

## No Hops to Flavor Beer without Insecticides or Fungicides

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Hops are a specialty crop used for bittering and flavoring beer. U.S. hop production is centered in the Northwestern states of Washington, Idaho, and Oregon. The U.S. produces enough hops annually to flavor approximately nine billion gallons of beer.

Hops in the Pacific Northwest are attacked by two key pests: the hop aphid and the two-spotted spider mite. If left uncontrolled, each pest can cause complete crop loss annually [1],[2]. 100% of the commercial hop acreage in the Northwest is treated with insecticides for these two pests [2].

Aphids feed directly on hop plants, extracting cell sap and nutrients with their sucking mouthparts. Hop aphids excrete prolific amounts of honeydew. Sooty mold grows on the honeydew and can destroy a crop's value, as mold renders hop cones unacceptable for brewing [2]. Spider mites puncture leaf tissue and destroy leaf cells while sucking plant juices from the leaves. Mites feed on and damage cones, reducing yields and producing off-flavors. Injured hop cones dry, turn red and shatter. Discolored hops may be rejected by customers. Research demonstrated that insecticides reduce the percentage of hop leaves infested with aphids and mites from 50-76% to 3% [3].

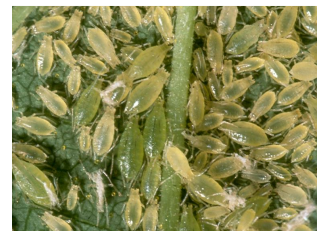
Nearly 100% of U.S. hop acreage is treated with fungicides targeted at downy mildew and powdery mildew. The downy mildew fungus overwinters in infected hop crowns and first appears in the spring as an infected shoot. The under surface of the leaves becomes blackened with millions of spores which spread the disease to other shoots. If infection occurs later in cone development, a portion of the cone becomes blackened and is unacceptable to brewers, or cones may shatter in harvest, resulting in yield loss. The fungus causing hop powdery mildew is known as *Podosphaera macularis* and only attacks hops. The fungus overwinters in infected buds. In the spring, the infected buds produce mildew covered shoots. Spores from the infected shoots disperse causing secondary infections. Powdery mildew infections lead to browning of hop cones, which may change the aroma of the cones making them unusable for brewers [4]. The hop industry estimates that without fungicide application 69% yield and quality losses would occur, with losses reaching 100% in many varieties [4].

### References

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2. USDA. 2001. *Crop Profile for Hops in Washington*. Available at: <http://www.ipmcenters.org/CropProfiles/docs/wahops.pdf>
3. Morrison, H.E. and B.G. Thompson. 1955. Control of hop aphid and two-spotted spider mite in Oregon. *Journal of Economic Entomology*. 48(6):706-710.
4. George, A.E. 2002. U.S. Hop Industry Plant Protection Committee. April 22, 2002. *Emergency Use of Tebuconazole to Control Powdery Mildew in Hops*. Letter to Steve Foss, Washington State Department of Agriculture.



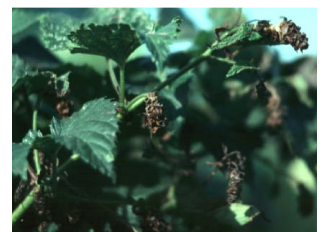
Aphid damage on hop at right



Hop aphids



Red hops from powdery mildew



Downy mildew on hops



Powdery mildew on cones and leaves