



International Journal of Emerging Technologies in Computational and Applied Sciences (IJETCAS)

www.iasir.net

Effect of Weather on Powdery Mildew on Mungbean

P.D.Deshmukh¹, N. S. Gandhi Prasad², P. G. Khot³, U. T. Dangore⁴

¹Assistant Professor of Statistics, College of Agriculture, Nagpur, Maharashtra, India.

²Associate Professor Statistics, Department of Agricultural Economics and Statistics,
Dr.Panjabrao Deshmukh Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India.

³Professor of Statistics, RSTM Nagpur University Nagpur, Maharashtra, India.

⁴Assistant professor (Agril. Econ.) College of Agriculture Nagpur, Maharashtra, India.

Abstract: This paper is aimed to study the relation between weather parameter and incidence of Powdery Mildew on Mungbean. The study is based on 20 years data of incidence and spread of disease and weather prevailed in Akola for the same period. The crop, usually sown during 2nd fortnight of June, is attacked by this disease during 1st or 2nd week of August. An intensive analysis of disease incidence and weather parameters such as Temperature (Maximum or Minimum), Bright Sunshine hours and Relative Humidity (Morning and Evening) indicated that after prevalence of favourable weather, the character of Disease is expressed in the field within 15-16 days. The historical data of 20 years revealed that, the most favourable conditions for the occurrence of the disease are expected during 15th July to 1st week of August. It further revealed that, during this period if Bright Sunshine Hours are a few (less than 4), and the temperature ranges in between 26 to 32 and Relative Humidity is below 65, then there is likelihood of occurrence of powdery mildew disease with a probability to the extent of 87.5 per cent as supported the historical data, Logistic Regression analysis and Simulated data of weather for 100 years.

I. INTRODUCTION

Mungbean is one of the important pulse crops grown in the region. This crop is cultivated in near about 7.6 lakh / ha. And 3.75 lakh (M.T.) of the Mungbean is produced every year in Maharashtra. In spite of many precautions, the popular varieties in Maharashtra are highly susceptible to Powdery Mildew disease. It has been estimated that near about 30-40 per cent grain losses occur every year owing to this disease. The general indications of cloudy weather, low temperatures (20-30) and high humidity exceeding 60 per cent or more there parameters range are too broad to identify the critical periods of weather prone for occurrence of the disease. In view of the above, an attempt is made to study the seasonal indices of powdery mildew on this crop and to determine the weather parameters leading to the incidence of disease. It may help the farmers for undertaking preventive measures well in advance to cause economic damage.

II. MATERIAL AND METHODS

The present investigation is based up on

- The record of incidence of Powdery Mildew on Mungbean(Kopargaon) for a period of 20 years (1980-2003) recorded at Pulse Research Unit, Dr.P.D.K.V.Akola and
- Daily weather data for the same period pertaining to Temperature (Maximum / Minimum), BSH, RH(Morning / Evening) from Agro Metrology, department of Agronomy, Dr.P.D.K.V.Akola

Weekly observations were made during the entire crop season. The day in which the incidence was noted for the first time, the percentage of disease and date of observation were recorded for that week. Progressive Disease percentages were recorded in the every week thereafter. The week on which the disease of incidence was recorded for the first time in a season is hereby referred as Incidence Day (ID) and a week preceding to it is referred as Non Incidence Day (NID)

In order to examine the extent of differences in weather conditions in respect of Temperature (Maximum / Minimum), Bright sunshine Hours (BHS) and relative humidity during 25 day prior to IW and NIW, **Student's t**

Test and Anova Technique one way classification) have been applied. It was hoped that the technique was facilitate the identification of critical periods differing in weather conditions causing outbreak of disease. Based on the historical data and the results of above statistical analysis, some periods are identified as a critical. In order to assess the influence of respective weather parameters prevailing during critical period on incidence of disease, the data were subjected to Logistic Regression Techniques.

Logistic Regression Technique is a technique similar to usual Regression Technique with a difference in the nature of dependent variable. Here, the dependent variable assumes exactly two distinct values (0 or 1) representing status of a phenomena like absent or present of disease. This technique also provides a reasonable estimate of Probability of Occurrence of the phenomena. A logistic regression can be formally stated as

$$Z = \text{LOG} \left[\frac{P_i}{1 - P_i} \right] = a + b_1 X_1 + b_2 X_2 + \dots + b_k X_k \quad (1)$$

Twenty ID and twenty NID observed during last twenty years was fitted to the above model. The variable Z is binary Variable and takes value 1 or 0 for ID or NID respectively and the variables X's are independent variable (weather variables). The value a and b_is are estimated not by usual OLS but by the method of maximum likelihood. Like R² and MSDFR of usual regression technique we have measure such Mc Fadden r² and – 2 times Log (g). The above model can be used to estimate the probability of occurrence of event given the values of a set of independent variables.

$$P = \frac{\text{EXP}(Z)}{1 + \text{EXP}(Z)}$$

The technique of Logistic Regression was used for all identified critical periods, of which a period yielding highest maximum likelihood value and maximum percentage of correct classification between weeks of incidence and non incidence has been chosen for the ultimate use.

The nature of random behavior of data pertaining to finally chosen weather parameter was studied with the help of descriptive statistics, appropriate probability distribution underlying with each weather parameter was identified from standard probability distributions (such as Normal, Log Normal, gamma and Uniform distribution). The data for 100 years simulated for estimating the probability of incidence of disease and to determine the ranges of weather parameters.

III. RESULTS AND DISCUSSIONS

The historical data of 20 years incidence of powdery mildew at Akola weather conditions reveals that this disease mostly occurs during last week of July to 3rd week of August depending up on the age and sowing period of the crop. A comparison between weather conditions prevailing 25 days prior to incidence of the disease is made with weather conditions of the same period from the last day of non observance of disease in weather conditions between incidence and non incidence of disease. This is achieved by t – test and the results of the same are given in Table- 1. It can be seen from the table that no significant differences in weather parameters prevailed during last 20 years. The weather conditions during last 25 day of absence of the disease symptoms and 25 days prior to the day of presence disease have not differed in significant manner.

In order to identify the critical periods which lead to the occurrence of disease, an attempt was made to identify the period in which the temperature is around 23-38, cloudy days (having small bright sun shine hours) and high humidity. Over a period of 20 years, the frequency of such weather conditions in the span of 25 days prior to incidence of disease has been computed for each parameter and the same are given in Table -2.

Sr. No.	Duration of favourable weather before appearance of disease	Parameters				
		Temp (Max)	Temp (Min)	RHM >90	RHE <60	BSH
1	1 st day to 5 th day	14	20	17	19	19
2	6 th day to 10 th day	17	20	15	19	19
3	11 th day to 15 th day	15	20	10	18	19
4	16 th day to 20 th day	15	20	12	17	20
5	21 st day to 25 th day	12	20	12	18	19

Considering the stage of crop and weather prevailed in the region, it can be inferred that congenial weather may lead to the appearance powdery mildew disease within 15-16 days (11th July to 4th August depending upon sowing date).

Table-1: Average weather parameters before and after incidence of Powdery Mildew (25 days)

Day	Tmax			Tmin			BSH			RH M			RHE		
	Before	After	T- test	Before	After	T- test	Before	After	T- test	Before	After	T- test	Before	After	T- test
1	33.76	31.3	0.157	23.06	23.3	0.454	2.7	3.94	0.235	87.05	87.1	1	69.25	67.2	0.642
2	30.04	31.2	0.043	23.08	23.4	0.234	2.375	3.89	0.177	87.95	85	0.105	71.95	62.6	0.035
3	30.15	31.0	0.228	23.14	23.3	0.49	2.59	3.26	0.521	88.5	84.9	0.064	73.6	65.1	0.083
4	30.51	31.6	0.262	23.25	23.1	0.764	4.345	3.91	0.691	87.5	85.2	0.288	70.45	64.7	0.252
5	32.11	31.9	0.215	23.26	23.6	0.231	4.59	4.93	0.769	86.4	83.6	0.162	66.25	63.3	0.481
6	31.32	31.9	0.037	22.85	23.4	0.202	3.88	5.01	0.26	86	83.2	0.143	64.3	60.5	0.428
7	30.35	31.7	0.019	23.32	23.3	0.909	2.7	4.07	0.195	87.45	82.6	0.015	67.2	61.5	0.221
8	31.07	30.7	0.905	23.32	22.8	0.181	3.54	3.78	0.826	89.15	85.1	0.065	72.3	60.3	0.013
9	30.28	30.7	0.519	23.31	23.4	0.833	3.935	3.36	0.626	87.05	85.9	0.635	67.2	67.3	0.983
10	32.06	30.5	0.398	23.42	23.3	0.759	3.89	3.61	0.811	84.95	84.3	0.771	62.55	68.6	0.228
11	31.78	30.2	0.35	23.32	23.2	0.532	3.255	2	0.203	84.85	87.1	0.289	65.05	69	0.42
12	33.34	31.4	0.835	23.14	23.4	0.527	3.91	3.31	0.559	85.15	86.7	0.508	64.7	72	0.133
13	28.92	31.2	0.429	23.64	23.7	0.936	4.925	4.31	0.603	83.55	84.1	0.806	63.3	70.2	0.164
14	30.85	31.0	0.247	23.39	23.3	0.695	5.005	3.48	0.117	83.2	84.9	0.457	60.5	67.4	0.175
15	29.14	31.1	0.369	23.28	23.2	0.882	4.07	2.52	0.11	82.6	84.6	0.376	61.45	67.9	0.194
16	31.66	31.3	0.502	22.81	23.7	0.023	3.775	3.23	0.587	85.05	84.8	0.905	60.25	70.3	0.029

17	35.31	30.2	0.607	23.44	23.6	0.851	3.355	2.12	0.258	85.9	86.3	0.87	67.3	65.7	0.727
18	30.41	31.6	0.265	23.31	23.7	0.304	3.605	2.83	0.458	84.3	84.6	0.922	68.6	74	0.3
19	31.01	31.7	0.092	23.16	23.6	0.21	2	3.8	0.076	87.1	85.4	0.443	69	62.7	0.23
20	32.18	32.1	0.471	23.37	23.5	0.563	3.31	4.1	0.485	86.65	84.6	0.369	71.95	63.1	0.097
21	30.16	31.8	0.522	23.67	23.7	0.887	4.31	3.76	0.618	84.1	86.6	0.329	70.2	64	0.253
22	34.49	32.9	0.06	23.28	23.7	0.279	3.475	4.39	0.361	84.85	85.6	0.767	67.35	64.4	0.545
23	28.38	32.7	0.078	23.22	24.1	0.07	2.515	5.24	0.005	84.6	81.7	0.3	67.85	62.1	0.235
24	31.69	32.8	0.11	23.66	23.6	0.942	3.225	6.05	0.008	84.8	81.4	0.245	70.25	59.4	0.032
25	32.01	33.1	0.002	23.56	23.6	0.976	2.12	5.67	0.017	86.3	82.4	0.154	65.65	58.9	0.198

In order to assess the influence of individual weather parameters prevailing during 11th July to 4th August, a logistic regression analysis was carried out. Two sets of independent variables representing (1) weather conditions measured 12-16 days before occurrence of disease and (2) weather conditions measured 15-16 days before the day of last non observance of disease. Thus in all 40 observations have been used for developing a suitable logistic Regression model. Besides above several logistic models were tried with weather parameters measured at various periods of which the following models has been found the best as it yielded the highest R² and maxim percentage of correct classification and the result of the same are given in the following table.

Table-3: Results of Logistic Regression Analysis.

Sr. No.	Variable	Coefficient	Standard Error	Significance level
1	Tmax 16	-0.810	.393	.039*
2	Tmax 17	0.466	.255	.068**
3	BS 16	0.468	.262	.074**
4	TMN 16	-1.445	.644	.025*
5	RE 16	-0.116	.046	.012*
6	Constant	50.474	.564	.004

*Significant at 5 %

** Significant at 10 %

The results of logistic regression analysis indicated that temperature and relative humidity are statistically significant below 5 per cent. Bright sunshine hours are found to be significant at 7.4 per cent. All the parameters measured 15 to 16 days are the expression of disease symptom have been further examined and the ranges for these parameters have been identified as detailed below.

1. Maximum Temperature 30-32⁰
2. Minimum Temperature 23-240
3. Bright Sunshine Hours 3-4 hrs
4. Relative Humidity (E) 63-68

In order to develop an independent estimate of probability of occurrence of disease, 100 sets of data for above weather parameters have been simulated with estimated mean and standard deviations as parameters of the distribution. The probability of such data sets provides an independent estimate of probability of occurrence of the disease whenever the weather parameters fall within critical limits. The estimated probability for the present instigation is found to be 0.879143. This indicates that on prevalence of congenial weather within above specified critical limits, there is likelihood of occurrence of powdery mildew to the extent of 87.91 per cent.

REFERENCES

- [1]. N. S. Gandhi Prasad etc. --- Studies on relation between weather parameters and incidence of important pest on cotton R. R. C. Report 2000, Dr. P. D. K. V. Akola
- [2]. Y. S. Ramakrishna etc. --- Technique for forecasting National food grains Production and forewarning pest and diseases using climatic data C.R.I.D.A. 2001 Hyderabad 500059
- [3]. IASRI, ICAR Forecasting Technique in Agriculture summer school 9th July to 29th July 2003.