

WEATHER BASED PEST AND DISEASE FOREWARNING MODELS IN GROUNDNUT IN THE CONTEXT OF CLIMATE CHANGE

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ABSTRACT:

Field experiments were conducted to study the influence of weather parameters on the incidence of pests and diseases in groundnut for 3 years i.e. 2004-05, 06-07 and 08-09 during *rabi* season at Agromet-cell, Agricultural Research Institute, Rajendranagar, Hyderabad. The data analyzes were pooled and analyzed statistically with weather parameters using correlation and regression techniques. Correlation studies showed significant positive relationship of thrips damage with morning and evening relative humidity, while *Spodoptera litura* damage was positively influenced by evaporation and age of the crop. Leaf spot and rust incidence was mainly influenced by maximum temperature, evaporation and age of the crop. The regression equations were developed for groundnut pest and diseases using linear and non-linear models. The coefficient of determination (R^2) was improved by 6 to 20% when non-linear regression equations were fitted. These models after validation will be utilized in issuing of agro advisories in the state.

1. INTRODUCTION

Groundnut is the major oilseed crop grown in India accounting for approximately 32% of oil seed area and 39% of oilseed production. (Ghenvande and Nanda gopal.1997) and it is cultivated in all the three seasons viz., *Kharif* (monsoon or rainy season), *rabi* (Post rainy winter season) and summer. The *Kharif* groundnut grown during the South west monsoon period across the country is generally rainfed. In Southern and South eastern regions of India, groundnut is grown during post rainy season as irrigated crop (October-March). The productivity of groundnut is quite low (1000 kg/ha) compared to that of USA (3000 kg/ha), China (2600 Kg/ha), Argentina (2100 kg/ha) and Indonesia (1550 kg/ha) (NRCG, 2005). The reason for low productivity of groundnut is due to biotic and abiotic stresses during crop growth period. Pests and diseases are the major biotic stresses affecting yield. Groundnut crop is attacked by about 90 species of insects and among them nine are considered to be economically important. The key insect pests are red hairy caterpillar, tobacco caterpillar, gram caterpillar, leaf miner, thrips, aphids and jassids. Among the diseases, Cercospora leaf spot and rust cause economic yield losses. Weather plays an important role on the population dynamics and distribution of pests and diseases. Temperature, rainfall, relative humidity, sunshine hours and wind speed are the chief weather parameters influencing the pest and disease incidence. Weather based pest and disease fore warning models have been developed to certain extent (Singh et al., 1990, Jayanthi et al., 1993 and Prasad et al., 2008). However a functionally viable model for pest and disease forecast is the need of the hour for effective integrated pest management strategy. Hence an attempt has been made to develop pest and disease forewarning models for *rabi* groundnut.

2. MATERIALS AND METHODS

Field experiments on groundnut were conducted under irrigated conditions during *rabi* season for 3 years i.e 2004-05, 06-07 and 2008-09 at Agromet – Cell, Agricultural Research Institute, Hyderabad using TMV2 as a test cultivar. Recommended agronomic practices like fertilizer application, weeding and irrigation etc were taken up. The crop was raised under unprotected conditions. Data pertaining to the age of the crop and pests and disease incidence was taken at weekly interval till the harvest of the crop. Weather parameters like maximum and minimum temperatures, (T.max and T.min), morning and evening relative humidity (RH1 and RH2), rainfall (mm), sunshine hours, evaporation (m/h) and wind velocity (km/hr) were recorded from the weather station located at Agricultural research, institute, Hyderabad. The data were analyzed by using simple correlation and step down multiple regression tools with the help of Indostat software to workout the relationship between weather parameters and pest and disease incidence.

3. RESULTS AND DISCUSSIONS

The correlation coefficients worked out between the weather parameters and incidence of pests and diseases of groundnut (3 years pooled data of *rabi* groundnut 2004-05, 06-07, and 08-09) sown during November first week and the results are presented in table 1.

The results revealed that among the pests, thrips damage showed significant positive relationship with morning (0.34) and evening (0.37) relative humidity whereas maximum (-0.60) and minimum (-0.50) temperatures (-0.62) and evaporation (-0.47) were negatively associated with thrips damage. Age of the crop also

showed negative influence (0.32) on thrips damage. The results are in agreement with the findings of Singh et al (1990). They reported a significant negative association of minimum temperature and wind speed with *Caliothrips indicus* while Jayanthi et al., (1993) observed that population of *C. Indicus* had a positive correlation with morning relative humidity and a negative correlation with evening relative humidity. None of the weather factors had any significant influence on *Helicoverpa armigera* damage. *Spodoptera* damage was positively influenced by evaporation (0.43) and age (0.44) of the crop. According to Singh et al. (1990) during *rabi* season the effect of individual weather parameters on the abundance of *Spodoptera* was not significant. Among the diseases, tikka leaf spot incidence was positively influenced by maximum temperature (0.48), minimum temperature (0.42), evaporation (0.61) and age (0.51) of the crop. Maximum temperature (0.39), evaporation (0.30) and age of the crop (0.40) recorded significant and positive relationship with rust incidence while morning relative

humidity (-0.33) was negatively associated with rust incidence, Mayee and Kokate (1987) observed that rust incidence was negatively correlated with relative humidity.

The multiple regression equations were developed for predicting the pest and disease incidence of *rabi* groundnut by using linear and non-linear regression models (table 2). Coefficient of determination (R^2) has improved when non linear regression models were fitted for predicting the pest & diseases incidence. By using step down linear regression models, the thrips, *Spodoptera*, leaf spot and rust damage can be predicted to an extent of 50%, 47%, 52% and 40% respectively while with non linear models, the prediction rate of above pests & diseases was improved to 56%, 65%, 70% and 52%, respectively

According to Prasad et al (2008) the coefficient of determination (R^2) between weather parameters and thrips population during *rabi* season was found to be 11.97% with seven years pooled data.

Weather Parameters	% Thrips Damage	% Spodoptera Damage	% Helicoverpa Damage	% Leaf Spot Damage	% Rust Damage
T max ($^{\circ}$ C)	-0.60**	0.25	-0.06	0.48**	0.39*
T min ($^{\circ}$ C)	-0.50**	0.17	-0.04	0.25	0.09
RH I (%)	0.34*	-0.18	0.16	-0.27	-0.33*
RH II (%)	0.37*	-0.05	0.15	-0.25	-0.24
Sun shine hours (SSH)	-0.21	0.15	-0.08	0.28	0.25
Wind speed (km h $^{-1}$) (WS)	-0.08	0.07	-0.30	0.08	-0.03
Evaporation (Ep)	-0.47**	0.43**	0.06	0.61**	0.50**
Mean Temp	-0.62**	0.24	-0.05	0.42**	0.28
Age (Days)	-0.32*	0.44**	-0.11	0.51**	0.40*

*Significant at 5% ($r=0.32$); **Significant at 1% ($r=0.41$)

Table 1: Influence of Weather Parameters and Age of the Crop on Groundnut Pests and Diseases (Pooled Data of *rabi* 2004-05, 2006-07 and 08-09)

Pest/Disease	Multiple Regression	Equation
% Thrips damage (Y)	Linear	$Y=42.14-14.33*T_{max} -13.75*T_{min} + 26.50*T_{mean}$ of preceding 1 week + 0.07* age of the crop. ($R^2=0.50$)
	Non Linear	$Y= 42.68-6.90*Max.temp-10.34*Min. Temp+14.09*Mean Temp+0.10*Age-0.106*Max.temp^2-8.72*Min. Temp^2+0.23* Mean Temp^2-2.791*Age^2$ ($R^2 = 0.56$)
%Spodoptera damage(Y)	Linear	$Y=-8.99-4.08*T_{max}-4.65*T_{min}+0.18 RH_2-0.44WS+0.29Epan + 83.63* T_{mean}$ of preceding week + 0.05*age ($R^2=0.47$)
	Non Linear	$Y=-46.93+2.10*MaxT -4.18*MinT+ 3.06* MeanT + 0.084*Age-6.98*RH_{II}+ 0.37*WS +0.48*EPAN*MaxT^2-0.023 *MinT^2 +0.12*MeanT ^2-2.67*Age^2+4.78*RH_{II}^2-0.101*ws^2-1.33*EPAN^2$ ($R^2 = 0.65$)
% Leaf spot (Y)	Linear	$Y=-197.12+8.56*T_{max} +0.42* RH_1 + 1.38 * RH_2+3.25*Epan-7.32*T_{mean}$ of prec. week +0.20*age ($R^2=0.52$)
	Non Linear	$Y=-249.82+1.024*MaxT+4.35*RH_1+ 1.91* RH_{II} +3.06*WS-0.24*EPAN-7.12*MeanT +0.65* Age+0.11* MaxT^2-2.70*RH_1^2-6.03 *RH_{II}^2-0.34*WS^2+0.58*EPAN^2+1.087* Mean xT^2-4.22*Age^2$ ($R^2 = 0.70$)
% Rust (Y)	Linear	$Y=-345.16-20.37*T_{min}+3.43*RH_2+4.80* Epan+21.91*T_{mean}$ of prec. Week +0.41* age ($R^2=0.40$)
	Non Linear	$Y=-784.75-28.81*MinT+3.83*RH_{II}+11.15* EPAN+ 61.517*MeanT+ 1.02*Age +0.29*MinT^2-1.074*RH_{II}^2-0.31*EPAN^2-0.84 *MeanT^2- 4.95*Age^2$ ($R^2 = 0.52$)

Table 2: Regression Equations Developed for Pests and Diseases of *rabi* Groundnut.

CONCLUSION

Forecasting the peak abundance of pest and diseases in advance helps in timely management of crop pests. The correlation and multiple regression analysis clearly showed the importance of weather factors in predicting the pest and diseases incidence. Among the regression models used for forecasting the pest and disease incidence, non linear regression models found to predict the pest and disease incidence more accurately than the linear models and hence these models can be utilized in agro advisories after validating with individual season data.

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