Crop Diseases and Reduced Tillage

Jeannie Gilbert, Cereal Research Centre
AAFC, 195 Dafoe Road, Winnipeg, MB R3T 2M9

This summary will cover the prevalent crop diseases that are impacted by reduced tillage or direct seeding. They are primarily either those caused by soil-borne pathogens or those that over-winter in crop residues. The principal crop diseases are caused by fungi which may cause disease in one or more parts of the plant: roots, stem, foliage and fruiting structure. Pathogens such as the rusts are brought up each year on winds from the southern US winter wheat belt; these pathogens do not survive our winters, and they are therefore not affected by tillage practice. Virus infections, with their aphid or wheat curl mite vectors, and air-borne loose smut also fall into this category and are not affected by tillage practice.

Direct tillage results in changes to the soil moisture and temperature, which in turn impacts the biological activity of soil microflora and fauna. The changes effected by direct tillage may favour some pathogens while limiting growth of others.

Root rots

All crops are susceptible to *Rhizoctonia solani* AG8 and to *Pythium* spp. *Rhizoctonia* causes characteristic spear-tip symptoms on the roots of every broadleaf and cereal species so far tested and the only effective ‘break’ for management is a period with no plants in the field (Cook 2001). *Rhizoctonia* root rot is generally more severe when wheat and barley are sown directly into cereal stubble than when sown into a seedbed using conventional tillage (Gill et al. 2001). However, the use of modified narrow sowing points that disturb the soil beneath the seed depth consistently reduce the level of *Rhizoctonia* root damage. This is not due to a reduction or elimination of the pathogen, but enhanced root growth in the loose soil which compensates for loss of root mass due to disease. Other diseases, such as common root rot, caused by *Cochliobolus sativus*, was reduced under zero-till while wilts caused by *Fusarium* spp. increased (Bailey et al. 2001). Root rot of pea is caused by a complex of organisms including *Fusarium* spp., *Pythium* spp. and *Rhizoctonia solani* (Turkington et al. 1997). Studies in the mid 90s, showed that there was significantly less root rot of pea in direct-seeded fields than in conventional-till fields.

Sclerotinia Stem Rot

Sclerotinia stem rot affects many legumes, which also means that rotations have to be carefully managed. Mueller et al. (2002) found that sclerotinia was more severe in no-till and had the lowest yields. Other studies, however, reveal different results. Prevalence of disease in soybeans is less in no-till, than either minimum or conventional-till, but more in minimum than conventional-till (Workneh and Yang 2000). The latter study suggested that in no-till culture the sclerotia (the overwintering structure of the pathogen that germinates in spring under conditions of adequate temperature and moisture) may remain trapped in the stems of the host which forms a physical barrier to germination. Under conventional-till sclerotia that remain deeply buried do not germinate, while under minimum tillage the surface disturbance may release sclerotia from host stems and retain them at the surface or sufficiently close to the surface to germinate and thus provide higher levels of inoculum. The prevalence of the disease is exponentially related to latitudinal position of the field reflecting the North-South variations in temperature. Disease is usually more severe in years when temperatures are cooler than normal (Workneh and Yang 2000).

Leaf Diseases of Cereals

Although the commonly isolated leaf spot pathogens that cause tan spot, septoria leaf blotch, stagonospora nodorum blotch and spot blotch all over winter on infested crop residue a study in southern Manitoba found that tan spot was more prevalent in no-till fields, septoria leaf blotch and stagonospora leaf blotch more prevalent in conventional till fields and spot blotch present at equal levels in both tillage systems (Gilbert and Woods 2001). Studies in Saskatchewan and Ontario also reported higher levels of tan spot in reduced tillage systems and higher levels of septoria leaf blotch in conventional-till. In a US study, higher levels of leaf spot diseases were associated with zero-till plots in years with higher than normal precipitation. Leaf spot diseases were consistently reduced by application of adequate levels of N (Krupinsky and Tanaka 2001). The higher levels in some years may have been associated with the practice of applying glyphosate within
24 hours of planting in the no-till plots. There is evidence that the rapid breakdown of plant tissue provides abundant nourishment for pathogens and results in an immediate increase of inoculum shortly after glyphosate is applied. It is recommended that a period of at least 2-3 weeks occur between spraying and seeding and for best management of the ‘green bridge’ producers should aim to provide up to 8 months between fall burn-off and spring seeding (Cook 2001). Net blotch of barley was found to be more severe in zero-till fields than in either minimum or conventional-till fields, especially in rotations in which barley was planted back into barley stubble (Turkington et al. 1997). Most studies in Saskatchewan have concluded that leaf spot diseases of wheat and barley are less affected by tillage practice than by weather conditions, nutrient status and rotation (Bailey et al. 1992, 2000, 2001).

**Blight**

*Aschochyta blight*

Tillage management was not found to be important for Aschochyta blight severity except in rotations with short re-cropping intervals. Following a disease outbreak, at least two non-host crops were needed between successive lentil or chickpea crops to substantially reduce inoculum of the pathogens that cause Aschochyta blight of lentil and chickpea. (Gossen and Derksen 2003, Gossen and Miller 2004).

*Fusarium head blight (FHB)*

As *F. graminearum* readily survives in crop residues, cultural practices may have an effect on development of FHB. While it is evident that rotations away from corn, wheat, and barley may reduce disease levels (Sutton 1982, Dill-Macky and Jones 1999) it has proved more difficult to evaluate the effects of different tillage practices on its development and severity (Dill-Macky and Jones 1999). Some studies have demonstrated reduced levels of FHB and DON in plots which were mold board plowed as opposed to chisel plowed or direct-seeded. The different tillage treatments left approximately, 10%, 30% and 60% cover of stubble on the soil surface. However, there were no differences between chisel plowed plots and direct seeded plots, and overall the levels were still unacceptably high even in mold board plowed plots (Dill-Macky and Jones 1999). It is possible that airborne ascospores blowing in from adjacent fields may have contributed to and masked amounts of inoculum from the different tillage treatments. After the 1993 epidemic in Manitoba, Gilbert and Tekauz (1994) found no significant impact of cultivar, rotation and tillage practices on percent weight of FDK in harvested samples, although the authors acknowledged that high infection pressure may have masked possible differences. The population of *F. graminearum* decreases once colonized host tissues decompose (Warren and Kommedahl 1973). While *F. graminearum* might persist for unknown periods of time, mainly on the debris in no-till plots, Miller et al. (1998) concluded that weather conditions are more influential than tillage practices in the development of FHB.

**Some Management Practices to reduce Disease in Direct Seeding**

Rotations - Many pathogens cause diseases in more than one host so choosing rotations that will help to control disease is a challenge. Weather conditions and crop rotations have a greater influence on disease development than tillage practice. Many diseases require a rotation of 3 or 4 years to manage inoculum development and disease levels. Crop rotations may be used to reduce leaf spot diseases, but producers should not rely exclusively on a single management practice to minimize disease risk. It is evident that strategies for disease management must be suited to individual production systems and location. Most fact sheets stress the use of long and diversified crop rotations. For root rots and residue-borne diseases of barley and wheat a 3 to 4 year rotation is recommended, for sclerotinia diseases, which attack a wide range of broad-leaf hosts, a 4 to 5 year rotation is recommended and a 4 year rotation is advised for blackleg of canola.

Glyphosate application - Inoculum may increase initially until stubble is decomposed. Extend the period between glyphosate application and seeding to allow for residues to decompose as much as possible.

Use of a seed treatment to control seed-borne diseases.

Choose varieties that have the best disease package to manage diseases that are problematic in your area.
References


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