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N Pavan
Department of Entomology,
College of Agriculture, PJTAU,
Rajendranagar, Hyderabad,
Telangana, India

Ch. Raja Goud
Department of Entomology,
Horticulture Research Station,
SKLTGHU, Kondamallepally,
Nalgonda, India

S Upendhar
Department of Entomology, BJR
Agricultural College, PJTAU,
Rajanna Sircilla, Telangana, India

M Venkateswara Reddy
Department of Horticulture,
College of Agriculture, PJTAU,
Rajendranagar, Hyderabad,
Telangana, India

Corresponding Author:

N Pavan
Department of Entomology,
College of Agriculture, PJTAU,
Rajendranagar, Hyderabad,
Telangana, India

Effect of weather parameters on the seasonal damage variability of sapota seed borer (*Trymalitis margarias* Meyrick) in central zone of Telangana

N Pavan, Ch. Raja Goud, S Upendhar and M Venkateswara Reddy

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Abstract

Seasonal damage variability of the sapota seed borer (*Trymalitis margarias* Meyrick) was investigated under unsprayed orchard conditions at the JVR Horticultural Research Station, Malyal, Mahabubabad, Telangana, during 2025-2026. Commercially cultivated sapota cultivar of Kalipatti were evaluated through fortnightly fruit damage observations from August 2025 to June 2026. The weather parameters on sapota seed borer incidence were analysed using correlation and multiple linear regression. No infestation was recorded during August, September and June. Infestation commenced in October, increased progressively to reach a peak during December-January, declined thereafter, and increased again to attain a second peak during March-April and declined with the onset of rainfall. The Kalipatti cultivar exhibited the highest level of fruit damage throughout the observation period, indicating its greater susceptibility to seed borer infestation. The maximum temperature exhibited a positive but non-significant association with sapota seed borer fruit damage ($r = 0.165$), whereas minimum temperature showed a significant negative correlation ($r = -0.470$). Morning relative humidity had a weak and non-significant negative relationship ($r = -0.060$). However, evening relative humidity ($r = -0.713$), rainfall ($r = -0.737$), and rainy days ($r = -0.896$) were significantly and negatively correlated with fruit damage, with the number of rainy days exerting the strongest influence. Multiple linear regression analysis ($R^2 = 0.90$) indicated that approximately 90% of the variation in fruit damage was explained by the combined effect of the weather parameters. These findings suggest that the seasonal incidence of *Trymalitis margarias* in Kalipatti is largely governed by prevailing climatic conditions.

Keywords: Sapota, per cent fruit damage, correlation analysis, weather parameters, Telangana

Introduction

Sapota (*Manilkara zapota* (L.) P. Royen), it belongs to the family Sapotaceae, is an important tropical and subtropical fruit crop native to southern Mexico and Central America. In India, where it is popularly known as Chiku the crop is widely cultivated because of its high fruit quality, high market demand and adaptability to diverse agro climatic conditions (Chadha, 1992; Chundawat, 1998) [4, 5]. In Telangana, sapota is grown mainly in the districts of Mahabubabad, Bhadradi Kothagudem and Nalgonda. During 2024-25, the crop occupied 1.10 thousand hectares with a production of 19.66 thousand metric tonnes and a productivity of 17.83 t ha⁻¹, indicating its growing economic importance in the state (INDIASTAT, 2025) [8].

Sapota is an evergreen fruit tree with continuous flowering and fruiting under favourable climatic conditions. Its prolonged fruit development period (10-11 months) results in fruits at different developmental stages throughout the year, favouring continuous infestation by insect pests (Patel *et al.*, 2013) [11].

Despite its commercial importance, sapota is attacked by nearly 25 insect pest species in India (Butani, 1979) [3]. Among them, the sapota seed borer, *Trymalitis margarias* Meyrick (Lepidoptera: Tortricidae), is one of the most destructive pests, causing fruit damage of up to 35% under severe infestation (Jayanthi and Verghese, 2007) [9]. The sapota seed borer is now widely established in the major sapota growing states of India, including Gujarat, Maharashtra, Karnataka, and Tamil Nadu. The pest has spread to major sapota-growing states since its first report from Maharashtra (Patel, 2001) [14].

The larvae infest immature fruits by feeding on the seed endosperm, leading to premature fruit

drop, deterioration in fruit quality, and considerable yield losses. As the larvae remain concealed within the fruit throughout their development, infestations often go unnoticed, making timely detection and effective management of the pest difficult (Jayanthi and Verghese, 2010) ^[10].

Seasonal incidence of *Trymalitis margarias* is influenced by weather parameters such as temperature, relative humidity, rainfall, and rainy days, which regulate its survival and population dynamics. However, information on the seasonal damage and occurrence of the pest in different sapota varieties under Telangana conditions is limited. In Telangana, severe infestations have been recorded in Mahabubabad, Bhadrachalam, Kothagudem and Nalgonda districts. Therefore, the present study was undertaken to assess the seasonal damage variability and peak activity of sapota seed borer in Kalipatti sapota in relation to weather parameters to facilitate timely and effective pest management.

Materials and Methods

The experiment study on the seasonal incidence of sapota seed borer, *Trymalitis margarias* Meyrick, in relation to weather parameters was conducted during 2025-2026 at the JVR Horticultural Research Station, Malyal, Mahabubabad district. The experiment was carried out in a Kalipatti sapota orchard comprising trees more than 15 years old, planted at a spacing of 10 × 10 m and maintained under natural field conditions. No insecticidal sprays were applied throughout the study period to facilitate the natural development of the pest population and to obtain an accurate assessment of seasonal seed borer incidence.

$$\text{Per cent fruit damage} = \frac{\text{Number of damaged fruits}}{\text{Total number of fruits observed}(n=100)} \times 100$$

Statistical Analysis

Fortnightly seed borer damage was plotted against Standard Meteorological Weeks (SMWs) to assess seasonal fluctuations and identify peak infestation periods. Pearson's correlation coefficient (r) was computed to determine the relationship between seed borer damage and weather parameters following the method of Snedecor and Cochran (1989) ^[16]. The combined influence of weather variables on seed borer damage was further evaluated using multiple linear regression analysis (R²).

Results and Discussion

In these study, Seasonal damage variability of the sapota seed borer under natural field conditions was assessed in relation to the prevailing weather parameters.

Number of damaged fruits per tree

The seasonal incidence of sapota seed borer was studied in the Kalipatti cultivar under unsprayed orchard conditions. No infestation was recorded during August, September and June, indicating that the rainy season was unfavourable for pest establishment. Infestation commenced in October, increased progressively to reach a peak during December-January, declined thereafter, and increased again to attain a second peak during March-April and declined with the onset of rainfall. The Kalipatti cultivar exhibited considerable fruit damage throughout the study period, indicating its susceptibility to sapota seed borer. Fruit damage varied seasonally, with infestation increasing during favourable weather conditions and declining during unfavourable periods (Table 1 and Fig. 1,2).

The seasonal incidence observed in the Kalipatti cultivar was in agreement with the findings of Bisane (2016) ^[1], who reported maximum sapota seed borer infestation during the dry season,

Weather Parameters

The important weather factors such as the mean maximum and minimum temperatures refer to highest and lowest temperature recorded, respectively. Relative humidity was recorded twice a day. RH-I represents the moisture level in the air during the morning, while RH-II represents the moisture level in the evening. Rainfall was measured in millimetres to determine the total amount of precipitation received. The number of rainy days was recorded to assess the frequency of rainfall occurrence during the experiment. The occurrence of natural enemies, including predators and parasitoids associated with insect pests of sapota, was recorded at fortnightly intervals during the peak pest activity period.

Sampling Procedure and Data Collection

Five plants were selected from each sapota variety and twenty fruits were tagged on each selected plant. Observation was recorded from these tagged fruits at 15 days intervals throughout the study period by using destructive sampling method.

Number of damaged fruits per tree

Fruits were examined for seed borer damage based on characteristics symptoms presence or absence of external exit holes, presence of frass, presence of larvae of feeding tunnels, exit holes size damage caused by seed borer and fruit borer. The number of damaged and healthy fruits was recorded and percentage of fruit damage caused by the seed borer was calculated using the following formula Bisane and Naik (2021) ^[2].

followed by a decline after the onset of rainfall. Similar observations were made by Bisane and Naik (2021) ^[2], who demonstrated that dry weather conditions favoured seed borer activity, whereas rainfall significantly suppressed pest incidence. The seasonal pattern recorded in the present study was further supported by Devi Priyanka *et al.* (2024) ^[6] and Shinde *et al.* (2016) ^[15], who also reported increased seed borer infestation during dry weather and reduced pest activity during rainy periods. These findings indicate that seasonal fluctuations in sapota seed borer incidence in the Kalipatti cultivar are primarily governed by prevailing weather conditions.

Natural enemy abundance remained low throughout the study period, with only sporadic occurrences of predators and parasitoids. Their activity was highest during January-March but was insufficient to provide effective natural suppression of sapota seed borer under field conditions (Table 1 and Fig. 1,2).

The present findings are in agreement with Hajare *et al.* (2008) ^[7], who reported low levels of natural parasitism in sapota orchards. In contrast, Patil and Suchithra Kumari (2024) ^[12] and Jayanthi and Verghese (2007) ^[9] recorded comparatively higher parasitisation by *Bracon* sp. and *Eurytoma braconidis*, particularly during fruit maturity. The relatively low parasitoid activity observed in the present investigation may be attributed to prevailing seasonal conditions and the concealed feeding behaviour of *Trymalitis margarias* larvae within the seed, which limits parasitoid access.

Correlation analysis revealed that maximum temperature had a positive but non-significant association with sapota seed borer incidence in the Kalipatti cultivar (r = 0.165). In contrast, minimum temperature showed a significant negative correlation (r = -0.470*). Morning relative humidity exhibited a weak negative but non-significant relationship (r = -0.060). However,

evening relative humidity ($r = -0.713^{**}$), rainfall ($r = -0.737^{**}$) and the number of rainy days ($r = -0.896^{**}$) were significantly and negatively correlated with fruit damage. Among the weather variables studied, the number of rainy days exerted the strongest negative influence on sapota seed borer incidence, indicating that increased rainfall and rainy days markedly suppressed pest infestation in the Kalipatti cultivar (Table 2).

The relationship between weather parameters and sapota seed borer incidence observed in the Kalipatti cultivar was in agreement with the findings of Bisane and Naik (2021) ^[2], Bisane (2016) ^[1], Patil *et al.* (2020) ^[13] and Shinde *et al.* (2016) ^[15], who reported that rainfall, relative humidity and minimum temperature were negatively associated with sapota seed borer incidence, whereas maximum temperature and bright sunshine hours showed positive associations. However, Devi Priyanka *et al.* (2024) ^[6] reported a significant positive relationship between maximum relative humidity and sapota seed borer incidence, which differed from the present findings.

The results of the multiple linear regression analysis describing the relationship between weather parameters and per cent fruit damage in the Kalipatti cultivar are presented in (Table 3).

Multiple linear regression analysis revealed that the selected weather parameters, viz., Maximum temperature (X_1), Minimum temperature (X_2), Morning relative humidity (X_3), Afternoon relative humidity (X_4), Rainfall (X_5) and Number of rainy days (X_6), on per cent fruit damage caused by sapota seed borer in three sapota cultivars. The regression equations and coefficient of

determination (R^2) values are presented in (Table 3).

In Kalipatti, an increase of one unit in maximum temperature, morning relative humidity and rainfall was associated with increases of 3.371, 1.064 and 2.311 units, respectively, in per cent fruit damage, whereas minimum temperature, afternoon relative humidity and number of rainy days were associated with decreases of 2.256, 0.346 and 6.646 units, respectively. The coefficient of determination ($R^2 = 0.909$) indicated that 90.9% of the variation in fruit damage (Table 3).

The multiple regression analysis obtained in the present investigation was in agreement with the findings of Bisane and Naik (2021) ^[2], who reported that weather-based regression models explained 72-93% of the variation in sapota seed borer incidence. Similar observations were made by Bisane (2016) ^[1], who found that 59-77% of the variation in seed borer infestation could be attributed to weather parameters, with bright sunshine hours positively influencing pest incidence, whereas minimum temperature, evening relative humidity and rainfall exerted negative effects. Comparable findings were also reported by Shinde *et al.* (2016) ^[15], who demonstrated that seasonal fluctuations in sapota seed borer incidence were largely governed by prevailing weather conditions. Likewise, the present study showed that weather parameters effectively explained the seasonal incidence of sapota seed borer in the Kalipatti cultivar ($R^2 = 0.90$), indicating their usefulness in predicting pest occurrence.

Table 1: Seasonal damage variability in per cent fruit damage caused by sapota seed borer (*T. marginatus*) in relation to weather parameters on sapota cultivar of Kalipatti during 2025-26

Year	Month	Fortnight	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	No of Rainy days	Percent fruit damage (%)	NE	Parasitoid
			T-Max (°C)	T-Min (°C)	Morning	Evening			Kalipatti		
2025	August	I	33.66	23.89	97.81	68.24	9.91	10.00	0.00	0	0
		II	31.08	24.04	97.12	75.54	8.55	9.00	0.00	0	0
	September	I	32.99	24.34	97.38	68.29	4.43	6.00	0.00	0	0
		II	32.43	23.70	98.21	69.69	8.28	8.00	0.00	0	0
	October	I	32.62	23.37	95.66	66.17	6.13	7.00	6.00	0	0
		II	32.63	22.69	91.15	58.74	14.10	8.00	13.00	0	0
	November	I	32.65	23.17	91.26	65.33	1.02	2.00	18.00	0	0
		II	32.83	23.05	90.87	64.15	0.94	0.00	28.00	0	1
	December	I	31.02	15.21	90.42	38.07	0.00	0.00	39.00	1	0
II		31.04	13.39	89.33	35.43	0.00	0.00	55.00	0	2	
2026	January	I	30.72	16.20	94.51	39.96	0.00	0.00	71.00	3	0
		II	31.96	17.04	95.00	39.10	0.00	0.00	61.00	1	0
	February	I	32.24	17.26	95.00	40.50	0.00	0.00	64.00	3	0
		II	33.48	19.18	95.00	39.66	0.55	1.00	47.00	1	0
	March	I	35.83	20.39	94.47	36.24	0.00	0.00	52.00	0	2
		II	35.89	21.99	95.00	42.23	0.00	0.00	58.00	0	6
	April	I	39.20	24.25	93.55	34.34	0.00	0.00	70.00	2	5
		II	41.57	25.45	84.01	31.23	0.00	0.00	63.00	3	2
	May	I	40.84	24.94	79.55	33.43	0.92	1.00	55.00	0	1
		II	43.19	27.91	65.06	27.66	0.00	0.00	48.00	2	0
	June	I	40.48	26.31	70.65	31.28	1.55	7.00	0.00	0	0
		II	38.33	25.55	84.20	40.56	4.89	6.00	0.00	0	0

Note: NE- Natural Enemies

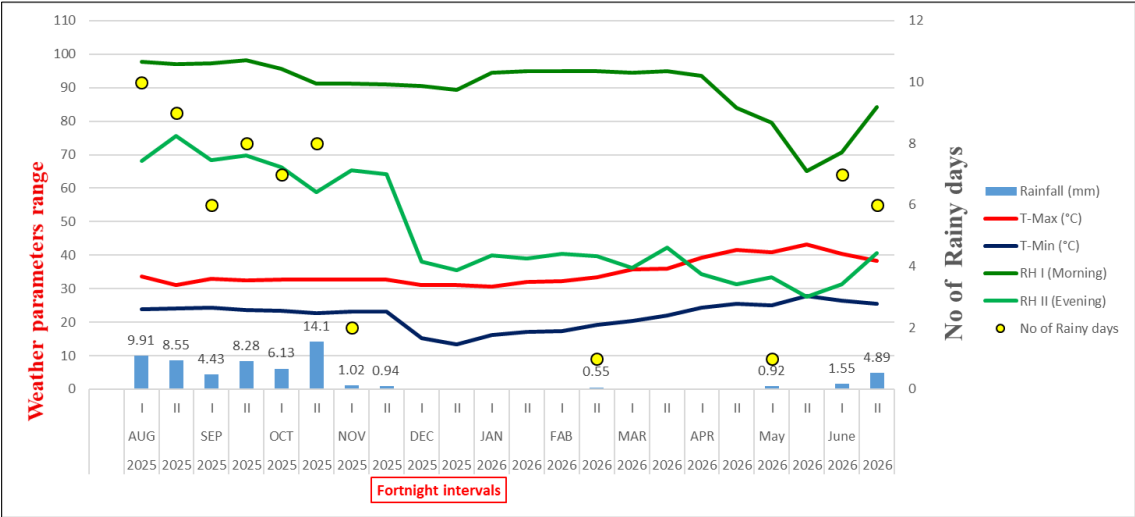


Fig 1: Seasonal damage variability in per cent fruit damage caused by sapota seed borer (*T. margarias*) in relation to weather parameters on sapota cultivar of Kalipatti during 2025-26.

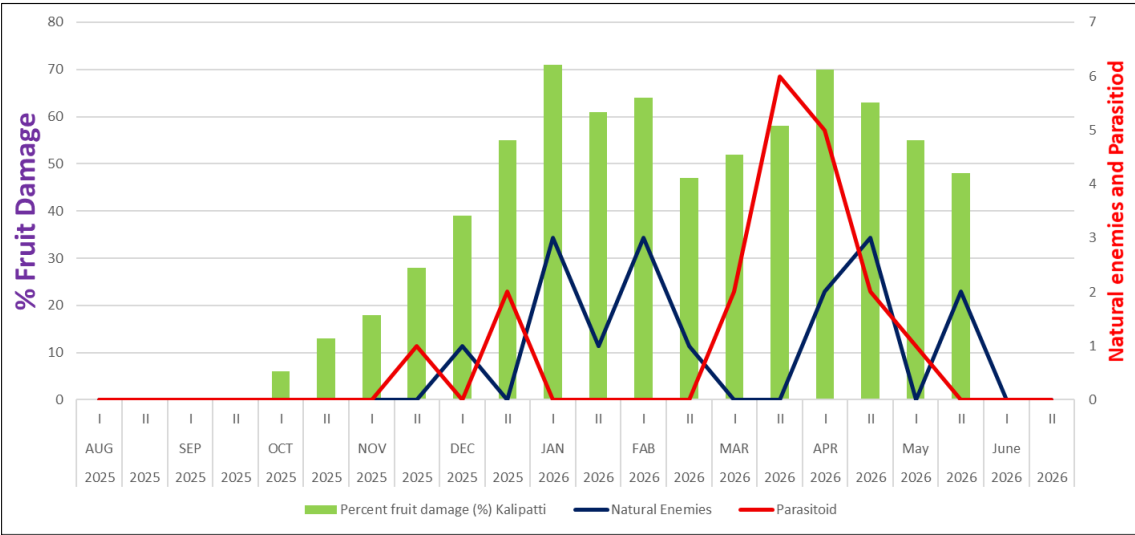


Fig 2: Seasonal damage variability in per cent fruit damage caused by sapota seed borer (*T. margarias*) in relation to weather parameters on sapota cultivar of Kalipatti during 2025-26.

Table 2: Simple correlation coefficient between weather parameters and the incidence of seed borer on sapota during 2025-26

Variety	T-Max (°C)	T-Min (°C)	RH I (Morning)	RH II (Evening)	Rainfall (mm)	Rainy days (No.)
Kalipatti	0.165 ^{NS}	-0.470 [*]	-0.060 ^{NS}	-0.713 ^{**}	-0.737 ^{**}	-0.896 ^{**}

*Significant at 5% level; **Significant at 1% level; NS: Non-significant

Table 3: Multiple linear regression analysis of per cent fruit damage incidence caused by sapota seed borer in relation to selected weather parameters in different sapota cultivars during 2025-2026

Year	Variety	Regression Equation	R ² Value
2025-2026	Kalipatti	Y = -100.254 + 3.371 X ₁ -2.256 X ₂ + 1.064 X ₃ -0.346 X ₄ + 2.311 X ₅ -6.646 X ₆	0.90

Conclusion

The study concluded that the seasonal incidence of sapota seed borer in the Kalipatti cultivar was strongly influenced by prevailing weather conditions. Evening relative humidity, rainfall and the number of rainy days exhibited significant negative effects on fruit damage, with rainy days exerting the greatest suppressive influence. The multiple regression model (R² = 0.90) indicated that weather parameters effectively explained the seasonal variation in sapota seed borer incidence, demonstrating their potential for forecasting pest occurrence and facilitating timely management interventions.

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