# Biology and Management of Almond Scab and Alternaria Leaf Spot

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## PROJECT SUMMARY

### Objectives:

- Determine population composition of the scab pathogen (*Fusicladium carpophilum*) and if sexual reproduction occurs.
- Evaluate new and registered fungicides for their efficacy in disease management.
- For scab management, evaluate the effect of dormant and in-season applications on sporulation of twig lesions.
- Establish baseline sensitivities, monitor for sensitivity shifts in pathogen populations to different fungicides, and characterize molecular mechanisms for SDHI and DMI resistance.

### Background and Discussion:

Scab (caused by *Fusicladium carpophilum;* formerly *Cladosporium carpophilum*) and Alternaria leaf spot (caused by three very closely related species in the *Alternaria alternata* complex) are economically important summer diseases of almond. Both occur especially in locations with high humidity and poor air circulation. Severity of both diseases was lower in 2014 and 2015 compared to previous seasons likely due to drought conditions and reduced irrigation schedules. Treatments based either on the DSV model with sensors on the outer perimeter of the canopy at a height of 3-5 m (10-16 ft) or a calendar-based timing beginning in late spring and continuing in ca. three-week intervals are currently suggested.

Using molecular population genetic approaches, we found no evidence for sexual recombination, and thus, populations of *F. carpophilum* appear to only reproduce as clonal populations. Less-sensitive sub-populations may develop based on survival of random mutants after repeated use of a selective pressure (i.e., one FRAC Group or FG). Resistance can be managed with properly timed applications of fungicides belonging to several FGs. Mixtures or rotations of different FGs prevent the overuse of any one mode of action.

In our trials on Alternaria leaf spot, the new EXP1 and the pre-mixtures EXP2 and EXP3 were highly effective. The new fungicide Kenja (isofetamid) also performed well by itself or mixed with the experimental IB18111. Among registered treatments, Merivon, Luna Sensation, Luna Experience, and rotations of the two Luna products, as well as those of Inspire Super with Quadris Top, Ph-D with Tebucon, Ph-D/Tebucon with Inspire Super, Syllit with Ph-D/Tebucon, and Bravo with Quadris Top, were the most effective.

For the management of scab, dormant treatments with copper-oil, chlorothalonil (e.g., Bravo)/oil, or Syllit-oil could not be evaluated due to low disease in 2015, likely because of the drought. Among in-season treatments (two applications starting at twig sporulation onset), rotations of Catamaran (FG M5/33) with Viathon (FG 3/33) and of Bravo (FG M5) with Quadris Top (FG 3/11) resulted in the lowest scab incidence in one trial; whereas Luna Experience (FG 3/7), Fontelis-Tebucon (FG 7+3), and the experimental EXP1 were most effective in a second trial. Spring-time treatments that were effective in other years include chlorothalonil (proposed label change to 60 days PHI), FG 3 fungicides such as Quash or Inspire Super, Ph-D (FG 19), Syllit (FG U12), and compounds containing FG 7 and FG 11. Under high scab pressure, a dormant application with chlorothalonil-oil and two in-season applications; whereas under low scab pressure, a dormant treatment or in-season treatments alone can be considered.

Cross-resistance among SDHI (FG 7) sub-groups is present in *Alternaria* and *Fusicladium* spp. In *Alternaria* spp., some of the cross-resistance groups are correlated with certain mutations in two sub-units of the target gene. Many isolates of *F. carpophilum* are insensitive to SDHI fungicides. DMI resistance is also common in some populations of *F. carpophilum*. Expression of the CYP51 gene, however, was not related to in vitro sensitivity values for metconazole or propiconazole. Therefore, a different resistance mechanism appears to be present in this organism.

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- Poster location 25 and 26, Exhibit Hall A + B during the Almond Conference; or on the web (after January 2016) at Almonds.com/ResearchDatabase
- 2014 - 2015 Annual Reports CD (14-PATH3-Adaskaveg); or on the web (after January 2016) at Almonds.com/ResearchDatabase
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