Why Are Alternate Hosts Important for Stem Rust, But Not for Stripe Rust in the US Pacific Northwest?

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Common barberry (*Berberis vulgaris*) has been known to serve as an alternate host for the wheat stem rust pathogen, *Puccinia graminis* f. sp. *tritici* (*Pgt*), under natural conditions in the US Pacific Northwest for a long time. The plant has been recently shown to be infected by basidiospores of the wheat stripe rust pathogen, *Puccinia striiformis* f. sp. *tritici* (*Pst*), under controlled conditions. However, it was not clear if barberry plays any role in stripe rust epidemics under natural conditions. To determine *Puccinia* spp. on barberry plants, we collected aecial samples from barberry plants in the Pacific Northwest from 2010 to 2013 and characterized by inoculation on wheat plants under controlled conditions and using molecular markers and sequences of the internal transcribed spacer (ITS) region of nuclear ribosomal DNA. All tests using single aecia clearly showed either *Pgt* or other formae speciales of *P. graminis*, but did not show any *P. striiformis*. The results strongly imply that barberry is essential for stem rust epidemics, but not for stripe rust under the natural conditions in the US Pacific Northwest.

To determine why *Pgt* is able to infect barberry plants but *Pst* cannot under the natural conditions, the viabilities of teliospores of both *Pgt* and *Pst* were investigated from 2011 to 2014 by studying their structures and determining the germination rates using telial samples collected periodically from wheat fields. After maturity, elongate telia of *Pgt* are exposed from the erupted plant epidermal tissue, but telia of *Pst* remain under the plant epidermal layer. When physically separated from plant tissue, *Pgt* teliospores could not be germinated, but *Pst* teliospores could be easily germinated under moist conditions and their respective optimal temperature conditions. Teliospores of *Pst* usually produced in July were physically degraded during winter, and their germination rate decreased from 50-90% in August to less than 1% in the following March and no germination after May. In contrast, *Pgt* teliospores usually produced in July and August remained physically intact and physiologically dormant, and could not germinate until February of the following year, and their germination rate gradually increased to 90% in May, at which time young leaves of barberry were susceptible to infection. In addition, a time-series experiment was conducted for inoculation of barberry plants with *Pst* teliospores. The results showed that *Pst* teliospores need a minimum of 32 h continual dew-forming condition to infect barberry, and infection reaches a peak after incubation of inoculated plants for 88 h. The lack of protracted moist conditions during the season of telial production effectively negates *Pst* infection of barberry plants in the Pacific Northwest.