Soil Management Strategies to Reduce Fusarium Wilt of Lettuce in the Organic Soils of the Everglades Agricultural Area

JESSE MURRAY, RICHARD RAID, AND GERMÁN SANDOYA*

Everglades Research and Education Center, University of Florida, IFAS, Belle Glade, FL

Additional index words. Fusarium wilt, disease management, histosols, lettuce

Lettuce (Lactuca sativa L.) cultivation worldwide is threatened by the soil-borne fungus Fusarium oxysporum f. sp. lactucae (Fol) which causes Fusarium wilt. Fol colonizes taproot vascular tissue and develops a root rot that deforms or kills plants. In 2017, Fol race 1 was confirmed in an isolated field of the primary lettuce producing region of the Everglades Agricultural Area (EAA) in Florida (Murray et al., 2020). Once established, Fusarium wilt is difficult to manage because chemical, cultural, and genetic interventions do not provide complete control. The soils in the EAA have high organic matter (> 80%) and require specific management such as maintaining soil pH, applying phosphorus (P) fertilizers and flooding fallow fields to reduce soil loss and biotic stresses. Potentially, these strategies could reduce Fol in different soil types; however, this information is lacking for histosol systems like the EAA. As a result, the goal of this research was to identify cultural practices that could further reduce disease symptoms.

Two experiments were conducted at the Everglades Research and Education Center (EREC) in Mar.–Apr. 2021 to test the effect of soil pH amendments and P fertilizer on Fusarium wilt. An isolated, disease-free field was quarantined to build 18 self-contained microplots (1.2 m² plastic beds). Fol was established in the microplots by incorporating Fol-infested out seeds and repeatedly planting susceptible ‘Chosen’. Wooden boards were then inserted to subdivide the microplots into four subplots, for a total of 72 (0.61 m²). Both experiments were conducted as a randomized complete-block design with 12 replications utilizing a factorial arrangement. The first factor consisted of six soil treatments: low pH (5.6); high pH (7.5); recommended P rate (75 kg·ha⁻¹, Rec. P); half-recommended P (Low P); double-recommended P (High P); and untreated control (No Trt). The second factor was two different cultivars: susceptible (S) Chosen and partially resistant (PR) Floricrisp 1265 in Expt. 1, and Floricrisp 1265 and UF breeding line 60182 (PR) in Expt. 2. Five lettuce seeds per cultivar were planted in separate rows for each subplot and monitored daily until moderate foliar symptoms appeared.

Disease severity was rated by dissecting the taproot longitudinally and scoring the vascular tissue for root discoloration severity (RDS) on a 0 to 5 scale, where 0 = no discoloration and 5 = dead plant (Fang et al., 2012). Root discoloration incidence (RDI) was calculated as the proportion of plants displaying RDS ≥1 and only results for RDI are presented. A non-parametric analysis of ranked means was used to test differences among treatments (SAS Institute Version 9.4, , Cary, NC). A third experiment (Experiment 3) was initiated in a greenhouse in Mar. 2021 to test three flooding durations for reducing the concentration of Fol. Soil was obtained from the field microplots and homogenized to fill 12 buckets with 4.5 kg of soil. Buckets were flooded for either 7, 21, or 30 days. The concentration of Fol colony forming units (CFU/g soil) was measured on a soil sample per bucket before and after flooding by performing serial dilution plating on Komada’s Semi-Selective Medium (Randall et al., 2020). A t-test was conducted to compare the reduction in Fol inoculum within each treatment.

Significant differences (P < 0.0001) in RDI were found among soil treatments and cultivars in Expts. 1 and 2. In both experiments, Low P and Rec. P significantly reduced RDI compared to Low pH. In Expt. 2, they also reduced RDI relative to No Trt. The decrease in RDI was greater for ‘Foricrisp 1265’ (PR) than ‘Chosen’ (S) in Expt. 1, and greater than 60182 (PR) in Expt. 2. These results suggest that applying P fertilizers at or below the recommended rate in infested soils may help reduce disease symptoms for PR cultivars. Flooding Fol infested soil in Expt. 3 resulted in an insignificant increase of 25.7% after 7 days, but significant reductions of 22.2% and 27.0% Fol CFUs were observed for 21- and 30-day flooding, respectively. Despite the observed reduction of Fol under 21- and 30-days flooding, over 1200 CFU/g soil were present. In the EAA, growers flood fallow fields for 40 days as a recommended practice, therefore, longer flooding durations need to be investigated to reduce Fol concentration to below a safe threshold.

Literature Cited


*Corresponding author. Email: gsandoyamiranda@ufl.edu