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Review Article

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Enhancing Sugarcane Productivity by Adopting Various Planting Techniques –Review

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ABSTRACT

The sugarcane planting techniques has a pivotal role in crop growth and increasing cane yield and improving its quality. The various plating methods with different row spacing is a crucial factor for quantity of nutrients uptake. The maximum yield and yield attributing character like millable canes, cane length, cane girth, number of internodes and weight of individual cane were recorded along with higher germination percentage, better plant height and more numbers of tillers as sugarcane planted with wider row spacing and paired row planting techniques.Wider planting and paired row planting provides greater scope for overall growth and development of individual plant as it provides better light interception and proper aeration due to the wider space available between set of rows having border effect which facilitating non lodging and better uptake of nutrients ultimately provides proper growth environment for crop. This wider planting will also facilitate the use of power tillers, other machinery and harvester for operations like weeding, earthing up and harvesting and to reduce cost of production in contrast to conventional planting. Juice quality parameters of sugarcane viz., brix %, pol%, purity %, CCS% are not significantly influenced by various plating techniques but due to available of sufficient moisture, optimum temperature and proper aeration soil in wider plating improves quality of sugarcane.

Keywords: *Planting techniques, Growth parameters, Juice quality, Millable canes, Nutrients uptake and Yield.*

INTRODUCTION

Sugarcane (*Saccharumofficinarum* L.) is an important agro-industrial commercial crop which plays pivotal role in national economy and sustains sugar industry. It is extensively grown in tropical and sub- tropical regions of India as cash crop. Besides sugar production, sugarcane produces several valuable by products like, ethanol used as a fuel, alcohol used by pharmaceutical industry, bagasse used for paper and chip board manufacturing and press mud used as a rich source of organic matter and nutrients for crop production. India is second largest sugarcane producer after Brazil, grown in an area of 4.73 million hectares with total production of 376.9 million tonnes of cane with average productivity of 68 tonnes per hectare (Anonymous, 2019).

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In Haryana, sugarcane cultivation in area of 1.14 lakh ha with total production of 9.63 million tonnes and average productivity is 84.4 t/ha (Anonymous, 2019). Recently, the demand for sugar is constantly growing and it is estimated that by 2020, the total sugar requirement of our country would be nearly 625 mt (Sundara, 1998). However, there has been continuous decrease in area under sugarcane crop, average size of land holdings and sugarcane productivity resulted into lower yield owing to increase in human population. There are various factors responsible for this low productivity and yield but one of the major causes of low cane yield is the planting techniques of sugarcane crop at narrow spacing with indigenous planting methods like conventional planting. Presently, the incredible increase in different industries resulted in scarcity of labours making all the operation difficult to carry out at proper time. Hence, farmers are in search of that option which is less human labour oriented. In this context, mechanized farming is need of hour. For operating big machine, wide row space planting of sugarcane is required. Wide row space planting also provides greater scope for overall growth and development of individual plant. It also provides proper space for intercropping and interculturing operations and also proper adoption of mechanization thereby increasing the per unit profitability (Panghal, 2010 & Chaudhari et al., 2010). Generally, in north India sugarcane is planted with conventional method at 60-75cm. Although this method is less time consuming but fast depletion of soil and setts moisture results in lower germination (30 – 35%), resulting in lesser plant population and lower cane yield (Singh et al., 2009). This method does not permit sugarcane to attain better growth due to poor aeration, lodging and less interception of solar radiation and mutual competition. Therefore, to meet the demand sugar the only option is to increase the crop productivity on the available land. The high cane yield was obtained in paired trench plantation than conventional planting (Singh et al., 2012). The cane yield increases with sowing of sugarcane at wider spacing and adopting of improved production techniques (Cheema et al., 2002 & Gill, 1995). Patel et al., (2104) found that significantly higher uptake of N, P, K were recorded at 120 cm wider spacing in compare to 90 cm,150 cm and 30:150 cm row spacing. The correct planting technique of sugarcane is pre-requisite to facilitate the crop plants to fully utilize environmental conditions to exhibit their optimum potential. The present review, therefore, was designed to assess the yield of sugarcane under different planting techniques.

Effect of planting techniques on growth parameters of sugarcane

Sugarcane growth was measured in term of germination percentage, plant height and numbers of tillers. The germination considered as the basis for good crop stand of any crop, a desirable germination is always required for proper establishment of sugarcane. The germination percentage of sugarcane crop was influenced by various planting techniques with different row spacing. The sugarcane germination is influenced by various internal and external factors which include sufficient moisture, optimum temperature, proper aeration and good quality seed. The significantly higher germination 43.1 % and 62.1 % was observed in wide bed and furrow paired row planting at 30 and 45 DAP respectively over conventional method and was par with half ridge open furrow irrigation planting and wider planting which might be due to adequate soil moisture (Singh et al., 2018). The significantly highest 100.33 number of millable canes (000 ha^{-1}) were recorded under paired row ridge (Prem et al., 2017). The higher number of millable canes is due to the improved germination as results sufficient moisture, optimum temperature, proper aeration because of putting small amount of soil on the setts and followed by half ridge irrigation *i.e.* ridge and furrow method, improves germination, which in results increases the cane yield (Anonymous 2014). Sugarcane germination increases progressively with the increase in the strip size from 45 to 120 cm (Khan et al., 2002 & Sundara, 2003). But the maximum emergence

(36.48%) plant height, green leaves, LAI and other growth parameters were also recorded superior in dual trench planting over other methods *viz.* flat, ridge and furrow and pit planting (Singh et al., 2015). The increased germination percentage at wider row spacing is supported by (Khan et al., 2002). Plant density per unit area has key role in sugarcane production which is solely depends upon tillering of sugarcane. From farmers point of view tillering is the most desirable character for establishing a desirable crop stand which is controlled by genetic characters like variety and management practices of crop. The good tillering not only ensures better yields but also enhance ratoon ability of a sugarcane crop. Significantly higher numbers of tillers population was recorded under wide bed and furrow paired row planting over the conventional method at all stages of cane growth upto 180 DAP which is might be due to higher germination (Singh et al., 2018). The tiller population increases upto 90 DAP then decreases upto to maturity which might be due to mortality of smaller and week tillers caused by lack of proper light interception and aeration (Singh et al., 2018 & Prem et al., 2017). Plant height in sugarcane is combination of crop growing conditions which plays very important role in determining cane yield. Plant height and stem girth are those character which makes cane weight so directly attributes to final harvest. The height between 120 and 180 DAP increases at faster rate due to better utilization of photosynthates during grand growth period. However, after 180 days the growth rate was slow down because of proceeding of plant toward maturity (Singh et al., 2018). The maximum plant height (255.6 cm) was recorded under wide bed and furrow paired row planting comparable with that of half ridge furrow irrigation planting (247.6 cm) followed by wider planting (235.3) and conventional (239.9 cm) at 180 DAP (Singh et al., 2018). This could be due to the fact that narrow row spacing between paired rows results in more competition among the plants for sun light there by using proper available moisture. Chhatha et al. (2007) and Roodagi et al. (2001) also reported significant plant height under paired row planting geometry over flat planting. But Chitakala Devi et al. (2005) reveals that higher germination per cent, tiller population, cane length, cane girth was recorded at 90 cm row spacing over wider rows space of 150 cm and 120/30 cm double row planting. The sugarcane plants attain more height at 120 cm apart row than 60 cm spaced ones because of proper orientation and establishment of plants in wider rows (Cheema et al., 2002). Plant height increases with the increase in row spacing (Lal, 1988) and higher cane yield is possible with 120 cm row spacing compared with narrow rows (Nazir, 2000).

Effect of planting techniques on yield attributes and yield of sugarcane

Sugarcane yield is the function of various yield attributing parameters like millable canes, cane length, cane girth, number of internodes and weight of individual cane. Millable cane refers to cane that have attained normal height and thickness at their physiological maturity and ready to harvest is major yield attributing component. The number of millable cane is major yield attributing component of sugarcane crop. The higher (23.2 %) production of cane yield in wide bed and furrow paired planting than conventional is a function of more no. of millable cane, cane length, weight of individual cane and cane girth (Singh et al., 2018). Kannan et al., (2007) also found the highest average cane yield (146.83 t/ha) in paired row planting followed by wider row spacing. The significantly more yield was obtained during paired row planted sugarcane 60 x 60 –120 cm as compared to the conventional method of planting 90 cm in furrows (Zarekar et al., 2018).The better cane girth, cane weight, more number of millable cane population and cane yield in paired row planting (75/105 cm) over planting at (90 cm) (Prabhakar et al., 2014). The maximum number of millable canesand yield (86.2 t ha^{-1}) were recorded in paired row ridge and furrow plantation method (100:120 cm) than conventional planting 60 cm row spacing (Prem et al., 2017 & Singh et al.,

2010). The highest number of millable canes and longer canes under paired row planting (105-75-105 cm) of sugarcane as the results higher cane yield was obtained under this method (Sarala et al., 2014). Ombase et al. (2009) observed that significantly the highest cane yield was recorded under paired row planting with spacing 90-180 x 30 cm in compare to single row planting. The higher cane production obtained in wide bed and furrow paired row planting due to deeper plantation, more moisture availability, better root establishment and better intercultural operations their by proper utilization of nutrients. The wide bed and furrow paired row method provides better light interception and proper aeration due to the wider space available between set of rows having border effect which facilitating non lodging and better uptake of nutrients ultimately provides proper growth environment for crop (Katiyar et al., 2013 & Gupta et al., 2004). But Lattief et al. (2016) found that the influence of three row spacing (100, 120, 140 cm) on yield and yield attributes. He reported highest values of stalk height, number of valid stalks and cane yield ha^{-1} under narrow row spacing (100 cm). On the other hand, the wide row spacing (140 cm) gave the highest values of stalk height, stalk thickness and stalk weight. Gulati et al. (2015) observed that significantly higher (149.5 t ha^{-1}) cane yield were obtained under small pit method of planting (120cm x 60cm spacing) and registered an increase of yield 5.7, 9.9, and 16.2 % over mega pit (150cm x 150cm), trench method (30cm x 30cm) and conventional method (15cm width 15cm depth) of planting, respectively. Patel et al. (2014) reveals that maximum number of millible cane (114775 ha^{-1}), cane length (251.8 cm), no. of internodes (20), cane yield (127 t ha^{-1}) and CCS (17 t ha^{-1}) yield was obtained at planting geometry of 120 cm which was significantly superior over 90 cm,150 cm and 30:50 cm row spacing respectively. He also reveals that mechanization is possible at 120 cm and 30:50 cm row spacing. But (Singh et al., 2013) Reported more cane yield were obtained in pit and trench methods of planting in compare to flat planting method. Singh et al., (2009) reveled that paired row trench planting using 8 t ha^{-1} three bud setts and 150 kg N ha^{-1} could be adopted as an alternate to flat planting method in spring sugarcane in south western Punjab. Manimaran et al. (2009) noticed that highest single cane weight, cane and sugar yield when crop planting techniques wider row spacing of 120 cm with cross planting method as well as successive intercropping with legume crop. The planting the cane setts in furrows, covering with 2 cm soil layer, followed by irrigation and blind hoeing increase cane yield by 6.4 % compare to conventional planting (Bhullar et al., 2002). More number of millable canes are possible with 90 cm inter-row spacing compared with 30 and 60 cm inter-row spacings (Raskar & Bhoi, 2003). The higher number of millable canes per unit area are produced by planting sugarcane in wider rows compared with closer rows (Cheema et al., 2002). The cane yield increases with sowing of sugarcane at wider spacing and adopting of improved production techniques (Cheema et al., 2002 & Gill, 1995).

Effect of planting techniques on juice quality parameters studies of sugarcane

Juice quality parameters of sugarcane viz., brix %, pol%, purity %, CCS% and commercial sugar yield. The cane maturity is commonly measured on the basis of brix degree. However, the sugar yield is one of the most important considerations for sugarcane crop grower which was significantly influenced by different planting methods which is directly related with the cane yield. The highest sugar yield (11.9 t/ha) was recorded under wide bed and furrow paired row planting which was 22.7 %, 9.5 % and 8.2 % higher than conventional (Singh et al, 2018). Juice quality parameters of sugarcane viz., brix %, pol%, purity %, CCS per cent was not affected by planting techniques, the significant effect on sugar yield was solely due to highest cane yield (Patel et al, 2006) also reported higher sugar yield was obtained under paired row planting. Roodagi et al. (2001) found that, the juice quality parameters *viz.* brix, sucrose, purity, commercial cane sugar and juice

extraction percent were not influenced by planting methods. Chakrawal and Kumar (2014) observed the maximum sugar yield at 90 cm row spacing which was 2.6. 27.3 and 54.4 % higher in compare to 30:120, 120 and 150 cm row spacing, respectively.

Effect of planting techniques on nutrients uptake by sugarcane

Sugarcane being a long duration crop and has more fertilizer requirement. The suitable plating techniques should be adopted which can enhance the nutrient uptake and nutrient content percent in plant. There are various planting methods has been developed that can increases uptake of nutrient like wider planting and paired row planting. The higher cane production obtained in wide bed and furrow paired row planting due to deeper plantation, more moisture availability, better root establishment and better intercultural operations their by proper utilization of nutrients and more uptake. This method provides better light interception and proper aeration due to the wider space available between set of rows having border effect which facilitating non lodging and better uptake of nutrients ultimately provides proper growth environment for crop (Singh et al., 2018 & Gupta et al., 2004). The maximum nutrient uptake recorded when paired row planted sugarcane intercropped with green gram. So, the paired row planting of sugarcane found to be more beneficial and profitable than their conventional planting 90 cm (Zarekar et al., 2018). Patel et al. (2104) found that significantly higher uptake of N, P, K were recorded at 120 cm wider spacing in compare to 90 cm,150 cm and 30:150 cm row spacing. Singh et al, (2013) reported that higher number of shoots and more germination percentage was recorded in trench planting because of the efficient adsorption of nutrient and water. More (2003) the higher uptake was recorded at 150 cm paired row planting than 270 cm single row planting of sugarcane. Bhullar et al. (2002) also recorded higher uptake by in two paired row planting could be attributed due to border effect. As the results more growth of crop results into the more yield. With regard to nitrogen application the cane yield increases significantly which might be due to continues uptake of nutrients under different levels of nitrogen which led to more tillering and proper growth and development of cane (Singh et al., 2018). Asokan et al. (2005) found the uptake of nitrogen increased with increased nitrogen application, but cane yield did not show any significant increase with N applications above 100 kg ha.$^{-1}$ Row spacing did not influence CCS% cane yield and but the uptake of N was found to be significantly higher under closer row spacing 75 cm as compared to normal row spacing 90 cm which may be due to more dry matter production at closer spacing, compared to an increase in N content.

CONCLUSION

Sugarcane planted with improved production techniques as wider spacing at 120cm and paired row planting resulted into the maximum yield and yield attributing character like millable canes, cane length, cane girth, number of internodes and weight of individual cane were recorded along with higher germination percentage, better plant height and more numbers of tillers as well as more nutrients uptake was observe which might be attributed due to border effect. The juice quality parameters viz., brix %, pol%, purity %, CCS% are not significantly influenced by various planting techniques. The wider space planting techniques facilitate mechanization in sugarcane crop by using power tillers, other machinery and harvester for operations like weeding, earthing up and harvesting and to reduce cost of production in contrast to conventional method of planting.

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