

Three Species of *Chrysanthemum*-Rusts in Japan and its neighbouring Districts¹).

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1. *Phakopsora Artemisiae* Hiratsuka in Jap. Jour. Bot. III, p. 298, 1927; Bot. Mag. Tokyo, XLIX, p. 854, 1935; Uredinolog. Stud., p. 265, 1955; Ito, Myc. Fl. Jap. II, no. 2, p. 146 & fig. 80, 1938.

Syn. *Uredo Artemisiae-japonicae* Dietel in Bot. Jahrb. XXXIV, p. 591, 1905.

Uredo autumnalis Dietel in Bot. Jahrb. XXXVII, p. 108, 1905.

Phakopsora circumvallata Sawada, Descript. Cat. Formosan Fungi, V, p. 49 & pl. III, figs. 4—9, 1931 (Nom. seminud.).

Phakopsora Artemisiae-japonicae Tranzschel, Conspect. Ured. URSS, p. 380, 1939.

Specimens examined:

II, III. On *Chrysanthemum indicum* L. (*Abura-giku*).

Japan Proper:- Shikoku: Pref. Kochi: Akinokawa (Nov., 1904, T. Yoshinaga). Pref. Ehime: Mikame-machi (Oct. 28, 1934, K. Kimura). Kyushu: Pref. Fukuoka: Omuta-shi (Miike) (Dec. 4, 1935, E. Tobinaga). Pref. Kumamoto: Tomioka-machi (Amakusa) (Dec. 21, 1939, N. Hiratsuka); Shikaki-mura (Amakusa) (Dec. 20, 1939, N. Hiratsuka); Shimoda-mura (Amakusa) (Dec. 22, 1939, N. Hiratsuka).

II, (III). On *Chrysanthemum japonense* Nakai (*Noji-giku*).

Japan Proper:- Shikoku: Pref. Kochi: Ashizuri-saki (Jan. 2, 1935, K. Ide). Pref. Tokushima: Hinotani-mura (Nov. 18, 1935, T. Yoshinaga). Kyushu: Pref. Miyazaki: Mt. Boroishiyama (Oct. 26, 1940, S. Hirata).

II, (III). On *Chrysanthemum Makinoi* Matsum. et Nakai (*Ryuno-giku*).

Japan Proper:- Honshu: Pref. Shizuoka: Mt. Amagi (Nov. 4, 1933, N. Hiratsuka). Pref. Kanagawa: Mt. Oyama (Nov. 9, 1952, N. Hiratsuka).

II, (III). On *Chrysanthemum morifolium* Ramat. var. *sinensis* Mak. (*Kiku*) (cultivated).

¹) Contributions from Laboratories of Phytopathology and Mycology, Faculty of Agriculture, Tokyo University of Education. no. 23.

Japan Proper:- Kyushu: Pref. Miyazaki: Kitago-mura (Jan. 5, 1941, Y. Aratake). Pref. Kagoshima: Kagoshima-shi (Nov. 1, 1934, K. Ide).

Ryukyu Isls.:- Okinawa Isl.: Naha-shi (March 24, 1940, Y. Taira); Shuri-shi (Feb. 21, 1940, Y. Taira).

II, (III). On *Chrysanthemum ornatum* Hemsl. (*Satsuma-nogiku*).

Japan Proper:- Kyushu: Pref. Kagoshima: Noma-saki (March 19, 1933, K. Ide); Kuroshimokoshiki-jima (April 2, 1933, K. Ide).

II, (III). On *Chrysanthemum Shiwogiku* Kitam. (*Shio-giku*).

Japan Proper:- Shikoku: Pref. Kochi: Ananai-mura (Nov., 1904, T. Yoshinaga).

II, (III). On *Chrysanthemum Shiwogiku* var. *kinokuniense* Shimotomai et Kitamura (*Kinokuni-shiogiku*).

Japan Proper:- Honshu: Pref. Wakayama: Shirahama-cho (Setokanayama) (Dec. 23, 1930, Dec. 22, 1936 & Dec. 23, 1938, N. Hiratsuka).

II, (III). On *Artemisia capillaris* Thunb. (*Kawara-yomogi*).

Formosa:- Prov. Taihoku: Taihoku (Oct. 6, 1935, Y. Hashioka).

II, III. On *Artemisia dubia* Wall. (*Yomogi*).

Japan Proper:- Honshu: Pref. Miyagi: Obara-onsen (Oct. 29, 1942, Naoharu Hiratsuka). Pref. Wakayama: Wakayama-shi (Dec. 12, 1928, E. Tobinaga); Nachi-machi (Nishikiura) (Jan. 6, 1942, N. Hiratsuka); Kushimoto-machi (Jan. 5, 1942, N. Hiratsuka). Shikoku: Pref. Tokushima: Washishiki-cho (Jan. 4, 1951, K. Ueta); Anabuki-machi (Nov. 23, 1934, T. Yoshinaga); Ikeda-machi (Nov. 17, 1935, T. Yoshinaga). Pref. Kochi: Ryukado (Nagaoka-gun) (Dec. 6, 1941, N. Hiratsuka). Kyushu: Pref. Fukuoka: Sasagurimachi (Nov. 22, 1936, Y. Maki); Omuta-shi (Ginsui-mura) (Dec. 7, 1935, E. Tobinaga). Pref. Kumamoto: Nishikino-mura (Aug. 12, 1936, E. Tobinaga). Pref. Oita: Kujyu-kogen (Oct. 17, 1939, N. Hiratsuka). Pref. Kagoshima: Mt. Kirishima (June 7, 1941, S. Hirata; Oct. 24, 1939, N. Hiratsuka).

Ryukyu Isls.:- Okinawa Isl.: Haneji-mura (Jan. 13, 1940, N. Hiratsuka); Mawashi-mura (Jan. 22, 1940, N. Hiratsuka).

Formosa:- Prov. Taihoku: Kussa (June 29, 1936, Y. Hashioka); Taihoku (Jan. 23, 1929, K. Sawada, type of *Phakopsora circumvallata* Sawada!; June 1, 1936, Y. Hashioka); Kizan (Oct. 23, 1932, Y. Hashioka).

II, (III). On *Artemisia japonica* Thunb. (*Otoko-yomogi*).

Japan Proper:- Shikoku: Pref. Kochi: Tonohama (Nov., 1903, T. Yoshinaga, type of *Uredo Artemisiae-japonicae* Dietel!). Kyushu: Pref. Kagoshima: Kagoshima-shi (Nov. 1, 1931, K. Ide).

Ryukyu Isls.: Okinawa Isl.: Urazoe-mura (March 13,

1940, Y. Taira). Korea:- Prov. Kanhoku: Shuotsuon-men (Aug. 16, 1940, N. Hiratsuka).

II, III. On *Artemisia montana* Pamp. (*O-yomogi*).

Japan Proper:- Hokkaido: Mt. Moiwa near Sapporo (Oct. 19, 1924, N. Hiratsuka); Sankakuyama, Sapporo (Sept. 2, 1922, N. Hiratsuka, type of *Phakopsora Artemisiae* Hiratsuka!); Zenibako (Oct. 25, 1925, I. Tanaka).

II, (III). On *Artemisia lactiflora* Wall. (*Yomogina*) (cultivated).

Formosa:- Prov. Taihoku: Rokuchori (April 24, 1932, Y. Hashioka); Hokuto (Oct. 22, 1933, Y. Hashioka).

II, III. On *Artemisia princeps* Pamp. (*Kazuzaki-yomogi*).

Japan Proper:- Honshu: Pref. Wakayama: Shirahama-cho (Setokanayama) (Dec. 23, 1930, N. Hiratsuka). Pref. Okayama: Yubara-onsen (Aug. 28, 1941, N. Hiratsuka & M. Omori); Yatsukamura (Aug. 29, 1941, N. Hiratsuka & M. Omori). Pref. Tottori: Tottori-shi (Oct. 23, 1941, N. Hiratsuka; Nov. 17, 1931, N. Hiratsuka & Y. Hashioka); Mt. Okinosen (Oct. 17, 1941, M. Omori); Mt. Daisen (Oct. 19, 1935, N. Hiratsuka); Daisenji (Aug. 20, 1930, N. Hiratsuka). Pref. Hyogo: Hatta-mura (Oct. 23, 1938, N. Hiratsuka & M. Irie). Kyushu: Pref. Oita: Honyabakei-mura (Kozu) (Oct. 13, 1939, N. Hiratsuka). Pref. Kagoshima: Mt. Kaimon-dake (Oct. 28, 1939, N. Hiratsuka).

II, (III). On *Artemisia* sp.

Ryukyus:- Yakushima Isl.: Kosugidani-Anbo (Aug. 2, 1954, S. Sato & Y. Hiratsuka).

II, (III). On *Aster ageratoides* Turcz. subsp. *amplexifolius* Kitamura (*Yamashirogiku*).

Japan Proper:- Honshu: Pref. Tottori: Tottori-shi (Oct. 18, 1934 & Oct. 28, 1941, N. Hiratsuka).

II, (III). On *Eupatorium chinense* L. (*Fujibakama*).

Japan Proper:- Shikoku: Pref. Kochi: Inabu-mura (Dec. 12, 1929, T. Yoshinaga).

II, III. On *Eupatorium japonicum* Thunb. (*Hiyodoribana*).

Japan Proper:- Shikoku: Pref. Kochi: Kochi-shi (Nagahama) (Sept. 10, 1935, T. Yoshinaga). Pref. Tokushima: Orono-mura (Nov. 10, 1941, T. Inobe). Kyushu: Pref. Miyazaki: Mt. Ichibusa (Nov. 3, 1946, S. Hirata).

II, (III). On *Eupatorium variabile* Mak. (*Yama-hiyodoribana*).

Ryukyus:- Yakushima Isl.: Mt. Mochomu (Oct. 19, 1949, S. Katsuki); "Yakushima" (Jan. 1, 1934, K. Ide).

II, III. On *Heteropappus hispidus* Less. (*Areno-nogiku*).

Japan Proper:- Honshu: Pref. Wakayama: Shirahama-cho (Setokanayama) (Dec. 23, 1938, N. Hiratsuka).

II, III. On *Kalimeris incisa* DC. (*Oyuga-giku*).

Japan Proper:- Kyushu: Pref. Kumamoto: Tomiokamachi (Amakusa) (Dec. 21, 1939, N. Hiratsuka); Shimoda-mura (Amakusa) (Dec. 22, 1939, N. Hiratsuka). Pref. Kagoshima: Kagoshima-shi (Oct. 27, 1939, N. Hiratsuka).

Distribution. Japan (Hokkaido, Honshu, Shikoku, Kyushu), Ryukyu Isls., Formosa, Korea, China.

This species is a collective one which is parasitic on various composite plants, especially various species of *Artemisia* and *Chrysanthemum*. In Japanese Archipelago, it is widely distributed, extending from Hokkaido to Ryukyu Islands and Formosa.

The first reference to the present fungus was made by Dietel in 1905, under the name *Uredo Artemisiae-japonicae* Dietel based upon a specimen of the uredostage on *Artemisia japonica* Thunb. collected by T. Yoshinaga at Tonohama, Pref. Kochi, Japan. Later, in 1927, the writer found its uredo- and teleutostages on a specimen of *Artemisia montana* Pamp. which was collected by himself at Sapporo, Hokkaido, and he transferred it to the genus *Phakopsora* naming it *Phakopsora Artemisiae* Hiratsuka.

In 1953, the writer attempted the following inoculation experiments with the uredospores in order to determine the parasitism of a form of *Phakopsora Artemisiae* Hiratsuka on *Chrysanthemum Makinoi* Matsum. et Nakai. In the experiment, the uredospores of this fungus which were collected by the writer at Asakawa, Pref. Tokyo on October 18, 1953, were used as inocula. Inoculations were made with the uredospores on the following 15 plants of *Chrysanthemum*, viz., *Chrysanthemum nipponicum* Matsum, *Ch. Leucanthemum* L., *Ch. cinerariaefolium* Vis., *Ch. arcticum* L. subsp. *Maekawanum* Kitamura, *Ch. ornatum* Hemsl., *Ch. Shiwogiku* Kitamura, *Ch. pacificum* Nakai, *Ch. pacificum* var. *radiatum* Mak., *Ch. Yoshinagathum* Mak., *Ch. Makinoi* Matsum. et Nakai, *Ch. japonense* Nakai, *Ch. boreale* Mak., *Ch. indicum* L. and *Ch. morifolium* Ramat. var. *sinense* Mak. The results of the experiments are given in the following table.

As seen from the preceding table, infection followed with a marked development of uredosori on *Chrysanthemum Shiwogiku*, *Ch. pacificum*, *Ch. pacificum* var. *radiatum*, *Ch. Yoshinagathum*, *Ch. Makinoi* var. *wakasaense*, *Ch. boreale*, *Ch. morifolium* var. *sinense* and the control plant, *Chrysanthemum Makinoi*, while on the remaining plants no sign of uredosori appeared.

2. *Puccinia Chrysanthemi* Roze in Bull. Soc. Myc. Fr. XVII, p. 92 & figs. 1, 2, 1900; Hiratsuka, Uredinolog. Stud., p. 308, 1955; Ito, Myc. Fl. Jap. II, no. 3, p. 319 & fig. 414, 1950; Kusano in Ann. Myc. VI, p. 306, 1908; Bull. Coll. Agric. Tokyo Imp. Univ. VIII, p. 1, 1908; Saccardo, Syll. Fung. XVI, p. 296; Sydow, Monogr. Ured. I, p. 46, 1902; p. 854, 1904.

Table 1. Results of inoculation experiments with uredospores of *Phakopsora Artemisiae* Hiratsuka on *Chrysanthemum Makinoi* Matsum. et Nakai.

Plants inoculated	Date of inoculation	Date of first appearance of uredosori	Degree of susceptibility
<i>Chrysanthemum nipponicum</i>	Oct. 19, 1953	—	—
	Oct. 22, 1953	—	—
<i>Ch. Leucanthemum</i>	Oct. 19, 1953	—	—
	Oct. 19, 1953	—	—
<i>Ch. cinerariaefolium</i>	Oct. 23, 1953	—	—
<i>Ch. arcticum</i>			
subsp. <i>Maekawanum</i>	Oct. 19, 1953	—	—
<i>Ch. ornatum</i>	Oct. 19, 1953	—	—
	Oct. 22, 1953	—	—
<i>Ch. Shiwogiku</i>	Oct. 19, 1953	Nov. 16	++
	Oct. 22, 1953	Nov. 10	++
<i>Ch. pacificum</i>	Oct. 19, 1953	Nov. 18	++
	Oct. 22, 1953	Nov. 10	++
<i>Ch. pacificum</i> var. <i>radiatum</i>	Oct. 19, 1953	Nov. 8	++
<i>Ch. Yoshinagathum</i>	Oct. 22, 1953	Nov. 18	++
	Oct. 22, 1953	Nov. 16	++
	Oct. 23, 1953	Nov. 8	+++
<i>Ch. japonense</i>	Oct. 19, 1953	—	—
	Oct. 22, 1953	—	—
<i>Ch. Makinoi</i>			
var. <i>wakasaense</i>	Oct. 20, 1953	Nov. 10	+
<i>Ch. indicum</i>	Oct. 19, 1953	—	—
	Oct. 22, 1953	—	—
<i>Ch. boreale</i>	Oct. 19, 1953	Nov. 8	++
	Oct. 23, 1953	Nov. 8	++
<i>Ch. morifolium</i> var. <i>sinense</i>	Oct. 19, 1953	Nov. 10	+++
<i>Ch. Makinoi</i> (control)	Oct. 22, 1953	Nov. 10	+++
	Oct. 19, 1953	Nov. 6	+++
	Oct. 22, 1953	Nov. 8	+++

Syn. *Puccinia Chrysanthemi-chinensis* Hennings in Hedwigia, XL, p. (26), 1901.

Dicaeoma Chrysanthemi Arthur in Proc. Ind. Acad. Sci (1903), p. 147, 1904.

Bullaria(?) Chrysanthemi Arthur, Résult. Sci. Congr. Internat. Bot. Vienne (1905), p. 346, 1906.

Specimens examined:

II, III. On *Chrysanthemum indicum* L. (*Abura-giku*).

Japan Proper:- Kyushu: Pref. Fukuoka: Mt. Wakasugi (May 19, 1941, Y. Maki; Oct. 19, 1941, E. Tobinaga); Wakamatsu-shi (May 11, 1941, E. Tobinaga); Mt. Fukuchi-yama (Oct. 25, 1936, E. Tobinaga); Omuta-shi (Ginsui-mura) (Dec. 7, 1935, E. Tobinaga). Pref. Oita: Hakusan-mura (Oct. 20, 1939, N. Hiratsuka). Pref. Kumamoto: Ariake-mura (Jan. 8, 1934 & Nov. 30, 1935, E. Tobinaga);

Shimoda-mura (Amakusa) (Dec. 21 & 22, 1939, N. Hiratsuka). Pref. Miyazaki: Takachiho-cho (Jan. 4, 1936, K. Ide; Oct. 19, 1941, S. Hirata); Mt. Sobosan (Oct. 18, 1941, S. Hirata). Pref. Kagoshima: Kagoshima-shi (Takeoka) (June 9, 1935, K. Ide).

II, III. On *Chrysanthemum Makinoi* Matsum. et Nakai (*Ryuno-giku*).

Japan Proper:- Honshu: Pref. Yamanashi: Mt. Fuji (Lake-side of Shoji-ko) (Aug. 24, 1950, S. Sato & S. Akasawa). Shikoku: Pref. Tokushima: Orono-mura (Nov. 2, 1941, T. Inobe).

II, III. On *Chrysanthemum morifolium* Ramat. var. *sinense* Mak. (*Kiku*) (cultivated).

Japan Proper:- Hokkaido: Sapporo-shi (Sept. 10, 1922, Oct. 10 & Dec. 12, 1924, N. Hiratsuka); Sapporo-shi (Shiroishi-mura) (Aug. 3, 1899, Naoharu Hiratsuka). Honshu: Pref. Miyagi: Sendai-shi (Dec. 15, 1926, Naoharu Hiratsuka). Pref. Yamagata: Higashizawa-mura (July 11, 1933, M. Kato). Pref. Tochigi: Kuroiso-machi (Nov. 12, 1939, K. Ide). Pref. Tokyo: Tokyo (Koishikawa) (Oct. 22, 1899, N. Nanbu, *type of Puccinia Chrysanthemi-chinensis* Hennings!); Tokyo (Komaba) (Nov. 5, 1949, N. Hiratsuka; Oct. 8, 1950, S. Sato). Pref. Kanagawa: Mt. Oyama (Nov. 9, 1952, N. Hiratsuka). Pref. Nagano: Iida-shi (Sept. 30, 1930, K. Kimura). Pref. Tottori: Tottori-shi (July 7, 1939, M. Irie); Daisen-mura (Nov. 9, 1920, N. Hiratsuka). Pref. Hiroshima: Togawachi-mura (Nov. 11, 1939, Y. Morimoto). Shikoku: Pref. Tokushima: Kamiwakekamiyama-mura (Nov. 23, 1934, T. Yoshinaga). Pref. Kagawa: Hirai-machi (Aug. 16, 1938, S. Hirata). Pref. Kochi: Sakawa-machi (Nov., 1901, T. Yoshinaga). Kyushu: Pref. Fukuoka: Hirano (Dec. 5, 1951, E. Tobinaga); Yamaguchi-mura (Aug. 29, 1931, O. Ishiuchi); Kashii-machi (June 17, 1941, M. Nomiyama).

Ryukyus: Amami-Oshima Isl.: Nase-shi (Oct., 1935, T. Tamotsu).

Korea:- Prov. Keiki: Keijyo (Aug. 21, 1940, N. Hiratsuka).

II, III. On *Chrysanthemum Shimotomaii* Mak. (*Nijiga-hamagiku*).

Japan Proper:- Honshu: Pref. Shimane: Yunotsu-machi (Jan. 26, 1939, N. Hiratsuka).

II, III. On *Chrysanthemum Shiwogiku* Kitamura (*Shio-giku*).

Japan Proper:- Shikoku: Pref. Kochi: Yasu-machi (Sengenya) (Oct., 1908, T. Yoshinaga).

II, III. On *Chrysanthemum Zawadskii* Herb. var. *latilobum* Kitamura (*Chosen-nogiku*).

Korea:- Prov. Keiki: Sokitsu-men (Sept. 16, 1941, Y. Fujikuro). Prov. Kogen: Onseirei (Soto-Kongo) (Oct. 18, 1941, T. Osada). Prov. Kannan: Eiko (Eiko-gun) (Oct. 17, 1941, K. Fumiiwa).

Manchuria:- Tokuriji (Oct. 4, 1929 & Sept. 16, 1931, H. Takasugi).

Distribution. Japan (Hokkaido, Honshu, Shikoku, Kyushu), Ryukyu, Isls., Korea, Manchuria, China, North America, Europe, New Zealand, Australia, South America, Africa.

The black rust of the cultivated chrysanthemums, *Puccinia Chrysanthemi* Roze is a native of the Eastern Asia including Japan, Korea and China, where it has been known for many years. It was introduced into England about 1895 and into North America sometime previous to 1896, and quickly spread around the world wherever the chrysanthemum is grown as a green-house crop, largely by the distribution of diseased cuttings.

The present species was first described by Roze in 1900, based upon a specimen on *Chrysanthemum morifolium* Ramat. var. *sinense* Mak. from France.

The writer attempted the following inoculation experiments with the uredospores in order to determine the parasitism of a form of *Puccinia Chrysanthemi* Roze on *Chrysanthemum morifolium* Ramat. var. *sinense* Mak. Two series of experiments were carried out. In the first series, the experiments were made with the uredospores on *Chrysanthemum morifolium* var. *sinense* which were collected by S. Sato at the experimental field of our laboratory, on October 18, 1950. In the second series, the uredospores which were gotten from the green-house belonging to the Horticultural Division, the Faculty, on October 28, 1953 were used as inocula.

The uredospores were inoculated on leaves of the following 14 plants of *Chrysanthemum*, viz. *Chrysanthemum nipponicum* Matsum., *Ch. Leucanthemum* L., *Ch. cinerariaefolium* Vis., *Ch. arcticum* L. subsp. *Maekawanum* Kitam., *Ch. ornatum* Hemsl., *Ch. Shiwogiku* Kitam., *Ch. pacificum* Nakai, *Ch. pacificum* var. *radiatum* Mak., *Ch. Makinoi* Matsum. et Nakai, *Ch. Yoshinagathum* Mak., *Ch. japonense* Nakai, *Ch. indicum* L., *Ch. boreale* Mak. and *Ch. morifolium* Ramat. var. *sinense* Mak. The results of the inoculation experiments are presented in the following table.

The above table shows that positive results were obtained on *Chrysanthemum pacificum* var. *radiatum*, *Ch. Makinoi*, *Ch. indicum* and *Ch. morifolium* var. *sinense*, while on the remaining plants inoculations were unsuccessful.

3. *Puccinia Horiانا* Hennings in Hedwigia, XL, p. (25), 1901; Hiratsuka, Uredinolog. Stud., p. 316, 1955; Ito, Myc. Fl. Jap. II, no. 3, p. 320 & fig. 416, 1950; Kusano in Ann. Myc. VI, p. 311, 1908; Saccardo, Syll. Fung. XVI, p. 296; Sydow, Monogr. Ured. I, p. 48 & pl. III, fig. 40, 1902.

Table 2. Results of inoculation experiments with uredospores of *Puccinia Chrysanthemi* Roze on *Chrysanthemum morifolium* Ramat. var. *sinense* Mak.

Plants inoculated	Date of inoculation	Date of first appearance of uredosori	Degree of susceptibility
<i>Chrysanthemum nipponicum</i>	Oct. 19, 1953	—	—
	Oct. 29, 1953	—	—
<i>Ch. Leucanthemum</i>	Oct. 19, 1953	—	—
	Oct. 29, 1953	—	—
<i>Ch. cinerariaefolium</i>	Oct. 10, 1950	—	—
	Oct. 19, 1953	—	—
<i>Ch. arcticum</i>	Oct. 19, 1953	—	—
	Oct. 29, 1953	—	—
subsp. <i>Maekawanum</i>	Oct. 19, 1953	—	—
	Oct. 29, 1953	—	—
<i>Ch. ornatum</i>	Oct. 19, 1953	—	—
	Oct. 29, 1953	—	—
<i>Ch. Shiwogiku</i>	Oct. 19, 1953	—	—
	Oct. 29, 1953	—	—
<i>Ch. pacificum</i>	Oct. 10, 1950	—	—
	Oct. 19, 1953	—	—
<i>Ch. pacificum</i> var. <i>radiatum</i>	Oct. 29, 1953	—	—
	Oct. 19, 1953	Nov. 6	+
<i>Ch. Makinoi</i>	Oct. 29, 1953	Nov. 8	+
	Oct. 10, 1950	Oct. 25	+
<i>Ch. Yoshinagathum</i>	Oct. 12, 1950	Oct. 26	+
	Oct. 19, 1953	—	—
<i>Ch. japonense</i>	Oct. 29, 1953	—	—
	Oct. 19, 1953	—	—
<i>Ch. indicum</i>	Oct. 29, 1953	—	—
	Oct. 10, 1950	Oct. 26	+
<i>Ch. boreale</i>	Oct. 19, 1953	—	—
	Oct. 29, 1953	—	—
<i>Ch. morifolium</i>	Oct. 10, 1950	Oct. 26	++
	Oct. 12, 1950	Oct. 23	++
var. <i>sinense</i> (control)	Oct. 19, 1953	Nov. 10	+++
	Oct. 29, 1953	Nov. 6	+++

Specimens examined:

III. On *Chrysanthemum indicum* L. (*Abura-giku*).

Japan Proper:- Shikoku: Pref. Tokushima: Washishiki-cho (Jan. 4, 1951, K. Ueta). Kyushu: Pref. Fukuoka: Omuta-shi (Miike) (March 20, 1935, E. Tobinaga); Miike-yama (July 22 & Dec. 8, 1951, E. Tobinaga). Pref. Kumamoto: Itsuma-mura (May 26, 1935, E. Tobinaga). Pref. Miyazaki: Aburatsu-machi (May 8, 1947, S. Hirata).

III. On *Chrysanthemum japonense* Nakai (*Noji-giku*).

Japan Proper:- Shikoku: Pref. Kochi: Akiyama-mura (Kodono) (May 23, 1908, T. Yoshinaga). Kyushu: Pref. Miyazaki:

Kinchaku-jima (Nov. 23, 1940, S. Hirata); Aoshima (July 3, 1942, N. Hiratsuka).

III. On *Chrysanthemum Makinoi* Matsum. et Nakai (*Ryuno-giku*).

Japan Proper:- Honshu: Pref. Shimane: Yokota-mura (June 25, 1937, N. Hiratsuka). Pref. Tottori: Mt. Daisen (Oct. 19, 1935, N. Hiratsuka; Aug. 2, 1943, T. Nishimura). Pref. Yamanashi: Mt. Fuji (Shoji-2-gome-Otawa) (Oct. 23, 1952, N. Hiratsuka & S. Sato). Pref. Shizuoka: Mt. Fuji (Subashiri-mura) (Aug. 15, 1950, Y. Hiratsuka); Mt. Fuji (Gotenba-Subashiri) (July 14, 1951, N. Hiratsuka & S. Sato). Pref. Wakayama: Mt. Izushi-yama (Aug. 4, 1937, E. Tobinaga). Shikoku: Pref. Kagawa: Hirai-machi (Aug. 16, 1938, S. Hirata). Pref. Tokushima: Aratano-cho (July 15, 1950, K. Ueta). Pref. Kochi: Asakura-mura (Nov. 10, 1910, T. Yoshinaga).

III. On *Chrysanthemum Makinoi* var. *wakasaense* Kitamura (*Chrysanthemum wakasaense* Shimotomai) (*Wakasa-hamagiku*).

Japan Proper:- Honshu: Pref. Tottori: Tajiri-mura (June 23, 1929, N. Hiratsuka). Pref. Hyogo: Nishihama-mura (Aug. 16 & Sept. 11, 1938, N. Hiratsuka).

III. On *Chrysanthemum morifolium* Ramat. var. *sinense* Mak. (*Kiku*) (*cultivated*).

Japan Proper:- Hokkaido: Sapporo (Sept. 25, 1924, S. Ito). Honshu: Pref. Niigata: Fukudo-mura (Oct. 5, 1903, K. Yoshino). Pref. Miyagi: Shiroishi-shi (Oct. 28, 1925, Naoharu Hiratsuka). Pref. Tokyo: Tokyo-to (Nishigahara) (July 28, 1895, S. Hori, *type of Puccinia Horiانا* Hennings!); Tokyo-to (Komaba) (June 10, 1952, S. Sato). Pref. Tottori: Nawa-mura (Kanda-bara) (July 19, 1946, N. Hiratsuka). Pref. Hiroshima: Gono-mura (Aug. 8, 1940, Y. Morimoto). Kyushu: Pref. Miyazaki: Udo-mura (June 1, 1946, S. Hirata).

III. On *Chrysanthemum Shiwogiku* Kitamura (*Shio-giku*).

Japan Proper:- Shikoku: Pref. Kochi: Yasu-mura (Tei-saki) (Dec. 24, 1924, T. Yoshinaga).

III. On *Chrysanthemum Shiwogiku* var. *kinokuniense* Shimotomai et Kitamura (*Kinokuni-shigiku*).

Japan Proper:- Honshu: Pref. Wakayama: Shirahama-cho (July, 1933, T. Yoshinaga).

Distribution. Japan (Hokkaido, Honshu, Shikoku, Kyushu) and China.

The present fungus is also very destructive, frequently resulting in complete loss of the crop in the green-house in Japan. It is widely distributed throughout Japan and Continental China.

It was first created by Hennings in 1901 under the name *Puccinia Horiانا* Hennings based upon a specimen on *Chrysanthemum*

Table 3. Results of inoculation experiments with sporidia from teleutospores of *Puccinia Hori*ana Hennings on *Chrysanthemum morifolium* Ramat. var. *sinense* Mak.

Plants inoculated	Date of inoculation	Date of first appearance of teleutospori	Degree of susceptibility
<i>Chrysanthemum coronarium</i>	May 25, 1951	—	—
<i>Ch. nipponicum</i>	May 14, 1951	—	—
	Oct. 22, 1953	Nov. 8	+
<i>Ch. Leucanthemum</i>	May 14, 1951	—	—
	May 25, 1951	—	—
<i>Ch. cinerariaefolium</i>	May 14, 1951	—	—
	May 25, 1951	—	—
<i>Ch. arcticum</i>	May 14, 1951	June 2	+++
subsp. <i>Maekawanum</i>	May 25, 1951	June 18	+++
<i>Ch. ornatum</i>	May 14, 1951	—	—
	May 25, 1951	—	—
<i>Ch. Shiwogiku</i>	May 14, 1951	May 31	++
	May 25, 1951	June 18	++
<i>Ch. pacificum</i>	May 14, 1951	June 1	++
	May 25, 1951	June 18	+++
<i>Ch. pacificum</i>	May 14, 1951	—	—
var. <i>radiatum</i>	May 25, 1951	—	—
<i>Ch. Makinoi</i>	May 14, 1951	May 28	+
	May 25, 1951	June 15	+
<i>Ch. Yoshinagathum</i>	May 14, 1951	May 27	+
	May 25, 1951	June 10	+
<i>Ch. japonense</i>	May 14, 1951	—	—
	May 25, 1951	—	—
<i>Ch. indicum</i>	May 14, 1951	May 29	++
	May 25, 1951	June 18	++
<i>Ch. boreale</i>	May 25, 1951	—	—
	Oct. 29, 1953	Nov. 19	+
	May 14, 1951	May 25	++
<i>Ch. morifolium</i>	May 14, 1951	June 18	+++
var. <i>sinense</i> (control)	Oct. 22, 1953	Nov. 6	+++
	Oct. 29, 1953	Nov. 12	++

mum morifolium Ramat. var. *sinense* Mak., which was collected by S. Hori at Tokyo (Nishigahara), Japan on July 28, 1895.

In May, 1951 and October, 1953, the writer attempted a number of inoculation experiments in order to determine the parasitism of the present species, as related in the paragraph.

In the experiments of 1951, the teleutospores of present fungus on *Chrysanthemum morifolium* Ramat. var. *sinense* Mak. which were collected by S. Sato at the experimental field belonging to Horticultural Division of the Faculty on May 1, 1951, were used as inocula. In the experiments of 1953, the teleutospores of this fungus on the same species which were collected by S. Sato at the experi-

mental field belonging to our laboratory on October 20, 1953, were used as inocula.

Inoculations were made with sporidia from the teleutospores on the following 15 plants of *Chrysanthemum*, viz. *Chrysanthemum coronarium* L., *Ch. nipponicum* Matsum., *Ch. Leucanthemum* L., *Ch. cinerariaefolium* Vis., *Ch. arcticum* L. subsp. *Maekawanum* Kitam., *Ch. ornatum* Hemsl., *Ch. Shiwogiku* Kitam., *Ch. pacificum* Nakai, *Ch. pacificum* var. *radiatum* Mak., *Ch. Makinoi* Matsum. et Nakai, *Ch. Yoshinagathum* Mak., *Ch. japonense* Nakai, *Ch. indicum* L., *Ch. boreale* Mak. and *Ch. morifolium* Ramal. var. *sinense* Mak. The results of the inoculation experiments are recorded in the following table.

The results given in the foregoing table, show that teleutospores were produced on *Chrysanthemum nipponicum*, *Ch. arcticum* subsp. *Maekawanum*, *Ch. Shiwogiku*, *Ch. pacificum*, *Ch. Makinoi*, *Ch. Yoshinagathum*, *Ch. indicum*, *Ch. boreale* and *Ch. morifolium* var. *sinense*, while on the remaining plants inoculations were unsuccessful.

The writer wishes to acknowledge his indebtedness to Mr. Sohji Sato for his faithful help on the present investigations.

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