Development of Robust Screening Methods to Evaluate Sunflowers for Resistance to Sclerotinia Head Rot

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For the past decade, the Carrington Research Extension Center has been advancing the development of commercial hybrids with reduced susceptibility to Sclerotinia head rot by leading a multi-location effort to screen commercial sunflower breeding lines and hybrids for head rot resistance. However, considerable variability in screening results has often been observed across screening locations, requiring that breeding lines and hybrids be evaluated across a large number of locations to confidently identify the susceptibility of an individual line. In order to reduce this variability and permit the successful screening of lines in a smaller number of nurseries, experiments were initiated in 2011 to identify strategies to improve the accuracy and repeatability of screening results.

The susceptibility of sunflowers to head rot is assessed by inoculating sunflower heads with laboratory produced spores of the causal pathogen, *Sclerotinia sclerotiorum*, and applying supplemental overhead irrigation. While it is generally understood that Sclerotinia head rot develops on sunflowers during the bloom period, the relative susceptibility of sunflowers at different stages of bloom and immediately after bloom has been unclear. In most crops, Sclerotinia diseases develop when spores of *S. sclerotiorum* colonize senescent blossoms, and it has been assumed that sunflowers remain highly susceptible to Sclerotinia head rot immediately after bloom, when the ray flowers are wilted and the head is covered with senescent blossoms. Accordingly, in head rot screening nurseries, inoculations have often been conducted both during and immediately after bloom.

The susceptibility of sunflowers to Sclerotinia head rot during and after bloom was tested in experiments conducted in Carrington and Langdon, ND in 2011 to 2013. Inoculation timing experiments were conducted on both resistant and susceptible hybrids, with heads bagged for three days after inoculations (to trap humidity and create an environment more favorable for disease) or left unbagged. Inoculations conducted at full bloom (40 to 90% of disk flowers in bloom or already completed bloom) consistently resulted in high levels of Sclerotinia head rot, but inoculations conducted immediately after bloom (ray flowers wilted, flowering complete) often only resulted in elevated levels of Sclerotinia head rot when conditions were particularly favorable for head rot – often, only the bagged heads treatment in the susceptible check. In related experiments conducted in Carrington in 2013, the susceptibility of sunflowers to head rot increased as bloom progressed, with sunflowers significantly more susceptible to the disease at late bloom than at early bloom. The results clearly indicate that the susceptibility of sunflowers to head rot is dependent on growth stage; to produce unbiased, replicable results from screening nurseries, all sunflower heads across all entries must be inoculated at the same growth stage.

The adoption of uniform methods in which every sunflower head across all breeding lines and hybrids is inoculated at precisely the same growth stage – once at mid-bloom and once at late bloom – has resulted in a marked improvement in the repeatability of results across screening locations. In 2012, results were 58 to 89 percent correlated across nurseries where inoculations were conducted in this manner and only 28 to 48 percent correlated where they were not. In 2013, inoculations were conducted in this manner across all screening nurseries, and results were 76 to 92 percent correlated across nurseries. The adoption of these methods is permitting a rigorous assessment of susceptibility to sunflowers to Sclerotinia head rot in fewer nurseries – and thus lower cost – than was previously possible.