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Effect of consortium of endophytic Nitrogen fixing bacteria on yield and quality of pre-seasonal sugarcane second Ratoon

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Abstract
The experiment was conducted oat PGI Farm, MPKV, Rahuriduring 2015-16 to study the "Effect of consortium of nitrogen fixing bacteria on yield and quality of pre-seasonal sugarcane (second ratoon)". In this experiment 6 treatments and 4 replications used in randomized block design. There were four levels of nitrogen 0, 25, 50 and 100 % and 100 % P_2O_5, 100 % K_2O along with and without foliar spray of consortium of endophytic nitrogen fixing bacteria. The result revealed that yield & quality of pre-seasonal sugarcane (second ratoon) were increased with foliar spray of consortium of endophytic bacteria along with 25 % N of RD. Among all the treatments, 100% N (RDF) recorded significantly highest yield and quality.

Keywords: sugarcane, second Ratoon, consortium, endophytes

Introduction
Sugarcane is botanically known as *Saccharum officinarum* (2n=80) belongs to family Poaceae. It is commercial crop grown under well and command areas of India. Sugarcane is economically more beneficial for farmers because four ratoons can be taken in sugarcane.
Ratoon crop is the second or another successive crop obtained from first crop. Sugarcane ratoon crop has high demand for fertilizer, because of shallow root system, decaying of old roots, sprouting of stubble buds and immobilization of nitrogen. Therefore, 25-30 more fertilizer is recommended for ratoon crop than plant crop.
Nitrogen is an essential element for plant growth & development a limiting factor in plant growth. It represents about 2% of the total dry matter. Nevertheless, plants cannot directly access nitrogen gas, which makes up about 80% of the atmosphere. Plants absorb the available nitrogen in the soil through their roots in the form of nitrogen and the dependence of crop growth on this element have spawned a massive on this element industry worldwide (Dobermann, 2007 and westhoff, 2009) [2, 12].
Endophytes nitrogen fixing bacteria are associative type nitrogen fixers. Mostly iyt is present in sugar contatining plants, but they also present in non-sugar plants. *Pennisetum purpureum*, *Ipomea batatas* (Dobereiner and Reis, 1993) [3], *Coffea Arabica* (Jimenez – Salgado *et al.*, 1997) [4], *Eleusine coracana* (Loganathan and Nair, 2003) [5] and *Ananas comosus* (Tapia – Hernandez *et al.*, 2000) [11] these are some examples of non-sugar plants in which endophytic bacteria stay.
Consortium of endophytic bacteria includes various bacteria like, *Acetobacter spp.*, *Agrobacterium spp.*, *Burkhloderia spp.*, *Azospirillum spp.*, *Herbaspirillum spp.*, *Azoarcus spp. etc.* Endophytes are defined as microorganisms living inside the plant organs and tissues without causing disease symptoms, have become highly interesting models to study plant microbe interactions (More, 2012) [6].
Keeping these points in consideration, field trial was conducted to enhance the yield and quality of pre-seasonal sugarcane (second ratoon) using 25% along with consortium of endophytic nitrogen fixing bacteria.

Materials and Method
The experiment was conducted at PGI Farm, MPKV, Rahuri during 2015-16, the soil was clayey in texture, moderately alkaline in reaction, medium in available nitrogen, phosphorus and sufficient in available potassium. Total 6 treatments including absolute control replicated 4 times. The experiment consists of different levels of nitrogenous fertilizer *viz.* 0, 25, 50 and 100 % of RD along with and without foliar application of consortium endophytic nitrogen fixing bacteria @ 3 L ha^{-1} or *Acetobacter diazotrophicus @2.5 L* $ha^{-1}$with 500 L water in

treatments. The crop was raised following recommended agronomic practices. The recommended dose of chemical fertilizers were applied @250:115:115 kg NPK ha^{-1} in two splits; first split at 64 days after harvesting of ratoon and second split at 4 month after harvesting of first ratoon. Intercultural operations like weeding, spraying of insecticide, fertilizer application and schedule of irrigation for ratoon sugarcane crop was carefully followed. The cop variety used was Co- 265. The data obtained was carefully analyzed and appropriately interpreted as per the methods described in "Statical Methodsfor Agricultural Workers" by Panse and Sukhatme, (1985) [10].

Results and Discussions

Yield of pre-seasonal sugarcane (second ratoon)

The results narrated in Table 1 indicate significant impact of consortium opf endophytic nitrogen fixing bacteria on top, cane and CCS yield of pre-seasonal sugarcane (second ratoon). Significantly highest top, cane and ccs yield of pre-seasonal sugarcane (second ratoon) were noted in RDF, but treatment 25% N + consortium of endophytic nitrogen fixing bacteria was found statically at par. Lowest top, cane and CCS yield were obtained in treatments T_1. These results are also corroborate with reports of More (2012) [6] as they revealed that this might be due to consortium of endophytic bacteria, which may worked with plant system by utilizing their source of energy as sugar from sugarcane plant and assimilated the nitrogen within the plant, which may be immediately utilized for growth and development of sugarcane plant. Thereafter, Oliveira *et al*. (2002) [9] noted that the fresh cane weight of sugarcane was significantly increased as compared to uninoculated control plot. Muchow *et al.* (1996) [7] also reported that increased cane yield with increasing levels of nitrogen application and lowering the commercial cane sugar.

Table 1: Cane, top and CCS yield of pre-seasonal sugarcane (second ratoon) as influenced by levels of nitrogen with consortium of endophytic bacteria

Sr. No.	Tr. No.	Treatment	Yield (Mg ha^{-1})		
			Cane	Top	CCS
1	T_1	Absolute control	52.78	9.01	7.30
2	T_2	RDF (100% N)	119.50	13.87	16.90
3	T_3	50% N + *Acetobacter Diazotrophicus* (Foliar treatment)	94.60	11.31	13.88
4	T_4	25% N + foliar application of consortium of endophytic bacteria	101.28	12.86	14.95
5	T_5	Foliar application of consortium of endophytic bacteria	57.74	10.21	8.22
6	T_6	Without consortium of endophytic bacteria	56.32	10.04	8.09
S.E. ±			6.06	0.54	0.90
C.D. at 5%			18.25	1.63	2.72

Juice quality of pre-seasonal sugarcane (second ratoon)

The data presented in the Table 2 revealed that Brix (degree), CCS (%), and non-reducing sugars (%) were obtained highest in treatment 25% N + foliar application of consortium of endophytic nitrogen fixing bacteria followed by 50% N + *Acetobacter diazotrophicus* (foliar application). Reducing sugars (%) was highest in RDF followed by foliar application of consortium of endophytic nitrogen fixing bacteria. Purity % was obtained highest in 50% N + foliar application of consortium of consortium of endophytic nitrogen fixing bacteria. Similarly, the higher levels of fertilizer nitrogen might have accelerated the inversion rate of sucrose. The high fertilizer N application decreased the sucrose content in fresh millable cane was also reported by Chapman (1994) [1]. Improvement in juice quality due to endophytic bacteria also reported by Muthukumarasamy *et al.* (1999) [8].

Table 2: Juice quality of pre-seasonal sugarcane (second ratoon) as influenced by levels of nitrogen with consortium of endophytic bacteria

Tr. No.	Treatments	Brix (^{0})	CCS (%)	Purity (%)	Reducing sugars (%)	Non reducing sugars (%)
T_1	Absolute control	20.31	13.81	95.24	0.33	19.31
T_2	RDF (100% N)	20.68	14.14	95.45	0.37	19.74
T_3	50% N + *Acetobacter diazotrophicus* (Foliar application)	21.06	14.67	96.74	0.33	20.37
T_4	25% N + foliar application of consortium of endophytic bacteria	21.43	14.76	95.98	0.32	20.56
T_5	Foliar application of conso. of endophytic bacteria	21.06	14.20	94.58	0.34	19.91
T_6	Without consortium of endophytic bacteria	20.93	14.36	95.73	0.33	20.04
	S.E. ±	0.423	0.253	0.690	0.030	0.36
	C.D. at 5%	1.274	0.764	2.079	0.092	1.075

Conclusion

The evaluation of results revealed overall effect of consortium of endophytic nitrogen fixing bacteria along with 25% N of RD has performed better for most of the traits under study. Hence, it can be concluded that the 25% N + foliar application of consortium of application of endophytic nitrogen fixing bacteria may be used for higher yield with better quality of pre-seasonal sugarcane (second ratoon).

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