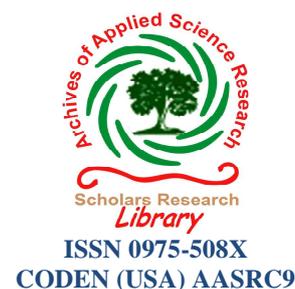




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Incidence and severity of powdery mildew fungi on some plants of Asteraceae and Rosaceae in Kashmir Himalayas

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ABSTRACT

Powdery mildew fungi caused heavy losses to several plants of economic importance. Therefore, a study on powdery mildews of some plants of Asteraceae and Rosaceae was carried out in different areas of Kashmir Himalayas. It was observed that in case of plants of Asteraceae the incidence of infection was high in *Helianthus annuus*, *Zinnia elegans* and *Xanthium strumarium* whereas moderate to mild infection was observed in other plants of the family Asteraceae. In Rosaceae, the *Rosa domescena*, *Rosa brunonii* and *Rosa macrophylla* showed moderate disease occurrence whereas other plants showed mild infection. However some plants such as *Malus domestica* showed mild infection or resistance against the powdery mildew disease. It was further revealed that the plants of both Asteraceae and Rosaceae were found infected with *Erysiphe cichoracearum* and *Sphaerotheca fuliginea*. The fungi were identified on the basis of anamorph and teleomorph characteristics.

Key words: Incidence, Severity, *Erysiphe cichoracearum*, *Sphaerotheca fuliginea*, Kashmir Himalayas, Rosaceae, Asteraceae.

INTRODUCTION

Powdery mildew is a disease of common occurrence on a variety of cultivated and wild plants across the world causing significant damage both on indoor and outdoor cultivated plants. Three powdery mildew species, *Erysiphe cichoracearum* DC., *Sphaerotheca fuliginea* (Schelecht) Poll. And *Levellula taurica* (Lev). Arn. infect various cultivated and wild crops in India as well as all over the world [1-9]. It was reported that *E. cichoracearum* and *S. fuliginea* are the casual organisms of the disease on Composites (Asteraceae) in the states of Punjab, Jammu and

Kashmir [10-13]. Further, it was also observed that both the species infect plants of Asteraceae in several other states like Himachal Pradesh [14] Maharashtra [15-17], Rajasthan [18] and Uttar Pradesh [19-22]. However, all the plants of Asteraceae and Rosaceae have not been evaluated for powdery mildew fungal infection and their occurrence and dominance has emerged from a relatively very few studies. Thus, the present study was undertaken to evaluate the incidence and intensity of powdery mildew disease on some plants of Asteraceae and Rosaceae in some districts of Kashmir Valley.

MATERIAL AND METHODS

A survey was carried out at different localities in district Kupwara, Baramulla and Srinagar of the Kashmir valley to assess the incidence and intensity of powdery mildews of some economically important plants of Asteraceae and Rosaceae. In each locality five to ten samples of each of the host plants encountered during the surveys were collected at random each of the available field plots, gardens, farm yards or other cultivation units in a locality. Samples containing of aerial parts of the plants (leaves and stems) of family Asteraceae such as *Callendulla officinalis*, *Helianthus annuus*, *Xanthium strumarium*, *Chrysanthemum indicum*, *Aster spp.*, *Zinnia elegans*, *Rudbecktia*, *Taraxacum officinale*, *Dahlia variabilis*, *Sonchus oleraceus* and *Sussurea albesenceus* and Rosaceae like *Rosa domescena*, *Rosa brunonii*, *Rosa macrophylla*, *Malus domestica*, *Filipendula vestita* and *Fragaria nubicula* properly marked and packed in polythene bags and brought to the laboratory for further studies. Incidence of disease (percent occurrence) on each host in a locality was calculated as per the method given by [23] as follows;

$$\text{Incidence (\%)} = \frac{\text{Number of infected plant units}}{\text{Total number (healthy and infected) of units assessed}} \times 100$$

Intensity (severity) of the disease on different members of the family Asteraceae and Rosaceae in different localities were rated as described by [24] as: (□) = no infection, (+) = mild infection (25 % infection), (++) = moderate infection (25- 60 % infection) and (+++) = heavy infection (60 – 100 % infection). Average of the ratings from different fields of a locality was assigned as severity grade on each infected plant in the locality.

All the samples were closely examined for studying the characteristics of symptoms on the hosts and were recorded. Conidia and mycelia were examined under the microscope for anamorph characters in the absence of teleomorph state (perithecia). The presence or absence of fibrosin bodies in conidia were assessed as per the method given by [25].

RESULTS AND DISCUSSION

A study was carried out at different localities in the district Kupwara, Baramulla and Srinagar of Kashmir valley in order to determine the incidence and severity of powdery mildew on different members of the family Asteraceae and Rosaceae. It was observed (Table 1-2) that different plants of family Asteraceae and Rosaceae were found to be attacked by powdery mildew fungi *Erysiphe cichoracearum* and *Sphaerotheca fuliginea*. The disease intensity also showed variation among different localities surveyed during the study.

It was revealed from the results that the plants of Asteraceae are the common hosts of the powdery mildew disease as they showed heavy to moderate infection in almost all the localities surveyed. In district Baramulla and Srinagar higher disease incidence and severity was observed than district Kupwara. In district Kupwara, localities such as Kupwara and Handwara showed heavy disease infection and severity on *Helianthus annuus* (80%), *Xanthium strumarium* (55.50%) and *Zinnia elegans* (58.50%) whereas the other members of the family showed mild to moderate disease incidence and severity (Table 1,3). In district Baramulla, *Xanthium strumarium* (60%), *Zinnia elegans* (70%) and *Calendula officinalis* (60.50%) showed heavy disease incidence in the localities of Baramulla and Sopore whereas the other members of the family showed mild to moderate disease infection (Table 1,3). In district Srinagar *Calendula officinalis* (65.50%), *Helianthus annuus* (90%), *Zinnia elegans* (78%) and *Dahlia variabilis* (60.50%) plants showed heavy disease infection and severity in the localities of Hazratbal, Nageen, Nishat and Shalimar whereas the other members of the family showed mild to moderate disease infection or were found resistant to the disease.

In case of family Rosaceae, the surveyed members showed moderate to mild disease incidence and severity in all districts. In district Kupwara, *Rosa domescena*, *Rosa brunonii* and *Rosa macrophylla* showed moderate to mild disease severity and incidence of powdery mildew (50.50%, 50% and 48.50%) respectively in the all surveyed localities whereas other plants of the family showed mild disease infection and severity (Table 2,4). In district Baramulla, moderate disease incidence and severity was found on *Rosa domescena* (52%), *Rosa brunonii* (48%) and *Rosa macrophylla* (50%) in all localities whereas other members of the family showed mild disease infection (Table 2,4). In district Srinagar, *Rosa domescena* (65.50%), *Rosa brunonii* (60%) and *Rosa macrophylla* (60.50%) showed heavy disease incidence and severity whereas the other members showed mild disease infection (Table 2,4).

The conidia (anamorph state) collected from infected plants were single, barrel to ellipsoidal in shape with 30.2 μm to 35.2 μm in length and 10.5 μm to 16.5 μm in width without fibrosin bodies. The germ tubes were simple with apical germination and having well developed appressoria at their tips. These conidial characteristics indicates that powdery mildew were *Erysiphe cichoracearum*. On the other hand conidia collected from some infected plants were mostly ovoid to cylindrical in shape with 25.8 μm to 34.6 μm in length and 12.4 μm to 15.8 μm in width with 4-8 fibrosin bodies. The germ tubes were forked produced from side walls of conidia without the appressoria. These conidial characters indicate that powdery mildew fungi infecting plants of Asteraceae and Rosaceae were *Sphaerotheca fuliginea*.

Teleomorph states were observed on some plants of *Helianthus annuus*, *Calendula officinalis* and *Chrysanthemum indicum* at Kupwara and Hazratbal localities but in case of other plants there was no evidence of teleomorph stage. It might be due to the absence of the two sexually compatible strains or the presence of only one mating type of both the species in the area. However, the influence of various environmental conditions on perithecial development cannot be ruled out [26, 27, 28, 29, 30, 31, 21]

The present study has demonstrated a high incidence and intensity of powdery mildew disease on some economically important plants of the families Asteraceae and Rosaceae found in the area.

The potential of this disease to attack various economically important plants of these families cannot be ignored and should be considered in the disease management strategies.

Table 1: Severity of infection by powdery mildew on plants of Asteraceae in some localities of district Kupwara, Baramulla and Srinagar of Kashmir valley

Locality	C	H	X	Ch	A	Z	T	D	So	Sa
Kupwara										
Kupwara	++	+++*	+++	+	+	+++	++	++	++	+
Handwara	++	+++	+++	+	+	++	+	+	+	+
Langate	+	+	+	+	+	++	+	+	+	-
Qalamabad	+	+	+	+	+	++	++	+	-	-
Baramulla										
Baramulla	+++	++	+++	++	+	+++	+	++	++	++
Sopore	+	+++	++	++	+	+++	+	++	++	++
Pattan	+	++	+	+	+	+	+	+	-	-
Gulmarg	+	++	++	+	+	+	+	++	-	-
Srinagar										
Hazratbal	+++*	+++*	++	++*	-	+++	++	+++	++	++
Nigeen	++	++	++	++	-	+++	++	++	+	+
Nishat	+++	++	+++	+	++	++	++	++	+	+
Shalimar	+++	++	+++	++	++	++	++	+++	+	+

+++ = Heavy infection, ++ = Moderate infection, + = Middle infection, - = No infection, * = Perithecial stage present. C = *Calendula officinalis*, H = *Helianthus annuus*, X = *Xanthium strumarium*, Ch = *Chrysanthemum indicum*, A = *Aster spp.*, Z = *Zinnia elegans*, T = *Taraxacum officinale*, D = *Dahlia variabilis*, So = *Sonchus oleraceus*, Sa = *Sussurea albesenceus*.

Table 2: Severity of infection by powdery mildews on plants of Rosaceae in some localities of district Kupwara, Baramulla and Srinagar of Kashmir valley

Localities	Rd	Rb	Rm	Md	Fv	Fn
Kupwara						
Kupwara	++	++	++	+		+
Handwara	++	++	+	+		+
Langate	+	+	+	+		+
Qalamabad	+	+	+	+		+
Baramulla						
Baramulla	++	++	++	+		+
Sopore	++	++	++	+		+
Pattan	+	+	+	+		+
Gulmarg	++	+	+	-		-
Srinagar						
Hazratbal	+++	+++	+++	+		+
Nigeen	++	++	++	-		-
Nishat	++	++	++	-		-
Shalimar	+++	++	++	+		+

+++ = Heavy infection, ++ = Moderate infection, + = Middle infection, - = No infection, * = Perithecial stage presen. Rd = *Rosa domescena*, Rb = *Rosa brnonii*, Rm = *Rosa macrophylla*, Md = *Malus domestica*, Fv = *Filipendulla vestita*, Fn = *Fragaria nubicula*

Table 3: Incidence of powdery mildews on Asteraceae in some districts of Kashmir valley

Host	Percent disease incidence		
	Kupwara	Baramulla	Srinagar
C	50.00	60.50	65.50
H	80.00	85.50	90.00
X	55.50	60.00	75.00
Ch	22.50	40.00	52.50
A	18.50	22.00	25.50
Z	58.50	70.00	78.00
T	38.50	20.00	32.50
D	40.50	78.50	60.50
So	38.50	30.50	40.00
Sa	20.00	22.50	25.00

C = *Calendula officinalis*, H = *Helianthus annuus*, X = *Xanthium strumarium*, Ch = *Chrysanthemum indicum*, A = *Aster spp.*, Z = *Zinnia elegans*, T = *Taraxacum officinale*, D = *Dahlia variabilis*, So = *Sonchus oleraceus*, Sa = *Sussurea albesenceus*

Table 4: Incidence of powdery mildews on Rosaceae in some districts of Kashmir valley

Host	Percent Disease Incidence		
	Kupwara	Baramulla	Srinagar
Rd	50.50	52.00	65.50
Rb	50.00	48.00	60.00
Rm	48.50	50.00	60.00
Md	10.00	09.00	08.50
Fv	12.00	10.50	10.50
Fn	10.50	12.50	12.50

Rd = *Rosa domescena*, Rb = *Rosa brnonii*, Rm = *Rosa macrophylla*, Md = *Malus domestica*, Fv = *Filipendula vestita*, Fn = *Fragaria nubicula*

Table 5: Morphological studies of conidia of powdery mildew species collected from plants of Asteraceae

Host	Dimensions of conidia(µm)			Shape of conidia	Fibrosin bodies	No. of F/ b per conidium	Shape of germ tube	Powdery mildew species
	Length (r ₁)	Width (r ₂)	Ratio (r ₁ / r ₂)					
Ch	32.5	15.2	2.13	Barrel to ellipsoidal in shape	Absent	-	Germ tube simple with apical germination Appressoria well developed at the tip of the germtube	<i>Erysiphe cichoracearum</i>
A	30.2	15.2	1.98		-	-		
T	35.2	16.5	2.13		-	-		
D	30.5	13.2	2.31		-	-		
So	28.5	15.0	1.90		-	-		
Sa	30.4	14.9	2.04		-	-		
H	32.6	13.6	2.39	Mostly Ovoid or Cylindrical in shape	Present	5-8	Germ tube forked Produced from sidewalls of Conidia, appressoria not developed	<i>Sphaerotheca fuliginea</i>
C	30.4	14.0	2.17		-	4-5		
X	25.8	12.4	2.08		-	6-8		
Z	30.8	15.0	2.05		-	7-8		

C = *Calendula officinalis*, H = *Helianthus annuus*, X = *Xanthium strumarium*, Ch = *Chrysanthemum indicum*, A = *Aster spp.*, Z = *Zinnia elegans*, T = *Taraxacum officinale*, D = *Dahlia variabilis*, So = *Sonchus oleraceus*, Sa = *Sussurea albesenceus*

Table 6: Morphological studies of conidia of Powdery mildew species collected from plants of Rosaceae

Host	Dimensions of conidia(μm)			Shape of conodia	Fibrosin bodies	No. of F/B per conidium	Shape of germ tube	Powdery mildew species
	Length (r_1)	Width (r_2)	Ratio(r_1/r_2)					
Rd	34.6	15.5	2.23	Barrel to ellipsoidal in shape	Present	4-6	Germ tube forked produced from side wall of conidia. Appressoria not well developed	<i>Sphaerotheca fuliginea</i>
Rb	32.5	15.8	2.05		-	4-6		
Rm	32.8	14.6	2.24		-	5-7		
Fv	26.2	10.5	2.49		-	5-6		
Fn	30.4	10.6	2.86		-	4-6		
Md	30.8	10.5	2.93	Cylindrical in shape	Absent	-	Simple with apical germination, Appressoria well developed.	<i>Erysiphe cichoracearum</i>

Rd = *Rosa domescena*, Rb = *Rosa brnonii*, Rm = *Rosa macrophylla*, Md = *Malus domestica*, Fv = *Filipendulla vestita*, Fn = *Fragaria nubicula*

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