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ROLE OF WEATHER FACTORS ON ANTHRACNOSE OF GRAPE

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ABSTRACT

Grape (*Vitis vinifera* L.) is an important commercial fruit crop globally, but its productivity and fruit quality are often reduced by fungal diseases. Among them, anthracnose caused by *Colletotrichum gloeosporioides* popularly known as "Bird's Eye Spot" is highly destructive, particularly in tropical and subtropical regions. The present study assessed the influence of weather parameters on the development of anthracnose in Thompson Seedless grapes during *Kharif* 2024 and 2025, first appearing in the 27th and 24th Standard Meteorological Weeks, respectively and reaching 100 per cent severity by season end. The disease onset and peak occurred earlier during 2025, coinciding with higher rainfall and relative humidity, indicating rapid progression under favourable weather conditions. The correlation analysis showed that, minimum temperature (r = -0.884) in 2024 and maximum temperature (r = -0.729) in 2025 were significantly and negatively correlated with disease severity, while morning (r = 0.487 to 0.756) and evening relative humidity (r = 0.424 to 0.773) were positively associated. The wind speed exhibited a significant negative correlation (r = -0.746 to -0.520), whereas rainfall and rainy days showed positive associations. The multiple regression analysis revealed that 79.4 to 90.9 per cent of the variation in anthracnose severity was explained by the combined influence of temperature, humidity, rainfall and wind. The apparent infection rate (r) fluctuated between 0.024 and 0.119 across seasons and the cumulative AUDPC ranged from 4110.30 to 4319.00, reflecting continuous and gradual disease buildup. The study also showed consistent trends, emphasizing that low temperature, high humidity and reduced wind create favourable microclimates for anthracnose epidemics.

Keywords : Grape anthracnose, *Colletotrichum gloeosporioides*, Epidemiology, Correlation, Apparent rate of infection (r) and Area under disease progress curve (AUDPC).

Introduction

Grape (*Vitis vinifera* L.) is an important commercial fruit crop cultivated worldwide for table, raisin and wine production. Its productivity and quality are significantly affected by fungal diseases, among them anthracnose or "bird's eye spot," is highly destructive. The disease has been known since ancient times, first mentioned by Pliny in Italy during first century of the Christian era and later scientifically described by Burrill (1886) in Illinois, U.S.A. In India, anthracnose was first reported near Pune in 1903 (Butler, 1905) and it is now widespread across major grape growing areas, including Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Punjab, Haryana and Uttar Pradesh (Agrios, 2005; Thind *et al.*, 2004). The disease is characterized by circular, sunken, greyish spots with dark margins on young leaves, shoots, and berries, causing defoliation, shoot drying, berry shrivelling, and yield losses. Annual losses in Maharashtra range from 15-30 per cent (Deshmukh, 2006), while global epidemics have caused losses up to 100 per cent in susceptible varieties (Anderson, 1956;

Winkler, 1965 and He, 1999). Globally, *Elsinoe ampelina* is the causal organism, but in tropical and subtropical regions, including India, *Colletotrichum gloeosporioides* predominates (Poolsawat *et al.*, 2009; Sawant *et al.*, 2012). Globally, grapes are grown on 7.1 million hectare, producing 77.7 million tonnes (10.9 t/ha), with India contributing from 179.63 thousand hectare in tropical regions, yielding 3,904.29 thousand tonnes (21.74 t/ha), mainly from Maharashtra, Karnataka, Telangana and Tamil Nadu, with Karnataka producing 1,224.67 thousand tonnes from 47.12 thousand hectare (25.99 t/ha) (Anon., 2024 and 2025). Disease development is influenced by weather parameters such as temperature, relative humidity and rainfall (Jamadar 2007 and Pampanagouda *et al.*, 2005). Understanding the epidemiological factors influencing anthracnose is essential for effective disease management and minimizing yield and quality losses.

Material and Methods

The role of weather factors in the development and severity of anthracnose on grapevine was assessed by recording observations on disease severity at weekly intervals in commercially cultivated variety Thompson Seedless. The study was conducted in an established grape vineyard located at the Horticultural Farm, University of Agricultural Sciences (UAS), Raichur, during the crop season. Back pruning (*Kharif*) was carried out on 15th April 2024 and 20th March 2025. The disease severity on each leaf was assessed using a 0-4 scale as proposed by Chatta (1992) and the Per cent Disease Index (PDI) was calculated accordingly. Observations were recorded at weekly intervals corresponding to the standard meteorological weeks. Simultaneously, weekly weather data including maximum and minimum temperatures (°C), rainfall (mm), relative humidity (%) during morning and evening hours and wind speed (km/hr) were collected from the Main Agricultural Research Station (MARS), UAS, Raichur (Table 1 and 2). The weekly disease index was calculated based on the recorded ratings and the compiled data were statistically analyzed to determine the correlation between disease development and prevailing weather conditions. Karl Pearson's correlation coefficient was calculated to examine the relationship between weather parameters and anthracnose severity. Each correlation was tested for significance at the five per cent probability level using the standard statistical formula. Additionally, regression analysis was performed to quantify the predictive influence of individual meteorological variables on disease development.

Category	Numerical value	Description
I	0	Healthy foliage or leaf spots in traces
II	1	Up to 10 per cent leaf area covered with anthracnose lesions
III	2	10.1-25 per cent leaf area covered with slight twig infection *i.e.,* 1-3 cankers per twig
IV	3	25.1-50 per cent leaf area covered with heavy twig infection *i.e.*, 4-10 cankers per twig
V	4	Above 50 per cent leaf area covered with very heavy twig infection *i.e.*, above 10 cankers per twig and heavy berry infection

Per cent disease intensity (PDI) was recorded by using formula:

$$\text{Per cent disease index} = \frac{\text{Sum of the individual disease ratings}}{\text{Number of leaves observed}} \times \frac{100}{\text{Maximum disease grade}}$$

Apparent rate of infection (r) and Area Under Disease Progress Curve (AUDPC) for anthracnose of grape in different varieties

The rate of disease development/ unit / day was estimated according to the method given by Van Der plank (1963). The apparent infection rate (r) for total period was:

$$r = \frac{1}{t_2 - t_1} \log e \frac{X_2(1 - X_1)}{X_1(1 - X_2)}$$

Where,

r = Rate of disease development

t_1 = Date of first observation

t_2 = Date of second observation

X_1 = Disease severity on first observation

X_2 = Disease severity on second observation

Area Under Disease Progress Curve (AUDPC)

$$\text{AUDPC} = \sum_{I=1}^{K} 1/2\,(S_i + S_{i-1})(t_2 - t_1)$$

Where,

S_i = Amount of disease at i^{th} time, I ranges from 1 to k

S_{i-1} = Amount of disease at $(i-1)^{th}$ time

$t_2 - t_1$ = Number of days between two observations

K = Number of successive evaluation of disease

Results and Discussion

Correlation analysis revealed that, most of the time individual weather factors alone may not be the most favourable for anthracnose development. However, the interaction among weather parameters had a greater influence, resulting in maximum disease severity.

During *Kharif* 2024, minimum temperature (r = -0.884) and wind speed (r = -0.746) showed highly significant negative correlations with disease severity, indicating that lower minimum temperatures and reduced wind speed favoured disease development. However, maximum temperature (r = -0.453) was negatively correlated but not significant. Morning relative humidity (r = 0.487) and evening relative humidity (r = 0.424) exhibited moderate positive correlations, while rainfall (r = 0.315) and number of rainy days (r = 0.295) showed positive associations with disease intensity (Table 3).

In *Kharif* 2025, maximum temperature (r = -0.729) showed a significant negative correlation, whereas minimum temperature (r = -0.421) was negatively correlated but not significant. Morning relative humidity (r = 0.756) and evening relative humidity (r = 0.773) showed highly significant positive correlations with disease severity, indicating that higher humidity strongly favoured anthracnose development. Wind speed (r = -0.520) also showed a significant negative correlation at five per cent, while rainfall (r = 0.306) and number of rainy days (r = 0.355) exhibited positive correlations with disease severity (Table 4). Overall, the results indicated that while individual weather factors may have variable effects, the combined influence of temperature, humidity, rainfall and wind significantly contributed to the onset, progression and severity of anthracnose in both years. The strong positive and significant correlations of both morning (r = 0.756) and evening (r = 0.773) relative humidity with anthracnose severity in *Kharif* 2025 indicated that high humidity was a key driver of disease development during this season. High relative humidity likely created a conducive environment for spore germination, infection and rapid colonization on grape foliage. The earlier onset and faster progression of the disease in *Kharif* 2025 compared to *Kharif* 2024, might be attributed to prolonged periods of elevated humidity, which maintained leaf wetness and enhanced pathogen survival and reproduction. These findings attributed that critical role of relative humidity in creating microclimatic conditions favourable for anthracnose epidemics and highlight the importance of monitoring and managing humidity levels in vineyards for effective disease management.

Although rainfall and the number of rainy days showed only weak positive correlations, they might have indirectly supported disease development by maintaining high humidity levels within the vineyard canopy. Conversely, negative correlations with maximum temperature and wind speed suggest that higher day time temperatures and stronger winds may reduce disease development by promoting faster drying of leaf surfaces and limiting pathogen establishment.

These findings align with Pampanagouda *et al.* (2005), reported that, grape anthracnose occurred from the second week of August to the second week of September under conditions of lower temperatures, high humidity and increased rainfall. They also reported that disease severity was positively correlated with rainfall and relative humidity but negatively correlated with temperature. Similarly, Anthracnose severity in grapes was moderately influenced by spore count, rainfall and relative humidity (morning RH1 and afternoon RH2), while temperatures, wind speed and bright sunshine had negative effects (Jamadar, 2007).

Correlation of different weather parameters for anthracnose of Thompson Seedless grapes in *Kharif* 2024 and 2025

The relationship between weather factors and anthracnose severity in Thompson Seedless grapes during *Kharif* 2024 and 2025 revealed several significant associations. The pooled data of both seasons were subjected to correlation analysis, which demonstrated the combined influence of meteorological factors on disease development. The per cent disease index (PDI) was negatively correlated with maximum temperature (r = -0.594) and minimum temperature (r = -0.585), indicating that higher temperatures tended to reduce disease intensity. Rainfall (r = 0.310) and rainy days (r = 0.324) exhibited positive associations with disease severity, while morning relative humidity (r = 0.617) and evening relative humidity (r = 0.588) were significantly and positively correlated, highlighting the role of high humidity in increasing disease development. Wind speed maintained a strong negative correlation (r = -0.675), suggesting that higher wind velocity discouraged the spread of anthracnose (Table 5). The interaction among various weather parameters revealed that anthracnose severity in Thompson Seedless grapes was favoured during periods of low temperature, high humidity and reduced wind movement, while higher temperatures and windy

conditions suppressed disease progression during back-pruning seasons of 2024 and 2025.

Regression analysis

The multiple linear regression analysis of per cent disease index (PDI) of grape anthracnose in relation to weather parameters during *Kharif* 2024 and 2025 indicated that the contribution of different climatic factors varied between the two years.

During *Kharif* 2024, the regression coefficients for maximum temperature (X_1), minimum temperature (X_2), rainfall (X_3), rainy days (X_4), morning relative humidity (X_5), evening relative humidity (X_6) and wind speed (X_7) were -24.485, -5.285, -0.054, 2.864, 7.855, -8.007 and -7.422, respectively (Table 6). The multiple linear regression equation fitted to the data is $Y = 820.390 - 24.485X_1 - 5.285X_2 - 0.054X_3 + 2.864X_4 + 7.855X_5 - 8.007X_6 - 7.422X_7$

This analysis showed that an increase of one unit in rainy days and morning relative humidity leads to an increase in per cent disease index by 2.864 and 7.855 units, respectively. Conversely, an increase of one unit in maximum temperature, minimum temperature, evening relative humidity and wind speed resulted decrease in a disease severity by 24.485, 5.285, 8.007 and 7.422 units, respectively. Rainfall showed a negligible negative effect of -0.054 units. The coefficient of determination (R^2) was 0.909, indicating that 90.9 per cent of the variation in PDI could be explained by the combined influence of the weather parameters.

During *Kharif* 2025, the regression coefficients for maximum temperature, minimum temperature, rainfall, rainy days, morning relative humidity, evening relative humidity and wind speed were 4.304, -10.131, 0.040, -10.346, -0.488, 4.170 and -4.634, respectively (Table 6). The multiple linear regression equation is $Y = 27.512 + 4.304X_1 - 10.131X_2 + 0.040X_3 - 10.346X_4 - 0.488X_5 + 4.170X_6 - 4.634X_7$

The analysis indicated that minimum temperature, rainy days, maximum temperature, morning relative humidity and wind speed negatively influenced disease severity, whereas rainfall and evening relative humidity had a slight positive effect. The R^2 value of 0.794 suggested that 79.4 per cent of the variation in PDI was explained by the combined influence of these weather parameters.

The multiple linear regression analysis for anthracnose severity in Thompson Seedless grapes during *Kharif* 2024 and 2025, in relation to weather parameters, revealed that the regression coefficients for maximum temperature (X_1), minimum temperature (X_2), rainfall (X_3), rainy days (X_4), morning relative humidity (X_5), evening relative humidity (X_6) and wind speed (X_7) were -14.721, -8.511, 0.096, -4.645, 2.651, -2.684 and -5.797, respectively (Table 6). The multiple linear regression equation was fitted to the data and the equation arrived for the weather parameters is as follows; $Y = 714.917 - 14.721X_1 - 8.511X_2 + 0.096X_3 - 4.645X_4 + 2.651X_5 - 2.684X_6 - 5.797X_7$

This analysis indicated that an increase of one unit in maximum temperature, minimum temperature, evening relative humidity, rainy days and wind speed led to a decrease in anthracnose severity by 14.721, 8.511, 2.684, 4.645 and 5.797 units, respectively. In contrast, an increase of one unit in morning relative humidity and rainfall slightly increased disease severity by 2.651 and 0.096 units. The coefficient of determination ($R^2 = 0.766$) suggested that about 76.6 per cent of the variation in anthracnose severity could be explained by the combined influence of these weather parameters.

These results align with a study conducted in Maharashtra from 2012 to 2014 on the Thompson Seedless grape variety, which showed that higher cumulative rainfall in 2013 and 2014 increased anthracnose severity (PDI 84.16% and 90.46%), while lower rainfall in 2012 resulted in a lower PDI of 54.48 per cent. Disease severity was positively correlated with rainfall and relative humidity and negatively correlated with temperature (Ghule *et al.*, 2015).

Similar findings were reported by Imrana (2023) on the Hussaini grape variety, showing that anthracnose incidence and severity were influenced by meteorological conditions. In 2021, disease incidence and severity were positively correlated with both maximum and minimum temperatures but negatively associated with relative humidity and rainfall. In 2022, all measured climatic factors including temperature, relative humidity and rainfall showed positive correlations with disease development. Multiple linear regression analysis for both years highlighted the combined influence of these environmental factors on anthracnose development.

Apparent rate of infection and disease progression of grape anthracnose

The progress of anthracnose severity in Thompson Seedless grapes was monitored at weekly intervals during *Kharif* 2024 and 2025. The Per cent Disease Index (PDI) was recorded from the start of infection till maximum disease development and subsequently, the apparent infection rate (r) and the area under disease progress curve (AUDPC) were calculated.

During *Kharif* 2024, disease initiation was noticed in the 27th Standard Meteorological Week (SMW) with 8.50 PDI, which gradually increased to 20.25 PDI by the 29th SMW. Further, PDI showed an increasing trend, reaching 43.75 at the 33rd SMW and achieved a maximum of 100.00 by the 39th SMW. The apparent infection rate (r) recorded the highest value (0.105) during the 36th SMW, while the lowest (0.024) occurred at the 33rd SMW. The maximum weekly AUDPC (677.25) was observed at the peak of disease (39th SMW), while the lowest (29.75) was at the 27th SMW. The cumulative AUDPC for *Kharif* 2024 was 4319.00, indicating gradual and continuous disease progression until the end of the season (Table 7).

In *Kharif* 2025, anthracnose symptoms were first observed during the 24th SMW with 7.13 PDI. Disease intensity increased steadily and reached 52.85 PDI at the 29th SMW. Further, PDI continued to rise, attaining 89.33 at the 33rd SMW and reaching its maximum of 100.00 during the 35th SMW. The highest apparent infection rate (0.119) was recorded in the 29th SMW, followed by 0.116 in the 33rd SMW, whereas the lowest 'r' value (0.032) was observed at the 31st SMW. The maximum weekly AUDPC (681.19) was noted during the 35th SMW and the lowest (24.94) was at the 24th SMW. The cumulative AUDPC on foliage for 2025 was 4110.30 (Table 8), which was slightly lower than that of 2024. It was observed from both seasons that, anthracnose severity in Thompson Seedless increased gradually from the initial infection and reached 100 PDI at end of the cropping period. The apparent infection rate (r) showed fluctuations depending on weather conditions, while the cumulative AUDPC values confirmed the continuous buildup of disease pressure.

Similar observations were reported by Van der Plank (1963), who emphasized that the apparent infection rate ('r') serves as a useful parameter to quantify the rate of disease development. The 'r' value has been widely employed to assess the effectiveness of management practices such as sanitation, fungicide application and host resistance. Further, Van der Plank (1963, 1968 and 1975) highlighted that epidemic analysis underscores the importance of a reduced infection rate (i.e., lower 'r') in the characterization of slow rusting, a concept later extended to the identification of slow rusting and slow mildewing resistance in various crops. These findings align with the observations of Wilcoxson (1986) and Aswathanarayana (2003), who highlighted the importance of the apparent infection rate (r) and the Area Under Disease Progress Curve (AUDPC) as key parameters for studying epidemic development.

Conclusion

Epidemiological studies during *Kharif* 2024 and 2025 revealed that, disease development correlated negatively with temperature and wind speed and positively with relative humidity, rainfall and rainy days. High humidity and frequent rainfall favoured disease initiation and spread, whereas warmer and drier conditions slowed its progress. The disease appeared earlier in 2025 than in 2024, with both seasons reaching 100 PDI by the end of the cropping period. Apparent infection rates fluctuated with changing weather conditions, indicating the strong influence of environmental factors on disease buildup. Overall, the study highlights the critical role of humidity and rainfall in the development of anthracnose epidemics.

Table 1 : Weather parameters recorded during back pruning 2024

SMW	Date of observation	Temperature (°C)		Rainfall (mm)	Rainy day	Relative humidity (%)		Wind speed (km/hr)
		Max.	Min.			Morning	Evening	
26	Jun 25-July 01	34.2	24.8	9.2	1	81	47	13.8
27	July 02-08	34.1	25.2	32.6	1	82	48	15.3
28	July 09-15	33.4	24.6	12.4	1	84	52	13.0
29	July 16-22	29.7	24.4	63.2	4	89	71	11.4
30	July 23-29	30.6	25.1	1.8	0	86	59	14.0
31	July 30-Aug 05	34.0	24.3	0.0	0	84	48	14.0
32	Aug 06-12	31.9	23.1	77.0	3	91	65	7.4
33	Aug 13-19	33.9	24.5	0.0	0	83	53	4.9
34	Aug 20-26	30.8	22.7	92.0	2	92	68	8.2
35	Aug 27-Sept 02	30.2	21.8	84.6	5	93	69	9.2
36	Sep 03-09	30.4	22.5	117.6	6	91	67	8.5
37	Sep10-16	31.8	21.4	0.0	0	84	54	7.8
38	Sep 17-23	33.3	22.2	6.8	1	83	51	6.6
39	Sep 24-30	31.9	22.3	20.4	2	89	62	6.2

SMW- Standard meteorological weeks

PDI- Per cent disease index

Table 2 : Weather parameters recorded during back pruning 2025

SMW	Date of observation	Temperature (°C)		Rainfall (mm)	Rainy day	Relative humidity (%)		Wind speed (km/hr)
		Max.	Min.			Morning	Evening	
23	Jun 4-10	35.9	22.8	16.4	2	75	40	9.7
24	Jun 11-17	32.4	22.6	29.8	4	87	58	11.7
25	Jun 18-24	35.3	22.4	4.0	1	78	41	14.6
26	Jun 25-July 01	34.8	22.5	3.0	0	78	42	15.1
27	July 02-08	33.2	22.2	23.0	2	81	48	14.3
28	July 09-15	34.6	22.0	5.4	0	81	44	12.2
29	July 16-22	33.3	23.0	139.0	2	84	55	10.3
30	July 23-29	29.5	22.2	29.4	3	84	63	13.4
31	July 30-Aug 05	32.9	23.1	4.6	1	84	53	8.8
32	Aug 06-12	31.5	22.3	88.8	6	94	64	6.0
33	Aug 13-19	29.0	22.0	72.2	5	93	72	9.4
34	Aug 20-26	30.4	21.2	3.6	1	90	63	8.7
35	Aug 27-Sept 02	30.3	22.1	24.6	3	91	65	8.6

SMW- Standard meteorological weeks

PDI- Per cent disease index

Table 3 : Correlation coefficients of weather factors with anthracnose progression in Thompson Seedless grape during back pruning 2024

Parameters	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Y PDI	1							
X_1 Maximum temperature (°C)	-0.453	1						
X_2 Minimum temperature (°C)	-0.884**	0.433	1					
X_3 Rainfall (mm/day)	0.315	-0.662**	-0.418	1				
X_4 Rainy day	0.295	-0.644*	-0.406	0.905**	1			
X_5 Morning relative humidity (%)	0.487	-0.869**	-0.499	0.840**	0.738**	1		
X_6 Evening relative humidity (%)	0.424	-0.939**	-0.425	0.807**	0.749**	0.953**	1	
X_7 Wind speed (km/hr)	-0.746**	0.246	0.682**	-0.274	-0.224	-0.357	-0.372	1

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Table 4 : Correlation coefficients of weather factors with anthracnose progression in Thompson Seedless grape during back pruning 2025

Parameters	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Y PDI	1							
X_1 Maximum temperature (°C)	-0.729**	1						
X_2 Minimum temperature (°C)	-0.421	0.481	1					
X_3 Rainfall (mm/day)	0.306	-0.300	0.255	1				
X_4 Rainy day	0.355	-0.599*	-0.031	0.571*	1			
X_5 Morning relative humidity (%)	0.756**	-0.832**	-0.405	0.468	0.721**	1		
X_6 Evening relative humidity (%)	0.773**	-0.955**	-0.372	0.466	0.730**	0.924**	1	
X_7 Wind speed (km/hr)	-0.520*	0.378	0.036	-0.426	-0.533	-0.669*	-0.558*	1

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Table 5 : Correlation coefficients of weather factors with anthracnose progression in Thompson Seedless grape during back pruning 2024-25.

Parameters	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Y PDI	1							
X_1 Maximum temperature (°C)	-0.594**	1						
X_2 Minimum temperature (°C)	-0.585**	0.270	1					
X_3 Rainfall (mm/day)	0.310	-0.471*	0.177	1				
X_4 Rainy day	0.324	-0.601**	-0.295	0.744**	1			
X_5 Morning relative humidity (%)	0.617**	-0.847**	-0.233	0.630**	0.688**	1		

| X_6 Evening relative humidity (%) | 0.588** | -0.944** | -0.198 | 0.628** | 0.702** | 0.937** | 1 | |
| X_7 Wind speed (km/hr) | -0.675** | 0.313 | 0.344 | -0.337 | -0.333 | -0.511* | -0.466* | 1 |

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Table 6 : Multiple linear regression analysis of weather factors influencing anthracnose in Thompson Seedless grape

Year	Location	Constant	X_1	X_2	X_3	X_4	X_5	X_6	X_7	R^2
Kharif 2024	MARS, Raichur	820.390	-24.485	-5.285	-0.054	2.864	7.855	-8.007	-7.422	0.909
	Multiple linear regression equation									
	Y= 820.390 − 24.485X_1 − 5.285X_2 − 0.054X_3 + 2.864X_4 + 7.855X_5 − 8.007X_6 − 7.422X_7									
Kharif 2025	Location	Constant	X_1	X_2	X_3	X_4	X_5	X_6	X_7	R^2
	MARS, Raichur	27.512	4.304	-10.131	0.040	-10.346	-0.488	4.170	-4.634	0.794
	Multiple linear regression equation									
	Y= 27.512 + 4.304X_1 − 10.131X_2 + 0.040X_3 − 10.346X_4 − 0.488X_5 + 4.170X_6 − 4.634X_7									
Kharif 2024-25	Location	Constant	X_1	X_2	X_3	X_4	X_5	X_6	X_7	R^2
	MARS, Raichur	714.917	-14.721	-8.511	0.096	-4.645	2.651	-2.684	-5.797	0.766
	Multiple linear regression equation									
	Y= 714.917 − 4.721X_1 − 8.511X_2 + 0.096X_3 − 4.645X_4 + 2.651X_5 − 2.684X_6 − 5.797X_7									

Where,

X_1 = Maximum temperature, X_2 = Minimum temperature, X_3 = Rainfall, X_4 = Rainy day,

X_5 = Morning relative humidity, X_6 = Evening relative humidity, X_7 = Windspeed

Table 7 : Apparent Infection Rate (r) and Area Under Disease Progress Curve (AUDPC) of Thompson Seedless during *Kharif* 2024

Sl. No.	Standard Meteorological week	Interval of observation	PDI	AUDPC	Cumulative AUDPC	'r' value /weak
1	26	Jun 25-July 01	0.00	-	-	-
2	27	July 02-08	8.50	29.75	29.75	-
3	28	July 09-15	13.63	77.44	107.19	0.076
4	29	July 16-22	20.25	118.56	225.75	0.068
5	30	July 23-29	24.75	157.50	383.25	0.037
6	31	July 30-Aug 05	28.25	185.50	568.75	0.026
7	32	Aug 06-12	39.63	237.56	806.31	0.073
8	33	Aug 13-19	43.75	291.81	1098.13	0.024
9	34	Aug 20-26	56.25	350.00	1448.13	0.072
10	35	Aug 27-Sept 02	68.75	437.50	1885.63	0.077
11	36	Sep 03-09	82.13	528.06	2413.69	0.105
12	37	Sep10-16	87.63	594.13	3007.82	0.062
13	38	Sep 17-23	93.50	633.94	3641.75	0.101
14	39	Sep 24-30	100.00	677.25	4319.00	-

PDI- Per cent disease index, r- rate of infection per day, AUDPC- Area under disease progress curve

Table 8 : Apparent Infection Rate (r) and Area Under Disease Progress Curve (AUDPC) of Thompson Seedless during *Kharif* 2025

Sl. No.	Standard Meteorological week	Interval of observation	PDI	AUDPC	Cumulative AUDPC	'r' value /weak
1	23	Jun 4-10	0.00	-	-	-
2	24	Jun 11-17	7.13	24.94	24.94	-
3	25	Jun 18-24	12.25	67.81	92.75	0.085
4	26	Jun 25-July 01	15.00	95.38	188.13	0.033
5	27	July 02-08	26.63	145.69	333.82	0.103
6	28	July 09-15	32.73	207.73	541.54	0.042
7	29	July 16-22	52.85	299.51	841.05	0.119
8	30	July 23-29	61.38	399.79	1240.84	0.050

9	31	July 30-Aug 05	66.50	447.56	1688.40	0.032
10	32	Aug 06-12	78.79	508.50	2196.90	0.089
11	33	Aug 13-19	89.33	588.39	2785.29	0.116
12	34	Aug 20-26	94.63	643.83	3429.11	0.106
13	35	Aug 27-Sept 02	100.00	681.19	4110.30	-

PDI- Per cent disease index, r- rate of infection per day, AUDPC- Area under disease progress curve

Disclaimer (artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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