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Research Article *Natural Resource Management*

Influence of Type of Seedlings, Planting Methods and Nitrogen levels on Yield and Quality of Sugarcane Under Drip Fertigation

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Abstract

A field experiment was conducted for three consecutive years from 2013-14 to 2015-16 at Regional Agricultural Research Station, Anakapalle, Andhra Pradesh, India. The experiment was laid out in split plot design, planting methods as main plot treatments and levels of nitrogen as sub plot treatments under drip fertigation. The main plot treatments constitute paired row planting with single node seedlings, paired row planting with bud chip seedlings, dual row planting with single node seedlings, dual row planting with bud chip seedlings and normal planting with three budded setts. Sub plot treatments are 75% RDN, 100% RDN and 150% recommended dose of nitrogen supplied through drip. Pooled data analysis of three years indicated that planting of single node seed lings in dual rows of 150×45 cm^2 (103.6 t ha^{-1}) or paired rows of 60/120×60 cm (102.4 t ha^{-1}) registered significantly higher cane yield as compared to the planting of bud chip seedlings in dual rows or paired rows and planting of three budded setts in furrows. Sugarcane cultivation with single node seedlings increased the cane yield to the tune of 5.0% compared to the normal planting under drip fertigation. However, bud chip seedlings also performed well in dual row planting. Application of nitrogen at 150% recommended dose through fertigation recorded significantly higher cane yield of 104.8 t ha^{-1} than 75% or 100% RDN.

Keywords: Drip fertigation, dual row planting, single node seedlings

1. Introduction

Planting is the most important and labour intensive operation in sugarcane cultivation (Nalawade et al., 2018). Sugarcane is planted commercially using 2 or 3 budded setts. This method of cultivation is gradually becoming uneconomical as the cost of seed used for planting accounts for over 20% of the total cost of production . In conventional system 6 -7 tons of seed cane ha^{-1} is used as planting material. One alternative to reduce the mass and improve the quality of seed cane is to plant bud chips/single nodes. These bud chips/single nodes are less bulky, easily transportable and more economical seed material. Hence, in recent years sugarcane cultivation with single node or bud chip seedlings is gaining importance in order to reduce the cost of planting material. It was observed that, due to saving in seed material, the maximum net returns were obtained with bud chips raised seedlings (Jain et al., 2009). Chavan et al. (2011) at Akola on black clay and clay

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loam soils found that the wider inter and intra row spacing recorded significantly higher sugarcane growth and yield parameters. Planting of sugarcane either with bud chip or single node seedlings under wider spacing is also essential in order to facilitate mechanization in sugarcane to reduce the labour cost. Further, there is a need to find out the potential risk of yield reduction under wider spacing which can be minimized with increased fertilization and nitrogen fertilizer in specific.

Sugarcane crop exhausts the available macro, secondary and micro nutrients from the soil. Therefore, mineral nutrition is one of the potential means of improving cane yield. Nitrogen, the luminary input of sugarcane production is also a single factor which contributes more to agricultural production. Urea is the widely used nitrogenous fertilizer (Hemalatha, 2015). The agronomic use efficiency of urea is abysmally low (around 20 to 40%) under predominantly subtropical agriculture in India (Suri et al., 2001). Drip fertigation, one of the potential technologies, offers the great scope to increase cane productivity up to 200-220 t ha^{-1} (Senthil Kumar, 2009). Sugarcane is the fastest growing, largest biomass and highest sucrose-accumulating agricultural crop in the world. Although sugarcane requires large inputs of N for successful crop growth (Laan et al, 2011), it is relatively inefficient in the recovery of N fertiliser (Vallis and Kating, 1994).

Sugarcane crop requires high water requirement of 2000-3000 mm (Malik and Baksha, 2008). About 250 tonnes of water is needed to produce one tone of sugarcane . As irrigation water is limited and costly input, irrigation methods like drip offers many advantages over flood irrigation such as reduced evaporation, efficient water use, greater water uniformity, enhanced growth, crop yield and quality (Camp et al., 1997). Drip fertigation, one of the potential technologies offers the great scope to save 40-50% irrigation water and enhanced nutrient efficiency by 40% (Solomon, 2012). In India, the potential for the drip irrigation system is estimated to be 21.27 mha (Narayanamoorthy, 2008). Water saving from drip irrigation system varied from 12 to 84% for different crops besides increasing the production of crops (Vijayakumar et al., 2010). The present study was undertaken to find out the impact of type of sugarcane planting material, methods of planting and levels of nitrogen fertilizer application through drip fertigation on yield and quality of sugarcane.

2. Materials and Methods

A field experiment was conducted at Regional Agricultural Research Station, Anakapalle (Longitude 17^0 41’ N and longitude $82^0$59’), Andhra Pradesh, India for three consecutive years from 2013-14 to 2015-16. Soil of the experimental site was sandy loam. The experiment was laid out in split plot design with three replications. Three methods of planting dual row planting (150×45 cm^2), paired row planting (60/120 cm×60 cm) with bud chip and single node seedlings and normal planting with three budded setts (90 cm spacing) were taken as main treatments. Thus, the main treatments constituting of T_1- Paired row planting (60/120 cm 60 cm) with single node seedlings, T_2- Paired row planting with bud chip seedlings, T_3- Dual row planting (150x45 cm^2) with single node seedlings, T_4- Dual row planting with bud chip seedlings and T_5-Normal planting with three budded setts. In dual row planting, two rows of sugarcane seedlings was planted with in 150 cm spacing. Nitrogen fertigation taken as sub-plots (N_1-75% , N_2- 100% and N_3-150% Recommended dose of Nitrogen i.e 112 Kg N ha^{-1}).

Drip was operated daily to replenish 100% evaporation losses taking into account rain fall, evaporation, pan and crop coefficient. Bud chip seedlings were raised in pro trays and single node seedlings were raised in polythene bags. 30 days aged bud chip and single node seedlings were planted in paired (60/120x45 cm^2) and dual row (150x45 cm^2) spacing along with 3 budded setts planted at a spacing of 90cm as check in main field during first week of March. P_2O_5 (100 Kg ha^{-1}) and K_2O (120 Kg ha^{-1}) fertilizers were applied as basal in furrows at the time of planting and nitrogen fertilizer was applied through fertigation as per the treatments. Fertigation schedule was started from planting of seedlings and continued up to 150 days after planting at weekly interval. Thus the N fertilizers in different doses were applied through drip in 20 equal splits. All other agronomic practices like hand weeding, earthing up, trash twist propping etc., were carried out as per recommendations. Yield attributing parameters like number of millable canes, cane length were recorded at the time of harvest. Cane yield was recorded after stripping the leaves and detopping. Juice quality parameters viz., sucrose %, CCS % and sugar yield were recorded at harvest by following standard procedures (Meade and Chen, 1971). Data collected during three consecutive years were done pooled analysis and the results were compared. The experimental data were analysed statistically by applying the technique of analysis of variance and significance was tested by variance ratio i.e. F value at 5% level of significance as described by Panse and Sukhatme, 1967.

3. Results and Discussion

3.1. Seedling survival (%)

Seedling survival % was recorded at 15 days after planting and data are presented in Table 1. Significant variation in survival of seedlings was not observed due to different planting methods and application of different nitrogen levels through fertigation. However, highest % survival was observed in planting of single node seedlings in dual row planting (76.4) or paired planting (73.8). Single node seedlings performed better than the bud chip seedlings in field condition. Normal planting of three budded setts recorded highest per cent germination of 76.9 which is more or less similar to single node seedlings. Galal (2016) observed more than 80% survival of bud chip seedlings raised through portrays in Egypt. There is not much

Table 1: Yield and quality of bud chip and single bud polythene bag raised seedlings of sugarcane as influenced different planting methods and N fertigation (pooled data of three years)

Treatment	Seedling survival (%)	NMC ha^{-1}	Cane yield (t ha^{-1})	Sucrose %	CCS %	Sugar yield (t ha^{-1})
Paired row planting with single node seedlings	73.8	93457	102.4	18.1	13.2	13.5
Paired row planting with bud chip seedlings	69.9	89192	97.9	18.0	13.1	12.8
Dual row planting with single node seedlings	76.4	91659	103.6	18.8	13.7	14.1
Dual row planting with bud chip seedlings	71.4	89133	100.3	18.2	13.4	13.5
Normal planting (Germination %)	76.9	88824	97.9	18.3	13.2	13.1
SEm+	1.97	565	1.25			
C.D(0.05)	NS	1810	3.80			
N levels						
75% RDN	73.0	88512	96.1	18.2	13.4	12.8
100% RDN	72.4	90840	100.4	18.3	13.8	13.4
150% RDN	73.3	92006	104.8	17.9	13.8	13.9
SEm+	0.95	628	1.07			
C.D(0.05)		1909	3.3			
Interaction		NS	NS	NS	NS	-

NMC: Number of millable canes; CCS: Commercial cane sugar

variation in survival % of seedlings due to application different doses of N fertilizer through fertigation.

3.2. *Number of millable canes*

Number of millable canes were recorded at harvest and data are presented in Table 1. Millable cane number varied significantly due to different planting methods and nitrogen levels. Single node seedlings planted in paired rows of 60/120×60 cm registered significantly higher number of millable canes (93,457 ha^{-1}) than other treatments. Normal planting with three budded setts recorded lowest number of millable canes (88,824 ha^{-1}). Natarajan (2011) observed that tillering under conventional system is very low, the millable canes resulting more from very high seed rate rather than from the inherent tillering potential of the buds planted unlike in transplanting of cane seedlings. A sugarcane clump comprises of several cane stalks arising from subsurface sprouting of the underground buds in the form of tillers which develop into millable canes (Subhashisa et al., 2017)

Significant differences in number of millable canes were observed with different nitrogen levels. Application of nitrogen fertilizer at 150% recommended dose (112 kg ha^{-1}) recorded significantly higher number of millable canes (92,00 ha^{-1}) as compared to 75% RDN but found on par with application of 100% RDN, indicating that increased nitrogen fertilization is required to produce more number of miilable canes.

3.3. *Juice quality*

Juices were analyzed for sucrose content treatment wise and data are presented in Table-1.Juice sucrose % values and commercial cane sugar did not vary significantly either due to planting methods or due to different nitrogen levels. However application of 100% RDN resulted in higher sucrose % of 18.3. Higher commercial cane sugar values were recorded with planting of single node seedlings in dual row planting (14.1), but found on par with other treatments.

3.4. *Cane yield (t ha^{-1})*

Cane yield varied significantly due to different planting methods and nitrogen levels (Table-1). Planting of single node seedlings in dual rows of 150 cm×45 cm^2 (103.6 tha^{-1}) or paired rows of 60/120×60 cm (102.4 tha^{-1}) registered significantly higher cane yield as compared to the normal planting with three budded setts (97.9 t ha^{-1}). Sugarcane planting with single node seedlings increased the cane yield to the tune of 5.0% where as with bud chip seedlings there is 1.2% increase in cane yield over normal planting under drip fertigation. Pannerselvam and Durai, 2011 reported that single node seedlings raised in polythene bags and transplanted in the main field recorded higher cane and sugar yields than conventional planting. Among the nitrogen levels, application of nitrogen at 150% recommended dose recorded higher cane yield of 104.8 t ha^{-1}. Selvan, 2000 also found improvement in cane yield of bud-chip seedlings with higher level of nitrogen.

3.5. *Sugar yield (tha^{-1})*

Sugar yield was higher in sugarcane planted with single node seedlings under dual row planting (14.1). Application of 150% recommended nitrogen dose registered higher sugar yields as compared to other levels of nitrogen.

4. Conclusion

In comparison single node seedlings performed better than budchip seedlings in terms of growth and yield. Higher cane and sugar yields can be obtained with single node seedlings in paired or dual row planting with application of higher dose of 150% RDN (168 kg ha^{-1}) fertilizer through drip fertigation. Planting of single node/bud chip seedlings is viable and economical alternative in reducing the cost of sugarcane production.

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