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ADDITIONS TO THE RUST FUNGI OF NEW ZEALAND—4

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SUMMARY

Four rust fungi not previously reported from New Zealand and two new species, *Puccinia gei-parviflori* and *Uromyces waipoua*, are described. A further three species recently recorded from the country are noted or described.

INTRODUCTION

This paper constitutes the fourth in a series of supplements to "The Rust Fungi of New Zealand" (Cunningham, 1931). Three supplements (Cunningham, 1945; Baker, 1956; McNabb, 1962a) and a revision of the graminicolous rust fungi (McNabb, 1962b) have been published at intervals in an attempt to keep the rust flora of New Zealand up to date.

As in previous supplements, species recorded from New Zealand in publications other than those of the present writer have been included. Descriptions are based on New Zealand specimens but are omitted where the material has not been examined.

Conventional symbols employed by Cunningham (1931) to indicate types of sori and their accompanying spore forms are used, viz, 0, Pycniosori; I, Aecidiosori; II, Uredosori; III, Teleutosori.

Type collections are deposited in the herbarium, Plant Diseases Division, Auckland (PDD). Herbarium accession numbers are cited after each specimen.

THE SPECIES

Puccinia arenariae (Schumacher) Winter,
Hedwigia 19: 38. 1880.

Puccinia arenariae was recorded with brief description by Jørstad (1957) on the endemic host *Stellaria parviflora* Banks & Sol. ex Hook. f. The single specimen, collected by S. Berggren from Dunedin in May 1874 and deposited in the herbarium, Swedish Museum of Natural History, Stockholm, has not been examined. *Puccinia arenariae* is widely distributed throughout the world and full descriptions of the species may be found in most regional monographs of the Uredinales (Arthur, 1934; McAlpine,

1906). The species is most abundant in oceanic conditions and should be sought at other coastal sites, especially in the cooler parts of the South Island.

***Puccinia gei-parviflori* sp. nov.**

(Fig. 1a)

O, I, II. Ignota.

III. Teleutosori hypophylli, in maculis decoloratis dispositi, dispersi, orbiculares, ad 1.5 mm diam., vel in gregibus confluentibus ad 2.5 mm diam., pulvinati, compacti, ferruginei; sporae linearo-oblongae, ad septum non vel leviter constrictae, $38-52 \times 9-13.5 \mu$, apice acuminato vel obtuso-acuminato, ad 9μ crass., basi attenuata; episporia pallido-flava, $0.5-1 \mu$ crass., levia; pedicelli hyalini, persistentes vel decidui, ad $40 \times 7.5 \mu$.

O, I, II. Unknown.

III. Teleutosori hypophyllous, seated on discoloured spots, scattered, orbicular, to 1.5 mm diam., or in confluent groups to 2.5 mm diam., pulvinate, compact, ferruginous; spores linear-oblong to fusoid, not or slightly constricted at septum, $38-52 \times 9-13.5 \mu$; apex acuminate to bluntly acuminate, thickened to 9μ , base attenuate; epispore pallid yellow, $0.5-1 \mu$ thick, smooth; pedicel hyaline, persistent or deciduous, to $40 \times 7.5 \mu$.

Host: *Geum parviflorum* J. E. Smith, III.

Canterbury: Godley River valley, Jan. 1959, D. Scott, (HOLOTYPE, PDD 21664).

The host is an indigenous species extending to Chile and Fuegia (Allan 1961).

Puccinia gei-parviflori is readily separable from *P. gei* McAlp., which occurs in New Zealand on the endemic *Geum uniflorum* Buchan., by the compact, non-pulverulent teleutosori and pallid, linear-oblong spores.

***Puccinia horiana* P. Hennings,**

(Fig. 1b)

Hedwigia 40: 25. 1901.

O. Not seen.

III. Teleutosori mainly hypophyllous, occasionally amphigenous, seated on discoloured spots, scattered, orbicular, to 1.5 mm diam., or in confluent groups to 4 mm diam., occasionally circinate arranged, pulvinate, compact, pallid ferruginous, dingy white or pinkish white; spores variable in shape, oblong, oblong-clavate or fusoid, slightly constricted at septum, $36-55 \times 12-16 \mu$; apex bluntly acuminate, truncate or attenuate, thickened to 7.5μ , base attenuate; germ pore of upper cell apical; of lower cell immediately below septum; epispore pallid yellow, apex slightly darker, $1-1.5 \mu$ thick, smooth; pedicel hyaline, persistent, to 35μ long.

TYPE LOCALITY: Japan, on *Chrysanthemum morifolium* var. *sinense* Mak.

DISTRIBUTION: Australia, China, Denmark, Great Britain, Japan.

HOST: *Chrysanthemum morifolium* Ramat. III.

Wellington: Palmerston North, Apr., May 1964, K. S. Milne, 23621-2.

Both rust and host are introduced species.

Puccinia horiana causes considerable damage to cultivated chrysanthemums and appears to be difficult to control. In a series of inoculation

experiments, Hiratsuka (1957) found that the rust infected nine species and varieties of *Chrysanthemum*.

The rust has recently appeared in Great Britain and Europe and was intercepted by United States quarantine services on chrysanthemums from Australia (*vide Rev. appl. Mycol.* 40: 153. 1961).

Puccinia horiana is characterised by compact, non-pulverulent teleutospores and pallid yellow spores. It is readily distinguishable from *P. chrysanthemi* Roze, which does not produce teleutospores in New Zealand.

Puccinia menthae Persoon,

(Fig. 1c)

Syn. Meth. Fung. 227. 1801.

O. Pycniosori hypophyllous and on stems and petioles, scattered or in groups, accompanying the aecidiosori, honey-coloured.

I. Aecidiosori hypophyllous, often on petioles and stems, seated on purplish spots on leaves, forming elongate, distorted areas on petioles and stems, orange; peridia cupulate, margins erect or slightly incurved, lacerate; spores subglobose to short-elliptical, $20-36 \times 15-21 \mu$; episore pallid yellow, $1.5-2 \mu$ thick, closely verruculose.

II. Uredosori hypophyllous, seated on brownish spots, scattered or sometimes confluent, orbicular, to 0.5 mm diam., cinnamon brown, soon naked and pulverulent, surrounded by the ruptured epidermis; spores subglobose to obovate, $21-28 \times 17-22 \mu$; episore pallid yellow, $1.5-2 \mu$ thick, echinulate; germ pores equatorial, 3, inconspicuous.

III. Teleutospores mainly hypophyllous, similar to uredosori but chestnut or chocolate brown in colour; spores short-elliptical, not or slightly constricted at septum, $25-35 \times 20-24 \mu$, apex rounded, not thickened, base rounded; germ pore of upper cell apical, of lower cell immediately below septum, each covered by a hyaline papilla; episore cinnamon brown, uniformly $1.5-2.5 \mu$ thick, verrucose; pedicel hyaline or faintly tinted, persistent or deciduous, rarely longer than spore.

TYPE LOCALITY: Europe, on *Mentha* sp. (Lectotype, Jørstad 1958).

DISTRIBUTION: Cosmopolitan.

HOST: *Mentha spicata* L. O, I, II, III.

Auckland: Remuera, Feb., Apr. 1964, J. M. Dingley, 23112, 23270; Mt Albert, Apr. 1964, R. F. R. McN., 23499. Canterbury: Christchurch, Sept. 1960, A. Hill, 19463; Feb. 1964, J.M.D., 23108; Riccarton, Apr. 1963, R. C. Close, 20807. Marlborough: Kaikoura, Blue Duck Stream, Feb. 1964, J.M.D., 23110. Wellington: Wadestown, Feb. 1964, J.M.D., 23111.

Puccinia menthae was recorded with a brief description of symptoms in 1964 (Anon. 1964). Since first collected in Christchurch in December 1959, the rust has become widespread throughout the country.

P. menthae, which occurs on a large number of genera of the Labiatae, displays a wide variation in characters such as colour, sculpturing and thickness of teleutospore walls, length of pedicels, and to a lesser degree, size of teleutospores. In a study of the variation encountered in *P. menthae* in North and South America and Europe, Baxter (1959) distinguished four varieties. New Zealand collections agree with var. *menthae*, the type

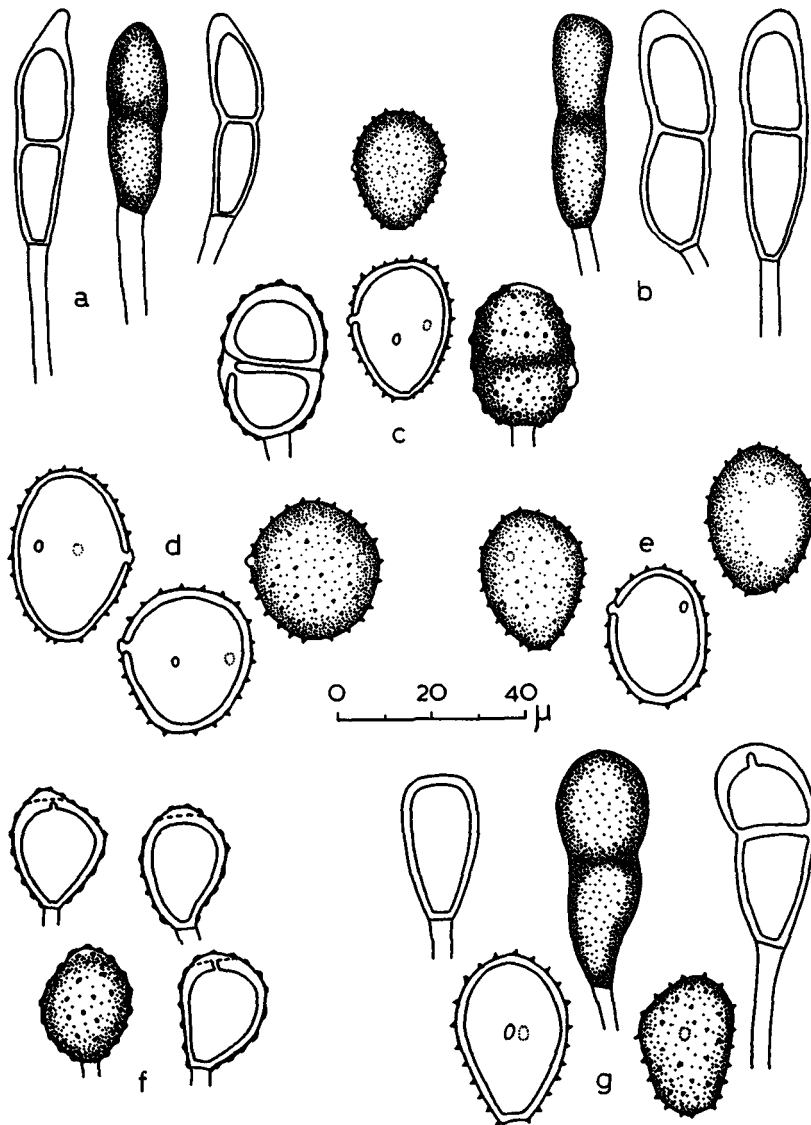


FIG. 1—*a. Puccinia gei-parviflori*; teleutospores. *b. P. horiana*; teleutospores. *c. P. menthae*; uredospores and teleutospores. *d. P. paspalina*; uredospores. *e. P. polygoni-amphibii*; uredospores. *f. Uromyces waipoua*; teleutospores. *g. Puccinia scirpi*; uredospores, teleutospores, and mesospore.

variety. Baxter (1960) later recognised two further varieties and reduced *P. pseudomenthae* G. H. Cunn., which occurs on the endemic *Mentha cunninghamii* Benth., to varietal rank. Var. *pseudomenthae* may be distinguished from var. *menthae* by non-umbonate teleutospores and the position of the germ pore in the lower cell.

***Puccinia paspalina* Cummins,**

(Fig. 1d)

Bull. Torrey bot. Cl. 72: 211. 1945.

Uredo paspalina Syd., Ann. mycol., Berl. 15: 177. 1917.

0, I. Unknown.

II. Uredosori mainly epiphyllous, seated on discoloured spots, oval to linear, to 1mm long, brown, soon naked and pulverulent, surrounded by the ruptured epidermis; paraphyses absent; spores ovate, obovate, or short-elliptical, often angular, $27-36 \times 21-26 \mu$; episore cinnamon brown, 1.5μ thick, moderately echinulate; germ pores approximately equatorial, 3, conspicuous.

III. Not seen.

TYPE LOCALITY: Birkdale near Brisbane, Australia, on *Paspalum orbiculare* Forst. f.

DISTRIBUTION: Australia, Philippine Islands.

HOST: *Paspalum dilatatum* Poir. II.

Auckland: Waipoua State Forest, Apr. 1964, R. F. R. McN., 23500.

In the absence of teleutospores there must be some doubt as to the identity of the rust described above, for at least 10 species possessing echinulate uredospores with equatorial germ pores, and lacking uredo paraphyses, have been described on *Paspalum*. However, the New Zealand fungus is indistinguishable from Queensland material of *Puccinia paspalina* on *Paspalum orbiculare*. *Puccinia paspalina* was recorded on *Paspalum dilatatum* as well as on *P. orbiculare* in the type description.

***Puccinia polygoni-amphibii* Persoon,**

(Fig. 1e)

Syn. Meth. Fung. 227. 1801.

0, I. Not seen—on Geraniaceae.

II. Uredosori mainly hypophyllous, occasionally amphigenous, seated on purplish spots, scattered or sometimes confluent, orbicular, to 0.5 mm diam., cinnamon to chestnut brown, soon naked and pulverulent, surrounded by the ruptured epidermis; spores elliptical to obovate, typically laterally compressed, $24-30 \times 19-22 \mu$; episore cinnamon brown, $1-1.5 \mu$ thick, finely echinulate, echinulations often absent from an area beneath each pore; germ pores super-equatorial, 2, conspicuous.

III. Not seen.

TYPE LOCALITY: Europe, on *Polygonum amphibium* L. (Lectotype Jørstad 1958).

DISTRIBUTION: Cosmopolitan.

HOST: *Polygonum hydropiper* L. II.

Auckland: Mangawhai, Te Henga, Mt Albert, Kairara, Mar.-Apr. 1964, R. F. R. McN., 23274, 23272, 23246, 23280.

The host is an introduced species common in damp situations throughout the country.

Arthur (1934) recognised three varieties of *Puccinia polygoni-amphibii* based on host differences and minor morphological characters. New Zealand specimens agree most closely with var. *polygoni-amphibii* (= var. *persicariae* (Strauss) Arth.).

The acedial stage on *Geranium* spp. has not been found in New Zealand.

***Puccinia scirpi* De Candolle,**

(Fig. 1g)

Flore française 2: 223. 1805.

0, I. Not seen—on Menyanthaceae.

II. Uredosori scattered or in rows, often confluent, elliptical or linear, to 1.5 mm long, cinnamon brown, long covered, becoming exposed by longitudinal fissuring of the epidermis; spores subglobose, ovate or obovate, often irregular, $20-36 \times 16-23 \mu$; epispore pallid brown, 1.5μ thick, coarsely and sparsely echinulate; germ pores equatorial, 2, conspicuous.

III. Teleutosori similar to uredosori but chestnut brown to black in colour; spores oblong to subclavate, not or slightly constricted at septum, $36-65 \times 13-22 \mu$; apex rounded, truncate or bluntly acuminate, thickened to 6μ , base attenuate; germ pore of upper cell apical, not seen in lower; epispore cinnamon brown in upper cell, paler in lower, smooth; pedicel tinted, persistent, to $45 \times 8 \mu$.

Mesospores common, subclavate to cuneiform, $25-38 \times 14-20 \mu$.

TYPE LOCALITY: France, on *Scirpus lacustris* L.

DISTRIBUTION: Europe, Japan.

HOST: *Schoenoplectus lacustris* (L.) Palla II, III.

Auckland: Bethell's Beach, Apr. 1964, R. F. R. McN., 23089.

The host is an indigenous species widely distributed throughout the world.

The acedial stage on *Nymphoides peltata* (S. G. Gmel.) O. Kuntze has not been found in New Zealand. McAlpine (1906) described acedia on *Limnanthemum indicum* Thw. from Queensland, but as the teleuto stage was not found, the rust was described under *Aecidium nymphoidis* DC.

No measurable differences could be found between uredospores of *Puccinia scirpi* and *Uredo scirpi-nodosi* McAlp., except for a higher percentage of irregularly shaped spores in the former. *U. scirpi-nodosi* occurs on four endemic or indigenous species of *Scirpus*, but until teleutospores have been found on one of these hosts it seems preferable to maintain the rusts as separate species.

***Uromyces waipoua* sp. nov.**

(Fig. 1f)

Aecidium disseminatum Berk. in Hook. f., Handbk. N.Z. Flora 756. 1867.

III. Teleutosori hypophylli, dispersi, orbiculares, ad 0.5 mm diam., cito nudi et pulverulenti, ferruginei; sporae subglobosae, ovatae vel obovatae, $19-26 \times 15-23 \mu$, apice rotundato, crassato ad 3.5μ , basi rotundata vel subattenuata; foramen germinans apical, connectum papilla exigua hyalina; episporium pallido-fulvum, $1.2-2 \mu$ crassum, verruculosum; pedicellus tinctus, deciduus.

0. Unknown.

I. Aecidiosori hypophyllous and on stems, scattered or in crowded groups, to 0.3 mm diam.; peridia slightly erumpent, margins reflexed, dentate, white; peridial cells polygonal, walls 4–5 μ thick, strongly sculptured; spores elliptical or polygonal, 16–21 \times 12–20 μ ; epispore hyaline, 1 μ thick, finely and closely verruculose.

III. Teleutosori hypophyllous, scattered, orbicular, to 0.5 mm diam., soon naked and pulverulent, surrounded by the ruptured epidermis, ferruginous; spores subglobose, ovate or obovate, 19–26 \times 15–23 μ , apex rounded, thickened to 3.5 μ , base rounded or subattenuate; germ pore apical, covered by a hyaline papilla; epispore pallid brown, 1.2–2 μ thick, verruculose; pedicel tinted, deciduous.

DISTRIBUTION: Australia, New Zealand.

HOSTS: *Hypericum gramineum* Forst. f. I.

Canterbury: Motunau, May 1941, A. J. Healy, 10024; Medbury Plains, Dec. 1943, A. J. H., 4379. Otago: Clyde, Mar. 1911, D. Petrie, 10022; Lammermoor Mts, Jan. 1929, H. H. Allan, 3468; Alexandra, Jan. 1937, E. E. Chamberlain and G. H. Cunningham, 4030.

Hypericum japonicum Thunb. I, III.

Auckland: St John's Lake, Oct. 1873, T. F. Cheeseman, 16719; Lake Waikaremoana, P. Hynes, 18595; Waipoua State Forest, 23 Apr. 1964, R. F. R. McN., (HOLOTYPE, PDD 23501). Wellington: National Park, Jan. 1941, A.J.H., 10023; Upper Hutt, Oct. 1952, A.J.H., 11698; upper Tauherenikau valley, Mar. 1953, A.J.H., 12042. Westland: Ross, Feb. 1947, A.J.H., 5372.

Both hosts are indigenous species. *H. gramineum* also occurs in Australia, Tasmania, and New Caledonia, and *H. japonicum* in Australia, Tasmania, and northwards to Japan (Allan 1961).

There is little doubt that *Aecidium disseminatum* is the aecidial stage of *Uromyces waipoua*, for in the type collection, aecidial and teleuto stages occur in close proximity on the same leaves. The type of *Aecidium disseminatum* was collected in New Zealand on *Hypericum japonicum*,

As far as can be ascertained, the only other rust described on either of the two hosts listed above is *Uredo hyperici-japonici* Petch, on *Hypericum japonicum* from Ceylon.

Uromyces waipoua may be separated from other *Uromyces* occurring on *Hypericum*, viz, *Uromyces hypericinus* Speg. and *U. triquetrus* Cooke, by the verruculose teleutospores with slightly thickened apices.

Uredo novae-zelandiae G. F. Laundon,

Mycol. Pap. No. 91. 16. 1963.

This species was erected to accommodate the rust on *Tetragonia* previously described by Cunningham (1931) as the uredo stage of *Puccinia tetragoniae* McAlp. Laundon recognised three varieties of *P. tetragoniae* on the basis of uredospore morphology and geographical distribution, viz, var. *austro-africana* E. M. Doidge from South Africa, var. *tetragoniae* from Australia and Tasmania, and (var.) *Uredo novae-zelandiae* from New Zealand. There is little doubt that *U. novae-zelandiae* is the uredo stage of *Puccinia tetragoniae*, but as teleutospores have not been found in New Zealand, it must be described as a uredo form.

ADDITIONAL HOST RECORDS

Puccinia allii Rud.

HOSTS: *Allium fistulosum* L. II, III.

Canterbury: Lake Tekapo, Apr. 1956, D. A. Richardson, 15996.

No measurable differences occur between the rust on this host and that on *A. schoenoprasum* except for an even higher percentage of mesospores in the teleutosori.

Allium sativum L. II, III.

Auckland: Epsom, Jul. 1963, J. M. Dingley, 21538.

No constant differences could be found between the rust on this host and that on *A. fistulosum* and *A. schoenoprasum*. The percentage of mesospores in the teleutosori varied from 50–95% in adjacent sori.

Allium schoenoprasum L. I, II, III.

Canterbury: Lake Tekapo, Mar. 1956, M. Hayter, 15994; Apr. 1956, D. A. Richardson, 15995; Christchurch, Sept., Oct. 1960, A. Hill, 19464, 19497; Oct. 1960, M. Adams, 19520; Feb. 1961, R. F. R. McN., 19606. Wellington: Levin, Nov. 1958, T. N. Flint, 18536.

In a previous publication (McNabb, 1962a), *Puccinia allii* was treated as a compound species embracing *P. porri* Wint. and *P. blasdalei* Diet. & Holw. Savile (1961) considered these three species, together with *P. mixta* Fuckl, worthy of specific rank. With the limited material available it has not been possible to test the validity of Savile's distinguishing characters and for this reason I prefer to retain the name *P. allii* for a compound and variable species which includes *P. porri* and *P. mixta*. *P. blasdalei* seems sufficiently distinct to warrant recognition as a separate species.

The above collections agree closely with Savile's description of *P. mixta* on *Allium schoenoprasum* from Canada. (New Zealand measurements: uredospores $25-33 \times 19-27 \mu$, germ pores 9–11, scattered; 2-celled teleutospores $33-45-(49) \times 19-27 \mu$; mesospores $23-38 \times 15-23 \mu$; up to 6% 2-celled teleutospores in sori.)

Aecidiosori were present in three spring collections from Christchurch and part of each collection was allowed to continue growth in a glasshouse until uredo- and teleutospores appeared.

Puccinia coronata Corda

HOST: *Festuca arundinacea* Schreb. II, III.

Auckland: Huia, Henderson Valley, Te Henga, Dec. 1963–Apr. 1964, J. M. Dingley, 23130, 23166, 23273; Mt Albert, Mangawhai, Waipoua State Forest, Waihue, Mar.–Apr. 1964, R. F. R. McN., 23168, 23161, 23258, 23278.

Uromycladium tepperianum (Sacc.) McAlp.

HOST: *Acacia riceana* Hensl. III.

Auckland: Remuera, Oct. 1963, J. M. Dingley, 21732.

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