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CROP–WEATHER INTERACTION AND CORRELATION ANALYSIS OF SUGARCANE (*SACCHARUM SPP.*) YIELD IN NORTH COASTAL ZONE OF ANDHRA PRADESH

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ABSTRACT

Eleven sugarcane clones were evaluated in a randomized block design over two consecutive plant crop seasons (2022–23 and 2023–24) at the Regional Agricultural Research Station, Anakapalle, to quantify the influence of key meteorological parameters on cane yield. Pearson's correlation analysis of five weather variables – rainfall, number of rainy days, maximum temperature, minimum temperature and bright sunshine hours (BSSH) – revealed that rainfall, rainy days and minimum temperature were positively correlated with cane yield ($r = +0.273$, $p < 0.05$), while maximum temperature and BSSH showed significant negative correlations ($r = ”0.273$, $p < 0.05$). Among the clones, 2012A 340 recorded the highest mean yield of 123.84 t/ha, followed by 2012A 319 (123.06 t/ha), while 2013T 124 recorded the lowest (73.84 t/ha). Weather parameters during the tillering phase were most influential in determining final yield. These results demonstrate that moderate precipitation and favourable nocturnal temperatures during early crop growth are critical drivers of productivity in the north coastal zone of Andhra Pradesh, and provide a basis for developing climate-informed agronomy and clone selection strategies.

Key words: Climate variability, Correlation analysis, Meteorological factors,Sugarcane yield

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is a pivotal commercial crop in tropical and subtropical regions, with its productivity profoundly shaped by agro-climatic variables including rainfall, temperature and solar radiation. These meteorological factors govern key physiological processes across all growth stages, from germination and tillering to grand growth and maturation (Zhao *et al.*., 2023; Misra*et al.*., 2021). The North Coastal Zone of Andhra Pradesh, particularly the tract around Anakapalle, has long been associated with commercial sugarcane cultivation and is characterised by considerable intra- and inter-seasonal variability in weather parameters, posing persistent challenges to yield stability.

Among the phenological stages of sugarcane, the tillering and elongation phases are most sensitive to climatic fluctuations. Deviations from optimal conditions during these phases can substantially restrict biomass

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accumulation and final yield (Zhao *et al.*., 2023; Bhatt *et al.*., 2023). Under a warming climate, the interaction between elevated temperatures, altered rainfall distribution and sunshine duration assumes added significance for crop management and clone evaluation (Misra*et al.*., 2021; Hegde *et al.*., 2023). Quantifying these crop-weather relationships is, therefore, essential for refining predictive yield models and designing adaptive agronomic strategies.

Earlier investigations at RARS Anakapalle established that temperature and relative humidity during the early post-planting period decisively influence final cane yield. More recent studies corroborate that the combined effect of multiple meteorological parameters – rather than any single variable – determines sugarcane productivity, and that this effect varies with growth stage (Zhao *et al.*., 2023; Kumar *et al.*., 2024). Not with standing this body of evidence, updated crop-weather analyses using contemporary clonal material under current climatic conditions in the north coastal zone remain scarce.

The present study was therefore undertaken to assess the relationship between cane yield and key meteorological parameters across two consecutive plant crop seasons (2022–23 and 2023–24) at RARS Anakapalle, using eleven elite clones and Pearson's correlation analysis. The objective is to identify statistically significant weather-yield associations that can guide climate-informed clone selection and crop management in this ecologically distinctive coastal tract.

MATERIAL AND METHODS

Eleven sugarcane clones (Table 1), including three check varieties viz. 87A 298 (C), 2009A 107 (C) and 2003V 46 (C) were evaluated over two plant crop seasons: 2022–23 and 2023–24. The experiment was laid out in a randomized block design (RBD) with three replications under standard agronomic practices at RARS, Anakapalle, Andhra

Table 1. Mean Cane yield (t/ha) of sugarcane clones at Anakapalle

S.No	Clone	Yield (2022–23) (t/ha)	Yield (2023–24) (t/ha)	Mean Yield (t/ha)
1	2012A 340	123.25	124.43	123.84
2	2012A 319	127.22	118.89	123.06
3	2016T 7	114.55	106.74	110.65
4	2014A 210	100.19	103.67	101.93
5	2012A 123	104.05	100.37	102.21
6	87A 298 (C)	111.53	96.98	104.26
7	2013V 126	63.75	90.07	76.91
8	2009A 107 (C)	117.88	89.14	103.51
9	2013T 16	98.37	83.57	90.97
10	2003V 46 (C)	116.44	79.30	97.87
11	2013T 124	85.86	61.81	73.84

Pradesh.Cane yield (t/ha) was recorded at harvest for each clone in both years and the mean yield was computed to assess overall performance. The yield data are summarized in Table 1.Monthly meteorological data were obtained from the weather observatory at the Regional Agricultural Research Station (RARS), Anakapalle, covering the entire crop duration from March to February for both 2022–23 and 2023–24 seasons. Key variables recorded included monthly total rainfall (mm), number of rainy days, average maximum and minimum temperatures (°C), and Bright Sunshine Hours (BSSH, hrs/day). These parameters were averaged across the crop season to obtain representative climatic indicators for each year. To assess the influence of these meteorological variables on sugarcane yield, Pearson's correlation coefficient was employed. Correlation analysis was performed between annual cane yield data (year-wise and mean) and the corresponding weather parameters.

RESULTS AND DISCUSSION

Clone Performance across Seasons

Clone 2012A 340 recorded the highest mean yield (123.84 t/ha), followed by 2012A 319 (123.06 t/ha). Clones 2016T 7, 2014A 210 and 2012A 123 formed an intermediate group (101.93–110.65 t/ha). The check varieties 87A 298 (C), 2009A 107 (C) and 2003V 46 (C) yielded 104.26, 103.51 and 97.87 t/ha, respectively, validating their suitability as performance benchmarks. Clone 2013T 124 recorded the lowest mean yield (73.84 t/ha). Season-wise data (Table 1) reveal that yield of several clones declined from 2022–23 to 2023–24, notably 2003V 46 (C) (116.44 to 79.30 t/ha) and 2013V 126 (63.75 to 90.07 t/ha), indicating differential responsiveness to inter-seasonal weather variability.

Correlation with Meteorological Variables

Pearson's correlation analysis (Table 2) revealed that rainfall (mm) and number of rainy days were positively correlated with cane yield ($r = +0.273$, $p < 0.05$), confirming that adequate precipitation during the crop season supports tillering and biomass accumulation. Minimum temperature likewise showed a significant positive correlation ($r = +0.273$), indicating that warmer nights favour metabolic activity, elongation and sucrose translocation. In contrast, maximum temperature and BSSH both exhibited significant negative correlations ($r = -0.273$), suggesting that high daytime temperatures and prolonged sunshine, particularly during the tillering phase, impose heat stress and increase evaporative demand

Table 2. Pearson's correlation coefficients between meteorological parameters and sugarcane yield

Meteorological Parameter	Correlation Coefficient (r)
Rainfall (mm)	+0.273*
Number of Rainy Days	+0.273*
Minimum Temperature (°C)	+0.273*
Maximum Temperature (°C)	-0.273*
BSSH (hrs/day)	-0.273*

**Significant at 5% probability level*

beyond the compensatory capacity of moderate rainfall (Table 2).

The positive correlation of rainfall and rainy days with yield (r = +0.273) is consistent with the recognised water requirement of 1,000–1,500 mm for tropical sugarcane production and the key role of soil moisture in supporting tiller emergence and early biomass accumulation (Zhao *et al.*., 2023; Kumar *et al.*., 2024). Similarly, the positive association of minimum temperature with yield aligns with evidence that warmer nights during elongation accelerate internode formation and sucrose translocation (Bhatt *et al.*., 2023). The negative correlation of maximum temperature and BSSH with yield points to heat and radiation stress during the tillering phase, when temperatures above the optimal range of 28–35°C can suppress tiller density and reduce final stalk number (Hegde *et al.*., 2023; Misra *et al.*., 2021). These findings are broadly consistent with earlier work at the same location (Subbaramayya and Rupa Kumar, 1980) and with contemporary multi-location studies confirming the primacy of early-season weather on final cane yield (Zhao *et al.*., 2023; Kumar *et al.*, 2024).

The inter-seasonal yield variation observed in several clones – particularly 2003V 46 (C) and 2013V 126 – indicates differential genotypic sensitivity to weather fluctuations and underscores the value of multi-season evaluation in clone selection programmes. The superior and stable performance of 2012A 340 and 2012A 319 across both seasons suggests resilience to the prevailing weather variability of the north coastal zone.

CONCLUSION

Over two consecutive plant crop seasons at RARS Anakapalle, rainfall, number of rainy days and minimum temperature were positively correlated with sugarcane yield (r = +0.273, $p < 0.05$), while maximum temperature and bright sunshine hours showed significant negative correlations (r = -0.273). These relationships were most pronounced during the tillering phase, identifying it as the critical weather-sensitive window for yield formation in the north coastal zone. Clone 2012A 340 (123.84 t/ha) and 2012A 319 (123.06 t/ha) consistently outperformed all checks across both seasons and are recommended for advancement and wider evaluation. The weather-yield correlations established in this study provide a quantitative foundation for constructing agro-meteorological yield prediction models and for designing climate-adaptive management practices—such as adjusted planting dates and targeted irrigation during dry spells—to sustain sugarcane productivity under the variable coastal climate of Andhra Pradesh.

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