STRAWBERRY ROOT ROT AND THE RECOVERY OF *PYTHIUM* AND *RHIZOCTONIA* SPP.

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One root disease complex often associated with strawberry plants grown in nonfumigated soil is referred to as black root rot. While not currently a widespread problem in properly fumigated commercial production fields, with the impending phase out of the use of methyl bromide and alteration of current fumigation practices this disease complex may once again become a problem. In other strawberry production areas in the world black root rot has been attributed to various combinations of root infection by *Pythium* species, three different anastomosis groups (AG) of binucleate *Rhizoctonia* spp., *Cylindrocarpon* sp., or the lesion nematode *Pratylenchus penetrans* (reviewed in Wing *et al*., 1994). In Connecticut it is believed that binucleate *Rhizoctonia* spp. and the lesion nematode are primarily responsible for the disease complex (LaMondia and S.B. Martin, 1989). In the strawberry production areas of central coastal California all of the fungal pathogens have been recovered from necrotic roots of plants growing in poorly or nonfumigated soil (Wilhelm et al. 1972; Yuen *et al*. 1991; F.N. Martin, unpublished), however, very little is known about the specific contribution of the different pathogens to disease expression in the local strawberry production system.

Having a better understanding of which pathogens are involved in this disease complex will facilitate development of disease control strategies. Current investigations include the evaluation of host cultivars for tolerance to the disease, efficacy trials of microbial inoculants for reducing disease severity, and evaluation of the influence of crop rotation on population dynamics of pathogen inoculum density.

Isolation of root pathogens

Both *Pythium* and *Rhizoctonia* spp. were commonly recovered from strawberry roots grown in the central coastal production area of California. When comparing the isolation frequency of these two genera of root pathogens *Pythium* spp. were recovered more frequently and represented 70% of the isolates from the Watsonville site, 39% from the Moss Landing site, 88 % from the Santa Cruz site, and 50% from the Salinas site. Several other collection sites in the Salinas area were examined and *Pythium* spp., but not *Rhizoctonia* spp., were recovered from these locations as well. In contrast to these collection locations the predominant pathogen from the Santa Maria site was *Rhizoctonia* spp. and very little recovery of *Pythium* spp. was observed. The time of the season may have some effect on the differential recovery of these two genera of root pathogens. At the Salinas site in 1998 there were frequent isolations of *Pythium* spp. but not *Rhizoctonia* spp. from roots collected in late winter, however, 83% of the isolations made from roots collected from the same location in late summer were binucleate *Rhizoctonia* spp. There was a similar low recovery of binucleate *Rhizoctonia* isolates from this site in the early spring of 1997.

Pythium spp.

Field Isolations - Quite a range of *Pythium* species has been recovered from the roots of symptomatic and asymptomatic plants. While *P. ultimum* is the most commonly recovered species, *P. irregulare* and *P. paroecandrum* also are frequently isolated. Species such as *P. diclinum*, as well as 16 yet to be conclusively identified homothallic species were recovered less frequently, making a total of approximately 20 different homothallic species that have been recovered from roots. In addition to these species, approximately 30% of the total *Pythium* sp. recovered did not form oospores individually or when paired with heterothallic testers and thus, could not be identified to a species level. They have been placed into three groups based on sporangial or hyphal swelling morphology (filamentous, lobate, and spherical), with 92% of these isolates having spherical hyphal swellings. Based on minor morphological differences (average diameter of hyphal swelling, growth habit over water, and temperature growth response) and virulence (some isolates can have a significant effect on the plant while others have minimal) these isolates do not represent a homogenous group. This is also supported by restriction fragment length polymorphism analysis using a portion of the mitochondrial DNA.

Pathogenicity and Virulence Tests - Pathogenicity tests have been run with a number of isolates with a range in aggressiveness observed on strawberry not only between species, but also within an individual species. Some isolates of *Pythium* have been found to readily infect the plant and cause significant root disease (*P. ultimum*. *P. irregulare*, and some hyphal swelling isolates) while others cause limited or no visual symptoms (hyphal swelling isolates 97NF-8 and T-3). Based on UPGMA analysis these pathogens clustered into different mitochondrial RFLP groups. A more detailed assessment and quantification of virulence is currently in progress.

Rhizoctonia spp.

Nuclear Condition and Anastomosis Grouping - A total of 123 isolates of *Rhizoctonia* spp. were recovered from strawberry roots over a period of 3 years and all but one isolate were binucleate. Anastomosis group (AG) testing of the binucleate *Rhizoctonia* spp. revealed that only three AGs were recovered, AGA, AGG, and AGI; these are the same AGs that were recovered from strawberry in Connecticut (Martin 1988). The most commonly isolated anastomosis group in California was AGA (68%) followed by AGI (21.3%) and AGG (10.7%), but the relative rates of recovery of each AG varied at the different collection sites (Fig. 1).

Pathogenicity trials – Pathogenicity trials revealed that all binucleate isolates of *Rhizoctonia* evaluated caused significant reduction in shoot weights of strawberry plants (Fig. 2A). While there were no consistent differences in the level of disease observed among the anastomosis groups, different levels of reductions in shoot growth were observed within an anastomosis group. For example, in AGA there were three different groupings for severity of reductions in shoot growth with isolates 98sOrt 1 and 98sOrt 12 causing the greatest reduction (from 68 – 73%) followed by the group containing isolates 98sOrt 27, SMNF3, M 1, M 18, and M 30 (from 43 – 52%). Among the AGA isolates,

isolate 98SW3-21 had the least effect on shoot growth (31% growth reduction). The three AGI isolates evaluated in this trial had an effect on shoot growth similar to each other and the AGA and AGG isolates, however, inhibition of shoot growth with these isolates was greater than observed for the AGA isolate SW3-21. These isolates had a similar effect on root growth, albeit to a lesser extent than observed for inhibition of shoot growth (Fig. 2B). Evaluation of isolate virulence by adding varying levels of pathogen inoculum revealed that there were differences in virulence among the isolates examined, with some of the isolates exhibiting low levels of virulence (data not shown).

References

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