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Soil health and sugarcane productivity management through integrated nutrient management by using different organic manure sources and planting geometries in lateritic soils of Konkan region of Maharashtra

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Abstract

The research experiment was conducted during 2018 (plant cane) and 2019 (ratoon cane) at Instructional Farm, College of Agriculture, Dapoli, Dist. Ratnagiri (M. S.) to study soil health and sugarcane productivity management through various integrated nutrient management by using different organic manure sources and planting geometries in lateritic soils of Konkan region in Maharashtra state. The field experiment was laid out in strip plot design with two factors consisted of six planting geometries viz., 75 cm SRP, 90 cm SRP, 60 - 90 cm PRP, 60 - 120 cm PRP, 60 - 150 cm PRP, 75 - 150 cm PRP and five integrated nutrient management treatments, viz., 100% RDF inorganic, 75% RDF N inorganic + 25% N organics, 50% RDF N inorganic + 50% N organics, 25% RDF N inorganic + 75% N organics and 100% N organics. Among the various planting geometries, planting of cane at 60-120 cm paired row recorded significantly higher number of millable cane, single cane weight, cane yield, commercial cane sugar yields compared to that of other planting geometries followed by 60-150 cm and 75-150 cm but did not showed any marked effect on various soil health parameters. Where as in integrated nutrient management treatment application of 75% RDF N inorganic + 25% N organics recorded statistically superior number of millable cane, single cane weight, cane yield, commercial cane sugar yields compared to that of other nutrient management combinations except 100% RDF inorganic, where both these treatments were found par with each other. Further, application of 100% RDF N through organics prepared from various organic sources showed marked improvement in bulk density, water holding capacity, pH, EC, per cent organic carbon, N P₂O₅ and K₂O availability, beneficial active microbial population recorded after harvest of plant and ratoon cane. Further, for each successive replacement of 25% organic N by inorganic source causes to significant decline of the various soil health parameters there by recording of lowest values, due to application of 100% RDF inorganic.

Keywords: Sugarcane, integrated nutrient management, planting geometries, physical and chemical properties of soil

Introduction

Sugarcane is an old energy source crop, of industrial importance next to cotton and occupies the pivotal position in the Indian economy. It also provides livelihood to millions through an organized industry, and it accounts about 60-70% of the cost of sugar production. It also contributes about 65% of the total world sugar production. The demand for the sugar in world is increasing and it was estimated that by 2030 AD, India requires about 33 million tonnes of white sugar. But with present level of cane productively, India would not able to meet the 75% of projected requirement. Thus productivity of the soil is to be enhanced to the tune of 110 tha⁻¹. Soil quality holds the prime importance for productivity of long duration high biomass producing crop like sugarcane. It describes the sum total of physical, chemical and biological properties of the soil. It regulates the nutrient and moisture availability dynamics and rooting behaviour. Fortunately, the sugarcane production system mainly comprises of ratooning practice which take an advantage of saving on land preparation planting seed cost.

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Thus, integrated use of various sources of organic manures along with chemical helps in improving the soil health as well as fulfil the nutrient demand of the crop and helps to sustain the sugarcane productivity on long term basis.

Another as important aspect in relation to sugarcane cultivation is the planting geometry. As sugarcane being a perennial crop and put forth the dense canopy cover throughout the life period creates the problems in aeration and impedes direct solar radiation led to direct competition for the recourses. It also hinders the intercultural operations and close planted cane requires high seed rate which ultimately increases the cost of cultivation. Thus the technique of spaced planting and above that paired row planting has brought out the promising results. Soby adjusting the row distance and changing the planting geometry will enhance maximum aeration, uniform solar light distribution, efficient irrigation and inter culturing helps to maintain the productivity to a desired level.

Thus keeping this views, the present investigation regarding soil health and sugarcane productivity management through integrated use of nutrients by using different sources of nutrient under different planting geometries was under taken at Agronomy form of College of Agriculture, Dapoli.

Materials and Methods

The field Experiment was conducted on plot number 60 and 63 of 'C' block of the Department of Agronomy, College of Agriculture, Dapoli. Geographically Dapoli (Dist. Ratnagiri) is located at the 17°45'57" N and 73°10'29" E in the subtropical zone. Standing at an altitude of 157.8 meters, slightly above mean sea level. The data regarding different weather parameters recorded at the meteorological observatory at department of Agronomy, College of Agriculture, Dapoli. The climate is sub-tropical which is characterized by warm and humid atmosphere. Over all the variations in weather parameters during both the years of investigation were not observed to considerable extent during both the years of study. The field experiment was laid out in strip plot design with two factors forming 30 treatment combinations replicated thrice. Horizontal strip consisted of six planting geometries viz., 75 cm SRP, 90 cm SRP, 60 - 90 cm PRP, 60 - 120 cm PRP, 60 - 150 cm PRP, 75 - 150 cm PRP and along vertical strips five integrated nutrient management treatments, viz., 100% RDF inorganic, 75% RDF N inorganic + 25% N organics, 50% RDF N inorganic + 50% N organics, 25% RDF N inorganic + 75% N organics and 100% N organics were allocated. The soil was also analysed for physical, chemical and biological properties. The soil analysis indicated that the soil of experimental plot was sandy clay loam in texture, moderately acidic in reaction with moderately high in organic carbon content. Soil was medium in available nitrogen, low in available phosphorus and fairly high in available potassium. The cultivar used was Co-92005 planted during February 2018 *suru* season and after harvesting; same was continued as ratoon during 2019 by repeating the same set of the treatments during next year. Planting of sugarcane was done to by using two budded sets after preparation of planting layout as per the treatments. Integrated nutrient management was done as per treatments by using straight fertilizers and various sources of organic manures to replace the chemical fertilizer N. Sources mainly consist of FYM 40%, poultry manure 40% and vermicompost 20%. All the crop management practices were carried out as per recommendation. Necessary plant protection measures were taken to keep the crop pest and disease free. Randomly five plants were selected for periodical growth, yield attributes and yields. Millable cane yield was estimated after

cutting, removing of trash and topping of canes from each plot and weight was recorded and converted on per hectare basis ($t\ ha^{-1}$). The biological analysis of soil was done to access the microbial count per gram of soil pertaining to bacteria ($X10^5\ cfu\ g^{-1}\ soil$), fungi ($X10^3\ cfu\ g^{-1}\ soil$) and actinomycetes ($X10^5\ cfu\ g^{-1}\ soil$) by using serial dilution technology at initial soil samples as well as after harvest of both plant and ratoon cane. Similarly, to assess the physical status of soil it was analysed for bulk density and maximum water holding capacity of soil. Chemical properties of soil were known by analysing the soil for pH, EC, % organic carbon along with N, P_2O_5 and K_2O availability $kg\ hectare^{-1}$ at initial and after harvest of plant cane and ratoon cane. Nutrient uptake studies were also done to assess the nutrient utilization by the crop during both the years. The data obtained is used for preparation of nutrient balance sheet to get the real picture of soil health build up during both the years of investigation.

Results and Discussion

Planting geometries

The data regarding growth parameters viz., height of plant (cm) number of leaves per plant dry matter accumulation (g), number of internodes per cane is presented in table showed a significant influence of the planting geometries. All these parameters showed statistically higher values due to planting of cane at 60-120 cm paired row as compared to the rest of the treatments; followed by 60-150 cm PRP and 75-150 cm PRP. However, decreasing the spacing between the rows led to decline in the trend of various growth parameters. Similar trend was also observed in yield attributes like number of millable cane ha^{-1} , number of internodes and single cane weight which was ultimately reflected in the cane yield $t\ ha^{-1}$. The treatment 60-120 cm PRP recorded improvement in the cane yield to the tune of 41.4%, 24.9%, 25.6%, 14.5%, and 15.9% in pooled data over 75 cm, 90 cm, 60-90 cm, 60-150 cm and 75-150cm planting spacing respectively. The increased growth and yield of cane with 60-120 cm owed due to the better air circulation, uniform distribution of light over plant canopy which might have enhanced photosynthetic efficiency. This might have increase the number of millable canes per hectare and individual cane weight which led to increased cane yield $t\ ha^{-1}$. Mahadevswamy, 2001, and Singh *et al.*, 2016^[6] also recorded the similar results. Further in present investigation among paired row plantings, it was also observed reduction in yield during both years and in pooled data at wider spacing. e. 60-150 cm and 75- 150 cm PRP as compared to 60-120 cm PRP, might be due to having direct relation with increased spacing between the rows causes to cessation of competition and compensation among shoots, and formation of non-productive voids (Benda *et al.*, 1987)^[1]. Lower growth and yields in case of close spaced planted cane i.e. 75 cm, 90 cm and 60-90 cm (PRP) as compared to the wider rows might be dense population led to severe competition among the shoots reduce the single cane weight. Conclusions drawn corroborate the findings of Yadav and Singh (1986)^[7]. Data regarding soil health parameters like bulk density, water holding capacity, soil microbial count, pH, EC and % organic carbon along with nutrient balance sheet after harvest of ratoon cane is presented in Table 3 and 4. Data reveals that all the soil health parameters were not significantly influenced due to various planting geometries. There is also very less variation was observed in net gain / loss of nutrients from the soil due to the effect of various planting geometries after two years of investigation.

Integrated nutrient management

i. Growth yield attributes and yield

Integrated application of 75% N inorganic + 25% N organic to the sugarcane recorded significantly higher number of shoots, leaf area per plant, dry matter accumulation and millable cane height as compared to rest of the treatments except 100% RDF through chemical where both these treatments were at par with each other during both the years. Further both these treatments showed their superiority over 50% N inorganic + 50% N organic followed by 25% N inorganic + 75% N organic followed by 25% N inorganic + 75% N organic and 100% N organic in that descending order of significance. Thus similar trend was also observed in the yield attributes like number of millable cane ha⁻¹, number of internodes and single cane weight which was ultimately reflected in the sugarcane yield tha⁻¹ during both the years and in pooled data analysis. The treatment 75% N inorganic + 25% N organic registered improvement in the yield to the tune of 1.8%, 22.6%, 44.6% and 66.9% over T₁, T₃, T₄ and T₅ respectively of pooled data of two years. This might be due to the fact that 75% N inorganic N was readily available to the crop and fulfil the initial nutrient demand and rest of 25% N through organic source insured slow and steady supply of nutrient there by maintaining nutrient availability during post tillering stage. Similar findings were also reported by Mulik, 2013 [4].

ii. Soil physico-chemical and biological properties

The data presented in Table. 3 revealed that application of 100% N through organic source registered significantly higher bulk density gcc⁻¹, maximum water holding capacity (%), soil microbial population (fungi, bacteria and actinomycetes) as well soil chemical parameters like EC, pH and % organic carbon. But for each successive replacement of 25% N organic by inorganic source of N, there was observed a significant decline in the soil health parameters there by, recorded higher bulk density, lower water holding capacity, pH, % organic carbon, but increased in

the electrical conductivity, indicating the deteriorations in soil health due to continuous use of chemicals in sugarcane crop during both years. It was observed the linear relationship in between the organic matter added and the physicochemical and biological properties of the soil. This might be due to the fact that due to addition of organic carbon in the soil, enhances the microbial activities in the soil, causing better soil aggregation due to the cementing action. (Kharche *et al.*, 2013) [2].

iii. Nutrient balance in the soil

The nutrient balance is the function of difference between initial soil nutrients + nutrient added and uptake of nutrients by crop and balance remain in the soil in available form. Data presented in Table 4 insinuates the fact that application of 100% N through organic source shows significant gain in N, P₂O₅ and K₂O in the soil and its trend was declined for each successive replacement of 25% N organic by inorganic source. Due to which 100% N through inorganic (T₁) showed net loss of nitrogen and potassium but slight gain in phosphorus after two years of experiment. The positive balance of N in organically treated plot might be due to temporary biological immobilization and continuous mineralization. (Singh *et al* 2010) [5]. Where as in case of P₂O₅, application of FYM and other sources reduce the phosphate fixation and increased 'P' mineralization. The extent of availability of potassium was low or negative might be due to the fact that there was luxuriant uptake of potassium by sugarcane. (Mulik, 2011) [4].

Interaction effect

Among the various interactions, the treatment combination 75% inorganic + 25% N organic along with planting of cane at 60-120 cm PRP (P₄T₂) recorded significantly higher single cane weight (kg) and cane yield t ha⁻¹ as compared to the rest of the treatment combinations followed by P₄T₁ similar findings were also reported by Manimaran *et al.*, 2009

Table 1: Growth, yield attribute and yield of suru planted and ratoon sugarcane as influenced by planting geometries and integrated nutrient management at harvest

Treatments	Growth parameters at harvest (Two years)							
	Number of shoots '000' ha ⁻¹		Leaf area per plant		Dry matter accumulation plant ⁻¹ (g)		Millable cane height (cm)	
Planting geometries(P)	2018 Plant	2019 Ratoon	2018 Plant	2019 Ratoon	2018 Plant	2019 Ratoon	2018 Plant	2019 Ratoon
P ₁ - 75 cm SRP	110.42	93.68	2.48	1.89	646.21	488.86	245.75	246.22
P ₂ - 90 cm SRP	107.28	86.25	2.85	1.99	649.25	493.33	249.50	251.09
P ₃ - 60 - 90 cm PRP	121.09	103.05	3.00	2.05	649.67	496.20	251.63	251.58
P ₄ - 60 -120 cm PRP	120.60	100.93	3.67	2.23	658.31	514.31	264.90	262.22
P ₅ -60 - 150 cm PRP	106.08	88.42	3.49	2.14	655.45	502.93	259.47	258.28
P ₆ -75 - 150 cm PRP	104.77	87.69	3.48	2.13	653.19	499.71	259.83	255.16
SEm±	0.82	0.71	0.05	0.02	0.85	1.08	1.01	1.03
C.D. at 5%	2.58	2.24	0.16	0.06	2.68	3.41	3.18	3.25
Integrated nutrient management (T)								
T ₁ -100% RDN-CF	121.83	99.52	3.67	2.26	657.36	504.61	266.82	259.63
T ₂ -75% RDN-CF + 25% N-OM	124.77	100.35	3.78	2.29	659.57	505.58	267.52	260.42
T ₃ -50% RDN-CF + 50% N-OM	111.27	94.36	3.15	2.07	652.58	499.56	257.39	253.40
T ₄ -25% RDN-CF + 75% N-OM	104.35	88.10	2.71	1.90	647.78	494.27	247.91	249.48
T ₅ -100% RDN - OM	96.30	84.59	2.38	1.85	642.78	492.10	239.74	247.53
SEm±	0.94	0.46	0.04	0.01	0.70	0.54	0.84	0.555
C.D. at 5%	3.08	1.49	0.14	0.04	2.28	1.75	2.75	1.81
Interaction effect (P x T)								
P X T	SIG	SIG	NS	NS	NS	NS	NS	NS
General mean	111.71	93.38	3.17	2.07	652.01	499.22	255.1	254.1

RDN recommended dose of nitrogen. PRP- Paired row planting, SRP- Single row planting CF- Chemical fertilizer OM – organic Manure

Table 2: Yield attributes and yield of suru planted and ratoon sugarcane as influenced by planting geometries and integrated nutrient management at harvest

Treatments	Yield attributes (Two years)									
	NMC '000' per ha.		Number of internodes per cane		Single cane weight (g)			Cane yield t ha ⁻¹		
Planting geometries(P)	2018 Plant	2019 Ratoon	2018 Plant	2019 Ratoon	2018 Plant	2019 Ratoon	Pooled data	2018 Plant	2019 Ratoon	Pooled data
P ₁ - 75 cm SRP	110.42	93.68	26.09	24.96	0.757	0.669	0.713	82.24	64.51	73.37
P ₂ - 90 cm SRP	107.28	86.25	27.55	25.59	0.839	0.831	0.835	92.33	73.82	83.08
P ₃ - 60 - 90 cm PRP	121.09	103.05	27.28	25.59	0.787	0.659	0.723	92.88	72.35	82.61
P ₄ - 60 -120 cm PRP	120.60	100.93	30.71	27.07	0.935	0.911	0.923	114.74	92.75	103.74
P ₅ -60 - 150 cm PRP	106.08	88.42	28.97	26.41	0.910	0.933	0.922	97.63	83.59	90.61
P ₆ -75 - 150 cm PRP	104.77	87.69	28.84	26.19	0.915	0.909	0.912	97.06	81.98	89.52
SEm±	0.82	0.71	0.26	0.16	0.011	0.009	0.007	1.13	0.53	0.49
C.D. at 5%	2.58	2.24	0.81	0.50	0.033	0.028	0.023	3.55	1.68	1.53
Integrated nutrient management (T)										
T ₁ -100% RDN-CF	121.83	99.52	30.48	26.96	0.986	0.914	0.950	119.85	89.64	104.75
T ₂ -75% RDN-CF + 25% N-OM	124.77	100.35	30.95	27.25	1.002	0.915	0.958	122.51	90.66	106.58
T ₃ - 50% RDN-CF + 50% N-OM	111.27	94.36	28.36	25.99	0.866	0.807	0.837	94.63	79.20	86.92
T ₄ - 25% RDN-CF + 75% N-OM	104.35	88.10	26.18	25.22	0.754	0.748	0.751	78.69	68.70	73.69
T ₅ -100% RDN - OM	96.30	84.59	25.23	24.41	0.677	0.709	0.693	65.04	62.64	63.84
SEm±	0.94	0.46	0.21	0.10	0.008	0.009	0.004	0.87	0.263	0.50
C.D. at 5%	3.08	1.49	0.67	0.34	0.025	0.030	0.012	2.83	0.86	1.63
Interaction effect (P x T)										
P X T	NS	NS	NS	NS	SIG	SIG	SIG	SIG	SIG	SIG
General mean	111.7	93.4	28.2	26.0	0.857	0.819	0.838	96.15	78.17	87.16

RDN recommended dose of nitrogen. PRP- Paired row planting, SRP- Single row planting CF- Chemical fertilizer OM – organic Manure

Table 3: Interactive effect of planting geometries and integrated nutrient management on Single cane weight (kg) and millable cane yield t ha⁻¹

Treatment	Integrated nutrient management					
Planting geometries (P)	T ₁ -100% RDN-CF	T ₂ -75% RDN-CF + 25% N-OM	T ₂ -50% RDN-CF + 50% N-OM	T ₂ -25% RDN-CF + 75% N-OM	T ₅ -100% RDN-OM	General mean
	Single cane weight (kg)(Pooled data)					
P ₁ - 75 cm SRP	0.80	0.82	0.69	0.66	0.60	0.71
P ₂ - 90 cm SRP	0.94	0.94	0.84	0.75	0.71	0.84
P ₃ - 60 - 90 cm PRP	0.84	0.86	0.74	0.63	0.56	0.72
P ₄ - 60 -120 cm PRP	1.05	1.06	0.92	0.83	0.75	0.92
P ₅ -60 - 150 cm PRP	1.05	1.03	0.88	0.80	0.76	0.90
P ₆ -75 - 150 cm PRP	1.02	1.05	0.91	0.81	0.75	0.91
General Mean	0.95	0.96	0.83	0.75	0.69	0.83
SEm±	0.013					
C.D. at 5%	0.04					
Sugarcane yield (t ha ⁻¹)						
P ₁ - 75 cm SRP	89.45	88.34	70.78	62.73	55.56	73.37
P ₂ - 90 cm SRP	98.51	100.84	83.16	72.59	60.29	83.08
P ₃ - 60 - 90 cm PRP	100.91	103.36	84.18	68.22	56.40	82.61
P ₄ - 60 -120 cm PRP	125.16	127.60	101.42	87.27	77.26	103.74
P ₅ -60 - 150 cm PRP	108.68	112.13	90.91	74.07	67.27	90.61
P ₆ -75 - 150 cm PRP	105.77	107.24	91.05	77.29	66.26	89.52
General Mean	104.75	106.58	86.92	73.69	63.84	87.16
SEm±	1.15					
C.D. at 5%	3.30					

Table 4: Quality and economics analysis of sugarcane as influenced by planting geometries and integrated nutrient management at harvest (two years)

Treatment	Soil physical properties				Soil biological properties						Soil chemical properties					
	Bulk density g cc ⁻¹		MWHC %		Bacteria (x10 ⁵ cfu g ⁻¹ soil)		Fungi (x10 ³ cfu g ⁻¹ soil)		Actinomycetes (x10 ⁵ cfu g ⁻¹ soil)		EC		Soil pH		% organic carbon	
Planting geometries (P)	2018 Plant	2019 Ratoon	2018 Plant	2019 Ratoon	2018 Plant	2019 Ratoon	2018 Plant	2019 Ratoon	2018 Plant	2019 Ratoon	2018 Plant	2019 Ratoon	2018 Plant	2019 Ratoon	2018 Plant	2019 Ratoon
P ₁ - 75 cm SRP	1.307	1.303	54.01	55.37	217.9	221.1	34.87	34.60	63.73	64.87	0.043	0.0470	5.886	5.819	0.883	0.919
P ₂ - 90 cm SRP	1.304	1.296	54.48	54.93	219.3	221.2	34.47	34.73	63.93	65.73	0.043	0.0469	5.878	5.819	0.890	0.923
P ₃ - 60 - 90 cm PRP	1.305	1.295	54.17	55.17	218.7	222.6	34.93	34.87	63.60	65.33	0.044	0.0467	5.860	5.816	0.893	0.921
P ₄ - 60 -120 cm PRP	1.312	1.285	54.57	55.59	219.7	223.4	35.60	34.67	63.40	65.00	0.043	0.0469	5.876	5.817	0.881	0.914
P ₅ -60 - 150 cm PRP	1.307	1.293	53.90	55.93	219.3	222.4	34.20	35.40	63.73	65.67	0.045	0.0467	5.874	5.803	0.887	0.922
P ₆ -75 - 150 cm PRP	1.307	1.294	54.51	55.80	219.5	221.3	34.00	35.53	64.13	65.73	0.044	0.0469	5.863	5.789	0.889	0.923
SEm±	0.003	0.003	0.34	0.43	0.6	0.9	0.46	0.34	0.22	0.38	0.0005	0.0004	0.007	0.010	0.004	0.006
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Integrated nutrient management (T)																
T ₁ -100% RDN-CF	1.383	1.402	47.38	44.54	204.9	203.5	24.33	21.72	51.72	49.28	0.057	0.060	5.711	5.594	0.791	0.725
T ₂ -75% RDN-CF + 25% N-OM	1.339	1.346	50.88	53.12	214.1	214.7	30.22	27.06	58.39	60.33	0.049	0.053	5.759	5.676	0.841	0.848
T ₃ -50% RDN-CF + 50% N-OM	1.303	1.291	54.77	56.25	219.7	223.3	34.94	35.28	64.06	66.22	0.044	0.045	5.842	5.779	0.897	0.916
T ₄ -25% RDN-CF + 75% N-OM	1.272	1.238	57.92	60.44	226.1	231.6	40.61	42.83	69.94	72.94	0.038	0.041	5.979	5.881	0.938	0.986
T ₅ -100% RDN - OM	1.237	1.195	60.42	62.98	230.6	236.9	43.28	47.94	74.67	78.17	0.032	0.034	6.073	6.123	0.969	1.127
SEm±	0.002	0.003	0.25	0.36	0.4	0.9	0.42	0.29	0.41	0.30	0.0005	0.001	0.007	0.003	0.003	0.006
C.D. at 5%	0.006	0.009	0.83	1.17	1.3	2.9	1.38	0.96	1.34	0.99	0.002	0.002	0.021	0.009	0.008	0.020
Interaction effect (PxT)																
P X T	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General mean	1.31	1.29	54.27	55.47	219.1	222.0	34.68	34.97	63.76	65.39	0.044	0.047	5.87	5.81	0.887	0.920
Initial values	1.36	1.31	49.34	54.27	214.0	219.1	26.0	34.68	54.00	63.76	0.055	0.044	5.06	5.87	0.840	0.887

RDN recommended dose of nitrogen. PRP- Paired row planting, SRP- Single row planting CF- Chemical fertilizer OM – organic Manure

Table 5: Balance sheet of available soil nitrogen, phosphorus and potassium as influenced by planting geometries and integrated nutrient management at harvest of sugarcane after both the years (2018to 2019)

Treatments	Initial soil available nutrients (kg ha ⁻¹)			Nutrients added during both years (kg ha ⁻¹)			Nutrients removal by crop during both years (kg ha ⁻¹)			Soil available nutrients after harvest of ratoon (kg ha ⁻¹)			Net soil nutrients gain/ loss (kg ha ⁻¹)		
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
Planting Geometries (P)															
P ₁ - 75 cm SRP	267.4	11.6	240.3	500	250	250	392.7	70.0	428.3	280.5	21.6	234.9	13.1	10.0	-5.4
P ₂ - 90 cm SRP	267.4	11.6	240.3	500	250	250	415.4	77.1	457.3	279.5	21.1	236.0	12.1	9.5	-4.3
P ₃ - 60 - 90 cm PRP	267.4	11.6	240.3	500	250	250	412.9	74.9	456.9	280.2	21.5	235.9	12.8	9.9	-4.4
P ₄ - 60 -120 cm PRP	267.4	11.6	240.3	500	250	250	465.4	90.2	512.1	279.9	22.0	236.1	12.5	10.4	-4.2
P ₅ -60 - 150 cm PRP	267.4	11.6	240.3	500	250	250	446.4	85.1	494.5	280.3	21.4	236.3	12.9	9.8	-4.0
P ₆ -75 - 150 cmPRP	267.4	11.6	240.3	500	250	250	438.5	83.4	491.9	281.0	21.9	236.6	13.6	10.3	-3.7
Integrated Nutrient management (T)															
T ₁ -100% RDN-CF	267.4	11.6	240.3	500	250	250	434.8	82.3	480.7	258.0	12.8	213.2	-9.4	1.2	-27.1
T ₂ -75% RDN-CF + 25% N-OM	267.4	11.6	240.3	500	250	250	440.7	84.2	485.3	268.1	17.6	222.3	0.7	6.0	-18.0
T ₃ -50% RDN-CF + 50% N-OM	267.4	11.6	240.3	500	250	250	428.6	80.3	473.1	286.6	22.3	237.8	19.2	10.7	-2.5
T ₄ -25% RDN-CF + 75% N-OM	267.4	11.6	240.3	500	250	250	422.4	78.0	466.7	294.5	26.3	248.3	27.1	14.7	8.0
T ₅ -100% RDN - OM	267.4	11.6	240.3	500	250	250	416.3	75.7	461.8	294.0	29.0	258.3	26.6	17.4	18.0
General mean	267.4	11.6	240.3	500	250	250	428.6	80.1	473.5	280.2	21.6	235.9	12.8	10	-4.4

RDN recommended dose of nitrogen. PRP- Paired row planting, SRP- Single row planting CF- Chemical Fertilizer OM –Organic

Conclusion

It is concluded that, for maintaining higher productivity of sugarcane with sustained soil health it should be planted at 60-120 cm (PRP) and fertilized with 75% N inorganic + 25% N organic.

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