

## ***Armillaria* spp. in aspen on national forests in northern Wyoming and western South Dakota**

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### **Introduction:**

*Armillaria* root diseases are caused by a complex of species. Studies have confirmed the distinctness among species in: mating types, morphology, DNA sequences, nuclear DNA content, aggressiveness, host range, and ecology (Anderson 1986; Anderson and Smith 1989; Anderson et al. 1980, Bérubé and Dessureault 1988; Gregory and Watling 1985; Guillaumin et al. 1993; Jahnke et al. 1987; Kile et al. 1991; Kim et al. 2000; Rishbeth 1982; Roll-Hansen 1985; Ross-Davis et al. 2012; Rishbeth 1986; Shaw 1985; Worrall et al. 1986).

These species are responsible for considerable economic damage in western forests and throughout the world (Basham 1973; Cruickshank 2002; Cruickshank et al. 2011; Kile et al. 1991; Wargo and Shaw 1985; Whitney and Myren 1978), but are often found as saprotrophic colonizers of trees killed by other damage agents. Root disease is frequently attributed to host stresses induced by the environment or other damage agents. However, live-stressed trees are not always colonized by these pathogens. Alternatively, *Armillaria* root diseases are often found in trees with no other apparent damage agent or perceptible stress.

Another paper in these proceedings (Blodgett et al. 2015) found the correlation between *Armillaria* spp. frequencies and aspen tree mortality was not significant. This study examines *Armillaria* by species versus combining the distinct diseases. The objective of this study was to test if *Armillaria* species differ in aggressiveness in aspen.

### **Methods:**

Samples of *Armillaria* spp. were collected in 2008, 2009, and 2012 during an aspen survey in the Shoshone, Bighorn, and Black Hills National Forests (Blodgett et al. 2015; 2014). *Armillaria* pathogens were assessed as present or not found in 465 plots and frequencies were quantified for stands (155 stands). Trees were examined within 30 m of plot centers. *Armillaria* spp. were confirmed by examining three recent dead trees per plot (9 per stand) for the presence of mycelial fans and/or rhizomorphs. If recent dead trees were not present, trees with root disease symptoms were examined next and then healthy trees. If *Armillaria* sp. was found, root disease was confirmed by examining two live aspen trees per plot (6 per stand) for the presence of mycelial fans (**Fig. 1**). Trees with root disease symptoms and/or near confirmed dead trees were preferentially selected.

Sixty samples were collected. Samples were collected from each forest with approximately half from stands where root disease was confirmed and the others from stands where root disease was not confirmed. Isolates were identified to species by mating tests (Harrington et al. 1992; Korhonen 1978; Wargo and Shaw 1985) and a subset was later confirmed using DNA sequences (Ross-Davis et al. 2012).

### **Results:**

*Armillaria* root diseases were killing trees independently and in combination with other damage agents. Although *Armillaria* spp. were found in 55% of the stands, *Armillaria* root disease was

not always confirmed. When potential pathogens were found in stands, root diseases were confirmed 24% of the time. In the remaining 76% of the stands only saprotrophic colonization of aspen was observed. The most common species, *A. solidipes* (= *A. ostoyae*) caused disease less frequently than expected by chance and *A. sinapina* and *A. gallica* caused disease more frequently than expected by chance (**Table 1**).

**Table 1.** *Armillaria* species identified in aspen and percentage of times found causing root disease in Wyoming and South Dakota.

| <i>Armillaria</i> species                  | Number of stands <sup>a</sup> | Root disease (%) <sup>b</sup> |
|--|-------------------------------|-------------------------------|
| <i>A. solidipes</i> (= <i>A. ostoyae</i> ) | 33                            | 27 <sup>c</sup> ↓             |
| <i>A. sinapina</i>                         | 22                            | 68↑                           |
| <i>A. gallica</i>                          | 5                             | 80↑                           |

<sup>a</sup> Number of stands in which *Armillaria* spp. were isolated from live or dead aspen trees and identified to species.

<sup>b</sup> Percentage of times root disease was confirmed in live aspen trees.

<sup>c</sup> Down arrows indicate less frequent than expected by chance and up arrows indicate more frequent than expected by chance based on Fisher's Exact Test ( $P = 0.0003$ ).

### Summary and Conclusion:

Some *Armillaria* species were more damaging in aspen than others, suggesting host-specialization among the species. *Armillaria sinapina* and *A. gallica* root diseases likely contributed to the mortality reported for the most damaging agents in aspen including *Encoelia pruinosa*, *Cytospora* spp., *Agrilus liragus*, and *Ganoderma applanatum* (Blodgett et al. 2015). *Armillaria solidipes* root disease is the least damaging species found in aspen hosts, but is likely the most common species found in aspen in the northern Rocky Mountain Region. *Armillaria sinapina* and *A. gallica* are important pathogens in these forests and *A. solidipes* appears to be mostly a saprotrophic colonizer of aspen. Since *Armillaria* species differ in aggressiveness in aspen, knowing the species of root disease present is important when determining aspen forest health.

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**Figure 1.** Root disease was confirmed by examining live aspen trees for the presence of mycelial fans.