



Orange Felt (Orange Cane Blotch) of Blackberry

Phillip M. Brannen, University of Georgia
Extension Plant Pathologist

With the recent expansion of the blackberry industry in Georgia, diseases which are mentioned only briefly as curiosities in other locations have often become problematic. One of these is the orange felt (also known as orange cane blotch) disease of blackberry, caused by the parasitic alga *Cephaleuros virescens*. **Orange felt is especially prevalent on blackberries grown in very hot, wet, and humid environments, such as those encountered in much of the Coastal Plain areas of the Southeast.** Where colony formation (i.e. the degree of coverage of the cane) is limited, it has been stated that this alga does not limit blackberry production. However, although research trials have not been conducted to determine the effects of this algal species in Georgia, we are currently recommending that producers utilize control methods. Where ideal environmental conditions occur, this alga may girdle canes or exacerbate other cane diseases, causing subsequent decline and death.

Causal organism. Only a few algal species attack plants, and of these, *C. virescens* is one of only two common species found in the United States. The *C. virescens* alga is prevalent in the South, and it has been reported as a pathogen of nearly 300 species and cultivars of plants; of these, roughly 80 include stem spots or lesions as symptoms. Though *C. virescens* is generally reported to colonize only between the cuticle (upper waxy layer) and the epidermis (outer cell layer), colonization has been observed between the epidermal cells of the plant, and damaged tissue has been observed within the plant cortex region – opening the door for the possibility that the plant may be “girdled” by the infections or subsequent damage. Since stem cracking also accompanies infection, this may also account for death of blackberry canes, due to secondary attack by opportunistic fungi such as *Botryosphaeria* species. **County extension offices can diagnose this disease, either directly through in-office examination or through shipment to extension diagnostic clinics; symptoms and microscopic observation of the algal filaments and/or sporangiophores can be used to confirm the diagnosis (Figures 1-5).**

Disease cycle and causal conditions. Through field observation and limited reports, it is assumed at this time that the disease cycle for *C. virescens* on blackberry is similar to that observed on other plant species, but again, this has not been studied in detail. Generally, colonies form where zoospores (mobile swimming spores) settled the prior summer. In the case of blackberries, spread has to occur from floricanes to primocanes in each year of

continued colony production. Algal filaments spread to form a colony (Figures 1-2). As the colonies develop and mature in early to mid-summer, they form hair-like stalks (sporangiophores; Figures 3-5), which subsequently produce multiple zoosporangia (Figure 5). Under wet conditions, the zoosporangia in turn release multiple zoospores (swimming spores), each of which is capable of forming a new colony. Spores can actually swim to a new spot on a cane, but spread from floricanes to primocanes is likely through splashing water from summer rains. Producing prolific numbers of viable spores, this alga can be aggressive. The disease cycle takes 8-9 months to complete.

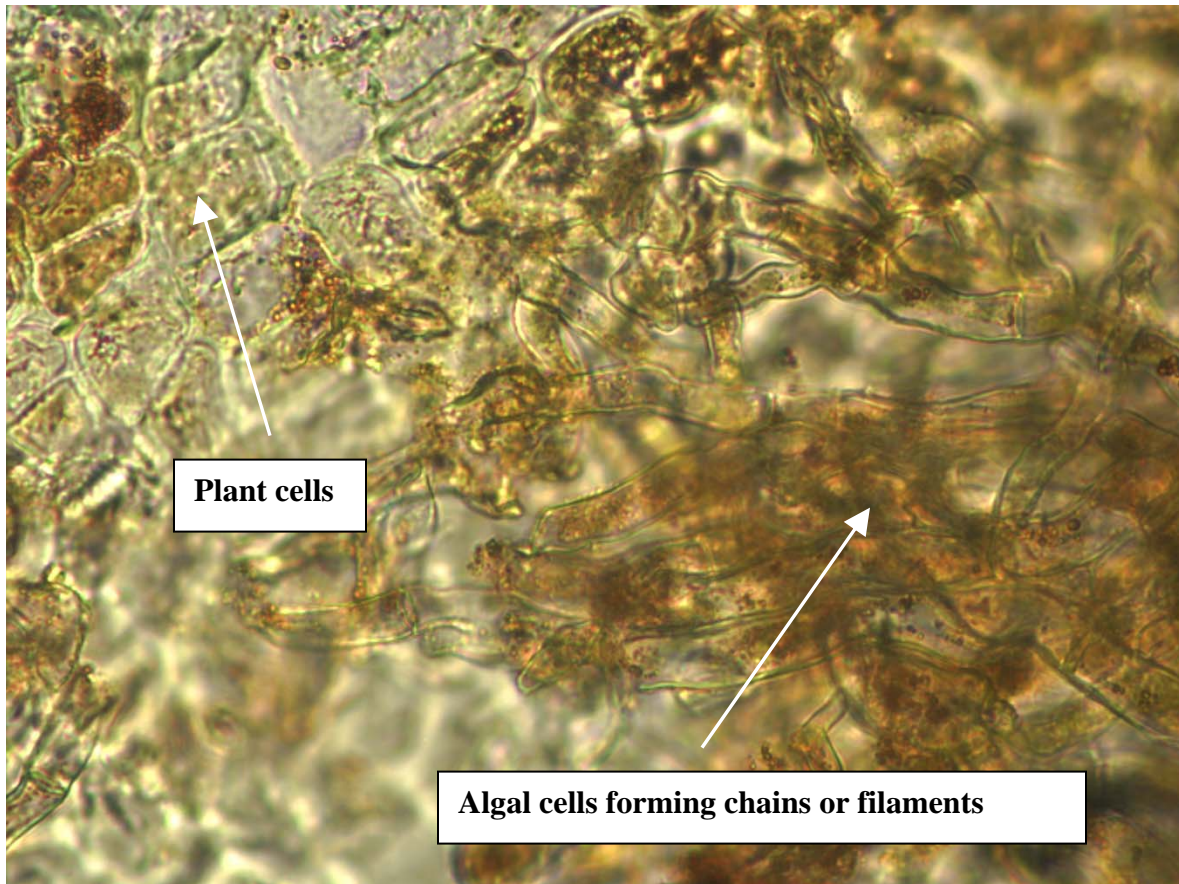


Figure 1. Microscopic image of filaments (algal cells) of *Cephaleuros virescens* growing across a blackberry cane (mainly observed between the cuticle and epidermal plant cells) at 400X magnification.

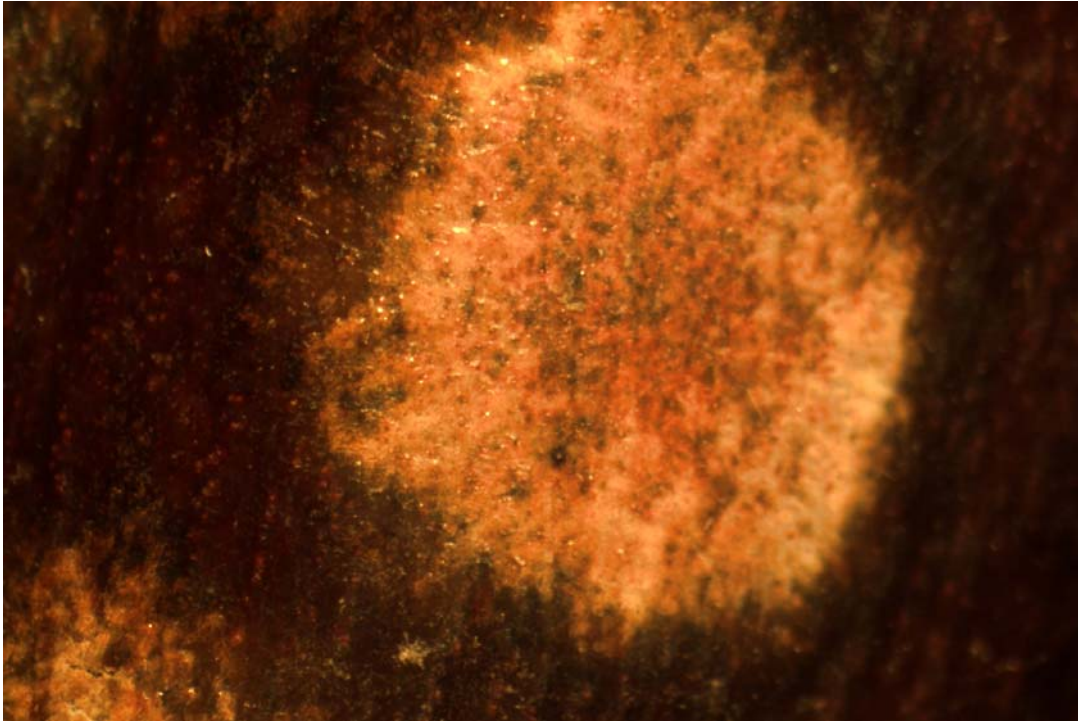


Figure 2. Appearance of spots when sporangiophores are not actively produced. At this stage, spots appear as orange, relatively smooth areas on the canes. These spots can be confused for rust diseases, though rust spores are not present.

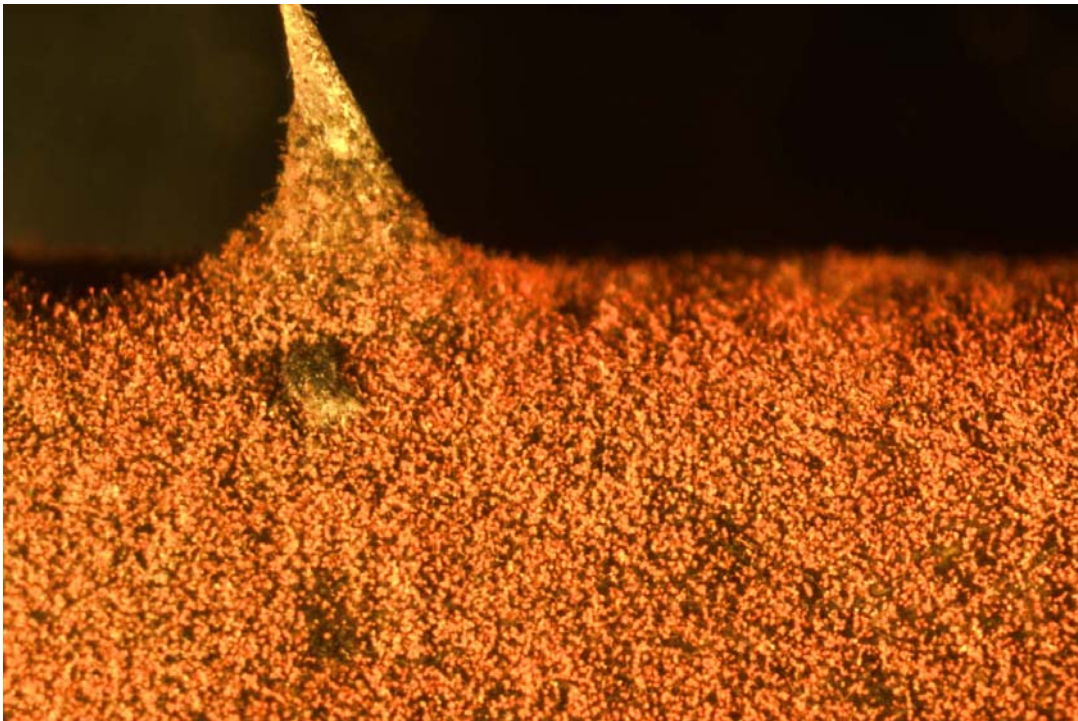


Figure 3. Clusters of *Cephaleuros virescens* sporangiophores (spore bearing structures). When actively sporulating, the zoosporangia are borne on stalks which give the “orange felt” appearance associated with the disease.



Figure 4. Individual sporangiophores (spore bearing structures) with multiple zoosporangia (round ball-like structures filled with spores) as observed under a dissecting microscope. Each zoosporangium is capable of producing multiple zoospores (mobile spores with propeller-like appendages which allow them to swim in water). Zoospores can spread by rain splash or active movement along wet canes.

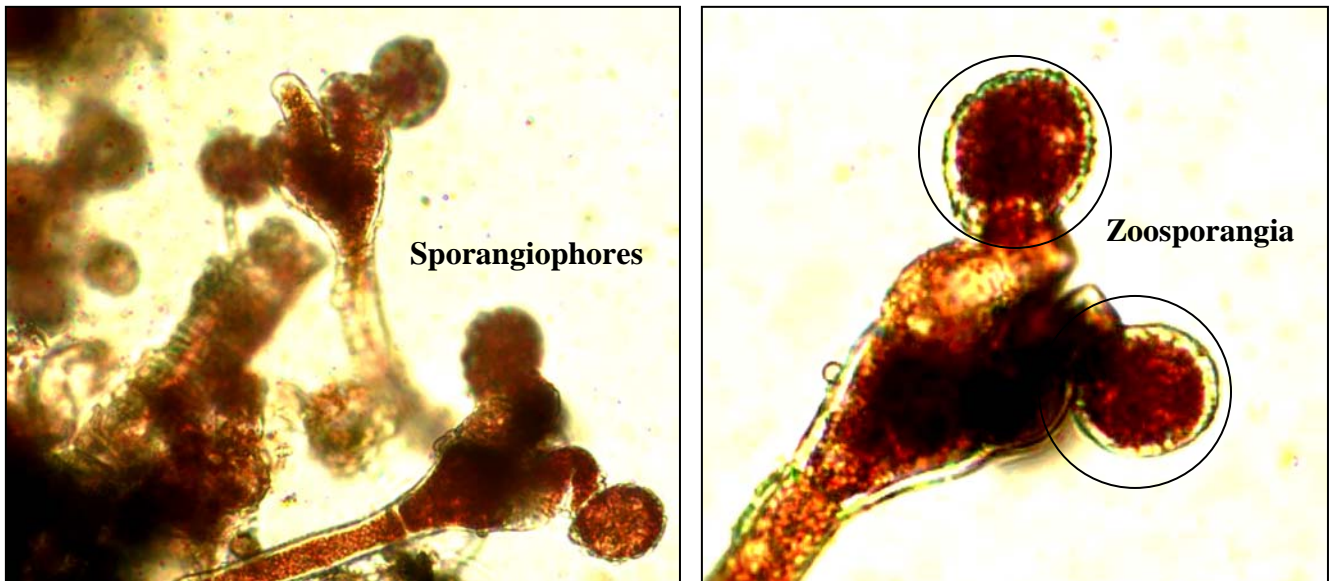


Figure 5. Multiple sporangiophores (left image) and individual zoosporangia (circled in right image) at 400X magnification. When wet, zoospores are produced which can form new infections on cane tissues. The infections generally start on the lower cane regions near the ground, but eventually they can cover the entire cane.

Symptoms. Initial symptoms are observed as colonies develop on canes. Orange felt is first characterized by the appearance of yellow, disk-shaped spots on the canes (Figure 6), which are usually more prevalent towards the cane base. The disease is later characterized by orange spots which are often blotchy or velvety in appearance. The orange color results from the production of haematochrome pigments by the spore-producing structures as they mature. Spots often coalesce (merge) under wet, humid conditions – virtually covering the entire cane; they can appear in the late spring, but are more prevalent throughout the summer and fall as the colonies develop. This disease is often confused with rust diseases of blackberry, since the spots are very orange in appearance as they mature. However, the two can be easily distinguished microscopically. In addition, rust spores readily rub off, forming a rust stain on whatever surface they touch, whereas lightly rubbing orange felt colonies does not result in a stain.



Figure 6. Yellow to orange velvet-like colonies formed by *Cephaleuros virescens* on a thornless blackberry cane. Orange felt forms yellow to orange spots, starting on the base of the canes in the late spring or early summer. Spots become more pronounced each fall. [Photo submitted through DDDI by Jerome Ethridge (Seminole County, GA)].

Cultural controls. (1). Removal of old floricanes immediately after harvest may help to prevent further spread of the algal spores to primocanes. Make cuts as close to the ground as possible. Ideally, old floricanes should be destroyed by either burning or burying them. As an alternative, flail mowing of old canes which are pulled to the row middles may help to destroy canes and inoculum through organic breakdown, though this method may not be as effective for control of algal species as it would be for cane-infecting fungi.

(2). Practices which promote quick drying of the canopy will help to decrease infection. A weed-free strip under the canopy will also aid in drying and air movement.

(3). Where producers have bedded and installed black plastic and drip-tape irrigation systems, orange felt has been reduced substantially (Steve McMillen; *personal communication*). In fact, though data are largely anecdotal to date, the results are excellent. It is thought that this practice promotes quick drying under the canopy, while also providing a physical barrier between the ground and the canes. Initial infections often come from the soil or surrounding debris, so this physical barrier likely reduces splash dispersal to the canes.

(4). Avoid stressing plants, making sure that all nutrient and water requirements are met. Soil and tissue samples allow for accurate fertilization and pH assessments. In other commodities where pathogenic algal infections occur, such as tea, stressed plants are more readily infected than non-stressed plants.

(5). Avoid planting in poorly drained sites. This is also important for root rot issues as well, but the increased humidity and splash dispersal which result from poor drainage will also increase orange felt.

Chemical controls. Copper sprays should also help to prevent spread. Many copper products are registered for control of a multitude of blackberry diseases, using relatively high rates for late dormant and fall applications and lower rates for times in which succulent tissue is present (read all labels for specific directions). Though orange felt may not be specifically listed on the label, orange felt may also be suppressed when applying copper for these other diseases. The currently labeled use times for most copper materials may not be sufficient to cover all infection periods. Also, copper injury can occur with prolonged use or under certain environmental conditions, such as very hot or prolonged moist periods (poor drying conditions). Since sporulation of this alga has been observed in June, this may indicate that additional, season-long or targeted applications of copper materials (reduced rates) may be necessary for optimal control; however, mid-summer copper applications are not generally allowed under most current labels, and once again, plant tissue damage may possibly occur under hot conditions. Likewise, Bordeaux mixture has been utilized for control of algal pathogens on other commodities, but it may be phytotoxic, and other formulations of coppers have generally replaced Bordeaux as the product of choice. Contact your local county agent for specific chemical recommendations.

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