

Impact of Tillage Systems on Insect, Mite & Slug Pests and Their Control in Selected Field Crops



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Range of Tillage Systems*

Conventional Tillage		Reduced Tillage <30% Soil Residue Cover	Reduced Tillage (Conservation Tillage) >30% Soil Residue Cover				
Moldboard plow	Heavy Offset Disk	Non-conservation Tillage	Other Tillage Systems	Ridge Till	Chisel Plow	Strip Till	No-till
—————		Increasing Residue Covering the Soil —————→					—————
—————		Decreasing Intensity and Frequency of Soil Disturbance —————→					—————

*Adapted from A. McGuire, Washington State University, MWPS-45





To effectively utilize a conservation tillage system, one's level of understanding & management of the system must elevate to a higher level!!

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Not only for agronomic &
production aspects, but
also pest management!!



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Conservation Tillage

- May, or may not, involve the planting of cover crops, such as wheat, rye, clover, etc.
- As we know, not all conservation tillage systems are the same & pest within those systems may not be the same!!



Adapted from S. D. Stewart, University of Tennessee, 2003 Beltwide Cotton Conference

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In Conservation Tillage

- Presence of weeds and cover crops can significantly impact the potential for insect, mite & slug problems.
- Good management of these can greatly reduce the potential for insects, mites & slugs !!



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How Does Tillage Impact Insects, Mites & Slugs??

- **Mechanical** -
 - Destruction or exposure of soil insects & slugs or residue harboring overwintering insect & slug populations.
- **Ecological** -
 - Removal of insect, mite & slug weed hosts.
 - Lack of residue/habitat for beneficial insect species.
- **Microclimate** -
 - Seedbeds may warm up faster in tilled systems, but temperature fluctuations may be greater & can impact pests.
 - Soils may get wetter faster, but they also dry quicker.
 - May affect plant growth and insect, mite & slug pest problems.

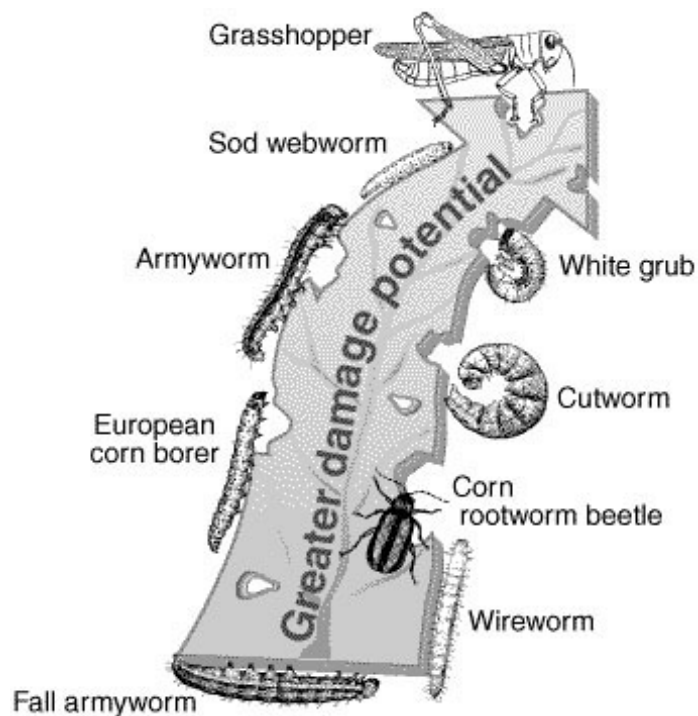
Adapted from S. D. Stewart, University of Tennessee, 2003 Beltwide Cotton Conference.

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The Potential for Damage in Conservation Tillage Crops Depends on the Pest*



*Adapted from Missouri No-Till Planting Systems Manual, MU Extension, M164.

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Economics of Pest Management - Thresholds Monitoring Crop Value(s) Management Costs





Effect of Reducing Tillage on Pest Populations in Corn*







	Some Decrease	No Effect	Some Increase	Moderate Increase	Large Increase
Western Bean Cutworm		←————→			
Stink Bugs		←————→			
European Corn Borer		←————→			
Corn Earworm		←————→			
Corn Rootworm		←————→			
Corn Leaf Aphid	←————→				

*Modified from A. McGuire, Washington State University, MWPS-45





Corn Insect & Slug Pests #1*

Common & Scientific Name	Attacking Stage	Damage
Gray Garden Slug <i>Deroceras reticulatum</i> (Muller)		
Black Cutworm <i>Agrotis ipsilon</i> (Hufnagel)		
Armyworm <i>Pseudaletia unipuncta</i> Haworth		

*In decreasing order of potential to cause problems in conservation tillage corn plantings.





Corn Insect & Slug Pests #2*


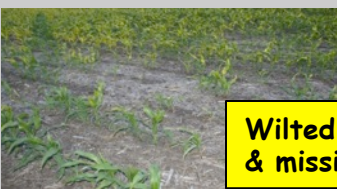

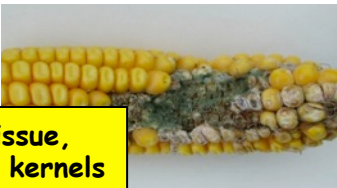
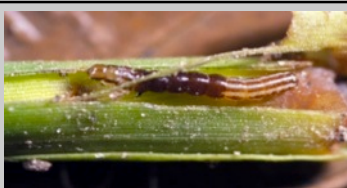

Common & Scientific Name	Attacking Stage	Damage
<p>Brown Stinkbugs <i>Halyomorpha halys</i> (Stahl), <i>Euschistus</i> spp.</p>		<p>Sucking action- deformity of plant & leaf holes</p> <p>Open seed slot</p>
<p>Seedcorn Maggot <i>Delia platura</i> (Meigen)</p>	<p>Burrows into seed & can destroy germ</p>	
<p>Wireworms <i>Melanotus</i> spp., <i>Agriotes</i> spp., <i>Limonius</i> spp.</p>		<p>Feed on seed & underground stem</p>

*In decreasing order of potential to cause problems in conservation tillage corn plantings.





Corn Insect & Slug Pests #3*







Common & Scientific Name	Attacking Stage	Damage
White Grubs <i>Phyllophaga</i> spp., <i>Papilla japonica</i> , <i>Cyclocephala</i> spp.,		 <p>Wilted, dead, & missing plants</p>
Western Bean Cutworm <i>Striacosta albicosta</i> (Smith)	 <p>Feed on leaf tissue, pollen, silks, & kernels</p>	
Stalk Borer <i>Papaipema nebris</i> (Guenee)		 <p>Bores into stems; leaves with holes</p>

*In decreasing order of potential to cause problems in conservation tillage corn plantings.





Corn Insect & Slug Pests #4*







Common & Scientific Name	Attacking Stage	Damage
European Corn Borer <i>Ostrinia nubilalis</i> (Hübner)	 <p>Leaf feeding, tunneling & stalk breakage</p>	
Western Corn Rootworm <i>Diabrotica virgifera</i> <i>virgifera</i> LeConte		 <p>Root destruction</p>
Corn Leaf Aphid <i>Rhopalosiphum maidis</i> (Fitch)		 <p>Leaves wilt & curl, & barren ears</p>

*In decreasing order of potential to cause problems in conservation tillage corn plantings.





Soybean Insect, Mite & Slug Pests #1*



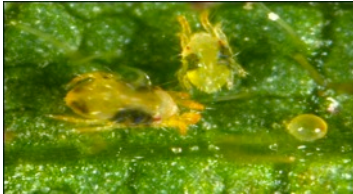



Common & Scientific Name	Attacking Stage	Damage
<p>Gray Garden Slug <i>Deroceras reticulatum</i> (Muller)</p>		 <p>Eat on seed, stem & leaves</p>
<p>Grasshoppers <i>Melanoplus</i> spp.</p>	 <p>Eat on leaves & pods</p>	
<p>Seedcorn Maggot <i>Delia platura</i> (Meigen)</p>		 <p>Burrow into seed & can destroy germ</p>

*In decreasing order of potential to cause problems in conservation tillage soybean plantings.





Soybean Insect, Mite & Slug Pests #2*

Common & Scientific Name	Attacking Stage	Damage
Bean Leaf Beetle <i>Cerotoma trifurcata</i> (Foster)		 <p>Feed on leaves & pods</p>
Twospotted Spider Mite <i>Tetranychus urticae</i> Koch		 <p>Leaf mottling & plant stunting</p>
Soybean Aphid <i>Aphis glycines</i> (Matsumura)		 <p>Reduced growth & seed count</p>

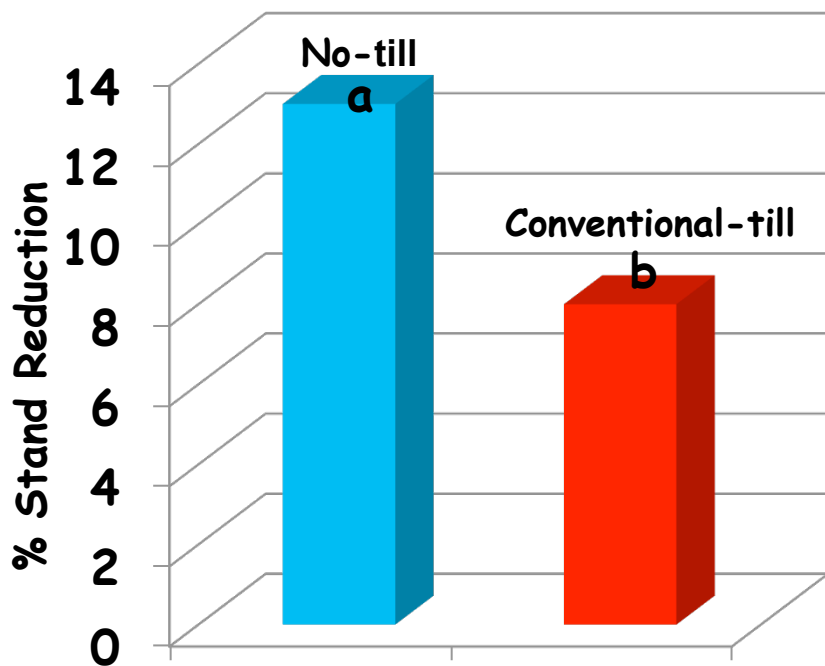
*In decreasing order of potential to cause problems in conservation tillage soybean plantings.



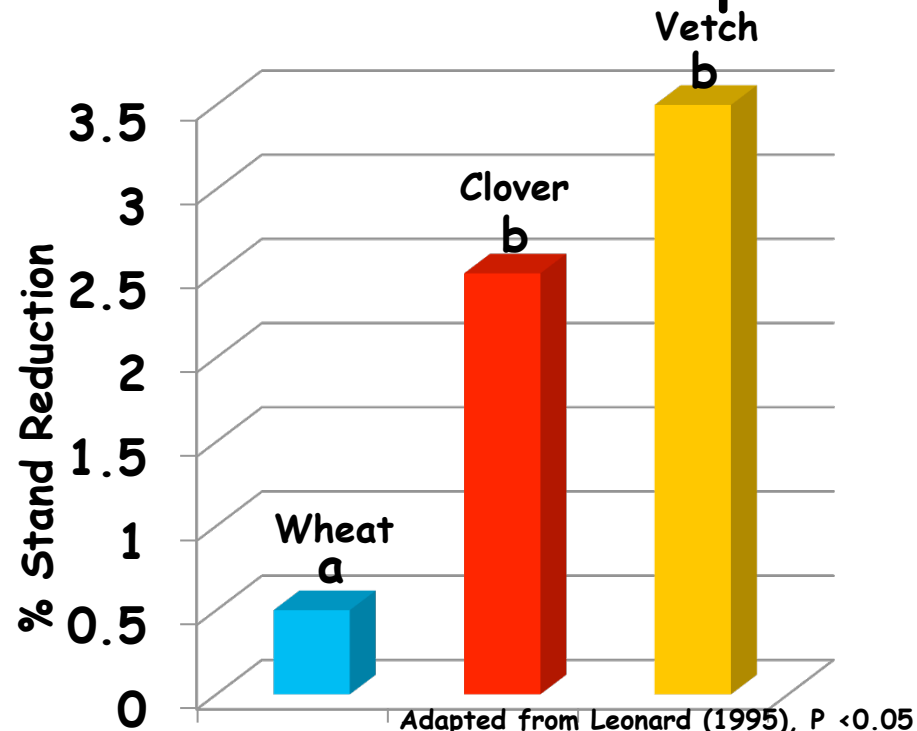


Cutworms as Impacted by Tillage

Tillage System

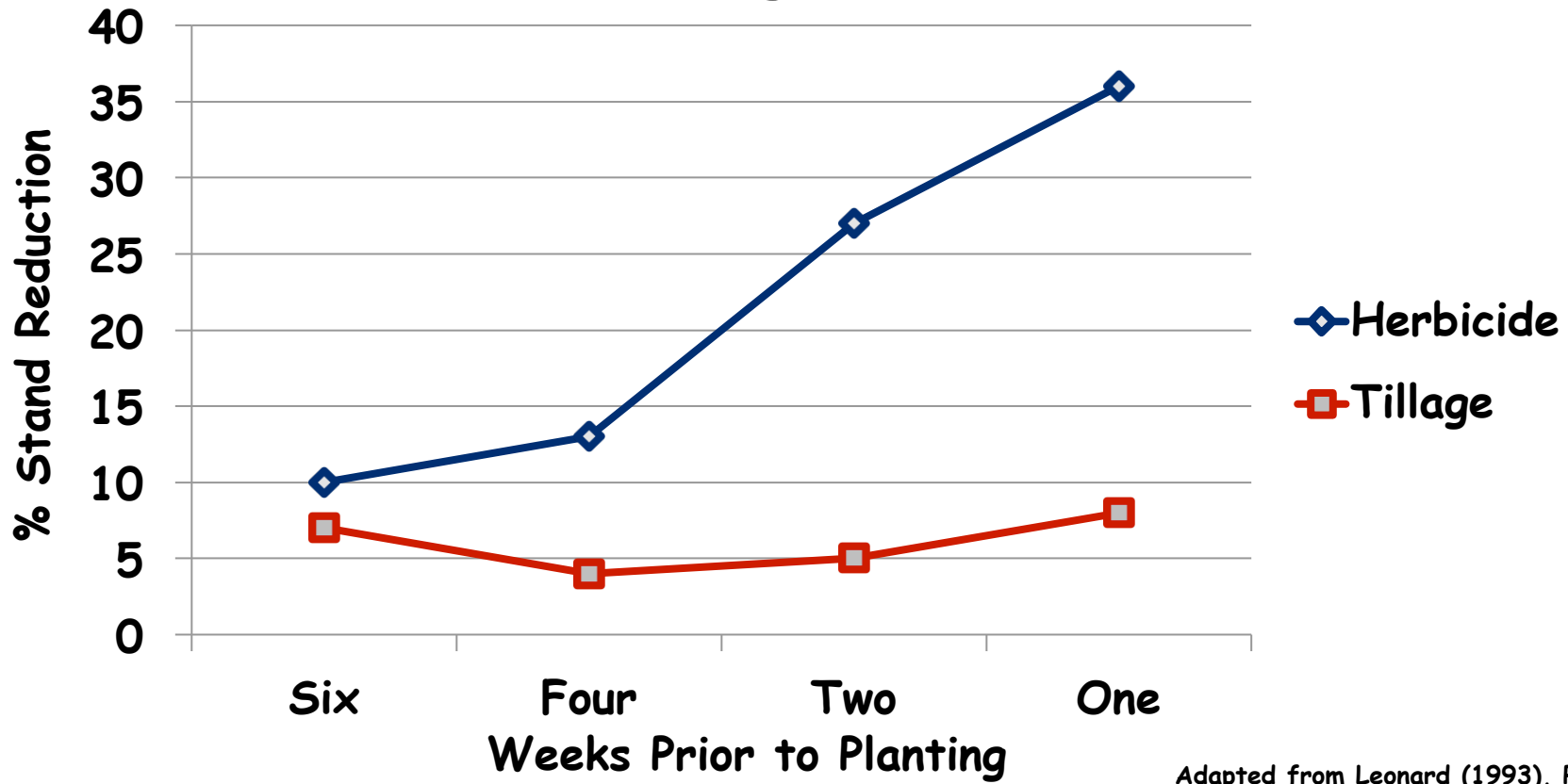


Winter Cover Crop





Cutworms - Tillage versus Herbicides



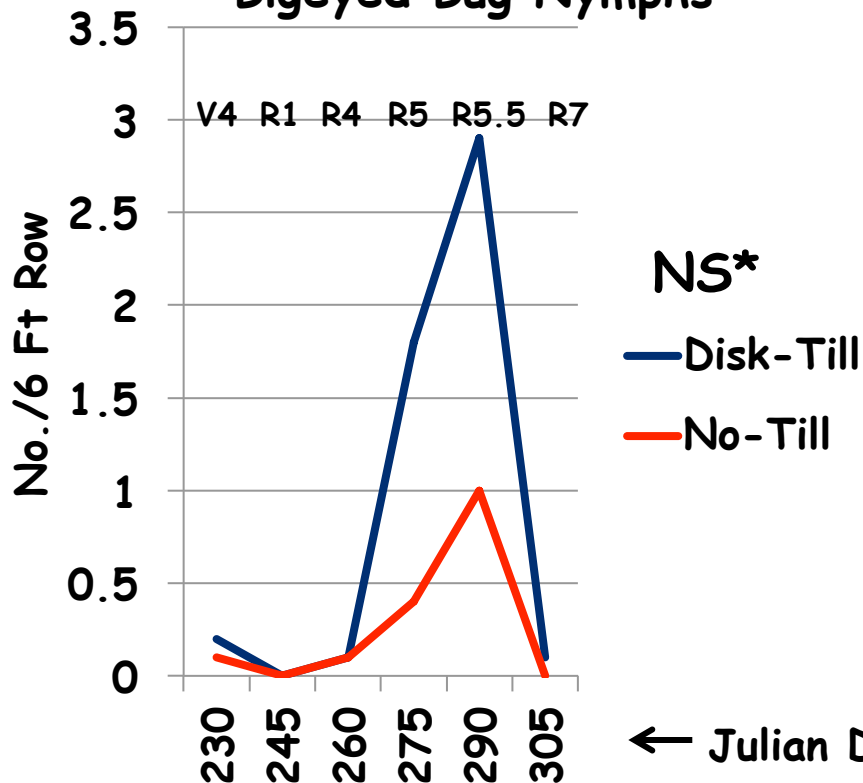
Adapted from Leonard (1993), P <0.05



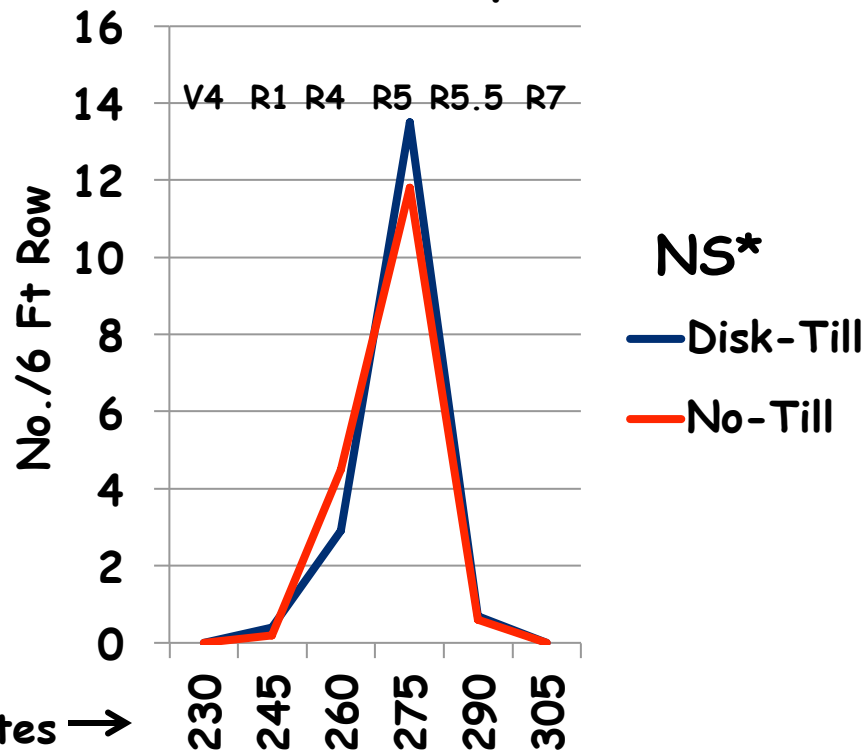


Soybean Doublecropped with Winter Wheat

Bigeyed Bug Nymphs



Velvetbean Caterpillar Larvae



Adapted from J.E. Funderburk, North Florida Research and Education Center, University of Florida.





Potential Effects of Conservation Tillage Systems on Insect and Slug Pests in Corn¹

Insects	Potential Effect ²	Control ³
Armyworm	0 to +++	S-PEB, F
Black Cutworm	+ to +++	S-PEB, S-IF, S-B, F, TG
Corn Earworm	0 to +	F, TG
Corn Leaf Aphid	0	F
Corn Rootworm	0	S-I, S-B, S-C, TG; Adults F
European Corn Borer	0 to +	F, F-B, TG
Hope Vine Borer	0 to +++	F, F-B

Insects/Slugs	Potential Effect ²	Control ³
Seedcorn Maggot	0 to +	ST, S-IF, S-B
Slugs	+++	B
Stalk Borer	0 to +++	F
Brown Stink Bugs	0 to +	F
Western Bean Cutworm	0 to +	F, TG
White Grubs	+	S-IF, S-B
Wireworms	0 to +	S-IF, S-B

²0 = no effect; + = some increase; +++ = substantial increase. The highest rating (+++) represents the extreme.

³B = broadcast application, F = foliar, F-B = banded on foliage, S-B = banded on soil, S-C = soil cultivation, S-IF = soil in-furrow, S-PEB = soil preemerge broadcast, ST = seed treatment, TG = transgenic seed.

¹Modified from F. W. Simmons, Soil Management and Tillage Systems, Illinois Agronomy Handbook





Potential Effects of Conservation Tillage Systems on Insect, Mite and Slug Pests in Soybean¹

Insects	Potential Effect ²	Control ³
Bean Leaf Beetle	0 to +	F
Grasshoppers	0 to +	F
Japanese Beetle	0 to +	F
Seedcorn Maggot	0 to +	ST
Soybean Aphid	0	F

Insects/Slugs	Potential Effect ²	Control ³
Spider Mites	0	F
Thistle Caterpillar	0 to ++	F
White Grubs	0 to ++	R
Wireworms	0 to ++	R
Slugs	+++	B

²0 = no effect; + = some increase; ++ = moderate increase, +++ = substantial increase. The highest rating (+++) represents the extreme.

³B = broadcast application, F = foliar, R = rotate to another crop so as to control, hopefully, with a soil insecticide, ST = seed treatment.

¹Modified from F. W. Simmons, Soil Management and Tillage Systems, Illinois Agronomy Handbook





Home Sweet Home!!



WEEDS

LOTS OF
CROP RESIDUE

POOR SEED SLOT CLOSURE

MOIST
SOIL

LUSH COVER CROPS



DELAYED PLANTING

GREEN MANURE





Managing Insect, Mite & Slug Pests in Conservation Tillage Fields

➔ Good weed control is a must!!*

What Weeds or Cover!!



*Also cover crops!



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Plant When Soils are Ready!!

Looks like
my kind of
farmer!!



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Managing Insects & Slugs in Conservation Tillage Fields

➔ Tank mix insecticides with herbicides when planting into live cover crops!!





Managing Insect & Slug Pests in Conservation Tillage Fields

➔ An open seed slot means a vulnerable seed & growing point!

Give me a break!
It's just a
little crack in
the soil!





Managing Insect, Mite & Slug Pests in Conservation Tillage Fields

➔ Scout/monitor your fields!!

What's a fellow to do?
I'm out of here!!





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Conclusions

- **Conservation tillage systems are at greater risk from attack by insect, mite & slug pests when compared to conventional tillage. In most instances, however, problems that do arise, or could potentially arise, can be overcome.**
- Risks levels are dependent on many factors, but timing and effectiveness of pre-plant herbicides and weather conditions play important rolls as to the actual risk.
- **Conservation tillage has mostly positive effects on populations of beneficial arthropods and these organisms can reduce or eliminate the impact of pest species.**
- In general, pest populations are not limiting factors to good production when producers are knowledgeable of potential threats, monitor their fields, know where to get assistance when the need arises, and plan ahead to meet all risks.

Adapted from presentations by C.R. Edwards & J.L. Obermeyer, Purdue University & S.D. Stewart, University of Tennessee.

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Conservation tillage pest problems aren't necessarily worse...



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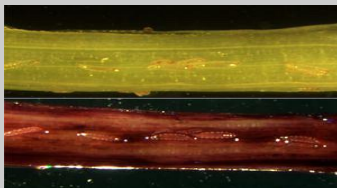

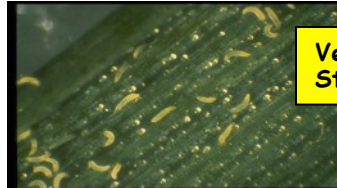





Questions or Comments!!





Wheat Insect & Mite Pests #1*







Common & Scientific Name	Attacking Stage	Damage
<p>Hessian Fly <i>Mayetiola destructor</i> (Say)</p>		 <p>Feed on stems & stems break</p>
<p>Wheat Curl Mite <i>Aceria tosichella</i> Keifer</p>	 <p>Vectors & transmits Wheat Streak Mosaic Virus</p>	
<p>Russian Wheat Aphid <i>Diuraphis noxia</i> (Kurdjumov)</p>		 <p>Plant stunting & rolled-up leaves</p>

*In decreasing order of potential to cause problems in conservation tillage wheat plantings.





Wheat Insect & Mite Pests #2*

Common & Scientific Name	Attacking Stage	Damage
<p>Army Cutworm <i>Euxoa auxiliaris</i> (Grote)</p>		 <p>Feed on leaves; plants may not green-up in spring</p>
<p>Pale Western Cutworm <i>Agrotis orthogonia</i> Morrison</p>		 <p>Feeds on stems underground</p>
<p>Aphid Complex <i>Rhopalosiphum padi</i> (Linn.), <i>Sitobion avenae</i> (Fab.), <i>Schizaphis graminum</i> (Rondani)</p>		 <p>Vectors & transmits Barley Yellow Dwarf Virus</p>

*In decreasing order of potential to cause problems in conservation tillage wheat plantings.





Potential Effects of Conservation Tillage Systems on Insect and Mite Pests in Wheat¹

Insects	Potential Effect ²	Control ³
Aphids	0	ST, F
Army Cutworm	0	F
Greenbug	0	F
Hessian Fly	0 to +++	V, FFD

Insects/Slugs	Potential Effect ²	Control ³
Pale Western Cutw	0	F
Russian Wheat Aph	0 to +	ST, F
W. Curl Mite	0 to +	FFD
W. Stem Sawfly	0 to +	P, VSS

²0 = no effect; + = some increase; +++ = substantial increase. The highest rating (+++) represents the extreme.

³F = foliar, FFD = planting after fly free date, P = enhancing environment for parasitoids, ST = seed treatment, V = varieties, VSS = varieties with solid stems.

¹Modified from F. W. Simmons, Soil Management and Tillage Systems, Illinois Agronomy Handbook

