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Influence of plant growth regulators on growth, yield and quality of sugarcane under south Gujarat

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Abstract

Field experiment to assess the effects of *ethrel* and gibberellic acid on growth, yield and quality of sugarcane was conducted for three years (2014-15, 2015-16 and 2016-17) at the Main Sugarcane research Station, Navsari Agricultural University, Navsari, Gujarat, India. The results of the experiment indicated that planting of sugarcane with overnight soaking in 50 ppm *ethrel* solution increase germination to tune of 18.54% over conventional system of planting. Tiller population was also noticed significantly highest almost with growth regulators applied plots at both stages. Leaf area index was significantly increased with overnight soaking of setts in 50 or 100 ppm *ethrel* solution with spraying of gibberellic acid (35 ppm) at 90, 120 and 150 DAP (days after planting) (T₈) as compared to three budded setts planting. Yield and yield parameters viz., number of millable cane (108.23 000 ha⁻¹), cane length (264.50 cm), cane and commercial cane sugar yield (124.09 and 16.55 t ha⁻¹) respectively, was also recorded significantly highest with treatment T₈ as compared to conventional planting. Significant difference in juice quality parameters were not observed due to growth regulators treatment. Thus, the study showed that to obtain higher sugarcane production, setts should be planted after overnight soaking in 100 ppm *ethrel* solution with spraying of GA₃ at 90, 120 and 150 DAP.

Keywords: *Ethrel*, Gibberellic acid, growth, Yield, Sugarcane

Introduction

Sugarcane is one of the important cash crop of India which is vegetatively propagated and grown for sugar and energy in tropical subtropical India. It require large quantity of seed cane about 6-8 tonnes ha⁻¹ (nearly 10% of total produce) for planting. Sugarcane crop be rationed for few year/years, so it is important to ensure food stand. Farmers often use high seed cane rates for good establishment. Plant growth regulators (PGRs) are organic compounds which are needed in small quantities at low concentrations to modify plant growth and development. These growth regulators are used to stimulate sugar accumulation in the stalk on mature cane and cause sprouting at lower nodes. This leads to better stands at planting using less seed material. Beneficial effects of various growth substances on growth and yield of sugarcane ^[1, 2, 3]. Gibberellic acid stimulated stem elongation in sugarcane under green house conditions and under commercial field conditions has been reported from different sugarcane growing countries of the world ^[4]. Although the effect of *ethrel* on cane flowering has been studied by earlier workers but there are not much studies on effect of *ethrel* on germination further germination % of sugarcane is generally low due to slow initial growth. Hence an attempt has been made in the present study to find out the effect of growth regulating substances viz. gibberellic acid and *ethrel* on germination, growth and yield of sugarcane under field conditions.

Materials and Methods

A field experiment was conducted during 2014-15 to 2016-17 at research farm of Main Sugarcane Research Station, Navsari Agricultural University, Navsari, Gujarat to study the influence of growth regulators on growth and yield of sugarcane. The experimental soil was clay in texture, medium in organic carbon, medium in available nitrogen, high in available phosphorus and high in potassium with 7.78 pH. The treatment were: T₁ – Conventional planting/ farmers practice (3 budded setts), T₂ – Planting of setts after overnight soaking in water, T₃ – Planting of setts after overnight soaking in 50 ppm *ethrel* solution, T₄ – Planting of setts after overnight soaking in 100 ppm *ethrel* solution, T₅ – T₁ + Gibberellic acid (GA₃) spray (35 ppm) at 90, 120 and 150 DAP, T₆ – T₂ + GA₃ spray (35 ppm) at 90, 120 and 150 DAP, T₇ – T₃ + GA₃ spray (35 ppm) at 90, 120 and 150 DAP and T₈ – T₄ + GA₃ spray (35 ppm) at 90, 120 and 150 DAP.

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Sugarcane (CoN 05071) was planted in furrow at 90 cm apart in randomized block design and replicated thrice. Healthy cane setts having viable buds were planted after above sett treatment in different experimental plots. The crop was uniformly fertilized with recommended dose of 250 kg N, 125 kg P₂O₅ and 125 kg K₂O ha⁻¹. Urea, single super phosphate and muriate of potash were taken as sources of nitrogen, phosphorus and potassium, respectively. 100% recommended dose of P₂O₅ (125 kg ha⁻¹) and K₂O (125 kg ha⁻¹) applied at the time of planting while nitrogen 100% (250 kg ha⁻¹) applied in four splits among which 15% of recommended dose of N (37.5 kg ha⁻¹) was applied at the time of planting and remaining 85% of N was applied in three splits i. e. 30%, 20% and 35% at 1.5 month, 3 and 5 month after planting respectively. In each year other recommended packages of practices were adopted as and when required by the crop. The crop was planted in autumn and harvested in early spring season during all the three years of experimentation. Commercial cane sugar (ccs) yield (t ha⁻¹) was calculated as: cane yield (t ha⁻¹) x ccs%/100. Whole cane samples were taken at the time of harvest and cane juice was extracted with power crusher and juice quality was estimated [5].

Result and Discussion

Germination counts were recorded at 40 days after planting. The pooled data of three years on growth is presented in Table 1. The data revealed that there was significant variation in germination per cent observed due to different treatments. Significantly higher germination per cent was recorded with planting of two budded setts after overnight soaking in 50 (T₃) (53.32%) and 100 ppm (T₄) (51.20%) *ethrel* solution and found equally effective over other treatment further T₃ recorded to the tune of 18.54% higher germination % over conventional system of planting. studies carried out at many places show that application of plant growth regulating chemical such as ethephon (*ethrel* or 2-chloroethyl phosphoric acid) leads to enhancement in seed cane sprouting under normal and late-planted conditions [6]. Tillers population at 90 and 150 DAP (166.17 and 182.59 000 ha⁻¹

respectively) was recorded significantly highest with treatment T₈ and at par with almost all the growth regulators receiving plots at both stages over conventional method of planting. Leaf area index at various growth stages was significantly increases with planting of setts after overnight soaking in 100 and 50 ppm *ethrel* solution with three spraying at 90, 120 and 150 DAP and remained at par with each other over three budded setts planting.

Looking to the yield parameters, significantly highest number of millable canes (NMC) and cane length were recorded with treatment T₇ and T₈ respectively over conventional method indicating growth regulators has beneficial effect on these parameters (table 1). Planting of setts after overnight soaking in 100 ppm *ethrel* solution + GA₃ spray at 90,120 and 150 DAP was excellent in increasing NMC and cane yield over conventional method [7]. Cane (124.09 t ha⁻¹) and CCS (16.55 t ha⁻¹) yields were also significantly higher in the treatment of T₈ (planting of setts after overnight soaking in 100 ppm *ethrel* solution + spraying of gibberellic acid (35 ppm) at 90, 120 and 150 DAP over conventional planting/farmers practices (3 budded setts) however it remained at par with setts planting after overnight soaking in 50 and 100 ppm without gibberellic acid spraying over farmers practices. The possibility of obtaining desirable response of sugarcane to foliar spray of GA₃ when applied at proper time [8]. Promising performance of gibberellic acid and *ethrel* on cane yield parameters confirming almost similar results [2]. GA₃ increased stem elongation and fresh weight of stem and leaf [9]. Effect of various treatments on juice quality parameters viz., brix%, pol % juice, purity %, CCS %, fibre % and pol % cane did not reach the level of significance (table 2). A significant increase in cane yield due to GA₃ application in pot experiment but no significant change in sucrose % and purity % of sugarcane juice was observed [10]. The main effect of applying *ethrel* to sugarcane as a ripener is increase in sucrose per cent, cane and juice purity without producing a noticeable effect on stalk mass within treatments. Gibberellic acid stimulated cane growth when it was sprayed at vegetative phase upto actively growing period. The results confirm the findings [11].

Table 1: Growth and yield of sugarcane as influenced by various treatments

Treatment	Germination % at 40 DAP	Number of tillers at (000/ha)		LAI (Leaf Area Index) at				NMC at harvest (000 ha ⁻¹)	Cane length (cm) at harvest	Cane yield (t ha ⁻¹)	CCS yield (t ha ⁻¹)
		90 DAP	150 DAP	90 DAP	150 DAP	210 DAP	300 DAP				
T ₁	44.98	149.07	155.75	0.28	1.00	2.51	3.59	86.70	225.69	100.45	13.37
T ₂	43.29	156.27	165.08	0.37	1.17	2.81	4.02	100.36	251.13	110.14	14.46
T ₃	53.32	162.46	172.41	0.33	1.13	2.89	4.14	103.49	258.01	115.22	15.41
T ₄	51.20	165.2	176.72	0.35	1.16	2.83	4.17	105.20	250.07	122.68	16.55
T ₅	44.60	158.15	164.50	0.33	1.02	2.58	3.83	97.26	242.37	105.31	14.45
T ₆	44.76	157.33	167.28	0.37	1.17	2.82	4.12	102.11	251.81	107.78	14.54
T ₇	47.55	164.75	183.27	0.36	1.23	3.00	4.38	109.48	262.61	121.38	16.25
T ₈	48.24	166.17	182.59	0.39	1.30	3.12	4.53	108.23	264.50	124.09	16.41
S.E.M.±	1.16	3.40	3.97	0.01	0.03	0.08	0.12	2.79	6.96	3.23	0.54
C.D. at 5%	3.29	9.64	11.24	0.03	0.10	0.22	0.35	7.90	19.72	9.16	1.52
C.V.%	7.99	6.75	7.47	9.94	9.29	8.17	8.65	8.21	8.55	8.49	9.82

Table 2: Effect of plant growth regulator on juice quality parameter

Treatment	Brix %	Pol % Juice	Purity %	CCS%	Fibre %	Pol % Cane
T ₁	20.93	19.02	90.42	13.30	14.11	14.43
T ₂	20.50	18.70	91.69	13.17	14.22	14.17
T ₃	20.69	18.91	92.20	13.34	14.24	14.33
T ₄	21.09	19.25	91.48	13.49	14.24	14.59
T ₅	21.43	19.35	90.01	13.73	14.30	14.65
T ₆	20.73	19.20	92.69	13.50	14.17	14.56
T ₇	21.02	19.20	91.97	13.38	14.21	14.55
T ₈	21.09	18.95	88.82	13.22	14.22	14.36
SEM.±	0.34	0.31	1.09	0.30	0.10	0.24
C.D. at 5%	NS	NS	NS	NS	NS	NS
C.V.%	4.71	3.40	3.83	4.57	2.30	3.40

Conclusion

Based on the results obtained, it can be concluded that planting of setts after overnight soaking in 100 ppm *ethrel* solution + GA₃ (35 ppm) spray at 90, 120 and 150 DAP was found excellent for increasing germination, tillers count, millable canes, cane and CCS yield than that of conventional system of planting.

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