International Journal of Science, Environment and Technology, Vol. 7, No 3, 2018, 1059 – 1065

ISSN 2278-3687 (O)
2277-663X (P)

PERFORMANCE EVALUATION OF WEEDERS

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BAU Communication No. 414/2018

Abstract: An experiment was conducted to evaluate the field performance of different weeders namely khurpi (T-1), twine wheel hoe (T-2), push pull type cycle weeder (T-3), and a push pull type cycle weeder certain refinements (T-4). The experiments were carried out in farmer's field along with KVK, Sabour experimental plots on HD-2967 verity of wheat in 2016-17 and 2017-18 seasons in a total area of 4 hectare. Various parameters such as Field capacity of weed management (ha/h), Weed Population/m^2 (Before and after interculturing), Yield (q/ha), Cost of cultivation (Rs./ha), Gross return (Rs/ha), Net return (Rs./ha) and B:C ratio. The field capacity of 0.002, 0.010, 0.020 and 0.035 ha/hr respectively observed for khurpi, twine wheel hoe, push pull type cycle weeder, and a push pull type cycle weeder with certain refinements. The maximum net return was found for refined cycle wheel weeder as Rs.36,394.50/ha, while minimum was recorded for Khurpi as Rs. 24,683/ha.
Keywords: Weeding, weeding efficiency, field capacity.

Introduction

Weeds are undesirable plants, which infest different crops and inflict negative effect on their yield. A weed can be thought of as any plant growing in the wrong place at the wrong time and doing more harm than good. Weeds waste excessive proportions of farmers' time, thereby acting as a brake on development. There are innumerable reports on the inhibitory effects of weeds on crop plants (Bhowmik & Doll, 1992; Javaid *et al.,* 2007). Generally weed-crop competition is complicated as weeds compete with the crop plants by occupying a space, which would otherwise be available to the crop plant. Anything that reduces this space reduces the plant growth (Wright *et al.*, 2001). Water requirement for the growth of weeds is primarily of interest from the stand-point of competition with the crop plant for the available moisture.

Weeding is one of the most important farm operations in crop production system. Weeding is an important but equally labour intensive agricultural unit operation. Weeding accounts for about 25 % of the total labour requirement (900–1200 manhours/hectare) during a cultivation season (Yadav and Pund, 2007). In India this

*Received May 23, 2018 * Published June 2, 2018 * www.ijset.net*

operation is mostly performed manually with khurpi or trench hoe that requires higher labour input and also very tedious and 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. Weeds compete with crop plants for nutrients and other growth factors and in the absence of an effective control measure, remove 30 to 40 per cent of applied nutrients resulting in significant yield reduction (Goel *et al*., 2008). There is an increasing concern over the intra row weeder because of environmental degradation and growing demand for the food. Today the agricultural sector requires non-chemical weed control that ensures food safety. Consumers demand high quality food products and pay special attention to food safety.

The most common methods of weed control are mechanical, chemical, biological and cultural methods. Out of these four methods, mechanical weeding either by hand tools or weeders are most effective (Manjunatha *et al*., 2014). But mechanical methods and intercultivation using agricultural implements are being practiced in many regions. But still the time spent in the field, the drudgery of the operator and the requirement of animal power are some of the points of concern in weed control (Veerangouda *et al*., 2010). As different methods of intercultivation are practiced in this region, there is a need to evaluate the performance of these weeders.

MATERIALS AND METHODS

The weeders which are evaluated in this paper are Khurpi (Fig. 1), Twin wheel hoe (Fig. 2), push pull type cycle weeder (Fig. 3), and a push pull type cycle weeder with certain refinements in the shovel (Fig. 4). The shovel in refined cycle weeder consists of three pointed fingers in place of a single shovel.

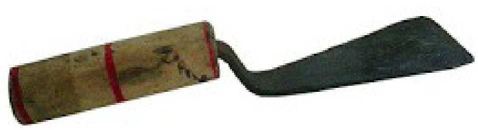

Fig. 1 Khurpi

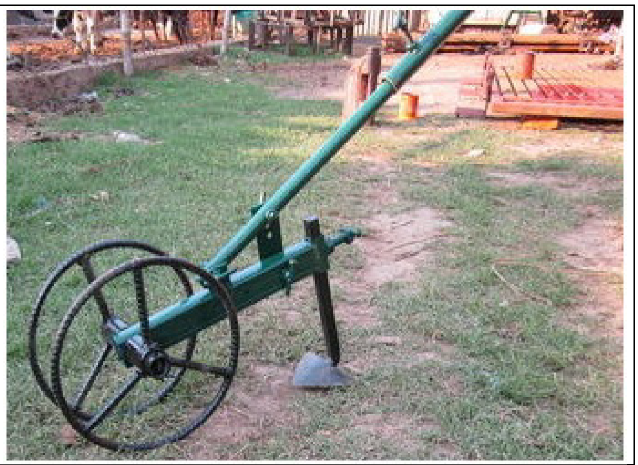

Fig. 2 Twin wheel hoe

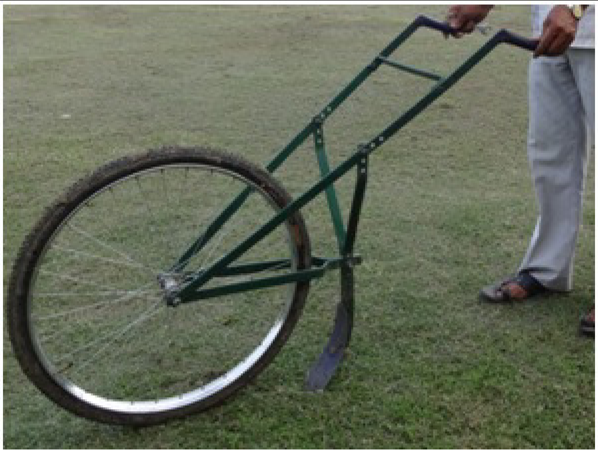	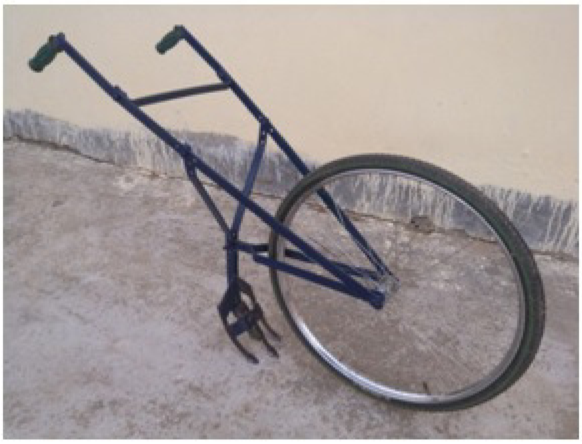
Fig. 3 Push pull type cycle weeder	**Fig. 4** Push pull type cycle weeder with refinement

Khurpi consists of a curved mild steel blade and a wooden handle. The blade has cutting edge on its outer surface and tong at the end. The tong is inserted firmly into the wooden handle. It is a manual push type of implement and has to be operated in the bending or sitting posture. The implement can be fabricated by the local village artisans. Push type Cycle weeder consists of bicycle parts of front axle, wheel hub and wheel for transportation. The parts of cycle weeder is Hub, Sprocket, Front Fork and back fork, Cycle hand, Pipe, Blade. V- Shaped blade was used for weeding. The V- shaped weeding tool made from the hardened steel was attached to fork with help of U-clamp.

The following field tests were carried out in the farmers and research fields to evaluate the performance of the different weeders for weeding operation. The field tests were carried out to ascertain the performance parameters as well as there effect on yield and financial benefit from them, like weeding efficiency, field capacity, yield and benefit cost ratio (BCR). Experiments were conducted at 11 locations, including 10 locations at farmers field and one location at KVK, Sabour.

Weeding efficiency (W.E.)

The weeder is tested on the same field to determine weeding efficiency. It is calculated by using equation.

$$W.E. = \frac{(W_1 - W_2)}{W_1} \times 100$$

Where,

W_1 = number of weeds before weeding

W_2 = number of weeds after weeding

W.E. = weeding efficiency

Effective field capacity

It is the actual average rate of coverage by the machine. It is expressed as ha/hr.

RESULTS AND DISCUSSION

Weeding efficiency under different implements

The maximum weeding efficiency was observed with 'T-4' ('83.65%) followed by 'T-1' (81.87 %), and by 'T-2' (79.02 %) and 'T-3' (78.89 %). Earlier Shekar et al., 2010 has reported that the weeding efficiency was highest for khurpi than other weeder. Now, the refined version of cycle wheel hoe 'T-4' has shown more weeding efficiency than Khurpi 'T-1'. The maximum weeding efficiency with ' refined version of cycle wheel hoe' was observed because of the capability of this tool to do more work because of three numbers of small furrows. However, push type cycle weeder and its refined version cannot be used for closer plants, in that case Khurpi is more suitable as its weeding efficiency is also much closer to the weeder 'T-4', which is showing highest weeding efficiency.

Table 1: weeding efficiency of different weeder

Technology option	W_1	W_2	W.E.
T-1	44.15	8	81.879955
T-2	46	9.65	79.021739
T-3	45.25	9.55	78.895028
T-4	46.8	7.65	83.653846

Effective field capacity under different implements

The effective field capacity was found maximum for 'T-4' (0.035 ha/h) followed by 'T-2' and 'T-3' as 0.02 ha/h. 'T-1' has shown lowest field capacity value as 0.010 ha/h. Shekar et al. (2010) was also found similar readings. The difference in effective field capacity of different tools/implements is because of the width of soil cutting parts and forward speed. 'T-4' due to its faster movement and its width it can cover larger field so that it has highest effective field efficiency compared to other weeders which are slow in speed. Intercultering operations with 'Khurpi' are usually done by the operator in sitting posture and the forward speed is quite less, which accounts the minimum field capacity of 'Khurpi' during weeding operation.

Table 2: Effective field capacity of different weeding tools

Technology option	Field capacity of weed management (ha/h)
T-1	0.002
T-2	0.010
T-3	0.002
T-4	0.035

Yield (q/ha) against use of different weeding tool

Higher yield was observed in 'T-4' as 36.10 q/ha, while lowest yield was observed in case of use of 'T-1' as weeding tool (33.05 q/ha). 'T-2' and 'T-3' has shown yield as 34.20 q/ha and 35.60 q/ha respectively. The higher yield shown by the use of 'T-4' is due to better weeding operation. As weed and canopy architecture especially plant height, location of branches and height of maximum leaf area determine the impact of competition for light and thus have a major influence on crop yield.

Table 3: Yield (q/ha) against use of different weeding tool

Technology option	Yield (q/ha)
T-1	33.05
T-2	34.20
T-3	35.60
T-4	36.10

Benefit Cost ratio (BCR) against use of different weeding tool

The cost of cultivation of 'T-1' was found maximum (Rs 37670/ha) followed by T-2, T-3 and T-4 as Rs. 33025/ha, Rs. 32292.5/ha and Rs. 31537.5/ha respectively. As weeding is a labour consuming process and because of minimum field capacity of 'khurpi' the cost of operation of 'khurpi' for weeding was maximum. Similarly lowest net return was observed in case of use of T-1 as Rs. 24683/ha, while in the case of T-2, T-3 and T-4, the observed values were Rs. 31377/ha, Rs. 34700.5/ha and Rs. 36394.5/ha respectively. Resulting in highest BCR value against use of T-4 as weeder, and lowest value of 1.655 was observed in the case of use of T-1 as weeder.

Table 4: BCR value under different weeding methods

Technology option	Cost of cultivation (Rs./ha)	Gross return (Rs/ha)	Net return (Rs./ha)	BCR
T-1	37,670.0	62,353	24,683	1.655
T-2	33,025.0	64,402	31,377	1.950
T-3	32,292.5	66,993	34,700.5	2.075
T-4	31,537.5	67,932	36,394.5	2.156

CONCLUSION

Weed control is one of the most difficult tasks in agriculture that accounts for a considerable share of the cost involved in agriculture production. Farmers generally expressed their concern for the effective weed control measures to arrest the growth and propagation of weeds. Lack of man power has been identified as one of the major problems for the sustainability of the agriculture industry. Hence transplanters and seeders were well developed as a step for mechanization. However, weeding method is still not well developed. Mechanical weed control not only uproots the weeds between the crop rows but also keeps the soil surface loose, ensuring better soil aeration and water intake capacity. Weeding by mechanical devices reduces the cost of labour and also saves time. The refined push pull type cycle weeder is much superior to farmers practice of Khurpi as weeding tool. While it is in par with the push pull type cycle weeder, with some advantages in terms of effective field capacity, yield and benefit cost ratio.

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