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RESEARCH PAPER

Severity and status of chilli powdery mildew in North Eastern Karnataka

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Abstract: An intensive roving survey was carried out to know the present status of powdery mildew of chilli in chilli growing districts of North Eastern Karnataka *viz.,* Yadgir, Koppal, Raichur, Ballari, Haveri and Gadag districts during *rabi* 2019-20. The results revealed that, the average disease severity was found more in Ballari district (64.56 PDI) followed by Raichur (47.67 PDI) and least in Gadag (30.37 PDI). The variation of disease severity at various locations is mainly attributed to the prevailing climatic factors like temperature, relative humidity, distribution of rainfall followed by varieties grown, cultural practices like sanitation and other suitable management practices. The other factors like age of the crop, cool nights and dry weather situation were also favourable for the severity of powdery mildew. Ballari and Raichur districts are considered as hotspots for powdery mildew of chilli.

Key words: Chilli, Disease, Powdery mildew, Weather parameter

Introduction

Chilli (*Capsicum annuum* L.), is an economically important commercial spice cum vegetable crop of the world and belongs to the family Solanaceae. It is believed to be originated from South America during 15th Century. It is an important Indian curry ingredient that is characterized by an enticing colour, taste and pungency. Chilli is used as paste (both green and red), powder and as a whole or in broken/split form, both as green and dry. It is also used in food processing and bakery industry. Hot peppers are also pickled as flavoring agents in salt and vinegar and are used in ketchups. Chilli varieties are used not only in the preparation of processed foods, but also in salad dressings, meat products, cosmetics and even clothing as coloring agents (Saxena *et al*., 2016). India is the largest producer of chillies in the world with an annual production of 13.76 million tonnes. Of the total world production of chilli (37.62 million tonnes), 36.57 per cent is contributed by India, followed by 7.97 per cent by China (Geetha and Selvarani, 2017). In India, chilli is cultivated in all the states including Andhra Pradesh, Assam, Karnataka, Maharashtra, Orissa, Rajasthan, Tamil Nadu and West Bengal. At the national level, the production of dry chilli is spread over 6.83 lakh ha with the production of 17.02 lakh tonnes. Among the various states, Andhra Pradesh ranks first in area (1.43 lakh ha) and production (6.60 lakh tonnes) of dry chillies in the country (Anon., 2019). In Karnataka, the production of dry chilli is spread over 0.876 lakh ha with the production of 1.80 lakh tonnes. Belgavi, Haveri, Ballari, Dharwad, Raichur and Shivamogga are the major chilli growing districts in Karnataka. Although the area under cultivation in Karnataka is higher, its production is low compared to that of the other states due to poor management of economically important pests and diseases (Anon., 2019). Chilli production is limited by biotic stresses like fungi, bacteria, viruses, nematodes and even abiotic stresses also. Among the foliar diseases, powdery mildew is an economically important disease (Hussain and Abid, 2011). Powdery mildew incited by *Leviellula taurica* Lev. (Arn) is one of the important fungal diseases in chilli causing considerable losses. India has recorded a yield loss of 50 per cent due to powdery mildew in unsprayed plots (Bademiyya and Ashtaputre, 2019).

Material and methods

An intensive roving survey was carried out in chilli growing districts of North Eastern Karnataka during *rabi* 2019-20 to assess the severity and distribution of powdery mildew. The survey was carried out from November to December at flowering to fruiting stage. In each taluk three villages were selected and in each village three farmer's fields were selected and in each field randomly four spots of one square meter area (10 plants) were observed for recording the disease severity. The severity of chilli powdery mildew was recorded by using 0-9 scale developed by Mayee and Datar (1986).

Results and discussion

The roving survey was conducted to assess the severity of chilli powdery mildew in major chilli growing districts of North Eastern Karnataka *viz*., Raichur, Koppal, Ballari, Yadgir, Haveri and Gadag during *rabi* 2019-20. It was noticed that, none of the surveyed fields were free from powdery mildew and the severity varied across the locations. The data pertaining to the survey is presented in Table 1 and 2. The survey results depicted that, the severity of chilli powdery mildew was noticed in all the surveyed areas and it ranged from 13.33 to 82.22 PDI, in chilli fields of Raichur, Koppal, Ballari, Yadgir, Haveri and Gadag districts of North Eastern Karnataka. The maximum disease severity was recorded in Ballari which ranged from 56.66 (Kurgod village) to 82.22 PDI (Hampasagar) followed by Raichur district with PDI ranging from 40.00 (Manvi village) to 57.78 PDI (Kurdi). In Koppal district PDI variedfrom 33.33 (Hanumasagara village) to 53.33 (Mandalmari and Harogeri villages), whereas 24.44 (Chincholi village) to 55.56 PDI (Saidapur village) in Yadgir district. In Haveri district powdery mildew severity ranged from

Table 1. Severity and distribution of chilli powdery mildew in North Eastern Karnataka during 2019-20

District	Taluk	Village	Variety	Crop stage	Other diseases observed	Latitude	Longitude	PDI
Raichur	Raichur	Harvi	Byadgi Dabbi	Fruiting	*Cercospora* leaf spot	16.075747	77.064823	48.89
		Matmari	Syngenta 5531	Fruiting	Bacterial leaf spot	16.037832	77.298502	46.67
		Khanapur	Byadgi Dabbi	Fruiting	Leaf curl	16.326022	77.109950	55.56
							Mean	50.37
	Manvi	Manvi	Indam-5	Flowering	Leaf curl	15.994812	77.047324	40.00
		Sankeswar	Syngenta 2043	Fruiting	*Cercospora* leaf spot	16.218977	77.317163	42.22
		Kurdi	Byadgi Dabbi	Fruiting	Bacterial leaf spot	16.055370	77.210063	57.78
							Mean	46.67
	Deodurga	Gabbur	Byadgi Kaddi	Fruiting	-	16.314507	77.154620	46.67
		Masarkal	Syngenta 5531	Fruiting	*Cercospora* leaf spot	16.379672	77.019522	44.44
		Amarapur	Byadgi Dabbi	Fruiting	Anthracnose	16.389328	76.832672	46.67
							Mean	45.93
Koppal	Koppal	Harogeri	Byadgi Kaddi	Fruiting	*Cercospora* leaf spot	15.356863	76.148909	53.33
		Vadaganal	Byadgi Dabbi	Fruiting	Anthracnose	15.338132	76.158770	48.89
		Hiresindogi	Indam-5	Flowering	Leaf curl	15.310246	76.081913	46.67
							Mean	49.63
	Yelburga	Mandalmari	Syngenta 5531	Fruiting	Anthracnose	15.678165	76.144206	53.33
		Bevoor	Indam-5	Flowering	-	15.569182	76.174023	37.78
		Arakeri	Byadgi Dabbi	Fruiting	*Cercospora* leaf spot	15.473309	76.103804	48.89
							Mean	46.67
	Kushtagi	Hosalli	Byadgi Dabbi	Flowering	*Cercospora* leaf spot	15.466083	76.522791	37.78
		Hanumasagara	Super-10	Fruiting	Anthracnose	15.876646	76.047021	33.33
		Dotihala	Syngenta 5531	Flowering	-	15.865912	76.206908	35.56
							Mean	35.56
Ballari	Siruguppa	Itagihal	Syngenta 5531	Fruiting	*Cercospora* leaf spot	15.645312	77.114319	58.88
		Nittur	Byadgi Dabbi	Fruiting	Anthracnose	15.555387	76.829311	70.00
		Sindigeri	Byadgi Dabbi	Fruiting	*Fusarium* wilt	15.360215	76.875537	61.11
							Mean	63.33
	Ballari	Somasamudra	Byadgi Dabbi	Fruiting	Leaf curl	15.239716	76.896568	59.99
		Kurugod	Byadgi Kaddi	Flowering	-	15.342669	76.691256	56.66
		Dhadesugur	GS-1	Fruiting	*Cercospora* leaf spot	15.342581	76.691255	58.88
							Mean	58.51
	Hagaribo-mmanahalli	Hampasagar	Byadgi Dabbi	Fruiting	Anthracnose	15.089065	76.045644	82.22
		Nagalapura	Byadgi Kaddi	Fruiting	Anthracnose	15.049520	76.197929	69.99
		Bannikal	Byadgi Dabbi	Fruiting	*Cercospora* leaf spot	14.961660	76.241498	63.33
							Mean	71.85
Yadgir	Yadgir	Gogi	GS-1	Flowering	-	16.732107	76.737444	35.56
	Khanapur	Byadgi Kaddi	Fruiting	*Cercospora* leaf spot		16.707072	77.008274	37.78
		Chatnahalli	Byadgi Kaddi	Fruiting	Anthracnose	16.760762	77.000421	46.67
							Mean	40.00
	Shahapur	Bheemara-yangudi	Syngenta 2043	Flowering	-	16.729159	76.790399	37.78
		Saidapur	Byadgi Dabbi	Fruiting	Leaf curl	16.704108	76.792056	55.56
		Hattigudur	GS-1	Fruiting	Anthracnose	16.604167	76.877417	51.11
							Mean	48.15
	Shorapur	Devatkal	Byadgi Kaddi	Fruiting	*Cercospora* leaf spot	16.456494	76.632270	42.22
		Bevinahal	Byadgi Kaddi	Fruiting	Anthracnose	16.520296	76.756504	48.89
		Chincholi	Indam-5	Flowering	*Cercospora* leaf spot	17.270454	76.405540	24.44
							Mean	38.52

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Haveri	Byadgi	Kadaram-	Byadgi Kaddi andaragi	Fruiting	*Cercospora* leaf spot	14.677219	75.474829	26.67
		Kalgonda	Indam-5	Flowering	-	14.582084	75.340994	23.33
		Kaginele	Byadgi Dabbi	Fruiting	Anthracnose	14.677219	75.474829	37.78
							Mean	29.26
	Ranebe-nnur	Hulihalli	Byadgi Dabbi	Fruiting	*Cercospora* leaf spot	14.634299	75.576657	33.33
		Honnatti	Byadgi Dabbi	Fruiting	Anthracnose	14.746384	75.636684	33.33
		Belur	GS-1	Flowering	-	14.720081	75.752534	28.89
							Mean	31.85
	Haveri	Devihosur	Byadgi Dabbi	Fruiting	-	14.793637	75.328273	57.78
		Venkatapur	Syngenta 2043	Fruiting	*Cercospora* leaf spot	14.690029	75.534910	31.11
		Benchalli	Byadgi Kaddi	Fruiting	-	14.796396	75.384449	35.56
							Mean	41.48
Gadag	Mundargi	Hatti	Syngenta-5531	Fruiting	Leaf curl	15.204134	75.920185	22.22
		Dambal	Indam-5	Flowering	*Cercospora* leaf spot	15.295999	75.768328	13.33
		Gangapur	Byadgi Dabbi	Fruiting	-	15.093192	75.876388	24.44
							Mean	20.00
	Gadag	Antur	Byadgi Dabbi	Fruiting	*Cercospora* leaf spot	15.379114	74.348904	40.00
		Kanavi	GS-1	Fruiting	Anthracnose	15.428925	75.615998	35.56
		Shirol	Indam-5	Flowering	-	15.825586	75.535576	26.67
							Mean	34.07
	Shirahatti	Belhatti	Indam-5	Flowering	-	15.087294	75.629455	31.11
		Nagaram-advuvu	Byadgi Dabbi	Fruiting	*Cercospora* leaf spot	15.428925	75.615998	42.22
		Hullur	Byadgi Dabbi	Fruiting	-	15.420193	75.524828	37.78
							Mean	37.04

Table 2. Average severity of chilli powdery mildew in North Eastern Karnataka during 2019-20

District	Taluk	Percent Disease Index (PDI)	
		Taluk mean	District mean
Raichur	Raichur	50.37	47.65
	Manvi	46.67	
	Deodurga	45.93	
Koppal	Koppal	49.63	43.95
	Yelburga	46.67	
	Kushtagi	35.56	
Ballari	Siruguppa	63.33	64.56
	Ballari	58.51	
	Hagaribommanahalli	71.85	
Yadgir	Yadgir	40.00	42.22
	Shahapur	48.15	
	Shorapur	38.52	
Haveri	Byadgi	29.26	34.20
	Ranebennur	31.85	
	Haveri	41.48	
Gadag	Mundargi	20.00	30.37
	Gadag	34.07	
	Shirahatti	37.04	

23.33 (Kalgond village) to 57.78 PDI (Devihosur village). The minimum powdery mildew severity was observed in the range of 13.33 (Dambal village) to 42.22 PDI (Nagaramadvuvu village) in Gadag district.

Among the taluks of Raichur districts, maximum disease severity of 50.37 PDI was noticed in Raichur taluk followed by Manvi (46.67 PDI) and Deodurga (45.93 PDI). In Raichur, the maximum disease severity of 55.56 PDI was noticed in Khanapur village on Byadgi Dabbi variety and least disease severity of 46.67 PDI was noticed in Matmari village of Raichur taluk. In Manvi taluk, the maximum disease severity of 57.78 PDI was noticed in Kurdi village followed by Sankeshwar village (42.22 PDI) and Manvi village (40.00 PDI). Whereas, in Deodurga taluk, maximum disease severity was noticed in Gabbur and Amarapur village (46.67 PDI) and least powdery mildew severity was recorded in Masarkal village (44.44 PDI). In all the taluks surveyed of Koppal district, the maximum disease severity was observed in Koppal taluk (49.63 PDI) followed by Yelburga (46.67 PDI) and Kushtagi (35.56 PDI). In Koppal taluk, maximum PDI of 53.33 was noticed in Harogeri village on Byadgi Kaddi variety and least disease severity of 46.67 PDI was observed in Hiresindogi village on Indam - 5 variety. In Yelburga taluk, Mandalamari village recorded maximum powdery mildew PDI of 53.33 and least disease severity was noticed in Bevoor village (37.78 PDI). Maximum powdery mildew severity of 37.78 PDI (Hosalli) followed by Dotihala (35.56 PDI) and Hosalli (37.78 PDI) was observed in Kushtigi taluk. In Ballari district, chilli fields of Hampsagar village of Hagaribommanahalli taluk recorded maximum disease severity of 82.22 PDI followed by Nagalapura (69.99 PDI) and Bannikal (63.33 PDI). In Siruguppa taluk, maximum disease severity of 70.00 PDI was observed in Nittur village and minimum PDI of 58.88 in Itagaihal village. In Ballari taluk, least powdery mildew severity was recorded in Kurugod village (56.66 PDI) and maximum disease severity was noticed in Somasamudra

Table 3. Severity of chilli powdery mildew in different varieties/ hybrids of chilli in North Eastern Karnataka during 2019-20

Varieties/ hybrids	Mean PDI
Byadgi dabbi	49.68
Byadgi kaddi	46.44
Syngenta 5531	43.52
Guntur selection-1	37.22
Indam-5	32.64
Syngenta 2043	40.00
Super 10	33.33

(59.99 PDI). In Yadgir district, maximum chilli powdery mildew was observed in Shahapur taluk (48.15 PDI) followed by Yadgir (40.00 PDI) and Shorapur (38.52) taluks. Among the different villages of Shahapur taluk, Saidapur village has recorded maximum powdery mildew severity of 55.56 PDI and least disease severity was observed in Bheemarayanagudi village (37.78 PDI).

Similarly, survey was conducted in different taluks of Haveri district and results showed that, maximum severity of powdery mildew was noticed in Devihosur village of Haveri taluk (57.78 PDI) and least disease severity was observed in Kalgond village of Byadgi taluk (23.33 PDI). Finally, in Gadag district, the powdery mildew severity was recorded to maximum extent of 42.22 PDI in Nagaramadavu village of Shirahatti taluk followed by Antur village (40.00 PDI) of Gadag taluk, Hullur village (37.78 PDI) and Belhatti village (31.11 PDI) in Shirhatti taluk and least disease severity was observed in Dambal village (13.33 PDI) of Mundargi taluk. Based on the information collected during intensive survey for chilli powdery mildew in North Eastern parts of Karnataka, mean maximum PDI was observed in Ballari district (64.56) followed by Raichur (47.65), Koppal (43.95), Yadgir (42.22), Haveri (34.20) and least powdery mildew severity was recorded in Gadag (30.37 PDI) district (Table 2). During roving survey, it was noticed that farmers have grown different varieties or hybrids of chilli. Among the varieties/hybrids, Byadgi Dabbi has shown highest powdery mildew severity of 49.68 PDI followed by Byadgi Kaddi (46.44 PDI), Syngenta 5531 (43.52 PDI), Syngenta 2043 (40.00 PDI), Guntur selection-1 (37.22 PDI), Super 10 (33.33) and least disease severity was recorded in Indam - 5 variety (32.64 PDI) (Table 3).

The results of survey for the severity of chilli powdery mildew revealed that, Ballari and Raichur districts can be considered as 'hot spots' for powdery mildew of chilli. The reasons for outbreak of powdery mildew disease could be attributed to intensive cultivation of chilli crop season after season, non adoption of proper recommended disease management practices, cultivation of susceptible cultivars (Byadgi Dabbi and Byadgi Kaddi) and warm weather days, less or no rainfall and cool nights which prevailed during *rabi* season.

In the present study, powdery mildew severity varied from locality to locality, because of different type of varieties/hybrids grown, environmental factors, cropping pattern and variations in the inoculum load in different environmental conditions and excess application of nitrogenous fertilizers which makes the plants succulent and susceptible for disease. Such variations in powdery mildew severity across different locations and weather conditions have been reported by earlier workerspi. Frequent irrigation also increases the disease severity when the susceptible age of the crop coincides with favourable weather parameters (Band *et al.,* 2008).The infected debris left in the field, serve as major source of infection causing epidemic throughout the season. Continuous cultivation of any crop over the seasons and years helps inbuild up of inoculum level to such an extent that the epidemic is a common phenomenon (Chaube and Singh, 2001). Lower disease at some places could be attributed to the balanced dose of fungicides, sanitation, cultivars and environmental conditions besides rapid disposal of crop debris. The results of our study are in close proximity with the observations made by Sudheendra Ashtaputre *et al*. (2007) who reported maximum disease severity of powdery mildew of chilli in Bellary (79.12 PDI) and Gulbarga (76.63 PDI) and least in Belgum (43.05 PDI) districts of North Karnataka. The survey work of Ramesh (2011) showed highest chilli powdery mildew severity in Ballari (66.24 PDI) followed by Yadgir with 64.74 PDI and least disease severity was recorded in Raichur district (63.16 PDI). Maximum disease severity of powdery mildew was recorded in the districts of Ballari and Gulbarga, where the chilli crop was cultivated continuously under irrigated conditions. In rainfed chilli growing areas, however, less disease severity has been reported compared to irrigated areas. Data were obtained during peak disease development in the months of November and December. There was no outbreak of powdery mildew prior to September, even in experimental areas. This clearly showed that, the severity of the disease depends on factors such as location, cultural traditions, followed by susceptible cultivars grown, the microclimate congenial for disease progress and meteorological factors like temperature, relative humidity and rainfall. The results are in agreement with the findings of several workers (Raghavendra, 2005).

In addition, the intensity varied to greater extent in different locations indicating the role of environment and or existence of physiological races in the pathogen. In general, the development of the disease under natural conditions was observed during the months of October to December, which coincided with cool and dry air. These results are in agreement with Raghavendra, 2005 in case of powdery mildew of chilli. It is impossible to analyze the environmental conditions of the fungus because of the striking divergence in the geographical spread of powdery mildew on separate hosts and the probable existence of *Leveillula* species with different pathogenic properties. High plant populations and the application of heavy fertilizer by farmers result in a suitable microclimate for the development of disease and host susceptibility. Intensive chilli cultivation resulting from continuous cultivation, where the proximity of infected crops and the amount of inoculum present, in addition to providing favorable environmental conditions, inevitably influence the occurrence of infection.

Conclusion

The results of roving survey revealed that Ballari and Raichur districts can be considered as 'hot spots' for powdery mildew of chilli due to dry and cool weather during day and night respectively.

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