Factsheets – Wheat

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Effects of Reduced Tillage on Wheat Diseases

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PROBLEM DEFINITION

Plant pathologists' traditional recommendations have been to clean-till fields. A few passes with the disk were good. Better yet, moldboard plow the residue under. Even better, burn the stubble, then plow it. Unfortunately, clean-tilling fields did not turn out to be a sustainable practice. Water and wind erosion claimed too much top soil and threatened to reduce the yield potential of our fields. Water quality of the streams and lakes also suffered.

As we change our tillage systems to reduce erosion, we need to ask how this will change the whole system. The objectives of tillage were to 1) develop a good seedbed, 2) control weeds, and 3) destroy insect pests and diseases in the debris. How can we achieve these same objectives while reducing or eliminating tillage? The purpose of this fact sheet is to focus on how wheat diseases might be affected by reduced tillage practices and what we might do about it.

HOW DOES TILLAGE AFFECT DISEASES?

Although a few diseases are suppressed under reduced tillage, most diseases are favored with more residue on the surface (see Table 1). The main way that reduced tillage affects disease is by increasing the amount of inoculum. Inoculum is a term for the pathogen propagules that initiate an epidemic. Tillage reduces crop debris that serves as a refuge for many pathogens. It also destroys volunteer plants that serve as a reservoir of pathogens, such as viruses or rusts, that require a living host.

Another way that tillage can affect diseases is through changes in the microenvironment. Reduced tillage, for example, tends to increase soil moisture and decrease soil temperature. These changes suppress some diseases such as dryland foot rot or common root rot. There are numerous other changes in the soil bulk density, porosity, and microbial community that may affect diseases. Tillage can also affect the behavior of vectors that carry diseases. For instance, aphids that carry barley yellow dwarf virus are less likely to land in fields with abundant crop residue on the soil surface.

The effect of tillage on subsequent disease severity depends heavily on the previous crop. For example, crop debris from wheat contains numerous pathogens which can harm a subsequent wheat crop. Therefore, no-tilling wheat into wheat stubble often results in high disease severity. On the other hand, crop debris from legumes contains very few pathogens that can harm wheat. Therefore, no-tilling wheat into legume stubble poses little risk.

Pathogen mobility affects the scale of tillage effects. Tillage has a strong localized effect on a nonmobile pathogen such as the take-all fungus but no effect one mile away. Conversely, tillage may have little localized effect on a mobile pathogen such as the scab fungus, but regional changes in tillage practices affect the scab inoculum level of an entire region.

HOW CAN WE MANAGE DISEASES UNDER CONSERVATION TILLAGE?

Identify the key diseases:

The first step in managing diseases under conservation tillage is to identify the specific diseases that are likely to become a problem. Otherwise, producers may waste time, money, and energy fighting the wrong battles. Disease risk will depend heavily on the particular crop rotation used. Use Table 1 to get an idea of the rotational crops that pose some risk. Incidentally, double-cropping does not count as a rotation crop because there is insufficient time for residue breakdown. Check with local Extension personnel for information on prevalence of diseases in your area. For instance, dryland foot rot is prevalent only in arid regions with chronic drought stress.

Don't forget to consider the mobile pathogens, which can move from field to field. Scab, for example, seems to be increasing in prevalence due to regional trends toward leaving more corn residue on the surface. Even though individual producers have little impact on the regional trend, they may need to plan for the impact nonetheless.

Plan alternative control strategies:

For each disease that poses a significantly increased economic risk with reduced tillage, we need to plan an alternative control strategy. There may be many opportunities for overlap between strategies for different diseases, insect pests, and even weeds. In most cases, control strategies for individual diseases can be combined into an overall integrated pest management plan.

The most important strategy to manage diseases under conservation tillage is to plan a good crop rotation sequence. Wheat is the worst preceding crop for wheat because it carries tan spot, take-all root rot, wheat streak mosaic, and numerous other diseases. Other small grains such as barley and rye have some diseases in common with wheat and are less than ideal as preceding crops. However, they are not as bad as wheat. Smooth brome is a strong source of take-all root rot and should be avoided as a preceding crop. Weedy brome or cheat species also carry take-all. Take-all can be a big problem when wheat follows alfalfa infested with weedy bromes. Corn is the number one source of scab inoculum. Although the scab pathogen is mobile, corn preceding wheat can result in higher scab levels.

Conservation tillage is not necessarily "all or nothing." Certain rotations could be planned that contain a mixture of tillage practices, depending on the preceding crop. For example, corn could be no-tilled into wheat stubble, but wheat could be planted after corn following disking or plowing to reduce inoculum. This option would not be appropriate for highly erodible land. Another thing to consider is that mulch tillage may reduce inoculum levels compared to no-till. Mulch tillage results in greater soil-residue contact, which may allow soil microbes to compete better against pathogens residing in the straw. No-till leaves a lot of standing stubble, which is ideal for survival of the pathogens.

Herbicides can substitute for tillage to control volunteer wheat or grassy weeds that harbor viruses (especially wheat streak mosaic virus), the take-all fungus, and rusts. Other problems carried by volunteer include Hessian fly and various mites. Volunteer wheat must be destroyed before planting time.

Choose varieties with resistance to important diseases. Excellent genetic resistance is available against tan spot, powdery mildew, Septoria tritici blotch, and leaf rust. Good resistance is available against wheat streak mosaic, Stagonospora nodorum blotch, and barley yellow dwarf. There is some scab resistance in a few varieties like Hondo, Heyne, and Karl 92. There are currently no satisfactory levels of resistance for take-all, seedling blight, common root rot, or dryland foot rot.

Seed treatment fungicides may improve emergence and reduce post-emergence damping-off of no-till wheat. Seedling problems tend to be worse under conservation tillage because soils will be cooler and wetter, and disease organisms will be associated with the old crop residue. Seed treatments also can control seedborne pathogens.

Avoiding early planting can reduce incidence of barley yellow dwarf, wheat streak mosaic, take-all, and common root rot.

Foliar fungicides can reduce severity of leaf rust, tan spot, Septoria tritici blotch, Stagonospora nodorum blotch, and powdery mildew. Unfortunately, fungicides are not always profitable, so evaluate fields carefully before spraying.

Provide balanced fertility. Excess nitrogen can cause lush stands with high humidity in the canopy. This promotes powdery mildew and other foliar diseases. Chloride deficiency has been shown to promote development of rusts and take-all root rot.

Table 1. Effects of reduced tillage on wheat diseases.

Disease	Previous Crop That Serves as Source of Pathogen	Pathogen Mobility	Effect of Reduced Tillage	Reason for Effect
tan spot	wheat	low	increased	inoculum
take-all root rot	wheat, barley, bromegrasses	low	increased	inoculum
wheat streak mosaic	living volunteer wheat, barley, someother grasses	medium	increased*	inoculum
scab	mostly corn; sometimes wheat or barley	medium	increased	inoculum
seedling blight	wheat, barley, other grasses	low	increased	environment
Cephalosporium stripe	wheat, barley, rye, other winter	low	increased	inoculum

	annualgrasses			
powdery mildew	wheat	medium	increased	inoculum
Septoria tritici blotch	wheat	medium	increased	inoculum
Stagonospora nodorum blotch	wheat	medium	increased	inoculum
leaf rust	wheat	high	increased*	inoculum
common root rot	wheat, barley, other grasses	low	decreased	environment
dryland foot rot	wheat, barley, other grasses	low	decreased	environment
barley yellow dwarf	wheat, barley, tall fescue, corn, othergrasses	high	decreased	vector behavior

* Applies only to tillage which destroys living volunteer wheat and/or grassy weeds. Destruction of hosts could also be accomplished with herbicides instead of tillage.

Table 2. Local versus residual impact of tillage on wheat diseases.

Disease	Local** Importance of Tillage	Regional** Importance of Tillage
tan spot	high	low
take-all root rot	high	low
wheat streak mosaic	high*	medium*
scab	low to medium	high
seedling blight	medium	low
Cephalosporium stripe	medium	low
powdery mildew	low	medium
Septoria tritici blotch	low	medium
Stagonospora nodorum blotch	low	medium

leaf rust	low*	low*
common root rot	medium	low
dryland foot rot	medium	low
barley yellow dwarf	low	none

Applies only to tillage which destroys living volunteer wheat and/or grassy weeds. Destruction of hosts could also be accomplished with herbicides instead of tillage.

*** Local importance of tillage means it has an effect on that particular field. Regional importance means that trends in tillage affect the whole surrounding neighborhood or region.*

For more information about wheat, visit the Kansas State University Wheat Page: http://www.oznet.ksu.edu/wheatpage/
