AGRICULTURAL RESEARCH FOUNDATION
INTERIM REPORT
FUNDING CYCLE 2016 – 2018

TITLE: Internal dry scale and associated bulb rots of onion: an emerging threat to Oregon onion producers

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SUMMARY:
Recent outbreaks of internal bulb rots have caused significant economic losses in the Treasure Valley onion production region. These rots have been found in association with internal dry scale. These internal issues have been particularly insidious because they are not evident until bulbs are cut. Growers and shippers may ship apparently "good" bulbs only to have them rejected by their customers.

One pathogen that has commonly been found in association with internal dry scale (also termed "incomplete scale") in 2014 and 2015 is the fungus *Fusarium proliferatum*. This is a different species from the causal agent of Fusarium basal rot of onion, which is *Fusarium oxysporum* (du Toit et al., 2003; Schwartz and Mohan, 1995). However, the fact that other bacteria and fungi have been found infesting bulbs with internal dry scale suggests that pathogen infection is a secondary result of the damage from the internal dry scale.

Our surveys of commercial onion fields in 2016 showed that there was a low level of internal bulb rots associated with internal dry scale. Internal dry scale was found from late July through harvest in September. The presence of internal dry scale was related to overall plant health. Onions with greater root mass and healthier appearing foliage were significantly less likely to have internal dry scale than less healthy plants. The likelihood of bulbs having internal dry scale decreased significantly with bulb size. These results indicate that maintaining overall plant health should reduce the problems with internal dry scale and subsequent secondary infections from *Fusarium proliferatum*.

OBJECTIVES:
1) Determine susceptibility of commercial onion varieties to internal dry scale.

2) Determine susceptibility of commercial onion varieties to internal decays and associations between internal dry scale and internal decays.
3) Determine the timing of infection of onion bulbs with pathogens that cause internal decays.
4) Desseminate information from these surveys to growers so that they are aware of the issues.

PROCEDURES:

To determine the susceptibility of different onion varieties to internal dry scale (objective 1) and their susceptibility to internal decays (objective 2), we surveyed commercial onion fields in Malheur County during the 2016 growing seasons. Our informal surveys in 2015 showed that internal dry scale was present in almost all commercial onions grown in Malheur County in 2015. The systematic survey that we are proposing to conduct will allow us to better assess the susceptibility of different varieties to these problems.

Samples of bulbs were collected from July through early September, Bulbs (100 per field) were cut down the middle and scored for the presence or absence of internal dry scales, and for the presence or absence of internal decays. Internal decays were classified as fungal or bacterial infections based on the following visual characteristics. General plant health was also rated based on the health of leaves and roots, and on bulb diameter.

SIGNIFICANT ACCOMPLISHMENTS TO DATE:

Surveys of commercial onions fields showed that relatively few onions were infected with *Fusarium proliferatum,* which has been the most concerning pathogen causing internal rots for the past two seasons. Overall, less than 1% of bulbs showed symptoms of *F. proliferatum* infection. This lack of disease may have been related to a less environmentally stressful growing season. Based on accumulated degree-days, the 2016 growing season was not as hot as in the in the 2015 growing season (Figure 1).

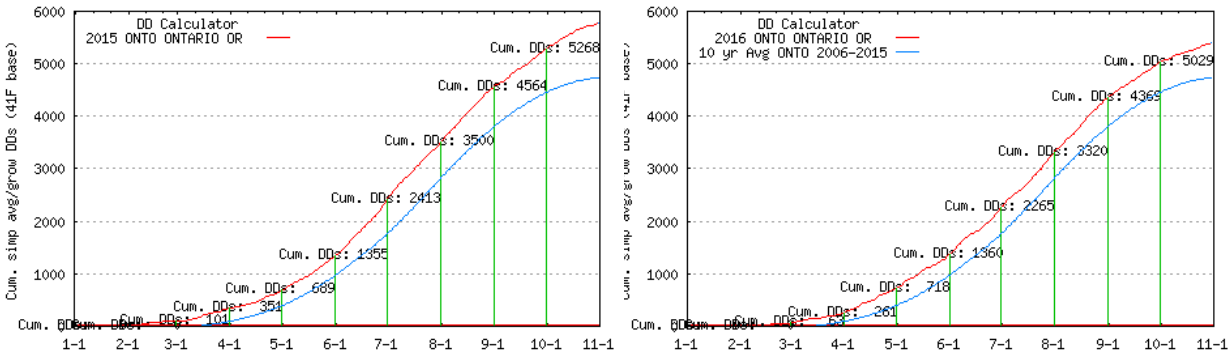


Figure 1. Accumated degree day recorded at the Malheur Experiment Station in 2015 and 2016. Although early spring 2016 was warmer than that of 2015, temperatures in the later spring and summer tended to be lower than in 2015.

Healthier plants were less likely to have internal dry scale. The probability of bulbs displaying internal dry scale decreased significantly with bulb size.

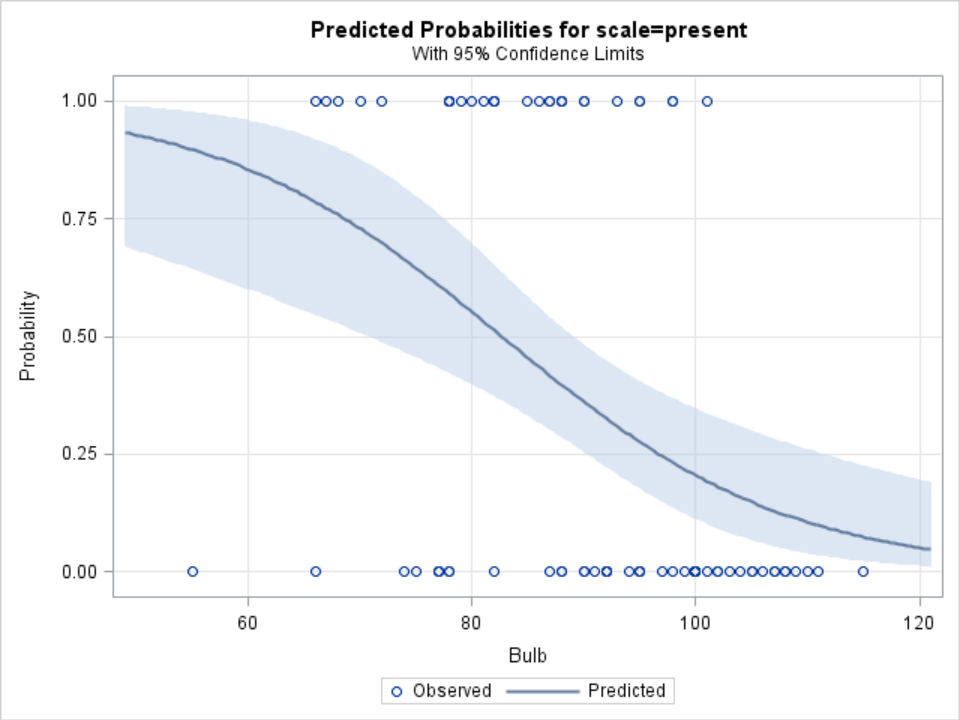
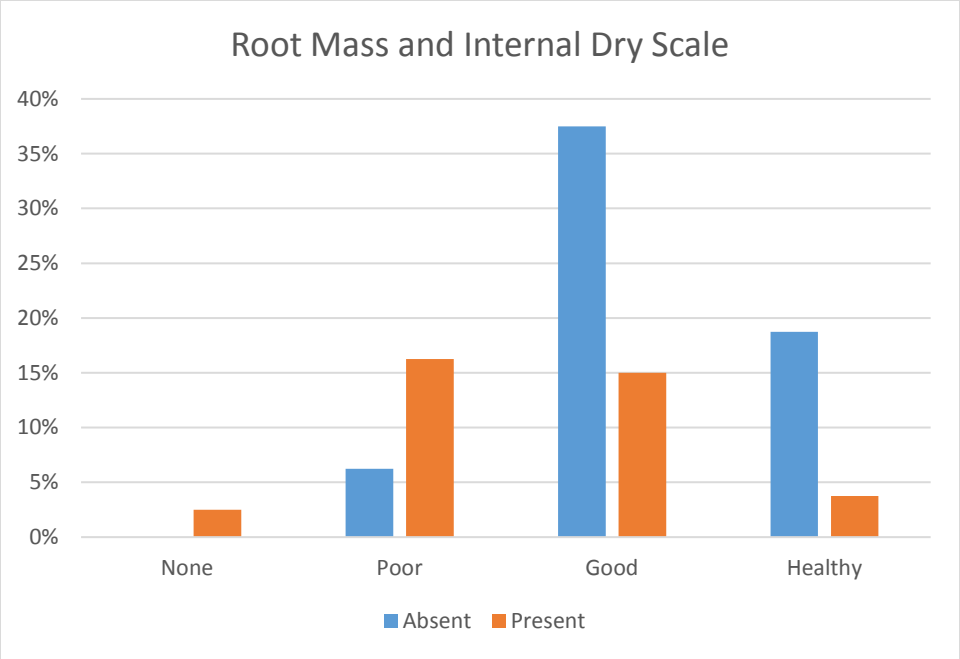


Figure 2. Probability of bulbs having internal dry scale in relation to bulb size, as measured by bulb diameter (mm). The probability of internal dry scale decreased with increasing bulb diameter ($\chi 2$ = 11.67, $p < 0.0006$).

Other plant health characteristics were also associated with internal dry scale. Plants with greater root mass, categorized as no roots, poorly developed root system, good root system, or a health root system



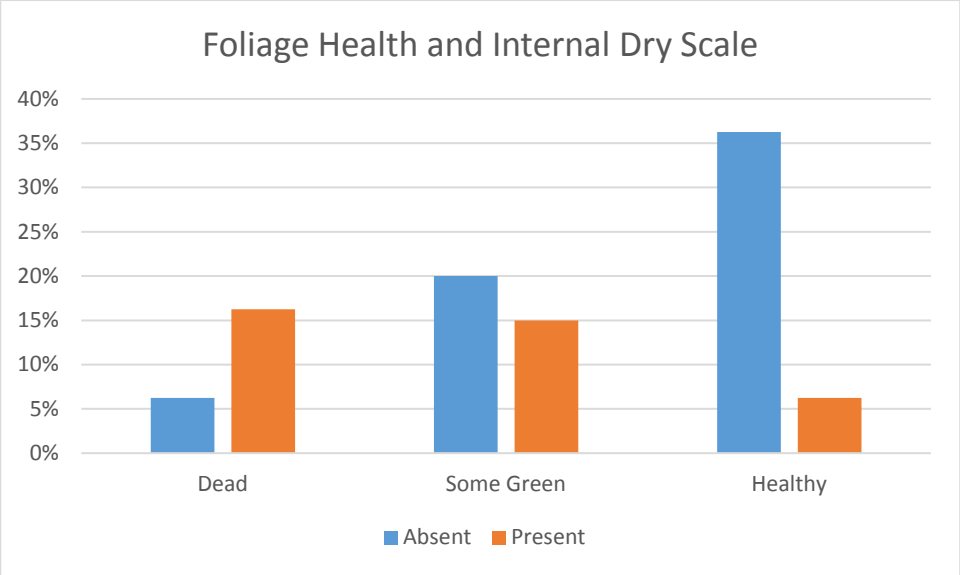


Figure 3. Likelihood of onion bulbs having internal dry scale based on qualitative ratings of root mass (upper graph) and foliage health (lower graph). Internal dry scale was less likely to be found in plants with greater root mass ($\chi 2$ = 17.3545, $p < 0.0006$) and healthier (greener) foliage ($\chi 2$ = 17.1394, $p < 0.0002$). Blue bars represent percentages of bulbs with no internal dry scale. Orange bars represent percentages of bulbs with internal dry scale.

These results indicate that maintaining overall plant health should reduce the problems with internal dry scale and subsequent secondary infections from *Fusarium proliferatum.*

To disseminate information (Objective 4), results were presented at the Pacific Northwest Vegetable Association (PNVA) meeting in 2016 and at other local grower group meetings.

ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM:

Funding for a complementary fungicide trial conducted at the Malheur Experiment Station was obtained from the Idaho-Eastern Oregon Onion Committee.

FUTURE FUNDING POSSIBILITIES:

Idaho-Eastern Oregon Onion Committee