Identification, biology, epidemiology and geographical distribution of fungal and bacterial pathogens associated with avocado in California

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1. Avocado Branch and Trunk Canker (aka Dothiorella canker)

Dothiorella canker has been shown to be caused by various species of *Botryosphaeria* (4) as well as *Diaporthe* spp. (5). Therefore, the name "Dothiorella" canker is outdated and will be replaced in this report with the name "branch and trunk canker".

Symptoms of branch and trunk canker include a brownish red sap that is exuded and dries to form a white to brownish powder. The bark and wood under the canker turns red-brown to brown. The bark is friable and easily removed over older cankers. Cankers can extend deep into the xylem and, if most of the xylem is involved, trees or limbs may collapse and leaves quickly turn brown but remain attached. In young trees, a canker can develop around the graft union (5).

For growers to remain competitive in the international market, they must find ways to manage their groves efficiently and significantly increase production. One way to do this is by replanting to densely planted orchards (2) which is already being practiced in Chile (3) and is becoming more common in California. More frequent pruning, such as would occur in a high density grove, could increase the transmission rate of canker pathogens from tree to tree, leading to an increase in canker development and a possible decrease in yield as branches with cankers are pruned out. Identifying and characterizing the primary causal agents of this disease will assist in developing the appropriate control measures to reduce yield loss.

In year 2 of 3 of this continuing branch canker study, our objectives are twofold: 1) to determine and advise growers on timing of pruning activity based on data obtained from our year-long spore trap study, and 2) to identify and evaluate effective chemical control strategies for avocado branch and trunk canker.

Spore Trap Study

The year-long spore trap study results were reported in the June 2010 Midyear Report.

To summarize the connection between timing pruning activity and its relationship with air-borne spores: Spores of *Botryosphaeria* spp. are known to enter the host plant through fresh wounds such as pruning wounds, split branches from wind damage, frost damage, mechanical and grafting wounds. Infection is more likely if the tree is already stressed from drought, flooding, insect attack, nutrient deficiencies or any other factor which weakens the tree. *Botryosphaeria* spores are produced in microscopic structures (pycnidia and perithecia) that can be found on dead bark, twigs and cankers and are dispersed by wind and rain-splash (5)

The aim of the spore trap study was to determine if the spores of *Botryosphaeria* can become airborne from pycnidia or perithecia, either by wind or rain splash, and thus transferred to open wounds of any kind on the trunk or branches.

Pycnidial and perithecial structures were discovered in California avocado groves on dead branches and twigs. Conidial spores from pycnidia ooze out from a central ostiole and are moved about via rain splash. In contrast, ascospores from perithecia are forcibly ejected through the ostiole and then moved around by wind (5). Since *Botryosphaeria* spores were recovered from our spore traps, this indicates that they are wind and/or rain disseminated from the pycnidia and perithecia. The winter months of December, January and February had an increase in rain which coincided roughly with an increase in spore trap numbers (see midyear report for graphs). The much drier summer months of June, July and August resulted in few to no spores trapped. Based on this information, it would be advisable to avoid pruning activity in the winter months to minimize the chance of infection by *Botryosphaeria* spores.

In order to evaluate effective chemical control strategies to manage branch canker, our field trials are scheduled for the winter 2011 which will give us the most favorable environmental conditions for canker production.

Chemical Control Strategies

We have concluded the *in vitro* part of the investigation into chemical control strategies for reducing the incidence of canker development.

Fifteen chemicals were evaluated in the lab using the spiral gradient dilution method (SGD) (1). With the SGD method, the toxicity of a fungicide to a target organism is generally expressed as the 50% effective concentration (EC_{50}), i.e., the fungicide concentration at which mycelial growth of the target fungus is reduced by 50%. To determine the EC_{50} value, various measurements are taken after three days incubation of the fungus-fungicide combinations. These measurements and various other parameters are entered into the SGD software program which determines the local fungicide concentration in the agar at 50% inhibition.

Our final results indicate that seven fungicides will be taken to the field (Table 1). The fungicides consist of three single chemicals and two combinations of chemicals.

Table 1. Fungicides to be tested in field trial, winter 2011.

Active ingredient	Trade Name	Manufacturer
Pyraclostrobin	Cabrio 20 EG	BASF
Metconazole	Quash 50 WDG	Valent
Myclobutanil	Rally 40 WSP	Dow AgroSciences
Propiconazole+azoxystrobin	Quilt Xcel	Syngenta
Fludioxonil+Cyprodinil	Switch 62.5 WG	Syngenta

Pathogenicity Tests

In the 2009-2010 midyear report, results were shown of a more comprehensive pathogenicity test completed in the greenhouse for the following *Botryosphaeria* and *Neofusicoccum* species identified by molecular analysis: *N. australe, B. dothidea, “B.” iberica, N. luteum, N. parvum, N. ribis, “B.” rhodina,* *"B." stevensii,* and *N. vitifusiforme* (Fig. 7). At that time the results for another fungal pathogen, *Diaporthe phaseolorum*, were not completed, but they are now included in the results shown in Fig. 8.

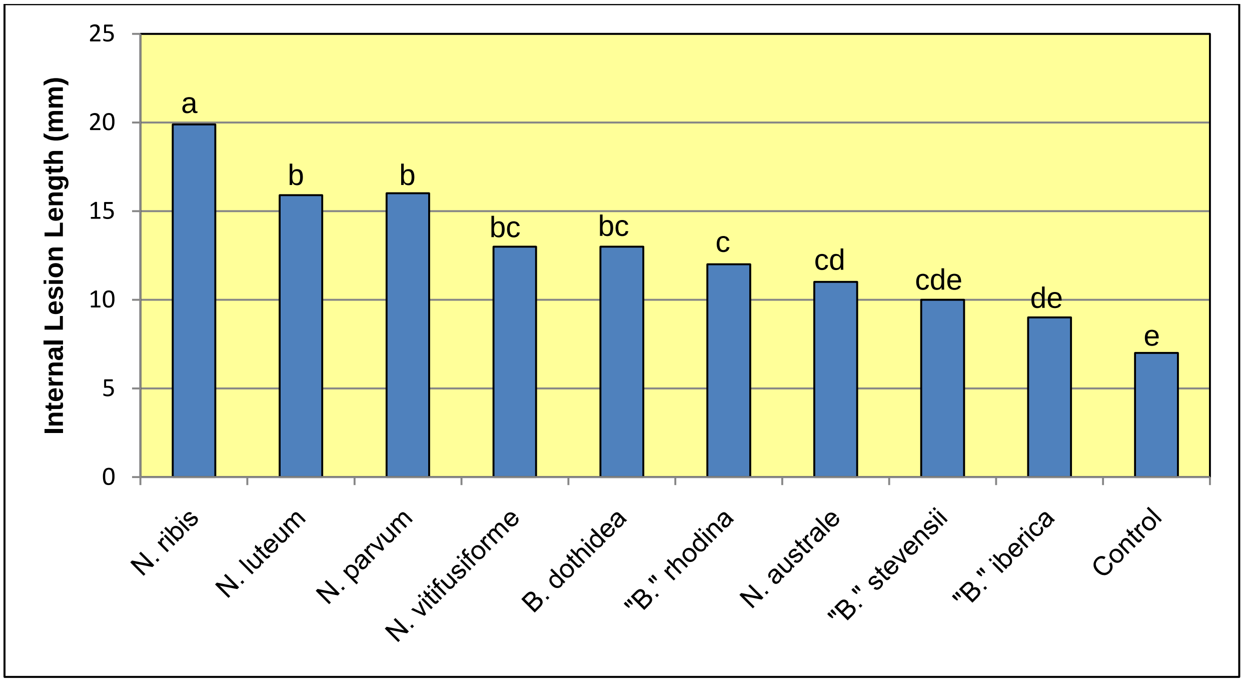

Fig. 7. Internal mean lesion length (primary lesion) caused by nine different *Botryosphaeriaceae* species on one-year-old Hass avocado seedlings. Each bar represents the mean of 10 avocado seedlings. Means with the same letter are not significantly different at the 0.05 level.

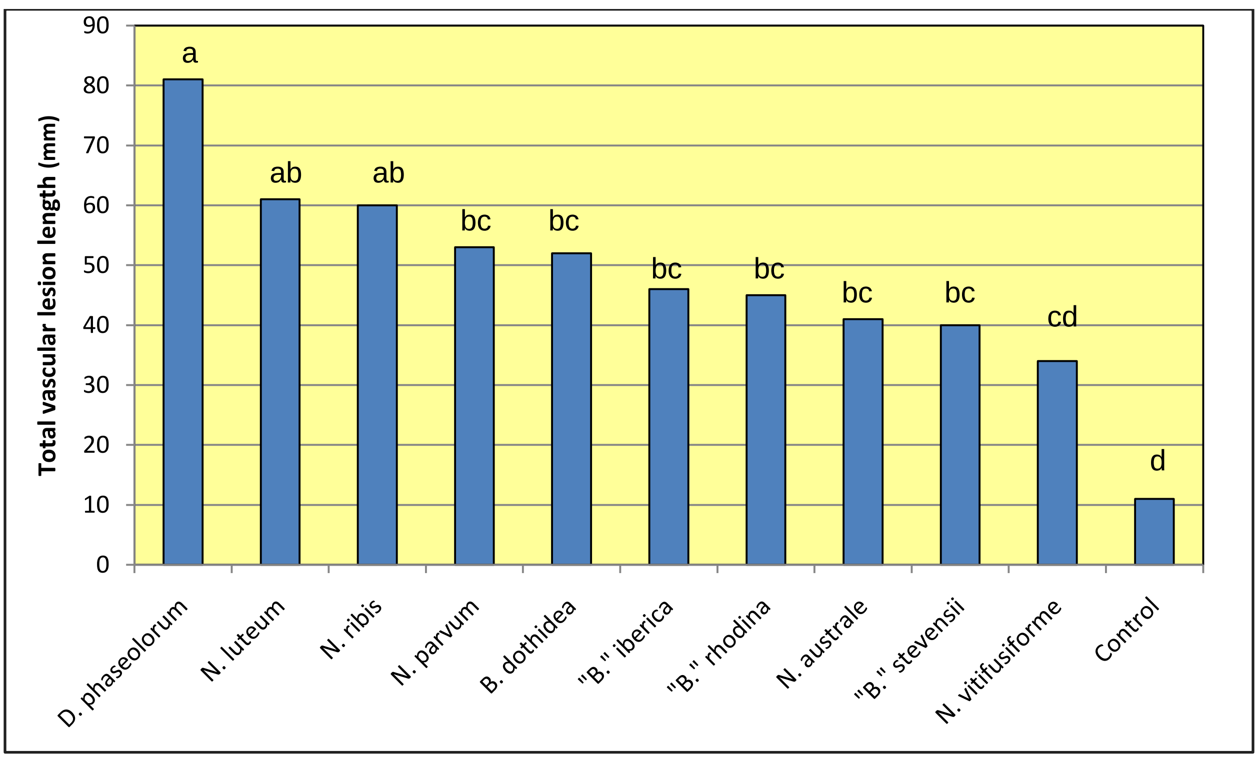

Fig. 8. Internal mean lesion length (upward and downward) caused by nine *Botryosphaeriaceae* species and one *Diaporthe* species (*D. phaseolorum*) on one-year-old Hass avocado seedlings. Each bar represents the mean of 10 avocado seedlings. Means with the same letter are not significantly different at the 0.05 level.

The lesion size measured in Fig. 7 was of the primary internal lesion, whereas the lesion size measured in Fig. 8 was of the total lesion extending upward and downward from, and including, the primary internal lesion (Fig. 9). This explains the difference in the two vertical axes between Fig. 7 and 8.

Fig. 9.

In Fig. 7, there was a significant difference from the control for seven of the nine fungi tested. In Fig. 8, there was a significant difference from the control for nine of the ten fungi tested.

References

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