Epidemiological study of downy mildew disease of opium poppy

ABSTRACT

The downy mildew caused by *Peronospora*spp is a majordestructive 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~~ Regression analysis between dependent variable (~~Downy~~ downy mildew disease incidence) *Vs.* independent variables (*viz*., rainfall, maximum and minimum temperature and relative humidity) showed that all the weather parameters ~~accounted~~ contributed more than 85 percent variation (R^2 = 0.869, 0.957, 0.859) in the downy mildew incidence of opium poppy. One unit (1°C) 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 disease 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~~cultivated for alkaloids such as morphine, codeine and thebaine ~~for the preparation of life~~used in formulations of several lifesaving drugs. The severity of downy mildew ~~depends on~~is affected by meteorological factors, i.e. high relative humidity, moderate temperature (20^{0}C)and rainfall (Landa *et al*,2007). ~~During the~~At high relative humidity~~large number of~~profuse asexual spore (sporangia) are producing by the ~~downy mildew pathogen~~fungus which~~is~~are~~immediately~~subsequentlydispersed from few hundred meters to several kilometers by air currents and cause~~d~~ primary infection. The~~se~~ primary infection~~scan~~

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~~evolve~~causes secondary infection on the abaxial surface of leaves (Navas- Cortes *et al*, 2009). Moist l~~L~~eaf ~~wetness~~ surfacefor 24hours after the primary infection showed~~,~~ prolific sporulation ~~was observed for~~and rapid spread of the disease (Cohen *et al*, 2013b). ~~Therefore, the main objective of this research was~~The study aims to examine the optimal meteorological factors for predisposing the disease ~~development~~ and its record disease progressin changing climatic scenario for recommendations and advisories to farmers for minimizing yield losses due to this devastating pathogen.

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~~ where the downy mildew disease of Opium poppy was ~~regularly occurred~~frequently recorded under natural field condition. ~~This~~ The diseasetrial was conducted during *Rabi* 2019-20 to 2021-22. The data ~~of~~ fordowny mildew disease was ~~undertaken~~ recorded~~without~~ under natural conditions~~any plant protection measures~~ however, ~~other~~ standard agronomical management practices were adopted. Observations ~~of~~ fordisease incidence were recorded at weekly interval ~~since~~ from30 days after sowing (DAS) throughout the study ~~in all the experimental years~~. Plot-wise disease incidence was ~~calculated~~ expressedas percentage of diseased plants over total plants. Weather ~~parameters~~ datanamely temperature, relative humidity and rainfall ~~were~~ recorded at weekly interval during the opium poppy growing ~~periods~~season~~for all the years~~during the study~~from~~ was obtained fromthe meteorological observatory of ANDUAT, Kumarganj,Ayodhya. Correlation and regression coefficients between disease incidence and weather ~~parameters~~ variables*viz*.,rainfall maximum and minimum temperature and relative humidity prevailing during the crop growing periods ~~were worked out~~was derived.

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~~the study from 2019-22 (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 during the study. 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~~In the 3rd SMW ~~when~~ the maximum temperature dropped ~~(~~to 17.33 ^{0}C~~)~~ and DMI reached ~~upto~~up to 20.00 percent. This favoured a ~~depicting the~~ progression and spread of downy mildew disease in opium poppy with the progressive decrease of maximum temperature. The maximum disease incidence was recorded

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at 92.53 percent in 10th SMW ~~when at~~maximum and minimum temperature were 29.03 ^{0}C and 13.53 ^{0}C respectively. 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. The results are in partial agreement to the previous report.

During the disease initiation ~~high~~a variation was observed in maximum (93.05%) and minimum (55.2%) relative humiditydue to rainfall (2.10mm) which had influence on spore build up 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 were also determining ;factors,~~when the~~formaximum downy mildew disease incidence ~~was reached at the peak~~(10th SMW) and were the best for maximum damage to crop.~~The present findings are in~~ similar results ~~with the~~were found by Daunde *et al* (2017) and Arti and Singh (2019) in ~~who reported increase of~~ downy mildew disease of cucumber and pearl millet respectively, up to ~~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 4rth (1.25mm) with relative humidity in the ~~range~~ranging from~~of~~ 91.4 to 95.6% ~~resulted to~~resulting in fast build up of downy mildew ~~incidence~~disease inoculum (22.33%). However, ~~variability~~ variationin~~an~~ amount of rainfall ~~is~~did not significantly affect~~edto~~ thedisease 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 consecutive cropping season ~~were~~ arecomputed (Table2). The results ~~were~~ show~~n~~a significant positive correlation between DMI and temperature vatiatin (minimum temperature(r=0.86), maximum temperature (r= 0.95)~~and~~ as well as relative humidity maximum relative humidity (r= 0.86). Whereas minimum relative humidity was found negative significant correlation (r= -052%). However, ~~T~~the effectsof rainfall~~was~~ werenot significant ~~with~~ forDMI. Dhaliwal *et al* (2018) also reported negative and significant correlation with temperature and rainfall in maize stem borer incidence.

The regression analysis of all ~~three~~ crop seasons~~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 for 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~~ that amultiple regression analysis of data which ~~has~~ revealed minimum temperature, relativehumidity in the evening and sunshine and cumulative rainfall played major role in *Alternaria* leaf blight disease development of cluster

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bean. Das and Raut (2002) ~~indicated~~ investigatedthat 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.

Conclusion is missing focus on relevance of study for the readers.

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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*

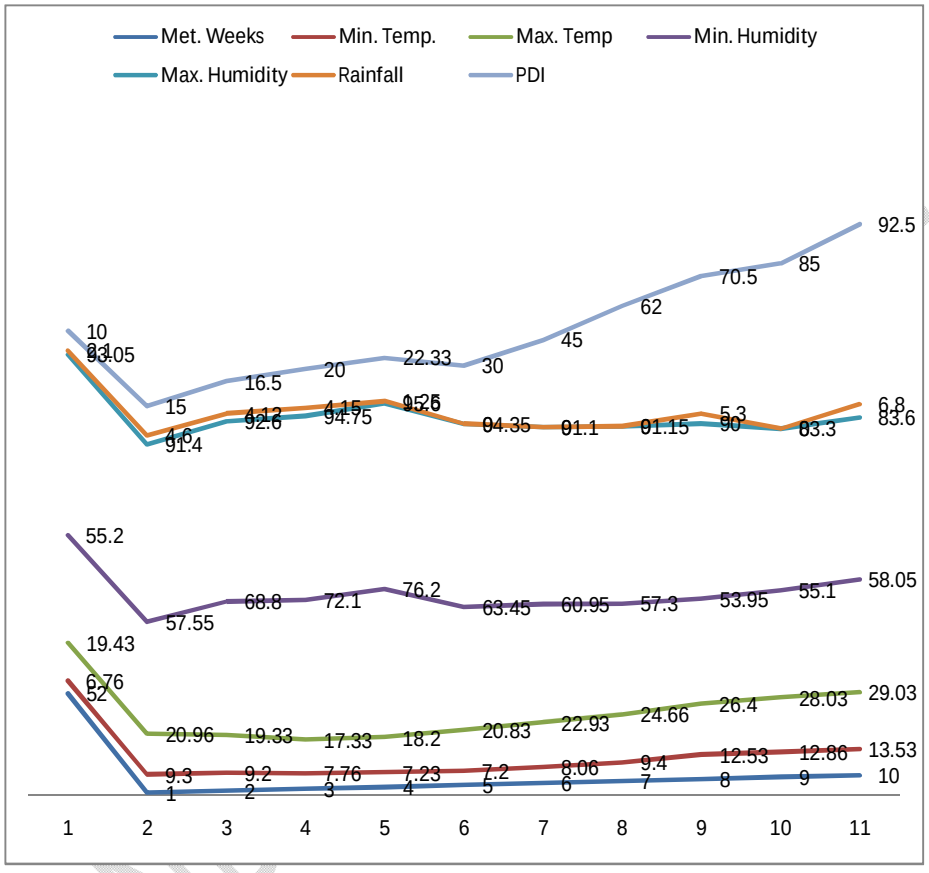

Fig-1:- Graphical representation of per cent disease incidence and meteorological factors