Biological Forum – An International Journal **15(9): 387-391(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Comparative Performance Evaluation of Power Operated Weeders for Sugarcane Crop in North Coastal Region of Andhra Pradesh

P. Sreedevi[1*], M. Madhava[2], M.B. G.S. Kumari[3], Ch.S. Rama Lakshmi[4] and P.V.K. Jagannadha Rao[5]

[1]Principal Scientist, Department of Agricultural Engineering,
Regional Agricultural Research Station, Anakapalle (Andhra Pradesh), India.
[2]Professor, Department of Agricultural Engineering,
College of Agricultural Engineering, Bapatla (Andhra Pradesh), India.
[3]Principal Scientist, Department of Agronomy,
Regional Agricultural Research Station, Anakapalle (Andhra Pradesh), India.
[4]Principal Scientist, Department of Soil Science & Ag. Chemistry,
Regional Agricultural Research Station, (Andhra Pradesh), India.
[5]Principal Scientist, Department of Agricultural Engineering,
Regional Agricultural Research Station, Anakapalle (Andhra Pradesh), India.

(Corresponding author: P. Sreedevi)*
(Received: 24 June 2023; Revised: 27 July 2023; Accepted: 27 August 2023; Published: 15 September 2023)
(Published by Research Trend)

ABSTRACT: Sugarcane is a second largest commercial crop in India requiring more labor force starting from planting to harvesting. Out of all operations, intercultural operations contribute 10-15% of the total labor cost. Weed management is the major constraint for high productivity of sugarcane. It has been estimated that weeds can cause 12 to 72 percent reduction in yield depending on the severity of infestation. Weeding operations in sugarcane crop were done manually by the farmers in North Coastal region of Andhra Pradesh which is very tedious and labor consuming. A study was conducted to evaluate the performance of different intercultural equipment such as mini tractor with rotavator (T1), Power weeder-I (T2), Power weeder-II (T3), manual weeding (T4), chemical weeding (T4) and compared with control (T6) under wider row spacing of 150 cm with dual row planting. Among all the treatments, cost of weeding operation in T1 treatment was found to be minimum (Rs.5207/-) with a saving of 70% in weeding operation cost and 98% time compared to manual weeding (Rs.17,290/-). Among all the treatments, weeding operation using mini tractor with rotavator recorded highest yield (85 t/ha) with corresponding high weeding efficiency (84%). Thus, intercultural operation with rotavator drawn mini tractor can be recommended in sugarcane crop under wider row spacing to reduce cost of cultivation and for higher yields.

Keywords: Intercultural operations, power weeders, wider spacing, Weeding efficiency.

INTRODUCTION

India is the second largest sugar producing country next to brazil producing about 439.43 million tons of cane from an area of 5.17 million hectares with average productivity of 84.9 t/ha (Anonymous, 2021-22). In Andhra Pradesh, the average area under sugarcane is 0.47 lakh hectares with production of 3.65 million tons of cane with average productivity of 77.5 t/ha (Anonymous, 2021-22). It was reported that sugarcane area in Andhra Pradesh was decreasing drastically from 1.22 Lakh hectares in 2015-16 to 0.86 Lakh hectares in 2019-20 (Ramarao 2020). The reasons for decrease in area of Andhra Pradesh are labor shortage, high cost of cultivation and non-adoption of package of practices. Weed management is the major constraint for high productivity of sugarcane. Hence, focus should be made on proper weed management by means of physical, chemical and mechanical methods to increase production and productivity of sugarcane.

Sugarcane is labor intensive crop requiring about 3300 man-hours per hectare for different operations (Murali and Balakrishna 2012). Out of which 400-600 man-hours per hectare is required only for weeding/intercultural operations. About 3 to 4 intercultural operations like loosening of soil, harrowing and weeding are required for sugarcane crop during entire crop period to maintain weed free crop. It was reported that yield loss caused by weeds ranges from 15 to 75% depending upon its nature and intensity (Olaoye and Adekanye 2006). It was reported that the magnitude of yield loss due to weed infestation ranges from 10% to complete failure (Srivastava *et al.*, 2005). In sugarcane, initial crop growth period of 90 to 120 days is most critical period for weed competition to get higher crop yield. In sugarcane cultivation, many factors such as relatively longtime for germination,

slow rate of crop growth in the initial stage, wider spacing, heavy manuring coupled with frequent irrigation provides congenial environment for weeds and their growth. It was reported that about 150 weed species including annuals, perennials and parasitic weeds exist in sugarcane field's indifferent parts of India. Weed management especially during the critical period is very much important to avoid yield loss (Ramesh and Rathika 2016). In sugarcane, weeds cause significant yield loss early in crop establishment. It was reported that weed growth of 4 weeks after spiking caused a yield reduction of 11%, delaying weed control until 8 and 12 weeks resulted in large yield losses of 23%, and 34%, respectively. Most of the farmers in Andhra Pradesh are practicing manual weeding which is time consuming and costlier. The demand for labor during peak season is high, thereby increasing the cost of cultivation. Also due to scarcity of labor, the weeding operation could not be done in time thus adversely affecting the yield. Chemical weeding is used extensively in Indian agriculture to control weeds to have timely weed management (Janaki *et al.,* 2013). Pre- emergence spraying of atrazine @1.0 kg a.i/ha followed by post emergence spray of 2,4-D Na salt@1.0 kg a.i./ ha on 110 DAP recorded high weed control efficiency on *Ipomoea sepiaria* and registered highest cane and sugar yield (Nageswari *et al.,* 2022). However, the use of weedicides not only effects soil health and but also gives detrimental effect on the quality of the produce. With the advancement of technology, today the agricultural sector requires non-chemical weed control that safeguards consumers demand for high quality food products as special attention was paid towards food safety. In this juncture, mechanical weeding was advantageous in terms of time, energy and cost effectiveness compared to manual weeding. Mechanical weeding not only reduces drudgery but also ensures better aeration and water intake capacity. The introduction of efficient mechanical weeding equipment is expected to encourage farmers to be self-sufficient, which will lead to increased yields and thus helps to reduce poverty (Olukunle & Oguntunde 2006); for the soil, it helps in stimulating microbial activity in the soil, reducing soil moisture evaporation and facilitating rainwater infiltration (Hegazy *et al.,* 2014). The use of mechanical weeders is very much limited in North coastal districts of Andhra Pradesh. Though, a number of power weeders are available in the market, due to lack of awareness on use of power weeder, the farmers were not utilizing them. Hence, it is highly essential to popularize the mechanical weeders among sugarcane farmers of North Coastal zone to decrease the cost of cultivation and drudgery. Hence, the present study was taken to evaluate different mechanical equipment to control the weeds so as to recommend the best power weeder suitable for sugarcane cultivation

MATERIALS AND METHODS

A. Description of the equipment used for Intercultivation

Three types of weeders namely self-propelled power weeder-I (Make: Garuda mini weeder), Self-propelled power weeder-II (Make: Greaves) and mini tractor drawn rotavator (Make: VST Mitsubishi Shakti) were used in the present study. Chemical weeding was done as per the recommendation of the university i.e. pre emergence spraying of metrubuzine @600g/acreon 3rd day after planting and post emergence spraying of metrubuzine 400g + 2,4-D sodium salt @800g per acre at 30 and 60 days of planting. In manual method, weeding is done manually and in control plot no weeding was done. The first equipment used for weeding operation is mini tractor drawn rotavator whose working width is 1.02 m and can cover one row during its operation. The second equipment is power weeder –I having working width of 60 cm and 0.5 rows was covered during its operation. Hence, the weeder is operated two times to cover one row. The third weeding equipment is power weeder-II which has a working width of 90 cm and will cover one row during its operation (Table 1). The weeding operation within the row for the treatments T1, T2 and T3 were carried out by manual labor.

Table 1: Technical details of equipment used for the study.

Sr. No.	Parameter	Rotavator	Power weeder-I	Power weeder-II
1.	Working width (mm)	1020	600	900
2.	Number of blades	28	12	24
3.	Number of rows covered in single pass	1	0.5	1
4.	Power source	Minitractor operated	Self-propelled diesel engine	Self-propelled air cooled diesel engine
5.	Horse Power	18	4.4	5.0

B. Experimental field

The field experiment was conducted at Regional Agricultural Research Station, Anakapalle, Visakhapatnam district, Andhra Pradesh (16˚ 30'N latitude and 18 ˚ 20' E longitude) with a variety 93A145 (Sarada) developed by Regional Agricultural Research Station Anakapalle during the year 2020-21. The planting was done with three budded setts in wider spacing of 150 cm. To facilitate intercultural operations using power weeders and to operating mini tractor, wider spacing of 150 cm was designed. However, in order to compensate the yield of sugarcane, the dual row planting was done in wider spacing.

The experiment was laid out in Randomized Block Design (RBD) with six treatments (T1- Minitractor

with rotavator; T2- Power weeder-I; T3-Powerweeder-II; T4- manual weeding; T5- chemical weeding and T6-control) and three replications for each treatment. Weeding was done twice i.e after 30 and 60 days of planting. During weeding operation, weeding efficiency, and field capacity were taken as performance indicators. Machine parameters like field capacity (Naik *et al.* 2013) and fuel consumption (Stevens, 1982) were measured and recorded. Weeding efficiency was determined as per the standard procedure (RNAM, 1983) using the following formula.

$$\text{Weeding efficiency, \%} = \frac{w1 - w2}{w2} \times 100$$

Where w1= weight of weeds before weeding
w2= weight of weeds after weeding

C. Biometric parameters

The biometric parameters *viz*., cane height, single cane weight, diameter of the cane and juice quality and yield in all the treatments was recorded. About 20 canes were selected at random from each plot at harvest time and the diameter of the cane was measured using vernier calipers at three different heights *viz.*, one foot above the bottom end, one foot below the top end and middle of cane, and the average was calculated. Cane yield was measured by harvesting the canes plot-wise leaving boundary rows and the weight of the canes was recorded after detrashing for each treatment plot and yield was calculated on hectare basis (Kumar and Tripati 2015).

D. Sugarcane juice quality analysis

Ten canes were collected at random. The canes were de-trashed and the tops were removed. The canes were washed with clean water and the juice was extracted using a clean three roller power operated crusher with a minimum of 60% of juice extraction within 12 h of harvest. The basic parameters of sugarcane juice *viz*., Brix and Sucrose (%) were measured using hand refractometer (Make: Atago; Model: PAL-1)) and saccharimeter (Make: Anton paar; Model: MCP 500 Sucromat) respectively.

The cost of operation of mechanical weeding per hour is calculated and the total cost for weeding operation was calculated for treatments. The performance of the mechanical weeding was compared with the manual weeding in terms of savings in labor cost and time.

E. Statistical Analysis

The experiments were performed in three replications and the results are represented as mean ± standard deviations. The parameters were statistically analyzed at 95% confidence level using SPSS-20 software (IBM SPSS Statistics, USA).

RESULTS AND DISCUSSION

The performance evaluation of power weeders for weeding of sugarcane is given in Table 2. Among the power operated weeders, the field capacity of mini tractor with rotavator was found to be high (0.26 ha/h). It was observed that weeding efficiency was high in treatment where weeding was done using minitractor operated rotavator followed by power weeder-II, power weeder-I, compared to manual weeding. Low weeding efficiency of 70% was recorded in chemical weeding. Similar results of higher weeding efficiency using mechanical equipment was reported by Singh and Bhosale (2014) in weed control of sugarcane crop in Uttarakhand region. The churning of soil together with cutting ability of blades of rotavator has resulted in higher weeding efficiency. The statistical analysis indicated that the weeding efficiency using different weeding equipment/method varied significantly at 5% level of significance. The weeding efficiency of power operated weeders recorded high compared to manual and chemical treatment as the churning action of blades of weeders resulted in complete uprooting of weeds. The weeding efficiency highly influences the number of millable canes, single cane weight and thereby the cane yield. Accordingly, the cane yield was recorded highest in T1 followed by T3, T2, T4, T5 and T6. The decrease in weed growth in the treatment resulted in development of new shoots and hence improved the yield. Similar result of significant increase in cane yield was reported in the treatment where weeding efficiency is high (Nageswari *et al.,* 2022). The biometric parameters of cane at the time of harvest in different treatment are given in Table 3. Though there is insignificant increase in single cane weight among the treatments, cane height were recorded significantly high in treatment where weeding is done by mini tractor with rotavator. The complete destruction of weeds with incorporation of weeds in the soil has improved soil fertility. In addition to it, low weed competition in this treatment helped to enhance the cane height. However, the ^{o}Brix and sucrose sugarcane in different treatment was found to be insignificant.

The cost of operation with mechanical weeding over manual and chemical weeding was evaluated in Table 4. Among the three mechanical weeders, though the cost of operation per hour using mini tractor with rotavator is recorded high (Rs. 472/-), the operating cost per hectareis recorded to be lowest of Rs. 1749/- compared to other power weeders. The cost of weeding operation per hectare was recorded highest in manual weeding (Rs. 17,290/-) and lowest was recorded in the treatment where weeding is done using minitractor with rotavator (Rs. 5207/-). A similar result of low cost of operation using power weeder in sugarcane was reported by Mohan *et al*. (2020). Manual weeding is found to be more expensive compared to other methods of weeding as the area covered per unit time in manual weeding is very low. It was observed that there is saving of 98% in time where weeding is done using rotavator with minitractor followed by weeding using power weeder-II, power weeder–I and chemical weeding compared to manual weeding. There is saving of 70% cost in weeding operation in the treatment where weeding was done using minitractor with rotavator over manual weeding. The cost of weeding operation in chemical weeding is on par with cost of weeding done by power weeder–I. However, lower yield is recorded in chemical weeded treatments compared to mechanical weeding.

Table 2: Performance of different Power weeders.

Parameter	T1	T2	T3	T4	T5	T6
Field capacity (ha/h)	**0.26**	0.057	0.1	-	-	-
Weeding Efficiency (%)	**84.4± 4.1**^{c}	79.3**± 3.5**^{bc}	81.9**± 3.3**^{bc}	75.3**± 3.2**^{ab}	70.1**± 3.1**^{a}	NA
Yield (t/ha)	**85.4± 5.1** ^{b}	81.8± 4.5^{b}	83.4± 4.8^{b}	79.4± 4.5^{b}	77.6± 4.2^{b}	64.7±4.0^{a}

Values are presented as mean ± standard error (N=6)
Alphabets in small letters (a-c) in the superscripts denote that the mean values are statistically different at $p< 0.05$ within row.

Table 3: Biometric and juice quality parameters of sugarcane in different treatment.

Parameter	T1	T2	T3	T4	T5	T6
Cane diameter (cm)	**2.6± 0.15**^{a}	2.24± 0.15 ^{a}	2.33± 0.21 ^{a}	2.16± 0.21 ^{a}	2.12± 0.2 ^{a}	2.09± 0.21 ^{a}
Cane height (m)	**3.33±0.18** ^{c}	2.89± 0.25^{abc}	3.03± 0.15^{bc}	2.85± 0.18^{abc}	2.71± 0.22^{ab}	2.44± 0.23 ^{a}
Single Cane weight (kg)	1.34**±0.08** ^{a}	1.29**±0.07** ^{a}	1.32**±0.08** ^{a}	1.21**±0.06** ^{a}	1.21**±0.07** ^{a}	1.18**±0.05** ^{a}
Brix	18.4±0.3^{ab}	18.1±0.2^{ab}	18.5**±0.2**^{ab}	18.5**±0.3**^{ab}	18.3**±0.1**^{ab}	17.9**±0.2**^{a}
Sucrose (%)	16.5± 0.2^{ab}	16.7± 0.3^{abc}	16.6± 0.3^{abc}	16.9± 0.2^{bc}	16.2± 0.2 ^{a}	16.4± 0.3^{ab}

Values are presented as mean ± standard error (N=6)
Alphabets in small letters (a-c) in the superscripts denote that the mean values are statistically different at $p< 0.05$ within row.

Table 4: Cost of weeding operation in different treatments.

Sr. No.	Parameter	T1	T2	T3	T4	T5	T6
1.	Time taken for one hectare (hours)	3.705	17.29	9.88	296.4	29.64	-
2.	Cost of operating equipment per hour (Rs)	472/-	354/-	293/-	-	-	-
3.	Cost of operating equipment per hectare (Rs)	1749/-	6121/-	2895/-	-	-	-
4.	Labor cost per hectare	3458/-	3458/-	3458/-	17,290/-	2347/-	
5.	Cost of chemicals per hectare	-	-	-	-	7044/-	
6.	Total Cost of weeding per hectare **(3+4+5)**	5207/-	9579/-	6353/-	17,290/-	9391/-	
7.	Saving in weeding operation cost (%)	**70**	45	63	-	46	-
8.	Saving in time (%)	**98**	94	96	-	90	-

*Labor charges for men = Rs. 600/- and women = Rs. 350/- per day of 6 hours
** Labor charges for skilled worker = Rs. 800/- per day of 6 hours, Diesel cost = Rs. 99/lit
*** Labor cost per hectare in T1, T2 and T3 indicates intra row weeding.

CONCLUSIONS

The study shows that the mechanical weeding can save labor cost and time compared to manual weeding and chemical weeding. Among the mechanical weeders studied, it was observed that weeding using mini tractor with rotavator can save time to a tune of 98% and labour cost of 70% with high yield of 85 t/ha followed by power weeder-II, power weeder-I compared to manual weeding. Hence, weeding using mini tractor with rotavator can be recommended to the farmers of North Coastal region with a spacing of 150 cm adopting dual row planting.

FUTURE SCOPE

The findings from this study can be adopted in the sugarcane growing areas of Andhra Pradesh for mechanical weeding in sugarcane cultivation to reduce cost of cultivation and for increased yields.

Acknowledgements. The authors are grateful to the Director of Research, Acharya N.G. Ranga Agricultural University and Associate Director of Research, Regional Agricultural Research Station, Anakapalle for the encouragement and providing facilities to carry out the experiment.
Conflict of Interest. None.

REFERENCES

Anonymous (2021-22). https://sugarcane.dac.gov.in/pdf/StatisticsAPY.pdf

Hegazy, R. A., Abdelmotaleb, I. A., Imara, Z. M. and Okasha, M. H. (2014). Development and evaluation of small-scale power weeder. *Journal of Agricultural Engineering*, *31*(3), 703-728.

Janaki, P., Rathika, S., Chinnusamy, C. and Prabhakaran, N. K. (2013). Field dissipation of metamitron in soil and sugar beet crop. *Bulletin of environmental contamination and toxicology*, *90*, 116-119.

Kumar, M. and Tripati, A. (2015). To study of the different modes of tillage for the performance of sugarcane cutter planter. *International Research Journal of Engineering and Technology*, *2*(3), 1416-1425.

Mohan, S. S., Sanjana, G., Avinash, D., Rohitha, M. and Kumar, D. A. (2020). Performance Evaluation of Power Weeder in Sugarcane Crop. *Current Journal of Applied Science and Technology*, *39*(38), 70-81.

Murali, P. and Balakrishnan, R. (2011). Labour Scarcity and Selective Mechanization of Sugarcane Agriculture in Tamil Nadu. *Agricultural Economics Research Review*, *24*(conf), 567-567.

Nageswari, R., Dhanushkodi, V., Chitra, K., Dhanalakshmi, K., Krishnaveni, S. A., Shanmuganathan, M., and Saranraj, T. (2022). Chemical and Mechanical options for Management of Weeds in Sugarcane in Cauvery Delta Zone of Tamil Nadu. *Agricultural Mechanization in Asia*, *53*(11).

Naik, R., Annamalai, S. J. K., Nair, N. V. and Prasad, N. R. (2013). Studies on Mechanization of planting of sugarcane bud chip settlings raised in protrays. *Sugar Tech.*, *15*, 27-35.

Olaoye, J. O. and Adekanye, T. A. (2006). Development and Evaluation of a rotary power weeder. *Proc. Nige. Soc. Agric. Engg.*, *3*, 189-199.

Olukunle, O. J. and Oguntunde, P. (2006). Design of a row crop weeder. In *Conference on International Agricultural Research for Development. Tropentag, University of Bonn. Germany*.

Ramesh, T. and Rathika, S. (2016). Management of emerged weeds in irrigated blackgram (*Vigna mungo* L.) through post-emergence herbicides. *Legume Research-An International Journal*, *39*(2), 289-292.

Ramarao, I. V. V. (2020). Economic Analysis of Sugarcane Cultivation in Andhra Pradesh, India. *International Journal of Theoretical & Applied Sciences*, *12*(1), 49-52.

RNAM (1983). RNAM test codes and procedures for farm machinery, Technical series Regional Network for Agricultural Machinery (RNAM), Bangkok, Thailand, *12*, 133-149.

Singh, T. P. and Bhosale, A. T. (2014). Comparative performance evaluation of different mechanical equipment for weed control in sugarcane crop in Northern-Western Tarai Region of Uttarakhand. *African Journal of Agricultural Research*, *9*(43), 3226-3232.

Srivastava, T. K., Chauhan, R. S. and Lal, Menhi (2005). Weed dynamics and their management in sugarcane under preceding crops and tillage system. *Indian Journal of Agricultural Sciences*, *75*(9), 254-260.

Stevens, G. N. (1982). Equipment testing and evaluation. Wrest park, Silsoe, Bedford, England: National Institute of Agricultural Engineering.154 p.

How to cite this article: P. Sreedevi, M. Madhava, M.B. G.S. Kumari, Ch. S. Rama Lakshmi and P.V.K. Jagannadha Rao (2023). Comparative Performance Evaluation of Power Operated Weeders for Sugarcane Crop in North Coastal Region of Andhra Pradesh. *Biological Forum – An International Journal*, *15*(9): 387-391.