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Effect of split application of organic manures and fertilizers on productivity, quality and economics of sugarcane grown on calcareous entisol of Bihar

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Abstract
A field experiment was conducted to study the effect of integrated nutrient management modules on productivity, quality and economics of Sugarcane grown on Calcareous Soil during 2018 -19 at Dr. Rajendra Prasad Central Agricultural University, Bihar. The treatments comprised of inorganic nutrient sources and their substitution by organic nutrient sources (biocompost + neem cake). The biocompost was applied at planting (PL) and neem cake at earthing up (EL) stages. Sugarcane crop (cv. CoP 2061) planted during spring season. The mean germination per cent, number of tillers, number of millable canes, cane yield and B: C ratio were calculated and shown to be highest for treatment receiving 50 per cent N through inorganic + 50 per cent N through organic fertilizer along with biofertilizers. Sugar yield is a function of cane yield and followed the similar pattern as cane yield. The juice recovery significantly varied due to different nutrient management modules while, their effect on brix, pol and purity coefficient was found non-significant. The uptake of N, P and K also varied significantly due to influence of different nutrient combinations. The uptake of nutrients followed the similar trend of cane yield.

Keywords: Biocompost, neem cake, planting, earthing up, nutrients uptake, sugarcane

Introduction
Sugarcane is grown in different countries since the middle of nineteenth century, primarily for the production of sugar. Sugarcane is one of the most important industrial crop in India occupying about 5.0 million hectares (Mha) in area *i.e.*, 3% of the gross cultivable area in the country. Sugar industry, one among the largest agro-based industries, contributes significantly to the rural economy. About 0.5 million people in sugar mills and 6 million sugarcane farmers, their dependents and a large mass of agricultural labour are involved in sugarcane cultivation, harvesting and ancillary activities, constituting 7.5% of the rural population (Venkatesh and Venkateswarlu, 2017) [38]. In Bihar, it occupies an area of 2.84 lakh ha with an average productivity of 54.42 t ha-1. The productivity of sugarcane in Bihar is below the national average. The area under sugarcane is not likely to increase and the increased sugarcane production has to be achieved through vertical growth in productivity.

Sugarcane crop growing only in 3% of the gross cropped area contributes a significant 1.1% to the national GDP. In the past two decades the contribution of sugarcane to the agricultural GDP has increased steadily from about 5% to 10% growing at an average annual growth of about 2.6% in comparison to 3% in agriculture sector in the country.

The imbalance use of fertilizers is the main reason behind decline in productivity of sugarcane crops. The continuous application of chemical fertilizers deteriorates the physical, chemical and biological property of soil in turn resulting low yield of sugarcane. The frequent and excessive use of chemical fertilizers has created various problems like widespread deficiency of secondary and micronutrients, decline in crop productivity and increasing environmental pollution (Pathak and Ghosh, 1996) [15].

Organic manures improves the quality of juice and jaggery due to balanced supply of all essential nutrients in right proportion and slow release throughout the cropping season. Organic sources of nutrients not only help in supplementing the nutrients to sugarcane but also maintain favourable physical, chemical and biological soil environment (Bhattacharya and Gehlot, 2003) [2] which in turn leads to better crop productivity. Sugarcane trash is one of the most commonly available farm wastes in sugarcane growing areas. About 5-8 t of trash can be obtained from one ha of sugarcane and contains about 5.4 kg N, 1.3 kg P_2O_5 and 3.1 kg K_2O t^{-1} of sugarcane trash and small quantities of micronutrients. The proper decomposition of sugarcane trash will be accelerated with the use of *Trichoderma* sp. *Trichoderma* sp., common inhabitants of the rhizosphere, besides accelerating decomposition of organic residues can act as bio-control agents of soil-borne plant pathogens (Harman, 2000) [6] and has also been found to improve soil health (Shukla *et al.*, 2008) [27].

Hence, with the raising apprehension on soil conservation and health in the context of depleting traditional organic manures, efforts are required to exploit the potentiality of easily available sources of organics effectively. Therefore, an experiment was carried out at RPCAU, Pusa with the motive of using different combination of inorganic and organic sources of nutrients to raise crop productivity.

Materials and methods

A field experiment to see the effect of split-application of organic manures along with chemical fertilizers on Sugarcane crop productivity and quality was conducted during 2018 -19 at Crop Research Centre, Pusa farm, Dr. Rajendra Prasad Central Agricultural University, Bihar.

The experimental site was situated on the south-west bank of river Burhi Gandak in Samastipur district of Bihar in the sub-tropical climate in between 25°98'' N latitude, 85°67'' E longitude and at an altitude of 52.0 m above mean sea level. The soil of experimental site was calcareous rich in free $CaCO_3$ (29.62%) belonging to order Entisol, suborder Fluvents and great group Typic Ustifluvent. The plot was medium upland, well drained with uniform topography. The experimental design was randomized block design with 7 treatments and 3 replications. The experimental soil was sandy loam in texture, with moderately alkaline pH, low in organic carbon (< 0.50%) and available N, K and medium in P.

The RDF for sugarcane (150 kg N- 85 kg P_2O_5- 60 kg K_2O ha^{-1}) was applied as per the treatment details outlined in table 1. Biocompost and Neem cake was applied in split doses as per treatment at planting and earthing up stages respectively in equally split amount. *Trichoderma* was applied @ 500 g t^{-1} of trash in treatment T_2. *Azotobacter* + PSB @ 4.0 kg ha^{-1} each was applied with biocompost at Planting in row as per the treatments. All the other management was followed as per the package and practices.

Observations recorded for crop growth, yield, quality and economics were statistically analyzed using Microsoft Excel. The least significant difference (LSD) at the 5% level was used for testing the significant difference among the treatment means.

Table 1: Treatments details of the experiment

1.	:	100% NPK- RDF (Control)
2.	:	100% N as IF + Organic mulching with ST @ 6t ha^{-1} + *Trichoderma*
3.	:	100% N as IF + GM with green gram as intercrop inoculated with *Rhizobium*
4.	:	25% N as IF + 75% N through organics; BC, PL + NC, ER (1/2 each) + *Azophos*
5.	:	50% N as IF + 50% N through organics; BC, PL + NC ER (1/2 each) + *Azophos*
6.	:	75% N as IF + 25% N through organics; BC, PL + NC, ER (1/2 each) + *Azophos*
7.	:	100% N through organics; BC, PL + NC, ER (1/2 each) + *Azophos*

RDF= Recommended Dose of Fertilizer, IF= Inorganic fertilizer, ST= Sugarcane Trash, BC= Biocompost, PL= Planting, NC= Neem Cake, ER= Earthing up, *Azophos*= *Azotobacter* + Phosphate solubilising Bacteria

1. RDF (150 kg N- 85 kg P_2O_5- 60 kg K_2O/ha) was applied as per treatment.
2. The recommended dose of phosphorus and potassium was applied in all the treatments except T_7 and N was substituted as per treatmnet.
3. Green gram was sown as intercrop and was incorporated in soil at 60 DAP.
4. Sugarcane trash inoculated with *Trichoderma* (@500 g t^{-1} of Trash) was spread between rows 55 DAP.
5. *Azotobacter* + PSB @ 4.0 kg ha^{-1} each was applied with BC at Planting (PL) in row.
6. The neem cake powder was applied at earting up stage at 120 DAP.

Results and discussion

1. Growth and yield attributes

i) Germination

The mean germination per cent varied from 23.7-33.9 per cent at 30 days after plantation (DAP) and between 36.1-47.5 at 45 DAP (table 2). At 30 DAP; treatments T_6 (33.9%) and T_4 (33.5%) recorded significantly higher germination over control (100% NPK), however, treatments T_5, and T_7 were found to be at par with treatments T_6 and T_4 at 30 DAP. The germination per cent increased from 30 DAP to 45 DAP in all the treatments. At 45 DAP; treatment T_6 recorded highest germination (47.5%) among all the treatments. The difference in germination was significant for T_6 receiving 75% N as inorganic + 25% N as organic fertilizer (biocompost + neem cake) along with biofertilizer over control (100% NPK), moreover, treatment T_4 was found to be at par with T_6 at 45 DAP. Treatment T_6 was found to be superior in terms of improving germination at both the stages of plant growth. This may be attributed to creation of a congenial environment due to integrated use of organic+inorganic nutrient sources which helped in maintaining good physical soil environment for proper growth. Significant improvement in germination of sugarcane due to application of organic and inorganic in combination was also reported by Vedprakash *et al.* (2009) [36] and Yadahalli (2008) [40].

ii) No of tillers

The data presented in table 2 shows significant differences in tillers per hectare for different combination of inorganic and organic sources of nutrients at both stages of crop growth. The highest number of tillers was obtained in treatment T_6 (155.7 x 10^3 ha^{-1}) receiving 75% N as inorganic + 25% N as organic fertilizer (biocompost + neem cake) along with biofertilizer at 120 DAP and treatments T_4 (145.7 x 10^3 ha^{-1}), T_5 (149.7 x 10^3 ha^{-1}) and T_7 (147.8 x 10^3 ha^{-1}) were found to be at par with treatment T_6. The differences among treatments were found non-significant for number of tillers at 150 DAP. However numerically highest number of tillers was recorded in treatment T_6 (160.3 x10^3 ha^{-1}) and lowest in control (136.9 x 10^3 ha^{-1}). Improvement in plant populations in terms of no. of tillers might be due to immediate supply of nutrients from inorganic fertilizer and sustained supply of nutrients from organics (biocompost + neem cake) along with biofertilizers during plant growth. Kathiresan *et al.* (1993) [10] also reported significantly higher no of tillers with the application of N as neem coated urea along with press mud, phosphobacteria and

Azospirillum. The results are in agreement with Sharma *et al*. (2002) [25], Sharma *et al*. (2003) [24] and Durai and Devaraj (2003) [4].

iii) Number of millable canes

The number of millable canes (NMC) at maturity stage of sugarcane as influenced by different nutrient modules has been presented in table 2. The examination of data revealed that treatment T_5 (116.2 x 10^3 ha^{-1}) recorded highest NMC followed by T_6 (110.1 x 10^3 ha^{-1}) and lowest in control (94.1 x 10^3 ha^{-1}) receiving 100% NPK as inorganics. However, treatments T_3 (114.2 x 10^3 ha^{-1}), T_5 and T_6 were found to be at par with each other. The perusal of data revealed that application of nutrient through both organic and inorganic sources recorded significantly higher NMC over 100% NPK through inorganics. Shankaraiah and Kalyanmurthy (2005) [21] reported significant improvement in number of millable canes due to use of press mud along with inorganic fertilizer. Similar findings of integrated nutrient application were also reported by Thakur *et al*. (2010) [33], Virdia and Patel (2010) [39], Thakur *et al*. (2012) [34], and Jamuna and Paneerselvam (2014) [7]. In addition, supply of nutrients from inorganic + organic sources along with biofertilizers resulted in significantly higher number of millable canes (Patel, 2006) [13].

iv) Single cane weight (SCW) (g)

The data pertaining to single cane weight has been presented in table 2. The effects of different nutrient management practices on single cane weight (SCW) were found non-significant. The mean SCW varied numerically and ranged from 710-803 g. The maximum value for SCW was recorded in treatment T_6 (803 g) followed by treatment T_5 (777 g $plant^{-1}$), T_2 (773 g $plant^{-1}$) and T_1 (760 g $plant^{-1}$). The lowest value for single cane weight was found in Treatment T_4 (710 g $plant^{-1}$) which received 25 per cent N through inorganic fertilizer + 75 per cent N through organics along with *Azotobacter* and phosphate solubilising bacteria. The numerical increase in single cane weight due to conjunctive use of inorganic and organic sources might be due to increased nutrient availability and uptake of nutrients which might have increased the photosynthetic efficiency of plants leading to better accumulation of photosynthates in the stalks. The above findings are in accordance with Shankaraiah *et al.* (2001) [23], Thakur *et al.* (2012) [33] and Rathore *et al.* (2014) [19].

Table 2: Effect of INM module on growth and yield parameters of sugarcane

Treatments	Germination (%)		No of tillers (x 10^3 ha^{-1})		No of millable canes (x 10^3 ha^{-1})	Single cane weight (g)
	30 DAP	45 DAP	120 DAP	150 DAP		
T_1	23.7	36.1	132.9	136.9	94.1	760
T_2	25.5	38.2	135.3	139.4	99.3	773
T_3	24.9	36.8	135.2	142.0	114.2	717
T_4	33.5	41.8	145.7	150.1	101.2	710
T_5	28.1	38.1	149.7	154.2	116.2	777
T_6	33.9	47.5	155.7	160.3	110.1	803
T_7	30.3	39.4	147.8	152.2	103.1	750
Sem (±)	2.22	2.18	5.19	4.87	4.29	32.22
LSD (0.05)	6.86	6.73	15.57	NS	13.23	NS

2. Cane and Sugar Yield

i) Cane yield

The effect of different nutrient management modules on cane yield has been presented in table 3. The integrated nutrient management modules significantly increased cane yield by 20.67% in treatment T_5 (89.18 t ha^{-1}), by 19.15% T_6 (87.51 t ha^{-1}) and by 13.40% T_3 (81.70 t ha^{-1}) treated with green gram inoculated with *Rhizobium* over control (70.75 t ha^{-1}). The highest cane yield was recorded in treatment T_5 receiving 50 per cent N through inorganic + 50 per cent N through organic fertilizer along with biofertilizer and lowest in T_1 receiving 100% NPK (control). However, Treatment T_3 and T_6 was found to be at par with treatment T_5 and significantly superior over treatment T_1, T_2, T_4 and T_7. The cane yield was in decreasing order of T5>T6>T3>T7>T2>T4>T1. The immediate and quick supply of plant nutrient through inorganic source for plant growth and steady supply of plant nutrients by organics throughout the growth period resulted in higher yield. Further, integrated use of organic and inorganic-N fulfills the demand of growing plants throughout the life cycle. The application of organic manures through biocompost at planting stage and neem cake at earthing up stage further improved soil environment condition congenial for plant growth. At initial stage, availability of plant nutrients might have increased due to decomposition of biocompost while, at later stage this might be due to decomposition and mineralization of concentrated organic manures (neem cake) resulting improvement in physical, chemical and biological properties of soil. This may also have improved soil fertility and absorption of nutrients by sugarcane plant (Sinha *et al.*, 2017) [28]. In sugarcane production single cane weight and number of millable canes assume practical significance as they are directly related to productivity (Venkatakrishnan and Ravichandran, 2007) [37]. The combined application of organic + inorganic-N sources significantly improved number of millable canes leading to more yield. In addition, application of organic manures might have improved the physical condition of soil by reducing bulk density and increasing soil macropores for better root proliferation which finally was reflected on cane yield. Similar findings were reported by Thakur *et al.* (2010) [34], Virdia and Patel (2010) [39], Patel *et al.* (2013) [14], Jha *et al.* (2015) [8] and Sinha *et al.* (2017) [29].

ii) Sugar yield

The significant variation in sugar yield was recorded due to application of nutrients from various organic and inorganic sources (Table 3). Integrated nutrient application brings significant changes in sugar yield. The result indicated that treatment T_5 (10.12 t ha^{-1}) and T_6 (10.06 t ha^{-1}) receiving integration of nutrient from inorganic + organic sources significantly increased sugar yield over control (8.34 t ha^{-1}). The higher cane yield resulted in higher sugar yield. Sugar yield is a function of cane yield and therefore followed the similar pattern as cane yield. Similar findings were also reported by Durai and Devaraj (2003) [4], Kathiresan (2004) [9], Hari and Srinivasan (2005) [5], Babu (2009) [1], Thakur *et al*. (2012) [33] and Sinha *et al*. (2017) [28].

3. Juice quality parameters
i) Brix, pol and purity coefficient
Data pertaining to Brix, Pol and Purity coefficient has been presented in Table 3. No significant differences were found in juice quality parameters due to application of different integrated nutrient modules. However, numerically higher value for brix and pol per cent was found in treatment T_7 receiving 100% organic sources of nutrients whereas Purity was found numericaaly highest in control plot receiving 100% RDF through inorganic sources. Thakur *et al.* (2010) [34] also reported that quality of juice remains unaffected due to addition of trash and biofertilizers. Rakkiyappan *et al.* (2001) [18] opined that the juice quality mainly depends upon genetic nature of the variety. Similar findings have been reported by Bokhtiar *et al.* (2008) [3], Kuri *et al.* (2014) [12] and Shridevi *et al.* (2016) [26].

ii) Juice recovery
The juice recovery significantly varied due to different nutrient management modules (Table 3). The result indicated that application of nutrients through organic sources resulted in significantly higher juice recovery in treatment T_7 (65.53%) as compared to control (60.55%) receiving 100% NPK through inorganics. The juice recovery numerically increased in treatments T_4, T_5 and T_6 receiving nutrients from inorganic + organic sources (biocompost + neem cake) along with biofertilizers as compared to T_1 (control) receiving 100% NPK through inorganics. The application of nutrients either through organics or its integration with inorganic nutrient sources improved juice quality parameters resulting in higher juice recovery.

iii) Commercial cane sugar (CCS%)
The CCS (%) remains unaffected due to different treatments (Table 3). CCS% varied from 11.35 - 12.03% with the maximum value recorded in treatment T_7 (12.03%) receiving 100 per cent N through organics (biocompost + neem cake) along with biofertilizers. It is obvious from the findings that application of organic nutrient source improved quality and recovery of sugarcane juice. Similar findings were reported by Sonawane and Sabale (2000) [30].

Table 3: Effect of INM module on Cane yield, sugar yield, and quality of juice in sugarcane

Treatments	Cane Yield (t ha^{-1})	Juice quality (%)			CCS (%)	Juice recovery (%)	Sugar yield (t ha^{-1})
		Brix	Pol	Purity coefficient			
T_1	70.75	19.2	17.02	88.5	11.77	60.55	8.34
T_2	75.70	19.1	16.71	87.6	11.51	57.94	8.72
T_3	81.70	18.9	16.56	87.8	11.42	57.24	9.33
T_4	71.05	18.8	16.55	88.2	11.43	62.30	8.12
T_5	89.18	18.8	16.47	87.7	11.35	61.44	10.12
T_6	87.51	18.9	16.66	88.0	11.50	62.65	10.06
T_7	76.33	19.7	17.41	88.2	12.03	65.53	9.17
Sem (±)	3.54	0.20	0.24	0.41	0.19	1.03	0.43
LSD $_{(0.05)}$	10.91	NS	NS	NS	NS	3.20	1.32

4. Nutrient uptake
The effects of integrated nutrient management module on uptake of N, P and K by sugarcane plant have been presented in table 4. The uptake of nutrients by sugarcane plant has increased significantly due to combined application of different organic + inorganic sources over control. The uptake of nitrogen, phosphorus and potassium was significantly higher in treatment T_5 receiving 50% N as inorganic + 50% N as organic fertilizer (biocompost + neem cake) along with biofertilizers. The maximum N-uptake (307.7 kg ha^{-1}) was found in treatment T_5 probably due to higher availability of N due to proper integration (50% inorganic + 50% organic) of nutrients. Further, application of *Azotobacter* enhanced N-availability and its uptake. The extent of increase of N-uptake over control for different treatments was 8.43, 8.78, 17.15, 26.42 and 30.16 per cent for treatment T_7, T_2, T_3, T_6 and T_5 respectively. Umesh *et al.* (2013) [35] reported similar findings. The maximum P-uptake (29.76 kg ha^{-1}) was found in treatment T_5 over control probably due to higher availability of phosphorus due to combined application of inorganic along with organic nutrients. Further, application of phosphate solubilizing bacteria enhanced P-availability and its uptake. Treatments T_3 (24.72 kg ha^{-1}), T_5 (29.76 kg ha^{-1}), T_6 (27.89 kg ha^{-1}) and T_7 (22.61 kg ha^{-1}) were at par. The maximum K-uptake (311.02 kg ha^{-1}) was found in treatment T_5 probably due to higher availability of K due to proper integration (50% inorganic + 50% organic) of nutrients along with biofertilizers. The higher availability might be due to release of fixed K from exchangeable sites by NH_4^+ (released during mineralization of organic manures). Treatment T_3 (262.45 kg ha^{-1}), T_5 (311.02 kg ha^{-1}) and T_6 (295.35 kg ha^{-1}) were at par with each other. K-uptake followed the order: $T_5>T_6>T_3>T_2>T_7>T_1>T_4$.

In general, data indicated that uptake of nutrients followed the similar trend of cane yield. Nutrient uptake is the function of concentration of nutrients and total biomass production. This increased uptake of nutrients (N, P and K) due to integrated nutrient use may be ascribed to soil microorganism mediated decomposition of organic matter which ensured consistent supply of nutrients throughout the growing period which improved root growth and its functional activity resulting greater extraction of nutrients. The uptake of nutrients might also have increased due to release of growth promoting substances released by microorganism present in soil. The above elucidated results are in accordance with Venkatakrishnan and Ravichandran (2007) [37], Srivastava *et al.* (2008) [31], Ravindrababu (2009) [20] and Keshavaiah *et al.* (2012) [11].

Table 4: Effect of INM module on uptake of nutrient by sugarcane

Treatments	Nutrient Uptake (kg ha^{-1})		
	N	P	K
T_1	214.9	18.31	217.56
T_2	235.6	20.44	238.46
T_3	259.4	24.72	262.45
T_4	213.2	19.98	215.81

T_5	307.7	29.76	311.02
T_6	292.1	27.89	295.35
T_7	234.7	22.61	237.58
Sem (±)	8.29	0.78	8.39
LSD $_{(0.05)}$	25.56	2.40	25.86

5. Economics

The cost of cultivation, gross income, net income and the B:C ratio (Table 5) computed for the sugarcane crop due to different management practices on per hectare basis and showed relevance to consider the practical adoptability of a particular treatment from farmer's point of view. The cost of cultivation ranged from 1,14,170.76 - 1,44,765.04 ha^{-1}. Minimum cost was incurred in treatment T_1 receiving 100% NPK (Control) and maximum cost of cultivation was recorded for treatment T_7 receiving 100% nutrient through organic sources.

Table 5: Effect of INM module on economics of sugarcane

Treatments	Total Cost of cultivation (₹ ha^{-1})	Gross Return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
T_1	1,14,170.76	2,05,174.63	91,003.83	1.80
T_2	1,15,111.56	2,19,529.53	1,04,417.93	1.91
T_3	1,18,728.04	2,36,002.00	1,17,274.00	1.99
T_4	1,37,438.99	2,06,045.00	68,606.00	1.50
T_5	1,29,898.07	2,58,622.00	1,28,723.90	1.99
T_6	1,21,922.42	2,53,779.00	1,31,856.60	2.08
T_7	1,44,765.04	2,21,357.00	76,592.00	1.53
SEm(±)	-	10275.57	10275.57	0.08
LSD$_{(0.05)}$	-	31662.2	31662.2	0.26

The value of economic produce i.e. cane yield depending upon the existing market price was used for determining gross returns under different nutrient management practices. The maximum gross return was obtained with treatment T_5 (2,58,622.00 ha-1) receiving 50% N as inorganic + 50% N as organic fertilizer (biocompost + neem cake) along with biofertilizers and minimum for T_1 (2,05,174.63 ha^{-1}) receiving 100% RDF.

Net returns calculated as difference of cost of cultivation from gross returns showed a maximum value for treatment T_6 (1,31,856.60 ha^{-1}) receiving 75% N as inorganic + 25% N as organic fertilizer (biocompost + neem cake) along with biofertilizer and minimum was obtained in treatment T_7 (76,592.00 ha^{-1}) which received 100% organic treatment. Nagaraju *et al.* (2000) also observed higher net return in case of application of press mud with *Azotobacter* and inorganics. Similar findings were reported by Shankaraiah and Nagaraju (2002) [22], Paul *et al.* (2005) [17] and Sridevi *et al.* (2016) [26].

Benefit: cost (B:C) ratio determines the practical feasibility of the experiment undertaken. It is calculated as the ratio of gross returns to the total cost of cultivation. The data revealed significant variation in B:C ratio (1.53 – 2.08) under different nutrient management practices. Treatment receiving 75% N as inorganic + 25% N as organic fertilizer (biocompost + neem cake) along with biofertilizer, T_6 (2.08) was significantly superior over all the treatments. However, Treatment T_1 (1.80), T_2 (1.91), T_3 (1.99) and T_5 (1.99) were at par with each other.

Paul and Mannan (2007) [16] also obtained a B:C ratio of 3.88 with the integration of organics and inorganics. Similar findings were observed by Srivastava *et al.* (2008) [31], Thakur *et al.* (2010) [34] and Suma and Savitha (2015) [32].

Conclusion

Based on above findings it was observed that application of 50% N through inorganic + 50% N through biocompost at planting stage + neem cake at earthing up stage (1/2 each) along with *Azotobacter and* PSB @ 4 kg ha^{-1} each recorded highest cane (89.18 t ha^{-1}) and sugar yield (10.12 t ha^{-1}) and was found at par with 75% N through inorganic fertilizer + 25% N through biocompost + neem cake (1/2 each) with *Azotobacter and* PSB. The maximum increment in cane yield by 20.67% was registered due to application of 50% N through inorganic + 50% N through biocompost at planting stage + neem cake at earthing up stage (1/2 each) along with *Azotobacter and* PSB @ 4 kg ha^{-1} each followed by 19.15% in treatment receiving 75% N through inorganic fertilizer + 25% N through biocompost + neem cake (1/2 each) with *Azotobacter* and PSB. The data further revealed that cane yield also increased significantly by 13.40% in plot treated with green gram inoculated with *Rhizobium* over control (100% NPK). Application of 100% N through biocompost + neem cake along with *Azotobacter* and PSB @ 4 kg ha^{-1} or *Trichoderma* inoculated trash@ 6 t ha^{-1} was found at par with 100% NPK(Control). The treatment receiving 75% N as IF + 25% N through organics; BC, PL + NC, ER (1/2 each) + *Azotobacter.*

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