Morphological Variability in Teliospores of *Puccinia penniseti*

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(Received 22 January 1973; revised 23 March 1973)

**SUMMARY**

Pure-line isolates of *Puccinia penniseti* Zimm. collected from various localities were induced to develop telia by growing infected plants of *Pennisetum typhoides* Stapf and Hubb. Telia developed not only normal two-celled teliospores but also occasionally one- and three-celled and rarely four- and five-celled teliospores. The shape and size of teliospores varied considerably in one-, two- and three-celled teliospores. Three morphological forms of *Puccinia penniseti* have been distinguished on the basis of this variability.

**INTRODUCTION**

Spore characteristics have been extensively used in fungi to distinguish different morphological forms of a pathogen. Stakman, Piemeisal & Levine (1919) noted considerable differences in the morphology of urediospores of wheat rust. Dalela & Sinha (1957) studied urediospore characters of *Puccinia penniseti* and found three distinct morphological forms of the pathogen. The use of urediospores in determining morphological forms in rust fringe is quite common, apparently because of the relative ease with which they can be obtained. In contrast, it is not always possible to get plentiful teliospores and hence these are less frequently employed in the recognition of morphological forms. In this study, morphological characteristics of teliospores of *Puccinia penniseti* Zimm., the fungus causing rust disease in *Pennisetum typhoides* Stapf and Hubb., have been studied with a view to determining the presence of morphological forms of the pathogen.

**METHODS**

Specimens of fresh uredial materials were collected from different localities around Agra (north) and Coimbatore (south), India. Single spore isolates of these were multiplied on *Pennisetum typhoides* var. Agra local. Development of telia was induced by growing plants in a greenhouse during the colder months of November to February, when they developed telia rapidly (Kapooria, 1970). The telia were scraped from infected tissue and teased in a drop of water on a microscope slide. One hundred random observations were made of each isolate. The significance of measurements was determined at the 5% probability level. Camera-lucida drawings of unusual teliospores were also made.

**RESULTS**

*Teliospore septation.* Puccinia species usually produce two-celled teliospores. Table 1 shows that teliospores developing in a sorus were sometimes also one- and three-celled.
Fig. 1. Different types of teliospores of *Puccinia penniseti* Zimm. (a–i) One-celled teliospores; (j–o) two-celled teliospores; (p–v) three-celled teliospores; (w–x) four- and five-celled teliospores respectively.

Four- and five-celled teliospores were observed infrequently. The chances of appearance of one- and three-celled teliospores in a sorus are the same. Fig. 1 shows the variety of shapes that teliospores of *Puccinia penniseti* exhibited.

*Measurements of various dimensions in two-celled teliospores.* The various dimensions of teliospores varied considerably (Table 2).

*Measurements of various dimensions in one- and three-celled teliospores.* The means of various dimensions of one- and three-celled teliospores varied in different rust isolates. The mean length and width in one-celled teliospores varied from 35.9 to 51.6 and 17.4 to 51.6 μm
Teliospores of *P. pennisetii*

Table 1. Distribution of one-, two-, three-, four- and five-celled teliospores observed in different isolates of *Puccinia pennisetii* Zimm

<table>
<thead>
<tr>
<th>Isolate</th>
<th>1-Celled</th>
<th>2-Celled</th>
<th>3-Celled</th>
<th>4-Celled</th>
<th>5-Celled</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>93</td>
<td>4</td>
<td>0</td>
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<td>100</td>
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<tr>
<td>2</td>
<td>2</td>
<td>96</td>
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<td>0</td>
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<tr>
<td>3</td>
<td>6</td>
<td>81</td>
<td>11</td>
<td>1</td>
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<tr>
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<td>0</td>
<td>96</td>
<td>4</td>
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<td>9</td>
<td>90</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2. Measurements (in μm) and length/width (l/w) ratios of two-celled teliospores in different isolates of *Puccinia pennisetii* Zimm (mean of 100 observations)

<table>
<thead>
<tr>
<th>Factors</th>
<th>Isolates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Length</td>
<td>68.2</td>
</tr>
<tr>
<td>Width</td>
<td>22.4</td>
</tr>
<tr>
<td>Wall thickness</td>
<td>1.1</td>
</tr>
<tr>
<td>Pedicel length</td>
<td>11.2</td>
</tr>
<tr>
<td>Apex thickness</td>
<td>6.7</td>
</tr>
<tr>
<td>l/w ratio</td>
<td>3.0</td>
</tr>
</tbody>
</table>

* Judged not significantly different from each other at 5% level.

respectively, and the same dimensions in three-celled teliospores varied from 59.9 to 86.2 and 22.6 to 32.4 μm respectively. Other dimensions, such as wall thickness, pedicel length, and apex thickness, also varied in one- and three-celled teliospores.

**Discussion**

Three distinct morphological forms of *Puccinia pennisetii* have been identified on the basis of the present observations. Ramakrishanan & Sundaram (1956) distinguished two races of *P. pennisetii* based upon their studies on materials occurring in nature. Dalela & Sinha (1958, 1959) indicated the presence of specialization but failed to identify the races. Later work of Dalela & Sinha (1962) showed *P. pennisetii* to be homothallic. The production of new races of the pathogen by hybridization would thus be ruled out. Since several additional causes of variability in pathogens, especially in rust fungi, have been suggested (Christensen, 1961), physiological as well as morphological forms of *P. pennisetii* might arise in a variety of ways. Dalela & Sinha (1957) identified three distinct morphological forms of *P. pennisetii* on the basis of biometric variations of urediospores.

That teliospores can also constitute a reliable basis for the distinction of morphological forms of rust genera is indicated by Guyot (1938, 1945), Guyot, Massenot, Montegut & Saccus (1948) and Savile & Corners (1951). Size as well as shape variations have been found to be useful taxonomic criteria (Warren, 1898; Hume, 1899; McAlpine, 1906; Taubenhaus, 1911; and Arthur 1929). Such variations in size and shape of spores occur not only in geographically isolated collections but also within the same sorus (Baxter, 1955). The presence of one- and more-celled teliospores in *Puccinia pennisetii* is not remarkable; Benada (1960) has reported the presence of multicellular teliospores in stem rust of wheat.
where they occur with normal spores in some pustules and alone in others, and abnormal
teliospores have also been reported by Payak (1962) in \textit{P. thwaitesii}.

The causes of abnormality in teliospores are unknown, though Arthur (1929) advanced
several explanations. That the abnormal teliospores constitute accidental structures without
any genetical significance is difficult to substantiate at present. There is some evidence to
suggest that certain isolates of \textit{Puccinia penniseti} have an intrinsic ability to produce more
abnormal teliospores than others.

I am indebted to Professor S. Sinha, Principal, Agra College, Agra, India, for suggesting
the problem, and to Dr S. N. Bhardwaj, Plant Physiologist, Indian Agricultural Research
Institute, New Delhi, India for help in statistical analysis of the data.

\textbf{REFERENCES}

Ldt.


14, 145–147.


Congress} 3 (Abstr.), 338.

function of pycnia. \textit{Indian Phytopathology} 15, 156–161.


penniseti}. \textit{Plant Disease Reporter} 54, 646–647.


Indian Academy of Sciences}, B 3, 190–196.

43, 186–195.


Taubenhaus, J. (1911). A contribution to our knowledge of the morphology and life history of \textit{Puccinia
malvacearum} Mont. \textit{Phytopathology} 1, 55–62.

Warren, J. A. (1898). Note on the variations in the teleutospores of \textit{Puccinia windsoriae}. \textit{American Naturalist}
32, 779–781.