Evaluation of performance parameters of power weeder

S Sai Mohan, G Sanjana and D Anil Kumar

Abstract
Power weeder was evaluated for its performance in sugarcane crop. This test was conducted at different moisture contents of soil and different speeds of weeder. The effective field capacity of power weeder was varied from 0.0476 to 0.231 ha h\(^{-1}\) at 3 forward speeds at 30, 45 and 60 DAS. The weeding efficiency of power weeder with 3 forward speeds at 30, 45 and 60 DAS were varied in the range of 98.74 to 91.22\% at 0.584 km h\(^{-1}\), 96.80 to 84.93\% at 1.35 km h\(^{-1}\), and 94.67 to 73.72\% at 4.153 km h\(^{-1}\). The minimum plant and maximum plant damage was observed at a forward speed of 0.584 km h\(^{-1}\) and 4.153 km h\(^{-1}\), respectively.

Keywords: Weeder, DAS, forward speed, field capacity, plant damage

1. Introduction
Sugarcane (Saccharum officinarum) is the main sugar-producing crop that contributes nearly 78.2\% to the total sugar pool at the global level. It is the prime source of sugar in India; also holding the prominent position as the commercial cash crop. It occupies 3.5\% (5.04 million hectares) of the total cropped area in the country. Sugarcane industry is a major contributor to the country’s economy offering employment to an estimated 6 million Indians.

Doob grass (Cynodon dactylon), the Pogan grass (Imperata cylindrica) are known to play as alternate hosts to ratoon stunting disease of sugarcane. Thus, weeds essesntially harm young sugarcane sprouts by depriving them of moisture, nutrients and sunlight. Poor growth of cane resulting from weed infestation also affects quality. Weeds flora in sugarcane field competes for moisture and light also remove about 4 times N and P and 2.5 times of K during the first 50 days of crop period. In sugarcane crop, weeds have been estimated to cause 12 to 72\% reduction in cane yield depending upon the severity of infestation (Hand book on Agriculture). Weeds, which present in the furrows i.e. along the cane rows are more harmful than those present in the inter-row spaces during early crop growth periods. Thus, the initial 90-120 days period of crop growth is considered as most critical period of weed competition. Therefore, the weed management practice should be adopted to ensure a weed-free field condition for the first 3-4 months period.

Today the agricultural sector requires non-chemical weed control that safeguards consumers demand for high quality food products and pay special attention to food safety. Through the technical development of mechanisms for physical weed control, such as precise inter and intra-row weeders, it might be possible to control weeds. (Blasco et al., 2002).

2. Material and Methods
The study was undertaken at farmers’ fields at Sangareddy, Telangana state. The power weeder was evaluated at 30.45 and 60 days after sowing and with different forward speeds i.e., 0.584 km h\(^{-1}\), 1.35 km h\(^{-1}\) and 4.153 km h\(^{-1}\) at different moisture content. The details of experimental methodology and measurement techniques adopted during the research were described in the following sections.
2.1. Crop Cultivation
Sugarcane crop was raised as per recommended agronomical practices. Accordingly, plot of 400 m$^2$ farm is situated at 15.54° N latitude and 80.30°E longitude at an altitude of 5 m above sea level located at Fasalwadi thanda, Kandi mandal, Sangareddy district which was sowed in the month of January, 2018. The study area is in sub-tropical climate with hot summers and cool winters with an average rainfall of 854 mm. The soil of the experimental farm is classified as alluvial soil group having sandy loam texture.

2.2. Evaluation of Performance Parameters

2.2.1. Weeding Efficiency
It is the ratio between number of weeds removed by power weeder to the number of weeds present in a unit area before weeding operation and is expressed as a percentage. (Tajuddin, 2006).

$$W = \frac{W_1 - W_2}{W_1} \times 100$$

Where,
$W_1$ = Number of weeds present per unit area before weeding operation.
$W_2$ = Number of weeds counted in same unit area after weeding operation.

2.2.2. Plant Damage
It is the ratio of the number of plants damaged after operation in a 10m length to the number of plants present before operation in the same length. It is expressed in percentage. (Tewari et al., 1993)

$$R = \left(1 - \frac{p}{q}\right) \times 100$$

Where,
$R$ = Plant damaged (%).
$p$ = Total number of plants in 10m length before the weeding operation.
$q$ = Total number of plants damaged in the same length after the weeding operation.

2.2.3. Actual Field Capacity
It is the actual area covered by the machine based on its total time consumed and actual working width under field condition. It is expressed as in terms of area covered per unit time of operation. It is calculated by

Field capacity (ha h$^{-1}$) = \frac{\text{actual area covered}}{\text{total time consumed}}

2.2.4. Theoretical Field Capacity
Theoretical field capacity (TFC) is a simple calculation involving speed and width with efficiency set at 100%. It can be calculated from the following equation:

Theoretical field capacity = \frac{w \times s}{10}

Where,
$w$ = Cutting width, m
$s$ = Speed, km h$^{-1}$

2.2.5. Effective Field Capacity
Effective field capacity is the actual average rate of coverage by the machine, based upon the total operation set time. It is a function of the rated width of the machine, the percentage of rated width actually utilized, speed of operation and the amount of field time lost during the operations. Effective field capacity is usually expressed as hectare per hour (Kepner et al., 1978).

Effective field capacity = \frac{\text{Actual field capacity}}{\text{Theoretical field capacity}}

2.2.6. Performance Index of Weeder
Performance of the weeder was assessed through performance index (PI) by using the following relation as suggested by Srinivas et al. (2010):

$$PI = \frac{FC \times (100 - PD) \times WE}{P}$$

Where,
$FC$ = Field capacity, ha h$^{-1}$
$PD$ = Plant damage %,
$WE$ = Weeding efficiency %, and
$P$ = Power, HP

3. Results and Discussion
The performance of power weeder for sugarcane crop at different speeds and different stages of crop was evaluated under field conditions. In this chapter, results were presented.

3.1. Machine Parameters
The Power weeder performance was evaluated under sugarcane crop. Machine parameters like field capacity, weeding efficiency, plant damage, performance index and energy consumption for weeder were discussed.

3.1.1. Effect of Performance Parameters on Field Capacity of the Weeder
The actual field capacity increased with the increase of forward speed, due to more area covered in less time. Same trend was observed in the 45 and 60 DAS intervals. With comparison to 30 DAS, field capacity at 45 and 60 DAS is less irrespective of the forward speed. It may due to increasing of crop canopy.
3.1.2. Effect of Performance Parameters on Weeding Efficiency in Sugarcane

The weeding efficiency decreased with increasing of operating speed, due to fast moving of machine, reduction in bite length (Beeny and Khoo, 1970; Chamen, 1979). The same trend was observed at 45 and 60 DAS.
3.1.3. Effect of Performance Parameters on Plant Damage in Sugarcane
Highest plant damage was observed at higher speed of operation. When the power weeder operates at high speed, the operator cannot control of machine movement on to the plants and high impact action of the rotary tynes to the tender plant stem. Among three different days of intervals, plant damage at 60 DAS was found to be highest due to spreading of crop roots widely and covering of rows with canopy. Power weeder should operate at lowest speed for lowest plant damage.

3.1.4. Effect of Performance Parameters on Performance Index
Performance index of the weeder is directly related to the field capacity, plant damage, and weeding efficiency and inversely related to power exerted. It was observed that the performance index increased with the increase of forward speed.

4. Conclusion
Power weeder was evaluated for its performance in sugarcane crop. This test was conducted at different moisture contents of soil and different speeds of weeder. The effective field capacity of power weeder was varied from 0.0476 to 0.231 ha h⁻¹ at 3 forward speeds at 30, 45 and 60 DAS. The weeding efficiency of power weeder with 3 forward speeds at 30, 45 and 60 DAS were varied in the range of 98.74 to 91.22% at 0.584 km h⁻¹, 96.80 to 84.93% at 1.35 km h⁻¹, and 94.67 to 73.72% at 4.153 km h⁻¹. The minimum plant and maximum plant damage was observed at a forward speed of 0.584 km h⁻¹ and 4.153 km h⁻¹, respectively.

5. References


