Host Range of Synchytrium aecidioides.

By John S. Karling (USA.).

Synchytrium aecidioides is the most common species of the genus in North America and may be found usually wherever the hog peanut, *Amphicarpaea bracteata,* is abundant. It has been reported also on leguminous hosts from Ecuador, the Philippine Islands, China, Japan, Java and India. Although collected much earlier apparently, it was described first by Peck as *Uredo aecidioides* in 1871. Farlow made a careful study of it in living material in 1878 and 1883, and transferred the fungus to *Synchytrium.* He described it as a variety, *decipiens,* of *S. fulgens,* but in 1885 he diagnosed it as a separate and distinct species, *S. decipiens.* Farlow's specific name has been used almost exclusively, although the name proposed by Peck has priority. This is due in part to Patouillard and Lagerheim's (1891) discovery of what they believed to be the same species on *Psoralea mutisii* in Ecuador and the subsequent exclusion of their species by Tobler (1912). They recognized the priority of Peck's name and called their species *S. aecidioides,* but Tobler excluded it on the grounds that collections of their material in the Berlin herbarium consisted of membrane-free sori similar to those produced by *Synchytrium* species on *Psophocarpus* and *Vigna* *).

Inasmuch as Peck's fungus appears to have a limited host range, it is quite probable that Patouillard and Lagerheim's material relate to a different species, or possibly a variety or biological race of *S. aecidioides.* In material of *U. aecidioides* on *Amphicarpaea monoica* (*bracteata*) which was distributed by Peck I have found open pustules with collapsed sporangia which are typical of dried herbarium specimens of *S. aecidioides,* and there is no doubt in my mind that Peck's original description concerns a species of *Synchytrium.* The name *aecidioides* not only has priority, but is more descriptive of the open aecidium-like pustules filled with sporangia.

This species has been reported as occuring on *Amphicarpaea monoica, Falcata comosa* and *F. pitcheri* in the U.S.A., *F. japonica* in China and Japan, and *A. edgeworthii* in India. According to Fernald (1950) *A. monoica, F. comosa* and *F. pitcheri* are synonymous

*) This study has been supported by a grant-in-aid from the National Science Foundation.

The author is very grateful to Mr. B. T. Lingappa for seeds of legumes from India, and to Dr. A. T. Guard for identifying several of the hosts.

with *A. bracteata* and *A. bracteata* var. *comosa,* and the latter species and variety appear to be the only hosts in North America. *Falcata japonica,* according to Ito (1936) is synonymous with *A. edgeworthii* var. *japonica.* Thusly, the reported *Amphicarpaea* hosts of *S. aecidioides* consist of two species and two varieties. In addition this fungus has been reported on *Psoralea mutisii* in Ecuador (Patouillard and Lagerheim), *Vigna vexillata* in Costa Rico (Stevens, 1927) and *Dolichos* sp. in the Philippine Islands (Baker, 1914).

The last three reports suggest that *Synchytrium aecidioides* may have a wide host range, but my failure over a period of many years to find it on other leguminous hosts growing among infected. *A. bracteata* plants has led me to question the identity of *S. aecidioides* (*decipiens*) reported on other hosts. All species of the subgenus *Woroninella,* to which *S. aecidioides* belongs, are very similar in the small size of their sporangia, type of galls produced, general appearance, and their limitation to leguminous hosts, and because of this the question has been raised of whether or not some of these species might be identical, or varieties, or biological races of *S. aecidioides.* Host range studies are obviously essential to the solution of such problems, and the need for such studies are becoming more important in view of the tendency of a great many workers to create a new species of *Synchytrium* for each new host. The present contribution is one in a series of such host range studies and concerns *S. aecidioides.* Similar studies on other species of the subgenus *Woroninella* are in progress.

As far as was possible in this study the same or closely related hosts of other *Woroninella* species were used. *Crotalaria* species, for instance, are reported to be the hosts of *S. crotalariae* and *S. atylosiae; Desmodium* species are hosts of *S. citrinum*; *Phaseolus* species are hosts *S. phaseoli*; *Psoralea* species are hosts of *S. aequatoriensis*; *Vigna sinensis* is the host of *S. vignicola*; *Dolichos* species are hosts of *S. dolichi,* and *Pueraria* species are hosts of *S. minutum.* In many cases it was impossible to secure seeds of identical hosts, and in such instances different species of the same genus were used.

The inoculum of *S. aecidioides* used in this study occured on *Amphicarpaea bracteata* plants in the Ross Biological Reserve of Purdue University. Heavily infected seedlings were transferred from the Reserve to a shady and damp plot adjacent to the greenhouses at Purdue University, and during a period of three years these plants and their offspring have spread and become well established along with their parasite. By this procedure an abundance of fresh and readily available inoculum was assured, which is highly essential to critical host range studies. The technique and procedure used in the inoculation experiments were first tested on seedlings of *A. brac-*

teata to determine their feasibility and effectiveness in causing infection. Also, the inoculum was examined microscopically to determine the presence of healthy sporangia and their ability to produce viable zoospores. In testing the susceptibility of various plants two procedures were followed. In the first method seeds were planted in 6″ pots, and as soon as the cotyledons and other leaves emerged they were washed with a 0.5% solution of the wetting agent „Tween 80" to insure a thorough wetting of the epidermis. They were then rinsed with distilled water to remove the detergent, and a heavily infected piece of *A. bracteata* leaf was inserted between them. The laeves and the inoculum were swathed in water-absorbent cotton, and the pots were covered with bell jars to maintain a moist environment. Care was taken to keep the host leaves and inoculum from becoming waterlogged. Examinations were made every three days over a period of four months to determine wheter or not infection occurred. In doubtful cases, the inoculated leaves were removed and examined under a low-power stereoscopic microscope. Also, free-hand sections were made and studied in cases where infections and galls appeared to be present.

In the second method seeds were germinated on filter paper in moist chambers, and the cotyledons and other leaves emerged they were inoculated in the manner noted above. Under such conditions it was not necessary to swath the leaves in water-absorbent cotton. Examinations were made every third day for infections, and when the seedlings became too large for the moist chambers they were planted in flats in the greenhouse where they were further observed for four months. It may be noted here that in both methods seedlings of *A. bracteata* became heavily infected, indicating that the procedures used were effective.

In addition to the two main procedures noted above, seeds of *Amphicarpaea bracteata, Crotalaria stricta, Glycine soja, Phaseolus vulgaris, P. limensis, Vigna sinensis* and *Pueraria thunbergiana* were sown in the late spring of 1953 in areas of the Ross Biological Reserve where heavily infected seedlings of *A. bracteata* were present. As these seeds germinated their seedlings became intertwined with the infected vines of *A. bracteata,* and excellent out-of-door opportunities and conditions for infection were provided.

In each of the laboratory and greenhouse experiments the following plants were used as hosts, and the number in parenthesis after each species indicates the number of plants inoculated:

Leguminoseae: *Amphicarpaea bracteata* var. *comosa* (12), *Amorpha fructicosa* (20), *Apios americana* (12), *Cajanus indicus* (15), *Cassia fasciculata* (12), *Crotalaria stricta* (28), *Desmodium bracteosum* (12), *Dolichos lablab* (red 15, black 15), *Dolichos lignosa* (12),

Glycine soja (15), *Petalostemom purpureum* (15), *Phaseolus atropurpurens* (5), *P. vulgaris* (15), *P. limensis* (15), *Pisum sativum* (15), *Psoralea onobrychis* (15), *Pueraria thunbergiana* (15), *P. phaseolioides* (15), *Robinia pseudo-acacia* (5), and *Vigna sinensis* (15).

Malvaceae: *Althaea officinalis* (10), *A. rosea* (10), *Malva rotundifolia* (10), *Modiola caroliniana* (10), *Hibiscus esculentus* (10), and *H. syriacus* (10).

Geraniaceae: *Geranium carolinianum* (10), *G. maculatum* (10), and *G. pusillum* (10).

Carophyllaceae: *Arenaria serpyllifolia* (10), *Cerastium vulgatum* (10), and *Stellaria media* (10).

The results of these inoculations of seedlings in moist chambers and in the greenhouse were negative with the exception of one plant of *Amphicarpaea bracteata* var. *comosa*. On this plant only a few scattered galls were present, and approximately one-half of these degenerated before the sori and sporangia of the parasite matured. Likewise, the results of the field experiments noted above were negative except for *Amphicarpaea bracteata*.

These results indicate that *S. aecidioides* from the Ross Biological Reserve will infect only *Amphicarpaea bracteata* and its variety *comosa* under the conditions of these experiments, and apparently has a very limited host range. In view of this it is possible that the *Synchytrium aecidioides* (*decipiens*) reported by various workers on other hosts relate to different species. On the other hand, it is equally plausible that they may relate to biological races of *S. aecidioides* which will infect other leguminous hosts besides *A. bracteata*. In that event the problem of host range, host specificity, and obligate parasitism of *S. aecidioides* may prove to be a complicated one. It will involve host testing of a large number of collections of *S. aecidioides* from various parts of the western hemisphere, particularly from localities where it is reported to occur on other hosts, as well as morphological studies on the size, shape and structure of the galls, sori, sporangia and zoospores of each collections.

Summary.

The host range and host specificity of *Synchytrium aecidioides* which occurred on *Amphicarpaea bracteata* in the Ross Biological Reserve were tested on 20 leguminous and 12 non-leguminous species. All but the original host and its variety *comosa* remained uninfected under laboratory, green house and field conditions. Apparently, this collection or strain of *S. aecidioides* has a limited host range. The reports in the literature of the occurrence of this species on other

legumes besides *A. bracteata* may relate possibly to different *Synchytrium* species or biological races of *S. aecidioides*.

Department of Biological Sciences
Purdue University
Lafayette, Indiana.

References.

Baker, C. F. 1914. The lower fungi of the Philippine Islands. Leaf. Philippine Bot. 6, Art. 102: 2065—2190.

Farlow, W. G. 1878. List of fungi found in the vicinity of Boston. pt. II. Bull. Bursey Inst. 2: 224—252.

— 1883. Notes on some species in the third and eleventh centuries of Ellis' North American fungi. Proc. Amer. Arts. Sci. 18: 65—85.

— 1885. The Synchytria of the United States. Bot. Gaz. 10: 235—245.

Fernald, M. L. 1950. Gray's Manual of Botany, 8th ed. Amer. Book Co., Boston.

Ito, S. 1936. Mycological Flora of Japan I. Phycomycetes. Tokyo.

Patouillard, N. and G. Lagerheim, 1891. Champignons de l'equateur. I. Bull. Soc. Mycol. France 7: 158—186.

Peck, C. H. 1871. Report of the botanist. Ann. Rept. State Mus., New York 24: 41—108.

Stevens, F. L. 1927. Fungi from Costa Rica and Panama. Ill. Univ. Biol. Monogr. II: 159—254.

Tobler, G. 1912. Die Synchytrien. Arch. Protist'k. 28: 141—238.