Germination of Basidiospores of Cronartium comandrae on Rocks and Vegetation

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ABSTRACT

Basidiospores of *Cronartium comandrae* exhibited a low capacity to form secondary spores on several kinds of vegetation and rocks common to the Rocky Mountains. This might indicate that germination by repetition only slightly increases the possibility for successful dissemination from comandra to lodgepole pine.

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Comandra blister rust, caused by the rust fungus *Cronartium comandrae* Peck, is a common and damaging disease of lodgepole pine (*Pinus contorta* Dougl.). Within the Rocky Mountain States, the principal alternate host is comandra (*Comandra umbellata* [L.] Nutt. ssp. *pallida* [A.DC.] Piehl). Being intolerant to dense shade, this small forb does not occur within closed stands of lodgepole pine, but inhabits rangelands adjacent to them. Inasmuch as these two hosts occupy separate habitats, basidiospores produced on comandra plants must traverse distances up to several kilometers to reach pines. An important impediment to successful aerial dissemination is the interception of basidiospores by vegetation, rocks, etc., before they reach infection sites. When such interceptions occur, redispersal might result from the formation of secondary basidiospores (3), as has been reported for *Cronartium ribicola* J. C. Fisch. ex Rabenh. and *C. fusiforme* Hedge. & Hunt ex Cumm. (1, 5).

We evaluated the possibility for formation of secondary basidiospores of *C. comandrae* on several of the most likely kinds of vegetation and rocks that might intercept basidiospores near lodgepole pines in the Rocky Mountains. The portion of this research on which I reported in 1969 (4) is expanded here to include grasses that might be planted in rehabilitation of rangelands.

Tests were made using fresh current-year leaves from four native plants and three introduced grasses as well as current-year needles and stems from lodgepole pine, 2% water agar (about pH 6.7), and local rocks. The four native plants included sagebrush (*Artemisia tridentata* Nutt. ssp. *vaseyana* [Rydb.] Beetle), comandra (*C. umbellata* ssp. *pallida*), aspen (*Populus tremuloides* Michx.), and subalpine fir (*Abies lasiocarpa* [Hook.] Nutt.). Introduced grasses included crested wheatgrass (*Agropyron cristatum* [L.] Gaertn.), intermediate wheatgrass (*A.*

TABLE 1. Germination of basidiospores of *Cronartium comandrae* on various substrates[a]

Secondary basidiospores (%)											
Intermediate wheat	Aspen	Comandra	Crested wheat	Smooth brome	Quartzite	Agar	Pine stem	Fir	Pine needles	Limestone	Sagebrush
13.2	13.2	12.5	8.2	7.0	6.5	6.0	4.8	3.8	2.0	1.2	0.0

Long germ tubes (%)											
Agar	Pine needles	Fir	Pine stem	Smooth brome	Intermediate wheat	Crested wheat	Quartzite	Comandra	Aspen	Limestone	Sagebrush
79.5	63.8	40.5	36.8	15.0	14.5	14.2	14.0	10.0	5.5	0.7	0.0

Stubby germ tubes (%)											
Limestone	Aspen	Comandra	Quartzite	Agar	Pine needles	Fir	Pine stem	Smooth brome	Crested wheat	Intermediate wheat	Sagebrush
69.0	38.3	35.5	15.5	9.5	6.8	5.3	3.0	1.2	1.0	0.5	0.0

[a]Mean percentages are ranked in descending order, and are compared by Duncan's new multiple range test (2) while using arc sine transformed data. Percentages not underlined in common were significantly different at the 95% confidence level.

intermedium [Host] Beauv.) and smooth brome (*Bromus inermis* Leyss.). Rock substrates consisted of small, clean pieces of quartzite and limestone collected from near a rust-damaged lodgepole pine stand in the Bear River Mountains.

Basidiospores were deposited by the suspension of germinating telia over the test substrates in dark culture dishes in moist chambers for 3 hr at 18 C. After the telia were removed, an additional 24-hr incubation under the same conditions was provided. The experiment had four replications, each consisting of a separate collection of *C. comandrae* of central Rocky Mountains origin. Three replicates were run in late summer; and one, in midwinter. All plant tissues were from greenhouse-grown plants; those in summer were about 5 months old, whereas tissues for the winter replicate were only about 1 month old. Germination was evaluated by making direct counts using incident light microscopy. For each replication on every substrate, 200 spores were examined individually and categorized as to whether they had (i) formed a secondary basidiospore; (ii) formed a long narrow germ tube; (iii) produced a short stubby germ tube; or (iv) failed to germinate. Mean percentages were compared by using arc sine transformed data in Duncan's new multiple range test (2).

The mode and amount of basidiospore germination varied greatly on different substrates (Table 1). Long germ tubes were particularly abundant on coniferous material, and rare on other vegetation and rocks. Long tubes were most frequent on 2% water agar; this suggests that agar is an excellent medium for use in laboratory tests to evaluate viability of basidiospores. The majority of spores on limestone formed stubby germ tubes; these appeared to be abortive sterigmata. Sagebrush proved to be unique among the substrates because it completely inhibited germination. This might indicate that *Artemisia* is a potential source for natural substances that would be useful in disease control. Since relatively few secondary spores formed on any test substrate, it might be reasonable to expect that, on the average, interception would be more than 90% effective in stopping basidiospore dissemination. These results are similar to Bega's findings for *C. ribicola*, where secondary spores were formed from only 3 to 20% of the basidiospores deposited on common nonhost tree species of the Sierra Nevada (1). Together, these findings tend to suggest that *Cronartium* rust damage in pines might be reduced through manipulating forest land vegetation so as to increase interception of basidiospores by nonhost plants.

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