MORPHOLOGICAL VARIABILITY IN *MELAMPSORA CILIATA* - THE INCITANT OF POPLAR LEAF RUST

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Introduction

Poplar leaf rust is worldwide occurrence and about 15 species of *Melampsora* are reported to be responsible for this disease. In India, Bakshi and Singh (1961) gave the first record of occurrence of this disease (*M. ciliata* Barclay) on *Populus ciliata*. Subsequent to this, Singh *et al.* (1983) reported that *M. ciliata* is not specific to *P. ciliata* but also attack *P. alba, P. deltoides, P. trichocarpa, P. nigra, P. x euramericana* and *P. yunnanensis*. The disease causes slight to severe damage to these *Populus* species and the pathogen is distributed in between 1500 to 2150 m above mean sea level. Recently, Sharma and Sharma (2000) have reported the distribution of pathogen from 700 to 3150 m above mean sea level and disease intensity upto 85 per cent. Since the pathogen is widely distributed from Shiwalik hills (365-914 m amsl) to dry temperate and cold desert (>2472 m amsl), the present investigations were planned to study the morphological variations in the species with respect to host genotype and climate conditions.

Material and Methods

To study the morphological variations in the pathogen, survey of various Poplar growing areas in ten districts of Himachal Pradesh viz., Solan, Sirmaur, Shimla, Kinnaur, Kullu, Lahaul & Spiti, Mandi, Bilaspur, Hamirpur and Kangra, representing four agroclimatic zones of the State, was conducted from 700-3150 m above mean sea level during the months of August to October. Diseased samples were collected from each location and brought to the laboratory for morphological studies. The morphological characters in respect of urediniospore size were studied with the help of ocular micrometer. Fifty urediniospores selected at random from slides prepared from each sample were measured microscopically and average dimensions and range was worked out.

Results

Information about the morphological variation in Poplar rust pathogen (*M. ciliata*) is lacking. Urediniospore size of *M. ciliata* infecting different *Populus*

species at different locations were compared to know the extent of variability in Poplar leaf rust pathogen (Tables 1 to 5).

The perusal of data (Table 1) shows that there were marked differences in the urediniospore size of *M. ciliata* produced in urediniopustules of *P. ciliata* in different agroclimatic zones. Minimum range of urediniospore size (16.34-25.41 x 12.71 x 18.15 µm) was recorded at Rahla, Kullu (Zone III) with an average urediniospore size of 20.88 x 15.43 µm, which was followed by Kalpa, Kinnaur (Zone IV) and Narkanda, Shimla (Zone III). On contrary to this, maximum range of urediniospore size (25.41-47.19 x 16.34-23.60 µm) was recorded at Raison, Kullu (Zone II) with an average urediniospore size of 36.30 x 19.97 µm. Urediniospores produced in Zone II were longest and had comparatively more width. Mean average size of urediniospores produced in Zone II, III and IV was 33.84

Table 1

Variation in urediniospore size of Melampsora ciliata on Populus ciliata from different locations

Zone	District/ Location	Altitude (m amsl)	Urediniospore size (µm)		Mean
			Range	Average	
II	Solan :				
	Nauni	1300	21.78-43.56 x 12.71-18.15	32.67 x 15.43	
	Shilly	1500	32.67-39.93 x 14.52-19.67	36.30 x 17.10	
	Barog	1600	25.41-39.93 x 10.89-18.15	32.67 x 14.52	
	Sirmaur				
	Neri Kotli	1520	21.78-43.56 x 10.89-18.15	32.67 x 14.52	
	Shimla				
	Nirath	945	23.60-36.30 x 10.89-18.15	29.95 x 14.52	
	Kullu				
	Kullu	1220	25.41-47.19 x 10.89-21.78	36.30 x 16.34	
	Raison	1400	25.41-47.19 x 16.34-23.60	36.30 x 19.97	33.84 x 16.06
III	Kullu :				
	Manali	2050	29.04-39.93 x 14.52-18.15	34.49 x 16.34	
	Rahla	2800	16.34-25.41 x 12.71-18.15	20.88 x 15.43	
	Shimla				
	Sarahan	1926	29.04-36.30 x 12.71-18.15	32.67 x 15.43	
	Sandhu	2475	27.23-36.30 x 10.89-18.15	31.77 x 14.52	
	Fagu	2550	21.78-36.30 x 14.52-21.78	29.04 x 18.15	
	Narkanda	2708	16.34-36.30 x 10.89-18.15	26.32 x 14.52	29.20 x 15.73
IV	Kinnaur :				
	Reckong	2290	25.41-47.19 x 12.71-21.78	36.30 x 17.24	
	Peo				
	Kalpa	2960	18.15-32.67 x 10.89-14.52	25.41 x 12.71	
	Lahaul & Spiti :				
	Sissoo	3130	18.15-43.56 x 10.89-16.34	30.86 x 13.62	30.86 x 14.52

Table 2

Variation in urediniospore size of Melampsora ciliata on Populus deltoides from different locations

Zone	District/ Location	Altitude (m amsl)	Urediniospore size (µm)		Mean
			Range	Average	
I	Solan :				
	Parwanoo	700	18.15-43.56 x 7.26-14.52	30.86 x 10.89	
	Bilaspur :				
	Barmana	700	25.41-36.30 x 14.52-25.41	30.86 x 19.97	
	Thoru	875	18.15-36.30 x 10.89-19.97	27.23 x 15.43	
	Hamirpur				
	Bhota	700	26.25-41.25 x 14.77-20.63	33.75 x 17.70	30.68 x 15.99
II	Solan :				
	Jabli	1156	18.15-43.56 x 7.26-14.52	30.86 x 10.89	
	Dharampur	1210	18.15-39.93 x 9.08-14.52	29.04 x 11.80	
	Nauni	1300	13.09-39.27 x 13.09-16.36	26.18 x 14.73	
	Shilly	1500	26.18-32.73 x 13.09-16.36	29.46 x 14.73	
	Barog	1600	18.15-36.30 x 10.89-18.15	27.23 x 14.52	
	Sirmaur :				
	Yashwant Nagar	1200	18.15-36.30 x 10.89-18.15	27.23 x 14.52	
	Ratoli	1350	18.15-36.30 x 10.89-18.15	27.23 x 14.52	
	Rajgarh	1400	21.78-36.60 x 10.89-18.15	27.23 x 14.52	
	Mandi :				
	Mandi	950	21.78-41.75 x 14.52-19.97	31.77 x 17.25	
	Pandoh	1035	18.15-43.56 x 14.52-19.97	30.86 x 17.25	
	Aut	1050	18.15-41.75 x 12.71-21.78	29.95 x 17.25	
	Jadol	1125	18.15-43.56 x 10.89-18.15	30.86 x 14.53	
	Sunder Nagar	1175	25.41-38.12 x 12.71-18.15	31.77 x 15.43	29.21 x 14.76
III	Sirmaur :				
	Chichrighat	1700	21.76-39.93 x 9.08-14.52	30.86 x 11.80	
	Shimla :				
	Shoghi	1790	29.04-47.19 x 14.52-18.15	38.12 x 16.34	34.49 x 14.07

x 16.06 µm, 29.20 x 15.73 µm and 30.86 x 14.52 µm, respectively.

Variations in the length and width of urediniospores produced in urediniopustules of *P. deltoides* in different agroclimatic conditions were observed (Table 2). Minimum range of urediniospore size (13.09-39.27 x 13.09-16.36 µm) with an average size of 26.18 x 14.73 µm was recorded at Nauni (Zone II). On the other hand, maximum range of urediniospore size (29.04-47.19 x 14.52-18.15 µm) with an average size of 38.12 x 16.34 µm was recorded at Shoghi (Zone III). In general, irrespective of zone, urediniospore size

Table 3

Variation in urediniospore size of Melampsora ciliata on Populus nigra from different locations

Zone	District/ Location	Altitude (m amsl)	Urediniospore size (µm)		mean
			Range	Average	
II	Kullu :				
	Bajaura	1097	27.23-43.56 x 14.52-16.34	35.40 x 15.43	
	Kullu	1220	21.78-41.75 x 10.89-21.78	31.77 x 16.34	
	Raison	1400	18.15-39.93 x 10.89-18.15	29.04 x 14.52	
	Kinnaur :				
	Jhakri	1280	21.78-36.30 x 10.89-16.34	29.04 x 13.62	31.31 x 14.98
III	Kullu :				
	Manali	2050	23.60-39.93 x 12.71-23.60	31.77 x 18.16	
	Kinnaur :				
	Bhawa	1624	25.41-43.56 x 14.52-21.78	34.49 x 18.15	
	Nagar				
	Tapri	1850	29.04-43.56 x 10.89-18.15	36.30 x 14.52	34.19 x 16.94
IV	Kinnaur :				
	Aakpa	2238	21.78-47.19 x 10.89-18.15	34.49 x 14.52	
	Moorang	2276	21.78-45.38 x 14.52-18.15	33.58 x 16.34	
	Reckong	2290	21.78-47.19 x 12.71-18.15	34.49 x 15.43	
	Peo				
	Lahaul & Spiti :				
	Sissoo	3130	21.78-47.19 x 14.52-18.15	34.49 x 16.34	34.26 x 15.66

ranged from 13.09-47.19 x 7.26-25.41 µm. The data further shows that urediniospores produced in Zone II had comparatively small length (29.21 µm). Urediniospores produced in Zone III were longest (34.49 µm) but width was minimum (14.07 µm). On the other hand, urediniospores produced in Zone I had more width (15.99 µm).

The perusal of data (Table 3) reveals that climatic conditions prevailing in different zones influenced the urediniospore size of *M. ciliata* produced in pustules of *P. nigra*. In general, urediniospore size ranged from 18.15-47.19 x 10.89-23.60 µm. Minimum range of urediniospore size (18.15-39.93 x 10.89-18.15 µm) with an average size of 29.04 x 14.52 µm was recorded at Raison (Zone II). On the other hand, maximum range (29.04-43.56 x 10.89-18.15 µm) with an average size of 36.30 x 14.52 µm was recorded at Tapri (Zone III). The data further depicts that urediniospores produced in Zone IV was larger in size (34.26 x 15.66 µm) while those produced in Zone II were smaller (31.31 x 14.98 µm).

Variations in the urediniospore size of *M. ciliata* produced on *P. alba* under cold desert conditions (Zone IV) are presented in Table 4. Size of urediniospores ranged

Table 4

Urediniospore size of Melampsora ciliata on Populus alba from different locations in zone IV of Himachal Pradesh

District/ Location	Altitude (m amsl)	Urediniospore size (µm)		Mean
		Range	Average	
Kinnaur :				
Spillo	2246	14.52-25.41 x 10.89-19.97	19.97 x 15.43	
Reckong Peo	2290	18.15-25.41 x 14.52-21.78	21.78 x 18.15	20.88 x 16.79

Table 5

Comparative urediniospore size of Melampsora ciliata on Populus species under different agroclimatic zones

Zone	Urediniospore size (µm)			
	P. ciliata	*P. deltoides*	*P. nigra*	*P. alba*
I	-	30.68 x 15.99	-	-
II	33.84 x 16.06	29.21 x 14.76	31.31 x 14.98	-
III	29.20 x 15.73	34.49 x 14.07	34.19 x 16.94	-
IV	30.86 x 14.52	-	34.26 x 15.66	20.88 x 16.79

- = Host species not found

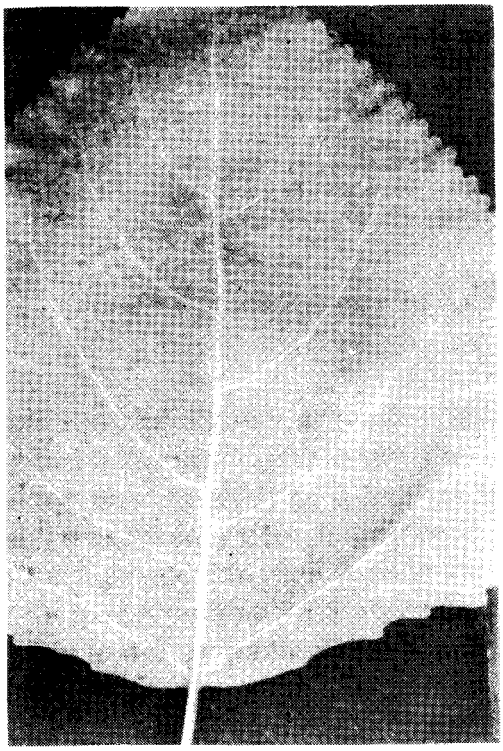
from 14.52-25.41 x 10.89-21.78 µm and smaller urediniospores were produced at Spillo (19.97 x 15.43 µm) as compared to Reckong Peo (21.78 x 18.15 µm). The mean spore size was 20.88 x 16.79 µm.

When spore size of *M. ciliata* was compared *Populus* species and zone wise, it was found that on *P. ciliata* larger spores were produced under Zone II (33.84 x 16.06 µm) and IV (30.86 x 14.52 µm) conditions, on *P. deltoides* in Zone III (34.49 x 14.07 µm) while on *P. nigra* in Zone IV (34.26 x 15.66 µm) and III (34.19 x 16.94 µm). On *P. alba*, smallest spores were produced (Table 5).

Discussion

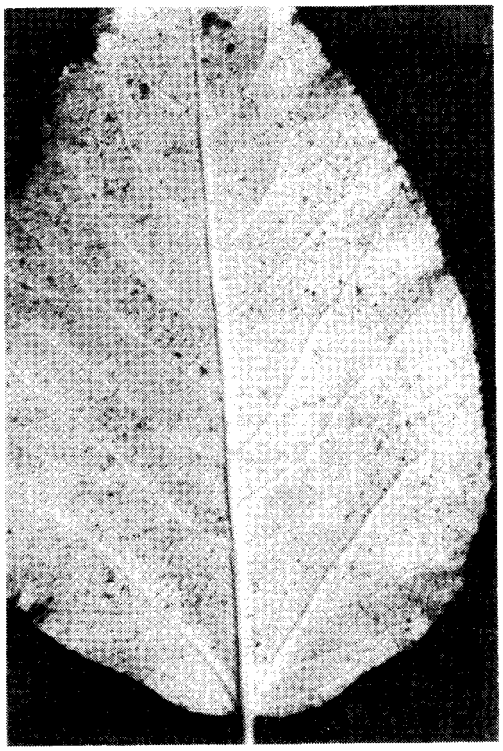
Variation in the dimensions of urediniospores of *M. ciliata* harvested from different Poplar species grown under different environmental conditions has been observed in the present investigations. Smallest urediniospores (20.88 x 15.43 µm) produced on *P. ciliata* were recorded at Rahla (Zone III) while largest (36.30 x 19.97 µm) were recorded at Raison (Zone II). Spores produced on *P. deltoides* and *P. nigra* were smaller in size at Nauni and Raison (Zone II), while larger spores on these species were recorded at Shoghi and Tapri (Zone III). Spores produced in

Fig. 1



Uredinio postules of *M. ciliata* on the adaxial surface of *P. deltoides* leaf

Fig. 2



Urediniospores of *M. ciliata* on the adaxial surface of *P. ciliata* leaf

pustules of *P. alba* at Spillo were smaller as compared to those produced at Reckong Peo. Irrespective of the Poplar genotype and zone, smallest spores were produced on *P. alba*. The distribution of the fungus on different Poplar species and under wide range of environment conditions probably indicates that *M. ciliata* possesses formae speciales and races which can flourish at low as well as at high temperatures or it is composed of many biological races that cannot be separated morphologically. Therefore, epidemic outbreaks attributed to new races could be expected. These studies are in agreement with earlier workers who reported variation in urediniospore size of *M. medusae* on different Poplar clones and species (Kraayenoord *et al.*, 1974; Schipper and Dawson, 1974; Sharma and Heather, 1977).

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SUMMARY

Variation in the dimensions of urediniospores of *Melampsora ciliata* harvested from different Poplar species grown under different environmental conditions has been observed in the present investigations. Smallest urediniospores (20.88 x 15.43 µm) produced on *P. ciliata* were recorded at Rahla (Zone III) while largest (36.30 x 19.97 µm) were recorded at Raison (Zone II). Urediniospores produced on *P. deltoides* and *P. nigra* were smaller in size at Nauni and Raison (Zone II), while larger spores on these species were recorded at Shoghi and Tapri (Zone III). Spores produced in pustules of *P. alba* at Spillo were smaller as compared to those produced at Reckong Peo. Irrespective of the host genotype and climatic zone, smallest urediniospores were produced on *P. alba*.

पोपलर में पर्णगेरिक रोग प्रेरक *मेलाम्पसोरा सिलियाटा* की रचनाकारिकीय विभिन्नीयता

संजीव शर्मा, आर०सी० शर्मा व जे०एन० शर्मा

सारांश

विभिन्न पर्यावरण दशाओं में उग रही भिन्न-भिन्न पोपलर जातियों से निकाले गए *मेलाम्पासोरा सिलियाटा* के निदाघ बीजाणुओं के आयाम में मिलने वाली विभिन्नताओं का प्रस्तुत अन्वेषण में प्रेक्षण किया गया । सबसे छोटे निदाघबीजाणु (20.88 x 15.43 माइक्रो मी०) *पो० सिलियाटा* पर बनते रहला (क्षेत्र III) से अभिलिखित हुए जबकि सबसे बड़े (36.30 x 19.97 माइक्रो मी०) रायसन (क्षेत्र III) से मिले । *पो० डेल्टायडिस* और *पो० नाइग्रा* पर बने निदाघबीजाणु नौनी और रायसन (क्षेत्र III) में आकार में छोटे रहे जबकि इन्हीं वृक्षजातियों पर बने बड़े बीजाणु शोधी और टपरी (क्षेत्र III) से अभिलिखित किए गए । स्पिलों में *पो० एल्बा* की पिंडिका पर बने बीजाणु रेकांग पिओ में बने बीजाणु से आकार में छोटे पाए गए । पोषी समपित्रक और जलवायु क्षेत्रों को अमान्य करते हुए सबसे छोटे निदाघबीजाणु *पो० एल्बा* पर बने ।

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