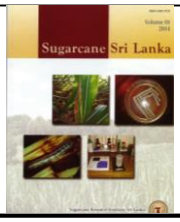
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RESEARCH

A Strategical Approach to Sugar Recovery Enhancement in Sevanagala using APSIM model

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ABSTRACT

The present study explored how environmental factors such as rainfall, temperature, and solar radiation affect sugarcane quality in the Sevanagala sugarcane plantation area of Sri Lanka. The research covered the period from 2017 to 2021. To identify the most suitable planting times and characterize the environmental interactions, the APSIM crop simulation model was utilized. This approach enables precise predictions based on regional climatic data and crop growth patterns. The current findings revealed a significant negative correlation between sugarcane quality and rainfall received during the period of three months prior to harvest. A positive relationship was observed between sugarcane quality and the average daily sunshine hours experienced over the five months prior to harvest. Based on the current results, the ideal planting time for the Yala season planting crops to maximize sugarcane quality was from the fourth week of March to the second week of April. For the Maha season commenced crops, the optimal planting period was from the fourth week of September to the second week of October. These findings offer valuable guidance for stakeholders in the Sevanagala sugar industry to strategically plan planting and harvesting schedules. Implementing these optimal timings can enhance sugarcane quality, improve overall productivity, and contribute to the sustainability and profitability of sugar production in the Lanka sugar Sevanagala, Sri Lanka.

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INTRODUCTION

In Sri Lanka, sugarcane cultivation is primarily concentrated in the dry and intermediate agro-ecological zones [1] being the Sevanagala region representing a key production area. The Sevanagala Sugar Factory, processes about 1,250 metric tons of cane daily and manages 4,215 hectares using both irrigated and rain-fed systems [2]. This plantation located in the DL 1b agro ecological zone, experiences annual rainfall of approximately 1,447 mm and average temperatures around 28°C [3]. The rainfall pattern is well suited for managing rain-fed plantations with a crop cycle that lasts one year.

Despite its favorable climate, Sevanagala has experienced a consistent decline in the recoverable cane sugar percentage (RCS) over the past decade. This trend raises concerns about the long-term sustainability and profitability of sugarcane cultivation in the project. The reduction in RCS is influenced by a complex interplay of environmental factors such as rainfall, temperature, and solar radiation along with soil quality, crop management, and varietal differences [4]. To understand the factors influencing sugarcane yield and quality, modeling efforts were undertaken to explore the interactions between climate and sugarcane plants using the Agricultural Production Systems Simulator (APSIM). APSIM is a comprehensive crop simulation tool that analyzes how climate, management practices, and soil variables impact crop growth and yield [4].

The objective of this study is to identify optimal planting schedule for maximizing sugar recovery, aiming to provide practical action plan for plantation managers and policymakers to enhance productivity of the sugar industry in Sevanagala.

MATERIALS AND METHODS

Study Area

The study was conducted in the Sevanagala sugarcane project area, over the period from 2017 to 2021. The Sevanagala plantation is approximately 4,215 hectares in extend and practice both rain-fed and irrigated cultivation methods. This research focuses specifically on the rain-fed sector of the Sevanagala sugarcane plantation in Sri Lanka. Geographically, the area is situated between latitudes 6°26'36.53"N and 6°20'4.35"N, and longitudes 80°50'31.94"E and 80°58'10.23"E. According to agro-ecological zone classification, Sevanagala falls within the low country dry zone (DL1b).

The region experiences a bimodal rainfall pattern, with two distinct rainy seasons: Yala and Maha. The Yala season, the minor rainy period, occurs from March to May, while the Maha season, the major rainy period, and takes place from October to January [5]. The primary growing season for rain-fed sugarcane in Sevanagala is during the Maha season [5]. The dominant soil type in the area is reddish-brown earth [6] with sandy loam to sandy clay loam in texture, characterized by well-drained to moderately drained soils [6].

Data

Historical data were collected from Sevanagala sugarcane project, encompassing daily weather parameters (rainfall, temperature, and solar radiation), sugarcane crop calendars, applied agronomic practices, and yield statistics. Sugarcane quality metrics, particularly the recoverable cane sugar percentage (RCS), were obtained from factory lab records, including the parameters of brix, polarity, purity, and recoverable cane sugar percentage for randomly selected rain-fed sugarcane fields.

APSIM Model Simulation

The APSIM model, calibrated previously by the Sugarcane Research Institute in Udawalwe, Sri Lanka was used for this study [7]. The model input parameters included daily weather data (rainfall, maximum and minimum temperatures, solar radiation), soil properties (texture, fertility, water-holding capacity), crop management practices (planting dates, irrigation regimes, fertilization schedules), and sugarcane varietal characteristics etc. Simulations were run for both Yala and Maha planting seasons.

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Data Analysis

Correlation (spearman rank method) and regression (linier and non linier methods) analyses were conducted to explore the relationships between environmental factors such as rainfall, temperature, and sunshine hours. Optimal planting schedules for each season were determined by simulating yield and RCS outcomes across various planting dates using APSIM model.

the sugar content that can be extracted from sugarcane [8]. The level of RCS is primarily influenced by various factors, including climate conditions [9] rainfall and solar radiation [10] have been identified as directly affect environmental influence for the physiological processes (photosynthesis, transpiration, and carbohydrate partitioning) that determine sugar accumulation in sugarcane.

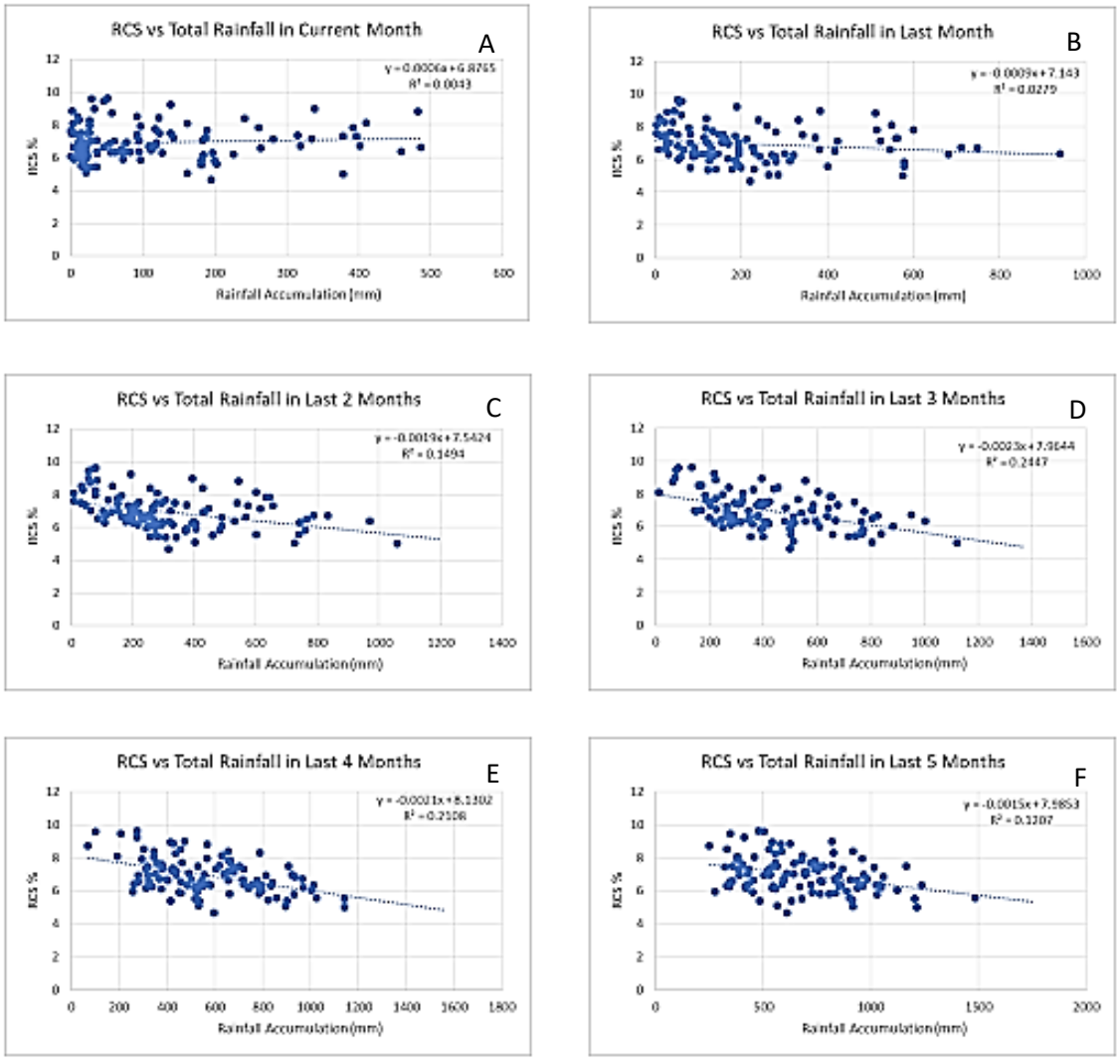


Figure 1: Relationship between recoverable cane sugar (RCS) and cumulative rainfall over 1 to 5 months prior to harvesting.

RESULTS AND DISCUSSION

Environmental effect over the recoverable cane sugar (RCS)

Recoverable cane sugar (RCS) is a key parameter used in the sugar industry to assess

Rainfall is the most important climatic factors that can impact RCS in tropical areas under rain-fed conditions [11]. Figure 1 demonstrates a comparison between the recoverable cane sugar at the harvesting time and the rainfall accumulation over the last five months.

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The findings indicate a significant reduction of RCS due to rainfall observed for 3, 4 and 5 month prier to harvesting (D, E and F in Figure 1). It was worthily noted that the rainfall during the harvesting month itself has not effected the RCS reduction significantly. Specifically, a high rainfall over the specified three-month period is associated with a noticeable decrease in the sugar production. Multiple studies from India [12], Australia [13] also reported similar results that increased rainfall in the three months before harvest reduces sugar recovery in sugarcane significantly.

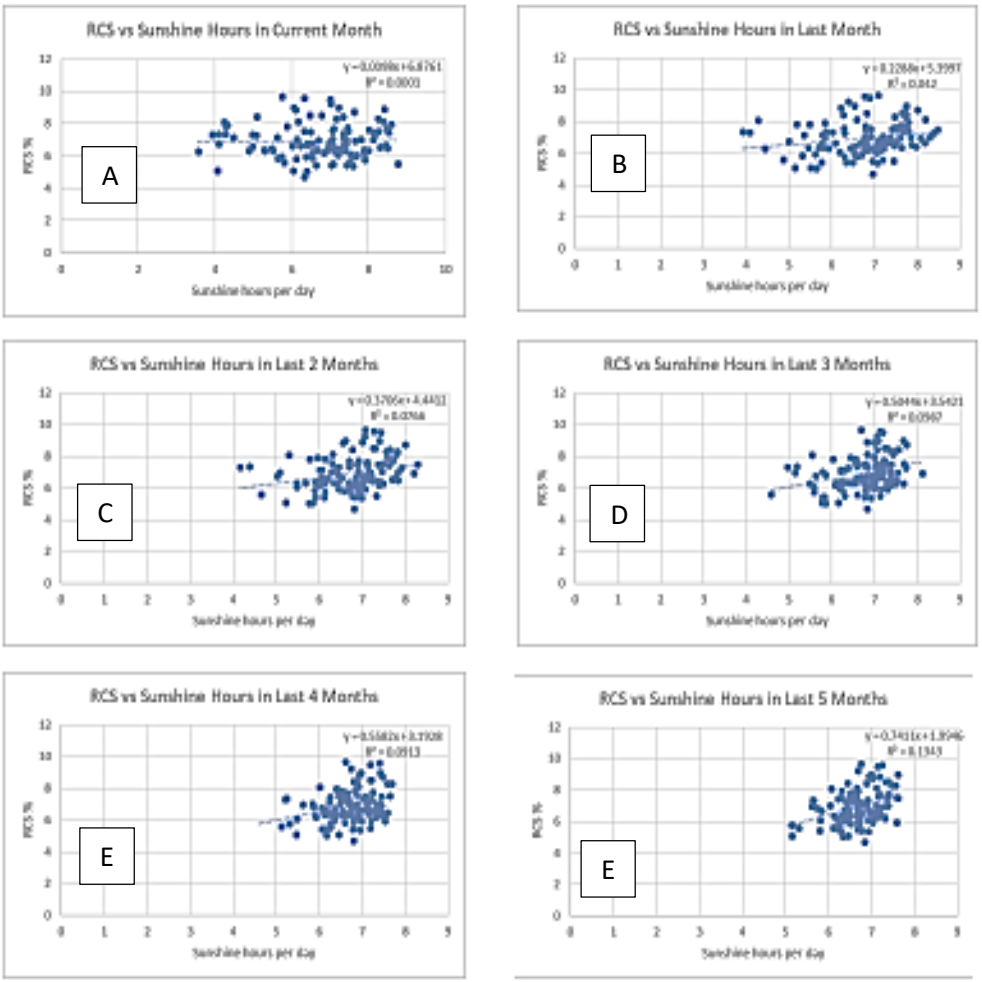


Figure 2: Relationship between recoverable cane sugar (RCS) vs solar radiation.

The main mechanisms to this phenomena is dilution of sugars in the stalk and a shift from storage to vegetative growth and formation of new shoots [14], both of which lower sucrose concentration and thus recoverable sugar. Wijayawardhana [1] highlighted that annual rainfall in the Sevanagala area is on an increasing trend. This rise in rainfall significantly impacts the low sugar recovery percentage observed in the region. However, as discussed by [13] the rainfall immediately before or during harvest has little effect on sugar recovery, but high risk at this stage is post-harvest deterioration rather than physiological conversion of the sucrose in to other forms. In short run, the second important environmental factor to the RCS is solar radiation, which is a consider result due to could cover during the rainfall season [11].

Figure 2 demonstrates a comparison between the recoverable cane sugar at the harvesting time and the solar radiation level in previous months to the harvesting date. A direct and positive correlation exists between recoverable cane sugar (RCS) and the daily sunshine hours (Figure 2). Sufficient sunlight is imperative for enabling sugarcane to

undergo photosynthesis, a vital process leading to sugar production within the plant [11],[15]. The current analysis revealed that significant positive effects were observed only for solar radiation during the five months prior to harvesting (Figure 2 -F). Unlike rainfall, this suggests that variations in solar radiation did not have a short-term influence for the RCS of sugarcane.

Planting date optimization

The simulation results from the APSIM model were used to analyze the interaction of weather variables including rainfall and solar radiation over the final sugar recovery percentage. It helped to ilustrate how sugar recovery percentage varies with different planting dates during the study period in Sevanagala. The identification of optimal planting dates is a crucial aspect of sugarcane plantation planning, as it directly influences sugar recovery at the factory. Figure 3 shows the relationship between observed and simulated sugar recovery (RCS) for Yala and Maha planting seasons.

sugarcane fields according to optimal planting times. In general, at least 50% of the planting new lands should be scheduled for planting at the appropriate times to ensure maximum sugar production point of view. For example, 40 % of the new planting areas in Yala season commenced crops can be allocated before the optimal planting period, while the remaining 10 % can be scheduled after the optimal period. This approach allows the entire planting campaign to be completed within six weeks and avoided the drought effect which is started June onwards.

For the Maha season, 50% of the new planting areas should be allocated during the optimal planting period. 40% lands can be scheduled before this period, and the remaining 10% should be planned for after the optimal planting time. The given planting schedule is a more practical option based on the current availability of machinery and human resources, but can be further optimized with the resource availability in future.

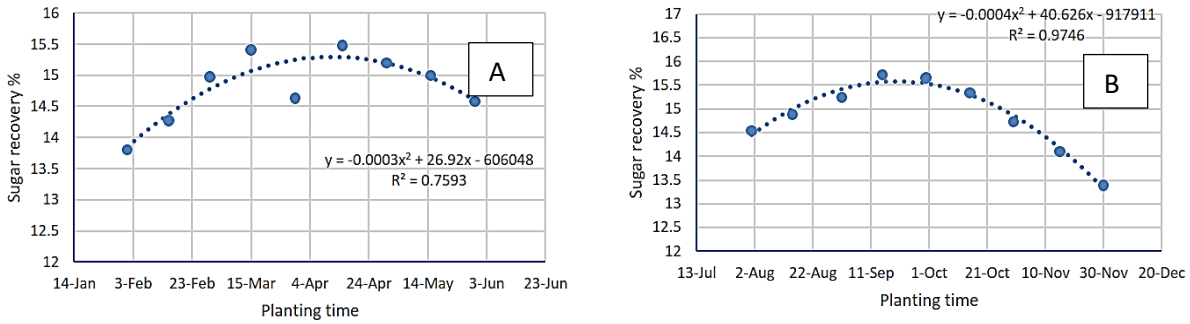


Figure 3: Impact of changers in planting date on sugar recovery (A= Yala planting season, B = Maha planting season)

The present results indicate that, for the Yala season, the most suitable planting period is from the 4th week of March to the 2nd week of April, based on the highest sugar recovery points shown in the graph. Similarly, the optimal planting time for the Maha season is from the 4th week of September to the 2nd week of October, aligning with the beginning of the northeast monsoon. These planting times are aligned with rain fall pattern and dry spell patterns in the area as well [16]. Based on the present findings, it can be suggested that the plantation management should establish an effective planting schedule by dividing the

CONCLUSIONS

The APSIM model suggested the optimum planting times for Yala and Maha planting season as from the 4th week of March to the 2nd week of April, and 4th week of September to the 2nd week of October respectively. The rainfall during the 3 months prior to the harvesting date had a significant negative effect on the sugar recovery percentage in the Sevanagala sugarcane project. Conversely, solar radiation did not show a short-term effect on sugar recovery; however, it had a

significant impact if consider the longer period more than five-month period.

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REFERENCES

[1] Wijayawardhana, L.M.J.R., Weerasinghe, K.D.N. and Navaratne, C.M. (2021). Climate Change Projections and their Consequences on Agro-Climate in Sugarcane Growing Areas of *Sevanagala*, Sri Lanka, *Sri Lankan Journal of Agriculture and Ecosystems*, 3(1), pp. 30–45. [CrossRef]

[2] Finance report, Department of Development Finance. (2016). *Development Policy for Sugar Industry in Sri Lanka*., Ministry of Finance.

[3] Wijayawardhana, L.M.J.R., Weerasinghe, K.D.N. and Navaratne, C.M. (2023). Adapting to Climate Change: Deficit Irrigation Planning for Rain-fed Sugarcane in *Sevanagala*, Sri Lanka with AquaCrop Software, *National Conference on Disaster Risk Reduction and Management in Sri Lanka: Science*, Policy and Practice, (August), pp. 54–56.

[4] Keating, B.A. *et al.* (1999). Modelling sugarcane production systems-Development and performance of the sugarcane module, *Field Crops Research*, 61(3), pp. 253–271.

[5] Keerthipala, A.P. (2007). Sugar industry of Sri Lanka: Major issues and future directions for development, *SugarTech*, 9(1), pp. 1–10. [CrossRef]

[6] Weerasinghe, H.A.S. *et al.* (2020). Variations in Soil Chemical Parameters of Long Term Sugarcane Growing Alfisols under Contrasting Cropping Conditions at *Sevanagala*, Sri Lanka, *Tropical Agricultural Research*, 31(2), p. 55. [CrossRef]

[7] Wijayawardhana. L.M.J.R. (2023). Assessment of soil water balance and water productivity of rain fed sugarcane plantation in *Sevanagala*, Sri Lanka, *PhD thesis- un published*., Faculty of graduate studies, University of Ruhuna, Sri Lanka.

[8] Solomon, S. (2016). Sugarcane Production and Development of Sugar Industry in India, *SugarTech*, 18(6), pp. 588–602. [CrossRef]

[9] Urgesa, G.D. and Keyata, E.O. (2023). Effect of storage periods and conditions on juice quality characteristics of sugarcane (Saccharum officinarum sp. Hybrid) at Finchaa sugar factory, Oromia, Ethiopia, *Vegetos* [Preprint]. [CrossRef]

[10] Shrivastava, P.K., Mali, S.C. and Thakare, H.S. (2014). Impact of weather changes on sugarcane production. *Research in Environment and Life Sciences*, 7(4), pp.243-246.

[11] Singh, H., Mishra, S.K., Singh, K., Singh, K., Pal, R.K., Gill, K.K. and Kingra, P.K. (2021). Simulating the impact of climate change on sugarcane production in

Punjab. *Journal of Agrometeorology*, 23(3), pp.292-298.

[12] Rao, P. S., & Rao, P. S. (1982). Effect of Rainfall on Cane and Sugar Yields in Andhra Pradesh. *Indian Sugar*, 32(7), 479–482.

[13] Kingston, G. (1994). Effect of irrigation and rainfall on cane and sugar yields in the Burdekin district. *Proceedings of the Australian Society of Sugar Cane Technologists*, 16, 115–121.

[14] Inman-Bamber, N. G., Muchow, R. C. (1999). A simple model for predicting sugarcane sucrose accumulation based on final stalk dry mass and crop age., *Field Crops Research*, 64(2–3), 181–196.

[15] James, G., 2008. *Sugarcane (Second edition)*. John Wiley & Sons, Blackwell Science Limited, United Kingdom.

[16] Wijayawardhana, L.M.J.R., De Silva, A.L.C., Witharama, W.R.G. (2014). Optimizing planting schedules of sugarcane for saving irrigation water in Sevanagala and Uda Walawe, Sri Lanka, *Sugarcane Sri Lanka*, Sugarcane Research Institute, Udawalawe, Sri Lanka. Volume - 1.

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