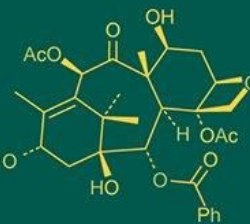
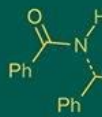
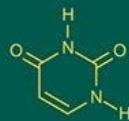
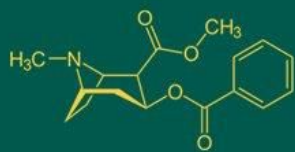


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(4): 198-207
www.biochemjournal.com
Received: 02-02-2026
Accepted: 04-03-2026

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Effect of organics on growth, yield, major nutrient content and uptake by sugarcane

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DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i4Sc.8085>

Abstract

A field trial was conducted at Organic Farm, Navsari Agricultural University, Navsari". The objectives of study to find out the effect of available organic resource-based treatments on growth, yield and nutrient uptake of sugarcane, the experiment was conducted using the RBD (factorial concept) with three replications. Two factors were tested in which one factor was spacing (S₁: 90 cm and S₂: 60 - 120 - 60 cm paired row with dhaincha green manuring) and another factor was compost levels (M₁: NADEP compost @ 100% RDN, M₂: NADEP compost @ 75% RDN, M₃: NADEP compost @ 50% RDN and M₄: NADEP compost @ 25% RDN + sugarcane trash @10 t/ha + jeevamrut @ 2000 l/ha.). The total plant height and millable cane height as well as single cane weight were affected significantly by the treatment of compost only. Higher values of these parameters were observed in compost treatment M₁, followed by M₂, M₃ and M₄. Similar trend of treatments was observed in case of millable cane yield/ha. Significantly higher millable cane yield was observed in treatment M₁ during the years 2019-20, 2020-21 and in pooled analysis. However, this treatment was remained statistically at par with treatment M₂ treatment. Among the N, P₂O₅, K₂O, content of cane and trash, content of N in cane and trash, P₂O₅ in cane and trash were affected significantly by the compost treatments in pooled analysis. Significantly higher content of these nutrients was observed in treatment M₁ as compared to remaining treatments. However, this treatment was remained at par with the treatment M₂ in N content in cane and trash. Uptake of N by trash, P₂O₅ by cane and total uptake, were affected significantly by the treatment of spacing in pooled analysis. The paired row spacing treatment S₂ (60 - 120 - 60 cm paired row with green manuring) observed significantly higher uptake of these nutrient in pooled analysis as compared to treatment S₁. In case of compost treatments, they exerted significant effect on uptake of N, P, K, by cane and trash during both the individual years as well as in pooled analysis. Treatment M₁ (NADEP compost @ 100% RDN) recorded significantly higher uptake of these nutrients by cane and trash during both the individual years and pooled analysis but it was remained statistically at par with treatment M₂ treatment in majority of cases.

Keywords: Sugarcane, organic farming, NADEP compost, nutrient uptake, millable cane yield

Introduction

Sugarcane belongs to the family poaceae and tropical sugarcane originated from Oceania (New Guinea) while Indian cane (*Saccharum spontaneum* L.) originated from North Eastern India. The word *Saccharum* is derived from the Sanskrit word "sharkara" and it indicates its Indian origin. Brazil led the world in sugarcane production. Sugarcane is an important agro-industrial commercial crop which plays pivotal role in national economy and sustains sugar industry. It is extensively grown in tropical and sub-tropical regions of India as cash crop. Besides sugar and gur production, sugarcane produces several valuable by products like, ethanol used as a fuel, alcohol used by pharmaceutical industry, bagasse used for paper and chip board manufacturing and press mud used as a rich source of organic matter and nutrients for crop production. India is second largest sugarcane producer after Brazil, grown in an area of 4.73 million hectares with total production of 376.9 million tonnes of cane with average productivity of 68 tonnes per hectare and the average sugar recovery of 10.23%. Considering area, Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, Bihar, Andhra Pradesh and Gujarat are the major sugarcane growing states. Gujarat produces only 3.72 per cent sugarcane from 4.65 per cent area of India. In Gujarat sugarcane area, production, productivity and sugar recovery, were 2.23 lakh hectare, 17.44 million tones, 78.31 t/ha and 11.09%, respectively (Anon., 2024). Surat, Navsari, Valsad, Bharuch, Tapi, Narmada, Bhavnagar, Rajkot, Junagadh and Jamnagar are the important sugarcane producing districts of Gujarat

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Organic farming perceptions are quite divergent but there is a strong consensus on its eco-friendly nature and inherent ability to protect human health. Also, many studies have revealed that organic agriculture is productive and sustainable. However, organic food production costs are higher as compared to conventional counterparts due to higher input cost and labour intensive in nature. Efforts have been made by the government of India on an overall basis to encourage organic farming. Even different organizations have been set up for the marketing of the produce of organic farming. The increasing demand for the organic food products in the developed countries as well as the policies adopted by the government of India to encourage the exports of the organic agri-products are the driving factors responsible for the uprising of the Indian organic food industries which have the potential to strengthen the Indian economy as well as the health standards of the Indian masses (Roychowdhury *et al.*, 2013) [9].

Materials and methods

The experiment was conducted using the RBD (factorial concept) with three replications. Two factors were tested in which one factor was spacing (S1: 90 cm and S2: 60 - 120 - 60 cm paired row with dhaincha green manuring) and another factor was compost levels (M1: NADEP compost @ 100% RDN, M2: NADEP compost @ 75% RDN, M3: NADEP compost @ 50% RDN and M4: NADEP compost @ 25% RDN + sugarcane trash @ 10 t/ha + jeevamrut @ 2000 l/ha.).

Total plant height and millable cane height (cm)

The selected five plants from each net plot were measured for their total plant height at harvest from the ground up to the top or tip of the main tiller and millable cane height also measured after removing trash. Average value of five plants for each treatment at harvest stage were computed and recorded.

Cane girth (cm)

At the time of harvest, the girth of five tagged canes was measured from top to bottom. Average cane diameter was recorded by using digital Vernier caliper (Mitutoyo, Japan). Cane girth is calculated using formula, $Girth = D \times \pi$, D = Diameter.

Lengths and Numbers of internodes

The lengths and numbers of internodes of five tagged plants from each plot were counted at harvest and the average was worked out.

Single cane weight (kg)

The weight of five randomly selected canes from plot were recorded individually and presented as average weight per cane.

Millable cane yield (t/ha)

The net plot was harvested separately for each treatment. The canes were detoured, and millable canes were prepared by cutting the top portion. The weight of these millable canes for each experimental plot was recorded in kilograms, and then it was converted into tonnes per hectare.

Plant analysis

Cane and trash samples were chopped with a knife, from this about 200g was taken, dried in the oven at $60 \pm 5^\circ\text{C}$

temperature until complete drying. This dried samples then powdered using a mixer with stainless steel blades. Powdered plant samples digested using a di-acid mixture, *i.e.*, 10 parts of HNO_3 and 4 parts of HClO_4 (Jackson, 1973) [6]. From the digested aliquot, elements, *viz.*, total P, K, Fe, Mn, Zn, and Cu content, were determined by using standard methods mentioned in Table 1. The N content in the samples was estimated separately by micro Kjeldahl's method after digesting with 30% H_2O_2 and concentrated H_2SO_4 (Bremner, 1965) [3].

Table 1: Plant analysis methods

Parameters	Methods/Formula	References
N	Micro Kjeldahl	Jackson (1973) [6]
P	Spectrophotometer	Jackson (1973) [6]
K	Flame photometer	Jackson (1973) [6]

Nutrient uptake

The macro nutrient (N, P and K) and micronutrient (Fe, Mn, Zn and Cu) uptake of cane and trash of sugarcane was calculated by using the following formula.

$$\text{Uptake of N, P}_2\text{O}_5 \text{ and K}_2\text{O} \left(\frac{\text{kg}}{\text{ha}} \right) = \frac{\text{Content (\%)} \times \text{Yield} \left(\frac{\text{kg}}{\text{ha}} \right)}{100}$$

Results and discussion

Total plant height and millable cane height at harvest

Results furnished in Table 2 is of height of plant and millable cane of sugarcane at harvest as influenced by different treatments. Result indicated that spacing treatments did not showed significant impact on plant height and millable cane height of sugarcane at harvest during individual year and pooled analysis. Numerically, higher total plant height (269.4, 279.0 and 274.2 cm) and millable cane height (234.0, 239.2 and 236.6 cm) was found with treatment S₂ (60 - 120 - 60 cm paired row with green manuring) while lower total plant height (263.5, 272.8 and 268.2 cm) and millable cane height (224.8, 238.0 and 231.4 cm) was noted with treatment S₁ (90 cm) during both the years 2019-20, 2020-21 and in pooled analysis, respectively.

Results given in Table 2 indicated that the treatments of compost levels affects the plant height and millable cane height of sugarcane at harvest significantly. Treatment, 100% RDN through NADEP compost (M₁) recorded significantly higher plant height *i.e.* 285.6, 297.4 and 291.5 cm during the years 2019-20, 2020-21 and in pooled analysis, respectively. However, it was remained statistically at par with the treatment M₂ (Application of 75% RDN through NADEP compost) during 2019-20, 2020-21 and pooled analysis. Similarly, millable cane height was also affected significantly by the compost treatments. Here also, treatment M₁ (100% RDN through NADEP compost) recorded significantly higher millable cane height *i.e.* 247.5, 253.8 and 250.7 cm during the years 2019-20, 2020-21 and in pooled analysis, respectively and found statistically at par with treatment M₂ (Application of 75% RDN through NADEP) and recorded millable cane height, 235.0, 240.6 and 237.8 cm during the years 2019-20, 2020-21 and in pooled analysis, respectively such result was also reported earlier in sugarcane crop by Yadav and Yaduvanshi (2001) [11].

Year effect as well as interaction effect of different treatments on plant height and millable cane height of sugarcane at

harvest was non-significant during both the individual years as well as in pooled analysis (Table 2).

Length of internodes and number of internodes

The results regarding length of internodes and number of internodes of sugarcane at harvest as influenced by different spacing and compost treatments are presented in Table 3.

The results paraded in Table 3 revealed that spacing treatments did not show significant impact on lengths and number of internodes of sugarcane at harvest during individual experimental period of both the years and pooled data analysis. The higher length of internodes (12.8, 13.3 and 13.0 cm) and number of internodes (17.8, 18.1 and 18.0) was noted in treatment S₂ (60 - 120 - 60 cm paired row with green manuring) as compared to S₁ during the year 2019-20, 2020-21 and in pooled analysis, respectively.

In case of compost treatments, it had significant effect on only lengths of internodes at harvest (Table 3). Significantly higher lengths of internodes, 13.8 and 14.2 cm was observed in treatment, application of 100% RDN through NADEP compost (M₁) during the year 2019-20, 2020-21, respectively. However, this treatment was remained at par with treatment M₂ (75% RDN through NADEP compost) during the both years. While in pooled analysis treatment M₁ (100% RDN through NADEP compost) recorded significantly the highest length of internodes (14.0 cm). Application of organic manure increased the yield and yield attributing characteristics without remarkable change in sugar content of cane and exhibited better impact on root development, increased chlorophyll a and b content of leaf tissues, prevent nutrient depletion, increased nutrient availability for longer time and maintain productivity as well (Bokhtiar and Sakurai, 2005) [2]. Number of internodes were not affected significantly by compost treatments during both individual year as well as in pooled analysis. However, numerically more and a smaller number of internodes were observed in treatments M₁ and M₄, respectively.

Lengths of internodes and number of internodes of sugarcane at harvest (Table 3) were not affected significantly by year as well as any of the interaction of different treatments (S x M, Y x S, Y x M, Y x S x M).

Cane girth of sugarcane at harvest.

The results regarding cane girth of sugarcane at harvest presented in Table 4 revealed that the effect of spacing and different levels of NADEP compost did not exert any significant effect on it during both the individual years as well as in pooled analysis. However, in spacing treatments, numerically higher cane girth (8.03, 8.19 and 8.11 cm) of sugarcane at harvest was found with treatment S₂ (60 - 120 - 60 cm paired row with green manuring) while lower cane girth (7.84, 8.06 and 7.95 cm) was found in treatment S₁ (90 cm) during the years 2019-20, 2020-21 and in pooled analysis, respectively. In manure treatment, numerically higher cane girth was observed in treatment M₁ (NADEP compost @ 100% RDN) and lower cane girth was observed in treatment M₄ (application of NADEP compost @ 25% RDN + Sugarcane trash @ 10 t/ha + jeevamrut @ 2000 l/ha.) during the year 2019-20, 2020-21 and in pooled analysis. Such result was also reported earlier in sugarcane crop by Sinha *et al.* (2014) [10].

Year effect on cane girth of sugarcane was non-significant. Similarly, none of the interactions of different treatment exert

significant effect on cane girth of sugarcane at harvest during individual years and in pooled analysis (Table 4).

Single cane weight and millable cane yield of sugarcane at harvest

The results pertaining to effect of different treatments on single cane weight and millable cane yield of sugarcane at harvest are presented in Table 5.

The results of two years of experiments revealed that mean single cane weight and millable cane yield of sugarcane at harvest was not affected significantly by different spacing treatments but significantly affected by the different levels of NADEP compost. Numerically, higher single cane weight (1.21, 1.29, 1.25 kg) was found in treatment S₂ (60 - 120 - 60 cm paired row with green manuring) while lower single cane weight (1.20, 1.27 and 1.24 kg, respectively) was noted with treatment S₁ (90 cm) during the years 2019-20, 2020-21 and in pooled analysis, respectively (Table 5). In case of millable cane yield, numerically higher millable cane yield (94.3, 106.3 and 100.3 t/ha) was found in treatment S₂ (60 - 120 - 60 cm paired row with green manuring) while lower millable cane yield (91.8, 101.1 and 96.4 t/ha) was found in treatment S₁ (90 cm) during the years 2019-20, 2020-21 and in pooled analysis, respectively.

In case of compost treatments, application of 100% RDN through NADEP compost (M₁) recorded significantly higher single cane weight (1.29, 1.35 and 1.32 kg) at harvest during the years 2019-20, 2020-21 and in pooled analysis, respectively (Table 7). However, this treatment was remained statistically at par with treatment M₂ (1.22, 1.32 and 1.27 kg) and M₃ (1.20, 1.25 and 1.22 kg) during the years 2019-20, 2020-21 and in pooled analysis, respectively (Table 5). In case of millable cane yield, significantly higher millable cane yield (101.7, 112.3 and 107.0 t/ha) was recorded under application of 100% RDN through NADEP compost (M₁) during the year 2019-20, 2020-21 and in pooled analysis, respectively. This treatment was remained statistically at par with the treatment M₂ and recorded yield 95.0, 110.0 and 102.5 t/ha during the year 2019-20, 2020-21 and in pooled analysis, respectively.

Here, significant year effect was observed on single cane weight and millable cane yield was significant and in both the parameters and higher yield was observed during the year 2020-21 (Table 5). However, single cane weight and millable cane yield at harvest were not affected significantly by any of the interaction of different treatments (S x M, Y x S, Y x M, Y x S x M).

Nutrient content and uptake of cane and trash of sugarcane

The results pertaining to N, P, K, Fe, Mn, Zn and Cu content and uptake of cane and trash of sugarcane as influenced by different treatments are furnished in Tables 6 to 11.

4.5.1 Nitrogen content of cane and trash

The results regarding N content (%) in cane and trash of sugarcane is presented in Table 6. Except N content in sugarcane trash in the year 2020-21, the effect of spacing treatment on N content in cane and trash of sugarcane at harvest did not differ significantly during individual year as well as in pooled analysis. During the year 2020-21, the paired row spacing treatment S₂ (60 - 120 - 60 cm paired row with green manuring) recorded significantly higher N content in sugarcane trash (0.748%) as compared to treatment S₁.

In case of compost treatments, it was significant with respect to N content in cane and trash during second year of experiment as well as in pooled analysis (Table 6). In the year 2020-21 and in pooled analysis, treatment M₁ recorded significantly higher N content in cane *i.e.* 0.48 and 0.45 per cent, respectively. However, this treatment was remained at par with the treatment M₂ with respect to N content in cane during the year 2020-21 as well as in pooled analysis. Similar treatment effect was also observed in N content in trash. Here also significantly higher N content was recorded in treatment M₁ but it was remained at par with the treatment M₂ during the year 2020-21 as well as in pooled analysis. These findings are in accordance with the earlier finding by Patil *et al.* (2015) and Gilbert *et al.* (2008)^[5, 8].

Year effect was significant on N content in cane and trash of sugarcane and significantly higher N content in cane and trash was observed during the year 2020-21 as compared that observed during the year 2019-20 (Table 6).

None of the interactions had significant effect on N content in cane and trash of sugarcane (Table 6).

Phosphorus content of cane and trash

The results of P₂O₅ content (%) in cane and trash of sugarcane as influence by different treatment are presented in Table 7. The results revealed that effect of different row spacing on P₂O₅ content (%) of cane and trash did not differ significantly during individual years and in pooled data analysis. However, higher P₂O₅ content in cane and trash was observed in treatment S₂ as compared to S₁.

However, compost treatments affect the P₂O₅ content in cane and trash of sugarcane significantly during first year of experiment as well as in pooled analysis (Table 7). In the year 2019-21 and in pooled analysis, treatment M₁ recorded significantly higher P₂O₅ content in cane *i.e.* 0.223 and 0.235 per cent during the year 2019-20 and in pooled analysis, respectively. Application of compost @ 100% RDN treatment (M₁) recorded significantly higher P₂O₅ content in trash during the year 2019-20 and in pooled analysis. Treatment M₄ recorded comparatively lower P₂O₅ content in cane and trash during all the individual years as well as in pooled analysis. The similar findings were also reported earlier by Caporali *et al.* (2004)^[4].

Year effect was significant on P₂O₅ content in cane and trash of sugarcane and significantly higher P₂O₅ content in cane and trash was observed during the year 2020-21 as compared that observed during the year 2019-20 (Table 7).

None of the interactions had significant effect on N content in cane and trash of sugarcane (Table 7).

Potassium content of cane and trash

Content of K₂O (%) in cane and trash of sugarcane was not affected significantly by the treatments of spacing and compost as well as year and their interactions (Table 8).

Nutrient uptake by sugarcane

Nitrogen uptake by cane and trash

The results regarding N uptake (kg/ha) by cane and trash of sugarcane is presented in Table 9. The result revealed that spacing did not affect the N uptake (kg/ha) by cane significantly during individual years as well as pooled data analysis. However, the spacing treatment affect the N uptake by trash significantly during the year 2020-21 and in pooled analysis. The paired row spacing treatment S₂ (60 - 120 - 60 cm paired row with green manuring) registered significantly

higher N uptake by trash during the years 2020-21 (39.0 kg/ha) and in pooled analysis (34.8 kg/ha) as compared to treatment S₁.

The compost treatment affects the N uptake by cane and trash of sugarcane significantly (Table 9). Application of NADEP compost @ 100% RDN (M₁) recorded significantly higher N uptake by cane (151.1, 188.7 and 169.9 kg/ha) during the years 2019-20, 2020-21 and in pooled analysis, respectively. However, this treatment was remained statistically at par with M₂ (application of NADEP compost @ 75% RDN). Similar treatment effect was observed in trash, here also application of NADEP compost @ 100% RDN (M₁) recorded significantly higher N uptake by trash (34.6, 43.8 and 39.2 kg/ha) during the years 2019-20, 2020-21 and in pooled analysis. However, it was remained statistically at par with treatment M₂ during the years 2019-20 and 2020-21 only. These findings are in accordance with the earlier finding by Patil *et al.* (2015)^[8].

In pooled analysis, year effect was significant on N uptake by cane and trash. Significantly higher N uptake by cane and trash was observed in the year 2020-21 as compared to the year 2019-20 (Table 9).

Interaction effect of S x M, Y x S, Y x M, Y x S x M did not exert any significant effect on N uptake by cane and trash of sugarcane at harvest during individual years and in pooled data analysis (Table 9).

Phosphorus uptake by cane and trash

The results regarding P₂O₅ uptake by cane and trash of sugarcane is presented in table 10. The result revealed that P₂O₅ uptake by cane was affected significantly by spacing treatments during the year 2020-21 and in pooled analysis. Spacing treatment S₂ (60 - 120 - 60 cm paired row with green manuring) recorded significantly higher P₂O₅ uptake by cane during the year 2020-21 (89.3 kg/ha) and in pooled analysis (78.3 kg/ha) as compared to spacing treatment S₁. However, P₂O₅ uptake by trash was not affected significantly by spacing treatments during the individual year and in pooled analysis. Compost treatment was significant during the individual year and in pooled analysis with respect to P₂O₅ uptake by cane and trash of sugarcane (Table 10). Significantly higher phosphorus uptake by cane (79.1, 97.6 and 88.4 kg/ha) was recorded in M₁ (application of NADEP compost @ 100% RDN) during the year 2019-20, 2020-21 and in pooled analysis and stood on at par with treatment M₂ during the year 2020-21. Similarly higher phosphorus uptake by trash (8.6, 10.2 and 9.4 kg/ha) was recorded in M₁ (application of NADEP compost @ 100% RDN) during the year 2019-20, 2020-21 and in pooled analysis, respectively whereas, treatment M₂ (application of NADEP compost @ 75% RDN) remained at par during the year 2020-21 and recorded P₂O₅ value of 9.4 kg/ha. This might due to use of organic manure have a higher positive effect on microbial biomass and hence soil health which helped in utilizing, increasing, available nitrogen as well as phosphorus from soil, the organic acid produced during decomposition also favoured solubilization of native soil phosphorus, reduced phosphorus fixation and retaining more available phosphorus for longer period resulting in higher uptake of phosphorus. (Bokhtiar & Sakurai 2005)^[2].

Year effect was significant on P₂O₅ uptake by cane and trash of sugarcane. Significantly higher P₂O₅ uptake by cane and trash of sugarcane was observed in the year 2020-21 as compared to the year 2019-20 (Table 10).

Interaction effect of S x M, Y x S, Y x M, Y x S x M did not exert any significant effect on P_2O_5 uptake by cane and trash of sugarcane at harvest during individual years and in pooled data analysis (Table 10).

Potash uptake by cane and trash

Result regarding K_2O uptake by cane and trash of sugarcane given in Table 11 revealed that it was not affected significantly by the spacing treatments during the year 2019-20, 2020-21 and in pooled analysis. However higher K_2O uptake by cane and trash was recorded in spacing treatment S_2 as compared to S_1 .

As far as compost treatment is concerned, it had significant effect on K_2O uptake by cane and trash of sugarcane during the year 2019-20, 2020-21 and in pooled analysis (Table 11). Significantly the higher K_2O uptake by cane (160.4, 183.1 and 171.7 kg/ha) and trash (35.1, 41.0 and 38.0 kg/ha) was recorded in treatment M_1 (application of NADEP compost @ 75% RDN) during the years 2019-20, 2020-21 and in pooled analysis, respectively. However, it was remained at par with

treatment M_2 (application of NADEP compost @ 75% RDN) during the year 2019-20, 2020-21 and in pooled analysis, respectively. The application of organic manure has been shown to replenish soil organic C and improve cation exchange capacity, water holding capacity, physical and biological quality of soil and reduced fixation of nutrients (Lakshmi *et al.*, 2011) [7]. Moreover, several kinds of microbial agents capable of fixing N or mobilizing K and others nutrients are becoming an integral component of organic manure so increasing yield as well as uptakes of nutrients.

Year effect was significant on K_2O uptake by cane and trash. Significantly higher K_2O uptake by cane and trash was observed in the year 2020-21 as compared to the year 2019-20 (Table 11).

Interaction effect of S x M, Y x S, Y x M, Y x S x M did not exert any significant effect on K_2O uptake by cane and trash of sugarcane at harvest during individual years and in pooled data analysis (Table 11).

Table 2: Effect of different treatments on plant height and millable cane height at harvest

Treatments	Total plant height (cm)			Millable cane height (cm)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor I: Spacing						
S_1 -(90 cm)	263.5	272.8	268.2	224.8	238.0	231.4
S_2 -(60-120-60 cm with GM)	269.4	279.0	274.2	234.0	239.2	236.6
S Em±	4.8	5.1	4.0	4.0	4.3	3.2
CD at 5%	NS	NS	NS	NS	NS	NS
Factor II: Compost levels						
M_1 -Com. @ 100% RDN	285.6	297.4	291.5	247.5	253.8	250.7
M_2 -Com. @ 75% RDN	270.5	284.0	277.2	235.0	240.6	237.8
M_3 -Com. @ 50% RDN	263.4	265.4	264.4	222.0	234.0	228.0
M_4 -Com. @ 25% RDN + ST @ 10 t/ha + JM @ 2000 l/ha	246.4	256.9	251.6	213.0	225.9	219.5
S Em±	6.8	7.2	5.7	5.6	6.1	4.5
CD at 5%	20.7	22.0	16.8	17.1	18.6	13.1
CV (%)	6.2	6.4	7.3	6.0	6.3	6.6
S x M						
S Em±	9.6	10.2	8.1	8.0	8.6	6.3
CD at 5%	NS	NS	NS	NS	NS	NS
Pooled	S Em±	CD at 5%		S Em±	CD at 5%	
Y	4.0	NS		3.2	NS	
Y x S	5.7	NS		4.5	NS	
Y x M	8.1	NS		6.3	NS	
Y x S x M	11.5	NS		9.0	NS	

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 3: Effect of different treatments on length of internodes and number of internodes in sugarcane at harvest

Treatments	Length of internodes (cm)			Number of internodes		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor I: Spacing						
S_1 -(90 cm)	12.4	13.1	12.8	16.8	17.8	17.3
S_2 -(60-120-60 cm with GM)	12.8	13.3	13.0	17.8	18.1	18.0
S Em±	0.2	0.2	0.2	0.3	0.4	0.3
CD at 5%	NS	NS	NS	NS	NS	NS
Factor II: Compost levels						
M_1 -Com. @ 100% RDN	13.8	14.2	14.0	18.3	18.4	18.4
M_2 -Com. @ 75% RDN	12.8	13.5	13.1	17.4	18.2	17.8
M_3 -Com. @ 50% RDN	12.1	12.7	12.4	16.8	17.8	17.3
M_4 -Com. @ 25% RDN + ST @ 10 t/ha + JM @ 2000 l/ha	11.6	12.3	12.0	16.6	17.4	17.0
S Em±	0.3	0.4	0.3	0.5	0.6	0.4
CD at 5%	1.1	1.2	0.8	NS	NS	NS
CV (%)	7.0	7.6	8.1	7.6	8.4	9.0
S x M						

S Em±	0.5	0.5	0.4	0.7	0.8	0.6
CD at 5%	NS	NS	NS	NS	NS	NS
Pooled	S Em±	CD at 5%	S Em±	CD at 5%		
Y	0.2	NS	0.3	NS		
Y x S	0.3	NS	0.4	NS		
Y x M	0.4	NS	0.6	NS		
Y x S x M	0.6	NS	0.9	NS		

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 4: Effect of different treatments on cane girth of sugarcane at harvest

Treatments	Cane girth (cm)		
	2019-20	2020-21	Pooled
Factor I: Spacing			
S ₁ -(90 cm)	7.84	8.06	7.95
S ₂ -(60-120-60 cm with GM)	8.03	8.19	8.11
S Em±	0.22	0.21	0.17
CD at 5%	NS	NS	NS
Factor II: Compost levels			
M ₁ -Com. @ 100% RDN	8.06	8.34	8.20
M ₂ -Com. @ 75% RDN	7.94	8.17	8.05
M ₃ -Com. @ 50% RDN	8.03	8.05	8.04
M ₄ -Com. @ 25% RDN + ST @ 10 t/ha + JM @ 2000 l/ha	7.72	7.95	7.84
S Em±	0.30	0.30	0.23
CD at 5%	NS	NS	NS
CV (%)	9.39	9.07	10.09
SXM			
S Em±	0.43	0.43	0.33
CD at 5%	NS	NS	NS
Pooled	S Em±	CD at 5%	
Y	0.17	NS	
Y x S	0.23	NS	
Y x M	0.33	NS	
Y x S x M	0.47	NS	

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 5: Effect of different treatment on mean single cane weight and millable cane yield at harvest.

Treatments	Single cane weight (kg)			Millable cane yield (t/ha)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor I: Spacing						
S ₁ -(90 cm)	1.20	1.27	1.24	91.8	101.1	96.4
S ₂ -(60-120-60 cm with GM)	1.21	1.29	1.25	94.3	106.3	100.3
S Em±	0.02	0.02	0.02	2.6	2.1	1.8
CD at 5%	NS	NS	NS	NS	NS	NS
Factor II: Compost levels						
M ₁ -Com. @ 100% RDN	1.29	1.35	1.32	101.7	112.3	107.0
M ₂ -Com. @ 75% RDN	1.22	1.32	1.27	95.0	110.0	102.5
M ₃ -Com. @ 50% RDN	1.20	1.25	1.22	88.8	97.6	93.2
M ₄ -Com. @ 25% RDN + ST @ 10 t/ha + JM @ 2000 l/ha	1.12	1.20	1.16	86.5	94.9	90.7
S Em±	0.03	0.03	0.03	3.6	3.0	2.6
CD at 5%	0.10	0.10	0.08	11.1	9.2	7.5
CV (%)	6.8	6.0	7.5	9.6	7.2	9.0
Year mean	1.20	1.28	1.24	93.0	103.7	98.3
S x M						
S Em±	0.05	0.04	0.04	5.2	4.3	3.6
CD at 5%	NS	NS	NS	NS	NS	NS
Pooled	S Em±	CD at 5%	S Em±	CD at 5%		
Y	0.02	0.1	1.8	5.3		
Y x S	0.03	NS	2.6	NS		
Y x M	0.04	NS	3.6	NS		
Y x S x M	0.05	NS	5.1	NS		

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 6: Effect of different treatments on N content in cane and trash

Treatments	N content (%)					
	Cane			Trash		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor I: Spacing						
S ₁ -(90 cm)	0.40	0.44	0.42	0.66	0.70	0.68
S ₂ -(60-120-60 cm with GM)	0.41	0.45	0.43	0.67	0.75	0.71
S Em±	0.01	0.01	0.01	0.01	0.01	0.01
CD at 5%	NS	NS	NS	NS	0.04	NS
Factor II: Compost levels						
M ₁ -Com. @ 100% RDN	0.43	0.48	0.45	0.70	0.78	0.75
M ₂ -Com. @ 75% RDN	0.41	0.46	0.44	0.66	0.75	0.71
M ₃ -Com. @ 50% RDN	0.40	0.43	0.41	0.65	0.69	0.68
M ₄ -Com. @ 25% RDN + ST @ 10 t/ha + JM @ 2000 l/ha	0.39	0.41	0.40	0.64	0.67	0.66
S Em±	0.01	0.01	0.01	0.02	0.02	0.01
CD at 5%	NS	0.04	0.02	NS	0.06	0.04
CV (%)	5.28	7.16	6.90	6.13	6.23	7.11
Year mean	0.40	0.44	0.42	0.66	0.72	0.69
S x M						
S Em±	0.01	0.02	0.01	0.02	0.03	0.02
CD at 5%	NS	NS	NS	NS	NS	NS
Pooled	S Em±		CD at 5%	S Em±		CD at 5%
Y	0.01		0.02	0.01		0.03
Y x S	0.01		NS	0.01		NS
Y x M	0.01		NS	0.02		NS
Y x S x M	0.02		NS	0.03		NS

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 7: Effect of different treatments on P₂O₅ content in cane and trash

Treatments	P ₂ O ₅ content (%)					
	Cane			Trash		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor I: Spacing						
S ₁ -(90 cm)	0.196	0.229	0.213	0.152	0.166	0.159
S ₂ -(60-120-60 cm with GM)	0.204	0.240	0.222	0.153	0.173	0.163
S Em±	0.005	0.004	0.004	0.005	0.005	0.004
CD at 5%	NS	NS	NS	NS	NS	NS
Factor II: Compost levels						
M ₁ -Com. @ 100% RDN	0.223	0.248	0.235	0.174	0.183	0.179
M ₂ -Com. @ 75% RDN	0.200	0.232	0.216	0.151	0.173	0.162
M ₃ -Com. @ 50% RDN	0.190	0.230	0.210	0.147	0.165	0.156
M ₄ -Com. @ 25% RDN + ST @ 10 t/ha + JM @ 2000 l/ha	0.187	0.228	0.208	0.138	0.158	0.148
S Em±	0.007	0.006	0.006	0.007	0.006	0.005
CD at 5%	0.022	NS	0.016	0.021	NS	0.015
CV (%)	8.840	6.490	8.876	11.240	9.080	11.379
Year mean	0.200	0.235	0.217	0.152	0.170	0.161
S x M						
S Em±	0.010	0.009	0.008	0.010	0.009	0.007
CD at 5%	NS	NS	NS	NS	NS	NS
Pooled	S Em±		CD at 5%	S Em±		CD at 5%
Y	0.004		0.01	0.004		0.01
Y x S	0.006		NS	0.005		NS
Y x M	0.008		NS	0.007		NS
Y x S x M	0.011		NS	0.011		NS

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 8: Effect of different treatments on K₂O content in cane and trash

Treatments	K ₂ O content (%)					
	Cane			Trash		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor I: Spacing						
S ₁ -(90 cm)	0.42	0.44	0.43	0.67	0.69	0.68
S ₂ -(60-120-60 cm with GM)	0.43	0.45	0.44	0.69	0.71	0.70
S Em±	0.01	0.01	0.01	0.01	0.02	0.01
CD at 5%	NS	NS	NS	NS	NS	NS

Factor II: Compost levels						
M ₁ -Com. @ 100% RDN	0.45	0.47	0.46	0.71	0.74	0.72
M ₂ -Com. @ 75% RDN	0.43	0.46	0.44	0.68	0.70	0.69
M ₃ -Com. @ 50% RDN	0.41	0.44	0.43	0.67	0.69	0.68
M ₄ -Com. @ 25% RDN + ST @ 10 t/ha + JM @ 2000 l/ha	0.41	0.42	0.42	0.66	0.67	0.66
S Em±	0.02	0.01	0.01	0.02	0.03	0.02
CD at 5%	NS	NS	NS	NS	NS	NS
CV (%)	8.81	8.01	9.31	6.75	8.98	8.81
S x M						
S Em±	0.02	0.02	0.02	0.03	0.04	0.02
CD at 5%	NS	NS	NS	NS	NS	NS
Pooled	S Em±	CD at 5%		S Em±	CD at 5%	
Y	0.01	NS		0.01	NS	
Y x S	0.01	NS		0.02	NS	
Y x M	0.02	NS		0.02	NS	
Y x S x M	0.02	NS		0.04	NS	

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 9: Effect of different treatments on N uptake by cane and trash

Treatments	N uptake (kg/ha)					
	Cane			Trash		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor I: Spacing						
S ₁ -(90 cm)	129.8	156.2	143.0	29.4	35.0	32.2
S ₂ -(60-120-60 cm with GM)	136.0	167.0	151.5	30.6	39.0	34.8
S Em±	4.1	4.8	3.4	0.9	1.0	0.7
CD at 5%	NS	NS	NS	NS	3.1	2.2
Mean	132.9	161.6	147.3	30.0	37.0	33.5
Factor II: Compost levels						
M ₁ -Com. @ 100% RDN	151.1	188.7	169.9	34.6	43.8	39.2
M ₂ -Com. @ 75% RDN	136.8	176.4	156.6	30.7	41.1	35.9
M ₃ -Com. @ 50% RDN	125.2	145.2	135.2	28.0	32.5	30.3
M ₄ -Com. @ 25% RDN + ST @ 10 t/ha + JM @ 2000 l/ha	118.4	136.1	127.2	26.7	30.7	28.7
S Em±	5.9	6.9	4.9	1.3	1.4	1.0
CD at 5%	17.9	20.9	14.3	3.9	4.3	3.1
CV (%)	10.8	10.4	11.5	10.5	9.5	11.2
Year mean	132.9	161.6	147.2	30.0	37.0	33.5
S x M						
S Em±	8.3	9.7	6.9	1.8	2.0	1.5
CD at 5%	NS	NS	NS	NS	NS	NS
Pooled	S Em±	CD at 5%		S Em±	CD at 5%	
Y	3.4	10.1		0.7	2.2	
Y x S	4.9	NS		1.0	NS	
Y x M	6.9	NS		1.5	NS	
Y x S x M	9.8	NS		2.1	NS	

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 10: Effect of different treatments on P₂O₅ uptake by cane and trash

Treatments	P ₂ O ₅ uptake (kg/ha)					
	Cane			Trash		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor I: Spacing						
S ₁ -(90 cm)	63.3	81.2	72.3	6.7	8.2	7.4
S ₂ -(60-120-60 cm with GM)	67.3	89.3	78.3	7.0	9.0	8.0
S Em±	2.2	2.5	1.9	0.3	0.2	0.2
CD at 5%	NS	7.8	5.6	NS	NS	NS
Mean	65.3	85.3	75.3	6.91	8.64	7.77
Factor II: Compost levels						
M ₁ -Com. @ 100% RDN	79.1	97.6	88.4	8.6	10.2	9.4
M ₂ -Com. @ 75% RDN	66.5	89.2	77.8	6.9	9.4	8.2
M ₃ -Com. @ 50% RDN	58.8	78.6	68.7	6.2	7.7	7.0
M ₄ -Com. @ 25% RDN + ST @ 10 t/ha + JM @ 2000 l/ha	56.7	75.6	66.2	5.7	7.1	6.4
S Em±	3.1	3.6	2.7	0.4	0.3	0.3
CD at 5%	9.6	11.1	8.0	1.3	1.2	0.9

CV (%)	11.8	10.5	12.6	15.5	11.2	14.5
Year mean	65.3	85.3	75.3	6.9	8.6	7.7
S x M						
S Em±	4.4	5.1	3.8	0.6	0.5	0.4
CD at 5%	NS	NS	NS	NS	NS	NS
Pooled	S Em±	CD at 5%	S Em±	CD at 5%		
Y	1.9	5.6	0.2	0.6		
Y x S	2.7	NS	0.32	NS		
Y x M	3.8	NS	0.46	NS		
Y x S x M	5.4	NS	0.65	NS		

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 11: Effect of different treatments on K₂O uptake by cane and trash

Treatments	K ₂ O uptake (kg/ha)					
	Cane			Trash		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Factor I: Spacing						
S ₁ -(90 cm)	134.5	157.0	145.8	29.6	34.2	31.9
S ₂ -(60-120-60 cm with GM)	143.0	166.7	154.8	31.7	36.6	34.1
S Em±	4.7	4.3	3.4	0.8	1.0	0.7
CD at 5%	NS	NS	NS	NS	NS	NS
Factor II: Compost levels						
M ₁ -Com. @ 100% RDN	160.4	183.1	171.7	35.1	41.0	38.0
M ₂ -Com. @ 75% RDN	143.4	175.2	159.3	31.5	38.4	34.9
M ₃ -Com. @ 50% RDN	126.6	150.9	138.8	28.6	32.1	30.4
M ₄ -Com. @ 25% RDN + ST @ 10 t/ha + JM @ 2000 l/ha	124.6	138.2	131.4	27.4	30.2	28.8
S Em±	6.6	6.1	4.9	1.2	1.5	1.0
CD at 5%	20.1	18.6	14.4	3.7	4.6	3.1
CV (%)	11.7	9.3	11.3	9.9	10.6	11.4
Year mean	138.8	161.8	150.3	30.6	35.4	33.0
S x M						
Pooled	S Em±	CD at 5%	S Em±	CD at 5%		
Y	3.4	10.1	0.7	2.2		
Y x S	4.9	NS	1.0	NS		
Y x M	6.9	NS	1.5	NS		
Y x S x M	9.8	NS	2.1	NS		

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Summary and conclusion

Spacing treatment did not show any significant impact on plant height and millable cane height of sugarcane at harvest during individual year and pooled analysis. Treatment, 100% RDN through NADEP compost (M₁) recorded significantly higher plant height and millable cane height, single cane weight and millable cane yield during the years 2019-20, 2020-21 and in pooled analysis. However, it was remained statistically at par with the treatment M₂ (Application of 75% RDN through NADEP compost) during 2019-20, 2020-21 and pooled analysis. Spacing treatments did not show significant impact on lengths and number of internodes of sugarcane at harvest during. In case of compost treatments, it had significant effect on lengths of internodes at harvest. However, number of internodes was not affected significantly by compost treatments during both individual year as well as in pooled analysis. application of 100% RDN through NADEP compost (M₁) during the year 2019-20, 2020-21, respectively. However, this treatment was remained at par with treatment M₂ during the both years. Similar treatment effect was observed in pooled analysis also. Effect of spacing and different levels of NADEP compost did not exert any significant effect on cane girth during both the individual years as well as in pooled analysis. Treatment effect of spacing on N, P, K, content of cane and trash was non-significant in pooled analysis. Content of N in cane and trash, P₂O₅ in cane and trash were affected significantly by the

compost treatments in pooled analysis. Significantly higher content of these nutrients was observed in treatment M₁ as compared to remaining treatments. However, this treatment was remained at par with the treatment M₂ in N content in cane and trash. Year effect was significant on N content in cane and trash, P₂O₅ in cane and trash and significantly higher content was observed during the year 2020-21 as compared that observed during the year 2019-20. Uptake of N by trash, P₂O₅ by cane of sugarcane were affected significantly by the treatment of spacing in pooled analysis. The paired row spacing treatment S₂ (60 - 120 - 60 cm paired row with green manuring) observed significantly higher uptake of these nutrient in pooled analysis as compared to treatment S₁. In case of compost treatments, they exerted significant effect on uptake of N, P and K by cane and trash of sugarcane during both the individual years as well as in pooled analysis. Treatment M₁ (NADEP compost @ 100% RDN) recorded significantly higher uptake of these nutrients by cane and trash of sugarcane during both the individual years and pooled analysis but it was remained statistically at par with treatment M₂ treatment in majority of cases.

Considering the findings of present investigations, the application of NADEP compost @ 100% RDN to sugarcane either grown in 90 cm spacing or paired row spacing (60 - 120 - 60 cm with dhaincha green manuring) increase the yield and nutrient content and uptake in resource based organic farming.

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