

Notes on Biogeography and New Records of Rust Fungi in the Great Lakes Region

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Uredinology (the study of rust fungi) includes research in the morphology, phylogeny, and classification of members of this important group of plant pathogenic fungi. This is not a new study, for the first Indiana rust fungus was collected in 1876 (8). Dr. J. C. Arthur published his first manuscript on rust taxonomy in 1883, so the Arthur Herbarium will soon be 100 years old. Biogeography of rust fungi dates back at least to 1929, with Arthur's textbook, *The Plant Rusts*. Our preliminary studies indicate that the Great Lakes area is a promising region for biogeographic studies of rusts. Many of the examples in this paper will be from Michigan, because the geography of the Great Lakes has had clear effects on plant distributions in that state.

At least three procedural problems must be faced. First, geographic information from specimen labels is frequently useless, because it may be out-of-date. A number of Arthur's specimens are from the "Rust Garden" near West Lafayette, Indiana, a small swamp south of town that was a very fertile collecting spot. This was one of two known North American sites for *Triphragmium ulmariae* (DC.) Link in Willd., the rust of *Filipendula rubra* (Hill) Robins. (Queen-of-the-prairie: Rosaceae) (8), but today we cannot locate that swamp. Other labels may be incomplete. For example, one specimen of *Gymnosporangium corniculans* Kern in Arth. (telia on *Juniperus horizontalis* Moench., prostrate juniper: Cupressaceae, MICHIGAN: Leland, 4 June 1909, Kern, PUR 11167, TYPE!) is marked "same place as collected last year". Fortunately, we can deduce from the other specimen (*G. corniculans*, aecia on *Amelanchier erecta* Blanch., shadbush: Rosaceae, 7 Sept 1908, Arthur & Kern, PUR 11157) that the location is the north end of Lake Leland in Leelenau County, Michigan. In addition, some of our other Michigan collections are marked as from "Ann Arbor, Battle Creek, etc." The packets contain three or more rusted leaf fragments, each presumably from a different spot. However, none of these examples are in the same league as that by E. L. Greene, the California botanist, who once published a species "from a locality known only to myself" (Peter Raven, welcoming comments at Missouri Botanical Gardens symposium, 17 Oct 1981).

Another problem encountered in distribution studies is shown in Figure 1. From a tally of the rust specimens in the Arthur Herbarium, in the Herbarium of Albion College (ALBC) in Albion, Michigan, and in the literature reports, there appears to be a roughly trimodal distribution of populations of rust fungi in Michigan. A small center occurs on Isle Royale, and larger assemblages are found near the Straits of Mackinac and in the south-central part of the state. Careful study reveals that these centers actually reflect a special collecting expedition to Isle Royale in 1930 (16), Arthur's summer vacations in Leland (1908, 1909, and 1913), and the locations of four institutions where mycologists have worked (Michigan State University, The University of Michigan, The University of Michigan Biological Station at Pellston, and Albion College). The conclusion must be that the recorded distribution of rust fungi is a function of the distribution of collectors of rust fungi. Thus, the mid-portion of Michigan remains largely a uredinological *terra incognita*. A

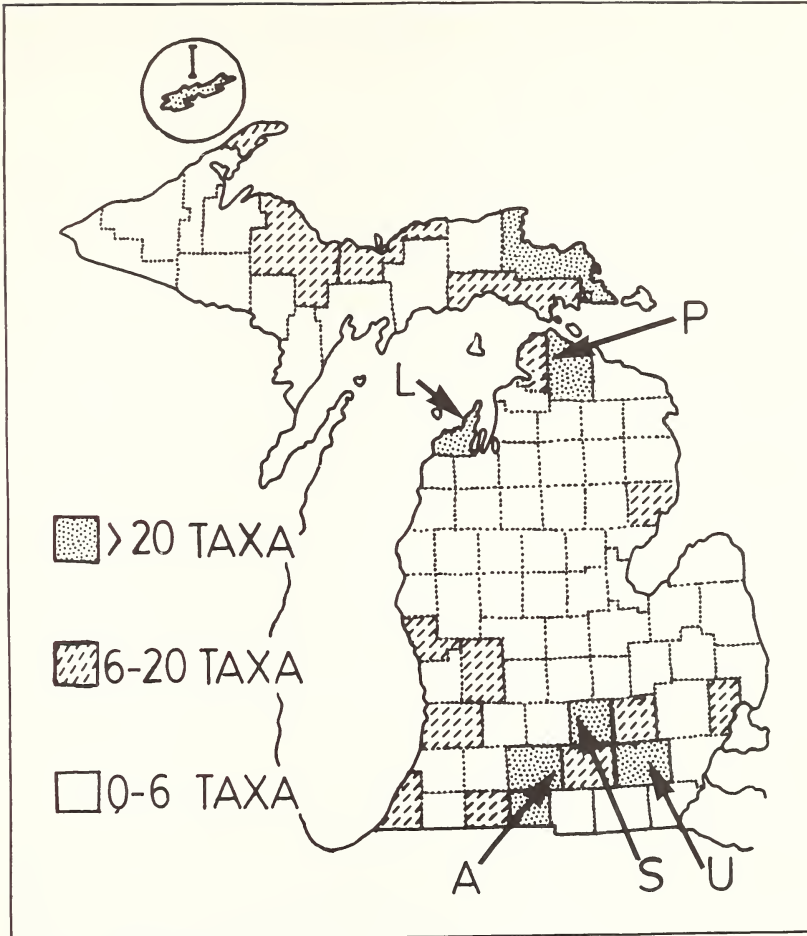


FIGURE 1. Distribution by county of rust species in Michigan, compared with distribution of mycologists. A-Albion College, I-Isle Royale National Park, L-town of Leland, vacation site of J. C. Arthur, P-The University of Michigan Biological Station at Pellston, S-Michigan State University, U-The University of Michigan.

similar analysis for Indiana is even more striking: apparently over 70% of Indiana rust fungi occur within easy collecting distance of West Lafayette! Therefore, although North America is botanically well-studied, compared to the tropics, for example, more rust collecting is still needed in the Great Lakes region, especially of rare species. Insufficient data are available because insufficient field work has been done.

Finally, rust fungi may sporulate at times of the year when the host is not flowering or may deter the host from doing so. Some rust collections consist of only the small portion of the host plant that bears the sori, such as a three-inch piece of a grass or sedge leaf blade. Consequently, the identify of the host plant may be difficult to verify.

One factor is on our side, however. Based on Arthur Herbarium records, only about 175 rust taxa are known from Michigan. Tropical workers have to contend with many more rusts. If El Salvador were the size of Michigan, it would have three times as many rust species.

Biogeography of Rust Fungi: Notes on Great Lakes Species

A goal of any taxonomist is to identify the true relationships of the organisms being studied. Rust taxonomy has often been based on a purely morphological basis or on host ranges. Many rusts cannot be identified until the host plant is named. Other characteristics must be evaluated if rust species are to represent true biological species, e.g., the type of life cycle of the rust. Because biogeography has been used with success by taxonomists of higher plants, we decided to test its application to rust taxonomy in the Great Lakes region. Although Arthur (2) wrote that rust biogeography would be difficult until there was agreement on what all the rust species were, it appears now that biogeography will help determine the identity of the species.

Some preliminary patterns of species distributions are evident among the rust fungi of the Great Lakes area. i) Many rusts are widely distributed in North America, whereas ii) some species are endemic to the Great Lakes. iii) Other species reach the extremes of their ranges in this area, especially those with western affinities, such as those infecting prairie plants. iv) At least three patterns of disjunct distributions can be identified involving Great Lakes rusts: (a) some have their main ranges in the Great Plains or the Rocky Mountains, (b) some are centered on the East Coast, and (c) some have disjunctions that are not easily explained. An example of the latter is the *Filipendula* rust mentioned previously, which is known from Europe, Siberia, and Japan, but only from West Lafayette and Dayton, Indiana, in the Western Hemisphere. v.) The final group includes the introduced rust species, which would give spurious results if not recognized as exotics.

Rusts of Wide Distribution

Indigenous species are defined as natives of a given region, but that region is not necessarily a restricted one. Some rusts have native ranges that extend over large portions of North America, including the Great Lakes states. Two examples are *Coleosporium asterum* (Diet.) Syd., with aecia on pine needles (*Pinus*: Pinaceae) and uredinia and telia on asters (*Aster*: Compositae), and *Pileolaria brevipes* Berk. & Rav. on poison ivy (*Toxicodendron radicans* (L.) Kze.: Anacardiaceae).

Endemic Rust Species

Endemic species are found in restricted areas. Thus, they could be either young species that have not had time to spread widely, or old species that are the remnants of their lineage. Some of the Great Lakes endemic rusts that have been identified so far may be young species because they have morphological characters that are often considered advanced in rust, e.g., wall sculpturing and deciduous pedicels, and may occur on advanced hosts. An example is *Puccinia erigeniae* (Orton) Arth., an autoecious rust of *Erigenia bulbosa* (Michx.) Nutt. (harbinger-of-spring: Umbelliferae). It is known from Ontario, Canada, Ohio, and Michigan (12) (specimen examined: OHIO: Highland Co., Bunker Hill, near Lynchburg, 5 May 1975, Cooke 49736, PUR 66172). Another is *Ravenelia opaca* Diet., an endemic rust so restricted in its range that it probably is now extinct. This lost *Ravenelia* species is known only from a single collection on honey locust (*Gleditsia triacanthos* L.: Leguminosae, ILLINOIS: Union Co., Clear Creek, 13 Aug 1890, Earle, PUR 6508).

A third example of an endemic rust is *Uromyces halstedii* DeT. Trilliums are aecial hosts of this rust in Illinois, Wisconsin, and Quebec (Arthur Herbarium records) but are best known as hosts in Taughannock Falls St. Park near Ithaca, New York (4). A recent collection on *Trillium grandiflorum* (Michx.) Salisb. (Liliaceae) by William Bridge Cooke from southern Ohio is the first report for that state: Pike Co., Pike Lake St. Park, 11 June 1966, *Cooke 37036* (PUR 66194). The telial hosts of this rust are *Brachyelytrum erectum* (Schreb.) Beauv., *Leersia oryzoides* (L.) Sw. (rice cutgrass), and *L. virginica* Willd. (Gramineae). However, the relationship of *Leersia* to this species should be reviewed because (i) there are slight but consistent differences in the rusts on *Brachyelytrum* and on *Leersia*, (ii) inoculation of cutgrass with aeciospores has not been done, and (iii) these hosts have different ecological preferences and are assigned to different tribes of the grass family.

Puccinia paradoxa Ricker, on *Melica smithii* (Gray) Vasey (Gramineae), is known only from Alger County in Michigan's Upper Peninsula and from one phanerogamic specimen from Emmet County, Michigan (10 mi S of the Straits of Mackinac, cited in 12). The distribution of the host is Upper Michigan, the Black Hills, and the Pacific Northwest, so the rust is limited to a disjunct population of the host. There is no evidence to determine if this rust diverged from another rust on Tribe Meliceae after *P. paradoxa* was isolated or if the rust has become extinct in the remainder of its old range.

Rust Species at the Extremes of Their Ranges

Species of flowering plants at the limits of their present range comprise 45% of the Indiana flora (15). Range limits also are known for rust fungi in this region. Some species of rusts reach the eastern extremes of their continuous ranges in Michigan's Upper Peninsula or near the southern Great Lakes at the edge of the prairie biome. *Puccinia grindeliae* Peck is a rust of Compositae, tribe Astereae, that is most common in the southern Rockies, but extends into our area to southwestern Wisconsin and to Isle Royale (16). The easternmost collection record for *Uromyces coloradensis* Ell. & Ev., a Great Plains rust species, is from Porter County, Indiana, on *Vicia americana* Muhl. (vetch: Leguminosae, June 1916, *Deam*, PUR 35315). Another Indiana example is *Puccinia vexans* Farl. on *Bouteloua curtipendula* (Michx.) Torr. (side-oats grama grass: Gramineae, Tippecanoe Co.: bluffs above Wea Creek S of State Road 25, near Shadeland, 24 June 1933, *Cummins & Smucker*, PUR 45685).

Rust Species with Discontinuous Distributions

(a) Rust species that have range discontinuities may be detected by careful mapping of collection records. The first task was to identify them; the unfinished job is to explain them. Recently, Marquis and Voss (13) reviewed western U.S. flowering plant species with separate populations in the Great Lakes region, especially near Lake Superior, and the possible explanations for these patterns. Many such answers involve patterns of glaciation to cause the wide range, and then Sears' Xerothermic Period to produce the discontinuities. Rusts with such disjunctions include *Pileolaria patzcuarensis* (Holw.) Arth. on fragrant sumac (*Rhus aromatica* Ait.) and skunkbush (*R. trilobata* Nutt.: Anacardiaceae), which occurs from Mexico to Colorado and on the eastern shore of Lake Ontario. Thus, this rust is not uniformly distributed, although its hosts are.

Other examples include *Phragmidium ivesiae* Syd., a rust of the western U.S. cordillera that first appeared in Ontario about 25 years ago (18). Three new collections are known from Michigan, all on *Potentilla recta* L. (creeping cinquefoil:

Rosaceae): Calhoun Co.: Albion, 1960, *Stowell*, (in ALBC); Leelenau Co.: Lighthouse Point Park, 7 mi N of Northport, 7 Aug 1978, *Ono 78US-405* (PUR 65635); and Montcalm Co.: Flat River St. Game Area, 2 mi N of Belding, 27 July 1980, *McCain 80016* (PUR 66324). *Uromyces amoenus* H. & P. Syd. on *Anaphalis margaritacea* (L.) B. & H. (pearly everlasting: Compositae) is known from "Wyoming to northern California and British Columbia" (5, p. 203), except for a collection from Rock Harbor on Isle Royale, Michigan (16). Povah (16) also collected, at the same location, *Uromyces fragilipes* Tranz. on *Deschampsia* sp. (Gramineae), a rust known previously only from the Pacific Northwest and from the Eastern Hemisphere.

Puccinia sporoboli Arth. var. *robusta* Cum. & Greene occurs on *Calamovilfa longifolia* (Hook) Hack. var. *magna* Scribn. & Merr. (sand-reed grass: Gramineae—specimen examined: MICHIGAN: Mason Co., Manistee National Forest, 22 Aug 1978, *McCain 78154*, PUR 65930). Voss (19, p. 192) indicated that the hosts in the Lake Huron and Lake Michigan area are of this more open-panicled variety, not listed by Cummins and Greene (6). Figure 2 shows the disjunct distribution of this rust: the sand hills and plains of western Nebraska, eastern Colorado and southeastern Wyoming, and over 400 miles to the east, the sand dunes of the Upper Great Lakes. Aecia on *Smilacina stellata* (L.) Desf. (starry Solomon's seal: Liliaceae) or *S. racemosa* (L.) Desf. (false Solomon's-seal) have been shown by association and by inoculation to be part of the life cycle of *P. sporoboli* var. *robusta* in the eastern section of the range. Most of the western telial material alternated with aecia on *Yucca* spp. (Liliaceae) (6). However, one *Smilacina* specimen is known from Denver, Colorado, and Baxter (4) produced aecia on *Yucca* in Wisconsin by inoculation. This tendency for the two geographic rust groups to have different aecial hosts suggests that the potential for speciation exists, but as yet, no morphological variation can be recognized between the two groups. Note: PUR 49822 is on *Calamovilfa* from Luce Co., Michigan, a county not marked in the distribution map of Voss (19).

(b) A second group of disjunct species in the Indiana vascular plant flora is centered in the Atlantic coastal plain (9). One rust that fits this distribution pattern

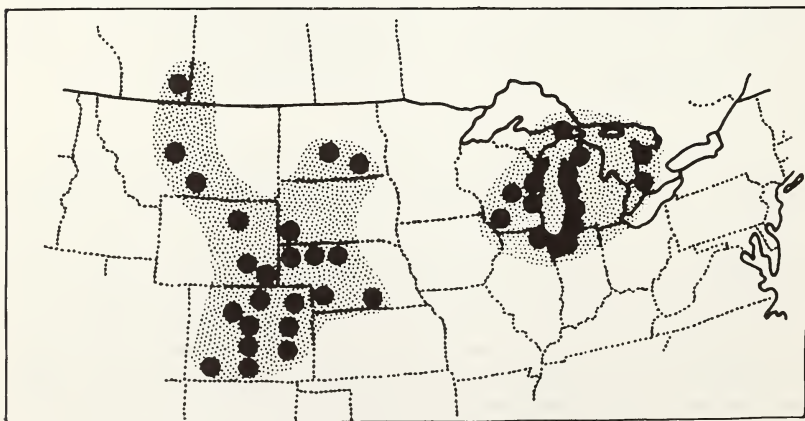


FIGURE 2. Distribution of *Puccinia sporoboli* Arth. var. *robusta* Cum. & H. C. Greene on sand-reed grass. Information from Arthur Herbarium collection records.

is *Puccinia sparganioides* Ell. & Barth., with telia on saltmarsh grass along the East Coast (*Spartina alterniflora* Loisel, *S. cynosuroides* (L.) Roth., and *S. patens* (Ait.) Muhl.: Gramineae) and on prairie cordgrass (*S. pectinata* Link) from north-western Ohio to the Great Plains (Fig. 3). This disjunction may be due to dispersal up the Hudson River corridor. Because these rusts have not yet diverged in morphology, the geographic isolation seems too recent to be due to the uplift of the Appalachian Mountains. Our previous aecial host record for Indiana was pumpkin ash (*Fraxinus profunda* Bush, Oleaceae, Posey County: in swamp 10 mi SW of Mt. Vernon, 15 June 1918, C.C. Deam, PUR 22447). Evans-Ruhl *et al.* (7) reported a new record for Indiana on white ash (*Fraxinus americanus* L., Jay Co., Redkey, 9 July 1981, Purdue Plant Disease Diagnostic Clinic specimen, PUR 66307).

(c) Finally, there is one other group of rust species with disjunct populations in the Great Lakes—the ones that do not seem to fit any pattern. They are far easier to identify than to understand. We exclude those obviously brought in on imported plants, e.g., the tropical *Cerotelium fici* (Butl.) Arth. on a fig tree (*Ficus carica* L., Moraceae, MICHIGAN: Ann Arbor, 1917, Povah, PUR 5546, presumably a greenhouse plant) and the western rust *Cumminsia mirabilissima* (Peck) Nannf. on cultivated grape holly (*Mahonia* sp., Berberidaceae) in Michigan (1). Some examples on wild plants include:

- 1) *Cerotelium tanakae* Ito, on *Amphicarpa* spp. (hog-peanut: Leguminosae), is known, outside of Japan, only from one collection on *A. bracteata* (L.) Fern from Brown County, Indiana (5).

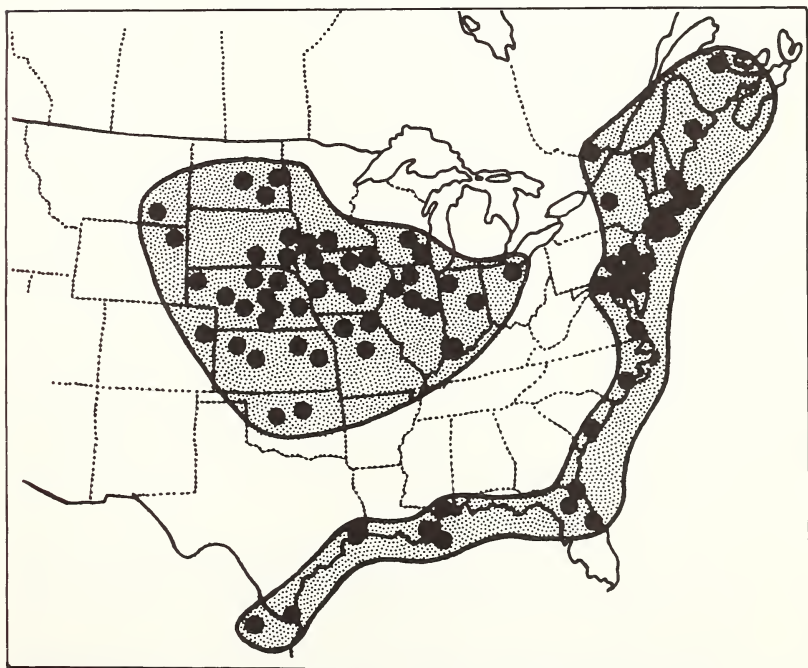


FIGURE 3. Distribution of cord-grass rust, *Puccinia sparganioides* Ell. & Barth. Information from Arthur Herbarium collection records.

2) *Puccinia andina* Diet. & Neg. has been found on *Ranunculus* spp. (buttercup: Ranunculaceae) only in Mexico, Chile, and Argentina, and from Chicago (8).

3) *Puccinia polemonii* Diet. & Holw., on *Polemonium* spp. (Jacob's-Ladder: Polemoniaceae), is known from Scandinavia, Siberia, Alaska, and the Pacific Northwest United States, and on *P. reptans* L. from Half Moon Pond in Posey County, southwestern Indiana. (12).

All three of these rusts were found in our area on native plants. It is unlikely that they were imported, but we cannot explain their distributions. No plate tectonic theory, to date, has suggested a close connection between Japan and central Indiana.

Puccinia andina and *P. polemonii* are known only in the telial state and are presumably microcyclic. One well-accepted route of evolution in rust fungi is life-cycle shortening, with restriction to the aelial host of the former full-cycled species. It would, then, appear reasonably to find widely scattered short-cycle derivatives. This might explain these peculiar disjuncts, except that there are no likely candidates for parental species for the rusts cited here.

Biogeography of Rust Fungi: Summary

Rust biogeography is an attempt to discover relations between rust fungi by study of their historic dispersal trends. Ecological ranges should be studied as well as geographic and host ranges. In addition, because rust fungi are obligate parasites of flowering plants, gymnosperms, ferns, and possibly even mosses, the biogeography of rust fungi is inevitably and intimately correlated with the distribution of their host plants. Rust biogeography is clearly the junior discipline, and few principles are yet available, except in the writings of D. B. O. Savile and E. E. Leppik. A few that may be proposed include:

i) Rust distributions can be a function of their spore dispersal methods. The urediniospores of wheat stem rust (*Puccinia graminis* Pers.) can spread the species, by wind dispersal at high altitudes, more readily and more widely than the teliospores which remain in place on wheat stubble.

ii) Rust fungi cannot be more widespread than their hosts, unless they can adapt to new hosts on which they can spread farther. Host "jumping" has been a major speciation method in rust fungi. Thus, in a given area, if the host does not occur, the rust probably does not, either. However, the converse of this rule does not necessarily follow.

iii) The centers of origin of rust fungi (centers of genetic diversity) are correlated with the centers of their hosts. However, rusts of economic crops, artificially spread with their hosts, will show human influence and not any natural patterns of distribution or variation. Common coffee rust (*Hemileia vastatrix* Berk. & Br.) is now known throughout the world wherever coffee is grown, but it probably originated with its host in Ethiopia.

iv) Topography can noticeably affect even those rusts with efficient wind dispersal adaptations. The gray coffee rust (*Hemileia coffeicola* Maubl. & Roger) has been limited in its spread by its preference for the climates of African mountains and its inability to survive in the intervening lowlands.

v) Because of their ability to jump to new hosts, heteroecious long-cycled rusts or rust species groups may be more widely distributed than species groups in which autoecious cycles are the rule (10). However, in very stable climates (e.g., the tropical rain forest, where host alternation may be superfluous) or in very extreme

climates (deserts or the arctic, where host alternation is risky), autoecism or various kinds of shortened life-cycles may be favored.

vi) Some rust fungi have ranges co-extensive with their hosts, e.g., *Cumminsella mirabilissima*, but others are known from only a limited portion of the range of their host plants.

In summary, the Great Lakes area appears to be a region in which useful rust biogeography studies can be done. A number of new host or distribution records for rust fungi in the Great Lakes region (*sensu lato*) were discovered in this study and are listed in Table 1. Incidental to this work, we also found several new Indiana county records for flowering plants (Table 2).

TABLE 1. *List of new rust or host records*

A. New Host Species Records for Rust Fungi

1. *Frommea obtusa* (Str.) Arth, uredinia on *Potentilla simplex* Michx. (Creeping cinquefoil: Rosaceae), MICHIGAN: Calhoun Co., Whitehouse Nature Center of Albion College, 25 Aug 1978, *McCain 78181* (PUR 65928, ALBC). Some earlier collections may have been on this host, but were combined under *P. canadensis* L.

2. *Puccinia caricina* DC. (*Puccinia pringsheimiana* Kleb. fide Savile, 1973), uredinia on *Carex davisii* Schw. & Torr. (Cyperaceae), INDIANA: Tippecanoe Co., Tippecanoe Battlefield National Historical Monument, 8 June 1978, *McCain 78035* (PUR 66322), in association with spermogonia and aecia on *Ribes cynosbati* L. (Gooseberry: Saxifragaceae), 13 May 1978, *McCain 78017* (PUR 66323). First report of this rust on this host species.

3. *Puccinia caricina* DC., uredinia and telia on *Carex gracilescens* Steudel, INDIANA: Miami Co., 7 1/2 mi S of Peru, 9 May 1978, *Clark* (PUR 65622). First report of a rust on this host species. Savile (17), because of the need for careful host-range and biogeographic studies of the rust species complexes on *Carex*, proposed a "moratorium" on collection of them except where an aecial host connection could be demonstrated. This requirement is fulfilled with the *Carex davisii* rust, but the *C. gracilescens* record could not be published under this standard. The proximity of this collection to either *Ribes* or *Urtica* (stinging nettle) is unknown. In either case, *C. gracilescens* would be a new host species, so mention of it seems warranted. Other species in *Carex* sect. *Gracillimae* (e.g., *Carex plantaginea* Lam. and *C. blanda* Dewey) produce aecia on *Ribes* spp. (including *Grossularia*) and not on *Urtica*.

4. *Puccinia dioicae* P. Magn., uredinia and telia on *Carex annectans* (Bickn.) Bickn. (Cyperaceae), INDIANA: Vigo Co., Kieweg Woods, 5 mi SW of Terre Haute, 19 Sept 1980 (6th Annual A. H. Smith Great Lakes Mushroom Foray), *McCain 80032* (PUR 65993). First report of rust on this host species.

B. Records of Rust Range Extensions

1. *Gymnosporangium clavipes* Cke. & Peck, telia on *Juniperus virginiana* L. (Eastern red cedar: Cupressaceae), INDIANA: Tippecanoe Co., bluffs above Wildcat Creek, 2 mi NE of Lafayette, 23 April 1981, *McCain 81001* (PUR 66234). New northwest range extension for this rust on this host. The former western distribution line ran from near Niagara Falls in Ontario, Canada, through Madison, Indiana, to Texas. Although the range of the host extends to mid-Nebraska, and the rust is found west to Mexico and British Columbia, the host west of Ohio and southern Ontario has been *Juniperus communis* L. var. *depressa* Pursh. (14).

2. *Puccinia malvacearum* Bert. & Mont. in Gay, telia on *Althea rosea* (L.) Cav. (hollyhock: Malvaceae), MICHIGAN: Midland Co., Midland, Dow Gardens, 28 July 1980, *McCain 80020-A* (PUR 66329) — ca. 70 mi NE of any specimen recorded in PUR. The host is an introduced ornamental, and the rust is Eurasian in origin.

3. *Puccinia podophylli* Schw., telia on *Podophyllum peltatum* L. (May apple: Berberidaceae), MICHIGAN: Montcalm Co., 1 1/2 mi S of Sheridan, 27 July 1980, *McCain 80018* (PUR 66325) — extension of range of rust 50 mi to NW.

C. New Indiana Host Records for Rust Fungi

1. *Coleosporium campanulae* Lev. ex Kickx., uredinia and telia on *Campanula rapunculoides* L. (bell flower: Campanulaceae), Lake Co.: 1 mi S of Cedar Lake, 26 July 1978, *Ono 78-US-337* (PUR 65631).

2. *Puccinia anemones-virginianae* Schw., telia on *Anemone canadensis* L. (thimble-weed: Ranunculaceae), Tippecanoe Co.: wet bluffs above Flint Creek, 3 mi W of West Point, 26 July 1978, *McCain 78094* (PUR 65629).

3. *Puccinia dioicae*, telia on *Carex communis* L. H. Bailey, Martin Co.: 1 mi W of Shoals, 5 May 1940, *Kriebel 8770* (PUR 65623- ex PUL).

TABLE 1.—Continued

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4. *P. dioicae*, telia on *Carex rosea* Schk. (in association with aecia on *Solidago* sp., goldenrod: Compositae), Tippecanoe Co., McCormick's Woods Forestry Laboratory of Purdue University, just W of West Lafayette, 27 June 1978, *McCain 78059* (PUR 66326).
 5. *P. helianthi* Schw., telia on *Helianthus microcephalus* T. & G. (small wood sunflower: Compositae), Dubois Co.: Jasper, Purdue plant disease clinic specimen *W80288*, ident. 20 Oct 1980 by J. W. McCain (PUR 66053). New Indiana reservoir host for sunflower rust.
 6. *P. malvacearum*, telia on *Malva neglecta* Wallr. (mallow: Malvaceae), Steuben Co.: Ashley, in strawberry patch, 30 May 1979, *McCain 78059* (PUR 66326).
 7. *P. sparganioides*, aecia on *Fragaria americana* (see text).
 8. *Puccinia striiformis* Westend. ("stripe rust") on *Triticum aestivum* L. (wheat: Gramineae), Carroll Co., 29 May 1981, *Schall* (PUR 66331).
 9. *Uromyces triquetrus* Cke., aecia on *Hypericum kalmianum* L. (St. John's-wort: Hypericaceae), Porter Co.: Indiana Dunes National Lakeshore, West Beach Unit, 29 July 1978, *McCain 78112* (PUR 65630).

D. New Records for Rust Fungi in Other Great Lakes States

1. *Coleosporium campanulae*, uredinia on *Campanula rapunculoides*, MICHIGAN: Leelenau Co., Lighthouse Point, 7 mi N of Northport, 23 Aug 1978, *McCain 78166* (PUR 65928)—new host for Michigan.
 2. *P. dioicae*, telia and scant uredinia on *Carex aenea* Fern., MICHIGAN: Keewenaw Co., Porter Island, Isle Royale Nat. Park, 11 Sept 1961, *Shelton 189* (PUR 66330, ex PUL 37002)—new host for Michigan. Previously reported from Minnesota, Wisconsin, and Montana.
 3. *P. iridis* (DC). Wallr., uredinia on *Iris tectorum* Maxim. (Iridaceae), OHIO: Hamilton Co., Anderson Twp., 17 Sept 1974, *Cooke 49483* (PUR 66205)—new host for Ohio.
 4. *P. malvacearum*, telia on *Malva rotundifolia* L. (cheeses: Malvaceae), OHIO: Clark Co., Springfield, Green Twp., 16 May 1976, *Carter* (PUR 65366)—new host for Ohio.
 5. *P. polygoni-amphibii* Pers., aecia on *Gewranium maculatum* L. (wild geranium: Geraniaceae), OHIO: Hocking Co., Old Man's Cave St. Park, 30 May 1964, *Cooke 34622-A* (PUR 66020)—new host for Ohio.
 6. *Transschelia pruni-spinosae* (Pers.) Diet., aecia on *Hepatica acutiloba* DC. (liver leaf: Ranunculaceae), OHIO: Highland Co., Fort Hill St. Memorial, 20 April 1963, *Cooke 33995-B* (PUR 66185)—new host for Ohio. This is an anamorph of the rust of wild black cherry.
 7. *Uromyces halstedii*, aecia on *Trillium grandiflorum*—see text.
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TABLE 2. List of new Indiana county records for flowering plants

Some of these reports are based upon specimens received for identification by the Plant Disease and Weed Diagnostic Clinic at Purdue University. Plant specimens received with requests for advice on herbicide control treatments sometimes have represented new state or county records, e.g., *Vulpia myuros*—which is listed only as an example. Such records have been excluded from this report, for the plants presumably are not persisting. The clinic specimens that are listed represent either those which are well established or those which were sent in to the clinic for information only. Nomenclature is according to *Gray's Manual of Botany*, 8th ed. (1950).

1. *Sparganium eurycarpum* Engelm. (giant bur-reed: Sparganiaceae), Tippecanoe Co.: swamp near Battle Ground, 9 June 1939, *Cummins 39-84* (PUL 974).
2. *Vulpia myuros* (L.) K. C. Gmel. (foxtail fescue: Gramineae), Whitley Co.: Columbia City, turf-grass farm (presumably extirpated), 26 June 1980, Purdue plant disease clinic specimen.
3. *Alopecurus aequalis* Sobol. (short-awn foxtail: Gramineae), Whitley Co.: Columbia City, 26 June 1980, Purdue plant disease clinic specimen.
4. *A. carolinianus* Walt. (Carolina false-timothy: Gramineae), Washington Co.: near Campbellsburg, 21 May 1979, Purdue plant disease clinic specimen *W79117*.
5. *Chloris verticillata* Nutt. (windmill grass: Gramineae), Jackson Co.: Seymour, 10 Aug 1981, Purdue plant disease clinic specimen *W81-142*.

TABLE 2. — Continued

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6. *Phalaris arundinacea* L. (reed canary grass: Gramineae), Tippecanoe Co.: West Lafayette, S edge of Purdue University campus along abandoned railroad tracks, 12 July 1978, *Hennen*.
 7. *Cyperus esculentus* L. (yellow nutsedge: Cyperaceae), Tippecanoe Co.: West Lafayette, Purdue University campus, 18 Sept 1963, *Stryker*.
 8. *Cyperus tenuifolius* (Steud.) Dandy (= *Kyllinga pumila* Michx.: Cyperaceae), Vanderburgh Co.: Evansville, 31 Aug 1981, Purdue plant disease clinic specimen.
 9. *Scirpus fluviatilis* (Torr.) Gray (River bulrush: Cyperaceae), Tippecanoe Co.: Purdue University wildlife area, 8 mi W of West Lafayette, T.23N, R. 6 W, Sect. 12, 17 July 1980, *McCain 80009*.
 10. *Carex tenera* Dew. (slender sedge: Cyperaceae), Carroll Co.: 1 mi S of Delphi, 16 June 1978, *Lembi*.
 11. *Juncus torreyi* Coville (rush: Juncaceae), Benton Co.: 1 mi SE of Fowler along US Hwy 52, 19 July 1978, *McCain 78088*.
 12. *Luzula echinata* (Small) F. J. Herm. var. *mesochorea* F. J. Herm. (woodrush: Juncaceae), Tippecanoe Co.: 3 mi SE of Green Hill, T. 23 N, R. 6 W, Sect. 34, 13 May 1979, *S. Ulrich*.
 13. *Castanea dentata* (Marsh.) Borkh. (American chestnut: Fagaceae), Tippecanoe Co.: West Lafayette, in woods about 200 yards west of Purdue University Horticulture Park, July 1978, *Hennen*.
 14. *Sagina decumbens* (Ell.) T. & G. (pearlwort: Caryophyllaceae), Vigo Co.: Terre Haute, weed in yard, 5 May 1979, Purdue plant disease clinic specimen.
 15. *Myosuros minimus* L. (mousetail: Ranunculaceae), Greene Co.: Worthington, 7 May 1979, *Weathers*.
 16. *Berteroa incana* (L.) D. (hoary alyssum: Cruciferae), Tippecanoe Co.: West Lafayette, 720 Vine St., no date, *Hansen* (PUL 9381).
 17. *Croton monanthogynus* Michx. (croton, prairie-tea: Euphorbiaceae), Tippecanoe Co., West Lafayette, gravel pit at S edge of Purdue campus, 8 Oct 1958, *Cummins* (PUL 12245).
 18. *Lysimachia nummularia* L. (moneywort: Primulaceae), Washington Co.: Salem, 14 June 1979, *Adams*.
 19. *Lamium amplexicaule* L. (henbit: Labiatae), Tippecanoe Co.: West Lafayette, Purdue University Horticulture Park, 1 May 1969., *Derr*.
 20. *Houstonia caerulea* L. (Bluets, Quaker-ladies: Rubiaceae), Tippecanoe Co.: West Lafayette, 15 May 1971, *Hewitt*.
 21. *Triosteum angustifolium* L. (yellow-flowered horse-gentian: Caprifoliaceae), Randolph Co.: near Farmland, 01 Oct 1979, Purdue plant disease clinic specimen 79-W197.
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