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OPTIMIZING WATER-USE EFFICIENCY IN SUGARCANE: COMPARATIVE PERFORMANCE OF VARIETIES UNDER VARYING IRRIGATION REGIMES

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ABSTRACT

A field experiment was conducted to evaluate the growth, physiological parameters and yield performance of pre released sugarcane varieties under varying irrigation regimes (0.3 & 1.0 IW/CPE) to identify drought-tolerant varieties, at research farms of Vasantdada Sugar Institute, Manjari Bk., Pune, Maharashtra, India during 2023-24 and 2024-25. The results revealed that increasing the irrigation level significantly enhanced several agronomic traits. At 1.0 IW/CPE irrigation regimes, there was a significant increase in tiller population at 120 and 150 days after planting, cane yield (137.36 t/ha), CCS yield (20.98 t/ha), cane height (301.04 cm) and dry matter accumulation at harvest (1104.84 g/clump), compared to 0.3 IW/CPE irrigation regimes. Among the varieties, VSI 21121, CoM 09057 and Co 12009 consistently performed better across multiple parameters. VSI 21121 recorded the highest cane yield (130.31 t/ha), tiller count (106.17 thousand/ha at 120 days after planting) and dry matter accumulation (1041.86 g/clump) while CoM 09057 showed superior germination (68.5%) and CCS yield (18.97 t/ha). Co 11015 had the highest sucrose content (23.17%). Sugarcane variety MS 10001 showed the most significant response, by achieving the highest cane yield of 114.43 t/ha under the deficit irrigation regime (0.3 IW/CPE), followed by VSI 21121 with 111.40 t/ha and Co 12009 with 108.90 t/ha. Based on the physiological traits and yield performance, MS 10001, VSI 21121 and Co 12009 demonstrated strong adaptability and yield stability under drought conditions, highlighting their potential as drought-tolerant sugarcane cultivars.
***Keywords* :** Moisture stress, sugarcane varieties, IW/CPE ratio, cane yield.

Introduction

India is one of the largest producers of sugarcane in the world, and sugarcane farming plays a crucial role in the country's agricultural economy it is cultivated primarily for sugar production and bioenergy. Notably, the states of Uttar Pradesh, Karnataka, and Maharashtra together contribute more than 80% of India's total sugar production (Bhakshiram, 2021). Sugarcane is a water-intensive crop, traditionally grown in tropical and subtropical regions with ample rainfall or access to irrigation.

Rapid urbanization, growing competition for agricultural land, dwindling freshwater resources, and the escalating effects of global warming are likely to make drought the most severe environmental stressor limiting global sugar production capacity. The frequent occurrence of drought conditions, particularly during critical growth stages, can severely affect cane yield, sugar content and overall crop viability (Manimekalai *et al.*, 2021).

Developing and adopting drought-tolerant sugarcane varieties has become a key strategy to ensure sustainable production under limited water availability. Drought tolerance in sugarcane is a complex trait influenced by a combination of physiological, biochemical, and morphological factors, including deep rooting systems, osmotic adjustment, reduced stomatal conductance and efficient water-use strategies (Mukunda Rao *et al.* 2021a). Along with other management techniques, sugarcane variety is crucial for drought management in order to partially offset yield loss (Mukunda Rao *et al.,* 2021b). Under these circumstances, this study was initiated to evaluate the performance of different sugarcane varieties under drought stress conditions by assessing parameters such as plant growth, physiological responses and yield components. The findings will contribute to breeding programs and inform cultivar recommendations for regions prone to water stress

Materials and Methods

Eight promising pre-released sugarcane varieties s were evaluated under irrigation regimes corresponding to IW/CPE ratios of 0.3 and 1.0 at Vasantdada Sugar Institute, Manjari Bk., Pune, Maharashtra, India (latitude 18°31′34.32″ N, longitude 73°58′28.56″ E, altitude 190 meters above mean sea level) during the 2023–24 and 2024–25 seasons. The experiment was laid out in a randomized block design (RBD) with three replications. Each variety were planted in five rows, each six meters in length, with a spacing of 135 cm between rows. The soils are slightly alkaline with low salinity, a high organic carbon content, medium nitrogen levels, and high phosphorus and potassium nutrient levels. A fertilizer dose of 250 kg N, 115 kg P_2O_5, and 115 kg K_2O per hectare was applied. Nitrogen was split into four equal doses, applied at planting, 45, 90 and 120 days after planting, while phosphorus and potassium were applied entirely as a basal dose at planting and at 120 days after planting. The data was recorded on germination percentage at 30 days after planting, tiller count at 60,90,120 and 150 days after planting, root dry weight count at 50, 100, 150 and 200 days after planting, leaf area index and specific leaf weight at 50,100,150 and 200 days after planting, NMC, cane yield, percent juice sucrose by adopting standard procedures. Extracted the juice using a power crusher to assess the quality of the cane samples and measured the brix and sucrose content following the method proposed by Meade and Chen (1977). Sucrose percentage was determined using Schmitz's tables. The commercial cane sugar (CCS) % was determined using the formula CCS% = {Sucrose % - (Brix ^{0} - Sucrose %) X 0.4} X 0.74.

Result and Discussion

The analyzed data from the 2023-24 and 2024-25 seasons on cane yield, yield components, and other quality parameters, along with relevant ancillary data, are presented in table 1 to 8.

Germination percentage (%) & Tiller Count (000'/ha)

The performance of eight sugarcane varieties was evaluated under two irrigation regimes 0.3 IW/CPE and 1.0 IW/CPE for germination percentage at 30 days after planting and tiller counts at 90, 120 and 150 days after planting. The results are presented in table 1. Germination percentage and tiller counts were generally higher under the 1.0 IW/CPE regime compared to 0.3 IW/CPE regime. Statistically significant differences were observed at 120 and 150 days after planting, with the 1.0 IW/CPE regimes resulting in higher tiller counts (100.17 and 83.00 thousand/ha, respectively) than the 0.3 IW/CPE moisture regime (89.13 and 74.79 thousand/ha). However, differences in germination percentage and tiller count at 90 days after planting were not statistically significant between the irrigation levels. Among the varieties s, VSI 21121 consistently recorded the highest tiller counts across all stages, particularly at 120 days after planting (106.17 thousand/ha) and 150 days after planting (94.33 thousand/ha), indicating vigorous early growth. CoVSI 9805 and MS 10001 also showed strong performance, especially at 120 and 150 days after planting. In contrast, Co 11015 had the lowest germination percentage (55.33%) and the lowest tiller counts at all observation stages. Statistically significant differences among varieties s were observed at 90, 120, and 150 days after planting. However, the interaction between irrigation levels and varieties s was not statistically significant at any stage, indicating that varieties performance was stable across both irrigation regimes. The lack of soil moisture has a substantial adverse effect on the growth and development of sugarcane. Under drought conditions, moisture deficiency can lead to bud desiccation, impaired root establishment, and a reduction in the number of sprouts. Tiller development is also negatively impacted, as water stress limits photosynthesis and energy production. Additionally, hormonal imbalances particularly elevated levels of abscisic acid can inhibit tiller initiation and growth. During the early tillering phase, insufficient moisture and nutrient uptake often result in the death of young tillers. Furthermore, inadequate root development under drought stress restricts the plant's ability to absorb water and nutrients, thereby reducing tiller emergence and survival. Similar findings were reported by Rao *et al.,* (2021), observed significant reductions in germination and tiller count under water limited conditions.

Millable Cane Population (000'/ha) and Cane, CCS yield (t/ha)

The yield of sugarcane mutants is directly influenced by the number of millable canes (NMC), As evident from the data presented in table no. 2 higher water availability (1.0 IW/CPE) significantly increased NMC count, cane yield, and CCS yield compared to the lower irrigation regime (0.3 IW/CPE). Specifically, NMC increased from 62.29 to 72.04 thousand per hectare, cane yield from 100.83 to 137.36 t/ha, and CCS yield from 15.41 to 20.98 t/ha. Among the varieties s tested, significant variation was observed in all traits. Varieties VSI 21121 recorded the highest NMC count (80.67 thousand/ha) and demonstrated strong yield performance with 130.31 t/ha cane yield and 18.47 t/ha CCS yield. The highest cane yield was observed in MS 10001 with 136.75 t/ha, while Co 12009 showed the highest CCS yield of 19.22 t/ha. The interaction between irrigation regimes and sugarcane varieties (table no. 2.1) had a significant effect on cane yield. An increase in irrigation regime resulted in higher cane yield across the varieties. Among sugarcane varieties, MS 10001 showed the most significant response by achieving the highest cane yield of 114.43 t/ha under the deficit irrigation regime (0.3 IW/CPE), followed by VSI 21121 with 111.40 t/ha, and Co 12009 with 108.90 t/ha. These varieties (MS 10001, VSI 21121 and Co 12009) demonstrated strong potential to maintain or improve cane yield under drought or water-limited conditions, making them promising candidates for cultivation in areas prone to moisture stress. Drought during the formative phase (30-90 days after planting) significantly limits the survival of tillers due to water and nutrient deficiencies. Hormonal imbalances (increase abscisic acid and reduced cytokinins) and weak root development further suppress new tiller formation. Water-limited conditions weaken root development, reducing the plant's capacity to support more tillers. Few tillers mature into millable canes, reducing the potential harvest population. Moisture stress disrupts sugar translocation and storage, reducing sucrose accumulation and juice quality, affecting commercial cane sugar yield. Ganapathy and Jayakumar (2023) reported in their experiment, significant reduce the number of milliable canes and cane yield in drought condition.

Drought-tolerant varieties efficiently use water through better stomatal regulation, reducing water loss and maintaining photosynthesis. They have deep root systems that extract moisture from deeper soil layers, resulting in quick and uniform germination even under moisture stress. These varieties maintain higher tiller survival rates, leading to more millable canes at harvest. They show less reduction in chlorophyll content and stay green longer, allowing for continued photosynthesis during dry periods. They accumulate osmoprotectants like proline and soluble sugars, maintain cell turgor pressure, and support tiller development and cane elongation. Lower levels of stress hormones like abscisic acid (ABA) and balanced growth regulators (e.g., cytokinins) support continued tiller development and cane elongation. They efficiently translocate and store sugars, resulting in higher Commercial Cane Sugar (CCS) yield. Mukunda Rao *et al.,* (2021a) observed that the sugarcane varieties Co 7219 and Co 6907 exhibited high tolerance to soil moisture stress. These varieties were able to survive under drought conditions while maintaining a good number of tillers and achieving satisfactory cane yields.

Growth and yield attributing characters

The results (table no. 3) showed that sugarcane varieties under optimal irrigation (1.0 IW/CPE) exhibited improved growth parameters over those under water-limited conditions (0.3 IW/CPE). Specifically, the number of internodes increased from 23.14 to 25.09, internode length from 11.68 cm to 13.97 cm, internode girth from 10.51 cm to 11.61 cm, total cane height from 258.56 cm to 301.04 cm and cane weight from 1.58 kg to 2.01 kg per cane. Statistically significant differences were observed in internode length, girth, total cane height, and cane weight, whereas the number of internodes showed no significant difference between irrigation regimes. Among the varieties s, MS 10001 showed the highest number of internodes (26.05), total cane height (295.11 cm) and cane weight (2.05 kg). Co 12009 recorded the tallest canes with an average height of 312.52 cm and showed strong internode length (13.58 cm). CoM 09057 had the largest internode girth (11.84 cm). Varieties s Co 11015 exhibited relatively lower values across most traits. No significant interaction effects between irrigation and varieties were observed for any of the measured traits, indicating that genotypic responses to irrigation regimes were consistent across traits.

Quality parameters

The findings (table no. 4) demonstrated that Brix (%) was slightly higher under the 0.3 IW/CPE irrigation regime (23.26%) compared to the 1.0 IW/CPE regime (22.88%), although the difference was not statistically significant. Similarly, sucrose content and CCS (%) showed only minor differences between the irrigation treatments, with sucrose recorded at 21.44% under 1.0 IW/CPE and 21.36% under 0.3 IW/CPE, while CCS was 15.32% and 15.36%, respectively. Interestingly, purity percentage was marginally higher under water-stressed conditions (93.35%) than under optimal irrigation (92.15%). Statistical analysis revealed no significant differences between irrigation treatments for any of the measured juice quality parameters. Significant differences were observed among varieties s for all quality parameters

except purity. The varieties Co 11015 recorded the highest values of Brix (24.62%), sucrose content (23.17%), and CCS (16.71%), followed by CoVSI 16121 and Co 09004. Varieties CoM 09057 also performed well with Brix at 23.29%, sucrose at 21.95%, and CCS at 15.85%. In contrast, MS 10001 and VSI 21121 had relatively lower juice quality parameters.
The interaction between irrigation and varieties was not significant for any of the juice quality traits, indicating consistent varieties performance across irrigation regimes.

Drought conditions reduce the water content in cane stalks while increasing the concentration of sucrose. During the maturity phase, moisture stress accelerates ripening by reducing metabolic activity, which promotes sucrose accumulation. Additionally, drought leads to a reduction in the synthesis of non-sugar compounds such as amino acids, reducing sugars, and organic acids substances that typically dilute the juice. Under limited water availability, the translocation of nutrients and impurities like potassium and chloride from the roots to the stalk is restricted, resulting in lower concentrations of ash and minerals in the juice. These combined effects contribute to an increase in juice purity under drought conditions. Kumar *et al.* (2021), observed that sugarcane varieties under water-limited conditions showed a marginal increase in juice purity due to higher sucrose concentration and lower non-sugar solids.

Leaf Area Index (LAI)

The results (table no. 5) showed that irrigation had a positive and significant effect on canopy development during mid to late growth stages. LAI values increased progressively from 50 to 200 days after planting under both irrigation regimes. At 200 days after planting, the highest LAI (1.70) was observed under the optimal irrigation treatment (1.0 IW/CPE), compared to 1.51 under the water-stressed condition (0.3 IW/CPE). Significant differences among varieties s were noted at 100, 150, and 200 days after planting. Varieties CoM 09057 exhibited the highest LAI at 150 days after planting (1.22) and 200 days after planting (1.70), followed by MS 10001 and Co 12009. In contrast, CoVSI 16121 and Co 11015 showed comparatively lower LAI values throughout the crop growth stages.

Specific Leaf weight (g/cm^2)

The findings (table no. 6) demonstrated that Specific Leaf weight progressively increased from 50 DAP to 200 DAP under both irrigation treatments. The highest values were recorded at 200 DAP, with significantly greater leaf weight (5.24 g/cm²) was observed under optimal irrigation (1.0 IW/CPE) compared to water-stressed conditions and it is indicating that adequate irrigation enhances leaf biomass accumulation at the later stages of crop growth. Significant differences among varieties s emerged at 150 and 200 DAP. At 150 DAP, Co 09004 and CoVSI 9805 recorded the highest specific leaf weight values (5.16 and 5.02 g/cm² respectively), while CoM 09057 and Co 12009 also maintained comparatively higher values. At 200 DAP, Co 09004 again led with 5.35 g/cm², followed by Co 12009 at 5.01 g/cm² and CoM 09057 at 4.77 g/cm². In contrast, varieties s like MS 10001 and VSI 21121 showed relatively lower values throughout the observation period. No significant interaction between irrigation regimes and varieties s was observed at any stage, suggesting a stable response of varieties s across both irrigation conditions with respect to specific leaf weight.

Dry matter accumulation (g/clump)

The findings (table no. 7) showed that adequate irrigation enhances dry matter accumulation**,** especially during peak vegetative and reproductive stages. highest dry matter accumulation (1104.84 g/clump) observed under 1.0 IW/CPE irrigation regime as compare to 0.3 IW/CPE irrigation regime (970.80 g/clump). Among the varieties CoM 09057 recorded the highest dry matter accumulation at every stage from 100 days after planting.

All varieties s showed increased dry matter accumulation (table no. 7.1) under 1.0 IW/CPE irrigation regime. The most significant response was observed in CoM 09057 at moisture stress condition (0.3 IW/CPE) achieving highest dry matter accumulation (579.76 g/clump), suggesting it is less sensitive to irrigation regime and potentially more drought-tolerant.

Root dry weight (g/clumps)

The results (table no. 8) showed that, significantly higher root dry weights were recorded under 1.0 IW/CPE irrigation regime. At 100, 150, and 200 days after planting, produced root dry weights of 7.83, 17.68, and 25.84 g/clump, respectively, which were significantly higher than those under 0.3 IW/CPE irrigation regime (6.84, 15.39, and 21.21 g/clump). This indicates that adequate irrigation plays a crucial role in enhancing root development. Among the varieties s evaluated, Co 12009 recorded the highest root dry weight at both 150 DAP (20.79 g/clump) and 200 DAP (25.18 g/clump), indicating its superior root development capacity. This robust root system underlines Co 12009 as a promising candidate for cultivation, especially under optimal irrigation conditions where effective water utilization and nutrient uptake are crucial for maximizing crop performance. The interaction between irrigation regimes and sugarcane varieties s (table no. 8.1) significantly influenced root dry weight at 100 days after planting. All varieties s responded positively to increased irrigation. The most significant response was observed in Co 09004 at moisture stress condition (0.3 IW/CPE) achieving highest root dry weight accumulation (8.28 g/clump), suggesting it is less sensitive to irrigation regime and potentially more drought-tolerant**.** CoVSI 16121 recorded the most pronounced response, followed by VSI 21121 and CoVSI 9805. These findings suggest that selecting water-responsive varieties s like VSI 21121 and CoVSI 9805 could enhance root growth and potentially improve yield under irrigated conditions.

Drought-tolerant sugarcane varieties tend to develop thicker and more resilient leaves as an adaptive mechanism to reduce transpiration. Under drought conditions, the accumulation of structural carbohydrates and osmoprotectants such as proline and soluble sugars increases, resulting in denser leaf tissue. Water limitations also restrict cell expansion, producing smaller but heavier leaves, which leads to a higher Specific Leaf Weight**.** A high Specific Leaf Weight is widely recognized as a physiological trait associated with drought stress adaptation, as these leaves retain water more effectively and maintain their functionality for longer periods under arid conditions. Kumari *et al.*, (2017), reported that sugarcane varieties under water stress conditions develop thicker leaves.

Conclusion

The field experiment was designed to assess drought tolerance in existing or prospective sugarcane varieties at various irrigation levels (0.3 and 1.0 IW/CPE ratios). The results revealed that, irrigating the crop at 1.0 IW/CPE ratio helps for securing maximum cane yield (137.36 t/ha) and CCS yield (20.98 t/ha) Whereas, with respect to varieties, variety VSI 21121 gained higher cane (130.31 t t/ha) and CoM 09057 gained higher CCS (18.97 t/ha) yield. Regarding juice quality, it was observed superior in Co 11015. Sugarcane variety MS 10001 showed the most significant response, by achieving the highest cane yield of 114.43 t/ha under the deficit irrigation regime (0.3 IW/CPE). Based on the physiological traits and yield performance, MS 10001, VSI 21121 and Co 12009 demonstrated strong adaptability and yield stability under drought conditions, highlighting their potential as drought-tolerant sugarcane cultivars.

Table 1 : Germination percentage, tiller population, as influenced by different irrigation regimes and varieties

Treatment details	Germination at 30 DAP (%)	Tiller count at 90 DAP (000'/ha)	Tiller count at 120 DAP (000'/ha)	Tiller count at 150 DAP (000'/ha)
Irrigation regimes				
I_1: 0.3 IW/CPE	57.83	56.92	89.13	74.79
I_2: 1.0 IW/CPE	62.46	61.25	100.17	83.00
Sem±	1.14	1.41	1.33	0.72
C.D. @ 5%	NS	NS	8.09	4.40
Varieties s				
V_1: MS 10001	63.00	71.67	101.33	81.17
V_2: CoM 09057	68.50	72.00	97.83	79.33
V_3: Co 11015	55.33	42.83	81.00	71.67
V_4: Co 09004	63.33	60.17	88.67	72.33
V_5: Co 12009	56.67	49.00	86.83	71.50
V_6: CoVSI 9805	52.83	61.67	102.67	83.83
V_7: CoVSI 16121	60.83	46.83	92.67	77.00
V_8: VSI 21121	60.67	68.50	106.17	94.33
Sem±	4.24	1.84	2.20	1.92
C.D. @ 5%	NS	5.60	6.68	5.82
Interaction I×V				
Sem±	3.95	2.89	1.69	1.59
C.D. @ 5%	NS	NS	NS	NS

Table 2 : Cane population and yield as influenced by different irrigation regimes and varieties

Treatment details	NMC count at harvest (000'/ha)	Cane yield (t/ha)	CCS yield (t/ha)
Irrigation regimes			
I_1: 0.3 IW/CPE	62.29	100.83	15.41
I_2: 1.0 IW/CPE	72.04	137.36	20.98
Sem±	0.82	1.49	0.31
C.D. @ 5%	4.99	9.11	1.91
Varieties s			
V_1: MS 10001	72.33	136.75	19.15
V_2: CoM 09057	66.67	119.53	18.97
V_3: Co 11015	64.50	101.59	16.96
V_4: Co 09004	68.50	113.42	18.13
V_5: Co 12009	63.50	125.80	19.22
V_6: CoVSI 9805	57.33	110.46	16.04
V_7: CoVSI 16121	63.83	114.89	18.62
V_8: VSI 21121	80.67	130.31	18.47
Sem±	2.35	1.69	0.53
C.D. @ 5%	7.13	5.13	1.62
Interaction I×V			
Sem±	3.06	2.57	1.10
C.D. @ 5%	NS	7.82	NS

Table 2.1 : Interaction effect of different irrigation regimes and varieties on cane yield (t/ha)

Treatment	I_1: 0.3 IW/CPE	I_2: 1.0 IW/CPE
V_1: MS 10001	114.43	159.07
V_2:CoM 09057	99.33	139.74
V_3:Co 11015	88.23	114.95
V_4:Co 09004	92.46	134.37
V_5: Co 12009	108.90	142.69
V_6:CoVSI 9805	91.08	129.83
V_7:CoVSI 16121	100.79	128.99
V_8:VSI 21121	111.40	149.22
Sem±	2.57	
C.D. at 5%	7.82	

Table 3 : Growth & yield attributes as influenced by different irrigation regimes and varieties

Treatment details	No. of Internodes	Length of internode (cm)	Internode girth (cm)	Total cane height (cm)	Cane wt. (kg)
Irrigation regimes					
I_1: 0.3 IW/CPE	23.14	11.68	10.51	258.56	1.58
I_2: 1.0 IW/CPE	25.09	13.97	11.61	301.04	2.01
Sem±	0.34	0.18	0.12	6.56	0.06
C.D. @ 5%	NS	1.14	0.75	39.95	0.41
Varieties s					
V_1: MS 10001	26.05	12.64	11.57	295.11	2.05
V_2: CoM 09057	25.83	12.35	11.84	286.46	1.98
V_3: Co 11015	22.07	12.07	10.28	255.06	1.46
V_4: Co 09004	23.22	13.84	10.76	283.52	1.61
V_5: Co 12009	25.22	13.58	10.78	312.52	1.93
V_6: CoVSI 9805	23.11	12.80	11.18	251.65	1.75
V_7: CoVSI 16121	23.50	12.44	10.75	269.94	1.79
V_8: VSI 21121	23.89	12.91	11.34	284.15	1.80
Sem±	0.69	0.56	0.22	8.57	0.09
C.D. @ 5%	2.11	NS	0.68	26.02	0.29
Interaction I×V					
Sem±	0.68	0.70	0.24	10.95	0.09
C.D. @ 5%	NS	NS	NS	NS	NS

Table 4 : Quality parameters as influenced by different irrigation regimes and varieties

Treatment details	Brix (%)	Sucrose (%)	CCS (%)	Purity (%)
Irrigation regimes				
I_1: 0.3 IW/CPE	22.88	21.36	15.36	93.35
I_2: 1.0 IW/CPE	23.26	21.44	15.32	92.15
Sem±	0.08	0.09	0.09	0.47
C.D. @ 5%	NS	NS	0.60	NS
Varieties s				
V_1: MS 10001	21.00	19.38	13.86	92.11
V_2: CoM 09057	23.29	21.95	15.85	94.29
V_3: Co 11015	24.62	23.17	16.71	94.07
V_4: Co 09004	23.29	22.09	15.99	94.86
V_5: Co 12009	22.53	21.20	15.29	94.11
V_6: CoVSI 9805	23.15	20.70	14.59	89.55
V_7: CoVSI 16121	24.58	22.62	16.16	91.99
V_8: VSI 21121	22.07	20.09	14.28	91.01
Sem±	0.41	0.43	0.38	1.42
C.D. @ 5%	1.24	1.32	1.15	NS
Interaction I×V				
Sem±	0.72	0.96	0.81	1.99
C.D. @ 5%	NS	NS	NS	NS

Table 5 : Leaf Area Index as influenced by different irrigation regimes and varieties

Treatment details	Leaf Area Index			
	50 DAP	**100 DAP**	**150 DAP**	**200 DAP**
Irrigation regimes				
I_1: 0.3 IW/CPE	0.13	0.44	1.05	1.51
I_2: 1.0 IW/CPE	0.12	0.58	1.18	1.70
Sem±	0.01	0.007	0.001	0.007
C.D. @ 5%	NS	0.05	0.007	0.045
Varieties s				
V_1: MS 10001	0.12	0.50	1.17	1.67
V_2: CoM 09057	0.14	0.53	1.22	1.70
V_3: Co 11015	0.11	0.45	1.13	1.53
V_4: Co 09004	0.12	0.52	1.09	1.65
V_5: Co 12009	0.12	0.53	1.10	1.66
V_6: CoVSI 9805	0.13	0.52	1.08	1.59
V_7: CoVSI 16121	0.12	0.51	1.05	1.50
V_8: VSI 21121	0.13	0.52	1.11	1.55
Sem±	0.01	0.014	0.019	0.035
C.D. @ 5%	NS	0.04	0.059	0.10
Interaction I×V				
Sem±	0.02	0.01	0.012	0.08
C.D. @ 5%	NS	NS	NS	NS

Table 6 : Specific Leaf Weight as influenced by different irrigation regimes and varieties

Treatment details	Sp. Leaf Wt. at (g/cm^2)			
	50 DAP	100 DAP	150 DAP	200 DAP
Irrigation regimes				
I_1: 0.3 IW/CPE	2.56	3.53	4.21	4.23
I_2: 1.0 IW/CPE	2.42	3.93	4.51	5.24
Sem±	0.09	0.09	0.08	0.15
C.D. @ 5%	NS	NS	NS	0.93
Varieties s				
V_1: MS 10001	2.29	3.48	3.91	4.57
V_2: CoM 09057	2.88	3.83	3.94	4.77
V_3: Co 11015	2.50	3.49	3.86	4.36
V_4: Co 09004	2.42	3.90	5.16	5.35
V_5: Co 12009	2.31	4.12	4.17	5.01
V_6: CoVSI 9805	2.80	3.99	5.02	4.73
V_7: CoVSI 16121	2.38	3.58	4.72	4.63
V_8: VSI 21121	2.38	3.44	4.09	4.44
Sem±	0.13	0.19	0.16	0.17
C.D. @ 5%	NS	NS	0.50	0.54
Interaction I×V				
Sem±	0.21	0.28	0.24	0.20
C.D. @ 5%	NS	NS	NS	NS

Table 7 : Dry matter accumulation as influenced by different irrigation regimes and varieties

Treatment details	Dry matter accumulation (g/clump)				
	50 DAP	100 DAP	150 DAP	200 DAP	At Harvest
Irrigation regimes					
I_1: 0.3 IW/CPE	30.66	141.07	488.43	729.04	970.80
I_2: 1.0 IW/CPE	27.98	156.33	527.17	772.10	1104.84
Sem±	0.53	1.02	3.56	1.50	9.39
C.D. @ 5%	3.25	6.20	21.70	9.15	57.17
Varieties s					
V_1: MS 10001	30.73	147.71	553.26	810.86	1106.54
V_2: CoM 09057	32.20	157.31	588.55	869.59	1170.29
V_3: Co 11015	27.61	138.93	450.64	631.00	970.93
V_4: Co 09004	26.76	156.21	531.54	763.34	1048.90
V_5: Co 12009	26.28	142.71	530.41	833.13	1052.80
V_6: CoVSI 9805	30.33	148.27	460.69	662.53	938.00
V_7: CoVSI 16121	29.57	145.63	430.26	644.81	973.23
V_8: VSI 21121	31.07	152.80	517.03	789.34	1041.86
Sem±	1.45	2.99	8.81	25.26	19.02
C.D. @ 5%	NS	9.09	26.72	76.62	57.69
Interaction I×V					
Sem±	1.57	2.86	5.92	8.69	28.25
C.D. @ 5%	NS	NS	17.96	26.38	NS

Table 7.1 : Interaction effect of different irrigation regimes and varieties on dry matter accumulation at 150 DAP

Treatment	I_1: 0.3 IW/CPE	I_2: 1.0 IW/CPE
V_1: MS 10001	517.77	589.74
V_2:CoM 09057	579.76	597.33
V_3:Co 11015	431.02	470.27
V_4:Co 09004	513.59	549.49
V_5: Co 12009	514.19	546.63
V_6:CoVSI 9805	438.61	482.77
V_7:CoVSI 16121	414.41	446.11
V_8:VSI 21121	499.06	535.00
Sem±	5.92	
C.D. at 5%	17.96	

Table 8 : Root dry wt. as influenced by different irrigation regimes and varieties

Treatment details	Root dry wt. (g/clump)			
	50 DAP	100 DAP	150 DAP	200 DAP
Irrigation regimes				
I_1: 0.3 IW/CPE	2.31	6.84	15.39	21.21
I_2: 1.0 IW/CPE	2.54	7.83	17.68	25.84
Sem±	0.08	0.05	0.12	0.46
C.D. @ 5%	NS	0.30	0.74	2.81
Varieties s				
V_1: MS 10001	2.42	7.38	13.38	24.75
V_2: CoM 09057	2.38	7.59	15.28	24.93
V_3: Co 11015	2.03	6.60	14.65	20.83
V_4: Co 09004	2.45	8.61	18.72	23.55
V_5: Co 12009	2.45	7.41	20.79	25.18
V_6: CoVSI 9805	2.80	6.73	18.59	21.87
V_7: CoVSI 16121	2.53	7.13	14.25	22.24
V_8: VSI 21121	2.34	7.23	16.61	24.84
Sem±	0.17	0.20	0.16	0.51
C.D. @ 5%	NS	0.61	0.48	1.56
Interaction I×V				
Sem±	0.22	0.14	0.21	0.87
C.D. @ 5%	NS	0.42	NS	NS

Table 8.1 : Interaction effect of different irrigation regimes and varieties on root dry wt. at 100 DAP (g/clump)

Treatment	I_1: 0.3 IW/CPE	I_2: 1.0 IW/CPE
V_1: MS 10001	7.17	7.59
V_2:CoM 09057	7.20	7.98
V_3:Co 11015	6.33	6.86
V_4:Co 09004	8.28	8.94
V_5: Co 12009	7.06	7.76
V_6:CoVSI 9805	6.26	7.19
V_7:CoVSI 16121	5.80	8.47
V_8:VSI 21121	6.64	7.82
Sem±	0.14	
C.D. at 5%	0.42	

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