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EVALUATION OF SUGARCANE PLANTERS AVAILABLE IN ANDHRA PRADESH

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ABSTRACT

The sugarcane set cutter planter is a versatile implement and can do five operation viz., furrow opening, set cutting and placement, fertilizer & fungicide application and covering in single go. Similarly seedling transplanting machine available for bud-chip method of sugarcane planting which can do four operations like furrow opening, seedling placement along with water pour and press the seedling in soil; was considered for study and evaluated operating parameters. The row spacing for planting with both machines were adjustable and can be done from 90 cm to 165 cm. The machines also evaluated for intra row spacing of planting which was continuous or up to required spacing as it is monitored by the feeding of cane in sett cutting machine. Similarly, fertilizer quantity can be metered through machine from 0.02 g/m to 0.44 g/m run in the furrow, whereas fungicide placement need to be done with knob position and can be varied from 1172 ml to 1549 ml. In case of bud chip seedling planter intra row spacing can be varied from 30.4 cm to the maximum of 57 cm by changing suitable gear ratio in the power train and water pour quantity per plant can be monitored from 47.4 ml to 244 ml.

KEYWORDS: Sugarcane sett cutter planter, Sugarcane budchip seedling transplanter, field performance.

INTRODUCTION

Sugarcane (*Saccharum officinarum L.)* is the most important agro industrial crop next to cotton. In India, the cane cultivable area is 5.09 million hectares with a total production of 347.87 million tone during 2013-14 (Directorate of Economics and Statistics and Ministry of Agriculture, 2013-14). In Andhra Pradesh and Telangana the area under sugarcane is 0.18 m ha with a production of 139 million tone in 2014-15 (Indiastat.com).

The development of tractor operated sugarcane sett cutter planter in which the sugarcane set were fed by operator during operation. It was developed by the IISR, Lucknow (Srivastava, 1978). This is the semi automatic unit and the main difference of this machine was sett cutting mechanism. The existing unit is designed to open furrow placement of setts and fertilizer. Select application, fungicide application, covering of setts with loose and moist soil. Apart from the above machine and also to encourage bud chip planting and reduce cost of cultivation, ANGRAU have introduced two row bud chip planter in which bud chips are used to grow in nursery and nursery seedlings are used for planting. This method of planting engages maximum approximately 100 per cent surveillance of planted crop. Even though the information on available planters in the state of Andhra Pradesh known, the farmers are still dependent on expensive manual planting. To find the reasons for non-adoption and bottlenecks of the process, investigation on the available machinery was conducted, to suggest region specific recommendations and reduce dependency on manual labour in turn cost of operation.

MATERIALS AND METHODS

The planters were tested evaluated in Agriculture Research Station, Perumallipalle, Tirupati. The soil was with sandy loam in texture and red in colour. The planters used for the study was Sugarcane Budchip seedling transplanter and Sugarcane sett cutter planter. The variety of sugarcane was 2005 T16.

Evaluation of set cutter planter

A machine shown in Fig. 2 was used for evaluation. It was operated with tractor and attached with three point hitch system as mounted type implement. Sugarcane are fed into the feeding mechanism of planter and were cut with the help cutter mechanism and the setts dropped into the furrow opened by the furrow opener of the machine. Simultaneously fertilizer is dropped into the furrow and fungicide is sprayed over setts and then it pressed in to soil with the help of rollers (Fig. 1).

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Row spacing

The machine was designed with two row set cutter planter and can be adjusted for varied spacing. The given main frame and other braces and brackets were tested for its maximum and minimum row spacing and its tension.

Set cutter size

Machine was evaluated for its effectiveness with different engine speeds and its influence on size and cutting efficiency.

Intra row spacing

The set planting intra row spacing does not have any metering mechanism. It mainly depends on the skill of the subject who feeds the cane into the cutter. Since the speed of the operation is influencing the placement of sets, this was tested against different speeds of operation and uniformity coefficient was evaluated.

Fertilizer placement

The evaluation was done on metered quantities of fertilizer drilled in the field along with setts. It was also analyzed the uniformity of the placement and quantity evaluation against requirement.

Fungicide dripping

Since there was no metering mechanism for fungicide application, evaluation of knob adjustment for maximum and minimum quantities of dripping and its sufficiency was calculated and machine was calculated (Choochart *et al.,* 2015).

Evaluation of Sugarcane bud-chip Seedling Transplanter

A machine shown in Fig. 4 was used for transplanting sugarcane seedlings in the field. It was operated with tractor and attached with three point hitch system as mounted type implement. Budchip seedlings were fed into the planting mechanism of planter. During dropping in the furrow, it triggers watering latch and simultaneously water poured in furrows and seedling is placed. The covering and pressing from both sides was done with inclined pressing wheels (Manisha *et al.,* 2008) (Fig. 3).

Row spacing

The adjustable two furrow opening unit with respective main frame was adjusted with the help of U brackets fastened to main square frame. The maximum row spacing and minimum row spacing achievable was measured.

The machine was raised from the ground. The fasteners are dismantled and adjusted the brackets from maximum to minimum position on the main frame. The data was documented.

Intra row spacing

The machine was evaluated for its maximum and minimum intra-row spacing adjustment in placement of seedling this in two rows. This was adjusted with the help of gear ratios (set of gears provided by the manufacturer) used in the power train of seedling metering rotary mechanism. This is operated by the drive from ground wheels arranged in the front of metering mechanism.

Metering water quantity

The water delivered to per plant was measured at different positions of the adjusting knob to flow per drop of the seedling and triggering the latch. The quantity of the water per seedling can be adjusted with the knob control by lowering or bringing out the plunger ball in the barrel. The minimum and maximum water delivering quantity per seedling was evaluated. The range was tabulated.

Press roller adjustment

The press rollers were designed with roller spacing adjustment and was evaluated for the minimum and maximum spacing to accommodate the size of root mass of seedling.

Missing plant

Missing plant was measured at different gear system and time intervals. The number of plants missing in a row was evaluated.

RESULTS AND DISSCUSION

Sugarcane budchip seedling equipment:

The two row machine main frame have provision of adjusting furrow opener along with all components as mentioned in Table 1. The minimum spacing between rows attainable was 95 cm below which the component getting inferred and tangled with fixed brace collers. Similarly maximum row spacing attainable was 170 cm, the minimum water quantity was 47.4 ml and maximum was 244.0 ml, the minimum furrow opener depth was 6 cm and maximum depth was 12 cm (Bhal and Sharma, 2001).

Intra row spacing adjustment

Spacing of the planting greatly influences the production and productivity. To maintain recommended spac-

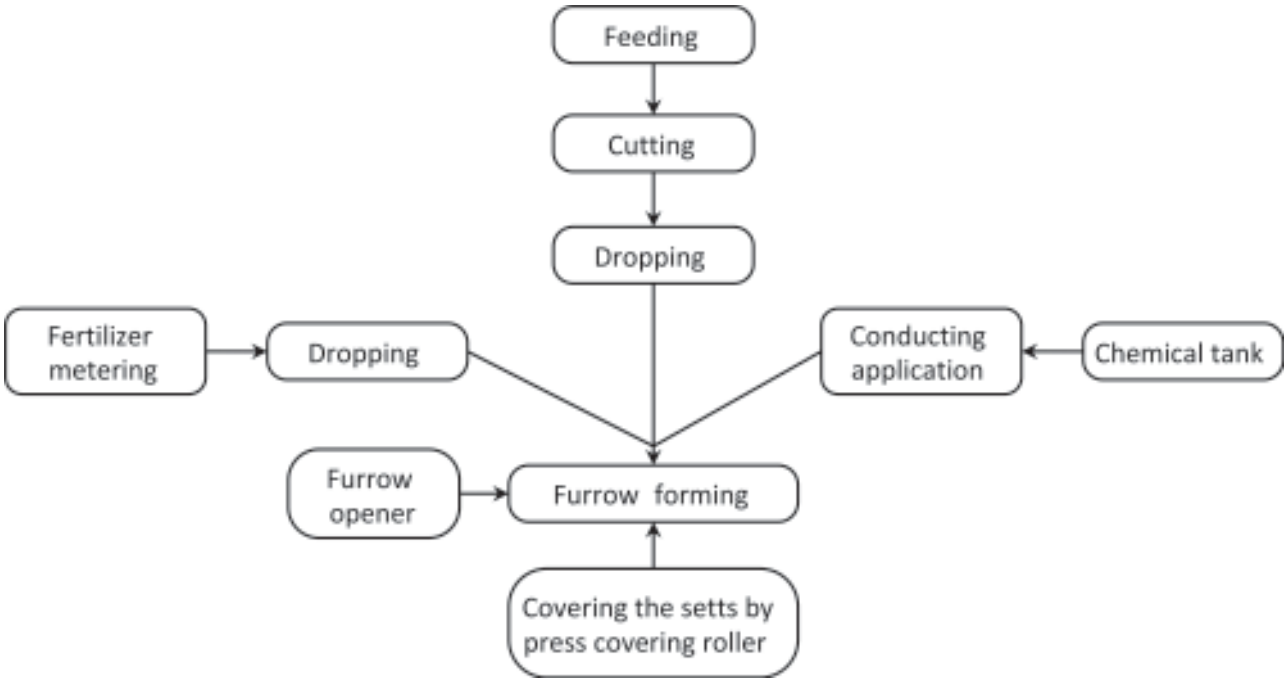

Fig. 1. Flowchart showing sequence of operations by sugarcane sett cutter planter

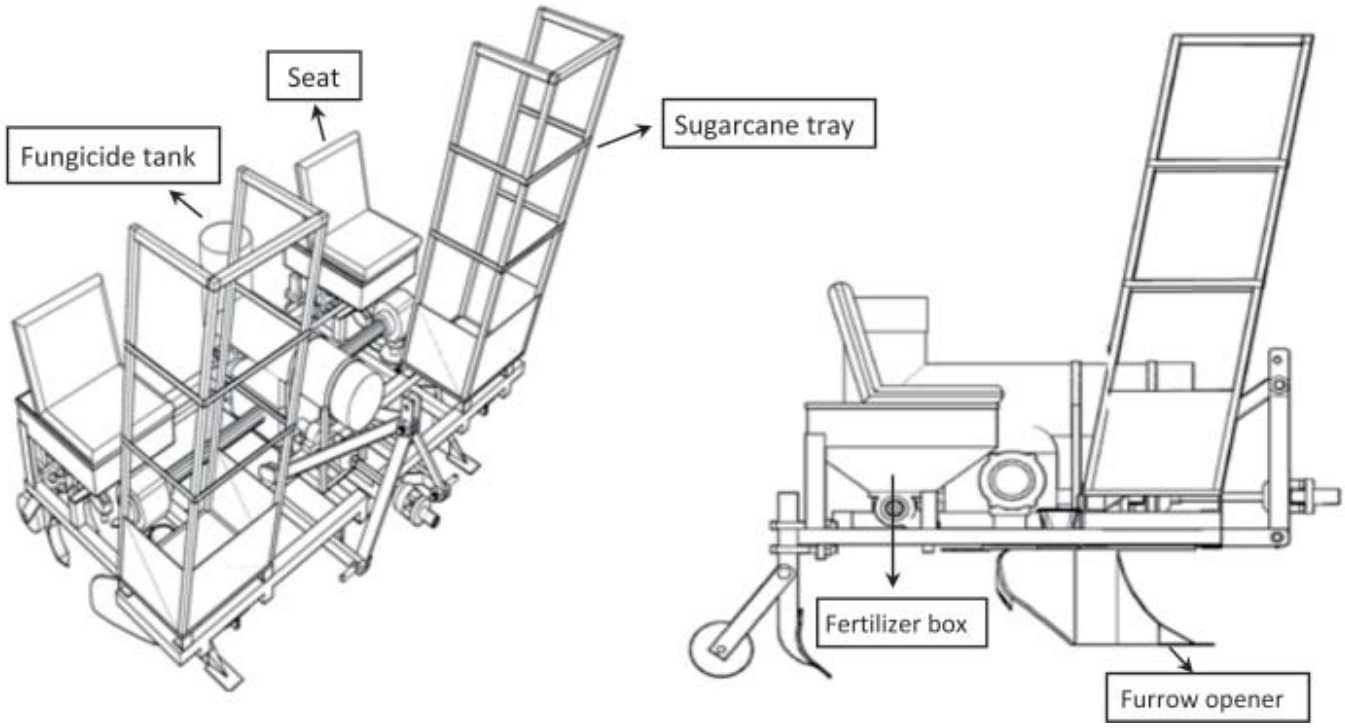

Fig. 2. Isometric and side view of sugarcane sett cutter planter

ing in the sugarcane planting is essential to have intra row spacing monitoring mechanism to adjust as per the recommendation. The results of the testing shown that the varying the gear ratio in the power train of the rotary mechanism significantly influences the intra row spacing. The variation of gear ratio from 12 × 10; 12 × 14; 12 × 16 and 12 × 18 teeth had increased intra row spacing of 30.4 cm, 45.9 cm, 50.8 cm and 57.0 cm respectively (Choochart *et al.,* 2015) (Fig. 4.1).

Variation of water distribution in the budchip seedling transplanter

The knob and control rack was designed to vary the water pour quantity depending upon soil type and the age of the seedling used for planting, which is a essential technical requirement for establishment of roots in the field there by reducing mortality. The seedling establishment and maintaining 100 per cent population is very important in the budchip seedling planting method.

Results of the test on watering capacity and its normality against water pump knob adjustment on threaded rack shows significant variation. The minimum mean quantity of water pour of 47.4 ± 0.89 ml at low position and maximum pour quantity was 244 ± 8.94ml at full open knob position. It was observed that intra pour variability was significantly high 8.94 ml in the full open position, where as it was significantly mean variation of 0.89 ml at low position. The water pour quantity at middle knob position on control rack was found to be 97.0 ± 1.41 ml (Umesh and Rajesh, 2007). The same was explained in Fig 5.

Variation analysis of the experiment was used to clarify the practical significances water measurement performance texted, as presented in the Fig. 5. The results from one-way ANOVA it is observed that there is significant difference among three treatments i.e high, medium and low knob position at 1 per cent level (p-value <0.01) with respect to knob position. This was a added advantage to the method of planting to meter the quality of water application along with nursery planting depending on the age of the sapling and its water requirement.

Missing of plants

The study also observed the missing plant during field operation. The results revealed that 5-8 per cent missing of plants observed after 20 min of operation. This was the result of non placement of seedling in rotary cups. This missing was mainly due to the continuous feeding without any break and monotonous operation leading to fatigue and causing missing feeding. It was also observed

Table 1. Sugarcane budchip seedling transplanter equipment and its adjustments

S. No.	Particulars	Adjustable	
		Min	Max
1	Row to row spacing (cm)	95	170
2	Water quality (ml)	47.4	244.0
3	Furrow depth (cm)	6	12

that the number of missing plants increased as the intra row spacing of the planting reduced and missing were significantly high and needs break (rest) in the feeding to maintain 100 per cent planting after 20 min (Marco and Tomaz, 2010).

From Table 2 it was observed among 4 gear system, significantly higher missing plants was observed at high

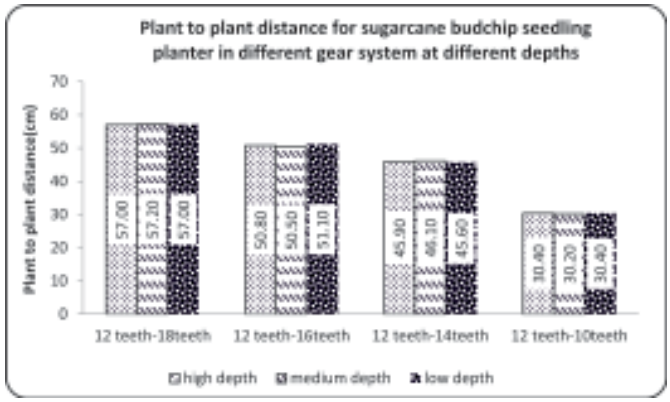

Fig. 4.1. Effect of plant to plant spacing in different depths depth

at 20-30 min in 12 teeth-10 teeth with 3.75 ± 0.957, significantly lower missing plants was observed at low at 0-10 min in 12 teeth-18 teeth and 12 teeth-16 teeth with 2.25 ± 0.500. This happens due to change in time and gear system.

Sugarcane set cutter planter

Sugarcane set cutter planter equipment and its adjustments

The two row machine main frame have provision of adjusting furrow opener along with all components as mentioned in Table 3. The minimum spacing between rows attainable was 90 cm below which the component getting infertangled and obstructed. Similarly maximum row spacing attainable was 165 cm, beyond which drive shaft (telescopic) not available, the minimum feeding unit was single node and maximum spacing was 4 nodes, the

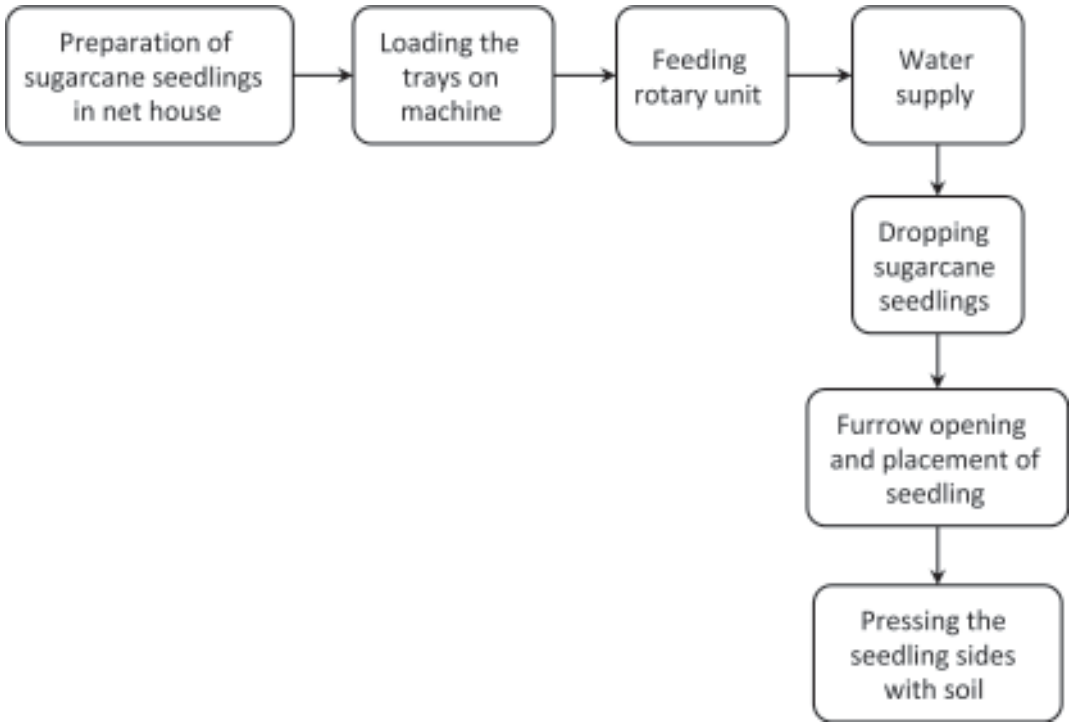

Fig. 3. Flowchart showing sequence of operations by sugarcane budchip seedling transplanter

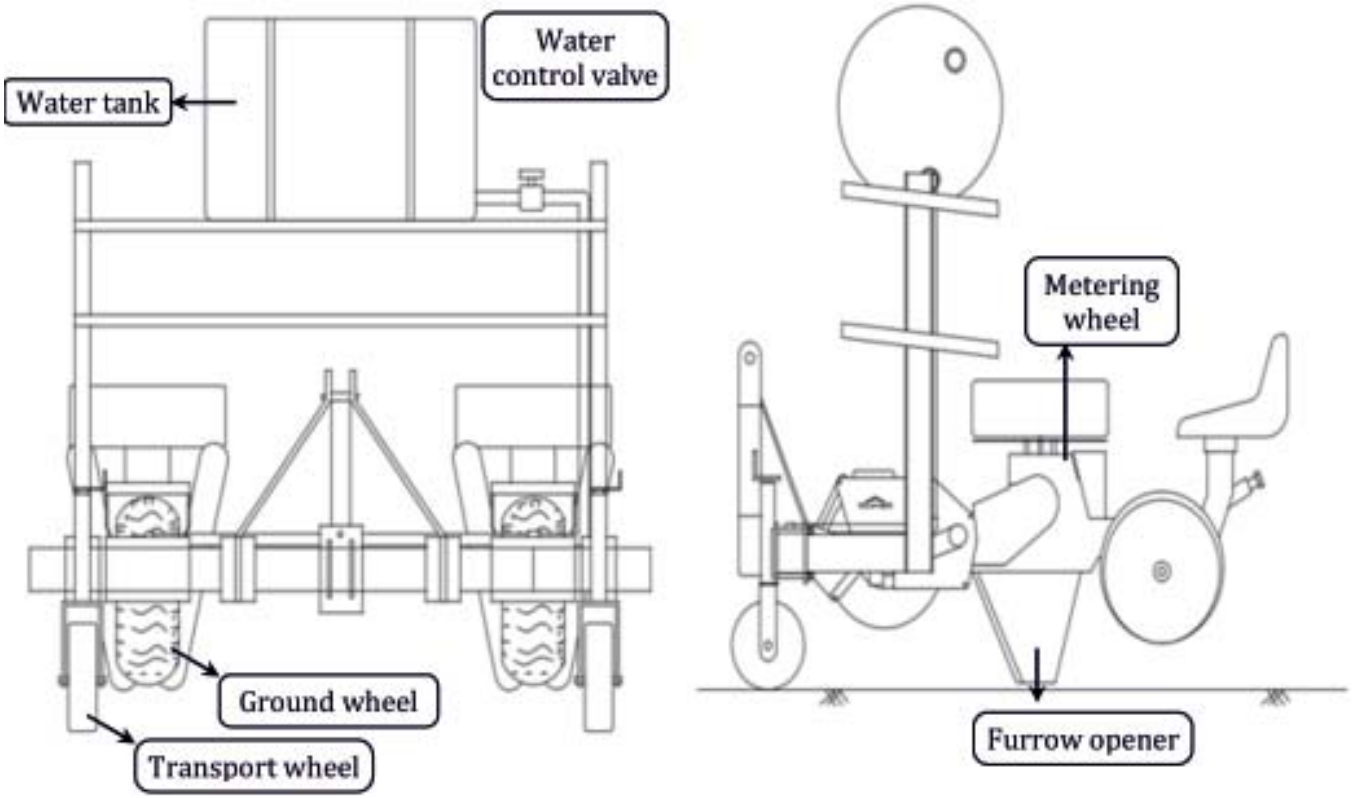

Fig. 4. Front and side view of sugarcane budchip seedling transplanter

Table 2. ANOVA analysis of effect on missing plants

Gear system with intra row distance	No. of replications	Planting duration					
		0-10 min		10-20 min		20-30 min	
		Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
12 teeth - 18 teeth (57 cm)	5	2.25	0.500	2.75	0.957	2.75	0.957
12 teeth - 16 teeth (50 cm)	5	2.25	0.500	2.50	0.577	3.25	0.500
12 teeth – 14 teeth (45 cm)	5	2.75	0.957	2.75	0.957	3.50	1.291
12 teeth – 10 teeth (30 cm)	5	2.50	0.577	2.75	0.500	3.75	0.957
Total	20	2.45	0.686	2.65	0.745	3.20	0.957

minimum fertilizer applied was 0.02 kg and maximum was 0.44 kg, the minimum fungicide applied was 1172 ml and maximum was 1549 ml, the minimum furrow opener depth was 6 cm and maximum depth was 12 cm (Manish and Tripathi, 2015).

Effects of blade speed on number of buds laid down from sugarcane 3 buded set cutter planter

From Table 4 it was observed among operational selected three speeds of cutting knives, speed significantly influenced the number of 1 or 2 or 3 budded setts. The maximum number of three budded setts (72.2%) attained from the machine at 30 rpm followed by 65.4 per cent at 47 rpm and 48 per cent at 67rpm. This evidently shows that the decrease of accuracy in feeding with the increase of speed,

CONCLUSIONS

1. Speeds of cutting knives, significantly influenced the number of 1or 2or 3 budded setts. The maximum number of three budded setts (72.2%) attained from the machine at 30 rpm followed by 65.4 per cent at 47 rpm and 48 per cent at 67rpm. This evidently shows that the decrease of accuracy in feeding with the increase of speed (Table 4).
2. In sugarcane budchip seedling transplanter, with varying gear ratio in the power train of the rotary mechanism of 12×10; 12×14; 12×16 and 12×18 teeth had increased intra row spacing of 30.4 cm, 45.9 cm, 50.8 cm and 57.0 cm respectively (Fig. 4.1).
3. Sugarcane budchip seedling transplanter water pour can be varied during the transplanting from 244 ± 8.94ml at full open knob position to 47.4 ± 0.89 ml at low position (Table 1).
4. The number of missing of plants increased as the intra spacing of the planting reduced as duration of planting exceeds 20 minute (Table 2).

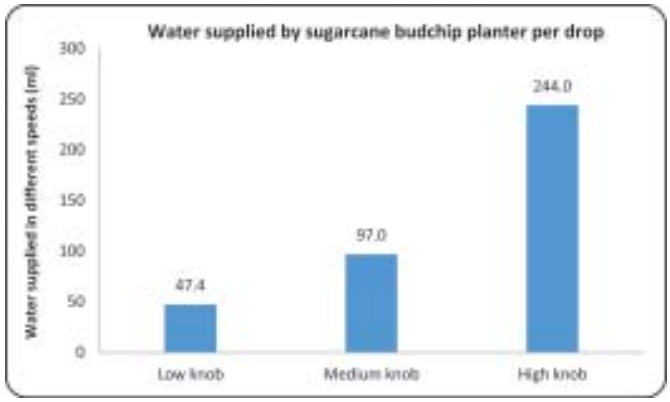

Fig. 5. Effect of knob position on water-pour during each drop of seedling

Table 3. Sugarcane set cutter planter equipment and its adjustments

S. No.	Particulars	Adjustable	
		Min	Max
1	Row to row spacing (cm)	90	165
2	Feeding unit (nodes)	Single	4
3	Fertilizer applier (kg)	0.02	0.44
4	Fungicide applicater (ml)	1172	1549
5	Furrow depth (cm)	6	12

Table 4. Association between speed of sugarcane cutter and number of buds laid down

Chi-square value	p-value	Number of buds				Total
13.368 *	0.038	1	2	3	4	
Speed	30 rpm	0	6	24	3	33
		0.0%	18.2%	72.7%	9.1%	100.0%
	47 rpm	0	5	17	4	26
		0.0%	19.2%	65.4%	15.4%	100.0%
	67 rpm	4	3	12	6	25
		16.0%	12.0%	48.0%	24.0%	100.0%
	Total	4	14	53	13	84
		4.8%	16.7%	63.1%	15.5%	100.0%

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