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Studies on epidemiology of *Alternaria blight* of marigold (*Tagetes erecta* L.) in Madhya Pradesh

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ABSTRACT

The present studies were carried out during winter season at college of Agriculture, Gwalior to investigate the epidemiology of *Alternaria blight* of marigold. The per cent disease intensity of leaf spot in the surveyed localities of Gwalior, Morena and Bhind districts was in the range of 20.2 (Ghatigaon) to 40.6 (Akbarpur), 20.4 (Porsa) to 30.2 (Joura) and 10.8 (Roan), 27.4% (Mehgaon), respectively. The intensity of flower blight per cent in the locations of above three districts was in the range of 23.3 (Utila) to 44.0 (Akbarpur) 26.6 (Ambah) to 32.2 (Joura) and 13.2 (Roan) to 20.0 per cent (Atter). The maximum intensity of leaf spot was recorded in Gwalior district (28.65%) followed by Morena (25.31%) and Bhind (16.85%). Similar to leaf spot the maximum intensity of flower blight was also recorded in Gwalior (31.61%) followed by Morena (29.26%) and Bhind (17.01%). The oil extracts of *Neem* and *Eucalyptus* @ 5 per cent and leaf extracts of *Neem* and *Eucalyptus* @ 20 per cent were found very effective against *A. tagetica* under *in vitro* condition. Regression study reveals that with one per cent. Regression study also reveals the 52.65 per cent seed germination under disease free condition and thereafter it decreases by 0.638 per cent with unit increase (1% each) in the intensity of flower blight.

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INTRODUCTION

Marigold is one of the commercially exlploited flower crop in India. Marigold belongs to the family compositae and genus *Tagetes erecta* and *Tagetes patula*. *Tagetes erecta* is popularly known as African marigold, while *Tagetes patula* as dwarf or French marigold. African marigold gained popularly amongst gardeners and flower dealers on account of its easy cultivation, wide adoptability to varying soil and climatic conditions, long flowers, wide spectrum of attractive colours, shape, size and excellence keeping quality of the flowers.

The leaf spot and flower blight caused by *Alternaria tagetica* is the most important disease of marigold. In northern Madhya Pradesh the leaf spot and flower blight disease has become a major biotic constraint in the full exploitation of high yielding scented African marigold varieties. The leaf spot and flower blight of marigold incited by *Alternaria tagetica* (Shome and Mustafee, 1966) is a serious disease of marigold in the country and in northern Madhya Pradesh. The disease gets initiated as dark brown necrotic spots on leaves, stem and flowers. With the progress of the disease the spots expand, coalesce which leads to drying of leaves. Now -a-days the disease has become a most important biotic constraint in the full exploitation of high yielding scented African marigold varieties.

MATERIAL AND METHODS

The present studies were conducted at college of Agriculture, Gwalior during winter season of 2006-2007. Gwalior is situated in northern part of Madhya Pradesh at an elevation of 211.52 meters from mean sea level and lies between latitude and longitude 26^0 14' east, respectively. The climate of Gwalior is subtropical. The rainy season normally starts from middle of June after commencement of southwest monsoon and last up to September. Maximum precipitation of rains occurred in the month July and August. Winter season runs from November to mid February, and hot summer season from April to mid June. October is the transitory month between rainy and winter season. The soil of experimental site is alluvial clay loam texture.

For epidemiological study African marigold cultivar Pusa orange was planted in early (6 October 2006) and late (6 November 2006) sown condition. Flower buds emerging out on the different dates were tagged separately. Ten disease free flower buds of the same age were tagged at an interval of ten days. The disease intensity was recorded on the tagged flowers after twenty days of tagging. The meteorological parameters *viz.*, temperature, humidity, rainfall, and rainy days were also recorded for preceding twenty days from the date of recording observation, then the correlation between disease intensity and meteorological parameters was worked out. Correlation and regression studies were carried out as follows:

$$\mathbf{r\,(xy) = \frac{Cov\,(xy)}{\sqrt{Var\,(x)\;X\;var\,(y)}}}$$

Suggest by Chandel (1999)

$$\mathbf{byx = \frac{Cov\,(xy)}{Var(x)}}$$

Regression line of y on x

$$\mathbf{y - \bar{y} = b_y\; x\,(x - \bar{x})}$$

where,

r= Co-efficient between x and y

Cov = Covariance between x and y

Var = Variance of x traits

Vari = Variance of y traits

$\bar{x}$ = Mean of x

$\bar{y}$ = Mean of y

The significance of treatments effect was tested with the help of 'F' (variance ratio), while for testing the significance between the treatment mean, critical difference was calculated. Correlation and regression were also worked out by the method given by Jhonson (1950). In a bivariate distribution (distribution involving two variables), it is important to find out the relationship (co-relation) between the two variables. Therefore, correlation co-efficient were worked out as per formula given below :

$$\mathbf{P\,(x,\ y) = \frac{Cov\,(x, y)}{\sigma x, \sigma y}}$$

where,

Cov (x,y) = Co- variance between two variables

x = Independent variable and

y = Dependent variable

$$\mathbf{Cov\,(x, y) = \frac{1}{n}\Sigma\,(x - \bar{x})\,(x - \bar{y})}$$

Σx = Standard deviation of x

RESULTS AND DISCUSSION

For epidemiological studies, the new emerging disease free flower buds (Ten buds) of the same age were tagged at periodical intervals of ten days. After 20 days of tagging the flower blight intensity was recorded on the tagged flowers. The meteorological parameter, *viz.*, maximum temperature, minimum temperature, average temperature, maximum relative humidity, minimum relative humidity, average relative humidity, total rainfall and total number of rainy days were also recorded of preceding 20 days from the date of recording the disease observation. Temperature and relative humidity were recorded as average, while rainfall and rainy days were recorded as total of preceding 20 days.

It is evident (Table 2) that maximum temperature, minimum temperature and average temperature did not show any significant correlation with the disease intensity, while maximum and mean relative humidity showed a significant positive relationship with the disease intensity, this indicate that the intensity of the flower blight increased with the corresponding increase in the maximum and mean relative humidity. The total rainfall and total number of rainy days also showed a significant positive correlation with the disease intensity. The Further, the regression equation was developed to predict the quantitative influence of the significant meteorological parameters. The regression equation "$y = 219.21 + 2.891 x_4$" clearly shows that at least 76 per cent maximum relative humidity is needed for the development of the disease and thereafter with per unit increase in the maximum relative humidity, the flower blight intensity would increase by 2.89 per cent.

The regression equation "$y = -359.88 + 5.7694 x_6$" indicate that development of disease and thereafter with 1 per cent increase in average relative humidity, the flower blight intensity may increase by 5.77per cent. The regression equation "$y = 27 + 4.1071 x_7$" indicate that rain is not essential for the initiation of the disease as it showed 27 per cent disease intensity in the absence of rain and thereafter 1mm rain fall may result in increase of disease intensity by 4.1 per cent. The regression equation "$y = 27 + 23 x_8$" clearly shows 27 per cent disease intensity in the absence of the rain and thereafter one rainy day may increase the disease intensity by 23 per cent.

Temperature and relative humidity were recorded as an average of twenty days, while rainfall and rainy days were recorded as total of preceding twenty days from the date of recording disease observation (Table 1).

The result of the present study shows that the intensity of flower blight increases with the increase in humidity, rainfall and number of rainy days. The regression study shows that the maximum and mean relative humidity during the flowering duration should be more than 76 and 62.4 per cent, respectively and thereafter with one per cent increase in maximum and mean relative humidity, the disease intensity would increase by 2.89 and 5.77 per cent, respectively. It is also clear from the present study that rain is not essential for the initiation of the disease as it showed 27 per cent disease intensity in the absence of rain and thereafter 1 mm rain fall may result in increase of disease intensity by 4.1 per cent.

Similar to rainfall the number of rainy days also showed a highly significant and positive relationship with

Table 1 : Effect of meteorological parameters on the development of flower blight caused by *A.tagetica*

Date of observation	Temperature (°C)			Relative humidity (%)			Total rainfall (mm)	Total No. of rainy days	Disease intensity (%)
	Max. X_1	Min. X_2	Mean X_3	Max. X_4	Min. X_5	Mean X_6	X_7	X_8	Y
30.12.06	20.16	4.66	12.41	83.30	49.40	66.35	0.00	-	7.50
9.1.07	20.80	4.80	12.80	89.95	49.20	69.57	0.00	-	22.50
19.1.05	22.32	4.63	13.47	90.00	45.25	67.62	0.00	-	37.50
29.1.07	20.16	4.66	12.41	89.40	47.25	68.32	5.60	1	47.50
8.2.07	20.27	6.71	13.49	90.95	51.80	70.97	5.60	1	52.50
18.2.07	23.92	9.87	16.89	87.00	49.25	68.12	0.00	-	40.00
28.2.07	25.22	10.24	17.73	82.25	50.60	66.42	0.00	-	27.50

Table 2 : Correlation and simple regression to find out the influence of meteorology parameters on the development of flower blight of marigold caused by *A. tagetica*.

Relationship	r	a	b	Regression equation
Maximum temperature (X_1) and disease intensity (Y)	0.0160 NS	-0.1219	36.233	36.233-0.1219x
Minimum temperature (X_2) and disease intensity (Y)	0.1555 NS	-0.9534	27.365	27.365-0.9534x
Mean temperature (X_3) and disease intensity (Y)	0.0817 NS	-0.577	25.384	25.394-0.577x
Maximum humidity (X_4) and disease intensity (Y)	0.6278*	2.891	-219.21	-219.21 + 2.891x
Minimum humidity (X_5) and disease intensity (Y)	-0.3418 NS	-0.2469	45.658	45.658-0.2469x
Mean humidity (X_6) and disease intensity (Y)	0.61578*	5.7694	-359.88	-359.88 + 5.7694x
Total rainfall (X_7) and disease intensity (Y)	0.7223*	4.1071	27	27 + 4.1071x
Total no. of rainy days (X_8) and disease intensity (Y)	0.7223*	23	27	27 + 23x

where, r = Correlation coefficient, a = Intercept at Y – axis (Y- bx), b =cov. (x,y)/var. (x),
* and ** indicate significance of values at P < 0.005 and < 0.001

the intensity of flower blight. The higher rainfall and more number of rainy days increase the humidity and also promote the secondary spread of the pathogen which ultimately increases the disease intensity (Mazumdar, 2000).

Correlation studies revealed a significant correlation to total rainfall (0.94 and 0.91), maximum temperature (-0.89 and -0.66), minimum temperature (-0.76 and -0.56), number of rainy days (0.86 and 0.96) and relative humidity (0.69 and 0.81) with disease development. Lower intensity of rainfall (1.53 to 4.90mm) with fewer rainy days (>2 days) coupled with relative humidity (76.23 to 82.76%) and average minimum and maximum temperature of 12^0C and 24^0C, respectively, were conducive for the development of leaf blight in marigold. Present finding is also supported by the work of Barnwal *et al*. (2001) who also reported that the maximum, minimum and average relative humidity ranged from 83.2 to 87.2, 30.2 to 55.9 and 58.7 to 71.1 per cent, respectively and average rainfall ranged from 0 to 0.2mm favored maximum disease development of marigold blight caused by *Alternaria tagetica*.

The leaf spot and flower blight (*Alternaria tagetica*) is a most important biotic constraint of African marigold in northern Madhya Pradesh comprising Gwalior, Morena and Bhind districts. The disease intensity was comparatively less under late planted condition. The disease increases with the increase in the relative humidity, rainfall and number of rainy days. Maximum and mean relative humidity during the flowering duration should be more than 76 and 62.4 per cent, respectively, for the initiation of the disease. Rain is not essential for the initiation of the disease as it showed 27 per cent disease intensity in the absence of rain and thereafter 1 mm rain fall may result in increase of disease intensity by 4.2 per cent. Regression study reveals that with one per cent increase in the intensity of flower blight, the corresponding losses in seed yield would increase by 0.965 per cent. Regression study also reveals the 52.65 per cent seed germination under disease free condition and thereafter it decreases by 0.638 per cent with unit increase (1% each) in the intensity of flower blight (Goudappagoudar *et al.*, 2013; Taware *et al.*, 2014 and Tiwari *et al.*, 2012).

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