IJABR, VOL.9 (4) 2019: 298-301 ISSN 2250 – 3579

INTERNATIONAL JOURNAL OF ADVANCED BIOLOGICAL RESEARCH

www.scienceandnature.org

COMPARATIVE EFFICACY OF LIQUID BIOFERTILIZERS OVER CARRIER BASED FORMULATIONS IN SUGARCANE PLANT –RATOON SEQUENCE

Ch. S. Rama Lakshmi*, A. Sireesha, T. Sreelatha, M. Bharatha Lakshmi & P. Jamuna
Anakapalle, Regional Agricultural Research Station, Anakapalle-531001,
Acharya N G Ranga Agricultural University, Andhra Pradesh, India

ABSTRACT

A field experiment was conducted in sugarcane plant-ratoon system at Regional Agricultural Research Station, Anakapalle, Andhra Pradesh with a variety 2001A63 during 2014-15 and 2015-16. Significantly highest cane population at different growth stages were reported with 100% recommended dose of NPK +liquid Azospirillum+ liquid PSB. Significantly highest juice sucrose (19.20%) and CCS (13.44%) was recorded with 100% NPK+ liquid Azospi+ liquid PSB with highest purity (89.8%) in 75% recommended dose of chemical fertilizers+ Azator + Azospir + PSB + VAM (liquid formulations except VAM). Among different nutrient levels 100% recommended dose of chemical fetilizers performed better in terms of cane and sugar yields over 75% chemical fertilizers + biofetilizers either carrier or liquid. Among different biofertilizers carrier based formulations in combination with chemical fertilizers recorded lower yields over liquid formulations with chemical fertilizers. Reduction of 25% of chemical fertilizers did not meet the nutrient requirement to sugarcane crop, though different biofertilizers were supplied, however on par yields were recorded with liquid formulations over carrier based formulations.

KEY WORDS: liquid biofertilizers, sugarcane, cane yields, soil nutrient status.

INTRODUCTION

Integrated nutrient supply system is the need of the hour, involving a judicious combination of organic, inorganic and biofertilizers for sustainable crop production. Biofertilizers play an important role in achieving this goal in an ecofriendly 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 (Boddey and Dobereiner, 1995). Among several beneficial bacterial genera reported with sugarcane, Azotobacter, Azospirillum, PSB & VAM have been widely used as biofertilizers for sugarcane. To get better benefit from biofertilizer application, it is essential that the bacterial culture be used in combination with suitable level of fertilizer. Yield improvement and N fertilizer economy for application of different biofertilizers have been reported by many workers (Patil and Hapase, 1981; Srinivasan and Naidu, 1987; Muthukumarasamy *et al*., 1994). These organisms were evaluated independently in different environments. Because of this, it is not possible to grade their efficacy for making valid recommendation to sugarcane production. Carrier based biofertilzers has already proved to be the best over the agro chemicals and have been showing the tremendous effect on the global agriculture productivity since the past two decades. Rectifying the disadvantages of the carrier based biofertilizers, liquid biofertilizers have been developed which would be the only alternative for the cost effective sustainable agriculture. The rate of consumption of biofertilizers is not to the optimum level in comparison with the agrochemicals. The reason attributed is the "non-availability of good and suitable carrier materials" that raises contamination problems and shorter shelf life. To cope with this alarming situation, Liquid formulations are being developed that ensure more quality over the conventional carrier based biofertilizers inaugurating a new era in the Biological input technology (Pindi, 2012). Keeping in in view present study was carried out to study the comparative efficacy of liquid formulations over carrier based formulations in sugarcane plant –ratoon sequence.

MATERIALS AND METHODS

A field experiment was conducted in sugarcane plant-ratoon system at Regional Agricultural Research Station, Anakapalle, Andhra Pradesh with a variety 2001A63 during 2014-15 and 2015-16 to find out the efficacy of liquid bio fertilizers over carrier based bio fertilizers in soil and crop productivity of sugarcane Plant - Ratoon sequence. The Experimental soils are neutral in reaction (7.32), normal in conductivity (0.53 dS/m), medium in per cent organic carbon (0.59 %) and available potassium status (269 kg/ha). low in available nitrogen (228 kg/ha) and high in available phosphorus (61.50 kg/ha). The experimental details are as follows :T1 :100% recommended dose of chemicals, T2: 100% recommended dose of chemicals + Azospirillum +Phosphorus solubilizing bacteria (carrier based), T3: 75% recommended dose of nitrogen and phosphorus+ Azospirillum + Phosphorus solubilizing bacteria (carrier based), T4 : 75% recommended dose of nitrogen and phosphorus + Azatobacter +Phosphorus solubilizing bacteria (carrier based), T5 : 75% NP + Azatobacter + Azospirillum + Phosphorus solubilizing bacteria + VAM (Carrier), T6 : 75 % NP + liquid Azospirillum + liquid Phosphorus solubilizing bacteria, T7 : 75 % recommended dose of nitrogen and phosphorus + liquid Azatobactor + liquid PSB, T8 : 75% NP+ liquid Azatobactor +liquid Azospirillum + liquid Phosphorus solubilizing bacteria +VAM (Carrier) and T9 : 100% RDF + liquid Azospirillum+liquid Phosphorus solubilizing bacteria. Liquid biofertilizers were applied each 1.25 lt/ha in 2 splits *i.e*. at basal and 45 days after planter and carrier based biofertilizers i.e Azatobacter, Azospirillum and PSB @ 10 kg/ha and VAM biofertilizer @ 12.5 kg/ha in 2 splits *i.e*. at basal and 45 days after planting were applied. Recommended dose of chemical fertilizers for sugarcane crop were 112-100-120 kg NPK/ha. Recommended dose of nitrogen fertilizers were applied at 45 and 90 days after planting, where as phosphorus and potassic fertilizers were applied applied at the time of planting. Soil samples were collected after harvest of the crop. Chemical analysis of soil samples were done as per the procedure described by HLS Tandon (1973). Juice analysis was carried out prior to harvesting, observations on Juice quality *i.e*. % CCS, % Purity and Sucrose percent was estimated as per the method suggested by Meade and Chen (1971). Sugar yields were computed from the cane yield multiplied with %CCS. In order to compare the effect of various treatments on yield, fertility status and nutrient uptake, Analysis of Variance (ANOVA) was performed using standard procedures for Randomized Block Design (Chandel, 2002).

RESULTS & DISCUSSION

Cane population at different growth stages:

Data presented in table- 1 revealed that, significantly highest cane population at different growth stages were reported with 100 % recommended dose of NPK + liquid Azospirillum+ liquid PSB. Lowest cane population was recorded with 75 % recommended dose of Nitrogen and Phosphorus + 100 % RDFK + Azospirillum + PSB (carrier based) and it was on par with 100% chemical fertilizers alone. Cane population was more in plant crop over ratoon crop, there is no particular trend among liquid and carrier based formulations. Reduction of 25 % chemical fertilizers + carrier based biofertilizers recorded comparatively lower cane population over 100 % chemical fertilizers alone, however application of liquid formulations with reduction of 25 % chemical fertilizers *i.e.* 75 % recommended dose performed better in terms of cane population at different growth stages.

TABLE 1. Effect of different biofertilizers on shoot population and NMC (No/ha) at different growth stages of sugarcane

Treatment	Formative		Grand growth		Harvest	
	Plant	Ratoon	Plant	Ratoon	Plant	Ratoon
T1: 100 % NPK	104978	98508	89170	79701	83390	78923
T2: 100 % NPK+ Azospirillum + PSB	111459	99805	84306	81388	78456	80609
T3: 75 % NP , 100 % K + Azospirillum + PSB	99350	97082	83139	77172	74720	76135
T4: 75 % NP, 100 % K + Azatobacter + PSB	104978	97471	73936	78534	75654	77302
T5: 75 % NP, 100 % K + Azatobacter + Azospirillum + PSB + VAM	108219	100778	82296	81777	75654	79572
T6: 75 % NP, 100 % K + liquid azospi+ liquid PSB	109498	100194	83268	83203	77522	81647
T7: 75 % NP, 100 % K + liquidAzato + liquid PSB	109327	99027	83139	80609	76588	78988
T8: 75 % NP, 100 % K + liquidAzator + liquid Azospir + liquid PSB + VAM	110863	99222	84306	80869	75346	78534
T9: 100 % NPK+ liquid Azospi+ liquid PSB	115723	106615	92218	83787	85126	82815
Mean	108266	99856	83975	80782	79392	79392
CD (%)	5330	NS	4230	3181	3650	3299

TABLE 2. Effect of different biofertilizers on cane juice quality at harvest

	Plant			Ratoon		
Treatments	Juice sucrose (%)	CCS (%)	Purity (%)	Juice sucrose (%)	CCS (%)	Purity (%)
T1: 100 % NPK	20.21	14.74	93.51	18.37	12.87	88.5
T2: 100 % NPK+ Azospirillum + PSB	20.27	14.75	93.08	18.67	13.07	88.8
T3: 75 % NP , 100 % K + Azospirillum + PSB	20.42	14.83	92.66	18.17	12.73	87.1
T4: 75 % NP, 100 % K + Azatobacter + PSB	19.81	14.28	91.21	18.50	12.94	88.5
T5: 75 % NP, 100 % K + Azatobacter + Azospirillum + PSB + VAM	20.97	15.40	95.01	18.40	12.90	86.5
T6: 75 % NP, 100 % K + liquid Azospi+ liquid PSB	20.25	14.67	92.21	18.30	12.80	88.2
T7: 75 % NP, 100 % K + liquid Azato + liquid PSB	20.42	14.84	92.79	18.73	13.11	88.9
T8: 75 % NP, 100 % K + liquid Azator + liquidAzospir + liquid PSB + VAM	19.90	14.57	94.52	18.93	13.24	89.8
T9: 100 % NPK+ liquid Azospi+ liquid PSB	20.11	14.65	93.38	19.20	13.44	87.6
Mean	20.26	14.75	93.15	18.59	13.01	88.21
CD (%)	NS	NS	NS	3.18	2.18	-

Sugarcane Juice quality

Though plant crop exhibited non significance in terms of juice quality, highest cane juice (20.97 %), percent CCS (15.40) and percent purity (25.01) was recorded with 75 % recommended dose of chemical fertilizers + carrier based formulations (Azatobacter + Azospirillum + PSB + VAM). Lowest cane juice sucrose (19.81 %), CCS (14.28 %) and purity (91.21 %) was observed in the plots which received 75 % recommended dose of chemical fertilizers with carrier based biofertilizers (Azatobacter + PSB). Significantly highest juice sucrose (19.20 %) and CCS (13.44 %) was recorded with 100 % NPK+ liquid Azospi+ liquid PSB with highest purity (89.8 %) in 75 % recommended dose of chemical fertilizers+ Azator + Azospir + PSB +VAM (liquid formulations except VAM)

TABLE 3. Effect of different biofertilizers on cane and sugar yield (t/ha) of sugarcane

	Cane yield		Sugar yield	
	Plant	Ratoon	Plant	Ratoon
T1: 100 % NPK	82.04	76.32	12.09	9.82
T2: 100 % NPK+ Azospirillum + PSB	84.24	79.97	12.42	10.45
T3: 75 % NP , 100 % K + Azospirillum + PSB	75.27	72.65	11.16	9.25
T4: 75 % NP, 100 % K + Azatobacter + PSB	74.40	71.89	10.62	9.30
T5: 75 % NP, 100 % K + Azatobacter + Azospirillum + PSB + VAM	77.76	71.80	11.97	9.26
T6: 75 % NP, 100 % K + liquid Azospi+ liquid PSB	78.66	73.10	11.53	9.36
T7: 75 % NP, 100 % K + liquidAzato + liquid PSB	77.10	72.40	11.44	9.49
T8: 75 % NP, 100 % K + liquidAzator + liquidAzospir + liquid PSB + VAM	80.67	76.70	11.75	10.16
T9: 100 % NPK+ liquid Azospi+ liquid PSB	87.55	82.65	12.82	11.11
Mean	79.74	75.28	11.76	9.80
CD (%)	5.38	8.35	0.86	NS

TABLE 4. Effect of different biofetilizers on soil physicochemical properties in post harvest soils of sugarcane

Treatments	pH		EC (dS/m)		OC (%)	
	Plant	Ratoon	Plant	Ratoon	Plant	Ratoon
Initial	7.32		0.526		0.59	
T1: 100 % NPK	7.15	7.19	0.116	0.43	0.60	0.69
T2: 100 % NPK+ Azospirillum + PSB	7.22	7.14	0.520	0.59	0.61	0.66
T3: 75 % NP , 100 % K + Azospirillum + PSB	7.38	7.23	0.601	0.38	0.60	0.66
T4: 75 % NP, 100 % K + Azatobacter + PSB	7.11	7.14	0.225	0.82	0.58	0.70
T5: 75 % NP, 100 % K + Azatobacter + Azospirillum + PSB + VAM	7.22	7.53	0.387	0.38	0.67	0.50
T6: 75 % NP, 100 % K + liquid Azospi+ liquid PSB	7.09	7.60	0.127	0.66	0.52	0.74
T7: 75 % NP, 100 % K + liquidAzato + liquid PSB	6.98	7.42	0.305	0.71	0.61	0.60
T8: 75 % NP, 100 % K + liquidAzator + liquidAzospir + liquid PSB + VAM	7.12	7.39	0.420	0.45	0.63	0.73
T9: 100 % NPK+ liquid Azospi+ liquid PSB	7.30	7.16	0.360	0.22	0.60	0.71
Mean	7.17	7.31	0.340	0.51	0.60	0.69
CD (%)	NS	NS	NS	NS	0.042	0.046

TABLE 5. Effect of different biofertilizers on soil available nutrient status in post harvest soils of sugarcane

Treatments	Nitrogen		Phosphorus		Potassium	
	Plant	Ratoon	Plant	Ratoon	Plant	Ratoon
Initial	228		61.5		269	
T1: 100 % NPK	239	239	70.5	75.49	271	213
T2: 100 % NPK+ Azospirillum + PSB	256	263	74.5	79.18	284	269
T3: 75 % NP , 100 % K + Azospirillum + PSB	237	218	71.6	80.53	274	235
T4: 75 % NP, 100 % K + Azatobacter + PSB	240	276	64.3	82.66	276	235
T5: 75 % NP, 100 % K + Azatobacter + Azospirillum + PSB + VAM	248	251	75.0	88.26	280	207
T6: 75 % NP, 100 % K + liquid Azospi+ liquid PSB	238	251	70.2	82.21	276	218
T7: 75 % NP, 100 % K + liquidAzato + liquid PSB	234	274	72.4	82.66	271	213
T8: 75 % NP, 100 % K + liquidAzator + liquidAzospir + liquid PSB + VAM	233	275	76.2	89.38	281	235
T9: 100 % NPK+ liquid Azospi+ liquid PSB	254	288	70.8	80.86	289	179
Mean	242	259	72.0	82.36	278	223
CD (%)	13.5	15.80	5.89	7.28	NS	NS

Cane and Sugar Yields

Significantly highest cane (87.55 & 82.65 t/ha, in plant-ratoon sequence) and sugar yields (12.82 & 11.11 t/ha in plant–ratoon sequence) were recorded with 100 recommended dose of chemical fertilizers +liquid biofertilizers. Lowest cane (74.40-plant) & 71.89t/ha-ratoon) and sugar yields (10.62 –plant & 9.30t/ha – ratoon) were recorded with 75% recommended dose of chemical fertilizers+carrier based biofertilizers (Azatobacter +PSB). Among different nutrient levels 100 % recommended dose of chemical fetilizers performed better in terms of cane and sugar yields over 75% chemical fertilizers+ biofetilizers either carrier or liquid. Among different biofertilizers carrier based formulations in combination with chemical fertilizers recorded lower yields over liquid formulations with chemical fertilizers. Reduction of 25% of chemical fertilizers did not meet the nutrient requirement to sugarcane crop, though different biofertilizers were supplied, however on par yields were recorded with liquid formulations over carrier based formulations. Similar results were reported by Misra and Naidu (1990). Michaelraj *et al*. (1984) compared the effect of Azospirillum and Azotobacter and reported that soil application of Azospirillum was better in improving the cane yield than Azotobacter, The better results for Azospirillum may be attributed to the associative symbiotic nature of Azospirillum, better survival and efficient colonization in wide. Application of liquid based biofertilizer as well as carrier based biofertilizer enhanced high number of cells in the rhizosphere, multiplication and subsistence of cells due to availability of carbon and energy sources (Pragya Gautam *et al*., 2017).

Physicochemical properties of post harvest soils

Selected soils are neutral in reaction with normal conductivity, data on post harvest soils also showed similar trend, however non significant results were obtained in cane of soil pH and electrical conductivity as biofertilizers are showing much influence on soil reaction and electrical conductivity in both plant and ratoon crops. Significantly highest organic carbon status was report with the treatments which received VAM biofertilizers in plant crop, where as in ratoon crop highest organic carbon status of 0.74% was recorded in the plots which received liquid formulations. Data on available macro nutrient status revealed that build up of available nitrogen and phosphorus was observed in all the biofertilizer treated plots and significantly superior over chemical fertilizers alone. Particular trend was not observed in case of available potassium in post harvest soils.

REFERENCES

Moddey, R.M. and Dobereiner, J. (1995) Nitrogen fixation associated with grasses and cereals: Recent progress and perspectives for the future. *Fert. Res.*, 42: 241–250.

Gaur, A.C. & Mathur, R.S. (1966) Stimulating influence of humic substances on nitrogen fixation by *Azotobacter*. *Sci. Cult.*, 32: 319

Meade, G.P., Chen, J.C.P. (1977) *Cane Sugar Hand Book* (10 ed.). Wiley Inter Science, John Wiley and Sons, New York, pp. 947

Misra, A. and Naidu, K.M. (1990) Effect of biofertilizers and their method of application on nitrogen economy in sugarcane. *Indian J. Agron.*, 35: 120–125

Pindi PK (2012) Liquid Microbial Consortium- A Potential Tool for Sustainable Soil Health. J Biofertil Biopestici., 3:124.

Piper, C.S. (1950) *Soil and Plant Analysis*, Hans Publications, Bombay, India.

Pragya Gautam1, L.N. Dashora, N.S. Solanki, R.H. Meena and B. Upadhyay (2017) Effect Carrier Based and Liquid Biofertilizers at Different Phosphorus Levels on Productivity of Hybrid Maize. International Journal of Current Microbiology and Applied Sciences. 6-12 pp. 922-927.

Srinivasan, T.R. and Naidu K.M. (1987) Response of sugarcane varieties to biofertilizers under different soil conditions. Sugarcane, 5-10.