

THE OCCURRENCE AND EFFECTS OF CEPHALOTHECIUM ROSEUM ON AVOCADO

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SUMMARY

Cephalothecium roseum occurs as a spoilage organism on avocado fruits and grows as a saprophyte on avocado stems. The infection of healthy avocados occurs through the exposed pedicel scar or through an open wound, and is enhanced by a high humidity. Such infections produce dark sunken areas on the surface of the fruit and are accompanied by the development of small, pink, compact masses of hyphae and conidia on the infected surfaces.

A limited survey of avocado orchards in Yorba Linda and La Habra indicated that *C. roseum* is distributed generally throughout Fuerte orchards. The fungus was not discovered on the stems of other avocado varieties. The prevalence of *C. roseum* on avocado stems is at a maximum during the cool, wet period of the year, and at a minimum during the warm, dry season.

Light inhibits the growth of *C. roseum*. The minimum temperature for growth is about 9° C., the optimum 21-24° C., and the maximum about 36° C.

Control measures include picking and handling fruit to prevent wounding ; removing dead wood which offers a suitable substratum for the fungus and which helps to scar the fruit; pruning out crowded branches to increase light and ventilation under trees; and harvesting when there is no water on the trees.

The literature concerning the occurrence and effects of *Cephalothecium roseum* on the avocado is limited to an acknowledgment by William T. Home (6) that a species of *Cephalothecium* occurs on old decayed fruits, and that it is often mistaken for *Colletotrichum gloeosporioides*, which causes anthracnose rot of avocados. Both organisms produce a powdery, pink, spore mass on the surface of decaying fruit.

Cephalothecium roseum is commonly encountered in fruit and vegetable produce markets where the fungus is responsible for the spoilage of many fruits and vegetables

(2, 7, 8). Some of the susceptible hosts include apples, pears, plums, peaches, melons, summer squash, cucumbers, avocados, sweet potatoes, egg plant, and lima beans. *C. roseum* has also been found on stored corn and wheat grains, on castor beans and flax, and causes less vigorous germination of soybean and oat seed. Other substrata favorable to the growth of *C. roseum* include wool, hemp, cotton bolls, butter, soil, and manure.

The purpose of this investigation was to determine, first, under what conditions avocados are infected by *Cephalothecium roseum*, and to what extent the fruit is damaged; second, to determine the distribution and effects of the fungus on avocado stems in the field; and finally, to suggest ways for preventing fruit damage by this fungus.

OCCURRENCE ON THE FRUIT

Cephalothecium roseum was obtained from 22 to 28 rotting avocados collected at a food market and placed in separate moist chambers for ten days at 20° C. From the same market, 21 of 28 rotting avocados yielded *C. roseum* under similar conditions a few weeks later. *Rhizopus nigricans*, *Cephalosporium sp.*, and *Acrostalagmus sp.* were isolated frequently from the rotted areas of these avocados.

To determine under what conditions healthy avocado fruits may be infected by *C. roseum*, the following inoculation tests were made. Recently picked avocados of the Fuerte and Nabal varieties were surface decontaminated in 95 per cent ethanol, and then rinsed in sterile water. Twelve fruit of each variety were inoculated by three different means with a conidial water suspension prepared from a potato dextrose agar slant culture of *C. roseum*.

The avocados of each variety were divided evenly into three groups. One group of each variety was inoculated on the unwounded surface with a drop of inoculum. Another group of each variety was inoculated in an X-cut wound on the side of each fruit with a drop of inoculum. The pedicels of the last two varietal groups were removed and a drop of the inoculum was placed in each pedicel scar. Half of the fruit from each group was placed in moist chambers, and the other half was left exposed to the atmosphere of the laboratory. Both groups of avocados were incubated for nine days at 20° C.

TABLE 1
Manner in which *Cephalothecium roseum* infects healthy avocados.

Conidial Suspension	Incubation Chamber	Number of Fruit		Number of Fruit Infected	
		Fuertes	Nabals	Fuertes	Nabals
On unbroken cuticle	moist	2	2	0	0
	open	2	2	0	0
In X-cut wound	moist	2	2	2	2
	open	2	2	0	0
In pedicel scar	moist	2	2	2	2
	open	2	2	2	2

The results, presented in Table 1, show that infection of healthy avocados by *C. roseum* occurs only through the exposed pedicel scar or through an open wound. The organism apparently cannot infect the healthy fruit through an unbroken cuticle. These results substantiate the claims of Hesler and Whetzel (5), Simonet (9), and Stevens (10) that *C. roseum* is a wound parasite.

The wounded avocados were infected only when incubated in moist chambers. In open chambers, when the inoculated wounds were on the upper side of the fruit, no infection occurred; but when the fruits were turned over so that the inoculated wound was against the bottom of the container, infection occurred.

The dry rot produced by *C. roseum* during these tests was characterized by the appearance of dark sunken areas on the surface of the infected fruit. Under the moist conditions the organism developed a compact mass of white mycelium in the lesion, which produced a pale pink mass of conidiophores and conidia within a few days (Fig. 1).

Where the pedicel scar was infected, a compact mass of mycelium and conidia grew within the scar pit. The stem-end surface of the fruit turned black as the rot advanced through the flesh. No infection of the seed was observed.

Inoculations were made on un-harvested fruits to determine if avocados can become infected with *C. roseum* while still hanging on the tree. Six Fuerte avocados, attached to the same tree and situated in a shaded, protected part of the tree were inoculated with a water suspension of conidia of *C. roseum*. The fungus was inoculated into a wound made on the side of the fruit. Three of the fruits were covered with waxed paper bags to insure a high relative humidity about the fruit. The other three fruits were left exposed to the atmosphere.

Three days after inoculation the three avocados which had been enclosed in waxed paper bags showed slight symptoms of infection. Small circular lesions, about one-half inch in diameter, were produced after one week, but failed to develop any further. The three inoculated avocados that had been left exposed to the atmosphere showed no

signs of infection after three weeks.

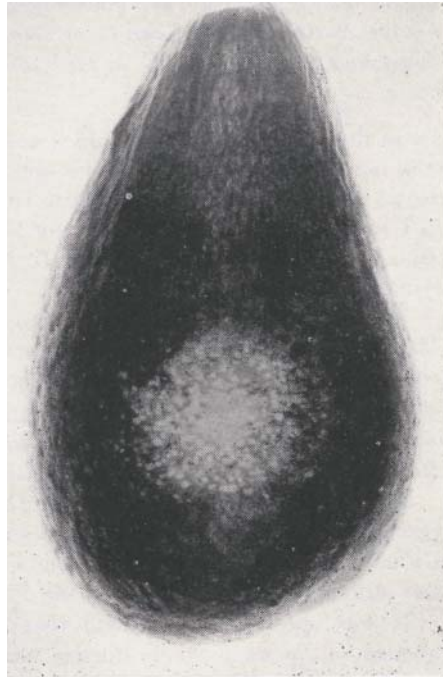


Fig. 1. *Cephalothecium roseum* on a *Fuerte* avocado.

It was concluded that avocados are slightly susceptible to infection by *C. roseum* while still attached to the trees, providing there is a wound in the fruit and there is sufficient moisture in the air to favor the growth of the fungus.

C. roseum was found occurring naturally on avocados still attached to the tree at two different times. In both cases the fruits had been wounded, and a meager growth of *C. roseum* was found on the exposed flesh of the fruits.



Fig. 2. *Cephalothecium roseum* on small Fuerte avocado stems: A and C, on stems dying back from the tips; B, in cankerous lesion.

OCCURRENCE ON THE STEM

Cephalothecium roseum occurs as a saprophyte on the dead branches and twigs which persist in the trees and on those which are found in the litter beneath the trees. It is found most commonly on the small branches which are dying back from the tip, in cankerous lesions on green stems, in stem scars, or beneath the bark on larger limbs (Fig. 2). It has not been found growing on avocado leaves, although Stevens (10) states that *C. roseum* has been reported growing on various other stems and leaves.

Transverse and longitudinal sections of avocado stems invaded by *C. roseum* were prepared in order to observe the characteristics of the organism within the host. The sections were cut at the margin of dead and healthy tissue. Observation of the sections demonstrated the hyphae to be intracellular. The hyphae appear to infect all of the stem tissues, but are more concentrated in the vessels and in the pith parenchyma.

In a limited survey of the Yorba Linda, La Habra, Encinitas, and Vista areas of southern California, *C. roseum* was found to be distributed generally in Fuerte avocado groves. It was not found on the stems of Puebla and Nabal trees although present in neighboring Fuerte trees.

It was observed in the field that the fungus was most prevalent and vigorous on avocado stems during periods of the year when the relative humidity was highest. During the dry summer months, stem invasions appear as dry, powdery patches of compact conidiophores and conidia in the cracks and on the surface. These apparently dormant patches are readily activated with the advent of damp weather, and they can

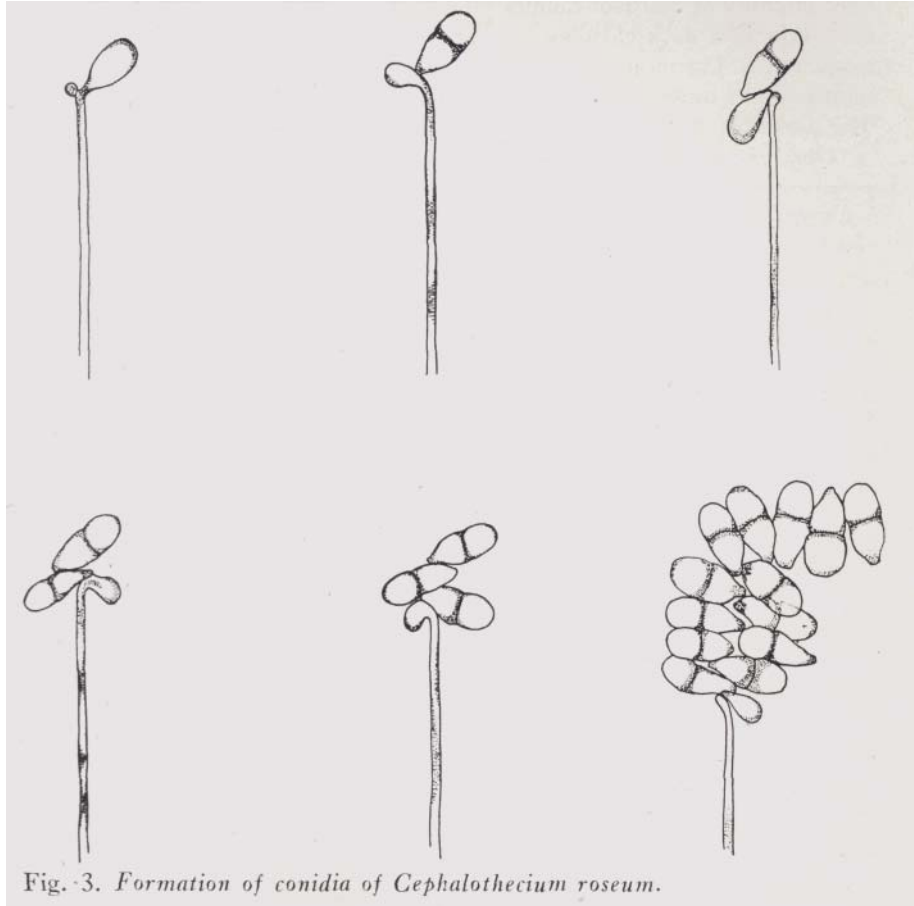
be immediately detected in the trees by their bright pink color.

CAUSAL ORGANISM

Cephalothecium roseum Corda is considered by many authors to be synonymous with *Trichothecium roseum* Link (3, 4). Clements and Shear (1) use the following characteristics to separate the two genera. With *Cephalothecium* Corda, the conidia are capitate; with *Trichothecium* Link, the conidia are solitary. The organism concerned with in this investigation is characterized by the production of capitate clusters of conidia borne one at a time at the tips of erect conidiophores. The formation is unique in that each conidium appears to be formed on a different side of the conidiophore from which the previous conidium was formed. This formation is illustrated in Figure 3.

THE EFFECTS OF TEMPERATURE AND LIGHT

The effects of temperature upon the growth of *C. roseum* were determined by growing the fungus at constant temperatures ranging from three to thirty-nine degrees Centigrade at three-degree intervals. Thirty-nine eight-inch test tubes were fitted with low dams two inches from their mouths, making it possible to form a horizontal layer of nutrient agar three-fourths the length of the tubes. Ten millimeters of potato dextrose agar were added to each tube, sterilized and then placed in a horizontal position until the agar media became firm. (*Formula (Ingredients per liter) 200 gm. infusion from potatoes, 20 gm. bacto-dextrose, 0.02 gm. yeast extract, 15 gm. bacto-agar.*) Each tube was inoculated at the open end with a small, uniform piece of inoculum, cut from a petri dish culture of *C. roseum*. The colony was allowed to grow at room temperature for twenty-four hours, and then a mark was placed on the outside of the tube at the margin of growth to serve as a reference point for future measurements. Three tubes were placed at each temperature and the linear growth of the fungus was measured to the nearest millimeter every twenty-four hours for three days. The mean growth increment for a twenty-four hour period at each temperature was determined. The results are shown in the temperature curve in Figure 4. Macroscopic growth of *C. roseum* begins at about 9° C., and the apparent optimum is between 21-24° C. The maximum temperature for growth is near 36° C.



To determine the effects of light intensity upon the rate of growth of *C. roseum*, four petri dish cultures of *C. roseum* were exposed to a constant light intensity of 230 foot candles for five days at 24° C. Four other cultures were kept in a dark chamber for the same length of time and at the same temperature. The mean growth of the cultures kept in the light was 17.0mm., compared to a mean growth of 31.5 mm. for the four cultures kept in the dark. The degree of sporulation appeared to be about the same in both cases.

Observations made in the field showed that *Cephalothecium roseum* growing on Fuerte avocado stems could be found more abundantly in the darkest and most shaded portions of the trees. Unpruned Fuerte avocado trees form a very dense canopy down to the ground, and the heavy shade beneath these trees offers an excellent environment for the growth of *C. roseum*. Branches exposed to full sunlight do not become infected with *C. roseum*.

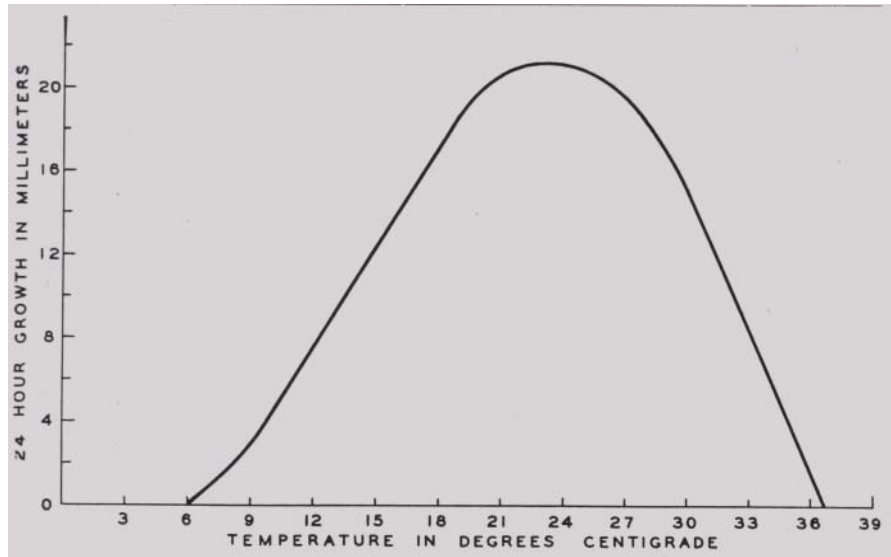


Fig. 4. *Temperature curve for Cephalothecium roseum, representing growth increment for a twenty-four hour period.*

CONTROL

Field observations and the results of this investigation indicate that the prevalence of *C. roseum* may be reduced by the application of certain beneficial cultural practices. These include picking and handling fruit to prevent wounding, pruning out crowded branches to increase the light intensity and ventilation under trees, harvesting when there is no water on the trees, removing dead wood which offers a suitable substratum for the fungus and which helps to scar the fruit, and employing irrigation methods which do not spray water up into the trees.

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