# Effect of Tillage on Take-All of Wheat

Craig S. Rothrock

Department of Plant Pathology. University of Georgia, Georgia Experiment Station. Experiment, GA 30212

Take-all of wheat, caused by Gaeumannomyces graminis var. tritici, has become a common disease in recent years in wheat fields throughout Georgia and other states in the Southeast. This fungus is a soil-borne pathogen which infects roots throughout the growing season, resulting in poor growth and premature ripening and thus a reduction in wheat yields. Survival and dissemination of the pathogen is primarily by infested wheat residue from the previous season.

Cultivation technique might be expected to affect root diseases because of the changes in the soil environment and the changes in the distribution of crop residue. The effect of tillage on take-all has been variable. In England, Brooks and Dawson (1968) found take-all severity was less when wheat was drilled directly into wheat stubble than when wheat was planted after cultivation. Novotny and Herman (1981) also reported that tillage increased take-all. Yarham and Norton (1981) observed no differences in disease incidence with different cultivation techniques. In the Pacific Northwest, Moore and Cook (1984) reported that wheat planted following no tillage had more take-all than wheat planted following tillage. Because of the increase in take-all in the Southeast and the discrepancy in the effects of tillage on disease severity, an experiment was established to examine the effect of tillage on disease incidence and severity of take-all.

## MATERIALS AND METHODS

Research plots were established in the fall of 1982 at the Bledsoe research farm in Pike County, Georgia, on land doublecropped with wheat and soybean since the fall of 1977. Take-all was observed in the experimental area in the spring of 1982.

The experiment was arranged in a randomized complete block split-split plot design. Tillage treatments were the main plots and were replicated six times. Cropping system and fumigation formed the subplots and sub-subplots, respectively. The two tillage treatments were no tillage and conventional tillage. Conventional tillage consisted of moldboard plowing and disking twice prior to planting wheat and disking or rotavating prior to planting soybean. The two cropping systems were wheat/fallow and wheat/soybean. Subplots were not split into fumigated and nonfumigated plots until the second wheat crop and will not be discussed in this paper. Sub-subplots were 6.1 x 4.6 m. The wheat cultivars McNair 1813 and Stacy were planted on November 9, 1982, and November 23, 1983, respectively.

Take-all was assessed between growth stages 11.1 and 11.2 using Feeke's scale. Ten tillers per plot were randomly selected and washed. Root systems were examined for symptoms of the disease by viewing roots under water against a white background using a stereomicroscope (x10) and the percentage of infected plants recorded. Plants were also rated for the percentage of roots infected; 0 = roots healthy, 1 = lesions on < 25% of the roots, 2 = lesions on 25% to < 50% of the roots, 3 = lesions on 50% to < 75% of the roots, and 4 = lesions on 75% - 100% of the roots. The area of the plots having whiteheads as a result of take-all was calculated by assessing disease at the intersection of one foot grids over the entire plot.

Organic residue was sampled in wheat/fallow plots prior to planting for the 1984-1985 wheat crop. Four subsamples were taken per plot from an area 15 cm in diameter by 15 cm deep. These samples were wet sieved through sieves with openings of 5.6, 2, and 0.7 mm. The residue was then dried and weighed. Surface residue was collected from 0.2 $m^2$ and weighed.

## RESULTS

Take-all was found in both 1983 and 1984. Incidence in 1983 was 28% and increased to 76% in 1984. Disease severity increased similarly from 0.5 in 1983 to 1.8 in 1984. Take-all was not significantly affected by the tillage treatment in 1983 as measured by either disease severity or incidence (Table 1). In 1984, take-all was significantly greater in the conventional tillage treatment. This increase in take-all was found for both the percentage of plants infected and the severity of infection. The increase in take-all with conventional tillage was found under both doublecropping and wheat monoculture, with no differences in take-all being observed between the two cropping systems. The percentage of the plot area with whiteheads as a result of take-all was greater with conventional tillage but was not significantly greater than the no-tillage treatment in either year.

No differences were found between the amount of plant residue sieved from soil under wheat monoculture between the two tillage systems (Table 2). The amount of residue left on the soil surface with no tillage was significantly greater.

## DISCUSSION

The effect of tillage on take-all was found to be similar to the effect reported by Brooks and Dawson (1968), with tillage not affecting or increasing take-all. Since G. raminis var. tritici has no spores that are important in the dissemination of the pathogen, infested wheat residue is thought to be the primary source of inoculum. Thus spread of the pathogen is limited to mycelial growth from infested residue and infected roots or physical movement of the residue. In this study, tillage was found to be important in the dissemination of the pathogen and thus disease development, as found by the increase in disease incidence and severity in 1984.

Moore and Cook (1984) found the opposite effect with tillage in the Pacific Northwest. They concluded that the increase in take-all under no tillage was a result of a greater amount of wheat residue at planting and thus a larger amount of inoculum of the pathogen. In this experiment no difference

in the amount of residue, and thus inoculum, was found between the two tillage systems. Thus, the only effect of tillage on take-all would be distribution of inoculum in the plots and thus an increase in disease where tillage moved infested residue.

## LITERATURE CITED

1. Brooks, D. H., and Dawson, M. G. 1968. Influence of direct-drilling of winter wheat on incidence of take-all and eyespot. Ann. Appl. Biol. 61:57-64.

2. Moore, K. J., and Cook, R. J. 1984. Increased take-all of wheat with direct drilling in the Pacific Northwest. Phytopathology 74: 1044-1049.

3. Novotny, J., and Herman, M. 1981. Effect of soil cultivation on incidence of winter wheat with take-all (Gaeumannomyces graminis). Sb. Uvtiz (Ustav Ved. Inf. Zemed.) Ochr. Rostl. 17:151-156.

4. Yarham, D. J., and Norton, J. 1981. Effects of cultivation methods on disease. Pages 157-166 in: Strategies for the Control of Cereal Disease. J. F. Jenkyn and R. T. Plumb, eds. Blackwell Scientific Publications, Boston, MA. 219 pp.

Table 1. Effects of tillage and cropping system on take-all of wheat

| Treatment | Incidence(%)[a] | | Disease severity[b] | | Whiteheads(%)[c] | |
|---|---|---|---|---|---|---|
| | 1983 | 1984 | 1983 | 1984 | 1983 | 1984 |
| Tillage | | | | | | |
| no | 26.7 | 67.8 | 0.38 | 1.35 | 5.2 | 16.7 |
| conventional | 29.4 | 84.6 | 0.55 | 2.23 | 11.6 | 21.1 |
| LSD(P=0.05) | ns | 13.7 | ns | 0.66 | ns | ns |
| Cropping System | | | | | | |
| wheat/soybean | - | 73.2 | - | 1.83 | - | 20.1 |
| wheat/fallow | - | 79.2 | - | 1.75 | - | 17.7 |
| LSD(P=0.05) | | ns | | ns | | ns |

[a] Incidence assessed as percentage of plants infected in a random sample of 10 plants per plot.
[b] Disease severity index 0-4 where 0=no roots infected and 4=75-100% of roots infected.
[c] Percentage of plot area with whiteheads.

Table 2. Effect of tillage on the amount of organic residue

| Residue | Tillage | |
|---|---|---|
| | no | conventional |
| Buried (g/kg)[a] | | |
| large | 0.3 | 0.5 |
| medium | 0.4 | 0.4 |
| small | 1.3 | 0.8[b] |
| combined | 1.9 | 1.6 |
| Surface ($g/m^2$) | 529.5 | 1.9[b] |

[a] Sieve size (opening); large = 5.6 mm, medium = 2 mm, small = 0.7 mm.
[b] The differences between treatment means for residue samples are significant (P=0.05).