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Impact of Weather Variables on the Development and Progress of Okra Powdery Mildew

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ABSTRACT: Powdery mildew, caused by the fungus *Erysiphe cichoracearum,* is a common and significant disease affecting okra (also known as lady's finger or gumbo). This disease can lead to substantial yield losses, impacting the overall economics of okra cultivation. Therefore, the development and progress of powdery mildew concerning meteorological factors were studied in a natural/field condition. Out of twelve factors, maximum temperature (0.903), mean temperature (0.728), bright sun shine hours (0.910), GDD (0.746), AGDD (0.962) and crop age (0.959) were found significantly positive correlation while minimum temperature (-0.840), morning relative humidity (-0.845), afternoon relative humidity (-0.935) and mean relative humidity (-0.929) were showed significantly negative correlation with the powdery mildew intensity of okra, in *Kharif* season. The values of the correlation coefficient value of *Rabi* season showed significantly positive relationship of PDI with minimum temperature (0.730), GDD (0.795), AGDD (0.986) and crop age (0.970) in the okra. Whereas, in *Summer* among all the variables, afternoon relative humidity (0.845), mean relative humidity (0.824), AGDD (0.949) and crop age (0.942) were registered significantly positive correlation while maximum temperature (-0.821), mean temperature (-0.755) BSSH (-0.907) and GDD (-0.756) showed significantly negative correlation. The result of regression analysis showed afternoon relative humidity, mean relative humidity and crop age were the crucial factors for the development of powdery mildew during *Kharif* season. Variation accounted by this regression equation is 97.5 per cent (R2 = 0.975). In *Rabi*, variation accounted by regression equation is 96.8 per cent (R2 = 0.968). So, morning relative humidity and crop age were identified as a crucial factors for the development of powdery mildew in *Rabi* season. In *Summer* season variation accounted by regression equation is 99.7 per cent (R2 = 0.997) and the mean temperature, bright sun shine hours and crop age were found as most associative factors, which can predict the PDI of powdery mildew in natural conditions.

Keywords: Meteorological variables, *Abelmoschus esculentus,* powdery mildew.

INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench], is an economically important vegetable crop grown in tropical and sub-tropical parts of the world. This crop is suitable for cultivation as a garden crop as well as on large commercial farms. The area under okra cultivation in India is 526.00 (000 ha) with production of 6460.00 (000 MT) & productivity of 12.10 MT/ha (Anonymous, 2022). In Gujarat, okra is grown throughout the year, providing a continuous and good source of income to the farmers. It is mainly grown in Vadodara, Surat, Junagadh, Banaskantha and Bhavnagar districts. It occupies an area of 75.27 thousand hectares with a production of 921.72 thousand metric tonnes, having an average productivity of 10.90 MT/ha (Anonymous, 2022).

Many factors responsible for yield loss of the crop, one of them is the diseases are major constraints for low yield of okra (Sastry and Singh 1974). A number of fungal, bacterial, viral diseases have been reported in India. Among the fungal diseases affecting okra crop, powdery mildew caused by *Erysiphe cichoracearum* DC is most important disease causes considerable yield losses. The occurrence of the disease has been reported from Mexico (Diaz-Franco, 1999). In India, the disease has been reported to occur in Delhi (Prabhu *et al*., 1971), Karnataka (Sohi and Sokhi 1973), Himachal Pradesh (Raj *et al.*, 1992) and Maharashtra (Jambhale and Nerkar 1983). The disease initiates as white minute patches first on the upper surface of lower older leaves and then spreads to younger ones. Grayish white powdery coating is visible on severely affected leaves. Leaves finally show necrosis resulting in withering, drying and defoliation. It is not appearing on stem, branches and fruits. Powdery mildew affects plants of all growth stages and may result yield losses to the tune of 17 to 86.6 per cent (Sridhar and Sinha 1989). Crop yield losses are significant under favorable weather conditions if the infection takes place in early stages of plant growth (Gupta and Thind 2006). The loss due to powdery mildew is proportionate to the disease intensity and varies considerably depending on the stage of the plant growth at which disease occurs. In southern regions of the state and other parts of the country this powdery mildew pathogen is known to produce only the conidial or anamorphic stage. The identification of the pathogen is therefore done only on the basis of the anamorphic stage.

Weather factors, mainly temperature and relative humidity above a threshold limit, are key factors for the occurrence of powdery mildews. Development of powdery mildews is characterized by an initial slow growth when favorable conditions just set in during susceptible stage of the host. But suddenly an epidemic starts with a devastating appearance, leaving no time for taking any appropriate control measures (Rajput *et al*., 2025). The fungi causing powdery mildews are very fast-growing (4 to 5 days latent period) pathogens, therefore, timely decision is vital for their management (Sharma *et al.*, 2022). Except for grape and mango, there is no appropriate forewarning system for powdery mildews on other crops. In the absence of any forewarning information, growers suffer heavy yield loss (González-Domínguez *et al*., 2023).

Epidemiology encompasses the study of the factors associated with disease development. The three major components of the disease *viz.,* susceptible host, virulent pathogen and favorable weather in time and space causes epidemic (Singh, 1996). Accurate forecast of the crop age at first appearance of the disease and the risk of a mildew epidemic would enable farmers to decide on the optimum timing of fungicide sprays and to avoid unnecessary pesticide application. Hence, the present study was undertaken to find out the relationship of meteorological parameters with disease development.

MATERIALS AND METHODS

The field experiment was conducted at College Farm, N.M.C.A., N.A.U., Navsari during all three seasons (*Kharif* 2014, *Rabi* 2014-15 and *Summer* 2015). The crop was kept totally unprotected where no any application of fungicides /botanicals was given. All the agronomical practices were followed as per the recommendation.

To determine the influence of various physical factors of environment on the development of the powdery mildew of okra, the data on powdery mildew intensity were correlated with different meteorological parameters *viz.*, maximum temperature (Max. Temp.), minimum temperature (Min. Temp.), average temperature (Av. Temp.), morning relative humidity (RH1), afternoon relative humidity (RH2), average relative humidity, rain fall (RF), sunshine hours (SH) and wind speed (WS) through analysis of correlation regression. The corresponding data on various weather parameters were collected from department of meteorology, N.M.C.A., N.A.U., Navsari. The powdery mildew intensity was recorded at weekly interval adjusting standard week in the field of susceptible variety GAO-5. The per cent disease intensity for powdery mildew were recorded by using formula proposed by Wheeler (1969). Powdery mildew intensity observed during the crop season at standard week's interval was correlated with the D-7 (Days prior to observation) weather parameters. For the regression equations, the multiple step wise regression analysis was carried out.

RESULTS AND DISCUSSION

In *kharif* season initiation of the disease was first noticed after 59 days of sowing (1.56%). After that, the linear progress of the disease was observed up to the maturity of the crop. The disease was appeared (1.56 %) at flowering stage (35^{th} SMW) and found highest (71.11 %) at maturity (42^{nd} SMW). The disease development was recorded higher during 38^{th} to 41^{st} SMW. The disease progress was found higher during 66 to 87 days of crop age *i.e.* at fruiting period. During *Rabi* season, the initiation of the disease was noticed after 45 days of sowing. Moreover, the disease progress was found higher from 6^{th} to 11^{th} SMW. The disease was increased up to 76.00 from 6^{th} to 12^{th} SMW. In summer season, the disease was initiated after 66 days of sowing in both the varieties. The maximum disease intensity, 30.89 per cent was noticed. The disease was started from 22^{nd} SMW and higher disease increasing trend was found from 23^{rd} SMW to 24^{th} SMW.

Comparatively, powdery mildew intensity was found higher during rabi and kharif seasons than the summer. The disease appearance was also found earlier (45 DAS) in rabi season, whereas, late appearance in summer season (66 DAS). The rise of per cent disease intensity in the initial stage of disease was very slow. This was followed by rapid progress of the disease due to favorable weather conditions and reaches maximum (Fig. 3 & 4) at maturity stage. The similar confirmation was given by Solanki *et al*. (1999) who found that powdery mildew intensity proportional with the crop age in powdery mildew of mustard.

Looking to the season wise, the disease was increased faster during 38th to 41st SMW in kharif, 6th to 11th SMW in rabi and 23rd to 24th SMW in summer. Moreover, there was negligible rainfall occurred in kharif & rabi during fruiting stage. In summer season, due to high rainfall during susceptible stage (fruiting stage) of crop very slow development of the disease was recorded.

In high rainfall areas and periods, other diseases become more prevalent but powdery mildews decreases as rainfall increases (Agrios, 2005). Light rainfall may induce high spore dispersal. Two main mechanisms are involved, the splash effect (Gregory, 1961) and the rain tap and puff effect (Hirst & Stedman 1963).

Correlation coefficient values (Table 1) reflect the extent of association between PDI with different meteorological factors, crop age and heat unit. Out of twelve factors, maximum temperature (0.903), mean temperature (0.728), bright sun shine hours (0.910), GDD (0.746), AGDD (0.962) and crop age (0.959) were found significantly positive correlation while minimum temperature (-0.840), morning relative humidity (-0.845), afternoon relative humidity (-0.935) and mean relative humidity (-0.929) were showed significantly negative correlation with the powdery mildew intensity of okra. During rabi season correlation coefficient values showed significantly positive relationship of PDI with minimum temperature (0.730), GDD (0.795), AGDD (0.986) and crop age (0.970). Whereas, in summer among all the variables, afternoon relative humidity (0.845), mean relative humidity (0.824), AGDD (0.949) and crop age (0.942) were registered significantly positive correlation while maximum temperature (-0.821), mean temperature (-0.755) BSSH (-0.907) and GDD (-0.756) showed significantly negative correlation. The results obtained from present study are in confirmation with the reports of earlier workers. Solanki *et al*. (1999) stated that mean temperature, bright sun shine hours, GDD, AGDD and crop age were significantly and positively correlated with powdery mildew disease intensity and progress on mustard crop. These results are also in conformity with the observations of Gupta *et al*. (2001); Kohire *et al*. (2008).

The result is moderately similar with the confirmation of Singh *et al*. (2008) who noted that maximum temperature were significantly and positively correlated, whereas bright sun shine hours and wind speed negatively correlated with powdery mildew disease intensity and AUDPC. While, Vikas and Ratnoo (2013) observed that sunshine hours positively and rainfall negatively correlated with powdery mildew development. Maximum and minimum temperature, morning and afternoon relative humidity and rainfall significantly and positively correlated with powdery mildew disease intensity reported by Singh and Pannu (2015).

To formulate the simple and effective linear regression equation for powdery mildew disease prediction, the various meteorological factors, heat unit (GDD and AGDD) and crop age were assessed. The maximum, minimum and mean temperature replaced by GDD and AGDD when heat unit were used in regression analysis. An independent variables *viz*., average of 7 previous days (D-7) of meteorological factors from initiation to maturity of crop heat unit (GDD and AGDD) and crop age with dependent variable PDI at respective SMW were computed by multiple step wise regression analysis.

Generally, the pathogen becomes most active over the susceptible host under the congenial environmental conditions. These important factors were critically studied during all the three seasons *viz*., kharif, rabi and summer of 2014-15.

The data of kharif season (Table 2) showed that meteorological factors *viz*., afternoon relative humidity (X5), mean relative humidity (X6) and crop age (X10) were identified as a most responsible factors for the disease development under natural conditions. Variation accounted by this regression equation is 97.5 per cent (R2 = 0.975). The obtained regression equation for the prediction of PDI (Y) is as under:

$$Y = -168.2943 - 3.4904\ (X5) + 4.552\ (X6) - 0.8580\ (X10) \quad (1)$$

Whereas, in rabi season (Table 3) meteorological factors *viz*., morning relative humidity (X4) and crop age (X10) were most crucial factors for the disease development under natural conditions (Fig. 3). Variation accounted by this regression equation is 96.8 per cent (R^2 = 0.968).The obtained regression equation for the prediction of PDI (Y) is as under:

$$Y = -4.9313 - 0.7027\ (X4) + 1.3092\ (X10) \quad (2)$$

In summer season (Table 4) meteorological factors *viz*., mean temperature (X3) bright sun shine hours (X8) and crop age (X10) were found as most associative factors for the disease development under natural conditions (Fig. 4). Variation accounted by this regression equation is 99.7 per cent (R2 = 0.997). The obtained regression equation for the prediction of PDI (Y) is as under:

$$Y = 30.4522 - 1.7341\ (X3) - 1.3610\ (X8) + 0.6045\ (X10) \quad (3)$$

In case of okra powdery mildew, the rain tap effect might be important both quantitatively and qualitatively for two reasons. First, germination of conidia is negatively affected by the presence of free water (Willocquet & Clerjeau 1998). Thus, the germination of conidia dispersed by rain splash may be hampered compared with that of dry spores. Second, powdery mildew colonies are mostly located on the lower surface of leaves, especially at the beginning of the growing season. As these colonies are not likely to be hit by rain drops, the rain tap effect may be the most important mechanism of spore dispersal by rain. In the okra, thus light rainfall can be considered as favorable to the fungus, as it would allow dispersal without the drawbacks associated with heavy or continuous rain (Sharma *et al*., 2022).

Under continuous rain, the conidial stock is likely to decrease and conidia may be washed off from leaves, leading to a decrease in spore concentration, as observed on 24 to 27 SMW in summer season. Such decreases because of rain have been reported for other powdery mildews (Willocquet and Clerjeau 1998; Hammett & Manners 1971; Sutton & Jones 1979; Pauvert, 1986). Continuous rainfall is also likely to be unfavorable to okra powdery mildew because of physical damage to leaf surface mycelium and conidiophores.

In present study the optimum maximum and minimum temperature for maximization of powdery mildew severity on okra leaves were 36.7 and 22.5°C for kharif and 12.9 to 34.4°C for rabi under field conditions was in confirmation to Bhattacharya and Shukla (2002) who have pointed out that optimum temperature for development of powdery mildew severity were 37.4 and 21.4°C under irrigated conditions.

E. cichoracearum from cantaloupe showed a temperature optimum of 25° to 28°C on the basis of *in vivo* length of hyphae reported by Yarwood *et al.* (1954). They also observed that growing mycelia are apparently more sensitive to high temperature than are quiescent conidia. The LD 50 of 37°C air temperature for a 3-day infection of *E. cichoracearum* on cucumber was about 10 hours, while with freshly inoculated leaves it was about 20 hours.

The short life of powdery-mildew conidia is associated with their high water content (Yarwood, 1950), but *E. cichoracearum* is more tolerant of high temperature than other *Erysiphe* spp. because it has lowest water containing conidia among the powdery mildews and has the longest-lived conidia at ordinary temperatures (Yarwood *et al.*, 1954).

Wide variation (10-15°C) in the maximum and minimum temperature and day and night relative humidity (30-40%) increases powdery mildew intensity in cucumber (Gupta *et al*., 2001). They also reported that too high and too low temperature did not favor powdery mildew development. The optimum temperature and relative humidity for conidial germination is 25°C and 100 per cent, respectively.

Production of conidia is optimal at 20°C and declines rapidly above and below that temperature (Ward and Manners 1974). Although conidia only survive for several days, they are capable of disseminating the fungus long distances. New pustules with conidia are produced every seven to ten days at optimal conditions and provide repeating cycles of spores. Conidia germinate most rapidly at 97 to 100 per cent relative humidity, but their high water content allows them to germinate when humidity declines below 50 percent. However, germ tube growth and appressorium production are greatly reduced below 92 per cent relative humidity (Friedrich *et al*., 1993).

According to Jyothi *et al.* (2014) conidia of powdery mildew germinated at 65 per cent and 100 per cent humidity, indicated the ability of fungus to infect both under dry and humid conditions. Similarly, Jacob *et al.* (2008) reported that conidia of *Oidium lycopersici* germinate well at 65 to 100% RH and best at 95%. They also reported that low light intensity was associated with optimal germination. The bright sunny periods militate against the development of the fungus, and have a lethal effect on detached spores (Peries, 1962).

Bhattacharya and Shukla (2002) concluded that increase in temperature and sunshine duration had positive effect on powdery mildew severity, whereas, relative humidity was negative under both irrigated and rainfed conditions. High association of powdery mildew severity with sunshine duration could be possible by its indirect effects as has been suggested by Calhoun (1973) or due to changes in sun's inclination resulting increase in temperature with sunshine duration and evapo-transpiration (Rotem, 1978). Germination decreased or was delayed in the presence of free water demonstrated by Butt (1978).

While, according to Kohire *et al*. (2008) dry and cool environmental conditions that means temperature range between 12.2 to 22.8°C and low relative humidity from 30.2 to 48.8 % ideal for conidial germination.

The result was also more or less similar with the findings of Vikas and Ratnoo (2013); Singh *et al*. (2008).

From the results of the present investigation, it is very clear that powdery mildew of okra is high to moderately occurring in Navsari district during throughout the year. The infection on leaf produced huge quantity of inoculum in the presence of favorable climatic conditions. Due to presence of heavy load of inoculum, the pathogen attacked on all the leaves (Lower, Middle and Upper, respectively). So, the weather during the period between 38st to 42nd, 6th to 11th and 23rd to 24th SMW were observed extremely crucial for development of the powdery mildew.

Table 1: Relationship of powdery mildew intensity with different variables during Kharif, Rabi and Summer seasons.

Sr. No.	Variables	Correlation coefficient "r"		
		Kharif (2014-15)	Rabi (2014-15)	Summer (2015)
1.	Maximum temperature (°C)	0.903	0.251 NS	-0.821
2.	Minimum temperature (^{0}C)	-0.840	0.730	-0.490 NS
3.	Mean temperature (^{0}C)	0.728	0.554 NS	-0.755
4.	Morning relative humidity (%)	-0.845	0.218 NS	0.674 NS
5.	Afternoon relative humidity (%)	-0.935	0.566 NS	0.845
6.	Mean relative humidity (%)	-0.929	0.492 NS	0.824
7.	Wind Speed (km/hrs)	-0.339NS	0.181 NS	-0.117 NS
8.	Bright Sun Shine Hours	0.910	0.183 NS	-0.907
9.	Rainfall (mm)	-0.475 NS	0.468 NS	0.490 NS
10.	GDD	0.746	0.795	-0.756
11.	AGDD	0.962	0.986	0.949
12.	Crop age (DAS)	0.959	0.970	0.942

Critical value (0.05) = +/- 0.666 (Kharif), +/- 0.602 (Rabi) and +/- 0.754 (Summer)

Table 2: Regression analysis of per cent disease intensity of powdery mildew with different meteorological factors and crop age in kharif season (Average of D-7).

Sr. No.	Independent Variables	Constant	Regression* coefficient 'b'	R^2
1.	X5 = Afternoon relative humidity (%)	-168.2943	-3.4904 (1.5447)	0.975
2.	X6 = Mean relative humidity (%)		4.5522 (2.4505)	
3.	X10 = Crop age (DAS)		0.8580 (0.2114)	

Standard error of est.= 5.3923

*'b' significant at 5% level and std. error of variable is given in parentheses

Table 3: Regression analysis of PDI of powdery mildew with different meteorological factors and crop age in rabi season (Average of D-7).

Sr. No.	Independent Variables	Constant	Regression* coefficient 'b'	R^2
1.	X4 = Morning relative humidity	-4.9313	-0.7027 (0.3772)	0.968
2.	X10 = Crop age		1.3092 (0.0857)	

Standard error of est.= 5.8375

Table 4: Regression analysis of PDI of powdery mildew with different meteorological factors and crop age in summer season (Average of D-7).

Sr. No.	Independent Variables	Constant	Regression* coefficient 'b'	R^2
1.	X3 = Mean temperature	30.4522	-1.7341 (0.8688))	0.997
2.	X8 = Bright sun shine hours		-1.3610 (0.6927)	
3.	X10 = Crop age		0.6045 (0.0514)	

Standard error of est.= 0.9985

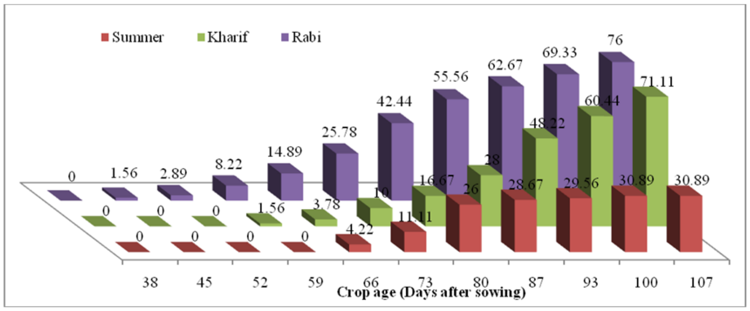

Fig. 1. Disease occurrence during different crop age in all three seasons.

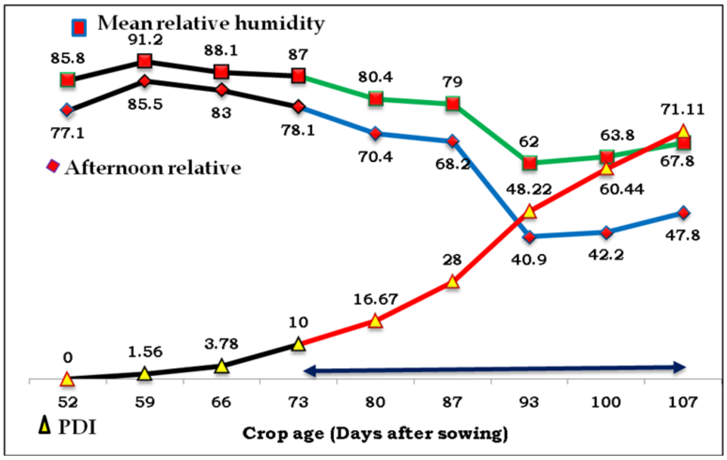

Fig. 2. Relation of disease intensity with afternoon relative humidity, mean relative humidity and crop age (Kharif).

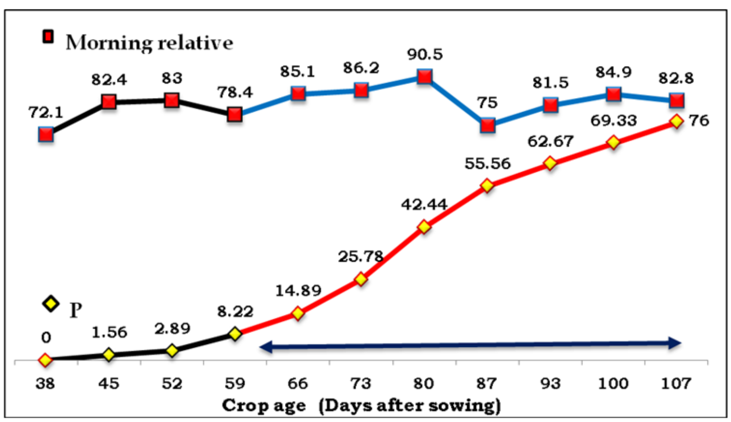

Fig. 3. Relation of disease intensity with Morning relative humidity and crop age (Rabi).

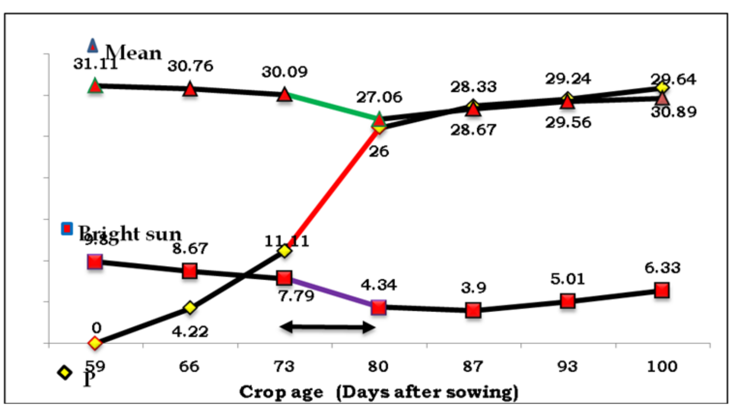

Fig. 4. Relation of disease intensity with bright sun shine hours and mean temperature and crop age (Summer).

CONCLUSIONS

The present study on development and progress of powdery mildew (*Erysiphe cichoracearum* DC) disease in relation to meteorological factors demonstrated that were maximum temperature, mean temperature, bright sun shine hours, GDD, AGDD and crop age were found positive correlation while minimum temperature, morning relative humidity, afternoon relative humidity and mean relative humidity were showed significantly negative correlation with the powdery mildew intensity of okra, in *Kharif* season. The values of correlation coefficient value of *Rabi* season showed significantly positive relationship of PDI with minimum temperature, GDD, AGDD and crop age. Whereas, in *Summer* among all the variables, afternoon relative humidity, mean relative humidity, AGDD and crop age were registered significantly positive correlation while maximum temperature, mean temperature, BSSH and GDD showed significantly negative correlation. Afternoon relative humidity, mean relative humidity and crop age were the crucial factors for the development of powdery mildew during *Kharif* season were found in regression analysis. In *Rabi*, morning relative humidity and crop age were identified as a crucial factors for the development of powdery mildew. Whereas, in *Summer* season mean temperature, bright sun shine hours and crop age were found as most associative factors, which can predict the PDI of powdery mildew in natural conditions.

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Conflict of Interest. None.

REFERENCES

Agrios, G. N. (2005). Plant Pathology. 5th Edition, Academic Press, New York. pp 395.

Anonymous (2018). Indian Horticulture Database Report.

Bhattacharya, A. & Shukla, P. (2002). Effect of environmental factors on Powdery mildew severity in field pea under irrigated and rainfed conditions. *Indian J. Agric. Res.*, *36*(3), 149-155.

Butt, D. J. (1978). Epidemiology of powdery mildews. *In*: The Powdery Mildews. D.M. Spencer (Ed), Academic Press, London. pp 51-81.

Calhoun, J. (1973). Effects of environmental factors on plant disease. *Annual Review of Phytopathology*, *11*, 343-364.

Diaz-Franco, A. (1999). Okra (*Abelmoschus esculentus*) powdery mildew in Mexico. *Revista Mexicana de Fitopathol*, *17*, 44-45.

Friedrich, S., Boyle, C. & Tantu, H. J. (1993). Simulation of infection probability of powdery mildew in winter wheat. In: *Mathematical and Control Applications in Agriculture and Horticulture* (Ed. Munack, K.). Proc 3rd IFAC Workshop, Hannover, Germany, pp. 243-248.

González-Domínguez, E., Caffi, T., Rossi, V., Salotti, I. & Fedele, G. (2023). Plant disease models and forecasting: changes in principles and applications over the last 50 years. *Phytopathology*, *113*(4), 678-693.

Gregory, P. H. (1961). The Microbiology of the Atmosphere. London: Interscience Publishers, Inc., pp. 34.

Gupta, S. K. & Thind, T. S. (2006). Diseases problems in vegetable production. Scientific Publishers, India, Jodhpur, pp. 576.

Gupta, S. K., Gupta, A., Shyam, K. A. & Bhardwaj, R. (2001). Morphological characterization and effect of meteorological factors on development of cucumber powdery mildew. *Indian Phytopath*, *54*(3), 311-315.

Hammett, K. R. W. & Manners, J. G. (1971). Conidium liberation in *Erysiphe graminis*. I. Visual and statistical analysis of spore trap records. *Transactions of the British Mycological Society*, *56*, 387–401.

Hirst, J. M. & Stedman, O. J. (1963). Dry liberation of fungusspores by raindrops. *Journal of General Microbiology*, *33*, 335–344.

Jacob, D., David, D. R., Sztjenberg, A. and Elad, Y. (2008). Conditions for Development of Powdery Mildew of Tomato Caused by *Oidium neolycopersici*. *Phytopathology*, *98*, 270-281.

Jambhale, N. D. & Nerkar, Y. S. (1983). Inheritance of resistance to powdery mildew in okra. National Seminar on Breeding Crop Plants for Resistance to Pests and Diseases, 25-27 May 1983, Coimbatore, Tamil Nadu.

Jyothi, D. A., Hundekar, R. L. & Veena, S. M. (2014). Epidemiologial aspects responsible for the conidial germination of *Erysiphe polygoni* DC on green gram. *Journal of Progressive Agriculture*, *5*(2), 37-41.

Kohire, O. D., Kohire, V. O., Ahmed, R., Chavan, S. S. & Khilare, V. C. (2008). Epidemiology of powdery mildew of mustard in marathwada. *J. Pl. Dis. Sci.*, *3*(2), 235-236.

Pauvert, P. (1986). *Les parame`trese´pide´miologiques de l'Oı¨-dium de l'orge* (*Erysiphe graminis* f.sp. hordei). Paris, France: Universite´ de Paris VI, Ph. D. thesis.

Peries, O. S. (1962). Studies on strawberry mildew caused by *Sphaerotheca macularis* (Wallr. ex Fries) Jaczewski, I. Biology of the fungus. *Ann. Appl. Biol.*, *50*, 211-224.

Prabhu, A. S., Pathak, K. D. & Singh, R. P. (1971). Powdery mildew of 'bhindi' (*Abelmoschus esculentus* (L) Moench) in Delhi state. *Indian Journal of Horticulture*, *28*, 310-312.

Raj, H., Bhardwaj, M. L., Sharma, I. M. & Sharma, N. K. 1992. Performance of commercial okra (*Hibiscus esculentus*) varieties in relation to disease and insect-pests. *Indian Journal of Agricultural Sciences*, *63*, 747-748.

Rajput, L. S., Shaikh, M. S., Borah, M., Kumar, S., Nataraj, V., Shivakumar, M., Maheshwari, H. S., Pathak, K., Gupta, A., Goswami, D., Keerthi, P., Kumar, S. & Jadon, K. S. (2025). Evaluation of Combination Fungicides for Charcoal Rot and Collar Rot Management in Soybean. *Agronomy, 15*(3), 528.

Rotem, J. (1978). In: Plant Diseases: An Advance Treatise, *1*, pp88.

Sastry, K. S. M. & Singh, S. J. (1974). Effect of yellow vein mosaic virus infection on growth and yield of okra crop. *Indian Phytopath*, *27*, 294-297.

Sharma, J. K, Shekhawat, H. V. S., Joshi, N., Patil, P. R., Sachan, R. & Sharma, K. (2022). Relationship of Meteorological variables with an Epiphytotic of Powdery Mildew Disease of Okra. *Biological Forum– An International Journal*, *14*(2), 1308-1313.

Singh, K., Mehta, N. & Sangwan, M. S. (2008). Influence of weather parameters on the progression of powdery mildew on four varieties of rapeseed-mustard in Haryana. *Pl. Dis. Res.*, *23*(2), 39-45.

Singh, R. D. (1996). Relevance of epidemiology in integrated disease management. *Indian Phytopath.*, *44*(2), 127-128.

Singh, S. & Pannu, P. P. S. (2015). Influence of weather factors on occurrence and progress of powdery mildew of wheat in the screen house.*Pl. Dis. Res.*, *30*(1), 50-55.

Sinha, P., Chakrabarti, U. & Varma, A. (2001). Critical weather factors for the development of mango powdery mildew. *Ann. Pl. Protec. Sci*., *9*, 264-267.

Sohi, H. S. & Sokhi, S. S. (1973). Behavior of okra varieties to damping off, powdery mildew and Cercospora blight. *Indian Phytopath, 26*(1), 91-92.

Solanki, V. A., Patel, B. K. & Shekh, A. M. (1999). Meteorological variables in relation to an epiphytotic of powdery mildew disease of Mustard. *Indian Phytopath*, *52*(2), 138-141.

Sridhar, T. S. & Sinha P. (1989). Assessment of loss caused by powdery mildew (*Erysiphe cichoracearum*) of okra (*Abelmoschus esculentus*) and its control. *Indian J. Agric. Sci*., *59*, 606-607.

Sutton, T. B. & Jones, A. L. (1979). Analysis of factors affecting dispersal of *Podosphaera leucotricha* conidia. *Phytopathology*, *69*, 380–390.

Vikas & Ratnoo, R. S. (2013). Effect of different weather parameters on progression of powdery mildew (*Erysiphe polygoni)* on fenugreek. *J. Pl. Dis. Sci*., *8*(2), 218-220.

Ward, S. V. & Manners, J. G. (1974). Environmental effects on the quantity and viability of conidia produced by *Erysiphe graminis*. *Trans. Brit. Mycol. Soc.*, *62*, 119-128.

Wheeler, B. E. J. (1969). An Introduction to Plant Diseases. John Wiley and Sons Ltd., London, pp. 301.

Willocquet, L. & Clerjeau, M. (1998). An analysis of the effects of environmental factors on conidial dispersal of *Uncinula necator* (grape powdery mildew) in vineyards. *Plant Pathology*, *47*(3), 227-233.

Yarwood, C. E. (1950). Water content of fungus spores. *Amer. Jour. Bot.*, *37*, 636-639.

Yarwood, C. E., Sidky, S., Cohen, M. & Santilli, V. (1954). Temperature relations of powdery mildews. *Journal of Agricultural Science*, *22*(17), 603-622.

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