

Rust Fungi on New Zealand Clematis.

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Abstract

Puccinia alboclava n.sp. is microcyclic and known only from seedlings of *Clematis indivisa*. It differs from *P. clavata* Syd. in having smaller, thinner-walled, unpigmented teleutospores and in forming lesions that are pale in colour. *P. clavata* is also microcyclic, and differentiated into physiologic races, a form from *C. hexasepala* being able to cross to *C. indivisa* while one on *C. foetida* could not. The uredospore stage previously attributed to *P. clavata* is described as *Uredo puauhananga* n.sp. Pyrenospores and aecidiospores of *Aecidium otagense* Linds. cannot infect *Clematis*. Species which have been tested unsuccessfully as possible alternate hosts of this fungus are *Danthonia cunninghamii*, *Poa astoni*, *Uncinia australis*, Cross 7 Wheat and I.A.B. ryecorn.

Puccinia alboclava n.sp.

Microcyclica et sine spermagoniis. Teleutosori hypophylli, in maculis vix incrassatis usque ad 1 cm. latis insidentes, nudi, pulvinati, in singulos usque ad 25 mm. lati sed trans aliquantum maculorum confluentes, isabellini vel mellini. Teleutosporeae hyalinae, formibus diversis, 26–54 μ longae, 11–18 μ latae (medie 41 μ x 12 μ), episporio levi, plerumque tantum 1 μ crasso, interdum apice usque ad 2 μ incrassato, pedicello brevi.

HABITAT. In foliis plantae juvenilis *Clematidis indivisae*.

HOLOTYPE. Mt. Maungatua, Otago, New Zealand, 1,300ft., coll. G. T. S. Baylis 9/7/1950, in herbario Plant Diseases Division, Auckland, No. 12685.

PARATYPES. Mt. Hauhangitahi, Volcanic Plateau, S. D. Baker 1/1954, P.D.D. No. 12894; Steep Hill, Merton, Otago, 800ft., Baylis 11/6/1953, O.U. No. 908; Swampy Spur, Dunedin, 1,500ft., Baylis 6/12/1950, O.U. No. 910; Maungatua, Otago, 1,200–1,500ft., Baylis 31/3/1953, O.U. No. 905.

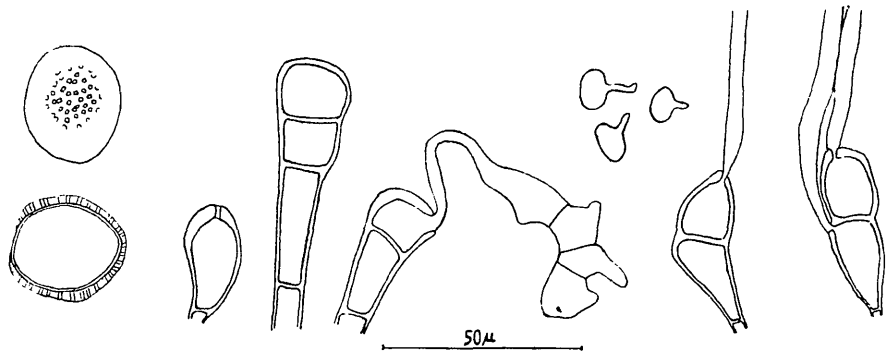


FIG. 1.—Uredospores of *Uredo puauhananga* (left), teleutospores, epibasidium and germinating basidiospores of *Puccinia alboclava* (right).

Puccinia alboclava has been found only upon the soft leaves of *Clematis indivisa* seedlings in the interior of moist montane forests. At present it is known from the vicinity of Dunedin and from the centre of the North Island but it will probably prove to occur in suitable intermediate localities. Species of *Puccinia* possessing almost colourless teleutospores are rare and this appears to be the first recorded on *Clematis*. The only other rust producing teleutospores on this host in New Zealand is *P. clavata* Syd. *P. clavata* is normally found on mature foliage, its teleutosori are black, and the spores themselves larger ($56\mu \times 19\mu$), stouter-walled and pigmented. The pale grey to buff colour of *P. alboclava* lesions readily distinguishes them in the field, and the comparatively delicate spores appear quite colourless when examined microscopically.

The microcyclic nature of *P. alboclava* was confirmed by infecting *C. indivisa* seedlings with teleutospore inoculum under controlled conditions employing apparatus comparable with that recommended by Arthur (1929, fig. 183). In the first of these experiments few epibasidia were formed by the inoculum and only two lesions developed on plants placed beneath it, but on the second occasion 18 lesions formed. They became recognisable after about a month as pale areas on the lower leaf surface, and a week later had assumed a diameter of about 2.5 mm. with a pale orange centre where the first sori were erupting. Though both experiments were performed in the spring, teleutospores were the first and only spore form produced.

THE LIFE CYCLE OF *Puccinia clavata* Syd.

The full series of spore forms attributed to *P. clavata* by Cunningham (1931, p. 147) implies that this species is macrocyclic and autoecious. But Table I shows that the pycnidia and aecidia are unknown apart from the 1928 Weraroa collection, and that the teleutospore and uredospore stages ordinarily occur quite independently. This suggests that *P. clavata*, which was originally described from teleutospore material alone, is normally microcyclic, a conclusion that has been confirmed by controlled inoculations, details of which are given in Table II.

TABLE II. CONTROLLED INOCULATIONS.

A. Employing teleutospores of *Puccinia clavata*.

Date	Inoculum on	Source	Host Tested	Result
13/ 6/51	<i>C. hexasepala</i>	Weraroa Sandhills, Wgtn.	<i>C. indivisa</i>	Many teleutosori
23/ 8/51	<i>C. foetida</i>	Taieri Mouth, Dunedin	"	Nil
14/10/51				
6/ 5/52				
16/11/52	"	"	<i>C. indivisa</i>	Nil
			<i>C. foetida</i>	Many teleutosori
B. Employing uredospores of <i>Uredo puawhananga</i> .				
11/12/53	<i>C. indivisa</i> (seedlings)	Swampy Spur, Dunedin	<i>C. indivisa</i>	Uredosori only
			<i>C. foetida</i>	Nil

These experiments also demonstrate the existence of physiologic races of *P. clavata*. Four attempts to transfer it from *C. foetida* to *C. indivisa* failed and this accords with field evidence in that at Dunedin *C. indivisa* is unattacked by this fungus though it may be plentiful on *C. foetida* growing in close proximity to it. On the other hand the single attempt to transfer the disease from *C. hexasepala* to *C. indivisa* caused heavy infections involving petioles and stems as well as foliage.

It seems inadmissible to retain under *P. clavata* the widespread uredo-stage found upon *Clematis*. Primitively *P. clavata* probably was macrocyclic and the pycnidia, aecidia and uredosori collected at Weraroa in 1928 may all have belonged to a macrocyclic race of the fungus. But these pycnidia and aecidia have not been found since though they have been recently sought in that district. The uredo-stage seems normally to lead a wholly independent existence, so that it does not necessarily agree in pathogenicity with teleutospore species which occupy the same district. Thus at Dunedin the *Uredo* is common along with *P. alboclava* on *C. indivisa* seedlings and cannot infect *C. foetida* (Table II B), while *P. clavata* is abundant on *C. foetida* and cannot infect *C. indivisa*.

Uredo puawhananga n sp.

Sori hypophylli, aurantini, sed post exsiccationem pallescentes, vel in circibus dispositi vel ubicumque erumpentes, rotundati, epidermide disrupta cingulati, usque ad 1.5 mm. lati, paraphysibus nullis. Uredosporae globosae, ellipticae vel obovatae, 19–29 μ longae, 15–24 μ latae (medie 23 x 18 μ) episporio verrucoso 1–2 μ crasso, sine poribus manifestibus. In foliis *Clematidis indivisae*.

HOLOTYPE. Swampy Spur, Dunedin, 1,200ft., coll. G. T. S. Baylis 1/3/1954 in herbario Plant Diseases Division, Auckland, No. 12908.

The powdery, orange sori about 1 mm. in diameter often disposed in circular groups cannot readily be confused with any other rust on New Zealand *Clematis*. Coriaceous sun leaves seem to resist attack, but the less heavily cutinized foliage produced in partial shade may yellow and fall as a result of intense general infection. The collections recorded in Table I show that the fungus also occurs on *C. hexasepala* and the exotic *C. vitifolia* and ranges from the Three Kings Is. to Stewart I.

Aecidium otagense Linds.

A. otagense infects both *C. indivisa* and *C. foetida* in the Dunedin district. Suspensions of aecidiospores have been incubated usually for three days, upon the following species without in any case producing infection:—

C. indivisa (3), *C. foetida* (1), *Danthonia cunninghamii* (3), *Uncinia australis* (3), *Poa astoni* (1), Cross 7 Wheat (1), I.A.B. ryecorn (1).

The number of separate experiments in which each was involved is given in brackets. *C. foetida* was the source of inoculum in the attempt to infect this species; in all other cases the inoculum was on *C. indivisa*. Some spore germination always occurred during the incubation period.

On two occasions suspensions of pycniospores washed from several lesions were incubated on *C. indivisa* without result.

Pycniosori of this fungus regularly appear on new infections in the field before the aecidia erupt, and single, isolated lesions commonly fail to develop beyond the pycnidial stage. This, together with the inability of the aecidiospores to infect *Clematis* supports the expectation that this will prove to be a heterothallic, macrocyclic and heteroecious rust. But it is remarkable for its ability to appear on vines in gardens considerably removed from native vegetation, and repeated searching in areas where it is common has failed to indicate the alternate host involved in completion of its cycle.

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REFERENCES

- ALLAN, H. H., 1947. Notes on N.Z. Floristic Botany No. 8, *Trans. Roy. Soc. N.Z.*, 76, 594.
ARTHUR, J. C., 1929. *The Plant Rusts*. Wiley & Sons, Inc., New York.
CUNNINGHAM, G. H., 1931. *The Rust Fungi of New Zealand*. John McIndoe, Dunedin.

TABLE I. HERBARIUM MATERIAL REFERRED TO *Puccinia clavata* SENSU CUNNINGHAM, 1931.

Herb. No.	Locality	Host	Collector and Date	Stages
O.U. 916	Great I., Three Kings	<i>C. indivisa</i> (shade leaves)	G. T. S. Baylis, 5/1/53	} Uredosori only = <i>Uredo puawhananga</i> n.sp.
P.D.D. 12213	Hunua Ra., Ak.	? (juvenile leaves)	J. M. Dingley, 1/3/53	
„ 12909	National Park	? (juvenile leaves)	S. D. Baker, 29/1/54	
„ 1365	Taupo	<i>C. hexasepala</i>	E. H. Atkinson, 3/1922	
„ 12105	Taupo	<i>C. hexasepala</i>	J. M. D., 26/3/53	
„ 12112	Upper Hutt, Wgtn.	<i>C. hexasepala</i>	A. J. Healy, 9/3/53	
„ 12154	Upper Hutt, Wgtn.	<i>C. vitalba</i>	A. J. Healy, 4/5/53	
O.U. 915	Swampy Spur, Dn.	<i>C. indivisa</i> (seedlings)	G. T. S. B., 6/12/50	
O.U. 914, 913	Maungatua, Dn.	<i>C. indivisa</i> (seedlings)	G. T. S. B., 9/7/50, 31/3/53	
P.D.D. 12910	Stewart I.	<i>C. indivisa</i> (seedlings)	J. M. D., 16/2/54	
O.U. 909	Totara N., N.Ak.	<i>C. foetida</i>	G. T. S. B., 28/12/50	} Teleutosori only = <i>P. clavata</i> Syd.
P.D.D. 3070	Weraroa, Wgtn.	<i>C. hexasepala</i>	G. H. Cunningham, 11/1927	
O.U.	Weraroa, Wgtn.	<i>C. hexasepala</i>	G. T. S. B., 2/1952	
P.D.D. 10853	Levin, Wgtn.	<i>C. hexasepala</i>	I. D. Parsons, 6/1951	
„ 6128	Whiteman's Va., Wgtn.	<i>C. hexasepala</i>	A. J. H., 2/1948	
„ 12051	Featherston, Wgtn.	<i>C. hexasepala</i>	A. J. H., 17/3/53	
„ 12102, 12177	Trentham, Wgtn.	<i>C. foetida</i>	A. J. H., 25/3/53, 19/5/53	
O.U. 918	Bot. Gardens, Dn.	<i>C. foetida</i>	G. T. S. B., 20/10/53	} Pycniosori aecidiosori uredosori
„ 912, 917	Taieri Mouth, Dn.	<i>C. foetida</i>	G. T. S. B., 20/8/51, 20/10/53	
P.D.D. 3416	Weraroa, Wgtn.	<i>C. hexasepala</i>	G. H. C., 10/1928	