VARIABILITY IN UREDINIOPUSTULE AND UREDINIOSPORE SIZE OF *MELAMPSORA CILIATA* ON POPLAR GENOTYPES

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Introduction

Poplar leaf rust is of worldwide occurrence and is responsible for early defoliation, reduction in diameter, height, dry weight (20--32%), volume (31-42%) and failure of trees to harden off properly (Peace, 1952; Wilcox and Farmer, 1967; Widin and Schipper, 1981). In India, the disease was first recorded on *Populus ciliata* Wall. ex. Royle, an indigenous species (Bakshi and Singh, 1961) and subsequently on *P. alba* L., *P. deltoides* Bartr, *P. trichocarpa* Torr. & Gray, *P. nigra* L., *P. x euramericana* (Dode) Guinar and *P. yunnanensis* Dode (Singh *et al.,* 1983). The disease is widely distributed between 700-3130 m a.m.s.l. in Himachal Pradesh and average disease severity in the state is 32.45 % (Sharma and Sharma, 2000; Sharma *et al.,* 2001). Variations in the dimensions of urediniospores of *Melampsora ciliata* Barclay have been observed under different agro-climatic conditions of Himachal Pradesh (Sharma *et al*., 2001). Due to widespread distribution of the pathogen in all the agro-climatic zones of Himachal Pradesh and higher disease intensity, it has become essential to study the variation in urediniopustule and urediniospore size of *M. ciliata* on poplar genotypes and therefore, present investigations were undertaken.

Material and Methods

To study the variability in respect of *M. ciliata* urediniopustule size in different species/hybrids/clones of poplar grown in Nauni nursery (1,300 m asl) of Y.S. Parmar University of Horticulture and Forestry, size (diameter) of at least 50 pustules selected at random from each sample was measured either directly or by measuring the size of chlorotic area on upper surface corresponding to the pustules and average pustule size and range were worked out. The morphological characters in respect of urediniospore size were studied with the help of ocular micrometer. Fifty urediniospores from each pathosystem were selected at random and measured microscopically (400X) and average dimensions and range was worked out.

Results

Information about the variability in urediniopustule and urediniospore size of poplar rust pathogen is lacking. Urediniopustule and urediniospore size of *M. ciliata* produced on different species/ hybrids/clones were compared to know the extent of variability in the rust pathogen (Tables 1 and 2).

Perusal of data (Table 1) shows that

Table 1

Variability in pustule and urediniospore size of Melampsora ciliata on different Populus species/cultivars.

Sl. No.	*Populus* species/cultivars	Pustule size (mm)		Urediniospore size (μm)	
		Range	Average	Range	Average
1	*P. yunnanensis*	0.38-2.30	1.34	13.1-39.3 x 13.1-15.1	26.2 x 14.1
2	*P. deltoides* 'G48'	0.25-0.56	0.41	26.2-32.7 x 13.1-16.4	29.5 x 14.7
3	*P. deltoides* '19'	0.25-1.00	0.63	13.1-39.3 x 13.1-16.4	26.2 x 14.7
4	*P. deltoides* 'Lux'	0.06-0.70	0.38	29.0-38.1 x 14.5-18.2	33.6 x 16.3
5	*P. x euramericana* 'Eugeni K'	0.06-1.00	0.53	26.2-36.0 x 13.1-19.6	31.1 x 16.4
6	*P. x euramericana* 'Rubra-Poiret'	0.50-1.00	0.63	26.2-32.7 x 9.8-13.1	29.5 x 11.5
7	*P. x euramericana* 'Robusta AE'	0.25-1.00	0.63	19.6-32.7 x 13.1-13.1	26.2 x 13.1

Table 2

Variation in pustule and urediniospore size of Melampsora ciliata in different Populus ciliata clones/hybrids.

Sl. No.	Clone/hybrid	Pustule size (mm)		Urediniospore size (μm)	
		Range	Average	Range	Average
1	2	3	4	5	6
Clones :					
1	Chopal-1	0.06-0.49	0.28	25.4-39.9 x 12.7-20.0	32.7 x 16.3
2	Chhatrari	0.06-1.73	0.90	21.8-43.6 x 12.7-18.2	32.7 x 15.4
3	Madhoni	0.25-0.70	0.48	32.7-39.9 x 14.5-19.7	36.3 x 17.1
4	Nagni-2	0.06-1.25	0.66	18.2-43.6 x 14.5-18.2	30.86 x 16.3
Hybrids :					
1	CM2-26	0.25-1.00	0.63	25.4-36.3 x 14.5-20.0	30.9 x 17.3
2	6M1	0.06-0.40	0.23	29.0-32.7 x 14.5-20.0	30.9 x 17.3
3	CM2-60	0.36-1.00	0.68	27.2-36.3 x 12.7-18.2	31.8 x 15.4
4	390M1	0.06-0.50	0.28	29.0-38.1 x 12.7-21.8	33.6 x 17.3
5	CM2-10-7/91	0.30-1.00	0.65	21.8-36.3 x 14.5-20.0	29.0 x 17.3
6	CM2-39	0.28-1.00	0.64	29.0-36.3 x 14.5-20.0	32.7 x 17.3
7	84M1	0.49-1.10	0.80	29.0-36.3 x 12.7-18.2	32.7 x 15.4

Contd...

1	2	3	4	5	6
8	CM2-95	0.06-0.60	0.33	29.0-34.5 x 14.5-25.4	31.8 x 20.0
9	CM2-4-15/91	0.25-0.50	0.38	29.0-36.3 x 10.9-18.2	32.7 x 14.5
10	CM1-8	0.06-1.00	0.80	23.6-32.7 x 12.7-18.2	28.1 x 15.4
11	59M1	0.25-1.00	0.63	25.4-39.9 x 14.5-20.0	32.7 x 17.3
12	53M1	0.06-0.25	0.16	21.8-32.7 x 12.7-18.2	27.2 x 15.4
13	CM2-13	0.16-1.00	0.58	18.2-39.9 x 10.9-21.8	29.0 x 16.3
14	CM2-5-20/91	0.25-0.70	0.48	21.8-36.3 x 14.5-21.8	29.0 x 18.2
15	CM2-84	0.25-1.15	0.70	25.4-41.8 x 12.7-21.8	33.6 x 17.3
16	112M1	0.25-1.00	0.63	18.2-39.9 x 14.5-23.6	29.0 x 19.1
17	CM2-14-10/91	0.25-1.00	0.63	18.2-36.3 x 16.5-18.2	27.2 x 17.4
18	64M1	0.06-0.70	0.38	29.0-43.6 x 12.7-21.8	36.3 x 17.3
19	30M2	0.06-0.50	0.28	30.9-39.9 x 12.7-20.0	35.4 x 16.3
20	2M2	0.13-1.00	0.57	25.4-43.6 x 12.7-20.0	34.5 x 16.3
21	M1xPC(1-3)	0.06-1.00	0.53	32.7-36.3 x 14.5-20.0	34.5 x 17.3

there were marked differences in the urediniopustule and urediniospore size of *M. ciliata* produced on different *Populus* species/cultivars. Smallest urediniopustules (average 0.38 mm) were produced on *P. deltoides* 'Lux' while range was 0.06 to 0.70 mm. Largest urediniopustule size was recorded in *P. yunnanensis* (average 1.34 mm) with range of 0.38 to 2.30 mm. Irrespective of species/cultivars, urediniopustule size ranged from 0.06 to 2.30 mm. The data also reveals variation in urediniospore size. Largest uredinio-spores spores measuring 33.6 x 16.3 μm were recorded on *P. deltoides* 'Lux' with a range of 29.0 - 38.1 x 14.5 - 18.2 μm. The least urediniospore size (26.2 x 13.1 μm) was recorded on *P x euramericana*. 'Robusta AE' with a range of 19.6 - 32.7 x 13.1 - 19.6 μm. Irrespective of species/cultivars, urediniospore size ranged from 13.1 - 39.3 x 13.1 - 19.6 μm. The host genotypes having largest urediniopustule size had smaller urediniospores and reverse is also true.

Variability in urediniopustule and urediniospore size of *M. ciliata* developed in *P. ciliata* clones and hybrids was also studied and data are presented in Table 2. Smallest urediniopustules were produced in hybrid 53M1 having average urediniopustule size 0.16 mm with a range of 0.06 to 0.25 mm. Hybrid 6M1 having average urediniopustule size of 0.23 mm with a range of 0.06 to 0.40 mm follows it. On the other hand, largest urediniopustules were produced on clone Chhatrari, which had an average pustule size of 0.90 mm while the range was 0.06 to 1.73 mm. The average urediniopustule size of *P. ciliata* clones varied from 0.16 to 0.80 mm. Sallest urediniospores (27.2 x 15.4 μm) were recorded in hybrid 53M1 with a range of 21.8 - 32.7 x 12.7 - 18.2 μm while largest urediniospores were recorded in 64M1 (36.3 x 17.3 μm) with a range of 29.0 - 43.6 x 12.7 - 21.8 μm. Irrespective of the clone/ hybrid, the urediniospore size ranged from 18.2 - 43.6 x 10.9 - 23.6 μm. The average urediniospore size of *M. ciliata* produced on *P. ciliata* clones ranged from 30.9 - 36.3 x 15.4 - 17.1 μm while that on *P. ciliata* hybrids ranged from 27.2 - 36.3 x 14.5 - 20.0 μm.

Discussion

Variations in the size of urediniopustules and urediniospores of *M. ciliata* produced on different species/ cultivars/ clones/ hybrids of poplar has been observed in the present investigation. Urediniopustule size has a role in the production of urediniospores per uredinium and thereby affects the development of an epidemic. There is no precise information available on the potential of individual uredinium to produce urediniospores throughout the course of an epidemic. Smaller urediniopustules were recorded on *P. deltoides* 'Lux' (0.38 mm) while largest were recorded on *P. yunnanensis* (1.34 mm), which was infected late in the season. On *P. ciliata* clones and hybrids, minimum urediniopustule size was recorded on 53M1 (0.16 mm) while maximum on Chhatrari (0.90 mm). This variation in the urediniopustule size may be ascribed to the differences in the initiation of the disease as at the start of epidemic from primary inoculum, the pustules appear bigger compared to those developed towards the end of the epidemic, results in increased density of urediniopustules per unit area, causes reduced pustule size. Changes in the environment during the epidemic may also affect urediniopustule size. No report is available in literature on the production of variable size of urediniopustules by *Melampsora* species on the same host. However, variation in the size of uredinia produced by different species of *Melampsora* has been reported by Bagyanarayana and Ramachar (1984) in case of *M. cumminsii* Bagyanarayana & Ramachar and *M. osmaniensis* Bagyanarayana & Ramachar infecting *Populus* sp. and *P. sieboldii* Miq., respectively. Variation in the urediniospore size produced in pustules of *Populus* species/cultivars/clones/hybrids was also observed. Largest spore size (33.6 x 16.3 μm) was recorded on *P. deltoides* 'Lux' while smallest on *P. x euramericana* 'Robusta AE'. In case of *P. ciliata* hybrids/clones, smallest urediniospores were recorded in 53M1 while largest in 64M1. The distribution of the fungus on different poplar species/cultivars/clones/hybrids probably indicates that *M. ciliata* 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* Thuem. (Kraayenoord *et al.,* 1974; Schipper and Dawson, 1974; Sharma and Heather, 1977) and *M. ciliata* (Sharma *et al.,* 2001) on different poplar species and clones under wide range of environmental conditions.

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SUMMARY

Variation in the dimensions of urediniopustules and urediniospores of *Melampsora ciliata* produced on different poplar species/cultivars/clones/hybrids has been observed in the present investigations. Smallest urediniopustules were produced on *P. deltoides* 'Lux' (0.38 mm) while largest on *P. yunnanensis* (1.34 mm). In *P. ciliata* clones/hybrids, smallest urediniopustules were

recorded in 53M1 (0.16 mm) while largest in Chhatrari (0.90 mm). Largest spore size (33.6 x 16.3 µm) was recorded on *P. deltoides* 'Lux' and 64M1 (36.3 x 17.3 µm) while smallest on *P. x euramericana* 'Robusta AE' and 53M1. Irrespective of species/cultivars, urediniospore size ranged from 13.1-39.3 x 13.1- 19.6 µm. The average urediniospore size of *M. ciliata* produced on *P. ciliata* clones ranged from 30.8 -36.3 x 15.4 - 17.1 µm while that on hybrids from 27.2 - 36.3 x 14.5 - 20.0 µm.

पोपलर समपित्रैकों के *मेलाम्पसोरा सिलियाटा* की निदाघपिडिका और निदाघबीजाणु के आकारों की विभिन्नीयता

संजीव शर्मा, आर०सी० शर्मा व ए०के० गुप्त

सारांष

विभिन्न पोपलर जातियों/कृषिकृत विभेदों/कृन्तकों/संकरों पर बनने वाले *मेलाम्पसोरा सिलियाटा* की निदाघपिडिकाओं और निदाघबीजाणुओं के आकारों में मिलने वाले अन्तर को प्रस्तुत अन्वेषण में पर्यवेक्षित किया गया है। सबसे छोटी निदाघपिडिकाएं *पा० डेल्टायडिस* लुक्स में (0.38 मिमी) बनी जबकि सबसे बड़ी *पा० युन्नानेंसिस* में (1.34 मिमी) बनती पाई गई। *पा० सिलियाटा* कृन्तकों/संकरों में सबसे छोटी निदाघपिडिकाएं 53 एम 1 में (0.16 मिमी) आलेखित की गई जबकि बड़ी निदाघपिडिकाएं छत्रारी (0.90 मिमी) में देखी गई। सबसे बड़ा बीजाणु आकार (33.6 x 16.3 µमी) *पा० डेल्टायडिस* 'लुक्स' और 64 एम 1 (36.3 x 17.3 µमी) में आलेखित किया गया, जबकि सबसे छोटा *पा0 x यूरामेरिकाना,* रोबस्टा एई और 53 एम 1 मिला। जाति/कृषिकृत विभेद पर ध्यान न देते हुए, निदाघबीजाणु का आकार 13.1 - 39.3 x 13.1 - 19.6 µ मी तक की सीमा में रहता पाया गया। *पा० सलियाटा* कृन्तकों पर बने *मे० सिलियाटा* का औसत निदाघबीजाणु का आकार 30.8 - 36.3 x 15.4 - 17.1 µ मी की परिसीमा में रहता पाया गया जबकि संकरों में यह परिसीमा का 27.2 - 36.3 x 14.5 - 20.0 µ मी रहती पाई गई।

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