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Effect of variety and irrigation regimes on growth attributes of sugarcane crop

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Abstract
A field experiment employing six elite sugarcane varieties, namely CoP 16437, CoP 112, BO 153, CoP 2061, BO 154 and CoP 9437 along with two different irrigation regimes (IW: CPE ratio 1.0 and 0.3) was conducted during *spring* season of 2018-19 at Sugarcane Research Institute, RPCAU, Pusa, Bihar to evaluate growth, yield and quality of sugarcane varieties as well as economics under drought condition. The experiment was laid out in strip plot design with three replications having twelve plots in each replication. In this paper, we discussed about only growth parameters. The data revealed that CoP 2061 performed well in terms of highest plant population (87.5×10^3 /ha and 130.8×10^3 /ha) at 60 and 90 DAP, plant height (130.0 cm and 196.0 cm) at 150 and 180 DAP, LAI (0.54, 1.81 and 2.99) at 50, 100 and 150 DAP, respectively. Application of irrigation regimes, IW: CPE ratio 1 showed significantly higher plant growth attributes compared to IW: CPE ratio 0.3 at all growth stages.

Keywords: Sugarcane, irrigation, growth, LAI

Introduction
Sweetness of any dish cannot be imagined without sugar. About 80 per cent of sugar production at global level is contributed by sugarcane crop. Sugarcane (*Saccharum* spp. hybrid complex) is a major agro-industrial crop of the country and holds a prominent position as a cash crop. Among the major sugarcane growing countries, India ranks second in the world after Brazil. In India, it is occupying around 5.0 million ha of area with an annual production of 411 million tonnes along with productivity of 81.5 t/ha (ISMA, 2019). In Bihar, it is cultivated in an area of 0.34 million ha with the production of 18.5 million tonnes and productivity of 62.0 t/ha (ISMA, 2019). Bihar opts rank 4th in the country under sugarcane area with a share of 5.58 per cent (2018-19). In India, Sugarcane is largely an irrigated crop and covered 90.2 per cent of area under irrigation (DES, 2017) [3]. However, in Bihar, only 79.3 per cent area of total cane cultivated under irrigation coverage (DES, 2017) [3] and rest is grown in rainfed conditions. Variety of any crop serves as reservoir for various traits. But under same input and environmental conditions all the varieties do not show same performance level. The response of specific variety depends on its genetic potential and the prevailing environmental condition where it is exposed during the course of life cycle. Sugarcane varieties with improved tolerance to adverse environmental conditions are highly desirable. Adoption of improved varieties not only increases cane productivity but also boosts sugar production. The selection of variety alone improves the cane yield in range of 28 to 60 per cent (Kathiresan *et al.*, 2001) [5]. Due to high tillering capability, wider adaptability to various agro climatic conditions and resistance to biotic and abiotic stresses with high yield potential, many successful varieties of sugarcane have been developed. Water is requisite ingredient for plant growth and development as well as other physiological processes of crop and these processes get altered due to the lack of this constituent (Sawhney and Singh, 2002) [10]. Lysimeter studies have shown that a sugarcane crop requires 88-118 kg water/kg cane and 884–1157 kg water/kg sugar produced, in plant and ratoon crops respectively (Shrivastava *et al.*, 2011) [11]. It has been estimated that sugarcane crop consumes about 250 tonnes of water per tonne of cane produced. According to need, irrigations are applied but irrigation number also depends upon various factors like climatic conditions, soil type, planting methods, use of manures and fertilizers and management practices. In sugarcane, irrigation assumes greater significance owing to the long duration of the crop leading to exposure to summer, winter and rainy season. Irrigation contributes to minimize water deficits which can ultimately cause reduction of dry matter

production, growth and yield of crop. Therefore, present investigation was undertaken to study the effect of variety and irrigation regimes on growth attributes of sugarcane crop.

Materials and Methods

Location and details of experimental site: An experiment was conducted at the Research Farm of Dr. Rajendra Prasad Central Agricultural University, Bihar, Pusa (Samastipur) during spring season of 2018-19. The soil of the experimental site was sandy loam in texture, alkaline in reaction and calcareous in nature. The plow layer of field was low in available nitrogen (210.0 kg/ha) and phosphorus (21.6 kg/ha), medium in potassium content (145.5 kg/ha). The experiment was laid out in strip plot design with three replications having twelve plots in each replication. The investigation comprising of 12 treatment combinations consisting of six different varieties (CoP 16437, CoP 112, BO 153, CoP 2061, BO 154 and CoP 09437) with two irrigation regimes (I_1 =1.0 and I_2=0.3) on the basis of IW: CPE ratio. Farm yard manure @ 200 q/ha was evenly spread and mixed thoroughly in soil at the time of field preparation. Half dose of N and full doses of P_2O_5 and K_2O were applied as basal and remaining half N was top-dressed at the time of earthing-up. Healthy canes with vigorous growth were selected for seed material. To check the fungal infection, setts were treated with bavistin (a fungicide) for 10 minute. Thimet 10 G (an insecticide) was applied in furrows @ 15 kg/ha. The treated setts were then placed in furrows and immediately covered up with soil using a country plough and finally the field was planked.

Data Collection

For the calculation of plant population, total number of plant population of four middle rows were recorded at monthly interval 60 and 90 DAP from each plot and expressed as thousand/ha. For plant height, ten randomly selected plants from net plot area were located and tagged. Height of these plants were recorded in centimeters from the soil surface to the blade joint of the full leaf on the top of the plant. Leaf area index was recorded from the forth row of each plot at interval of 50, 100, and 150 DAP. Leaf area of two leaves were determined by multiplying length, width, number of specific leaves and a correction factor (0.6274) determined by Bathla and Sharma (1978) [2]. LAI was determined by using the following formula:

$$LAI = \frac{\text{Total leaf area of 50 cm row length}}{\text{Land area (50 cm} \times \text{90 cm)}} \times 100$$

In order to test the significance of variation in experimental data obtained from various treatment effects, data were statistically analyzed by standard statistical procedure (Rangaswamy, 2006) [9]. The treatment means were compared at 5% level of significance.

Result and Discussion

Effect of variety and irrigation regimes on plant population is presented in table 1. Data from table showed that significantly higher plant population was recorded with the variety CoP 2061 (87.5× 10^3 /ha and 130.8× 10^3 /ha) which was followed by BO 153 and BO 154 at all the stages of growth. Higher plant population in the genotype CoP 2061 is due to their higher germination percentage at 45 DAP and high adaptability under existing conditions with higher water and nutrient use efficiency capabilities which may also enhanced photosynthetic rate, stomatal conductance and transpiration ratio. The results are in conformity with the findings of Meena *et al.* (2013) [6], Parajuli (2016) [8] and Archana *et al.* (2016) [1].

The plant population exhibited variable response to applied irrigation. Irrigation regimes at IW: CPE ratio of 1.00 recorded significantly higher plant population at all the stages of growth. This might be due to the fact that increased number of irrigation at formative phase (critical stage) led to effective uptake of water and nutrients leading to higher plant population.

The interaction effect of variety and irrigation regimes on plant population was found significant at 60 DAP. The variety CoP 2061 along with 4 irrigations at IW: CPE ratio 1.0 (I_1) was found significantly superior over rest of the varieties at 60 DAP.

Table 1: Effect of variety and irrigation regimes on plant population (× 10^3 /ha) of Sugarcane

Treatment	60 DAP	90 DAP
Variety		
CoP 16437	59.4	80.7
CoP 112	66.7	89.3
BO 153	77.8	112.0
CoP 2061	87.5	130.8
BO 154	71.5	102.2
CoP 9437	59.4	88.7
S.Em (±)	2.81	3.98
CD (P=0.05)	8.9	12.6
CV (%)	9.8	9.7
Irrigation regimes (IW: CPE)		
I_1 (1.0)	76.7	111.5
I_2 (0.3)	64.1	89.7
S.Em (±)	1.53	2.`21
CD (P=0.05)	9.3	13.4
CV (%)	9.2	9.3
Mean	**70.4**	**100.6**
Interation effect (V×I)		
S.Em (±)	2.17	4.31
CD (P=0.05)	6.9	NS
CV (%)	5.4	7.4

Among tested varieties, CoP 2061 (130.0 cm and 196.0 cm) gave the highest plant height followed by CoP 16437 at 150 and 180 DAP, respectively (Table 2.). The minimum plant height was recorded due to the variety BO 153. The variations in plant height among the varieties might be attributed to variation in partitioning of photosynthates by different varieties. Similar results were also noticed by other investigators (Zheng *et al.* 2011, Meena *et al.* 2013 and Parajuli 2016) [14, 6, 8].

Irrigation regimes significantly increased periodic plant height. The significant increase in plant height may be due to optimal supply of moisture at critical stages, thereby resulting in better growth and development of crop.

Table 2: Plant height (cm) at different growth stages of sugarcane as influenced by variety and irrigation regimes

Treatment	150 DAP	180 DAP
Variety		
CoP 16437	125.0	190.0
CoP 112	124.0	188.0
BO 153	98.5	153.5
CoP 2061	130.0	196.0
BO 154	123.5	187.0
CoP 9437	114.0	174.0
S.Em (±)	5.51	8.10
CD (P=0.05)	17.4	25.53
CV (%)	11.3	10.9
Irrigation regimes (IW: CPE)		
I_1 (1.0)	128.5	196.0
I_2 (0.3)	109.8	166.8
S.Em (±)	2.36	4.24
CD (P=0.05)	14.4	25.82
CV (%)	8.41	9.9
Mean	119.2	181.4

Data presented in table 3 revealed that among the variety, CoP 2061 recorded higher values of LAI (0.54, 1.81 and 2.99) over rest of the varieties at 50, 100 and 150 DAP, respectively. The higher plant population under this variety at all the stages of growth might be responsible for greater LAI. Similar findings were also reported by Naidu *et al.* (2008) [7], Singh *et al.* (2008) [12] and Sudhakar *et al.* (2010) [13].

Application of irrigation at 1.00 IW: CPE ratio gave the significantly highest LAI at 100 (1.42) and150 (2.74) DAP. The increase in LAI at higher level of irrigation may be attributed to enhanced growth of cane under adequate moisture level.

Table 3: Leaf area index (LAI) of sugarcane as influenced by variety and irrigation regimes

Treatment	50 DAP	100 DAP	150 DAP
Variety			
CoP 16437	0.52	1.45	2.75
CoP 112	0.31	1.02	2.13
BO 153	0.37	1.14	2.46
CoP 2061	0.54	1.81	2.99
BO 154	0.40	1.22	2.74
CoP 9437	0.39	1.15	2.43
S.Em (±)	0.02	0.05	0.12
CD (P=0.05)	0.05	0.17	0.37
CV (%)	9.70	9.90	11.24
Irrigation regimes (IW: CPE)			
I_1 (1.0)	0.41	1.42	2.74
I_2 (0.3)	0.43	1.18	2.43
S.Em (±)	0.01	0.03	0.05
CD (P=0.05)	NS	0.17	0.30
CV (%)	12.11	9.31	8.28
Mean	0.42	1.30	2.58

Conclusion

Sugarcane crop is of great importance in the Indian economy and industry as well as in Bihar as it is major sugar and energy crop. Based on findings, it is revealed that Variety CoP 2061 has performed significantly well in terms of plant population, plant height, and leaf area index at all the growth stages of observation. Similarly, in terms of highest growth parameters application of irrigation regime with an IW: CPE ratio 1.0 found significantly higher over IW: CPE ratio 0.3.

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