

Original Research Article

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Effect of Consortium of Endophytic Nitrogen Fixing Bacteria on Yield Observations of Seasonal (Suru) Sugarcane under Drip Irrigation

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ABSTRACT

The present investigation entitled “Effect of consortium of endophytic nitrogen fixing bacteria on yield and quality of seasonal (Suru) sugarcane (*Saccharum officinarum*) under drip irrigation” was carried out at AICRP on Water Management, M.P.K.V., Rahuri during 2014-15. The experiment was laid out in Randomized Block Design with six treatments and four replications. There were four levels of nitrogen (100%, 50%, 25% and 0%) with P₂O₅, K₂O, PSB, FYM and foliar application of consortium of endophytic nitrogen fixing bacteria with and without combination and set treatment of *Acetobacter diazotrophicus*. The experiment conducted revealed that highest number of internodes, length of internodes, higher number of millable canes (9.17), top yield (11.47 t.ha⁻¹), cane yield (284 t.ha⁻¹) and cane dry matter weight (79.63 t.ha⁻¹) was recorded in the treatment 25% N + Consortium of Endophytic Bacteria foliar spray.

Keywords

Nitrogen fixing bacteria, Yield and Observation.

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Introduction

Sugarcane (*Saccharum* spp. hybrid) is a tall, perennial grass (family Poaceae, subfamily Panicoide), and is cultivated in tropical and warm-temperate regions between 35°N and 35°S and from sea level to altitudes of 1,000 m in a wide variety of soil types (Reis *et al* 2007). Most of the commercial sugarcane varieties are hybrids with *Saccharum officinarum*. The optimal temperature for sugarcane cultivation is between 20 and 35°C and the minimum rainfall requirement is 1,200mm per year (Ando. 2010). The stalks (stems) of sugarcane are harvested at 9 to 18 months after planting the mother stem cutting (setts).

Once planted, sugarcane can be harvested several times, because new stalks, called ratoons, repeatedly grow from the stubble. For many years, sugarcane has been used for sugar and an alcoholic drink production. Sugarcane being a long duration crop produces huge amount of biomass, and requires large quantity of water (1100-2200 mm) and is mostly grown as an irrigated crop using surface irrigation. The drip irrigation adoption in sugarcane increases water use efficiency (60-200%), saves water (20-60%), reduces fertilization requirement (20-33%) through fertigation, produces better quality crop and increases yield (7-25%) as compared with conventional irrigation. However, if not

installed properly, it may result in wastage of water, time, money and yield. Adoption of drip irrigation (surface or subsurface) system in sugarcane is technically feasible and economically viable and needs to be vigorously followed (Kaushal *et al.* 2012). Nitrogen is one of the most important key elements in the agricultural production of various crop plants, sugarcane crop responds well to the nitrogenous fertilizers in terms of their yield and economic produce. Sugarcane being a very exhaustive and extracting crop, removes about 205 kg nitrogen for yielding a crop of 100 t.ha⁻¹ and for sustaining productivity, nitrogen is replenished through chemical fertilizer @ 340 kg.ha⁻¹ in sugarcane. In 2011, world production of sugarcane was 1,794 million tons (FAO STAT, 2011) which is much higher than other major crops such as maize (883 million tons), paddy rice (723 million tons), wheat (704 million tons) and potatoes (374 million tons). Sugarcane production is highest in Brazil (734 million tons), followed by India (342 million tons), and China (115 million tons). Sugarcane was cropped over an area of 25 million hectares all over the world; the average yield was 70.5 tons per hectare. It has occupied 40.75 lakh ha. Area in India, while 7.36 lakh ha. In Maharashtra state most of the sugar obtained in the world i.e. 60% is from sugarcane. Consortia of endophytic bacteria include various bacteria like, *Acetobacter*, *Agrobacterium*, *Burkholderia*, *Azospirillum*, *Herbaspirillum*, *Azoarcus* etc. *Acetobacter diazotrophicus* now a day's known as *Glucanacetobacter diazotrophicus* is an acid loving bacterium requiring pH of 4.0 to 4.5 for growth and N fixation. It showed positive growth at 25⁰, 30⁰ and 40⁰C temperature. Among the biofertilizers, the endophytic bacteria *Glucanacetobacter* and *Herbaspirillum* are gaining more importance, since they fix atmospheric nitrogen endosymbiotically.

Materials and Methods

The investigation was carried out at AICRP on Water Management, M.P.K.V., Rahuri during 2014-15. Soil was medium black it belongs to Inceptisols. The climate of this area is semi-arid. The seedling material of sugarcane Co.M -0265 (Phule - 0265) was procured from Chief Scientist, AICRP on Water Management, Department of Agronomy, M.P.K.V., Rahuri. The experiment was laid out in RBD design with four replications and six treatments including one control and one recommended dose of fertilizers.

Basal dose of nitrogen, phosphorus, and potassium i.e. recommended dose (250:115:115 kg of N, P₂O₅ and K₂O ha⁻¹) along with organic manures i.e. full dose of FYM, *Acetobacter diazotrophicus* and PSB as per the different treatment details per plot and replication wise were given before transplanting of seedlings. Remaining doses of fertilizers were applied at 6-8, 12-14, and 18-20 weeks after transplanting i.e. top dressing. Consortium of Endophytic Bacteria foliar spray were taken at 60 days after transplanting for treatments 4 and 5 in all the four replications. Two hand weedings were carried out to keep plots free from weeds. Irrigation schedule for drip at alternate day as per 100% ETc was fixed.

Details of treatments

T₁ - Absolute control (No fertilizers),

T₂ - RDF (100% N, P₂O₅ and K₂O)

T₃ - 50% N + *Acetobacter diazotrophicus* @ 10 kg.ha⁻¹ (set treatment)

T₄ - 25% N + Consortium of Endophytic Bacteria @ 3 L ha⁻¹ (500L water ha⁻¹) [foliar spray at 60 DAT]

T₅ - 0% N + Consortium of Endophytic Bacteria @ 3 L ha⁻¹ (500 L ha⁻¹) [foliar spray at 60 DAT]

T₆ - 0% N + without Consortium of Endophytic Bacteria.

Note: 75% P₂O₅, 100% K₂O, 20 t.ha⁻¹ FYM, 1.25 kg.ha⁻¹.

PSB common to all treatments except T₁.

The Consortia of Endophytic Nitrogen fixing bacteria was applied as foliar application @ 3 lit ha⁻¹. (500 lit water) at 60 days after transplanting.

The following endophytic bacteria are the components of consortia:

Acetobacter
Agrobacterium
Burkholderia
Azospirillum
Herbaspirillum
Azoarcus

Harvesting

Initially the ring lines of the gross plot were removed and the net plot harvesting was done on 7th February, 2015, and the plot wise weights and observations were taken on the same day.

Yield observations

Five plants were randomly selected from each plot for recording number of Millable canes at 10 months age, and girth and length of internodes, number of internodes at harvest.

Yield per net plot

At the time of sugarcane crop harvest, the ring lines from all the sides of the plot were

excluded and the yield per net plot was recorded in kg. The weight was recorded using electronic balance.

Yield per hectare

Based on the yield per net plot and the plot size the yield per hectare was calculated and recorded in tonnes per hectare.

The data was analyzed statistically by using randomized block design as per procedure described by Panse and Sukhatme (1985).

Results and Discussion

The data regarding the number of internodes and girth and length of seasonal sugarcane is given in table 1.

The treatment T₃ recorded highest number of internodes at harvest (26.60) which was at par with the treatments T₂, T₄, T₅, T₆ (25.50, 26.20, 24.95, 24.85, respectively).

The lowest numbers of internodes (22.23) was observed in T₁.

The highest mean girth of internodes of sugarcane at harvest (12.40 cm) was recorded in treatment T₂ which was at par with the treatment T₄ (12.00 cm). The least girth of internodes (9.60 cm) was observed in T₁.

The significantly highest internodal length of sugarcane at harvest (15.55 cm) was observed in treatment T₃ however, it was at par with treatments T₂, T₅, T₆ (15.50, 15.00, and 14.60, respectively). The least internodal length (13.70 cm) was observed in T₁.

This might be due to combined use of organic, inorganic fertilizers and biofertilizers which primarily improved the fertility status of soil and created congenial environment for better growth and development of sugarcane

plant, thus improved internodes, cane girth and length. These results are in conformity with those reported by Mehta *et al.* (1996), Kumar (2012) and Soomro *et al.* (2013).

Table.1 Effect of consortium of endophytic nitrogen fixing bacteria on Internodes of seasonal sugarcane

Sr. No	Treatments	Internodes at Harvest		
		No. of Internodes	Girth (cm)	Length (cm)
T ₁	Absolute control	22.23	9.60	13.70
T ₂	RDF (100% N,P ₂ O ₅ ,K ₂ O)	25.50	12.40	15.50
T ₃	50% N + <i>Acetobacter diazotrophicus</i>	26.60	11.60	15.55
T ₄	25% N + consortium of endophytic bacteria foliar spray	26.20	12.00	14.10
T ₅	0% N + consortium of endophytic bacteria foliar spray	24.95	11.65	15.00
T ₆	0% N + without consortium of endophytic bacteria foliar spray	24.85	10.80	14.60
	S.Em. ±	0.72	0.23	0.35
	CD at 5 %	2.18	0.69	1.05
	Mean	25.05	11.34	14.74

Table.2 Effect of consortium of endophytic nitrogen fixing bacteria on millable canes and Yield of seasonal sugarcane

Sr. No	Treatments	No. of Millable Canes per plant	Top yield (t.ha ⁻¹)	Cane Yield (t.ha ⁻¹)
T ₁	Absolute control	6.92	10.04	183
T ₂	RDF (100% N,P ₂ O ₅ ,K ₂ O)	8.00	11.23	254
T ₃	50% N + <i>Acetobacter diazotrophicus</i>	9.09	11.19	269
T ₄	25% N + consortium of endophytic bacteria foliar spray	9.17	11.47	284
T ₅	0% N + consortium of endophytic bacteria foliar spray	8.09	10.64	243
T ₆	0% N + without consortium of endophytic bacteria foliar spray	7.75	10.64	202
	S.Em. ±	0.24	0.23	9.34
	CD at 5 %	0.71	0.69	28.17
	Mean	8.17	10.87	239

Yield observations

The data regarding the yield observations are given in table 2. Which indicated that yield was significantly influenced by treatments.

The treatment T₄ recorded significantly highest number of millable canes (9.17) and cane yield (284 t.ha⁻¹) which were at par with treatment T₃ (9.09 and 269), respectively. The

least number of millable canes (6.92) and cane yield (183 t.ha⁻¹) was observed in T₁. The significantly highest top yield (11.47 t.ha⁻¹) was observed in treatment T₄ which were at par with treatment T₂ (11.23 t.ha⁻¹) and T₃ (11.19 t.ha⁻¹). The lowest top yield (10.04 t.ha⁻¹) was observed in T₁.

Similar results were also reported by Mehta *et al.* (1996), Chauhan *et al.* (2010) and Babar *et*

al. (2011) who opined that apportioning of nitrogen dose through soil and that harvested from the air by the endophytic bacteria, substantiate the need of crop thereby improving the physiological conditions of photosynthetic activities leading to more yields. The rhizosphere soil condition with respect to moisture and other physical properties also plays a key role to accelerate the microbial activity, also might be due to drip irrigation which maintained the soil moisture.

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