BIO-FERTILIZERS FOR SUSTAINABLE SUGARCANE PRODUCTION: A SOCIO-ECONOMIC ANALYSIS

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Abstract

Monocropping has resulted in high nutrient turn over in the soil-plant system and this is all the more pronounced in a crop like sugarcane of long duration. To sustain crop productivity and to ensure soil health, this nutrient depletion has to be stockpiled through an efficient nutrient supply approach including bio-fertilizers. However, such management practices have been largely overlooked by cane growers. This paper deals with the various sociological and economical issues concerned with use of bio-fertilizers in sugarcane. Farmers realized considerable increased net returns through improved cane productivity. Every farmer had his own reason for adopting biofertilizers - to get a lush green crop, good crop growth, high cane yield with reduction in fertilizer cost and thereby better profit and improved soil health. Nevertheless, they experienced certain constraints of non-availability of timely labour, high labour cost and non-availability of good quality bio-fertilizers in time; yet, the farmers favoured the adoption of this technology. The study helps to get a better understanding of the performance of bio-fertilizers in farmer's fields and their apprehensions of this technology.

Key words: Sugarcane, biofertilizers, advantages, constraints, economics

Introduction

Nutrient management is one of the major issues of concern for the farmers throughout the world. Sugarcane growers in particular, need to pay attention to this issue as few crops put such heavy demand on soil resources, as sugarcane (Hartemink and Wood 2000). Sugarcane production can be sustained only if profitability can be ensured through reduction in cost of cultivation and improvement in productivity. The technologies in sugarcane that can minimize the cost of cultivation with increased returns include wider row spacing, bio-fertilizers, bud chip settlings, integrated nutrient management etc. (Rajula Shanthy 2012).

Fertilizer use in India is inadequate, imbalanced, skewed and is in favour of nitrogen. The frequent and excessive use of chemical fertilizer has created problems like deterioration of soil health and ecology. It has been observed in recent years that yield of sugarcane has reached a plateau due to decline in factor productivity (Yadav et al. 2009). Current soil fertility improvement strategies are mainly focused on use of inorganic chemical fertilizers, which are not sustainable in the long run both in terms of ensuring continual soil health and also non-viable economics of cultivation. Apart from this, adverse effects of inorganic fertilizers on soil properties as a whole and serious threat to human health and environment, necessitates use of organic manures and bio-products especially to improve soil biological properties. A soil without adequate biological organisms can be in all aspects termed as lifeless. The exploitation of beneficial microbes as a bio-fertilizer has assumed paramount importance in agriculture sector for their potential role in food safety and sustainable crop production. The eco-friendly approaches inspire a wide range of application of plant growth promoting rhizobacteria, endo- and ectomycorrhizal fungi,

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cyanobacteria and many other useful microscopic organisms that lead to improved nutrient uptake, plant growth and plant tolerance to abiotic and biotic stress.

The use of inorganic fertilizers does not necessarily lead to better farming than the use of natural and organic methods in agriculture. Due to continuous application of only inorganic fertilizers and plant protection chemicals in agriculture, soils have been badly degraded. It has destroyed stable traditional ecosystem of the soil (Manimaran et al. 2009). There is a need to encourage more productive, cost efficient and eco-friendly farming system (Bokhtiar et al. 2003). Integrated nutrient supply system is the need of the hour, involving a judicious combination of organic, inorganic and bio-fertilizers for sustainable crop production. Bio-fertilizers play an important role in achieving this goal in an eco-friendly manner by fixing nitrogen, improving the crop growth by production of growth promoting chemicals and improving the nutrient uptake of the crops. Association of several bacterial genera and high nitrogenase activity in sugarcane crop has been reported by Boddey et al. (1995).

For quite a long time now, bio-fertilizers are being recommended for sugarcane crop by the researchers and the impact of the technology has been demonstrated to the cane growers. However, social surveys indicate that adoption of this practice is still a reservation by many cane growers and the present study aims to get insights into this technology. The main objectives of this study are to analyze the profile of farmers adopting bio-fertilizers, extent of adoption of bio-fertilizers, advantages of adoption, constraints faced by farmers, the economics involved and to propose suggestions to resolve the constraints in adoption of bio-fertilizers.

Materials and methods

The study was conducted by using descriptive type of research design applying ex-post facto approach and the respondents were selected among cane growers adopting bio-fertilizers. The study was purposively carried out in Rajshree Sugars and Chemicals Ltd., Villupuram taluk, Tamil Nadu during 2014-16 as they have been recommending bio-fertilizers and the mill had also been producing and supplying micronutrients, green manure seeds, compost and bio-fertilizers at subsidized rates to the registered cane growers. The operational area of the mill spreads over two districts (Gingee taluk, Villupuram district and Kilpennathur taluk, Thiruvannamalai district), from which 60 cane growers were selected from the following divisions- Semmedu (9), Ananthapuram (10), Gingee North(6), Gingee South (6), Vallam (13), Avalurpettai (15) and Kilpennathur (1) at random for conducting the study.

The particulars were collected using an interview schedule, the sociological appraisal was done through focus group discussions / observations, and yield data were recorded from the individual farms. The data collected were tabulated and analyzed using descriptive statistics.

Results and discussion

The present study focused on the profile of farmers adopting bio-fertilizers, extent of adoption of bio-fertilizers, advantages of adoption, constraints faced by farmers, the economics involved and to propose suggestions to resolve the constraints in adoption of bio-fertilizers.

Demographic profile of farmers adopting bio-fertilizers

Demographic profile of the participants of the study indicated that they were mostly middle aged (35-50 years: 50.00%) to young aged (<35 years: 26.73%) and literates with up to secondary education (88.4%); Agriculture was the main occupation for all the respondent farmers and 91.8% had up to 20 years of experience in sugarcane farming. Majority of them (76.3%) owned up to

two acres of land. Hardly 13.3% of the farmers were self-sufficient in implement possession while majority of them either fully or partially depend on hiring. Crop rotation was followed by all the respondents with groundnut, paddy or pulses. One-third of the respondents owned livestock such as cows, buffaloes, draught animals and poultry for additional source of income, apart from their own use; Mass media channels used by the respondents were radio, television and newspaper; All of them owned radio/ television and 90% had the habit of regularly watching agricultural programmes. Majority (68.3%) of them had medium level of social participation as they were more into agriculture. The source of information about various nutrient management measures and specifically bio-fertilizer as expressed by 96.7% of the respondents was sugar factory officials followed by Agricultural Department officials and input dealers.

Extent of adoption of bio-fertilizers

The sugar mill had realized the ill-effects of continued use of inorganic fertilizers by the multitude of 45,000 farmers involved in cane cultivation in its cane command area. Proactively, in the year 2000, the company embarked on sustained research and development efforts through Rajshree Bio solutions LLP to mass multiply beneficial micro-organisms through in-house production of bio-products and organics. The products produced now include Rajshree Azogro (A) liquid bio-fertilizer containing local efficient isolates of *Azospirillum* sp., Rajshree Phosol (P) containing Phosphobacteria (*Bacillus* sp.) a phosphate mobilizing bio-fertilizer, Rajshree Potavit (K) bio-fertilizer containing *Frateuria* sp., a potash solubilizing bacteria, Nutrivam containing Vesicular arbuscular mycorrhiza (VAM) and Humiplus.

Year of adoption of bio-fertilizer application practices

The details regarding the year of adoption of bio-fertilizer application practices are given in table 1.

Table 1. Year of adoption of bio-fertilizer

(n=60)

Year	No. of respondents who adopted	Percentage
1998	1	1.70
2000	3	5.00
2005	4	6.70
2008	1	1.70
2009	1	1.70
2010	3	5.00
2011	1	1.60
2012	8	13.30
2013	25	41.70
2014	11	18.30
2015	2	3.30
	60	100

It could be seen from table 1 that the sample farmers had started adopting bio-fertilizers from the year 1998 onwards. Though the sugar mill had started production of bio-fertilizers from 2000, it had taken almost a decade for the technology to get popularized. Nearly 41.70% of the respondents had started applying bio-fertilizers from 2013 followed by 18.3% from 2014. On a positive note, it was inferred that all the farmers who had adopted bio-fertilizers had realized the benefits and continued adoption.

Due to continuous monocropping, soil fertility decline was noticed in almost all the sugarcane growing areas in the mill zone. Farmers rely too much on chemical fertilizers due to non-availability of adequate amount of organic manure due to dwindling cattle population. Realizing this, the factory management apart from production of

bio-fertilizers had taken concentrated efforts to popularize the various options for adding sugarcane wastes and bio-fertilizers back into the same land since 2008.

Bio-fertilizer application practices followed by farmers

Depending on the level of exposure to various bio-fertilizer application practices and the necessity realized to enrich the soil fertility, farmers have adopted the various methods of bio-fertilizer application methods as listed in table 2.

Table 2. Bio-fertilizer application practices followed by farmers

(n=60)

Bio-fertilizer application practices	No. of Respondents	Percentage
Soil application with farm yard manure	57	95.0
Application through drip system	3	5.0

It could be seen from table 2 that 95% of the respondent farmers had applied bio-fertilizer at the rate of 1.00 litre/ acre per application of each bio-fertilizer on 30-35 and 60-70 days after planting. The bio-fertilizers are mixed with 200-250 kg of farm yard manure or sand, slightly moistened and kept overnight and applied next day in the base of clumps and irrigated. Hardly 5% of the respondents had used the liquid bio-fertilizer formulation through drip irrigation.

Yield increase due to application of bio-fertilizer

The level of yield increase due to bio-fertilizer application practices followed in plant / ratoon crop is given in table 3.

Table 3 reveals the response to bio-fertilizer application in the respondent farmer's fields in terms of plant and ratoon crops as compared with demonstration plots laid by the mill. The table indicates that the biofertilizer application practices gives an additional cane yield ranging from 1.71 to 8.52 tons per acre. It could be noticed that the yield increase was more pronounced in ratoon crop than in plant crop, with the response increasing in progressive ratoons, being 2.32 tons/acre in third ratoon. This might probably be an indication that farmers in the study area gave utmost care to subsequent ratoon crops in order to get sustained yields.

The maximum advantage in terms of increased cane yield was 8.52 tons per acre incurring an additional cost of Rs 3000 to Rs 4000 in demonstration plots covering 56.30 acres laid by the mill in farmer's fields. The cost incurred was comparatively less in drip irrigated plots, being

Table 3. Bio-fertilizer application practices: area adopted and yield increase

Bio-fertilizer application practices	Area adopted (acres)	Yield increase (tons/acre)
Plant crop	56.39	1.85
Ratoon-I	248.50	1.70
Ratoon-II	125.00	1.65
Ratoon-III	62.09	2.32
Demo plot with drip & biofertilizer in farmers field	52.29	8.31
Demo plot with conventional irrigation with bio-fertilizers in farmers field	56.30	8.52

Rs. 2000-2500 per acre mainly due to the saving in labour cost for application. When compared to the total cost of cultivation, it could be seen that the amount incurred towards biofertilizer application was very meagre.

Economics involved in adopting bio-fertilizers

Relative economic advantage is an important criterion for adoption of any new technology. The economics worked out in the study is an indicative of the actual expenses involved for various operations in raising a sugarcane crop. Comparisons in yield were given based on previous crops without bio-fertilizer application.

The cost of bio-fertilizers is: Azogro -1 litre @ Rs.175, Phosol -1 litre @ Rs 175, Potavit -1 litre @ Rs. 175, VAM - 5 kg @ Rs.225/kg and Humic acid - 5 l @ Rs.675/l . Cost of labour involved for applying biofertilizers is Rs. 3200. Farmers spent on an average Rs 5625/- per acre towards bio-fertilizer application.

The study indicated that farmers could get up to 15.10 t/ha increased cane yield due to applying bio-fertilizers. This gets translated into an additional income of Rs. 8871 per acre or Rs. 22178 per hectare wherein they hardly spent Rs. 5625 additionally.

Overall yield analysis:

Average yield obtained by respondents		
Through conventional management	:	44.21 t/acre
Average yield obtained after adopting bio-fertilizers	:	50.25 t/acre
Yield increase due to bio-fertilizer application	:	6.04 t/acre
Quick review of economics		
Cost of cultivation without bio-fertilizers	:	Rs. 71458/acre
Average cost of cultivation with bio-fertilizers (plant crop-Rs.70229/acre, Ratoon crop – Rs.61437/ acre)	:	Rs. 65833/acre
Additional yield expected on an average	:	6.04 t/acre
Value of additional yield after deducting harvest charges (Rs.520/ton)	:	Rs. 14496/acre
Additional expenses per acre after adopting bio-fertilizers	:	Rs. 5625/acre
Total additional income (after bio-fertilizers)	:	Rs. 8871/acre

Advantages of adoption of bio-fertilizers

Selection of an appropriate sugarcane variety suited to the location is the first step towards reaping a good sugarcane crop. Added to this, adoption of recent technologies recommended by research institutes also help to boost the productivity of sugarcane crop.

On the whole, the farmers in the study area were found to be realistic in their level of adoption of various bio-fertilizer application practices.

In the present context, sugar mills need to stabilize their cane area and production and ultimately attain a viable and sustainable operation besides up-keeping farmer's enthusiasm in cane cultivation (Panghal 2010). This can be achieved only through viable technologies that can reduce the cost of cultivation with no compromise on cane yield.

Bio-fertilizers help in increasing biological fixation of atmospheric nitrogen and enhancing native phosphorous availability to the crops. Use of organics such as farm yard manure, compost,

trash and pressmud in appreciable quantities, will serve as a source of energy for soil micro organisms and improve the efficiency of N fixation and P solubilization (Gopalasundaram et al. 2012).

Any new innovation has its own advantages and disadvantages during and after adoption. If the farmers perceived that the advantages of the new technology are more than its disadvantages, i.e., it has high positive factor percentage, then it leads to adoption of that technology. In this study, the respondents were asked to enlist the advantages of application of bio-fertilizers with an open ended schedule (Table 4).

Bio-fertilizer application gives additional yield and thereby net profit: All the respondent cane growers in the study revealed that application of bio-fertilizers gave additional cane yield to the tune of up to 8 tonnes per acre and thereby they could realize increased net profit. This is in line with the findings of Shankariah et al. (2000) that application of bio-fertilizers significantly increased cane yield in both plant and ratoon crops. Boddey et al. (2003) stated that *Gluconacetobacter diazotrophicus*, an endophytic diazotroph of sugarcane is mainly responsible for high biological N fixation potential (30-80%) in sugarcane. Babu et al. (2007) also reported that an additional cane yield of 14-27 t/ha was realized with different organic manures plus inorganic fertilizers over inorganic fertilizers alone. Hari and Srinivasan (2005) have also observed better results regarding both the morphological and yield parameters in sugarcane in combination treatment i.e. biofertilizer + chemical fertilizer treatment than using either treatments alone. Similarly, Saini et al 2006 have recorded positive influence of bio-fertilizer application on the yield parameters viz., height, weight and diameter of millable cane due to increasing levels of fertility and addition of PMC in general.

Table 4. Perception levels of the advantages of bio-fertilizer application

Advantages	No. of respondents	Adoption percentage
Bio-fertilizer application gives additional yield	60	100.00
Increase in net profit	60	100.00
Gives a lush green color to the foliage	60	100.00
Improves overall crop growth	58	96.67
Reduction in the amount of N,P&K fertilizers	56	93.33
Reduced cost of fertilizers	56	93.33
Considerable improvement in soil health	52	86.67
Improves water retention in root zone	51	85.00
Enhanced tillering is noticed in fields with bio-fertilizer	49	81.67
Possibility of getting more number of millable canes	39	65.00
Soaking setts in bio-fertilizers induces germination and increases early vigour	31	51.67
Gives improved resistance to pests and diseases	26	43.33
Slight improvement in juice quality	24	40.00

Gives a lush green color to the foliage: Azotobacter, Azospirillium and *Gluconacetobacter (Acetobacter*) having different habitats are being used as bio-fertilizer for different crop plants of Poaceae family (Kaur et al. 2008). Nutrivam containing Vesicular arbuscular mycorrhiza (VAMs) are fungi that live in a harmonious relationship with plant roots. This is a symbiosis in which the fungi provide the plant with extra nutrients from the soil, especially phosphorus and

zinc, in exchange for sugars (exudates) provided by the plants. Humiplus contains humic acid, produced by biodegradation of dead organic matter. Humic acid can form complexes with ions that are commonly found in the environment creating humic colloids and are commonly used as a soil supplement in agriculture. All the respondent farmers who used N fixers, phosphorous solubilizers, Nutrivam and Humiplus revealed that 5-7 days after application of bio-fertilizers, the crop had luxuriant green vegetation and thereby a healthy look, irrespective of the soil type.

Improves overall crop growth: Beneficial microorganisms in the rhizosphere improve the crop growth by nitrogen fixation, phosphate solubilization and plant growth promotion. They also produce polysaccharides (gummy substances), vitamins, growth regulators, regulatory enzymes, antibiotics and antimicrobial substances (Hari 2017). All these get reflected in the performance of crop growth and 96.67% of the farmers have reported that the intermodal length and cane weight improves with bio-fertilizer application. Bokhtiar et al. (2003) observed that application of organic manure and bio-fertilizers in combination with chemical fertilizer has increased absorption of N, P and K in sugarcane leaf tissue in the plant and ratoon crop, compared to chemical fertilizer alone.

Reduction in the amount of N,P&K fertilizers and reduced cost: Certain species of *Azotobacter, Azospirillum* and *Bacillus* were reported to economize fertilizer nitrogen requirement by as much as 50% (Ahmad et al. 1978). In fields where farm yard manure, biofertilizers and Sakthi special are applied, the farmers reduce urea application by 10-15 per cent resulting in the cost of fertilizers (Rajula Shanthy and Subramanian 2015). The N use efficiency (NUE) of sugarcane improves upon *G. diazotrophicus* inoculation under pot-house condition (Suman et al. 2009). It is highly desirable as NUE of sugarcane is only 35–40% of applied chemical N fertilizer (150 kg ha-1 for sugarcane plant and 200 kg ha^{-1} for ratoon crop) in subtropical India (Yadav 2008). A similar trend was reported by 93.33% of farmers in the present study stating that they reduce urea application by 20-25% and 10-15% of phosphorous dosage. This gives a substantial reduction in the amount spent towards fertilizers.

Considerable improvement in soil health: As high as 86.67% of the respondents stated that more than the immediate benefits of bio-fertilizer application, long term effect on the soil is pronounced in the soil. Farmers feel that continuous application of bio-fertilizers enhances the physical characteristics of soil. Rajula Shanthy and Subramanian (2015) stated that application of farm yard manure, biocompost and biofertilizers creates a conducive environment for the development of soil flora and soil fauna and this makes the soil healthy. Increase in cane weight could be the probable reason for increased cane yield. Kaur et al. (2008) stated that *Azotobacter* inoculation resulted in multiplication and establishment of the culture in the inoculated field soil. Being plant growth promoting and plant probiotic bacteria *Azotobacter* count increase is a good sign of the improved soil microbial status and hence better soil health. Application of organic manures together with chemical fertilizers, compared to the addition of organic fertilizers alone, had a higher positive effect on microbial biomass and hence soil health (Kelly *et al.,* 2001). Dahiya et al. (2003) reported that the use of organic fertilizers together with chemical fertilizers, compared to the addition of organic fertilizers alone, had a higher positive effect on microbial biomass and hence soil health.

Improves water retention in root zone: Over three-fourth of the respondents opined that in fields applied with bio-fertilizers, the interval between irrigations can be increased by 2-3 days. This

might probably be due to the increased microbial build up in the root zone.

Enhanced tillering is noticed in fields with bio-fertilizer: Studies conducted at ICAR-Sugarcane Breeding Institute, Coimbatore indicated that application of phosphobacteria along with combinations of super phosphate and rock phosphate increased the available phosphorous in soil and enhanced tillering (Kailasam 1999). In the present study, 81.67% of the respondents opined that tillering was increased in fields with bio-fertilizer application and this leads to good cane yield.

Possibility of getting more number of millable canes: The fact that high tillering results in more number of millable canes is an established verity in sugarcane. Around one-third (65.00%) of the respondents revealed that bio-fertilizer application helps them get more number of millable canes, both in plant and ratoon crop.

Soaking setts in bio-fertilizers induces germination and increases early vigour: Over half of the respondents (51.67%) reported that setts soaked in bio-fertilizers had better germination and the plant grows healthily. Hari (2017) stated that sett soaking can be done by soaking setts for 30 minutes in diluted bio-fertilizer and setts must be planted immediately for better results.

Gives improved resistance to pests and diseases: A healthy crop can cope up with both biotic and abiotic stresses than an unhealthy one. This was realized by 43.33% of the respondent farmers and they have reported that the field wherein bio-fertilizers were applied could resist pests and disease incidence far better than fields with chemical fertilizers alone.

Slight improvement in juice quality: Application of phosphobacteria improved juice quality and sugar yields and this was reported by 40% of the sample farmers who were also into making jaggery and sale of sugarcane for juice. Ahmed et al 1978 reported that inoculation of N fixing microbes to sugarcane increase cane yield by 5-15%, save 25 kg fertilizer N ha^{-1} and also improve the juice quality parameter viz., sucrose and purity. Hari (2017) also had reported that application of phosphobacteria along with combinations of superphosphate and rock phosphate resulted in increased P availability in the soil, high tillering and improved juice quality.

Constraints faced by farmers in adopting bio-fertilizers

Every year, new technologies are introduced by research stations to the farmers. These technologies are introduced after conducting field demonstration trials. However, when the farmers adopt the technologies in a large scale, they face a lot of problems which they may or may not realize. Any attempt made by the researchers to eliminate these constraints will result in increased adoption of technologies of recommended package of practices which will ultimately lead to increase the production, productivity and also improve the sugar recovery %. Thus farmers will get monetary benefits with reduction in cost of production.

The constraints faced by the respondent farmers in adopting bio-fertilizers are discussed in their order of importance.

Non-availability of labour: Labour has become a scarce factor for doing timely agricultural operations. Over one-half (58.33%) of the respondents reported that availability of labour during peak seasons is a major hindrance for adoption and the cost of available labour also is alarming.

Timely application is not possible: Nearly one-third (33.33%) of the cane growers reported that they couldn't apply the recommended bio-fertilizers on time, either due to non-availability of bio-fertilizers or labour for application. This was

mainly because majority of the farmers opt for soil application.

Non-availability of good quality bio-fertilizers: The efficiency of bio-fertilizers is totally dependent on the strain of microbes and the microbial load available. The respondent farmers mostly use the bio-fertilizers supplied by the sugar mill and hence this was a problem reported by less than a quarter (21.67%) of the farmers and this too when they get it from other sources.

Slow increase in yield: The impact of application of bio-fertilizers is visible in terms of lush green crop in a week's time but the real impact in terms of cane yield is realized at the time of harvest. Few farmers (20%) are of the opinion that the microbial build-up in the soil takes considerable time and hence takes long period to reap the effect.

Low awareness about the technology: Bio-fertilizers are being recommended for sugarcane for over three decades and lot of research has been done to identify new strains of bio-fertilizers and efficient mode of application. However, the application of this technology is yet to gain momentum and farmers still lack complete knowledge as expressed during conversations with non-sample cane growers.

Measures to resolve constraints in adoption of bio-fertilizers

Due to the advancement in scientific approach towards agriculture, many new technologies are available for adoption. It is not the dearth of technology that haunts Indian agriculture today, but the non availability of adequate knowledge and conviction about the technologies to the intended clients. Though the benefits of bio-fertilizers are well established, it is not being adopted by all the cane growers. With an intention of getting some tangible solutions for this problem, focus group discussions involving cane growers, factory personnel and researchers were conducted in the study area. The plethora of outcomes of such deliberations is discussed below:

Cane growers' perspective

- Creation of awareness about the importance of bio-fertilizers among cane growers.
- Better methods of application through soil.
- Motivating farmers to adopt the bio fertilizer application.
- Giving need based on-farm training to farmers.
- Make farmers realize the effectiveness of bio-fertilizer application.

Action plan for sugar mills

- Frequent / Periodical village meetings should be conducted to popularize the importance of bio-fertilizer application.
- Bio-fertilizers of good quality need to be supplied to the cane growers at a subsidized rate at least till it gets popularized.
- Rewards to cane growers who obtain high cane yield due to bio-fertilizer application.
- Having model farms depicting bio-fertilizer application practices and its effects.
- Short video films on success stories of farmers in the village with bio-fertilizer application can be produced and screened during village meetings.
- Supply of adequate literature to farmers on bio-fertilizer application practices.

Researchers

- Capacity building programmes can be provided for cane staff and cane growers on production of quality bio-fertilizers.
- Demonstration plots can be laid by the researchers in farmer's field so as to convince them about the importance of bio-fertilizer application.

- ❖ Efficient strains of bio-fertilizers can be made available to suit the different situations where sugarcane is being grown.

Conclusion

Survey among sugarcane growers have revealed the existence of wide technological gap as well as yield gap in sugarcane that leads to reduced production and productivity (SezhianBabu 1990; Gupta 2009; Rajula Shanthy et al. 2010). Even viable technologies like Bud chip planting, wider row spacing etc. are not readily and completely accepted by the cane growers; rather they take their own time to adopt it. Though bio-fertilizer application is a proven technology by the researchers, complete adoption is still a question. Nevertheless, in the present study it was seen that timely application of bio-fertilizer had resulted in farmers getting a better harvest and is cost-effective.

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