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EFFECT OF INTEGRATED USE OF FYM, GREEN MANURING AND BIOFERTILIZERS ON CANE YIELD AND JUICE QUALITY IN ORGANICALLY GROWN SUGARCANE

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ABSTRACT

The experiment was conducted at research farm of RRS, CCSHAU, Karnal (HR) entitled to study the effect of integrated use of FYM, green manuring and biofertilizers on cane yield and juice quality in organically grown sugarcane. The experiment was planned out in afactorial randomized block design with five treatments and three replications. For the plant sugarcane crop five treatments in *viz.* $\mathbf{T_1}$: FYM @10t/ha + BF (bio fertilizer) + GM (green manuring) + IPM, $\mathbf{T_2}$: FYM @20t/ha + BF + GM + IPM, T_3: FYM @30t/ha + BF + GM + IPM,$\mathbf{T_4}$: Zero Budget Technique and $\mathbf{T_5}$:RDF were applied in two varieties CoH 160 and CoH 167 (Total 10 treatments). Similarly, five treatments in ratoon sugarcane crop *viz.* $\mathbf{T_1}$:FYM @20t/ha + BF+ TM + IPM, $\mathbf{T_2}$: FYM @25t/ha + BF + TM + IPM, $\mathbf{T_3}$: FYM @30t/ha + BF + TM + IPM, $\mathbf{T_4}$: Zero Budget Technique, and $\mathbf{T_5}$**:**RDF were applied in two varieties CoH 160 and CoH 167 (Total 10 treatments). In both plant and ratoon sugarcane crops out of the two organically cultivated varieties, CoH167 was found significantly superior as compared and CoH 160 in term of cane yield [67.52 and 65.37 t/ha for CoH 167 and CoH160 in Plant crop (P)] and [78.13 and 75.60 t/ha –for CoH 167 and CoH160 in Ratoon(R)], whereas, CoH160 was found significantly superior as compared CoH 167 in term of juice quality- CCS % (12 and 11.6%-P) and (12.3 and 12.1%-R). In both plant and ratoon sugarcane crops the treatment of FYM @30t/ha + BF + GM or TM + IPM produced significantly highest cane yield (71.85 and 86.52t/hafor plant and Ratoon), and number of millable canes (81278 and 92055/ha) and juice quality CCS% (12.7 and 13.2%), this was followed by the treatment of FYM @ 20 or 10 t/ha + BF + GM + IPM in plant sugarcane crop and the treatment of FYM @ 25 or 20 t/ha + BF + TM + IPM in ratoon sugarcane crop which were at par with the treatment of RDF. In both plant and ratoon sugarcane crops the treatment of Zero Budget Technique produced significantly lowest cane yield, number of millable canes and Juice quality CCS%.

***Key words*:** Sugarcane, organic sources, farm yard manure, cane quality.

Introduction

The unsustainability of modern agricultural practices have led farming communities the world over to look for alternatives. The majority of these alternatives indicate a return to traditional, eco-friendly practices; organic farming is one among them. Organic farming is basically a holistic management system which promotes and improves the health of agro ecosystem related to biodiversity, nutrient biocycles, soil microbial and biochemical activities. It emphasizes management practices involving substantial use of organic manures, green manuring and management of pests and diseases through the use of non-synthetic pesticides and practices. To stop the continuous decline in soil fertility it is important to use organic source through organic farming. This will not only improve the chemical fertility of soil but also maintain the physical and biological health of soil (Singh *et al.*, 2011).

The organic farming is not only the need of the hour but also a timely answer to the problems of environment degradation, unsafe food, polluted water, degraded land and a plethora of agro maladies emanating from the conventional agriculture practiced in the recent past. Organic agriculture in keeping with the traditional Indian agro-eco system not only maintains ecological balance but also ensures sustainability in terms of food production and safeguarding the human health. Organic manures like farm yard manure, composts, sugar and distillery industrial solid waste composts, sugarcane trash composts etc., 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. Various organic sources like farm yard manure (FYM), press mud cake, vermicompost, green manure, legume as intercrops and sugarcane trash are used as sources of nutrients since ages (Kuri *et al.*, 2014).

Material and Methods

Experimental site and climate

Field experiment was conducted at a research farm of Regional Research Station, CCS Haryana Agricultural University, Karnal located at latitude of 29° 43'42.19" N, longitude of 76° 58'49.88" E and at an altitude of 253 meters above mean sea level.The climate is sub-tropical with mean maximum temperature ranging between 34-39° C in summer and mean minimum temperature ranging between 6-7°C in winter. Most of the rainfall is received during the months of July to September and few showers during December to late spring.

Field preparation and layout

The experimental field was ploughed repeatedly and brought to a fine tilth. Two separate experiments No 1 and 2 were conducted separately by growing plant-ratoon crops. Each experiment consists of two genotypes namely CoH167 and CoH160 in main plots and five levels of fertility and management practices in subplots replicated 3-time R1, R2 and R3 in factorial RBD. The treatments were different for plant and ratoon crops. In the experiment no.1 plant was grown in year 2018-19. In the experiment no.2 plant was grown in year 2019-20. There were 2 main plots of varieties*i.e.*, 1.CoH160- Early maturing and good ratooner, 2. CoH167- Mid maturing and good ratooner and in sub plot there were fivefertility treatments. For the plant sugarcane crop five treatments were 1.FYM @10t/ha + Biofertilizers (BF)+ Green manuring of *Sesbania* in inter row space (GM) (No inorganic fertilizers) at the time of sowing +control of insect pest and diseases through organic mode practices (IPM), 2. FYM @20t/ha + BF + GM + IPM, 3. FYM @30t/ha + BF + GM + IPM, 4. Seed treatment with organic formulation no. 1 (Beejamrit + three sprays with organic formulation no. 2 (Jeevamrit) during the months of April, May and June (Zero Budget Technique, ZBT) 5. Recommended dose of fertilizer through inorganic application of fertilizer (RDF) were applied in two varieties CoH 160 and CoH 167 (Total 10 treatments).

Similarly, five treatments in ratoon sugarcane crop were 1.FYM @20t/ha + BF+ trash mulch alternate rows (TM) + IPM, 2. FYM @25t/ha + BF + TM + IPM, 3. FYM @30t/ha + BF + TM + IPM, 4. ZBT and RDF were applied in two varieties CoH 160 and CoH 167 at the time of ratoon initiation.

The effects of these treatments were study on the yield parameters and juice quality parameters. Manure was be applied at the time of sowing before opening the ridges (No inorganic fertilizers in this treatments). The setts were treated with biofertilizers viz. *Azotobacter/ Acetobacter* + PSB (Phosphorus solubilizing bacteria for enhancing phosphorus availability to the crop) + *Trichodermaviride* before sowing. The yield parameters and juice quality parameters under study were number of millable canes (NMC), cane yield, commercial cane sugar (CCS) percentage and sugar yield.

Organic Formulation No.1 and its method of production: Prior to sowing it is very important to make setts treatment. Organic formulation no. 1 is made of following materials: 1. Indigenous cow dung: 5 kg, 2. Indigenous cow urine: 5 litres, 3. Lime: 250 g, 4. Water: 20 litres, 5. Soil from field: handful of undisturbed soil. Mix all these materials put it for 24 hours. After stirring it with wooden stick two times daily, then applied organic formulation no.1 over the seed. The seed should have to be dried under the shade.

Organic Formulation No.2 and its method of production: Organic formulation no. 1 is made of following materials: 1. Indigenous cow dung: 5 kg, 2. Indigenous cow urine: 5 litres, Lime: 250 g, 4. Water: 20 litres and 5. Soil from field: handful of undisturbed soil. All material was mixed in plastic drum keeping it in shade for 2-3 days and simultaneously stirs the content two to three minutes daily in clock wise direction in morning and evening hours. Organic formulation no.2 was covered with jute cloth. Its decomposition evolved harmful gases like ammonia, carbon monoxide, carbon dioxide and methane. After seven days application of organic formulation no.2 over the crop was be made.

Manure was applied at the time of sowing before opening the ridges. No inorganic fertilizer was applied in treatments from 1 to 4. The setts was treated with bio-

Table 1: Physico-chemical properties of soil of the experimental field.

Sr.	Parameter	Values observed
1.	Soil texture	Clay loam
2.	pH	8.0
3.	Electrical Conductivity (dS/m)	0.16
4.	Organic carbon (%)	0.35
5.	Available nitrogen (kg/ha)	115.2
6.	Available phosphorus (kg/ha)	10
7.	Available potassium (kg/ha)	384
8.	Available Zinc (mg/kg)	0.7
9.	Available Iron (mg/kg)	4.4
10.	Available Manganese (mg/kg)	4.0
11.	Available Copper (mg/kg)	0.27

fertilizers *viz; Azotobacter/Acetobacter* + PSB (Phosphorus solubilizing bacteria) for enhancing nitrogen and phosphorus availability to the crop) and *Trichodermaviridae* before sowing.

Ecological based management practices recommended and to be adopted for organic farming for weed management, insect pests of sugarcane were fallowed for both experiments. The physiochemical properties of the soil of experimental field are presented below in Table 1. The perusal of soil analysis data reveals that the soil of the experimental field was clay loam in texture, non-saline, no calcium carbonate, average in organic carbon, low in available nitrogen, low in available phosphorus and high in available potassium.

The Department of Agricultural Statistics at the College of Basic Science and Humanities, CCSHAU, Hisar used computer software to analyses the data using the method outlined by Cochran and Cox (1967). The "F" test was used to compare the variances of the various sources of variation in the ANOVA with the value of Table F at the 5% level of significance, S.Em.±, critical differences and the coefficient of variation (C.V.%) were also calculated.

Results and Discussion

Effect of treatments on cane yield

Plant

Significant higher cane yield of plant crop was observed in CoH167 variety (67.52 t/ha) as compared to CoH 160 variety (65.37 t/ha). The treatment of FYM @ 30 t/ha + BF + GM + IPM produced significantly 5.0 to 15.4% higher cane yield (71.85 t/ha) compared to application of FYM @ 10 or 20 t/ha + BF + GM + IPM (63.29 t/ha and 68.22 t/ha) or ZBT (60.77 t/ha) or RDF (68.09 t/ha) (Table 2). The treatment of FYM @ 20 t/ha + BF + GM + IPM being at par with RDF produced significantly higher cane yield compared to application of

Table 2: Effect of application of various organic treatments on the cane yield (t/ha) of two varieties CoH 160 and CoH 167 as compared to RDF in Plant and ratoon crop of sugarcane.

Plant		Varieties (A)		Mean (B)
Organic treatments and RDF (B)		CoH 160	CoH 167	
T_1	FYM @10t/ha + BF + GM + IPM	62.29	64.30	63.29
T_2	FYM @20t/ha + BF + GM + IPM	67.78	68.67	68.22
T_3	FYM @30t/ha + BF + GM + IPM	70.29	73.41	71.85
T_4	Zero budget technique	58.71	62.82	60.77
T_5	RDF	67.80	68.39	68.09
Mean (A)		65.37	67.52	
Factors		C.D.		SE(m)
Varieties (A)		1.46		0.49
Organic treatments and RDF (B)		2.31		0.78
(A*B)		N.S		1.10
Ratoon		**Varieties (A)**		**Mean (B)**
Organic treatments and RDF (B)		**CoH 160**	**CoH 167**	
T_1	FYM @20t/ha + BF + TM + IPM	74.39	71.21	72.80
T_2	FYM @25t/ha + BF + TM + IPM	80.24	81.12	80.68
T_3	FYM @30t/ha + BF + TM + IPM	86.11	86.92	86.52
T_4	Zero budget technique	67.60	74.09	70.84
T_5	RDF	69.69	77.32	**73.50**
Mean (A)		**75.60**	**78.13**	
Factors		**C.D.**		**SE(m)**
Varieties (A)		**1.43**		**0.48**
Organic treatments and RDF (B)		**2.27**		**0.76**
(A*B)		**3.21**		**1.08**

FYM @10 t/ha + BF + IPM or ZBT. The treatment of ZBT produced significantly 10.8% lower cane yield compared to RDF. The treatment of ZBT produced significantly lowest cane yield among all the treatments in plant crop. Similar results were also obtained by Singh *et al*., (2007), Kumar *et al*., (2019), Yadav *et al*., (2019). The result of Kumar *et al*., (2019) showed that the application of FYM @ 30 t/ha at the time of sowing + Biofertilizers (BF) + Green manuring of *Sesbania* in inter row space (GM) (No inorganic fertilizers) was at par with RDF (Recommended doses of fertilizer) through inorganic application of fertilizer (69.43 t/ha and 70.10 t/

Table 3: Effect of application of various organic treatments on the number of millable canes/ha (NMC) of two varieties CoH 160 and CoH 167 as compared to RDF in Plant and ratoon crop of sugarcane.

Plant		Varieties (A)		Mean (B)
Organic treatments and RDF (B)		CoH 160	CoH 167	
T_1	FYM @10t/ha + BF + GM + IPM	71445	73888	72666
T_2	FYM @20t/ha + BF + GM + IPM	76778	79335	78056
T_3	FYM @30t/ha + BF + GM + IPM	77222	85335	81278
T_4	Zero budget technique	69000	70444	69722
T_5	RDF	76780	79330	78055
Mean (A)		74245	77666	
Factors		C.D.		SE(m)
Varieties (A)		1531		515
Organic treatments and RDF (B)		2422		815
(A*B)		N.S		1152
Ratoon		Varieties (A)		Mean (B)
Organic treatments and RDF (B)		CoH 160	CoH 167	
T_1	FYM @20t/ha + BF + TM + IPM	80890	84333	82611
T_2	FYM @25t/ha + BF + TM + IPM	85110	89333	87221
T_3	FYM @30t/ha + BF + TM + IPM	91000	93111	92055
T_4	Zero budget technique	76000	84222	80111
T_5	RDF	84220	89000	86610
Mean (A)		83444	87999	
Factors		C.D.		SE(m)
Varieties (A)		1624		546
Organic treatments and RDF (B)		2569		864
(A*B)		N.S		1222

ha) and produced significantly higher cane yield and yield attributes. On an average CoH 167 variety (63.16 t/ha) produced higher cane yield as compared to CoH 160 variety (54.01 t/ha).

Ratoon

Significant higher cane yield of ratoon crop was observed in CoH 167 variety (78.13 t/ha) as compared to CoH 160 variety (75.60 t/ha). The treatment of FYM @ 30 t/ha + BF + TM + IPM produced significantly 6.8 to 18.1% higher cane yield (86.52 t/ha) compared to application of FYM @20 or 25 t/ha + BF + TM + IPM (72.8 t/ha and 80.7 t/ha) or ZBT (70.84 t/ha) or RDF (73.50 t/ha) (Table 2). The treatment of FYM @ 20 t/ha + BF + TM + IPM produced significant cane yield being at par with RDF or ZBT. The treatment of ZBT produced significantly 3.6% lower cane yield compared to RDF. The treatment of ZBT produced significantly lowest cane yield among all the treatments in ratoon crop. These results are in accordance with the finding of Yadav *et al.*, (2019). They revealed that addition of 10 t/ha FYM/ compost along with inorganic fertilizers on the basis of soil test + biofertilizers (Azotobacter + PSB) @ 12.5 kg/ ha each had a positive effect on sugarcane growth and yield in both plant (113.10 t/ha) and ratoon crops (98.84 t/ha) as compared to other treatments.

Effect of treatments on number of millable canes (NMC)

Plant

Significant higher number of millable canes (NMC) was observed in CoH 167 variety (77666) as compared to CoH 160 variety (74245). The treatment of FYM @30t/ ha + BF + GM + IPM produced significantly higher number of millable canes (81278/ha) compared to application of FYM @10 or 20 t/ha + BF + GM + IPM (72666/ha and 78056/ha) or ZBT (69722/ha) or RDF (78055/ha) (Table 3). The treatment of FYM @20t/ha + BF + GM + IPM being at par with RDF produced significantly higher number of millable canes compared to application of FYM @10 t/ha + BF + GM + IPM or ZBT. The treatment of ZBT produced significantly lower number of millable canes compared to RDF. The treatment of ZBT produced significantly lowest number of millable canes among all the treatments in plant crop (Table 3). These findings are in close conformity with those reported by Kumar and Chand (2019) and Nooli *et al*., (2019). The results of Nooli *et al*., (2019) revealed that significantly higher cane weight (1.24 kg), number of millable canes (88740/ha), cane (126 t/ha) and sugar yield (17.30 t/ha) was recorded by application of FYM (1/3rd) + Vermicompost (1/2th) + In situ green manuring (1/4th) equivalent to Recommended dose of nitrogen over others treatments.

Ratoon

Table 3 data indicate the significant higher number of millable canes (NMC) was observed in CoH 167 variety (87999) as compared to CoH 160 variety (83444). The treatment of FYM @30t/ha + BF + TM + IPM produced significantly higher number of millable canes (92055/ha) compared to application of FYM @20 or 25 t/ha + BF +TM + IPM (82611/ha and 87221/ha) or ZBT (80111/ha) or RDF (86610/ha) (Table 3). The treatment

Table 4: Effect of application of various organic treatments on the Commercial cane sugar (CCS) percentage of two varieties CoH 160 and CoH 167 as compared to RDF in Plant and ratoon crop of sugarcane.

Plant		Varieties (A)		Mean (B)
Organic treatments and RDF (B)		CoH 160	CoH 167	
T_1	FYM @10t/ha + BF + GM + IPM	11.2	10.5	**10.8**
T_2	FYM @20t/ha + BF + GM + IPM	12.5	12.2	**12.3**
T_3	FYM @30t/ha + BF + GM + IPM	13	12.4	**12.7**
T_4	Zero budget technique	11.1	10.5	**10.8**
T_5	RDF	12.4	12.2	**12.3**
Mean (A)		12	**11.6**	
Factors		C.D.		SE(m)
Varieties (A)		**0.1**		**0.04**
Organic treatments and RDF (B)		**0.2**		**0.07**
(A*B)		**N.S**		**0.10**
Ratoon		**Varieties (A)**		**Mean (B)**
Organic treatments and RDF (B)		**CoH 160**	**CoH 167**	
T_1	FYM @20t/ha + BF + TM + IPM	11.3	11.2	**11.3**
T_2	FYM @25t/ha + BF + TM + IPM	13	12.7	**12.8**
T_3	FYM @30t/ha + BF + TM + IPM	13.4	13	**13.2**
T_4	Zero budget technique	11.2	11.2	**11.2**
T_5	RDF	12.8	12.6	**12.7**
Mean (A)		12.3	12.1	
Factors		**C.D.**		**SE(m)**
Varieties (A)		0.02		0.007
Organic treatments and RDF (B)		0.03		0.01
(A*B)		0.05		0.01

of FYM @25 t/ha + BF + TM + IPM being at par with RDF produced significantly higher number of millable canes compared to application of FYM @20 t/ha + BF +TM + IPM or ZBT. The treatment of FYM @20 t/ha + BF + TM + IPM produced significant number of millable canes being at par with ZBT. The treatment of ZBT produced significantly lower number of millable canes compared to RDF. The treatment of ZBT produced significantly lowest number of millable canes among all the treatments in ratoon crop. In both plant and ratoon sugarcane crops addition of nutrients through various organic treatments and RDF has showed significant changes in cane yield and yield parameters. Yield parameter as number of millable canes (NMC) and the overall cane yield has greatly influenced by the various organic treatments and RDF. In both plant and ratoon sugarcane crops variety CoH 167 produced significantly higher cane yield and NMC as compared to variety CoH 160. In both plant and ratoon sugarcane crops the treatment of FYM @ 30 t/ha + BF + GM or TM + IPM produced significantly maximum cane yield and NM Cover the all treatments. In plant sugarcane crop the treatment of FYM @ 10 or 20 t/ha + BF + GM + IPM has found significantly at par or similar cane yield and NMC with RDF. In ratoon sugarcane crop the treatment application of FYM @ 20 or 25 t/ha + BF + TM + IPM has found significantly at par or similar cane yield and NMC with RDF. In both plant and ratoon crops the treatment with Zero Budget Technique produced significantly lower cane yield and NMC as compared to RDF. In both plant and ratoon crops the treatment with Zero Budget Technique produced significantly lowest cane yield and NMC among all the treatments. These findings are in close conformity with those reported by Patel *et al.*, (2002), Patel, (2012), Kuri (2014), Nooli *et al*., (2019) and Yadav *et al.*, (2019) and The result of Kuri (2014) showed that the higher number of millable canes (94.70 thousands/ha), single cane weight (1.24 kg/ cane), trash yield (5.56 t/ha), cane (116.2 t/ha), sugar (18.09 t/ha) and jaggery yield (13.17 t/ha) was recorded by application of FYM + Vermicompost + enriched press mud @1/3rd each with bio-fertilizers (*Azospirillium* and PSB @ 10 kg/ha each) and liquid manures (*beejamruth, jeevamruth* and *punchagavya*).

Effect of treatments on commercial cane sugar (CCS) percentage

Plant

For plant crop significant higher CCS% was observed in CoH 160 variety (12%) as compared to CoH 167 variety (11.6%). The treatment of FYM @30t/ha + BF + GM + IPM produced significantly 3.1% to 14.9% higher CCS% (12.7%) compared to application of FYM @10 or 20 t/ha + BF + GM + IPM (10.8% and 12.3%) or ZBT (10.8%) or RDF (12.3%) (Table 4). The treatment of FYM @20t/ha + BF + GM + IPM being at par with RDF produced significantly higher CCS% compared to application of FYM @10 t/ha + BF + GM + IPM or ZBT. The treatment of FYM @10 t/ha + BF + GM + IPM produced significant CCS% being at par with ZBT. The treatment of ZBT produced significantly 12.2% lower CCS% compared to RDF. The treatment of ZBT produced significantly lowest CCS% among all the treatments in plant crop. The present findings are in

Table 5: Effect of application of various organic treatments on the sugar yield (t/ha) of two varieties CoH 160 and CoH 167 as compared to RDF in Plant and ratoon crop of sugarcane.

Plant		Varieties (A)		Mean (B)
Organic treatments and RDF (B)		CoH 160	CoH 167	
T_1	FYM @10t/ha + BF + GM + IPM	7.21	6.57	**6.89**
T_2	FYM @20t/ha + BF + GM + IPM	8.58	8.32	**8.45**
T_3	FYM @30t/ha + BF + GM + IPM	9.56	8.74	**9.15**
T_4	Zero budget technique	7.02	6.16	**6.59**
T_5	RDF	8.51	8.32	**8.42**
Mean (A)		**8.18**	**7.62**	
Factors		C.D.		SE(m)
Varieties (A)		0.1		0.06
Organic treatments and RDF (B)		0.2		0.09
(A*B)		N.S		0.13
Ratoon		**Varieties (A)**		**Mean (B)**
Organic treatments and RDF (B)		**CoH 160**	**CoH 167**	
T_1	FYM @20t/ha + BF + TM + IPM	8.07	8.37	**8.22**
T_2	FYM @25t/ha + BF + TM + IPM	10.54	10.25	**10.40**
T_3	FYM @30t/ha + BF + TM + IPM	11.68	11.22	**11.45**
T_4	Zero budget technique	8.31	7.58	**7.94**
T_5	RDF	9.96	8.81	9.39
Mean (A)		**9.71**	**9.25**	
Factors		**C.D.**		**SE(m)**
Varieties (A)		**0.17**		**0.06**
Organic treatments and RDF (B)		**0.2**		**0.09**
(A*B)		**0.4**		**0.13**

accordance with the findings of Jeyaraman *et al.*, (2003). They observed that the application of green manuring (*dhaincha*) after 60 days of sowing and phosphobacteria incorporation in the soil at the time of planting of setts and found the highest tiller production, millable cane, brix, purity, CCS 12.7% and sugar yield.

Ratoon

For ratoon crop significant higher CCS% was observed in CoH 160 variety (12.3%) as compared to CoH 167 variety (12.1%). The treatment of FYM @30t/ha + BF + TM + IPM produced significantly 3.0% to 15.2% higher CCS% (13.2%) compared to application of FYM @20 or 25 t/ha + BF + TM + IPM (11.3% and 12.8%) or ZBT (11.2%) or RDF (12.7%) (Table 4). The treatment of FYM @25 t/ha + BF + TM + IPM being similar with RDF produced significantly higher CCS% compared to the treatment application of FYM @20 t/ha + BF + TM + IPM or ZBT. The treatment of ZBT produced significantly 11.8% lower CCS% compared to RDF. The treatment of ZBT produced significantly lowest CCS% among all the treatments in ratoon crop. Variety CoH 160 produced significantly higher CCS% as compared to variety CoH 167 in the treatments FYM @20 t/ha + BF + TM + IPM, FYM @25 t/ha + BF + TM + IPM, FYM @30 t/ha + BF + TM + IPM, and RDF. Jeyaraman *et al.*, (2003). They observed that the application of green manuring (dhaincha) after 60 days of sowing and phosphobacteria incorporation in the soil at the time of planting of setts and found the highest tiller production, millable cane, brix, purity, CCS 12.7% and sugar yield.

Effect of treatments on sugar yield (t/ha)

Plant

For plant crop significant higher sugar yield was observed in CoH 160 variety (8.18 t/ha) as compared to CoH 167 variety (7.62 t/ha). The treatment of FYM @30t/ha + BF + GM + IPM produced significantly 7.6% to 28% higher sugar yield (9.15 t/ha) compared to application of FYM @10 or 20 t/ha + BF + GM + IPM (6.89 t/ha and 8.45 t/ha) or ZBT (6.59 t/ha) or RDF (8.42 t/ha) (Table 5). The treatment of FYM @20t/ha + BF + GM + IPM being at par with RDF produced significantly higher sugar yield compared to application of FYM @10 t/ha + BF + GM + IPM or ZBT. The treatment of ZBT produced significantly 21.7% lower sugar yield compared to RDF. The treatment of ZBT produced significantly lowest sugar yield among all the treatments in plant crop. These findings are in close conformity with those reported by Khandagave (2001), Raghu *et al.*, (2007) and Shridevi *et al.*, (2013). Shridevi *et al.*, (2013) showed that better quality Jaggery with higher sucrose (76.05%) and lower reducing sugars (12.82%) were recorded with 100 % organics (FYM + Vermicompost + Enriched Pressmud + In situ green manuring of Sunhemp + Biofertilizers + Beejamrutha + Jeevamruth + Panchagavya). Better quality Jaggery with net rendement value of 62.50 was obtained with sugarcane cultivar Co-92005 with the application of 100 per cent organics than other treatments.

Ratoon

Significant higher sugar yield was observed in CoH 160 variety (9.71 t/ha) as compared to CoH 167 variety

(9.25 t/ha). The treatment of FYM @30t/ha + BF + TM + IPM produced significantly 9.2% to 30.6% higher sugar yield (11.45 t/ha) compared to application of FYM @20 or 25 t/ha + BF + TM + IPM (8.22 t/ha and 10.40 t/ha) or ZBT (7.94 t/ha) or RDF (9.39 t/ha) (Table 5). The treatment of FYM @25t/ha + BF + TM + IPM being similar with RDF produced significantly higher sugar yield compared to the treatment application of FYM @20t/ha + BF + TM + IPM or ZBT. The treatment of FYM @20t/ha + BF + TM + IPM produced significant sugar yield being at par with ZBT. The treatment of ZBT produced significantly 15.4% lower sugar yield compared to RDF. The treatment of ZBT produced significantly lowest sugar yield among all the treatments in ratoon crop. Variety CoH 160 produced significantly higher sugar yield as compared to variety CoH 167 in the treatments FYM @30t/ha + BF + TM + IPM, ZBT and RDF. These findings are in close conformity with those reported by Shukla *et al.,* (2008), Shridevi *et al.,* (2013) and Kumar and Chand (2019). Kumar and Chand (2019) showed that the treatment FYM/Compost 20 t/ha + 100%RDF or NPK-STV (Maximum cane yield 107.8 t/ha for plant 100.5 t/ha for 1st ratoon and 93.6 t/ha for 2nd ratoon) or FYM/Compost @ 10 t/ha + BF + NPK-STV (106.8 t/ha for plant, 95.1 t/ha for 1st ratoon and 89.9 t/ha for 2nd ratoon) were found best and at par treatments in terms of number of tillers, millable canes and cane and sugar yield. In both plant and ratoon sugarcane crops various organic treatments and RDF have direct influence on the quality of sugarcane and showed desirable changes in juice quality parameters (CCS %) and sugar yield (t/ha).

In both plant and ratoon sugarcane crops variety CoH 160 produced significantly higher juice quality parameters (CCS %) and sugar yield (t/ha) as compared to variety CoH 167. In both plant and ratoon sugarcane crops the treatment of FYM @ 30 t/ha + BF + GM or TM + IPM produced significantly maximum CCS % and sugar yield (t/ha) over the all treatments. In plant sugarcane crop the treatment of FYM @ 20 t/ha + BF + GM + IPM has found significantly at par or similar juice quality parameters(CCS %) and sugar yield with RDF. In ratoon sugarcane crop the treatment application of FYM @ 25 t/ha + BF + TM + IPM has found significantly at par or similar juice quality parameters (CCS %) and sugar yield with RDF. In both plant and ratoon sugarcane crops the treatment with Zero Budget Technique produced significantly lower juice quality parameters (CCS %) and sugar yield as compared to RDF. In both plant and ratoon sugarcane crops the treatment with Zero Budget Technique produced significantly lowest juice quality parameters (CCS %) and sugar yield among all the treatments.

Conclusion

In plant crop the treatment of FYM @ 30 t/ha + BF + GM + IPM produced significantly 5.0 to 15.4 % highest cane yield and NMC, 3 to 17.6 % , Juice quality 3.1 to 14.9 % CCS% and 7.6 to 28 % sugar yield. This was followed by application of FYM @ 20 or 10 t/ha + BF + GM + IPM which was similar in all respects to the treatment of RDF. In plant crop the treatment of Zero Budget Technique produced significantly 10.8% lower cane yield and 10.6% lower NMC and Juice quality 12.2% lower CCS %) and 21.7% lower sugar yield when compared to RDF. Similarly in ratoon crop the treatment of FYM @ 30 t/ha + BF + TM + IPM produced significantly 6.8 to 18.1 % highest cane yield and 5.2 to 12.9 % NMC, Juice quality (3 to 15.2 % CCS %) and 9.2 to 30.6 % sugar yield. This was followed by the application of FYM @ 25 or 20 t/ha + BF + TM + IPM which were similar to the treatment of application of RDF. In ratoon crop also the treatment of Zero Budget Technique produced significantly 3.6 % lower cane yield and lower 7.5 % NMC and lower Juice quality 11.8% CCS % and 15.4 % sugar yield when compared to RDF. In both plant and ratoon crops variety CoH167 had significantly higher in cane yield and NMC. In both plant and ratoon crops to achieve equivalent cane and sugar production to RDF, at least 20t/ha FYM + BF + GM in plant crop and 25t/ha FYM + BF +TM + IPM in ratoon crop is required. If we want to achieve still higher yield and have more soil health, we should add 30t/ha FYM + BF + GM or TM + IPM in both plant and ratoon crop.

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