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National Academy of Agricultural Science (NAAS) Rating : 3.03

Influence of Nutrient Management Practices on Yield and Quality of Sugarcane and Jaggery in Cauvery Command Area

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ABSTRACT: *A field investigation was carried out at Zonal Agricultural research station, V.C.Farm, Mandya, Karnataka, to know the effect of nutrient management practices with two varieties of sugarcane on the yield of sugarcane and jaggery and quality of jaggery. Co 86032 variety of sugarcane recorded higher jaggery yield (13.01t ha^{-1}) though cane yields were lower compared to Co 62175 (12.70 t ha^{-1}). Among the nutrient management practices, recommended package of practices recorded higher cane as well as jaggery yield (15.8 tha^{-1}) followed by 50 per cent N through pressmud and 50 per cent N through fertilizer and biofertilizer (N6) (15.27 t ha^{-1}). Organic nutrient management practices recorded lower yields but produced superior quality jaggery compared to integrated nutrient management practices or chemical fertilizers alone.*

Key words: *Integrated Nutrient Management Practices, Jaggery quality.*

INTRODUCTION

Sugarcane is one of the important commercial crops cultivated in the command areas of Karnataka state. In the state it is cultivated in an area of around 5 lakh hectares annually with a productivity of 90 tons/ hectare. Karnataka ranks 3rd with respect to area of sugarcane (Hunsigi, 2012). Out of the total sugarcane produced around 60 per cent goes for sugar extraction in the sugar mills and 30-35 per cent is diverted for jaggery preparation. As such jaggery preparation is an important cottage industry of Karnataka. In simple terms jaggery is the solidified mass obtained on boiling and condensing of sugarcane juice in an open pan with removal of impurities.

Jaggery is an important natural sweetener widely used in confectionaries, culinary preparations and Ayurvedic medicines. Jaggery has got both nutritive and medicinal values unlike white sugar and much more sweeter than white sugar by virtue of its higher content of reducing sugars. Cauvery command area in southern Karnataka is an important sugarcane growing belt with over 5000 jaggery boiling units under operation during 1999-2000. However the number of jaggery boiling units has reduced gradually because of market fluctuations over the years and also non availability of required labours in the rural areas.

Cauvery command is the only area in India where jaggery is manufactured in the off-season (June-Sep), apart from the regular crushing season (Oct.-March). But, the farmers in this area do not get appreciable price for jaggery because of poor quality. The APMC market in Mandya, which exclusively deals with jaggery, has recorded arrival of 11482 quintals in 2009-10 and 9548 quintals in 2010-11(Anonymous, 2011).

Sugarcane is being cultivated in the command areas for either extraction of sugar or jaggery preparation depending on the price in the jaggery market. Jaggery preparation is a cottage industry in the Cauvery Command area unlike sugar industry which caters to the need of large section of people both sugarcane growers as well as the people directly or indirectly depending on it. Notwithstanding the fluctuations in the jaggery prices, in the years of higher prices the jaggery units will become functional. Moreover, the jaggery produced in Cauvery Command area will have greater demand as the period of jaggery production in other areas is a lean one. Considering this aspect the jaggery unit owners in the Cauvery Command area get a greater benefit.

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However, quality of jaggery is the important factor which creates demand in other states and jaggery importing countries. Ensuring better quality with relatively longer shelf life is the key for creating greater demand for jaggery. Nutrients, particularly nitrogen and phosphorus play a pivotal role in influencing the juice as well as jaggery quality. Hence a study on the effect of nutrient management practices on juice as well as jaggery quality was conducted at the Zonal Agricultural research station, V.C.Farm, Mandya to know the influence of nutrients on sugarcane yield and jaggery quality.

MATERIALS AND METHODS

A field investigation was carried out to study the effect nutrient management practices on yield and quality of sugarcane and jaggery. Field experiment was laid out in split plot design with two sugarcane varieties as main plot treatments and eight nutrient management practices as sub plot treatments in plant crop of sugarcane.

The treatments included two varieties of sugarcane *viz*., Co 62175 (V1) and Co 86032 (V2) as main plot treatments and the details of nutrient management practices as the sub plot treatments are as under.

The experiment was laid out with three replications with a gross plot size of 9.0 m x 6.0 m (54 m^2) and net plot of 7 m $\times$4 m (28 m^2) with a spacing of 150 cm apart. The data recorded during the course of investigation were compiled and analysed for statistical significance as per the analysis of variance to the split plot design. Fisher's method of analysis of variance (ANOVA) as per method outlined by Cochron and Cox (1965) was adopted for the purpose.

RESULTS AND DISCUSSION

The data on sugarcane yield harvested from the plant crop are provided in Table 1 and Fig. 1. Sugarcane varieties significantly differed with respect to cane yield. Variety Co 62175 recorded significantly higher cane yield (149.40 t/ha) compared to C0 86032 (130.05 t/ha).

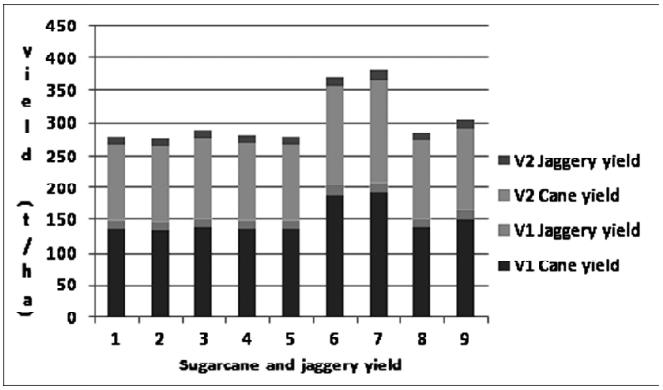

Figure 1: Sugarcane and jaggery yield as influenced by nutrient management practices

Among the nutrient management practices, 50 per cent N through pressmud and 50 per cent N through

Sub-plot treatments

N_1	Pressmud (150 kg N equivalent/ha)	Sunnhemp (50 kg N equivalent/ha)	Biofertilizers (50 kg N equivalent/ha)	
N_2	Pressmud (100 kg N equivalent/ha)	Farmyard manure (100 kg N equivalent/ha)	Biofertilizers (50 kg N equivalent/ha)	
N_3	Pressmud (75 kg N equivalent/ha)	Farmyard manure (75 kg N equivalent/ha)	Frenchbean as intercrop (50 kg N equivalent/ha)	Biofertilizers (50 kg N equivalent/ha)
N_4	Pressmud (87.5 kg N equivalent/ha)	Farmyard manure (87.5 kg N equivalent/ha)	Neem cake (25 kg N equivalent/ha)	Biofertilizers (50 kg N equivalent/ha)
N_5	Pressmud (87.5 kg N equivalent/ha)	Farmyard manure (87.5 kg N equivalent/ha)	Vermicompost (25 kg N equivalent/ha)	Biofertilizers (50 kg N equivalent/ha)
N_6	50% N equivalent through organic and 50% NPK through chemical fertilizers			
	Pressmud (75 kg N equivalent/ha)	Chemical fertilizer (125 kg N, 50 kg P and 62.5 kg K_2O/ha)	Biofertilizers (50 kg N equivalent/ha)	
N_7	Recommended package of practices			
	Chemical fertilizers (250 kg N : 100 kg P_2O_5 : 125 kg K_2O/ha)	Farmyard manure (25 t/ha)		
N_8	Chemical fertilizers alone (250 kg N : 100 kg P_2O_5 : 125 kg K_2O/ha)			

Table 1
Sugarcane and Jaggery yield (t ha^{-1}) as influenced by nutrient management practices in plant crop of sugarcane

		Varieties					
		V_1		V_2		*Mean*	
	Nutrient Management Practices (N)	*Cane yield*	*Jaggery yield*	*Cane yield*	*Jaggery yield*	*Cane yield*	*Jaggery yield*
N_1	Pressmud + sunnhemp + biofertilizers	135.31	11.50	118.95	11.90	127.13	11.70
N_2	Pressmud + FYM + biofertilizers	133.83	11.38	118.52	11.85	126.17	11.61
N_3	Pressmud + FYM + French beans + biofertilizers	137.35	11.67	126.69	12.67	132.02	12.17
N_4	Pressmud + FYM + neem cake + biofertilizers	136.11	11.57	121.25	12.13	128.68	11.85
N_5	Pressmud + FYM + vermicompost + biofertilizers	135.99	11.56	119.69	11.97	127.84	11.76
N_6	50% N through pressmud + 50% NPK through fertilizer + biofertilizer	187.94	15.97	152.72	15.27	170.33	15.62
N_7	Recommended package of practices	191.65	16.29	157.99	15.80	174.82	16.04
N_8	100% NPK through fertilizers only	137.04	11.65	124.63	12.46	130.83	12.06
	Mean	**149.40**	**12.70**	**130.05**	**13.01**	**–**	**–**
		S.E.m ±		*C.D. @ 5%*			
	Varieties (V)	0.94	0.094	2.73	0.27		
	NMP (N)	1.73	0.174	5.02	0.51		
	V × N	2.45	0.25	7.10	0.72		
	N × V	2.48	0.24	7.18	0.71		

V_1 = Co.62175; V_2 – Co.86032.

fertilizer and biofertilizer recorded significantly higher cane yield (170.33 t/ha) over all other practices except N_7 (174.82 t/ha) which was on par with it. Among the organic nutrient management practices, combination of pressmud, FYM, French Beans and biofertilizers recorded significantly higher (132.02 t/ha) yield over N_2 and was on par with rest of the practices including the chemical fertilizer alone. Dineshkumar *et al*., (1996) also found that application of pressmud (equivalent to 25% RDN) along with 75 per cent of the recommended inorganic fertilizers remained on par with 100 per cent recommended fertilizers in terms of cane and sugar yield Bhalerao *et al*., (2005) reported that 40 per cent chemical fertilizers could be substituted with higher sugarcane yields (127 t ha^{-1}) using either 9 tons of pressmud + 2 ton spent wash + bifertilizers or 20 tons FYM + urea blending with neem cake + biofertilizers.

The interaction effect was statistically significant. Combination of Co 62175 and 50 per cent N through pressmud and 50 per cent N through fertilizer and biofertilizer recorded significantly higher sugarcane yield (187.94 t/ha) over rest of the combinations except the RPP (191.65 t/ha) with which it was on par. The interaction effect of organic nutrient management practices with Co 62175 was on par with each other. The chemical fertilizer alone with Co 62175 was also on par with all the organic nutrient combinations. Similar trend of interaction was observed between Co 86032 and nutrient management practices.

Significantly higher jaggery yield was recorded (Fig. 1) with Co 86032 variety of sugarcane (13.01 t ha^{-1}) by virtue of its higher sucrose content though the sugarcane yield was low compared to Co 62175 variety (12.70 t ha^{-1}). Among the nutrient management practices, higher jaggery yield was recorded with recommended package of practices (N7) (15.8 t ha^{-1}) followed by N6 (50 per cent N through pressmud and 50 per cent N through fertilizer and biofertilizer) (15.27t ha^{-1}). The organic nutrient management treatments N1 to N5 did not yield higher jaggery because of their lower cane yield. The jaggery yield differ with respect to the sugar content of cane and the variety of sugarcane has a direct bearing on the quality of jaggery (Anonymous,2000). These results were also confirmed by by Shankaraiah *et al*., (1999) that jaggery yield and quality was improved with application of P solubilising biofertilizers along with pressmud.

The results of the jaggery samples analyzed for sucrose per cent, reducing sugar (RS), ash and grading according to net rendament value (NRV) are presented in Table 2 and 3. The data on sucrose per cent in jaggery was not significant due to varieties.

Sucrose content in jaggery was significant due to nutrient management practices. Combination of nutrient sources of pressmud, sunnhemp and biofertilizers recorded significantly higher sucrose in jaggery (81.44%) over other practices and was on par with N_2, N_3 and N_5.However, the interaction effect of varieties and nutrient management practices was not significant.

The reducing sugar was not significant due to varieties and nutrient management practices.

Table 2
Sucrose content and reducing sugar (%) in jaggery samples as influenced by nutrient management practices in plant crop of sugarcane

		Sucrose			*Reducing sugar*		
		Varieties (V)			*Varieties (V)*		
	Nutrient Management Practices (N)	V_1	V_2	*Mean*	V_1	V_2	*Mean*
N_1	Pressmud + sunnhemp + biofertilizers	79.67	83.20	81.44	3.30	3.28	3.29
N_2	Pressmud + FYM + biofertilizers	78.33	82.19	80.26	3.17	3.19	3.18
N_3	Pressmud + FYM + French beans + biofertilizers	78.67	82.67	80.67	3.17	3.20	3.18
N_4	Pressmud + FYM + neem cake + biofertilizers	77.67	80.36	79.01	3.20	3.21	3.21
N_5	Pressmud + FYM + vermicompost + biofertilizers	80.50	79.55	80.03	3.17	3.21	3.19
N_6	50% N through pressmud + 50% NPK through fertilizer + biofertilizer	75.83	77.20	76.52	3.43	3.68	3.56
N_7	Recommended package of practices	75.83	77.36	76.60	4.32	4.22	4.27
N_8	100% NPK through fertilizers only	74.83	76.68	75.56	4.42	4.52	4.47
	Mean	**77.67**	**79.91**	**-**	**3.52**	**3.57**	**-**
		S.E.m ±		*C.D. @ 5%*	*S.E.m ±*		*C.D. @ 5%*
	Varieties (V)	0.74		NS	0.02		NS
	NMP (N)	0.57		1.65	0.10		0.30
	V × N	0.81		NS	0.15		NS
	N × V	1.06		NS	0.14		NS

V_1 = Co.62175; V_2 – Co.86032.

Table 3
Ash content (%) and net rendament value (NRV) of jaggery as influenced by nutrient management practices in plant crop of sugarcane

		Ash content Jaggery			*NRV jaggery*		
		Varieties (V)			*Varieties (V)*		
	Nutrient Management Practices (N)	V_1	V_2	*Mean*	V_1	V_2	*Mean*
N_1	Pressmud + sunnhemp + biofertilizers	2.15	2.00	2.08	68.84	72.92	70.88
N_2	Pressmud + FYM + biofertilizers	2.53	2.18	2.36	66.30	71.39	68.84
N_3	Pressmud + FYM + French beans + biofertilizers	2.45	2.30	2.38	66.93	71.42	69.17
N_4	Pressmud + FYM + neem cake + biofertilizers	2.29	2.20	2.25	66.45	69.45	67.95
N_5	Pressmud + FYM + vermicompost + biofertilizers	2.50	2.19	2.35	68.57	68.68	68.63
N_6	50% N through pressmud + 50% NPK through fertilizer + biofertilizer	3.02	2.50	2.76	61.84	64.76	63.30
N_7	Recommended package of practices	3.10	2.45	2.78	60.67	64.57	62.62
N_8	100% NPK through fertilizers only	3.22	2.45	2.83	59.15	63.59	61.38
	Mean	**2.66**	**2.28**	**-**	**64.84**	**68.35**	**-**
		S.E.m ±		*C.D. @ 5%*	*S.E.m ±*		*C.D. @ 5%*
	Varieties (V)	0.01		0.04	0.80		NS
	NMP (N)	0.03		0.08	0.57		NS
	V × N	0.04		0.12	0.81		2.34
	N × V	0.04		0.12	1.10		NS

V_1 = Co.62175; V_2 – Co.86032.

However, the interaction effect was significant. Co 62175 variety with RPP recorded significantly higher reducing sugar (4.32%) over others and was on par with N_8. The rest of the interaction effects recorded lower reducing sugar values and were on par. Similar interaction trend was observed with Co 86032 variety and nutrient management practices.

The ash content in jaggery was significant due to varieties and nutrient management practices. Co 86032 variety recorded significantly lower ash content (2.28%) compared to Co 62175. Among the nutrient management practices, N_1 recorded significantly lower ash content. Other organic nutrient management practices also recorded significantly lower ash content compared to N_6, N_7 and N_8. The interaction of varieties and nutrient management practices was significant. Co 86032 variety with N_1 recorded significantly lower ash content compared to V_2N_6, V_2N_7 and V_2N_8. Other combinations of organic practices also recorded significantly lower values

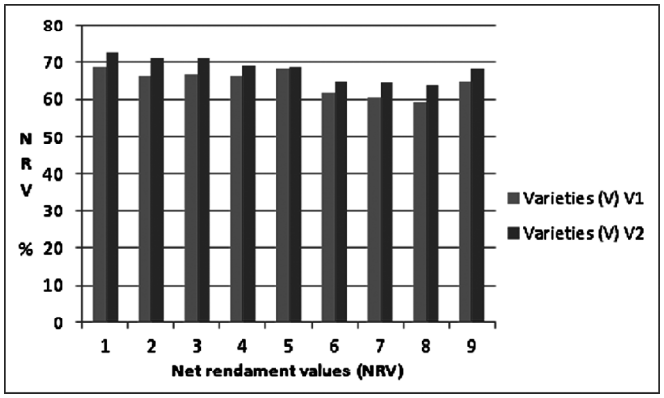

Figure 2: Net Rendament Value (NRV) as influenced by nutrient management practices

compared to V_2N_6, V_2N_7 and V_2N_8 and they were on par. Similar trend was observed in the interaction effect of Co 62175 and nutrient management practices. Based on the above three parameters of jaggery samples, the net rendament value (NRV) was computed to classify the jaggery (Fig. 2) in to different grades. The NRV was not significant due to varieties used or the nutrient management practices. Trials conducted at V.C.farm, Mandya have indicated that incorporation of French beans stover after the harvest of the green pods has yielded jaggery of higher quality and on par with application of press mud and biofertilizer inoculation (Anonymous, 2000). The interaction effect was significant. Co 86032 variety of sugarcane with sunnhemp and biofertilizers produced high quality jaggery (A1 quality) which was on par with jaggery from treatment N_2, N_3. A2 quality of jaggery was produced with rest of the combinations of nutrient management practices. The same trend was observed with Co 62175 combinations also.

To infer the study, higher sugarcane yield was recorded with Co 62175 variety compared to Co 86032. On the contrary, higher jaggery yield was recorded with Co 86032 variety by virtue of its higher sugar content. Among the nutrient management practices integrated nutrient management practices recorded higher cane as well as jaggery yiled. However, higher quality of jaggery was obtained with organic nutrient management practices with lower ash, reducing sugar content and higher sucrose content thereby yielding superior (A1) quality jaggery.

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