POPULATION DYNAMICS OF PLANT-PATHOGENIC AND NONPATHOGENIC FUNGI IN A REDUCED-TILLAGE EXPERIMENT MULTICROPPED TO RYE AND SOYBEANS IN FLORIDA.

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When compared to conventional-tillage, reduced-tillage may result in decreased soil erosion and an increased soil retention of plant nutrients, organic matter, and water. Multicropping may be used in conjunction with reduced-tillage as an effective way to use land, labor, and equipment. Crop management utilizing both reduced-tillage and multicropping is increaseing in popularity in the Southeastern United States(3). Because many of these crop management systems have been proposed only recently, much research remains to be done on the feasibility of using these systems in a given region. One of the factors determining the feasibility of any cropping system is its performance with regard to plant pests. Plant pathologists have demonstrated that certain plant pathogens survive in crop residues. Due to the increased crop debris found in soil managed under reduced-tillage, it might then be expected that these cropping systems will foster and possibly succumb to certain pathogens. This scenario has been suggested, and documented for certain pathosystems but not for others. If experience with pathosystems in different environments has demonstrated anything, however, it is that it is difficult to predict which pathogens may become a problem in a given cropping situation on the basis of one's intuition or past experience in related situations. Certainly, additional research on plant pathogens found in these nonconventional cropping systems is warranted.

The purpose of the present research was to identify and quantify populations of pathogenic and nonpathogenic fungi recovered from soil in a reduced-tillaae experiment multicropped to rye (Secale cereale) and soybean (Glycine max) in Florida.

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METHODS AND MATERIALS

The experimental field assayed in this study wae maintained on the Green Acres research facility of the Agronomy Farm of the University of Florida at Gainesville. For 4 years. prior to the start of this. study, plots in the field were not tilled and were either subsoiled at a depth of 45 cm to break compacted subsurface layers or not subsoiled. 'Bragg' soybean was planted in May and harvested in October and 'Wrens Arbuzzi' rye was planted in November and harvested as grain in April. At the beginning of this study, plots subsoiled and not subsoiled in the field were either tilled to a depth of 15 cm or not tilled; in the resultant split-plot design, subsoiled plots became main plots and tillage plots were subplots. Tillage and subsoiling treatments were imposed before the rye crop was planted each year and both crops were drill-planted. Treatments were replicated four times.

On 22 sample dates soil samples were taken from the surface 5 cm of treatment plots in the field; the sample dates spanned 820 days at intervals of approximately 5 weeks. Forty subsamples were taken with a 2.5-cm-diameter soil core sampler from within plant rows in each treatment plot. Soil subsamples were pooled for each treatment plot and the pooled samples were used in assays for fungi. KO's (5) medium amended with 0.5% benomyl (2) was used for the isolation of Rhizoctonia spp. for the first six sample dates and Flowers' (8) medium was used for isolating Rhizoctonia spp. for the last 16 sample dates. Difco cornmeal agar amended with 10 ppm pimaricin, 250 ppm ampicillin, 10 ppm rifamycin, and 100 ppm PCNB was used to assay soil for Pythium spp. (4). Difco potato dextrose agar amended with 1000 ppm Tergitol NPX and 50 ppm chlortetracycline was used for estimated the population densities of common spore-forming fungi found in field soil (7). Data were analyzed with a SAS (Statistical Analysis Systems) GLM (General Linear Models) program.

RESULTS AND DISCUSSION

Fungi in the genera Penicillium, Asperaillus, Trichoderma, Fusarium, and Rhizopus accounted for 38 to 71% of all fungi recovered from a given treatment plot on a given sample date. Less frequently isolated fungi included species of the genera: Laetisaria, Mortierella, Mrrothecium, Mucor, Neocosmospora, Neurospora, Paecilomyces, Phoma, Pyrenochaeta, and several others that were not identified. The following fungal species are listed in descending order of frequency of recovery for a given genus. Species of Penicillium recovered from the field included P. citrinum, P. purpurogenum, and two other species that were not identified. Asperaillus orhraceus, A. clavatum, A. flavus,

and A. niger constituted the total detectable Aspergillus population in field soil. Only two species of Trichoderma were routinely isolated during these studies: T. harzianum, and T. hamatum. Isolates of Fusarium and Rhizopus were not idenfified to species.

Nine anastomosis groups or species of Rhizoctonia were isolated from field soil; isolates of R. solani AG 4 and the binucleate Rhizoctonia spp. anastomosis group CAG 3 were the most commonly isolated of these. Prthium irregulare, P. acanthicum, and several other unidentified species of Pythium were isolated from th'e field.

In general, fungal population densities were influenced significantly by tillage and sample date; subsoiling effects were not significant (p=O.O5) for any of the fungi tested. The effects of tillage and sample date on population densities of total fungi were highly significant, as was the tillage X sample date interaction; Rhizoctonia spp., Pythium spp., Penicillium spp., and Rhizopus spp. responded to these influences on variability in a similar manner. Tillage and sample date influenced significantly the population densities of P. irregulare, Aspergillus spp., and Fusraium spp.; tillage X sample date interactions were not significant for these fungi. Population densities of R. solani AG 4 and Trichoderma spp. were affected significantly by sample date but not by tillage.

Others have described the influence of reduced-tillage on soilborne microbes. In soils planted to winter wheat, Lynch and Panting (6) reported an increase in soil biomass in no-till soils versus tilled soil; they attributed this difference to an increase in fungal biomass. Doran (1) studied surface soils from several different cropping systems, and found consistently higher populations of three groups of microorganisms in no-till soils than in conuentionally-tilled soils. In a multicropping study, Sumner et a1. (9) reported higher population densities of R. solani (mainly AG 4) and Pythium spp. in surface soil from reduced-tillage systems than from conventionally-tilled soils shortly after planting. Wacha and Tiffany (10) studied a 4-year rotation of corn and soybean. They found no significant quantitative differences between total fungal populations from no-till and conventionally-tilled soils; however, their soil samples were taken at the end of the soybean growing season and after plant debris had been removed from the soil surface. These factors likely obscured any quantitative differences that may have existed after plowing and during the growth of the soybean crop.

Our results with fungal population densities agree with those of Lynch and Panting (6), Doran (1), and Sumner et a1. (9). When population densities of total fungi were broken into their component genera and species, however, these were not always positively influenced by no-tillage. Although Sumner et al. (9) found higher population densities of R. solani AG 4 in no-till soils versus conventionally-tilled soils they did not quantitate the population densities of the various anastomosis groups of this species from the different tillage treatments in their study. In our work, population densities of Rhizoctonia spp. were higher in no-till plots, but when populations of R. solani AG 4 were quantitated no difference was found between populations in no-till and 15-cm till plots; no-tillage was not associated with increased populations of R. solani AG 4 pathogens in this experiment.

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