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PARASITISM OF COMANDRA UMBELLATA

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PARASITISM OF COMANDRA UMBELLATA

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One of the most important and most injurious of the stem or blister rusts occurring on pines is *Peridermium pyriforme* Peck, which attacks *Pinus (murrayana) contorta* Loud., *P. ponderosa* Laws., and *P. ponderosa scopulorum* Engelm. in the western United States, *P. divaricata* Du Mont de Cours. in the Northern States, and *P. pungens* Michx. and *P. rigida* Mill. in the Northwestern States. *Peridermium pyriforme* is a heteroecious rust and is dependent for its existence upon its alternate, or summer, stage, which occurs on species of *Comandra*.

The problem of the eradication of this important rust being so intimately associated with plants of *Comandra* spp. led the writer to investigate their manner of growth and means of propagation. It was found that the plants of at least two species, *C. pallida* A. DC. and *C. umbellata* (L.) Nutt., have apparently become largely dependent on parasitism for their continued existence. The other two North American species, *C. livida* Richards, and *C. richardsiana* Fernald, resemble the former species in appearance and habit and are probably equally parasitic in their nature.

The writer has carefully examined the root system of living plants of both *C. umbellata* and *C. pallida*, but only of dried specimens of the other two species. The former have long underground rootstocks which bear here and there small roots or rootlets usually less than 5 inches in length. These rootlets branch sparsely and are nearly always attached to the roots or underground stems of other species of plants. At the point of attachment there is formed by the root of *Comandra* spp. a nearly hemispherical disk or holdfast. This holdfast is either superficial or slightly embedded in the cambium layer of tissues of the host, but does not send out haustoria, as is the case in species of *Razoumofskyia* on the limbs and trunks of coniferous trees. The chief function of the roots of *Comandra* spp. appears to be that of attachment to host plants for the purpose of obtaining nourishment and a water supply. Plants of *Comandra* spp. frequent dry, rocky soils, which often have a low water content.

Plants of all these species of *Comandra* bear leaves; and although attached as parasites to the roots of other plants, they are not entirely dependent upon their host plants for organic compounds, since they are able to further elaborate these compounds in the liquids received from

their hosts. In this respect their development is similar to that of plants of species of *Phoradendron*.

Both *C. umbellata* and *C. pallida* very commonly are associated with and parasitic upon species of *Vaccinium*, but are not at all dependent upon this genus for host plants. This has especially been noted in the case of *C. pallida* in the States of Colorado, Montana, Nebraska, South Dakota, and Wyoming, and in *C. umbellata* in the States of Connecticut, Maryland, Michigan, Minnesota, New Jersey, New York, Pennsylvania, Vermont, Virginia, and Wisconsin, and the District of Columbia. Plants of both species are parasitic upon a great variety of plants belonging to widely different sections of the Spermatophyta. No attachment to plants of any member of the Pteridophyta has been noted.

C. umbellata has been found by the writer as a parasite on the roots of the following species of plants in the Eastern States:

<i>Acer rubrum</i> L.	<i>Meibomia paniculata</i> (L.) Kuntze.
<i>Achillea millefolium</i> L.	<i>Panicum</i> sp.
<i>Andropogon virginicus</i> L.	<i>Poa compressa</i> L.
<i>Angelica villosa</i> (Walt.) B. S. P.	<i>Poa pratensis</i> L.
<i>Antennaria plantaginifolia</i> (L.) Richards.	<i>Populus tremuloides</i> Michx.
<i>Aster ericoides</i> L.	<i>Potentilla monspeliensis</i> L.
<i>Aster macrophyllus</i> L.	<i>Quercus coccinea</i> Muenchh.
<i>Aster patens</i> Ait.	<i>Quercus digitata</i> (Marsh.) Sudw.
<i>Aster undulatus</i> L.	<i>Quercus marilandica</i> Muenchh.
<i>Baptisia tinctoria</i> (L.) Br.	<i>Quercus nana</i> (Wood) Britton.
<i>Betula nigra</i> L.	<i>Rhus copallina</i> L.
<i>Betula populifolia</i> Marsh.	<i>Rosa blanda</i> Ait.
<i>Carex</i> sp.	<i>Rosa canina</i> L.
<i>Castanea dentata</i> (Marsh.) Borkh.	<i>Rubus canadensis</i> L.
<i>Chimaphila umbellata</i> (L.) Nutt.	<i>Rubus procumbens</i> Muhl.
<i>Chrysopsis mariana</i> (L.) Nutt.	<i>Rubus villosus</i> Ait.
<i>Comptonia peregrina</i> (L.) Coulter.	<i>Solidago bicolor</i> L.
<i>Danthonia compressa</i> Austin.	<i>Solidago caesia</i> L.
<i>Fragaria americana</i> (Porter) Britton.	<i>Solidago juncea</i> Ait.
<i>Fragaria virginiana</i> Duchesne.	<i>Solidago nemoralis</i> Ait.
<i>Gaylussacia frondosa</i> (L.) T. and G.	<i>Solidago speciosa</i> Nutt.
<i>Hieracium venosum</i> L.	<i>Spiraea salicifolia</i> L.
<i>Ionactis linariifolius</i> (L.) Greene.	<i>Vaccinium atrococcum</i> (A. Gray) Heller.
<i>Lespedeza violacea</i> (L.) Pers.	<i>Vaccinium nigrum</i> (Wood) Britton.
<i>Lysimachia quadrifolia</i> L.	<i>Vaccinium vacillans</i> Kahn.

In addition to the foregoing and incomplete list there must be added at least three unidentified species of grasses.

During the last three years a number of attempts, with varying success, have been made at Washington, D. C., to grow plants of *C. umbellata* and *C. pallida*, both by germinating the seed and by transplanting rootstocks to beds and pots in greenhouses. In every case where living rootstocks unattached to host plants have been transplanted to pots or

beds without the host plants present, little or no growth on the part of the plants of *Comandra* spp. has taken place, and the plants eventually died. Successful results in growing these species have been accomplished by only two methods: First, by transplanting sods containing the plants of *Comandra* spp. from out of doors to the greenhouse without breaking the attachments of the roots of the parasite to those of the host; second, by planting seed in flats in the fall out of doors and germinating them in the presence of the roots of host plants after exposing the seeds to freezing temperatures by allowing the flats to remain out of doors all winter.

Dr. E. P. Meinecke, of the Office of Forest Pathology, reports by letter that he has three plants of *C. umbellata* raised from seed sown in 1913, which remained dormant till 1915, when they germinated and grew without any host plant. These plants were 5 inches high on July 17, 1915. This is positive proof that this species of *Comandra* can live without parasitism if necessary. It remains to be seen whether these plants will continue to grow indefinitely without the presence of host plants.

The results from our experiments indicate that when the rootstocks of plants of *Comandra* spp. are broken entirely loose from their root attachment to host plants they usually die through an inability to re-attach themselves. These new data on a subject which apparently has not been previously investigated indicate a greater degree of parasitism in species of *Comandra* than has hitherto been suspected, and will render more obvious the desirability of the destruction of plants of *Comandra* spp. in the vicinity of forest-tree nurseries.

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