Fusarium and its Role in Stand Failure of the Annual Grass Bromus tectorum

JanaLynn Franke¹

¹ USDA Forest Service and Brigham Young University: Plant and Wildlife Sciences Department Provo, Utah, United States of America.

Humans have made a significant impact on shrublands of the western United States; most notable is the accidental introduction of cheatgrass (Bromus tectorum) in the Great Basin [3]. This causes massive ecosystem disruption resulting in increased size and frequency of wildfires. Non-dormant cheatgrass seeds germinate rapidly, making it extremely competitive with the native species [1]. In some areas these cheatgrass monocultures have been observed to experience a complete stand failure—a phenomenon referred to as ‘die-off’. Strains closely related to Fusarium tricinctum have been isolated multiple times from field die-off locations and are believed to play a major role in these die-offs. These Fusarium strains have been observed to infect and kill non-dormant cheatgrass seeds at an astonishing rate under natural conditions [2]. It has also been observed that seed dormancy plays a unique role in the infection and mortality of the seeds. This paper will focus on the visual aspects of the mode of attack used by these Fusarium strains.

Fusarium strains were cultured from cheatgrass seeds and seedlings grown in die-off soil. Spores were grown and harvested from PDA (potato dextrose agar). Seeds were then inoculated at a rate of 250,000 spores/ml and placed in a dish lined with a blotter soaked in PEG (polyethylene glycol) in order to recreate an environment with a negative water potential. Seeds were then sampled at 2, 24, 48, and 72 hours after inoculation. Selected samples were then prepared for SEM (scanning electron microscopy) by fixing and mounting the samples. Stereomicroscopy samples were selected based on visual appearance a white tuft indicative of infected seeds.

Figures 2 and 3 reveal that Fusarium macroconidia have attached and begun germination 2-24 hours after inoculation on non-dormant seed. Regardless of location of spore germination, mycelium grows preferentially towards and culminates at the radicle end of the seed. This culmination is what leads to the conspicuous mycelial growth that eventually envelops the seed head. In figures 4B, 5 and 6 hyphae appear to concentrate their attack at the hilum on the radicle end of the seed, penetrating the non-dormant seed and feeding on the embryo as it prepares to germinate. However, figure 4A shows that on rare occurrences the Fusarium is opportunistic and it appears capable of entering through other locations on the seed that eventually allow it access to the embryo which is its ultimate goal.

Based on this research it is believed that there is a signal that is given off by the germinating seed that the Fusarium senses. Dormant cheatgrass seeds do not appear to be affected by the Fusarium unless the seed is severely damaged and allows for easy access to the embryo. Because of this we can assume that the signal is only produced by germinating seed. This signal could be a hormone produced during germination or possibly nutrients from the digestion of the starches in the endosperm are leaking through the vascular tissue of the hilum. In the end the radicle is unable to do anything but surrender to this extraordinary fungus called Fusarium [4].
References:
[4] The author acknowledges funding from the Joint Fire Sciences Program, and thank the Brigham Young University SEM laboratory for their assistance in obtaining these photographs.