Influence of Weather Parameters on Occurrence and Development of Early Leaf Spot of Groundnut in Orissa

Diptanu Datta[1] and Akshaya Kumar Senapati[2]

[1,2]*OUAT, Bhubaneswar-751003*
E-mail: [1]diptanu.agri@gmail.com, [2]akshayasenapati@yahoo.co.in

Abstract—*Early leaf spot disease in groundnut is prevalent in all growing seasons but it is rampant during Kharif season. Due to favourable climatic conditions for spore germination weather parameters are found to influence the development of disease significantly. Successful initiation as well as spread of disease requires virulent inoculums, susceptible host and most importantly a conducive environment. Weather parameters affect every step of infection process starting from propagule germination, penetration of germ tube and host colonization. Study conducted at Orissa University of Agriculture and Technology reveal a positive correlation of the disease with weather parameters like T_{max}, T_{min}, afternoon relative humidity, rainy days and evaporation. A regression analysis of the data inferred that the weather parameters as a whole contribute about 87.03% to the incidence of disease, of these evaporation and rainy days contributed 51.22% and 29.87% respectively. Afternoon relative humidity, T_{max}, T_{min} played a much less role in disease incidence than the previous factors.*

1. INTRODUCTION

Groundnut is affected nearly by 46 fungal, 15 viral, 1 bacterial and 11 nematode diseases (Kokalis-Burelle et.al. 1997). Among the diseases, early leaf spot caused by *Cercospora arachidicola* accounts for a great loss in economic yield. The disease can solely cause a loss in pod yield of over 50%. Besides the reduction in yield, the disease has an adverse influence on seed quality and food grade characteristics deteriorate the quality of plant biomass and thus render the fodder unsuitable as animal feed. Among the diseases, the early leaf spot disease is prevalent in all growing season but its occurrence is rampant during Kharif season that triggers the infection by enhancing the germination as well as the production of airborne conidia. Weather parameters significantly influence the development of the disease. The present investigation was planned to ascertain the correlation of different weather parameters on the occurrence of early leaf spot of groundnut.

2. MATERIALS AND METHODS

A field trial was conducted and observations on the incidence of early leaf spot were recorded starting from initiation of disease to harvest of the crop during the period from Jan 2016 to Apr 2016 at weekly interval. Data on weather parameter like maximum temperature, minimum temperature, relative humidity, rainfall and evaporation of this period were obtained from Department of Meteorology, OUAT, Bhubaneswar. A correlation-regression study was done to study the incidence and spread of the disease. The disease incidence was recorded as per 0-9 scale and PDI (plant disease incidence) calculated by the formula –

$$\% \text{ infection/Disease severity} = \frac{\text{Sum of all disease ratings}}{\text{No. of leaves observed} \times \text{max disease grade}} \times 100\%$$

3. RESULT AND DISCUSSION

Successful initiation, as well as the spread of the disease, requires virulent inoculums, susceptible host and the most importantly conducive environment. Weather parameters affect every step of infection process starting from propagule germination, germ tube penetration and host colonization to spread to other hosts. By studying the relation between weather parameters & disease incidence the disease can be forecasted & preventive measures can be implemented at the proper time to avoid the disease epidemic. The data recorded on weather parameters such as temperature (max & Min), RH (morning & afternoon), rainfall, rainy days and evaporation are presented in Table 1.

The correlation study between percent disease incidence of early leaf spot and seven weather parameters revealed that the disease incidence is positively correlated with T_{max}(0.7433), T_{min} (0.8542), afternoon RH(0.7253), rainy days(0.5562) and evaporation(0.8415) and negatively correlated to Morning RH(0.5287). Jensen and Boyle (1965) through their studies on climatic elements had also reported the influence of

temperature & relative humidity on the development of *Cercospora* leaf spot in groundnut. Similar findings were also recorded by Lokhande and Newaskar (2000) in India who observed that temperature range of 25-30% and RH of 74-87% were highly conducive for leaf spot development. Frag et al. (1992) from the USA too reported the similar influence of RH (80%) and mean temperature (23.2^0c).The decrease in maximum temperature and increase in humidity are the epidemiological factors for leaf spot incidence in India(Adiver et al. 1998). Samui et al. (2005) reported that max temp $<34^o$ c, min temp $>22^o$c, morning relative humidity $>82\%$ and afternoon relative humidity $>78\%$ were the most suitable conditions for leaf spot incidence in India. Rainfall does not show any significant relationship with the disease incidence.

From the regression analysis, it can be concluded that the weather parameters as a whole contribute about 87.03% to the incidence of disease. But evaporation and rainy days solely contributed 51.22% and 29.87 % respectively. The contributions of other factors were much less than these two. Vijayalaxmi et al. in 2010 reported the contribution of various climatic factors towards leaf spot development in groundnut, they are max temp. (0.48%), min. temp.(42%) and evaporation (0.61%).

Table 1: Effect of weather parameters on incidence of early leaf spot disease of groundnut.

Week No.	Met. week	Temperature		Relative Humidity (%)		Rainfall	No. of rainy days	Evaporation (mm)	ELS
		Max.	Min.	Morning	Afternoon				
3	15Jan-21Jan	27.1	11.81	86.71	32.42	0	0	3.47	0
4	22Jan-28Jan	29.64	13.48	93.86	41	0	0	3.53	0
5	29Jan-04Feb	29.13	14.5	89.57	41	0	0	3.64	0
6	05feb-11Feb	31.26	15.17	93.43	36.29	0	0	3.64	0
7	12feb-18feb	31.8	17.4	94.57	47.86	18.4	1	3.76	0
8	19Feb-25Feb	35.19	19.27	94	53.28	0	0	4.1	1.5
9	26Feb-04Mar	53.69	20.37	90.71	37.71	2.8	1	4.53	2.6
10	05Mar-11Mar	34.69	19.81	90.28	32.86	0	0	6.77	3.4
11	12Mar-18Mar	36.56	21.13	89.14	34.71	0	0	6.41	5.25
12	19Mar-25Mar	36.34	23.18	94.71	43.43	19.4	1	6.33	7.43
13	26Mar-01Apr	36.14	22.91	91.28	49	2.6	1	6.29	10.23
14	02Apr-08Apr	37.51	25.08	90.86	58	26.2	1	6.78	12.42
15	09Apr-15Apr	35.9	23.36	88.28	46.43	3.2	1	6.31	15.25
16	16Apr-22Apr	38.36	24.76	84.71	46	3.8	1	7.1	17.68
17	23Apr-9Apr	38.36	23.46	89	49.71	82.6	3	6.2	18.52
18	30Apr-06May	36.56	25.27	88.57	57.71	0	0	8.04	19.68

Table 2: Correlation studies of weather parameters with incidence of ELS disease.

	X1	X2	X3	X4	X5	X6	X7	y
$T_{max.}$ X1	1							
$T_{min.}$ X2	0.9616	1						
Morning RH X3	-0.1777	-0.2458	1					
Afternoon RH X4	0.4675	0.6437	-0.0982	1				
Rainfall X5	0.2960	0.3309	-0.0012	0.4059	1			
Rainy days X6	0.4714	0.5048	-0.1110	0.4710	0.8807	1		
Evaporation X7	0.8276	0.8881	-0.4354	0.5081	0.1764	0.2662	1	
ELS Y	0.7433	0.8542	-0.5287	0.7253	0.4327	0.5565	0.84145	

■ Significant at P=0.05 (r=0.497), ■ Significant at P=0.01(r=0.623)

The prediction equation for PDI of ELS

ELS= 47.68-0.15X1+0.42X2-0.72X3+0.27X4+0.025X5+1.16X8+1.52X7

R^2= 0.9308

R (Adjusted)=0.8703

Table 3: Regression values of weather parameters to incidence of ELS.

Regressors	Coefficients	Coeff. sq.	% Cont.
Intercept	47.6882		
T_{max}	-0.15014	0.022541	0.499807
T_{min}	0.481949	0.232275	5.150178
Morning RH	-0.72549	0.526336	11.67033
Afternoon RH	0.266271	0.0709	1.572053
Rainfall	0.025063	0.000628	0.013927
No. of rainy days	1.160599	1.346991	29.86649
Evaporation(mm)	1.519989	2.310367	51.22721
Total		4.510039	100

REFERENCES

[1] Adiver, SS., Anahosur, KH., Giriraj, K., and Naik, SI., 1998. "Forecasting studies for foliar diseases of Groundnut (*Arachis hypogae*a .L.)", *Karnataka Journal of Agricultural Science*, 11[1]:96-99.

[2] Frag, HC., Hsu, CS and Hwang, SC., 1992.. "Ecology and resistant breeding of peanut rust(china)", *Plant Protection Bulletin*(Taipei), 34:101-108.

[3] Kokalis-Burelle, N., Porter, DM., Rodrigues-Kabana, R., Smith, DH., and Subrahmanyam, P., 1997. "Compendium of Peanut Diseases". *2nd Ed. American Phytopathological Society*, St. Paul, MN.

[4] Lokhande, NM., and Newaskar, VB., 2000. "Epidemiology and forecasting of leaf spot of groundnut", Proceedings of International conference on integrated plant disease management for sustainable Agriculture(D.K. Mitra ed.), *Phytopathological society held at New Delhi*,pp.1281.

[5] Samui, RP., Chattopadhyay, N., and Ravindra, PS.,2005. "Forewarning of incidence of tikka disease on groundnut and operational crop protection using weather information in Gujarat", *Mausam*, 56:337-342.

[6] Vijayalaxmi, K., Raji Reddy, D., and Varma, NRG.,2010. "Weather Based Pest and Disease Forewarning Models in Groundnut", *Indian Journal of Plant Protection*,38[1]:28-30.