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Research Article

USE OF MAJOR NUTRIENT FERTILIZER BRIQUETTES FOR SUGARCANE RATOON

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Abstract: Field experiment was conducted entitled "Application of NPK fertilizer briquettes in sugarcane ratoon" at the Central Sugarcane Research Station, Padegaon, Tal Phaltan, Satara, M.S. to study the effect of NPK briquette on sugarcane ratoon for cane yield, nutrient uptake and soil health during 2009-10 to 2011-12 for three years on medium deep black soil (Inceptisol) in randomized block design, with eight treatments and three replications. The applications were in two equal splits, 50 % at the time of ratooning and remaining 50 % at 135 days after ratooning. The results showed that application of 100 % recommended dose of NPK through briquette by crow bar recorded significantly highest cane yield, CCS yield, average cane weight and number of millable cane however, it was at par with application of 75 % recommended dose of NPK through briquettes by crow bar. The application of 100 % recommended dose of NPK through briquettes by crow bar recorded significantly higher total nitrogen, phosphorus, and potassium uptake. The maximum nutrient use efficiency of N, P and K were recorded in application 100 % recommended dose of NPK through briquettes by crow bar and the per cent increase of nutrient use efficiency of briquette over non briquette form was maximum in application of 75 % recommended dose of NPK through briquettes by crow bar. The application of 100 % recommended dose of NPK through briquettes by crow bar recorded highest gross monetary returns and net monetary return with followed by application of 75 % recommended dose of NPK through briquettes by crow bar. While, the highest B:C ratio was recorded in 75 % recommended dose of NPK through briquettes by crow bar it means indicate that saving of 25 % recommended dose of NPK fertilizers. On the basis of three years sugarcane ratoon data the application of 75 % recommended dose of NPK through briquettes by crow bar in two equal splits *i.e.,* 50 % at the time of ratooning and 50 % at 135 days after ratooning for sugarcane ratoon was found economic beneficial for higher cane and CCS yield with maintenance of soil fertility.

Keywords: *Briquette, Fertilizer use efficiency, Soil health, Crow bar, Sugarcane ratoon*

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Introduction

The sugarcane is a long duration crop and it demands large amount of nutrient for their production and this crop gives response to fertilizer application. The use efficiency of NPK fertilizer is low particularly N (40-50%) and P_2O_5 (15-20 %) because of various reasons such as volatilization losses, surface runoff, leaching losses, ammonium fixation, denitrification, phosphorus fixation. More or less similar situation exists for K_2O also even though use efficiency of potassic fertilizer is about 70-80 %. The low use efficiency of fertilizer leads to higher application of NPK fertilizers than the actual needed by the crop involving extra expenses. To minimize such losses as well as to increase efficiency of applied fertilizer, deep placement of fertilizer, use of slow release as well as nitrification inhibitors, use of inorganic fertilizers along with organic manures and use of biofertilizers are recommended [1,2]. The high cost of chemical fertilizer in India due to fertilizer dependent and import from other country. The policy of Government of India is to minimize fertilizer application in different crop using fertilizer use efficiency. Hence, we are need to saving of fertilizer application with different ways in which use of urea super granules, urea briquettes and urea-DAP briquettes are another developments in this direction and they have been used for low land transplanted rice crop under anaerobic condition and found to be beneficial. These products are, however, not used for other crops grown under aerobic conditions except in some cases of sugarcane. For example, NPK fertilizer briquettes were tested for Adsali sugarcane and it was found beneficial for increasing cane and CCS yields with saving of 25 % recommended dose of NPK [3]. The pocket application of NPK fertilizers in two equal splits first at one side of plant within 15 days after harvest of plant cane and second dose on opposite side on 135 days after ratoon initiation was found beneficial in sugarcane ratoon.

The use of NPK briquettes in two equal splits helped to save 20 % fertilizers as compared to normal practice of surface application of NPK fertilizers in which N was applied in four splits and P_2O_5 and K_2O in two splits. However, these NPK briquettes are not used along with organic sources and biofertilizers for different seasons of sugarcane crops. Thus, information on, NPK briquettes for sugarcane as well as ratoon crops are almost lacking. It is, therefore, proposed to conduct experiment on "Enhancing nutrient use efficiency through NPK fertilizer briquettes in sugarcane ratoon with trash mulch".

Material and Methods

Field experiment was conducted during 2009-10 to 2011-12 for three years at Central Sugarcane Research Station, Padegaon, M.S. on medium deep black soil (Inceptisol) in randomized block design, with eight treatments and three replications. The dates of ratooning and harvesting of sugarcane ratoon during three years of experimentation were as follows. It consists of Absolute control (No fertilizer), 100% NPK RD through straight fertilizer by conventional method, 100% NPK RD through straight fertilizer by crow bar, 100% NPK RD through briquette by crow bar, 75% NPK RD through straight fertilizer by crow bar, 75% NPK RD through briquette by crow bar, 50% NPK RD through straight fertilizer by crow bar and 50% NPK RD through briquette by crow bar. The recommended dose for ratoon sugarcane was 250: 115: 115 kg N, P_2O, K_2O/ha and application were in two equal splits, 50 % at the time of ratooning and remaining 50 % at 135 days after ratooning. The briquettes are prepared by using Urea, DAP and MOP and weight of each briquette is 2.60 gm. Briquettes are applied by Crow bar at 10 cm deep, 10 to 15 cm from the stool keeping 30 cm spacing between two holes.

Table-1 Yield and yield contributing parameters of sugarcane ratoon (Pooled)

Treatments	Cane yield (t ha^{-1})	CCS yield (t ha^{-1})	NMC ('000' ha^{-1})	ACW (Kg)	CCS (%)
T_1: Control (No fertilizer)	51.55	7.01	71.62	0.67	13.65
T_2: 100% NPK RD through straight fertilizers by conventional method.	98.62	13.66	90.90	1.08	13.88
T_3: 100% NPK RD through straight fertilizers by crow bar	96.34	13.35	92.07	1.02	13.88
T_4: 100% NPK RD through briquette by crow bar	112.41	15.7	101.06	1.11	13.98
T_5: 75% NPK RD through straight fertilizers by crow bar	86.73	12.05	80.73	1.06	13.92
T_6: 75% NPK RD through briquette by crow bar	107.02	14.81	96.83	1.13	13.89
T_7: 50 % NPK RD through straight fertilizers by crow bar	75.05	10.44	81.14	0.93	13.91
T_8: 50 % NPK RD through briquette by crow bar	82.88	11.74	87.40	0.93	14.18
SE±	3.39	0.5	1.16	0.03	0.16
CD at 5%	10.29	1.5	3.5	0.08	NS

Table-2 Soil chemical parameters and nutrient uptake of sugarcane ratoon (Pooled)

Tr. No.	Soil pH	Soil EC (dSm^{-1})	Organic carbon (%)	Available nutrient (kg ha^{-1})			Total nutrient uptake (kg ha^{-1})		
				N	P	K	N	P	K
T_1	7.81	0.21	0.60	261.85	21.53	247.20	121.59	37.07	137.27
T_2	7.38	0.23	0.77	323.55	31.43	302.32	214.95	64.96	225.66
T_3	7.58	0.20	0.74	309.99	37.68	288.19	306.76	60.72	339.99
T_4	7.52	0.20	0.78	324.85	37.76	318.73	330.00	78.88	366.27
T_5	7.76	0.20	0.70	313.30	27.46	332.72	175.62	51.79	207.95
T_6	7.57	0.25	0.72	320.49	27.54	291.31	240.63	61.35	292.08
T_7	7.70	0.25	0.74	304.69	20.00	289.80	170.10	41.74	199.88
T_8	7.66	0.22	0.73	310.64	21.19	268.26	181.24	45.48	237.81
SE±	0.07	0.04	0.03	4.49	3.19	9.11	3.98	3.67	5.11
CD at 5%	0.22	NS	0.08	13.62	9.69	27.63	12.91	10.87	14.99

Table-3 Effect of different treatments on nutrient use efficiency. (Pooled)

Treatments	Nutrient use efficiency (%)				% Increase of nutrient recovery efficiency of briquette over non briquette form of fertilizers			
	NUE	PUE	KUE	Mean	NUE	PUE.	KUE	Mean
T_1: Control (No fertilizer)	--	--	--	--	--	--	--	--
T_2: 100% NPK RD through straight fertilizers by conventional method.	43.43	42.93	39.17	41.84	--	--	--	--
T_3: 100% NPK RD through straight fertilizers by crow bar	60.36	38.95	59.62	52.98	--	--	--	--
T_4: 100% NPK RD through briquette by crow bar	63.16	53.01	62.52	59.56	4.42	26.53	4.63	11.86
T_5: 75% NPK RD through straight fertilizers by crow bar	30.77	28.43	33.99	31.06	--	--	--	--
T_6: 75% NPK RD through briquette by crow bar	49.47	39.58	53.00	47.35	37.81	28.18	35.87	33.95
T_7: 50 % NPK RD through straight fertilizers by crow bar	28.52	11.19	31.32	23.68	--	--	--	--
T_8: 50 % NPK RD through briquette by crow bar	32.91	18.5	42.28	31.23	13.35	39.51	25.91	26.26
Mean	--	--	--	--	18.53	31.41	22.14	24.02

Table-4 Economics of different treatments (Pooled)

Treatments	Yield (t ha^{-1})	Gross monetary returns (Rs. ha^{-1})	Cost of Cultivation (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B : C Ratio
T_1: Control (No fertilizer)	51.55	95367.5	--	--	--
T_2: 100% NPK RD through straight fertilizers by conventional method.	98.62	182447	37259	145188	3.90
T_3: 100% NPK RD through straight fertilizers by crow bar	96.34	178229	38579	139649	3.62
T_4: 100% NPK RD through briquette by crow bar	112.41	207959	33861	174098	5.14
T_5: 75% NPK RD through straight fertilizers by crow bar	86.73	160451	36168	124283	3.44
T_6: 75% NPK RD through briquette by crow bar	107.02	197987	30169	167818	5.56
T_7: 50 % NPK RD through straight fertilizers by crow bar	75.05	138843	33756	105087	3.11
T_8: 50 % NPK RD through briquette by crow bar	82.88	153328	26477	126851	4.79
SE ±	3.39	6275.07	--	6275.07	0.037
CD at 5 %	10.29	19033.3	--	19033.3	0.11

The initial and after harvest soil samples were analyzed for pH and EC in 1:2.5 soil: water suspension, organic carbon by Walkly and Black Wet Oxidation method as described by Nelson and Sommers (1982) [4]. The available N of soil was estimated by alkaline permanganate method [5], available P as per Olsen, *et al.*, (1954) [6] and the available K was determined by flame photometry. The juice quality parameters sugarcane ratoons were determined using procedure outlined by Nelson and Sommers (1982). The data obtained on chemical properties of soil, uptake of nutrients by plant, quality of juice and yield of sugarcane were analyzed statistically by using standard methods of analysis of variance [7].

Results and Discussion

Yield and yield contributing parameters

The pooled data on yield and yield contributing parameters are presented in [Table-1] and revealed that significantly higher cane and CCS yields (112.41 and CCS 15.70 t ha^{-1}) were recorded with application 100 % recommended dose of NPK through briquettes by crow bar (T_4), however, it was at par with treatment T_6 receiving 75% recommended dose of NPK through briquettes by crow bar (107.02 and 14.81 t ha^{-1}). In case of yield contributing parameters, application of 100 % recommended dose of NPK through briquettes by crow bar (T_4) recorded significantly higher number of millable cane (101.06 '000' ha^{-1}) and the treatment T_6 receiving application 75% recommended dose of NPK through briquettes by crow bar recorded significantly highest average cane weight (1.13 kg) and it was found at par with treatment T_3, T_5 and T_6.

The non-significant result was recorded in case of CCS %. These results are in conformity with Banger and Shrma (1992) [8], Dai and Zhou (2020) [9], Rajput, *et al.*, (2020) [10] and Talekar and Dongale (1993) [11].

Residual soil properties, total nutrient uptake and nutrient use efficiency

The pooled data on residual soil properties, total nutrient uptake and nutrient use efficiency are presented in [Table-2] shows the highest soil pH was observed in treatment T_1 (Control) and lowest noticed in treatment T_2 receiving application of 100% recommended dose of NPK through straight fertilizers by conventional method.

The treatment T_4 receiving application of 100 % recommended dose of NPK through briquettes by crow bar recorded significantly higher organic carbon content (0.78 %) and it was at with all the treatment except T_1 (Control). The soil EC was found to be non-significant. Similar observations were also reported by More, *et al*., (2012) [12] and Nagrajan and Prakash (2021) [13].

Significantly the highest available nitrogen and phosphorus (324.85 and 37.76 kg ha^{-1}) were recorded in treatment T_4 receiving application of 100 % recommended dose of NPK through briquettes by crow bar. However, it was at par with treatment T_2, T_5 and T_6 in respect to available nitrogen and treatment T_2 and T_3 in respect to available phosphorus. While, treatment T_5 receiving application of 75% NPK recommended dose of fertilizer through straight fertilizers by crow bar recorded significantly higher available potassium and it was at with treatment T_4. The same treatment T_4 receiving application of 100 % recommended dose of NPK through briquettes by crow bar recorded significantly higher total nitrogen, phosphorus and potassium uptake (330.00, 78.88 and 366.27 kg ha^{-1}, respectively). Similar observations were also reported by Nagrajan and Prakash (2021).

The higher nutrient use efficiency of N, P and K (63.16, 53.01 and 62.52 % respectively) were recorded in the treatment T_4, receiving application of 100 % recommended dose of NPK through briquettes by crow bar and the per cent increase of nutrient use efficiency of briquette over non briquette form was maximum in treatment T_6, receiving application of 75 % recommended dose of NPK through briquettes by crow bar (37.81, 28.18 and 35.87 % respectively). Similar observations were also reported by Panse and Sukhatme (1978) and Yu, *et al.,* (2018) [14].

Economics

The pooled data on economics of different treatments revealed that, the treatment T_4 receiving application of 100 % recommended dose of NPK through briquettes by crow bar recorded highest gross monetary returns and net monetary return (Rs.2, 07,959 and 1,74,098 ha^{-1} respectively) and it was followed by treatment T_6 receiving application of 75 % recommended dose of NPK through briquettes by crow bar. While, the B:C ratio (5.56) was recorded highest in 75 % recommended dose of NPK through briquettes by crow bar (T_6) it means indicate that saving of 25 % recommended dose of NPK fertilizers. Similar observations were also reported by Spencer and Meade (1964) [15], Talekar and Dongale (1993), More, *et al.,* (2004) [16].

Conclusion

Application of 75 % recommended dose of NPK through briquettes by crow bar in two equal splits *i.e*., 50 % at the time of ratooning and 50 % at 135 days after ratooning for sugarcane ratoon was found economic beneficial for higher cane and CCS yield with maintenance of soil fertility.

Application of research: Use of major nutrient briquettes will help to increasing cane yield of sugarcane with maintenance of residual soil fertility. Saving of chemical fertilizer with increasing nutrient use efficiency through NPK briquettes. To minimize the fertilizer import and saving of Indian currency

Research Category: Nutrient briquettes in Sugarcane

Abbreviations: CCS- Commercial Cane Sugar, ACW- Average Cane Weight
NMC- Number of Millable Cane, PSB- Phosphate Solubilizing bacteria
RDF- Recommended dose of fertilizer, FYM- Farm Yard Manure
NUE- Nitrogen Use Efficiency, PUE- Phosphorus Use Efficiency
KUE- Potassium Use Efficiency

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