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WEATHER-BASED REGRESSION ANALYSIS FOR PREDICTION AND VALIDATION OF GROUNDNUT LEAF MINER (*APROAEREMA MODICELLA*) INCIDENCE UNDER ARID ALFISOLS

P. RADHIKA*

Agricultural Research Station, Ananthapuramu,Andhra Pradesh-515001
Acharya N G Ranga Agricultural University, Lam , Guntur

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ABSTRACT

A study was conducted during 2020 to 2022 under arid alfisols at the Agricultural Research Station, Ananthapuramu, Andhra Pradesh.A Regression analysis of Groundnut Leaf Miner (GLM) moth catches with weather parameters revealed a significant positive correlation with Relative Humidity-I (RH-I) at 5 days lag (0.55*) and 6 days lag (0.59*) and Rainfall (RF) at 8 days lag (0.51*) and negative correlation with Wind velocity (Wv) (-0.51*).The leaf damage showed significant and positive correlation with Maximum Temperature (Tmax) (0.67*), Mean Temperature (Tmean) (0.53*),Evaporation (Evp) (0.72*) at 6 days lag and negative correlation with Relative Humidity-II (RH-II)(-0.68*) and Wv(-0.5*) at 5 days lag, and RH-I (-0.5*),Rf(-0.65*) at 6 days lag. RH-II at (-0.58*) at 7 days lag and 8 days lag RH-II (-0.55*) and Sun shine hours (Ssh) (-0.69*).No.of Live larvae/plant recorded significant positive correlation with Tmean(0.5*) and Rf(0.67*) at 9 days lag. and significant negative correlation with Rainfall (-0.5*) at 6 days lag and Wv(-0.79*) at 7 days lag and Minimum Temperature (Tmin) (-0.50*), Tmean(-0.55*) at 8 days lag and Tmax(-0.62*), Tmin(-0.65*), Tmean(-0.74*) and RH-I (-0.5*) at 9 days lag. The study showed that mean temperature was the strongest positive predictor of groundnut leafminer incidence, while higher maximum and minimum temperatures suppressed the pest. Morning humidity slightly favoured infestation, but higher afternoon humidity reduced it. These results highlight temperature and humidity as key weather drivers of leafminer outbreaks. With an R^2 of 0.97, the model explained most of the variation in pest incidence, though independent validation is needed to confirm its reliability.

Key words: Groundnut leaf Miner, Integrated Pest Management, Lagged weather effects, Pest Forecasting, Regression modelling,

INTRODUCTION

Groundnut is a widely cultivated oilseed crop of global significance, with India being one of the leading producers. Its productivity is largely affected by insect pest pressure and moisture stress, particularly under rainfed conditions. During 2020–21, India occupied the first position in terms of cultivated area (55.72 lakh ha) and ranked second in production with 102 lakh tonnes, achieving an average yield of 1831 kg ha{ ¹ (Agricoop.nic.in). In Andhra Pradesh, groundnut was grown over 8.25 lakh

**Corresponding author email id:* p.radhika@angrau.ac.in

hectares during 2021–22, producing 5.15 lakh tonnes with a mean productivity of 625 kg ha{ ¹, contributing about 5.03% to the national output (des.ap.gov.in). The state's average yield remains considerably lower than the national mean (Suneel Kumar *et al*., 2023).Several factors contribute to this yield gap, among which inadequate plant protection practices, especially under rainfed farming systems, play a crucial role. Among the insect pests affecting groundnut, the leaf miner, *Aproaeremamodicella* (Deventer), is regarded as one of the most destructive in Andhra Pradesh. This gelechiid moth, commonly referred to as the groundnut leaf miner (GLM), is an important oligophagous pest attacking groundnut, soybean, and a few other leguminous crops across South and Southeast Asia (Syobu*et al*. 2003). Therefore, the present investigation was undertaken to examine the effect of weather parameters on the seasonal incidence of this pest in rainfed groundnut, with a view to developing effective management strategies.

MATERIAL AND METHODS

A long-term investigation was undertaken to evaluate the relationship between pheromone trap catches, prevailing weather conditions, and the extent of damage caused by groundnut leaf miner (GLM) over the periods 2008–2016 and 2021–2023 at Ananthapuramuunder arid Alfisol conditions. The experiment was conducted during Kharif 2020–2022at the Agricultural Research Station, Ananthapuramu, Andhra Pradesh, using the groundnut variety Kadiri-6 (K-6). The crop was established in plots measuring 25 X 25 m, maintaining a spacing of 30 cm × 10 cm, with sowing carried out during the fourth week of July following recommended agronomic practices of ANGRAU, without adopting any plant protection measures. For pest observations, ten plants were randomly selected within a 1 m × 1 m quadrat in each experimental plot and tagged. Data on insect pests and their natural enemies were recorded at three-day intervals and summarized according to Meteorological Standard Weeks (MSW), beginning from 15 days after sowing (DAS) until crop harvest. The incidence of *Aproaeremamodicella* was quantified by counting the number of larvae on the tagged plants. The percentage of foliar damage was estimated based on the ratio of damaged leaves to total leaves per plant. Weather data were collected daily from the meteorological observatory, aggregated on a weekly basis, and subjected to correlation analysis with pest incidence using SPSS software.

Estimates of correlation were determined between the parameters of GLM and weather parameters. Regression models were determined to predict the adult mothsthrough weather parameters.Correlation only checks linear association.Regression diagnostics ensure that a regression model is valid, reliable and interpretable by testing assumptions, detecting problems and preventing false conclusions. Stepwise regression is a variable selection method used when more no. of predictors areavailable. It builds the regression model iteratively by adding or removing predictors based on statistical criteria.When predictors or response are time dependent, lagged variables are often introduced. Selecting correct lag order is critical to avoid underfitting or overfitting. Lag setting criteria here was based on the duration of larval period and life cycle of GLM Prediction of changes in different parameters was made and assessed the convergence of observed and simulated values. Predicted values were compared with observed values mainly through residual plots, fit statistics and influence diagnostics to check whether the regression model adequately represents the data and assumptions are satisfied.Based on the coefficient of determination (R^2), the models were assessed for their usefulness for prediction of adult moths over years.

RESULTS AND DISCUSSION

GLM adult moth catches

Analysis of GLM moth trap catches in relation to weather variables indicated a significant positive association with morning relative humidity (RH-I) at a lag of 5 days (r = 0.55*) and 6 days (r = 0.59*), as well as with rainfall at an 8-day lag (r = 0.51*). In contrast, wind velocity exhibited a significant negative correlation (r = “0.51*). These observations are in agreement with the findings reported by Radhika (2015).Stepwise regression analysis further supported these relationships, yielding the models: Y = “49.40 + 0.70 RH-I (R^2 = 0.31) at a 5-day lag, Y = “48.04 + 0.71 RH-I (R^2 = 0.35) at a 6-day lag, and Y = “42.84 + 2.65 Tmax + 0.19 Rf “ 4.94 Evp (R^2 = 0.50) at an 8-day lag(Table 1 & 2).

Leaf damage

The leaf damage showed significant and positive correlation with Tmax (0.67*), Tmean(0.53*), Evp(0.72*)at 6 days lagandnegative correlation with RH-II (-0.68*) and Wv(-0.5*) at 5 days lag, and RH-I (-0.5*), Rf(-0.65*)at 6 days lag. RH-II (-0.58*) at 7 days lag and 8 days lag RH-II (-0.55*) and Ssh(-0.69*)(Table3) The stepdown regression also revealed thatY=66.53-0.66RH-I-6.29Rf (R^2=0.73) at 6 days lag and Y=87.81-25.36Tmax-25.82Tmin+5089315.56Tmean-1.26RH-II (R^2=0.94) at 8 days lag (Table 7).

No.of webs/plant

No.ofwebs/plant showed significant positive correlation with Tmean(0.5*)at 6 days lag and Tmax(0.5*), Ssh(0.61*) at 7 days lag and significant negative correlation with Ssh(-0.5*) at 5 days lag, Rainfall(-0.5*)at 6 days lag and Tmin at 9 days lag (-0.5*). The step-down regression also revealed Y=-58.56-79.75 Tmax-82.82 Tmin+164. 19Tmean + 0.22Wv+0.35Rf(R^2=0.99) at 9 days lag (Table 4). The model was based on the huge data of ten years (2006 to 2016).

No.of Live larvae/plant

No.ofLive larvae/plant recorded significant positive correlation with Tmean(0.5*) and Rf(0.67*) at 9 days lag. and significant negative correlation with Rainfall (-0.5*) at 6 days lag and Wv(-0.79*) at 7 days lag and Tmin(-0.50*), Tmean(-0.55*) at 8 days lag and Tmax(-0.62*), Tmin(-0.65*), Tmean(-0.74*),RH-I (-0.5*) at 9 days lag. The step down regression also revealedY=-160.10-4.17Tmax +8.50Tmean+0.97RH-I-0.67RH-II+1.75Wv+0.47Rf (R^2=0.99) at 5 days lag and Y=-7.59-8.83Tmax-8.56Tmin+17.24Tmean+0.12RH-I-0.22RH-II(R^2=0.97) at 6 days lag and Y=65.24-143.44Tmax-143.25Tmin+284.54Tmean-0.07RH-I+0.42RH-II (R^2=0.99) at 9 days lag (Table 10). These results may be due to the coincidence of change in the instar I e., from larvae to pupa.No.of live pupae/plant has significant positive correlation with Tmax(0.58*) and Evp(0.52*) at 5 days lag and Evp(0.5*) at 7 days lag and significant negative correlation with RH-II (-0.5*) and Tmin(-0.71*) at 8 days lag and RH-I (-0.5*) at 9 days lag (Table7).

From this study, it is evident that temperature and relative humidity had a significant influence on leaf miner catches in kharif groundnut as reported by Dubey*et al*.(1995) who showed that high maximum and minimum temperatures of pre-monsoon period with low relative humidity, followed by continuous rains coupled with high maximum

Table 1. Correlation studies of GLM moth catches with weather parameters

S.No	Weather parameters	5 Days lag	6 Days lag	7 Days lag	8 Days lag	9 Days lag
1	T max	0.15	-0.03	0.09	-0.02	0.35
2	T min	-0.32	-0.27	-0.10	-0.10	0.007
3	Tmean	-0.04	-0.22	0.007	-0.06	0.31
4	RH-I	0.55*	0.59*	0.21	0.21	-0.13
5	RH-II	0.16	-0.14	0.09	0.10	0.05
6	Wind velocity	-0.51*	-0.42	-0.35	-0.21	0.009
7	Ssh	0.22	0.04	0.29	-0.01	0.16
8	Rainfall	0.01	-0.11	-0.03	0.51*	0.37
9	Rainy days	-0.05	-0.10	-0.03	0.30	0.13
10	Evaporation	0.26	0.08	-0.02	-0.34	-0.16

Table 2. Step down Regression equation of pheromone moth catches with weather parameters

GLM moth catches	Regression Equation	R^2 Value
5 days lag	Y=-49.40+0.70RH-I	0.31
6 days lag	Y=-48.04+0.71RH-I	0.35
8 days lag	Y=-42.84+2.65Tmax+0.19Rf-4.94Evp	0.50

Table 3. Populationdynamics of GLM (Leaf damage%) as influenced byweatherparameters

S.No	Weather parameters	5 Days lag	6 Days lag	7 Days lag	8 Days lag	9 Days lag
1	T max	0.09	0.67*	0.32	-0.18	0.16
2	T min	-0.32	-0.35	-0.07	-0.027	-0.01
3	Tmean	-0.07	0.53*	0.078	-0.15	0.06
4	RH-I	0.09	-0.5*	-0.42	-0.42	-0.37
5	RH-II	-0.68*	-0.38	-0.58*	-0.55*	-0.18
6	Wind velocity	-0.5*	-0.22	-0.18	-0.14	0.33
7	Ssh	-0.27	0.44	0.08	-0.69*	0.04
8	Rainfall	-0.11	-0.65*	-0.27	0.31	0.06
9	Rainy days	-0.14	0	-0.27	0	0.01
10	Evaporation	0.22	0.72*	0.15	-0.008	0.33

and minimum temperatures followed by monsoon break for a week or two, favoured the outbreak of the pest. Bagmare*et al.*(1995) also reported that maximum and minimum temperatures and sunshine hours had a positive correlation with GLM trap catches, while rainfall and relative humidity had negative influence. Further, Wheatley *et al.*, (1989)

Table 4.Population dynamics of GLM (Live larvae/plant) as influencedby weather parameters

S.No	Weather parameters	5 Days lag	6 Days lag	7 Days lag	8 Days lag	9 Days lag
1	T max	-0.31	0.21	0.21	-0.41	-0.62*
2	T min	0.32	0.17	0.06	-0.50*	-0.65*
3	Tmean	-0.11	0.5*	0.16	-0.55*	-0.74*
4	RH-I	-0.13	0.06	-0.09	-0.13	-0.5*
5	RH-II	0.07	0.10	-0.17	-0.11	0.002
6	Wind velocity	0.39	0.12	-0.79*	-0.19	-0.09
7	Ssh	-0.13	0.09	0.18	-0.11	-0.35
8	Rainfall	-0.03	-0.5*	-0.15	-0.21	0.67*
9	Rainy days	-0.23	0	-0.22	-0.22	0.27
10	Evaporation	-0.30	0.36	-0.15	-0.52*	-0.36

Table 5.Population dynamics of GLM (No.of webs/plant) as influenced by weather parameters

S.No	Weather parameters	5 Days lag	6 Days lag	7 Days lag	8 Days lag	9 Days lag
1	T max	-0.31	0.21	0.5*	0.27	0.26
2	T min	-0.00	0.17	0.19	-0.03	-0.50*
3	Tmean	-0.26	0.5*	0.36	0.19	-0.20
4	RH-I	0.05	0.06	-0.04	0.21	0.03
5	RH-II	-0.28	0.10	-0.09	-0.37	-0.10
6	Wind velocity	0.09	0.12	0.14	0.05	-0.01
7	Ssh	-0.5*	0.09	0.61*	0.33	0.42
8	Rainfall	-0.18	-0.5*	-0.33	-0.29	0.003
9	Rainy days	-0.35	0	-0.32	-0.32	0.42
10	Evaporation	-0.13	0.36	0.21	0.20	-0.02

observed that leaf miner *A.modicella* was most densely infected on the most drought stressed plants of groundnut where leaf surface temperatures were highest. On the contrary, significant positive correlations of morning and evening relative humidity and number of rainy days were found with pheromone trap catches of GLM (Das, 1999). Whereas rainfall showed a significant influence on leaf miner moth catches in the present study which was in conformity with the findings of Radhika(2015).Chaudhuri and Senapati(2004) also reported that the leaf miner incidence was significantly and positively correlated with minimum temperature as reported in this study during kharif. The current findings are also in accordance with Pazhanisamy and Hariprasad (2014) and Suneel Kumar *et al.*(2023) demonstrating the significant positive

Table 6. Population dynamics of GLM (Live pupae/plant) as influenced by weather parameters.

S.No	Weather parameters	5 Days lag	6 Days lag	7 Days lag	8 Days lag	9 Days lag
1	T max	0.58*	0.20	0.24	0.017	0.037
2	T min	-0.28	0.37	-0.13	-0.71*	-0.42
3	Tmean	0.35	0.40	0.07	-0.31	-0.26
4	RH-I	0.25	0.09	0.10	0.31	-0.5*
5	RH-II	-0.21	-0.5*	-0.32	-0.20	-0.19
6	Wind velocity	-0.27	-0.31	-0.35	-0.03	0.42
7	Ssh	0.41	0.21	0.34	0.12	0.38
8	Rainfall	-0.08	0.05	0.015	0.03	-0.09
9	Rainy days	0.02	0	0.014	0.01	-0.36
10	Evaporation	0.52*	0.24	0.5*	-0.08	0.17

Table 7. Stepdown regression equation for GLM asinfluenced by weather parameters

Time lag	Step down Regression equation	R^2 Value
Damage %		
6 days lag	Y=66.53-0.66RH-I-6.29Rf	0.73
8 days lag	Y=87.81-2544659.36Tmax-2544655.82Tmin+5089315.56Tmean-1.26RH-II	0.94
No of webs		
9 days lag	Y=-58.56-79.75Tmax-82.82Tmin+164.19Tmean+0.22Wv+0.35Rf	0.99
Live larvae/plant		
5 days lag	Y=-160.10-4.17Tmax+8.50Tmean+0.97RH-I-0.67RH-II+1.75Wv+0.47Rf	0.99
6 days lag	Y=-7.59-8.83Tmax-8.56Tmin+17.24Tmean+0.12RH-I-0.22RH-II	0.97
9 days lag	Y=65.24-143.44Tmax-143.25Tmin+284.54Tmean-0.07RH-I+0.42RH-II	0.99

association of minimum temperature with larval population of groundnut leaf miner.

CONCLUSION

Groundnut leafminer (GLM) moth catches and weather parameters revealed a significant positive correlation with Relative Humidity-I and Rainfall and negative correlation with Wind velocity.The leaf damage showed significant and positive correlation with Maximum temperature, Mean temperature, Evaporation and negative correlation with Relative Humidity-II.No.of Live larvae/plant revealed significant positive correlation with Tmean and Rf and significant negative correlation with rainfall and wind velocity. These results highlight temperature and humidity as key weather drivers of leafminer outbreaks, with an R^2 of 0.97, the model explained most of the variation in pest incidence, though independent validation is needed to confirm its reliability.

REFERENCES

Bagmare, A., Deepesh Sharma and Ajay Gupta. 1995. Effect of weather parameters on the population buildup of various leaf miner species infesting different host plants. Groundnut pest-disease Weather Relationship. Crop Res., 10(3): 344-352.

Chaudhuri, N. and S. K. Senapati 2004. Incidence and biology of Leaf miner (*Liriomyzatrifoli Burgess*) on tomato as influenced by weather conditions. Ann. Pl. Protec. Sci., 12(1) : 55-58.

Das, S. B. 1999. Seasonal Activity of groundnut leafminer, *Aproaerema-modicella* in West Nimer Valley, Madhya Pradesh. Insect Environ., 5:69

Dubey, R.C., Ballal, A.S., Mandal, N.C., Das Gupta, M.K., Ghosh, D.C., Mukhopadhyay, S.K., Das Gupta, D. and Majumdar, D.K. 1995. Influence of weather factors on the groundnut leaf miner attack. AgroEcosys. Manage, 94-96

Pazhanisamy ,M. and Hariprasad, Y.2014. Field evaluation of entomopathogens against leaf miner, *Aproaerema modicella* (Deventer) (Gelechiidae : Lepidoptera) in groundnut .Plant Archives Vol. 14 No. 1, 2014 pp. 285-288

Radhika, P.2015.Influence of abiotic factors on the incidence of insect pests of groundnut with special reference to groundnut leafminer, *Aproaerema-modicella* in the scarce rainfall zone of A.P. The Andhra Agric. J.62(4):859-867.

Ranga Rao, G.V., Reddy, D. and Shanower, T. 1997. Status of groundnut leaf miner in Peninsular India: management options, Meeting Abstracts of Pest management Research Unit, United States Department of Agriculture (USDA).

Suneel Kumar, G.V., Rajesh Chowdary, L. and Sarada, O. 2023 . Seasonal incidence and weather based forewarning models for foliage feeders of groundnut. The Pharma Innovation Journal, SP-12(8): 95-101

Syobu S., Mikuriya, H. and Kondon, T.2003.Relationship between adult pheromone rap catches and injury in soybean leaves.Japanese J. of Applied entomology and Zoology, 47:137-141

Wheatley, A.R.D., Whiteman, J.A., Williams, J.H. and Wheatly, S.J. 1989. The influence of drought stress on the distribution of insects on four groundnut genotypes grown near Hyderabad. India. Bull. Ent. Res., 79: 567–577.

Radhika, P., 2025. Weather-based regression analysis for prediction and validation of Groundnut leaf miner (A*proaerema modicella*) incidence under arid alfisols. The Journal of Research ANGRAU,53(5): 165-171