

Red Leaf Disease of Native Hawaiian *Vaccinium* Species Caused by *Exobasidium vaccinii*

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ABSTRACT

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Red leaf disease, caused by an *Exobasidium* species referable to as *E. vaccinii*, is newly reported on *Vaccinium reticulatum*, *V. peleanum*, and *V. calycinum*, endemic Hawaiian species. Symptoms include bright red leaves, witches' brooms, and branch swelling followed by defoliation and death of infected branches. The disease on *V. reticulatum* and *V. peleanum* is conspicuous and widespread.

Vaccinium reticulatum Sm. and *V. peleanum* Skotts. are endemic Hawaiian species and major components of the native flora of the Hawaii Volcanoes and Haleakala national parks. The fruit of *V. reticulatum* (ohelo) is valued for local human consumption. These plants have long been known to show conspicuous reddening of the leaves in individual branches. Casual observers have in the past equated this condition with the red coloration of normal leaves on newly flushing shoots rather than considering it an abnormality.

Recent critical examination has established the presence of a pathological condition distinguished by the often bright red color of affected leaves that contrasts sharply with the green foliage of normal surrounding branches. Proliferation of small twigs results in witches' brooms (Fig. 1), which are often accompanied by swelling and mild contortion of larger branches, indicating systemic infection.

Affected leaves are uniformly red without spots. They are not hypertrophied. Red leaves may be of about normal size and shape, but they are often stunted with the margins rolled under. Diseased twigs eventually defoliate and die.

Infection may be confined to a single branch or may involve major portions of the host plant. Various stages of disease

progression may be found on a severely infected plant. The disease is common in most regions where *V. reticulatum* and *V. peleanum* occur. Aerial observations have shown that the disease is distributed throughout extensive remote areas of Haleakala National Park, where *V. reticulatum* is the dominant vegetation. The red foliage of infected branches is prominent and readily visible from considerable distances.

The disease also attacks *V. calycinum* Sm. (tree ohelo) but to a more limited extent. *V. calycinum* is an endemic species confined to rain forest habitats.

Earlier suggestions that the disease may be caused by a mycoplasma-like organism (MLO) were investigated (J. T. Kliejunas and D. E. Hemmes, unpublished; D. E. Gardner and W. S. Sakai, unpublished). Electron microscope observations failed to reveal MLO bodies in diseased phloem, however.

MATERIALS AND METHODS

Diseased and healthy leaf tissue was processed and permanent sections were prepared and stained by standard techniques (3). Freehand cross sections of fresh leaf tissue were cut for direct examination. Scrape mounts of diseased leaf and twig surfaces were also prepared (4).

RESULTS AND DISCUSSION

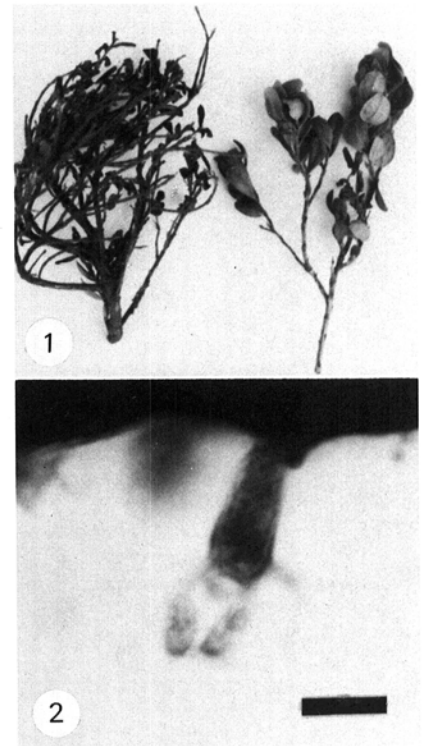
Gray, feltlike fungal growth was visible on lower surfaces of red leaves, and corresponding extensive intercellular mycelium occurred among the lower cell layers of leaves as observed in permanent sections. Basidia (Fig. 2) associated with the intercellular mycelium extended from the lower leaf surfaces. The basidia usually projected 8–15 μm , were 3–6 μm wide, and had three to five sterigmata

that were 2–3 \times 1 μm . Basidiospores were 6–12 \times 2–3 μm , were slightly to moderately curved, and appeared to be aseptate.

Numerous unattached spores of various sizes were observed among the fungal material on lower leaf surfaces. These spores were probably conidia and mature and immature basidiospores that had become dislodged.

These observations indicate that a species of *Exobasidium* is the causal agent and establish *V. reticulatum*, *V. peleanum*, and *V. calycinum* as new hosts.

Morphological characteristics of the fungus approximate those given for *E. vaccinii* Wor. (4) sufficiently that the pathogen reported here is referred to as that species in its broad interpretation.



Figs. 1 and 2. (1) Witches' broom on *Vaccinium reticulatum*, compared with a healthy branch, indicating systemic infection by *Exobasidium vaccinii*. (2) Typical basidium and basidiospores of *E. vaccinii* on the lower surface of an infected leaf of *V. reticulatum*. Scale bar = 5 μm .

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Variations among hosts and environmental factors may be expected to exert some influence on spore and basidial morphology. *E. vaccinii* has been reported from numerous *Vaccinium* and other Ericaceous hosts elsewhere (4,5), often causing leaf galls. However, the uniform reddening of foliage unaccompanied by hypertrophy observed on Hawaiian *Vaccinium* species is also typical of *E. vaccinii* infection of other hosts, such as lowbush blueberry (1).

Since Hawaii's indigenous flora is a unique and valued resource, it is

important that managers of native environments be aware of presence and effects of disease. Furthermore, appropriate management action depends on the endemic or foreign origin of the pathogen. *E. vaccinii* is considered to have been introduced to Hawaii. This species has been previously reported on *Rhododendron indicum* (L.) Sweet (azalea) in Hawaii (2) and may have been introduced with that host. No record documenting the first appearance of the red leaf disease on native *Vaccinium* species has been found, however.

ACKNOWLEDGMENT

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