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Ikshu PSB – A Potential Phosphate Solubilizing Microbial Inoculant for Plant Growth Promotion and Increasing Cane Yield in Sugarcane Crop

Sugarcane crop is commercially cultivated across the country. Uttar Pradesh state has approximately 23 lakh hectare sugarcane area of the 50 lakhs sugarcane area of the country. In recent years, this state has achieved a better position in sugar production in the country. During sugarcane cultivation, farmers are applying quantum chemical fertilizers besides the recommended dose of fertilizers. The recommended dose of fertilizers for sugarcane cultivation in the sub-tropical region of the country is in the ratio of 150:60:60 (N,P,K). Phosphatic and potassic fertilizers are applied at the time of planting as a basal application. Only one-time application is done to fulfill the requirements of these plant nutrients. Nitrogenous fertilizers are applied in three split doses and advised to be used within 90 days of the crop or before the onset of the monsoon. To reduce our dependency on phosphatic fertilizers, minimize the cost of cultivation as well as enhance crop yield, a phosphate solubilizing microbial product named Ikshu PSB was developed and validated in experimental trials. Field level demonstrations were conducted at ICAR-Indian Institute of Sugarcane Research,

Lucknow, and Farmers Field of Lakhimpur district, Uttar Pradesh. It was recorded that Ikshu PSB treated field had better cane yield. The increased cane yield was 23.74 percent higher than the standard control. Based on this, net income was calculated and found a 57.67 percent increase compared to non-treated fields. The monetary return was also 24.41 percent higher. Besides this, it was noticed that crop loss caused by biotic factors mainly due to diseases was negligible in treated fields. While some borer damages were noticed by in both treated and non-treated fields. The technology was demonstrated to sugarcane growers, students, and researchers during various institutional activities. The technology has been commercialized with a private agency for its mass multiplication and distribution to the benefit of sugarcane growers in the subtropical regions of the country.

INTRODUCTION

Sugarcane is a commercial crop worldwide. The crop is cultivated in both tropical and sub-tropical regions of the country. Major sugarcane-producing states of the sub-tropical region are Uttar Pradesh, Bihar, West Bengal, Haryana, Punjab, and Gujarat. The sub-tropical region covers a greater extent sugarcane area of the country. Uttar Pradesh state has alone 23.0 lakh hectare sugarcane area and produces more than 120.0 lakh tonnes sugar. For better crop growth and development, good soil conditions and climate play a major role in its cultivation. In changing scenario, the quantity of chemical fertilizers applied in sugarcane crops is a serious concern. The non-judiciously applied chemical fertilizers create adverse soil conditions; reduce the population of beneficial microbes, and human health hazards as well. The non-judiciously applied chemical fertilizers are also polluting soil and water through the leaching process. Some applied chemical fertilizers are more toxic to nature and persist for a longer duration. Besides this, available organic content is also decreasing very fast. Available organic content is not only good for better soil tilth and texture but also substrate for the survival of the microbial population. Beneficial microbes affect numerous biological activities in the ecosystem. Keeping the importance and reducing chemical fertilizers load in the ecosystem, we have identified and developed efficient phosphate-solubilizing inoculants which could solubilize phosphorus content, enhance crop growth and yield in sugarcane crops.

FIELD DEMONSTRATION

Uttar Pradesh state of the country is major sugarcane producing state and it has highest sugarcane production area (approximately 23.0 lakhs hectare) as well as sugar production (approximately 120.0 lakh tonnes) in the country. Western and North part of the Uttar Pradesh state mainly Meerut, Muzaffarnagar, Baghpat, Saharanpur, Lakhimpur, and Shahjahanpur region cover the maximum sugarcane area. Sugarcane crop is considered an economically viable crop in the state and cultivated to a greater extent. At present, Uttar Pradesh state has around 120 functional sugar mills. Efficient phosphate solubilizing bacterial strain was isolated and identified. Demonstration trials were conducted on the application of Ikshu PSB (*Pseudomonas Fluorescens* strain PSB28) at ICAR-Indian Institute of Sugarcane Research, Lucknow, and at Farmers Field, Lakhimpur district and also provided culture to State Horticultural Department, Uttar Pradesh (Fig., 1). Sugarcane seed cane of sugarcane variety – CoPk 05191 was procured and three budded setts were prepared. The setts were treated with the Ikshu PSB microbial suspension containing 10⁷ CFU/ml for 30 minutes. In the microbial suspension, the quantity of 2 percent carboxymethyl cellulose (CMC) and jaggery was added to provide stickiness in the suspension as well as an immediate substrate for the culture. Single superphosphate was used as a phosphate source and applied as standard control (60 kg/ha). Treated setts were planted in trenches made by trench opener. After placing the setts in the trenches, 3-5 cm soil was placed over it. In treated plots, the quantity of phosphatic fertilizers reduced up to 50 percent. The observations were recorded on plant growth promotion and cane yield. Besides this, observations were also noticed on biotic stresses on the crop at regular intervals. It was recorded that crop vigor and yield was much better in Ikshu PSB treated plots/fields compared to non-treated (Fig. 2). The crop yield was higher almost 23.74 percent compared with the application of a full dose of phosphatic fertilizers. The monetary benefits was 24.41 percent higher with phosphatic fertilizers applied (Table 1). The increased monetary benefit was due to increased crop vigor and cane yield. Besides this, treated sugarcane variety was almost free from major sugarcane diseases (red rot, wilt, smut and pokkah boeng, etc.) but the incidence of borers (root borer, shoot borer, and top borer) was noticed. The trials were demonstrated to sugarcane growers, students,

Table 1. Performance of Ikshu PSB technology vis a vis standard check for increase in productivity and benefits

Microbial Technology	Cane yield (t/ha)	Gross cost of cultivation (Rs./ha)	Gross income (Rs./ha) @ 325 per Qtl.	Net income (Rs./ha)	B:C ratio
Ikshu PSB + 50% application of phosphate fertilizers	98.48	1,67,176	2,87,560	1,20,384	1.72
Standard Control	77.47	1,68,324	2,19,277	50,953	1.30
% increase	23.74	0.68 % less	23.74	57.67	-

**Figure 1. Ikshu PSB****Figure 2. Crop growth performance of Ikshu PSB in sugarcane var. CoPk 05191**

and researchers in the various training programmes. Keeping potential and performance of Ikshu PSB culture, technology has been commercialized with Indo-Gulf Fertilizers Ltd – Amethi, Uttar Pradesh on mass multiplication and distribution among farming communities for the benefits of farmers.

CONCLUSION

The study indicates that cane yield enhancement in the sugarcane crops was 23.74 percent higher than the standard recommended dose of phosphatic fertilizers (77.47 t/ha). The cost of applied phosphatic fertilizers was reduced by 50 percent. The net income enhancement was 57.67 percent higher in treated fields while monetary benefits were 24.41 percent higher. It also indicates that the occurrence of sugarcane diseases was almost absent in the treated

field while the presence of borers insect pests was poor in treated compared with non-treated fields. In various training platforms, sugarcane farmers are advocated for the use of bio-fertilizers in integrated nutrients management schedule which could reduce our cost of production as well as an environmental risk without compromising crop performance and yield.