
Status and Epidemiology of Downy Mildew of Mustard (*Brassica juncea* L.) in Jammu Sub-Tropics

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Mustard (*Brassica juncea* L.) is an important cruciferous crop of the family Brassicaceae. One of the most destructive diseases that causes widespread losses in mustard is downy mildew. Investigations were conducted during *Rabi* season of 2023-2024 regarding the status and epidemiology of downy mildew of mustard. Survey was conducted in different locations of Jammu, Samba, Kathua and Udhampur district to assess the status of disease and the data revealed that disease was prevalent in all the locations surveyed and varied from 19.36 to 32.11 per cent. Epidemiological studies revealed that relative humidity, both morning and evening exhibited a highly significant and positive correlation with disease development while temperature (maximum and minimum) and rainfall showed a non-significant and negative impact.

Keywords : Downy mildew, epidemiology, mustard, survey

INTRODUCTION

Mustard (*Brassica juncea* L.) is a major Cruciferous crop used exclusively for oils and vegetables around the world. It was known to the Greeks, Indians, Romans, and Chinese approximately 2000 years ago. It is an annual crop that belongs to the *Brassicaceae* family. Indian mustard is the most important and major edible oil seed crop and is known by numerous names, including brown mustard, red mustard, brown sarson, Raya and laha. Mustard is the world's third most important edible oilseed crop, following soybean and oil palm (USDA, 2011). The crop's productivity is low due to biotic and abiotic stressors. Diseases are one of the most serious biotic pressures. Many diseases attack the crop at various phases of development, including downy mildew, Alternaria blight, white rust, and sclerotinia rot. Downy mildew disease may arise concurrently with white rust and is now known to exist in all the key rapeseed-mustard growing states of the country such as Uttar Pradesh, Bihar, Punjab, Haryana, Rajasthan, West Bengal, etc. (Yadav *et al.* 2019).

Downy mildew, caused by *Peronospora parasitica*, is the most common disease of mustard and was first described by E. J. Butler in 1918. According to Sharma *et al.* (2018), the pathogen targets cotyledons and initial leaves first. Minor, pale to yellow, angular dots appear on the upper surface of the leaf and can consolidate to form irregular brown patches. Vandenlangenberg *et al.* (2016) discovered that on the lower side surface, the matching spots are surrounded by a light grey fungal growth composed of multibranched conidiophores containing conidia. Keeping in view the importance of disease, socio-economic status of the crop, losses inflicted to the farming community in terms of volume and value the present investigation was carried to assess the status of the disease and identify the effect of various environmental factors on disease development. Mustard estimated global area, output and yield are 36.59 million hectares, 72.37 million tonnes and 1980 kg/ha, respectively. Globally, India accounts for 19.8 per cent and 9.8 per cent of total mustard area and production, respectively (Anonymous, 2019). India ranks first in terms of area and third in terms of production, accounting for approximately 12 per cent of global rapeseed-mustard "seed" and 8.5 per cent of global rapeseed-mustard "oil". The major

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rapeseed-mustard growing states are Rajasthan (44.97 %), Haryana (12.44 %), Madhya Pradesh (11.32 %), Uttar Pradesh (10.60 %) and West Bengal (7.53 %). Rapeseed mustard is a key oilseed crop during the *Rabi* season in Jammu and Kashmir. The overall area under rapeseed mustard crop in J&K is 55,236 ha with Jammu province accounting for around 11,241 ha which includes both temperate and subtropical areas. The average productivity of rapeseed mustard in J&K is 6.99 q/ha (Kumar *et al.* 2018).

MATERIALS AND METHODS

Status of downy mildew of mustard in Jammu sub-tropics

To find the status of downy mildew disease of mustard, survey was conducted in the Jammu, Samba, Kathua and Udhampur districts of Jammu division between first week of December, 2023 to first week of March of 2024 to record the incidence of disease. During the survey three blocks were selected from each district and in each block three major mustard growing villages were selected. Three mustard growing fields from each village were randomly selected and disease incidence was recorded from each field. From each field plant samples were observed randomly and the disease incidence was calculated by using the following formula. (Mc Kinney, 1923) :

$$\text{Disease incidence (\%)} = \frac{\text{Number of infected plants}}{\text{Total No. of plants observed}} \times 100$$

Epidemiological studies

A field experiment was carried out at Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu to study the effect of meteorological parameters such as temperature (Minimum and maximum), relative humidity (Morning and evening) and rainfall on disease intensity. The disease intensity was recorded at weekly interval. The meteorological data was obtained from Division of Agro-meteorology, FoA, SKUAST-Jammu. Simple correlation and linear regression analysis was also obtained. The correlation and simple linear regression analysis were done by using SPSS software.

RESULTS AND DISCUSSION

Survey

Field surveys were carried out in different locations of mustard growing areas of Jammu, Samba, Kathua and Udhampur during the *Rabi* season of 2023-24 to ascertain the status of disease. The data revealed that the disease was prevalent in all the mustard growing areas of the Jammu division. The disease incidence varied from 19.36 to 32.11 per cent with an overall mean of 24.23 per cent in all the locations taken under the survey. The disease incidence ranged from 19.36 to 32.11 per cent with overall mean of 24.23 per cent. In Jammu district, the disease incidence varied from 20.38 to 30.48 per cent with mean of 24.86 per cent. In Kathua, the disease incidence ranged from 19.36 to 28.22 per cent with mean of 22.93 per cent whereas in Samba district the incidence varied from 20.04 to 32.11 per cent with mean of 24.66 per cent. In Udhampur district, 21.15 to 29.81 per cent disease incidence was recorded (Table 1 and Fig. 1). Our findings are completely consistent with those of Sharma *et al.* (2011) who surveyed eight districts of Uttar Pradesh and found downy mildew incidence from 2 to 100 per cent which was very high in the Hathras district with 100 per cent incidence. However, Machenahalli *et al.* (2013) also recorded the downy mildew incidence in gherkins from different locations of Himachal Pradesh. Gupta *et al.* (2014) reported 67.31 percent and 49.16 percent mean disease incidence and severity of downy mildew of cucumber.

Epidemiological studies

The data obtained from 47th Meteorological Standard Week (MSW) had very little influence on the intensity of the disease (10.00%) when the maximum temp., minimum temp., relative humidity (morn.), relative humidity (even.) were 24.74!, 9.11!, 91.71 per cent, 48.57 per cent respectively, but the disease eventually increased to 40.00 per cent in the 3rd standard week when the maximum temp., minimum temp., relative humidity (morning), relative humidity (evening) were 13.66!, 3.34!, 96.57 per cent and 71.57 per cent respectively. The variation in disease incidence in different regions depends upon the

Table 1 : Status of Downy mildew of mustard in different locations of Jammu, Samba, Kathua and Udhampur during 2022-23

District	Block	Village	Disease incidence (%)	
Jammu	Rspura	Chohalla	23.72	
		Chak Musa	30.48	
		Badyal Brahmana	20.38	
		Mean±SE	24.86±2.97	
		Range	20.38-30.48	
		Maralian	26.92	
	Miran Sahib	Jindlehar	25.12	
		Bagga Zina	24.96	
		Mean±SE	25.67±0.63	
		Range	24.96-26.92	
		Suchetgarh	Lalyandi	25.43
			Biaspur	25.93
	Suchetgarh		21.00	
	Mean±SE		24.12 ± 1.57	
	Samba	Nud	Range	21.00-25.93
			Overall Mean	24.88±0.45
			Overall Range	20.38-30.48
Balore			22.85	
Stah			24.23	
Mananu			32.11	
Mean±se		26.40±2.89		
Range		22.85-32.11		
Parmandal		Anandpur	26.54	
		Nagrota	29.21	
	Khada	23.88		
	Mean±se	26.54±1.54		
	Range	23.88-29.21		
	Ghagwal	Nonath	22.59	
Rajpura		20.56		
Sangwali		20.04		
Mean±SE		21.06±0.78		
Range		20.04-22.59		
Overall Mean		24.66 ± 1.80		
Kathua	Marheen	Overall Range	20.04-32.11	
		Ladhwai	22.00	
		Gair	25.67	
		Channrorian	22.90	
		Mean±SE	23.52±1.10	

		Range	22.00-22.90
	Hiranagar	Jandi	20.06
		Sherpur	21.18
		Hiranagar	26.34
		Mean±SE	22.53 ± 1.94
		Range	20.06-26.34
	Barnoti	Ghati	19.36
		Skatachak	28.22
		Budhi	20.65
		Mean±SE	22.75 ± 2.76
		Range	19.36-28.22
		Overall Mean	22.93 ± 0.30
		Overall Range	19.36-28.22
Udhampur	Chenani	Gharian Kalan	29.81
		Mantalai	26.36
		Gharian Khurd	21.65
		Mean±SE	25.94 ± 2.36
		Range	21.65-29.81
	Udhampur	Sunari	25.97
		Patta	21.15
		Samole	27.55
		Mean±SE	24.89 ± 1.93
		Range	21.15-27.55
	Majalta	Thalora	24.73
		Majalta	24.76
		Battal	20.05
		Mean±SE	23.18 ± 1.56
		Range	20.05-24.76
		Overall Mean	24.66 ± 0.80
		Overall Range	20.05-29.81
		Overall Mean	24.23 ± 0.58
		Overall Range	19.36-32.11

presence of initial inoculum, contaminated seeds, prevailing environmental temperatures, irrigation and wetness of the leaf.

Correlation studies revealed that maximum temperature and minimum temperature showed a highly significant negative correlation with the progression of the disease whereas both morning and m relative humidity demonstrated a statistically significant and positive correlation with

the disease development. Rainfall was found to have a statistically significant and negative association with disease intensity. Thus, epidemiological factors played a very crucial role in disease development in an area over a specific period of time. These observations are in accordance with the finding of Sangeetha and Siddaramaiah (2007) who reported maximum downy mildew incidence at minimum temperature (14-16°C) and maximum temperature (26-29°C).

Table 2: Effect of different meteorological parameters on the development of Downy mildew of mustard under field conditions

MSW	Max.Temp.(°C)	Min.Temp.(°C)	RH% (Morning)	RH% (Evening)	Rainfall(mm)	Disease Intensity(%)
47	24.74	9.11	91.71	48.57	0.00	10.00
48	23.77	9.84	93.29	58.29	2.57	18.33
49	23.31	6.59	95.57	48.00	0.00	25.56
50	21.37	4.80	96.57	48.14	0.46	29.44
51	21.46	4.87	95.00	50.57	0.00	32.78
52	17.77	6.33	96.29	71.71	0.00	34.44
1	11.54	5.99	94.29	83.57	0.00	37.78
2	9.13	4.43	97.00	88.57	0.00	39.44
3	13.66	3.34	96.57	71.57	0.00	40.00

Table 3 : Correlation of different meteorological parameters with development of downy mildew of mustard

	Maximum Temperature (°C)	Minimum Temperature (°C)	RH% (Morning)	RH% (Evening)	Rainfall (mm)
Maximum Temperature (°C)					
Minimum Temperature (°C)	0.635 ^{NS}				
RH% (Morning)	-0.547 ^{NS}	-0.837 ^{**}			
RH% (Evening)	-0.941 ^{**}	-0.365 ^{NS}	0.373 ^{NS}		
Rainfall (mm)	0.376 ^{NS}	0.607 ^{NS}	-0.341 ^{NS}	-0.180 ^{NS}	
PDI (%)	-0.838 ^{**}	-0.866 ^{**}	0.814 ^{**}	0.696 [*]	-0.425 ^{NS}

Table 4: Linear regression of epidemiological factors with disease intensity of downy mildew of mustard

Variety	Regression equation	Correlation coefficient (r)	Coefficient of Determination (R ²)
Varuna	Y = -26.41 + 2.20X ₁ - 5.66X ₂ - 0.09X ₃ + 0.92X ₄ + 1.05X ₅	0.950	0.974

The regression equation implied that weather parameters were responsible for 97.40 per cent variation in downy mildew disease.

Where, X₁ = Maximum temperature (°C)

X₂ = Minimum temperature (°C)

X₃ = Relative humidity morning (%)

X₄ = Relative humidity evening (%)

X₅ = Rainfall (mm)

Y = Disease Intensity (%)

CONCLUSION

An extensive survey of mustard fields conducted in Rabi season of 2023-24 revealed that the disease was prevalent in all the locations surveyed and per cent disease incidence varied from 19.36 to 32.11 per cent with an overall mean of 24.23 per cent. The maximum disease incidence of 32.11 per cent was observed from Mananu in Nud block of district Samba, whereas

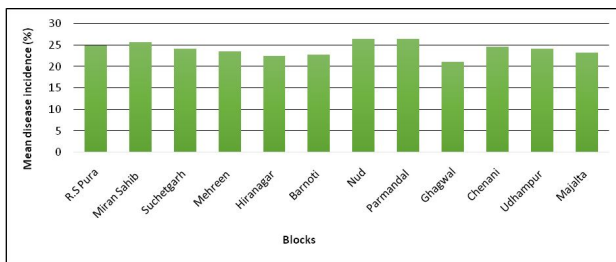


Fig. 1: Mean disease incidence (%) of downy mildew of mustard at various location of Jammu, Kathua, Samba and Udhampur

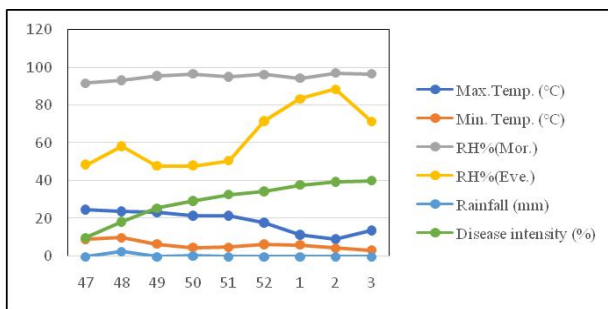


Fig. 2: Graphical representation showing effect of meteorological parameters on the development of downy mildew of mustard under field conditions

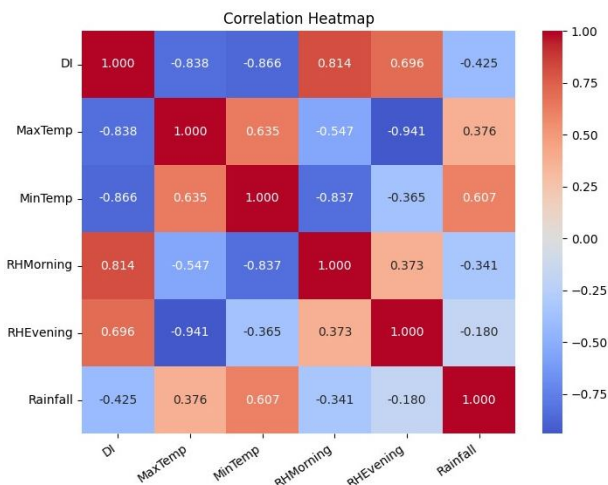


Fig. 3: Correlation heatmap of different meteorological parameters with disease development

minimum disease incidence of 19.36 per cent was recorded from Ghati in Barnoti block in Kathua district. It was observed that meteorological factors were very important in progression of the disease. The correlation analysis revealed that relative humidity (morning), relative humidity (evening) had a significant and positive relationship with disease development whereas maximum temperature, minimum temperature, rainfall had significant and negative relationship

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DECLARATION

Conflict of interest. Authors declare no conflict of interest.

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