Epidemiological study of downy mildew disease of opium poppy

ABSTRACT

The downy mildew caused by *Peronospora*spp is a major destructive disease of many plant species. The data on downy mildew incidence on opium poppy (*Papaver somniferum*L.) were collected in three years from 2019-20 to 2021-22 for prediction of weather parameters on the progression of downy mildew disease. The downy mildew disease initiation was recorded in the 52nd SMW (10.0%DMI) when the maximum temperature was 19.43 ^{0}C. It was in the 3rd SMW when the maximum temperature dropped 17.33 ^{0}C and DMI reached up to 20.00 percent depicting the progression and spread of downy mildew disease in opium poppy with the decrease of maximum temperature. The maximum disease incidence was recorded 92.53 percent in 10th SMW when maximum and minimum temperature were 29.03 ^{0}C and 13.53 ^{0}C. Findings of the regression analysis between dependent variable (Downy mildew disease incidence) *Vs.* independent variables (*viz.*, rainfall, maximum and minimum temperature and relative humidity) showed that all the weather parameters accounted more than 85 percent variation (R^2 = 0.869, 0.957, 0.859) in the downy mildew incidence of opium poppy. One unit change of maximum temperature, minimum temperature, maximum and minimum relative humidity might cause to change 0.128, 0.70, 0.117 0.130 units in downy mildew incidence, respectively.

KEY WORDS: Downy mildew, *Peronospora arborescens*, correlation, regression, weather parameters

INTRODUCTION

Downy mildew of opium poppy (*Papaver somniferum*L.) caused by biotrophic obligate parasite *Peronospora arborescens* (Berk), which is one of the most destructive disease for the economically important crop of opium poppy (Kapoor,1995). Opium poppy is a strategic crop for the pharmaceutical industry and provides alkaloids such as morphine, codeine and thebaine for the preparation of life saving drugs. The severity of downy mildew depends on meteorological factors, i.e. high relative humidity, moderate temperature (20^{0}C)and rainfall (Landa *et al*,2007). During the high relative humidity large number of asexual spore (sporangia) are producing by the downy mildew pathogen which is immediately dispersed from few hundred meters to kilometers by air currents and caused primary infection. These primary infectionscan evolve secondary infection on the abaxial surface of leaves (Navas- Cortes *et al*, 2009). Leaf wetness for 24hours after the primary infection, prolific sporulation was observed for rapid

spread of the disease (Cohen *et al*, 2013b). Therefore, the main objective of this research was to examine the optimal meteorological factors for disease development in changing climatic scenario.

MATERIAL AND METHODS

The study was conducted in the experimental field of medicinal and aromatic plants research station, A.N.D University of Agriculture & Technology Kumarganj, Ayodhya, Uttar Pradesh, India, Where the downy mildew disease of Opium poppy was regularly occurred under natural field condition. This trial was conducted during *Rabi* 2019-20 to 2021-22.The data of downy mildew was undertaken without any plant protection measures however, other standard agronomical management practices were adopted. Observations of disease incidence were recorded weekly interval since 30 days after sowing in all the experimental years. Plot-wise disease incidence was calculated as percentage of diseased plants over total plants. Weather parameters namely temperature, relative humidity and rainfall were recorded at weekly interval during the opium poppy growing periods for all the years from the meteorological observatory of ANDUAT, Kumarganj,Ayodhya. Correlation and regression coefficients between disease incidence and weather parameters *viz*.,rainfall maximum and minimum temperature and relative humidity prevailing during the crop growing periods were worked out.

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RESULT AND DISCUSSION

The pooled data for weekly mean values of weather variables and downy mildew incidence in the Opium poppy variety Kirtman for the Rabi 2019-20 to 2021-22 revealed that downy mildew incidence (DMI) occurred from 52nd to 10th standard meteorological week(SMW) during all three growing years (Table-1). The average maximum and minimum temperature ranged from 17.33 ^{0}C to 29.03 ^{0}C and 6.76 ^{0}C to 13.53^{0}C respectively with 95.6 and 53.95 percent maximum and minimum relative humidity. The downy mildew disease initiation was recorded in the 52nd SMW (10.0%DMI) when the maximum temperature was 19.43 ^{0}C. It was in the 3rd SMW when the maximum temperature dropped (17.33 ^{0}C) and DMI reached upto 20.00 percent depicting the progression and spread of downy mildew disease in opium poppy with the decrease of maximum temperature. The maximum disease incidence was recorded 92.53 percent in 10th SMW when maximum and minimum temperature were 29.03 ^{0}C and 13.53 ^{0}C. Sangeetha and Siddaramaih (2007) reported maximum downy mildew incidence in mustard when minimum and maximum temperature were 26 ^{0}C and 29 ^{0}C respectively

During the disease initiation highvariation was observed in maximum (93.05%) and minimum (55.2%) relative humidity due to rainfall (2.10mm) in the 52nd SMW, which have influenced the spore multiplication. The high rainfall (6.8mm) and maximum (92.53%) and

minimum (58.05%) relative humidity were also recorded; when the downy mildew disease incidence was reached at the peak (10thSMW).The present findings are in similar results with the Daunde *et al* (2017) and Arti and Singh (2019) who reported increase of downy mildew disease of cucumber and pearl millet respectively, from 28th SMW with high morning and evening relative humidity. The rains received during standard meteorological weeks were in 52nd (2.10mm), 1st (4.6mm) 2nd (4.12mm), 3rd (4.15mm) and 4^{rth} (1.25mm) with relative humidity in the range of 91.4 to 95.6% resulted to fast build up of downy mildew incidence (22.33%). However, variability in an amount of rainfall is not significantly affected to disease development. These results are similar with the findings of Ghule *et al* (2015).

The correlation coefficients between downy mildew incidence (DMI) and weather parameters over the three cropping season were computed (Table2). The results were shown significant positive correlation between DMI and minimum temperature(r=0.86), maximum temperature (r= 0.95)and maximum relative humidity (r= 0.86). Whereas minimum relative humidity was found negative significant correlation (r= -052%). The effect of rainfall was not significant with DMI. Dhaliwal *et al* (2018) reported negative and significant correlation with temperature and rainfall in maize stem borer incidence.

The regression analysis of all three years 2019-20 to 2021-22 is presented in table2. Findings of the regression analysis between dependent variable (Downy mildew disease incidence) *Vs.* independent variables (*viz*., rainfall, maximum and minimum temperature and relative humidity)showed that all the weather parameters accounted more than 85 percent variation (R^2 = 0.869, 0.957, 0.859) in the downy mildew incidence of opium poppy. One unit change of maximum temperature, minimum temperature, maximum and minimum relative humidity might cause to change 0.128, 0.70, 0.117 0.130 units in downy mildew incidence, respectively. Saharan and Saharan (2004) reported to multiple regression analysis of data which has revealed minimum temperature, relative humidity in the evening and sunshine and cumulative rainfall played major role in *Alternaria* leaf blight disease development of cluster bean. Das and Raut (2002) indicated that relative humidity was one of the most important weather parameters, which determine strip disease development in sorghum.

CONCLUSION

The results were shown significant positive correlation between DMI and minimum temperature(r=0.86), maximum temperature (r= 0.95) and maximum relative humidity (r= 0.86). Whereas minimum relative humidity was found negative significant correlation (r= -052%). The effect of rainfall was not significant with DMI.

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This is results. I suggest placing something very specific.

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Table-1:- Mean weather variable and per cent downy mildew disease incidence inopium poppy during (2019-20,2020-21 and 2021-22 Pooled mean)

Month	Standard Met. Week(SMW)	Temperature (^{0}C)		Relative humidity (%)		Rainfall(mm)	Per cent downy mildew incidence
		Minimum	Maximum	Minimum	Maximum		
Dec.	52	6.76	19.43	55.2	93.05	2.10	10.00
Jan.	1	9.3	20.96	57.55	91.4	4.6	15.00
	2	9.2	19.33	68.8	92.6	4.12	16.50
	3	7.76	17.33	72.1	94.75	4.15	20.00
	4	7.23	18.2	76.2	95.6	1.25	22.33
	5	7.2	20.83	63.45	94.35	0.00	30.00
Feb.	6	8.06	22.93	60.95	91.1	0.00	45.00
	7	9.4	24.66	57.3	91.15	0.00	62.00
	8	12.53	26.4	53.95	90.0	5.3	70.50
	9	12.86	28.03	55.1	83.3	0.00	85.00
March	10	13.53	29.03	58.05	83.6	6.8	92.53

Table -2:- Correlation and regression coefficient between three year (2019-20, 2020-21 and 2021-22) pooled per cent disease incidence of downy mildew disease of opium poppy and meteorological factors.

S.No.	Environmental factor	Correlation coefficient	Regression coefficient	
			Regression equation	R^2 value
1.	**Minimum temperature**	0.86987**	Y= 0.070x+6.421	0.869483**
2.	**Maximum temperature**	0.957554**	Y=0.128x+16.98	0.957079**
3.	**Minimum relative humidity**	-0.5187*	Y=-0.130x+67.24	0.518652*
4.	**Maximum relative humidity**	0.85951**	Y=0.117x+95.99	0.859069**
5.	**Rainfall**	0.08569	Y=0.007x+2.270	0.083666

***** *Significant* ****Highly Significant*

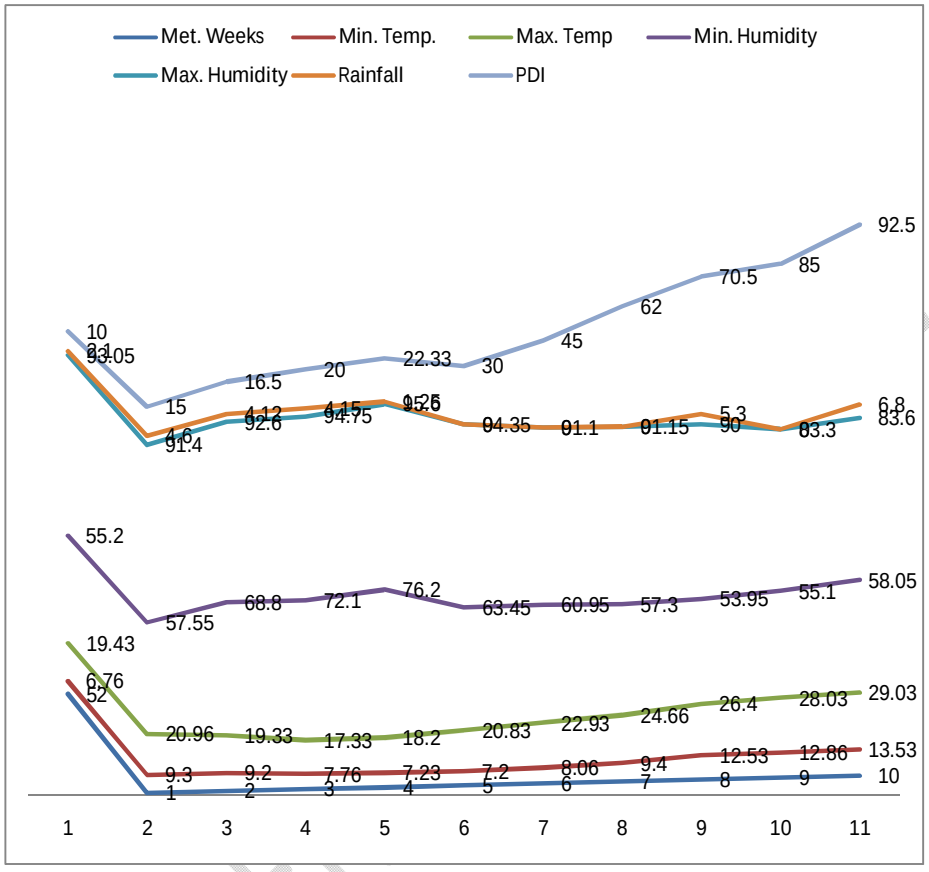

Fig-1:- Graphical representation of per cent disease incidence and meteorological factors