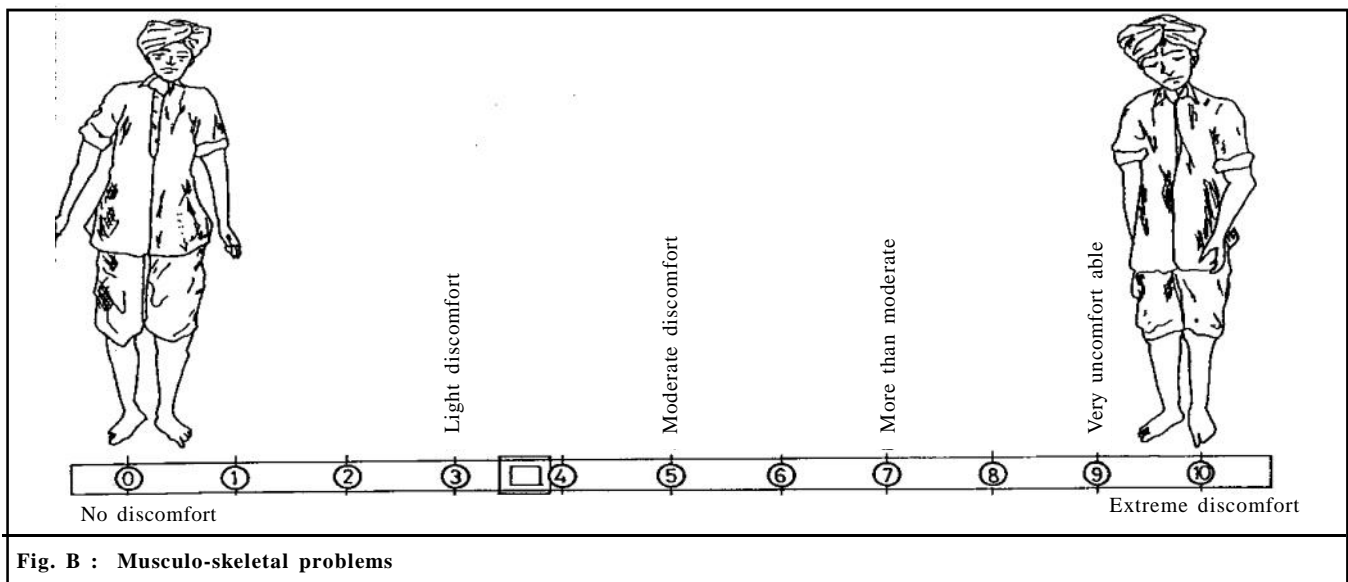


Fig. B : Musculo-skeletal problems

doing weeding operations (Kumar *et al.*, 2011).

Musculo-skeletal problems:

Incidence of musculo-skeletal problems was identified using the body map (Fig. B) indicating pain in different parts of the body before and just after the completion of the activity. Five-point scale was used to record the intensity of pain in the various body parts *viz.*, 5, 4, 3, 2 and 1 for the intensity of pain as very severe, severe, moderate, mild and very mild, respectively.

Severity scale:

5. Very severe 4. Severe 3. Moderate 2. Mild 1. Very mild.

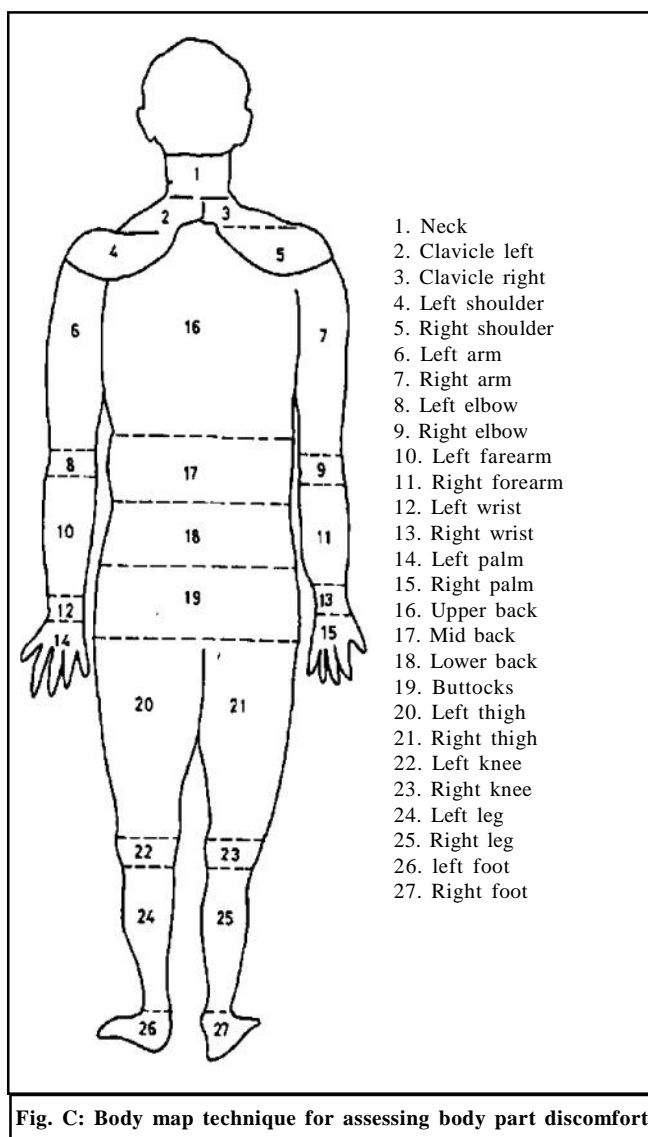


Fig. C: Body map technique for assessing body part discomfort

Drudgery index:

Drudgery was operationalized as physical and mental strain, fatigue, monotony and hardship experience by farm women while doing weeding operations (Kumar *et al.*, 2011).

Drudgery index (DI) was calculated on the basis of
Drudgery index = [(X+Y+Z)/3] x 100

X = Co-efficient pertaining to difficulty score.

Y = Co-efficient pertaining to performance score.

Z = Co-efficient pertaining to average time spent

DI score between 70 and above = Maximum drudgery

DI score between 50 and 70 = Moderate drudgery

DI score between 50 and below = Minimum drudgery

Plant damage per cent:

It is measured by using following relation

$$q = [1 - (Q/P)] \times 100$$

where,

q = Plant damage per cent

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

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

Field capacity of weeder:

– It is measured in terms of area/hour (E.g. hectares/hour)

– Let the subject operate the weeder for a fixed time

– Now measure the area that was covered in the weeding activity

– Then calculate the field capacity of the weeder.

Weeding index per cent:

Weeding efficiency of weeder is the number of weeds that can be removed by a specific weeder in a given time. The weeder is tested on the same field to determine weeding index

– It is calculated by using the following formula:

$$e = [(W_1 - W_2) / W_1] \times 100$$

where,

e = Weeding index, per cent.

W₁ = Number of weeds/m² before weeding

W₂ = Number of weeds/m² after weeding.

■ RESULTS AND DISCUSSION

Basic anthropometric data of the subjects have been presented in Table 1. The mean age of the selected farm women was 34 yr with the average height of 154.2 cm and gross body weight was in the range of 45-56 kg. The mean body mass index was calculated to be 23.86 which meant that they were in the normal category.

Workload:

The rating of health status of women on the basis of BMI was done as per the classification given by Garrow (1987). The distribution of respondents as per BMI scores is presented in Table 2.

As evident from Table 2, majority of the respondents (84%) were having BMI scores in normal range. It was observed that 6 per cent women belonged to low weight health status. It is seen that 10 per cent of respondents

were in exceptional health category of obesity grade I.

Over all discomfort (ODR):

Weeding in vegetable crops is an activity where musculo-skeletal problems are very pronounced. The reason the activity is time taking and performed continuously for prolonged hours. The traditional method employs continuous sitting posture while weeding either with bare hands or using traditional hand hoe. The overall discomfort rate of hand hoe and three tyne wheel hoe was 8.1 and 4.7 (Table 4) *i.e.* more than moderate and light discomfort, respectively.

Musculo-skeletal problem (MSP):

The musculo-skeletal problems and posture were evaluated by asking the respondents as to where they felt pain in their body after weeding with traditional and

Table 1: Physical characteristics of the respondents (n=20)			
Sr. No.	Physical characteristic	Range	Mean
1.	Age in years	24-45	34.0
2.	Height (cm)	130-158	154.2
3.	Gross weight (kg)	45-60	56.25
4.	Body mass index	19.3-26.2	23.86

Table 2: Distribution of respondents as per BMI scores (n=30)			
Sr. No.	BMI score	Interpretation	Per cent
1.	< 16.0 -	*CED grade III (severe)	--
2.	16.0-17.0	*CED grade II (moderate)	--
3.	17.0-18.5	*CED grade I (mild)	--
4.	18.5-20	Low weight normal	6 %
5.	20.0-25.0	Normal	84%
6.	25.5-30.0	Obese grade I	10
7.	> 30.5	Obese grade II	--

Table 3 : Mean value of overall discomfort rating (ODR), responses on musculo-skeletal problems and perceived exertion experienced by respondents				
Type of weeding	ODR	MSP	RPE*	Drudgery index score
Hand hoe	8.1	Severe pain in shoulders, upper back, hands and fingers	Heavy	72%
Wheel hoe	4.7	Moderate to light pain in shoulder, hands and arms	Moderate	53%

Table 4 : Change in output by use of twin wheel hoe over traditional hand hoe			
Parameters	Hand hoe	Wheel hoe	% change over improved over existing
Plant damage per cent	33	25	24
Output m ² /hr	63.4	122.6	93.3
Weeding efficiency m ² /hr	91.4	78.5	14

improved technology. The data (Table 3) depict that weeding with traditional tools in strenuous posture cause severe pain in shoulders, mid back, hands and knees. The women perceived the task as heavy. On the contrary, using improved weeding tool induced moderate to light discomfort/pain in shoulders, hands and arms. They were relieved from back pain and improved tool employed standing posture and eliminated continuous sitting posture as well as some movement is also employed while working on a three tyne wheel hoe. The rating of perceived exertion was also reported as moderate to light with use of three tyne wheel hoe.

Drudgery index:

The drudgery index of weeding with hand hoe and three tyne wheel hoe was determined by calculating the time co-efficient, frequency of performance co-efficient and difficulty co-efficient. By using this three tyne wheel hoe, moderate drudgery (drudgery index score 53 %) was recorded whereas in traditional practice (hand hoe) maximum drudgery (drudgery index score 72%) was recorded.

Output:

The result (Fig. 1) depicts the work output of the weeding activity with the traditional and improved technology. Three tyne wheel hoe have significantly higher work output than the hand hoe. Plant damage was recorded has 33 per cent in hand hoe and 25 per cent with wheel hoe. It means that work output was 24 per cent improved over the existing.

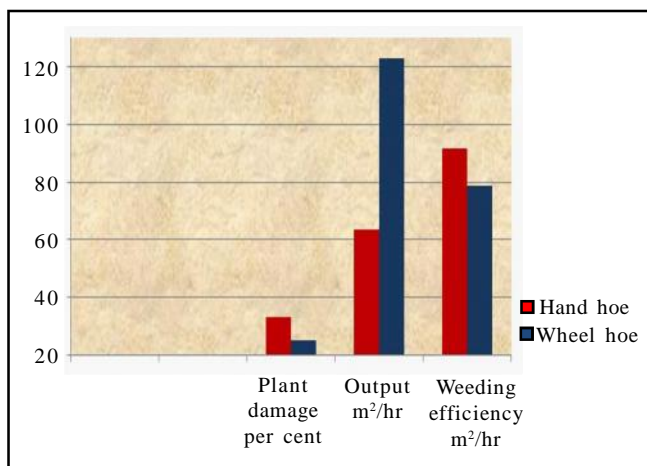


Fig. 1: Change in output by use of three tyne wheel hoe over traditional hand hoe

The output capacity was higher using three tyne wheel hoe (122.6 m²/hr) as compared to with hand hoe (63.4m²/hr) *i.e.* the percentage increase in output was improved by 48.2 per cent when compare to traditional practice. It means that work output was near about more, as compared to traditional implement so working by three tyne wheel hoe is recommended.

The weeding efficiency (Fig.1) was found maximum for hand hoe (91.4%) followed by wheel hoe (78.5%). The maximum weeding efficiency with hand hoe was because of time consumption and heavy drudgery (72%) while weeding. However, the wheel hoe can take less time and moderate drudgery (53%) for removing the weeds. The wheel hoe has the capacity to till the soil to the desired depth, therefore, it works much better between two rows for weeds control. But the hand hoe may cause damage to crop plant, if it is tilled nearer to the rows. Similar results were also obtained by Shekar *et al.* (2010) Manjunatha *et al.* (2014) and Verma *et al.* (2013).

Implication of the study:

This study indicates that in order to ensure health, safety and well being and thereby improving the quality of work life and achieving higher productivity, it is essential that working implement must be designed ergonomically and should be women friendly. The weeding efficiency of the three tyne wheel hoe was found satisfactory and it is easy to operate. It is women-friendly tool because it increases the work efficiency, reduces drudgery and provides comfortable working posture. It reduces the exertion and fatigue and women feel comfortable. They earn money by reducing the labour. By introducing such small tools, the work and work environment can be improved, physiological workload can be reduced in the weeding and the efficiency and work output can be improved significantly. Hence, promoting such tools among the farm women engaged in the agricultural operation should be done at the priority.

Conclusion:

In agriculture, weeding is one of the important labour intensive activity and adoption shows increase not only in, efficiency but in terms of money also by reducing labour engagement during weeding, productivity of worker is increased with the equipment than traditional method. Three tyne wheel hoe was found useful in terms of saving time, human effort, increasing work capacity

and productivity. It was found to be compatible, easy to handle and applicable in field situation as well as most efficient for weeding vegetable fields. It was observed that use of weeder, improved posture and efficiency of worker. The body discomfort reduced with use of weeder because it involved standing posture eliminating muscular fatigue and excessive loading of inter-vertebral discs of backbone. This proved that weeders were ergonomically sound, women friendly, drudgery reducing and improved worker's efficiency.

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■ REFERENCES

- Behera, B.K. and Swain, S. (2005).** Ergonomics evaluation and design modification of push-pull type weeders. In: Proc. International Ergonomics Conference, HWWE, IIT, Guwahati (Assam) India.
- Corlett, E.N. and Bishop, R.P. (1976).** A technique for assessing postural discomfort, *Ergonomics*, **19** : 175-182.
- Garrow, J. (1987).** *Human nutrition and dietetics*. Nutrition News 1991. National Institute of Nutrition, Hyderabad (A.P.) India.
- Gite, L. P. and Singh, G. (1997).** *Ergonomics in agricultural and allied activities in India*. Central Institute of Agricultural Engineering, Bhopal, India. Technical Bulletin No. CIAE/97/70.
- Goel, A.K., Behera, D., Behera, B.K., Mohanty, S.K. and Nanda, S.K. (2008).** Development and ergonomic evaluation of manually operated weeder for dry land crops. *CIGR J. Agric. Engg. Internat.*, **10**: 1-11.
- Kumar, Bharat P., Govinda, P., Gowda V. and Khandekar, Neeta (2011).** Time utilization pattern and drudgery of horticulture farmers. *Internat. J. Engg. Manage. & Sci.*, **2** (2): 93-96.
- Manjunatha, K., Shirwal, S., Sushilendra and Vijayakumar, P. (2014).** Development and evaluation of manually operated sprocket weeder. *Internat. J. Agric. Engg.*, **7** (1):156-159.
- Shekhar, S., Chandra, S. and Roy, D.K. (2010).** Performance evaluation of different weeding tools in maize. *Indian J. Weed Sci.*, **42** (1&2): 95-97.
- Verma, Shilpi, Gupta, Shobhana and Pachauri, C.P. (2013).** An ergonomic study on evaluation of single wheel hoe in reducing drudgery. *Agric. Update*, **8**(4): 665-669.

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