

## The Effects of Reducing Tillage on Pest Management

An increasing number of farmers in the Columbia Basin are adapting reduced tillage systems from other regions to our conditions and crops. This paper will examine the general effects of reducing tillage on the management of weeds, insects, and diseases. Because these systems have been developed mainly in the Midwest and Canada, much of the information presented here is for the conditions and crops (mainly corn and wheat) in those regions. Experience will show what holds true under our conditions.

Much of the information presented here applies to no-till systems (also called direct seeding) which have the least soil disturbance and highest amounts of residue of all conservation tillage systems. Direct seeding refers to planting the seed into the stubble of the previous crop without any previous tillage or soil disturbance, except that which is necessary to place the seed at the desired depth. The chart below shows the range of tillage systems, from high disturbance systems commonly used in the Columbia Basin on the left to very low disturbance systems on the right.

Conventional tillage		Reduced tillage <30% soil covered by residues	Reduced tillage (also called conservation tillage) >30% soil covered by residues				
Moldboard plow	Heavy Offset Disk	Non- conservation tillage	Other tillage systems	Ridge tillage	Tined tillage (chisel plow)	Strip tillage	No-till, direct seeding
←		→ Increasing residues covering soil			←		
←		→ Decreasing intensity and frequency of soil disturbance			←		

This paper presents the effects, both beneficial and detrimental, of no-till systems on pest management. The effects of systems with more soil disturbance than no-till may be different than those presented in this paper.

### Recommended Management Practices

Pest control in reduced tillage systems can be as effective as in conventional systems, but requires a higher level of management. Key cultural practices include:

**Crop rotation.** For weed management, strategic crop rotation (including herbicide-resistant crops) allows different herbicides to be used to control different problem weeds. Rotating grass crops with broadleaf crops, annuals with perennials (alfalfa), fall-planted with spring-planted crops, and legumes with non-legumes will not only help control weeds, but insects and diseases as well. Insects that live in the soil and those with limited mobility are most affected by crop rotation. Many pathogens that survive in or on crop residues can be managed through the strategic choice of crop sequence in a diverse rotation. For corn, this includes foliar, ear, stalk or stem rots.

**Scouting.** Regular and extensive scouting is especially important before planting to catch weeds at the proper growth stage with the right herbicides. With insects and diseases, scouting, combined with anticipation of potential problems, can improve control.

**Pest identification.** Reducing tillage may shift pest populations to unfamiliar pests. Learning to identify these new weeds, insects, and diseases will assist in their management.

**Variety selection.** Selecting varieties that are resistant or tolerant to insect and disease pests should not be overlooked. Warren Mason, an agronomist for AgriNorthwest, South of Tri-Cities, believes that their strip-tilled corn produces as well as their conventional corn because of careful variety selection.

## *Effects on Weed Management*

Tillage can kill weeds directly and bury weed seed. When tillage is reduced, other means of control are needed. Along with the cultural practices already mentioned, reduced tillage systems rely on herbicides to control weeds. Pre-plant residual herbicides that can be incorporated with irrigation water and burndown and postemergence herbicide applications are used widely.

No-till farmers apply burndown herbicides before, at, or after planting to kill existing winter annuals or early summer annuals. They may use split applications to catch early and later germinating weeds. A residual soil-active herbicide is often mixed with the last burndown application to control later germinating summer annuals that would otherwise compete with the crop.

When no-till systems were being developed, it was thought that the crop residues would “tie up” herbicides. This, however, is not the case. Rain or irrigation can be used to wash residual herbicides off residues and into the soil. However, thick mats of residue can prevent proper distribution of herbicides in the soil. Straw and chaff spreaders on combines are often used to distribute residue uniformly.

The timing of these applications is critical. Weeds should be treated when they are small but if they are sprayed too early, a second spray may be required to kill later germinating weeds. When a mixture of soil-active and burndown herbicides is applied early, the residual’s activity may dissipate too soon to catch weeds that can compete with the crop. Even with proper timing, one or more post-emergent herbicide applications may be required.

As no-till continues to be used on a field, the number of summer annuals tends to decrease. However, unless controlled, perennials, biennials, and winter annuals will increase. These weeds are controlled through burndown herbicides, applied in the fall and/or spring, or by rotating to herbicide-resistant crops. Perennial weeds will probably not be a problem on fields where potatoes or onions are part of the crop rotation because of the tillage used with these crops.

The increased reliance on herbicides in reduced tillage systems requires that the proper rate be applied. As always when using pesticides, read and follow label instructions. The following factors can affect herbicide activity and therefore the needed rate:

**Soil texture** – increase rates with increasing clay content of the soil.

**Soil Organic Matter** – increase rates with increasing soil organic matter levels (not undecomposed residues)

**Crop residue level** – increase rates with increasing thickness of crop residues

**Timing** – increase rates for early preplant applications of soil-active herbicides or select more persistent chemicals.

**Size/density of weeds** – increase rates when spraying larger or more numerous weeds.

Unfortunately, specific guidelines have not been developed. Look for no-till instructions on the label.

Without tillage, weed seeds are left on the soil surface under crop residue. This environment favors the germination and growth of small seeded weeds over larger seeded weeds. Therefore, in continuous no-till there is a shift to smaller seeded weeds (generally grasses) and away from larger seeded weeds (generally broadleaved). Of course, small seeded broadleaf weeds like lambsquarters and pigweed can still be a problem in no-till systems.

## Effects on Insect Management

Although reducing tillage can shift the number and type of insects in a field, entomologists seldom alter their control recommendations for different tillage systems.

However, there are some changes in reduced tillage systems that increase the potential for problems with specific pests. Those pests that overwinter in the soil or in crop residues and become active early in growth of the crop benefit most from tillage reduction. Although lower soil temperatures (2-5 °F cooler) may cause these insects to develop more slowly than in tilled soil, they can be more numerous because they have not been exposed to tillage.

Other insects may decrease after a number of years of no-till. This may be due to increased survival of beneficial insects, ants, ground beetles, rove beetles, and spiders, all of which can contribute to insect pest control.

The effects vary depending on the crop and pest:

Notes on specific insects:

**Wireworm** numbers have increased in general in the past few years, but research does not suggest a direct link to reduced tillage. They may increase and cause damage after grassy weeds, with reduced soil disturbance, and where germination is delayed by cool soils.

**Slugs** can cause extensive damage to seedlings, especially in low lying wet areas. They are favored by unincorporated crop residues and cool, wet conditions. There are chemical controls but they are expensive.

**Seedcorn maggots** are more of a problem where green manures are incorporated than where dead crop residues cover the soil.

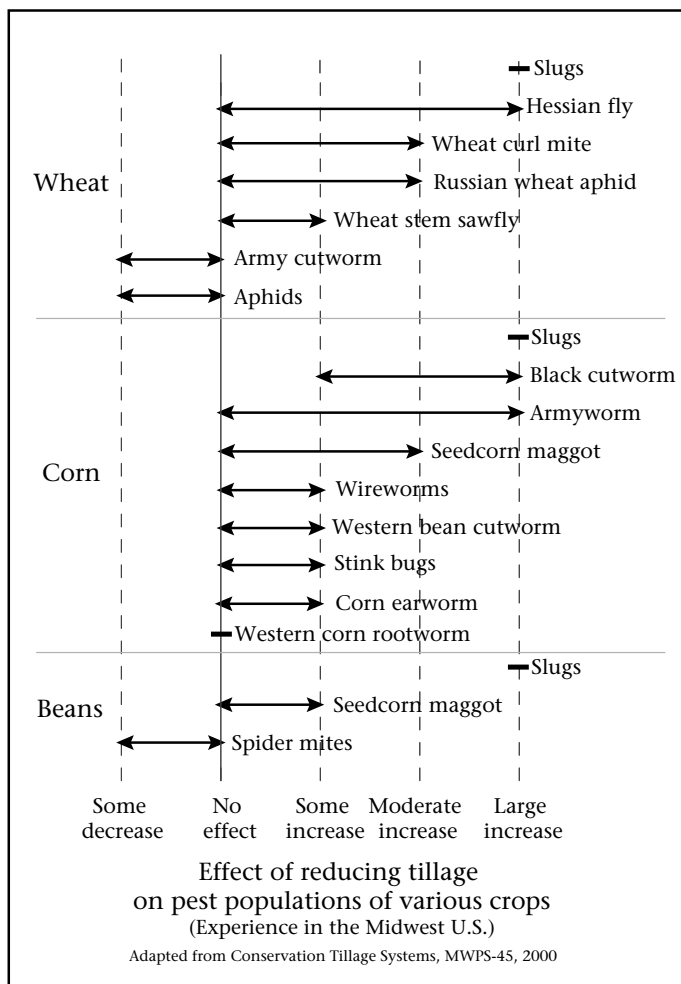
**Winged aphids** are more often attracted to barren ground than to residue covered ground. This can limit infestations in new stands but not after canopy closure.

**Corn earworms** may increase where planting or crop development is delayed in no-till fields.

**Black cutworms** prefer to lay eggs in fields with unincorporated crop residues.

Again, basic pest management practices will be more important when reducing tillage, especially when just starting.

Planting corn into a grassy sod or wheat residue requires a high level of insect management. Wireworms and cutworms can be problem. Wheat curl mite can also move from green grass to emerging corn and can infect crops with virus diseases like high plains disease. Killing any grasses with herbicides several weeks before planting can reduce this problem and also limit damage from foliage feeding pests. Insecticide seed treatments should be considered when planting in high risk conditions and are the preferred control method for many insects in no-till systems.



## *Effects on Disease Management*

Because some diseases survive on dead crop residue, it was at first thought that reducing or eliminating tillage would greatly increase disease incidence. However, this has not proven to be the case. Reducing tillage may increase the potential for certain diseases but not necessarily their occurrence. As with insects, the effects of reducing tillage on disease management are variable, depending on the disease, the crop, and the environment. While the risk of foliar diseases may increase, over time, soilborne diseases may decrease in no-till systems because of increased biological activity and beneficial microorganisms. Pathogens that thrive in cool, wet soils may become more of a problem, while diseases favored by higher soil temperatures and drier soils may be seen less often. These changes due to tillage are often small compared to those due to weather, rotations, and variety selection.

For disease to occur, a virulent pathogen must have a favorable environment and a susceptible crop. Therefore, management of the environment (as much as feasible) and selection of disease-resistant varieties are very important in limiting disease outbreaks. With no-till corn, control volunteer small grains and weedy grasses in and around fields 3-4 weeks before planting. If these are allowed to grow while the crop emerges, they can serve as "green bridge" for soilborne diseases and as hosts for viral diseases and their insect vectors.

Planting into soils that are warm enough to promote good germination and quick emergence will reduce the opportunity for development of damping off diseases. Planting at the proper depth and spacing is also important. Consider using a fungicide seed treatment if conditions are favorable for disease development.

Reduced tillage may offer the opportunity to prolong the period before irrigation with early planted crops like peas. This may in turn, reduce soilborne diseases by keeping the soil drier early in the crop's development.

Where early planting is required, soil warming and drying may be increased by using row cleaners on the planters to move residues (not soil) to the side of the row. Strip tillage systems take advantage of this, but it remains to be seen whether this extra tillage is needed in our coarse, well-drained soils.

Under irrigation, we have the advantage of being able to manage soil moisture most of the time. If soils are not allowed to become too wet, many diseases will be avoided or their damage decreased. Keep in mind that soil under reduced tillage will not dry as quickly as tilled soils.

Other recommendations for limiting risk of disease:

1. Do not exceed recommended plant populations for the crop and variety.
2. Control weeds to increase the air movement through the crop canopy and limit disease development.
3. Control insects to limit virus infection and wounds which become infection points for pathogens.
4. Maintain adequate soil fertility and pH

Specifics for Corn:

- Plant when soil temps are above 52°F to limit seed rots and seedling blights.
- Select hybrids with good stalk strength and rotate to non-grass crops to limit ear and stalk diseases.

Andy McGuire, WSU Extension, Grant-Adams Area, Lauzier Agricultural Systems Educator, amcguire@wsu.edu, 509.754.2011 ext. 413.

Main Reference: Conservation Tillage Systems and Management. 2000. MidWest Plan Service, MWPS-45

---

Cooperative Extension programs and policies are consistent with federal and state laws and regulations on nondiscrimination. Evidence of noncompliance may be reported through your local Cooperative Extension office. Trade names may be used to simplify information; no endorsement is intended.