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## Response of inter and intra row spacing of sugarcane by using single eye bud settling on nutrient content, uptake and soil fertility status after harvest of sugarcane

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**Abstract**

A field experiment was conducted in clay soil in texture, low in organic carbon (0.27 and 0.32%), low in available nitrogen (210 and 204 kg/ha), medium in available phosphorus (24 and 29 kg/ha), high in available potassium (281 and 289 kg/ha) and slightly alkaline in reaction (pH 7.57 and 7.54) with normal electrical conductivity (0.33 and 0.38 dS/m) during the year 2017-18 and 2018-19, respectively to study the response of inter and intra row spacing of sugarcane by using single eye bud settling on nutrient content, uptake and soil fertility status after harvest of sugarcane at Main Sugarcane Research Station, Navsari, Navsari Agricultural University, Gujarat, India during 2017-18 and 2018-19. On the basis of pooled analysis, significantly higher total nitrogen, phosphorus and potassium uptake at harvest recorded under planting of single eye bud settling at 120 cm (R2) and remained at par with planting of single eye bud settling at 135 cm (R3) inter row spacing. Maximum total potassium uptake at harvest noted significantly under planting of single eye bud settling at 120 cm inter row spacing over rest of the treatments. Significantly superior total nitrogen and phosphorus uptake at harvest obtained under planting of single eye bud settling at 60 cm (S2) intra row spacing over rest of treatments. The interaction effect between different inter and intra row spacing showed that treatment combination 120 cm x 60 cm (R2S2) found significantly higher total nitrogen, phosphorus and potassium uptake at harvest which remained at par with 135 cm x 60 cm (R3S2). Nutrient content in cane and trash as well as soil nutrient status after harvest of crop did not show any significant influence due to different inter and intra row spacing of sugarcane.

**Keywords:** Spacing, nutrient content, uptake and soil fertility status

**Introduction**

Sugarcane is the most important commercial crop of India and cultivated sugarcane on 4.73 million hectares area with production of 376 million tonnes of sugarcane, 32.32 million tonnes of sugar and 10.73% sugar recovery with an average productivity 79.60 t/ha during 2017-18 (Anonymous, 2019) [1]. The important sugarcane producing districts of Gujarat are Junagadh, Baroda, Namrada, Bharuch, Tapi, Surat, Navsari and Valsad. The state cultivated crop on area of 1.82 lakh hectares with production of 120.52 lakh tonnes of sugarcane and 10.67 lakh tonnes of sugar, 10.19% sugar recovery with an average productivity 66.22 t/ha during 2017-18 (Anonymous, 2019) [1]. Among different agronomic management practices, row spacing influences sugarcane productivity by maintaining adequate stalk population per unit area. Planting geometry plays an important role in water use efficiency, interception of solar radiation and evaporation. Row spacing is considered to be the most important planting geometry parameter in sugarcane. It ensures more uniform allocation of plants in an area and makes canopy of plant more efficient in intercepting radiant energy. Sugarcane yield is also affected by the spacing between the rows (Garside *et al.*, 2009) [3]. Planting density plays an important role in the amount of solar radiation intercepted and water transpired by crop canopy which intern affects the photosynthesis and ultimately the dry matter produced and sugar extracted by sugarcane plant. Plant spacing is the critical one for providing proper nutrition, water and light to the crop plants. Hence this research serves to come up standard intra row plant spacing that can be adopted by sugarcane grower so as to attain high returns. Transplanting sugarcane seedlings in wider row spacing provides more

space and sunlight for a longer duration which increases cane productivity and also facilitates intercropping and mechanization of sugarcane agriculture from transplanting to harvesting. The maximum net returns were obtained with bud chips raised seedlings (Jain *et al.*, 2009) <sup>[7]</sup>.

South Gujarat has good potential of expanding area under sugarcane by adopting alternative planting method like sugarcane settling. One of the reasons for decline in yield is due to planting of pre-season and suru sugarcane immediately after harvest of the *kharif* crop without proper land preparation due to time limitations. Settling planting also reduces the seed requirement by 50 to 60% than that of conventional sett planting. The other advantages are reduced water requirement during nursery stage. Progressive farmers are adopting settling planting material for sugarcane planting. However, no adequate information is so far available on inter and intra row spacing of sugarcane by using single eye bud settling in Gujarat. Keeping all these aspects in view, the present study was carried out with an objective to find out suitable inter and intra row spacing of sugarcane by using single eye bud settling for improving sugarcane productivity.

### Materials and Methods

A field study was carried out at Main Sugarcane Research Station, Navsari, Navsari Agricultural University, Gujarat, India during 2017-18 and 2018-19. It comprised total sixteen treatments of four inter row spacing *viz.*, planting of single eye bud settling at 105 cm row spacing (R1), at 120 cm row spacing (R2), at 135 cm row spacing (R3) and at 150 cm row spacing (R4) and four intra row spacing *viz.*, planting of single eye bud settling at 45 cm (S1), at 60 cm intra row spacing (S2), at 75 cm intra row spacing (S3) and at 90 cm intra row spacing (S4) were evaluated in split plot design with three replications. Single eye bud settlings were transplanted as per different treatments of inter and intra row spacing. The composite soil samples from 0 to 20 cm depth were collected before planting and at harvest from treatment wise net plot area. Soils were air dried in shade, powdered and passed through 2 mm sieve and standard methods analysed for pH and EC (Jackson, 1979) <sup>[6]</sup>, Organic carbon (Walkley and Black, 1934) <sup>[17]</sup>, available N (Subbiah and Asija, 1956) <sup>[15]</sup>, P<sub>2</sub>O<sub>5</sub> (Olsen, 1954) <sup>[10]</sup> and K<sub>2</sub>O (Jackson, 1973) <sup>[5]</sup>. The plant samples were sun dried for week and oven dried at 60°C ± 5°C temperature for 24 hours. The dried samples were powdered using mixer having stainless

steel blades. The plant samples were analyzed for total N (Trivedi *et al.*, 1999) <sup>[16]</sup>, P and K content (Jackson, 1979) <sup>[6]</sup> by standard procedures. The dry matter yield and individual concentration of element were used for computing uptake. The total uptake was calculated by summation of whole cane uptake. Settlings of sugarcane variety CoN 05071 were planted in first week of December, 2017 and 2018 and harvested in the first week of December, 2018 and 2019. Recommended doses of fertilizers were applied to sugarcane (N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O 250: 115: 115 kg/ha). Nitrogen was applied in four splits (15% at planting, 30% at 6-8 weeks after planting, 20% at 12-16 weeks after planting and 35% at earthing up) and dose of phosphorus and potassium fertilizers (50% at the time of planting and 50% at the time of earthing up). Data obtained from the field study was statistically analyzed by standard statistical methods by Panse and Sukhatme (1967) <sup>[11]</sup> and Gomez and Gomez (1984) <sup>[4]</sup>.

### Results and Discussion

#### Effect on nutrient content and uptake Effect of inter row spacing

It is evident from the data presented on nitrogen, phosphorus and potassium content in cane and trash at harvest (Table 1) as influenced by different inter row spacing did not exert any significant influence in pooled results. Similar results are reported by Krishnamurthy *et al.*, (2018) <sup>[9]</sup> and Singh *et al.*, (2019) <sup>[14]</sup>.

The perusal of data on total nitrogen (132.54 kg/ha) and phosphorus (37.78 kg/ha) uptake at harvest (Table 2) were significantly higher at planting of single eye bud settling at 120 cm (R2) and remained at par with planting of single eye bud settling at 135 cm (R3). Total potassium uptake at harvest (248.69 kg/ha) was significantly maximum under planting of single eye bud settling at 120 cm (R2) over rest of the treatments. This might be due to higher cane yield resulted into higher uptake of nutrients. These results are in consonance with those of Jayaramudu (2012) <sup>[8]</sup>, Patel *et al.*, (2014) <sup>[12]</sup>, Krishnamurthy *et al.*, (2018) <sup>[9]</sup> and Singh *et al.*, (2019) <sup>[14]</sup>.

#### Effect on intra row spacing

The result revealed that nitrogen, phosphorus and potassium content in cane and trash (Table 1) did not influence due to various intra row spacing in pooled analysis. Similar findings are reported by Chaudhari (2019) <sup>[2]</sup>.

On the basis of pooled results, superior total nitrogen (147.03 kg/ha), phosphorus (42.23 kg/ha) and potassium (278.39 kg/ha) uptake at harvest (Table 2) recorded significantly under planting of single eye bud settling at 60 cm (S2) over rest of the treatments. The higher uptake of nutrients resulted in higher yield of cane, indicating thereby the response to intra row spacing of 60 cm than 90 cm intra row spacing. Results are earlier reported by Raskar (2002) <sup>[13]</sup> and Chaudhari (2019) <sup>[2]</sup>.

#### Interaction effect

In pooled findings data, interaction effect between various inter and intra row spacing failed to express its significant effect on nitrogen, phosphorus and potassium content in cane and trash. Significantly higher total nitrogen (167.18 kg/ha), phosphorus (48.46 kg/ha) and potassium (314.52 kg/ha) uptake at harvest (Table 2a) were reported under treatment combination 120 cm x 60 cm (R2S2) which remained at par with 135 cm x 60 cm (R3S2). The difference in uptake might be due to difference in cane yield under different inter and intra row spacing. These findings are in agreement with Yadav (1984) <sup>[18]</sup>, Raskar (2002) <sup>[13]</sup>, Krishnamurthy *et al.*, (2018) <sup>[9]</sup> and Chaudhari (2019) <sup>[2]</sup>.

#### Effect on soil status after harvest Effect of inter row spacing

The perusal of data (Table 3) on soil pH, EC and organic carbon after harvest

of sugarcane revealed that various inter row spacing did not exert any significant effect during both the years. These results were in close conformity with Krishnamurthy *et al.*, (2018) <sup>[9]</sup>. Data furnished in Table 4 showed that different inter row spacing did not affect significantly on soil available nitrogen, phosphorus and potassium after harvest of sugarcane crop during both the years. Similar results are reported by Krishnamurthy *et al.*, (2018) <sup>[9]</sup>, Singh *et al.*, (2019) <sup>[14]</sup> and Chaudhari (2019) <sup>[2]</sup>.

**Effect of intra row spacing**

An examination of data presented in Table 3 on soil pH, EC and organic carbon after harvest of sugarcane revealed that various intra row spacing failed to express its significant influence during both the years. These results are in close conformity with Krishnamurthy *et al.*, (2018) <sup>[9]</sup>. Data summarized in Table 4 revealed that different intra row spacing did not differ significantly on soil available nitrogen, phosphorus and potassium after harvest of sugarcane during both the years. Similar results are reported by Krishnamurthy

*et al.*, (2018) <sup>[9]</sup>, Singh *et al.*, (2019) <sup>[14]</sup> and Chaudhari (2019) <sup>[2]</sup>.

**Interaction effect**

Interaction effect between inter and intra row spacing on soil pH, EC, organic carbon, soil available nitrogen, phosphorus and potassium (kg/ha) after harvest of sugarcane failed to get the level of significance during both the years. The results are in conformity with the findings of Krishnamurthy *et al.*, (2018) <sup>[9]</sup>, Chaudhari (2019) <sup>[2]</sup> and Singh *et al.*, (2019) <sup>[14]</sup>.

**Table 1:** Nutrient content (%) in cane and trash at harvest as influenced by different treatments of row and intra row spacing

Treatment	Nutrient content (%) in cane			Nutrient content (%) in trash		
	Nitrogen content (%)	Phosphorus content (%)	Potassium content (%)	Nitrogen content (%)	Phosphorus content (%)	Potassium content (%)
<b>(A) Main plot factor (Inter row spacing)</b>						
R1: Planting of single eye bud settling at 105 cm	0.234	0.083	0.525	0.523	0.073	0.725
R2: Planting of single eye bud settling at 120 cm	0.232	0.086	0.505	0.523	0.074	0.713
R3: Planting of single eye bud settling at 135 cm	0.232	0.086	0.504	0.521	0.074	0.716
R4: Planting of single eye bud settling at 150 cm	0.236	0.086	0.510	0.521	0.072	0.718
SEm±	0.001	0.001	0.005	0.002	0.001	0.003
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV (%)	2.72	5.49	4.91	2.124	5.512	1.901
<b>(B) Sub plot factor (Intra row spacing)</b>						
S1: Planting of single eye bud settling at 45 cm	0.233	0.085	0.518	0.518	0.072	0.720
S2: Planting of single eye bud settling at 60 cm	0.231	0.086	0.510	0.521	0.075	0.716
S3: Planting of single eye bud settling at 75 cm	0.236	0.086	0.509	0.524	0.073	0.719
S4: Planting of single eye bud settling at 90 cm	0.235	0.085	0.508	0.524	0.073	0.716
SEm±	0.001	0.001	0.003	0.002	0.001	0.002
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV (%)	2.66	4.49	2.73	1.816	6.141	1.143
<b>Interaction (M x S)</b>						
SEm±	0.0025	0.0016	0.0057	0.004	0.002	0.003
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV (%)	2.66	4.492	2.729	1.816	6.141	1.143
General mean	0.234	0.085	0.511	0.522	0.073	0.718

**Table 2:** Effect of inter and intra row spacings of sugarcane on total nutrient uptake (kg/ha) at harvest

Treatment	Total nitrogen uptake (kg/ha)	Total phosphorus uptake (kg/ha)	Total potassium uptake (kg/ha)
<b>(A) Main plot factor (Inter row spacing)</b>			
R1: Planting of single eye bud settling at 105 cm	107.41	29.60	206.56
R2: Planting of single eye bud settling at 120 cm	132.54	37.78	248.69
R3: Planting of single eye bud settling at 135 cm	121.80	34.85	228.52
R4: Planting of single eye bud settling at 150 cm	110.90	31.31	207.63
SEm±	3.87	1.14	5.88
CD (P=0.05)	11.94	3.52	18.13
CV (%)	16.06	16.74	12.93
<b>(B) Sub plot factor (Intra row spacing)</b>			
S1: Planting of single eye bud settling at 45 cm	111.18	31.21	213.08
S2: Planting of single eye bud settling at 60 cm	147.03	42.23	278.39
S3: Planting of single eye bud settling at 75 cm	120.76	34.00	224.88
S4: Planting of single eye bud settling at 90 cm	93.67	26.09	175.06
SEm±	2.75	0.77	5.39
CD (P=0.05)	7.82	2.19	15.32
CV (%)	11.41	11.29	11.84
<b>Interaction (M x S)</b>			
SEm±	5.50	1.54	10.78
CD (P=0.05)	15.65	5.90	30.64
CV (%)	11.41	11.29	11.84
General mean	118.16	33.38	222.85

**Table 3:** pH, EC and organic carbon in soil after harvest of sugarcane as influenced by different treatments of inter and intra row spacing

Treatment	pH		EC (dS/m)		Organic carbon (%)	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
<b>(A) Main plot factor (Row spacing)</b>						
R1: Planting of single eye bud settling at 105 cm	7.58	7.56	0.33	0.34	0.33	0.35
R2: Planting of single eye bud settling at 120 cm	7.63	7.65	0.34	0.35	0.36	0.36
R3: Planting of single eye bud settling at 135 cm	7.60	7.64	0.34	0.35	0.35	0.35
R4: Planting of single eye bud settling at 150 cm	7.58	7.62	0.35	0.36	0.34	0.34
SEm±	0.02	0.03	0.01	0.01	0.01	0.01
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV (%)	1.11	1.39	7.86	5.57	8.01	7.45
<b>(B) Sub plot factor (Intra row spacing)</b>						
S1: Planting of single eye bud settling at 45 cm	7.56	7.62	0.34	0.35	0.33	0.35
S2: Planting of single eye bud settling at 60 cm	7.64	7.63	0.34	0.35	0.35	0.34
S3: Planting of single eye bud settling at 75 cm	7.63	7.62	0.33	0.34	0.36	0.37
S4: Planting of single eye bud settling at 90 cm	7.57	7.60	0.35	0.36	0.34	0.36
SEm±	0.04	0.03	0.01	0.01	0.01	0.01
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV (%)	1.63	1.45	5.20	5.39	7.67	9.97
<b>Interaction (M x S)</b>						
SEm±	0.07	0.06	0.01	0.01	0.02	0.02
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV (%)	1.63	1.45	5.20	5.39	7.67	9.97
General mean	7.60	7.62	0.34	0.35	0.34	0.35
Initial status	7.57	7.54	0.33	0.38	0.27	0.32

**Table 4:** Available nitrogen, phosphorus and potassium in soil after harvest of sugarcane as influenced by different treatments of inter and intra row spacing

Treatment	Available nitrogen (kg/ha)		Available phosphorus (kg/ha)		Available potassium (kg/ha)	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
<b>(A) Main plot factor (Row spacing)</b>						
R1: Planting of single eye bud settling at 105 cm	275.38	265.91	25.20	32.66	287.76	305.19
R2: Planting of single eye bud settling at 120 cm	271.39	263.67	24.77	32.80	285.82	301.92
R3: Planting of single eye bud settling at 135 cm	276.69	266.09	25.26	33.67	287.98	306.81
R4: Planting of single eye bud settling at 150 cm	271.44	259.27	25.08	32.88	281.86	301.97
SEm±	4.44	4.74	0.68	0.41	4.13	4.47
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV (%)	5.62	6.22	9.42	4.35	5.00	5.09
<b>(B) Sub plot factor (Intra row spacing)</b>						
S1: Planting of single eye bud settling at 45 cm	273.35	264.80	24.93	32.68	286.09	303.80
S2: Planting of single eye bud settling at 60 cm	272.50	259.81	24.71	33.29	281.09	302.67
S3: Planting of single eye bud settling at 75 cm	273.18	263.89	25.18	32.73	285.89	303.94
S4: Planting of single eye bud settling at 90 cm	275.88	267.69	25.50	33.32	289.47	305.48
SEm±	2.96	3.05	0.64	0.67	3.22	2.87
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV (%)	3.74	4.01	8.77	7.00	3.90	3.27
<b>Interaction (M x S)</b>						
SEm±	5.91	6.11	1.27	1.33	6.44	5.74
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV (%)	3.74	4.01	8.77	7.00	3.90	3.27
General mean	273.73	263.92	25.08	33.00	285.85	303.97
Initial status	210	204	24	29	281	289

**Table 2a:** Interaction effect as influenced by different inter and intra row spacing on nutrient uptake of sugarcane

Intra row spacing (S)	Nitrogen uptake (kg/ha)				Phosphorus uptake (kg/ha)			
	Inter row spacing (R)							
	R1	R2	R3	R4	R1	R2	R3	R4
S1	100.23	120.32	112.37	111.80	27.90	33.91	32.08	30.97
S2	114.60	167.18	162.56	143.79	31.93	48.46	46.85	41.70
S3	104.84	142.32	125.58	110.29	28.68	40.73	35.95	30.63
S4	109.95	100.32	86.67	77.74	29.88	28.03	24.52	21.93
SEm±	5.50				1.54			
CD (P=0.05)	15.65				4.37			
CV (%)	11.41				11.29			
Intra row spacing (S)	Potassium uptake (kg/ha)							
	R1	R2	R3	R4				
	R1	R2	R3	R4				
S1	193.76	233.69	213.13	210.31				
S2	218.59	314.52	308.69	271.74				
S3	200.57	261.34	229.44	208.18				
S4	211.92	185.21	162.80	140.30				
SEm±	10.75							
CD (P=0.05)	30.56							
CV (%)	11.82							

## Conclusion

From this experimental results, it was concluded that different inter and intra row spacing failed to get the level of significance on soil pH, EC, organic carbon, soil available nitrogen, phosphorus and potassium after harvest of sugarcane during both the years. Significantly higher total nitrogen, phosphorus and potassium uptake at harvest were recorded under treatment combination 120 cm x 60 cm (R2S2) inter and intra row spacing, respectively which remained at par with 135 cm x 60 cm (R3S2).

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