



Integrated Pest Management Academy 2013

SCOUTING SMALL GRAINS IN MICHIGAN

SMALL GRAINS IN MICHIGAN – 2012 ACREAGE

SOURCE: USDA NASS "AGRICULTURE COUNTS" ACREAGE REPORT, JUNE 29, 2012

- ✘ Winter wheat, soft red & white – 570,000 acres
- ✘ Oats – 50,000 acres (including cover crops)
- ✘ Barley – 11,000 acres
- ✘ Other – *not reported*
 - + Fall Rye
 - + Spring wheat
 - + Spelt



Photo Michigan Farm Bureau

Based on state-wide acreage, winter wheat is by far the most important small grain grown in Michigan, followed by oats, barley and rye.

SMALL GRAIN VOCABULARY

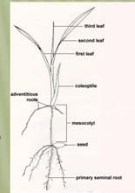
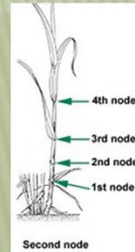
- + **Anther:** The part of the flower that produces the pollen.
- + **Anthesis:** The period during which a flower is fully open and functional.
- + **Boot stage:** The time when the seedhead is enclosed within the sheath of the flag leaf
- + **Coleoptile:** The sheath that encloses the first main shoot leaf and provides protection as it emerges from the soil.
- + **Flag leaf:** The leaf immediately below the head.
- + **Floret:** An individual flower within the head.



Terms needed to discuss small grain development and condition.

SMALL GRAIN VOCABULARY

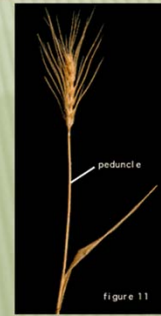
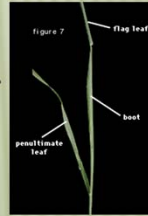
- + **Glumes:** The pair of bracts located at the base of a spikelet in the head.
- + **Internode:** The part of a stem between two nodes.
- + **Jointing:** Stage of wheat development when stem nodes are first detected above the soil: Zadoks stage 31.
- + **Leaf blade:** The flattened portion of a leaf above the sheath.
- + **Leaf sheath:** The lower part of a leaf enclosing the stem.
- + **Main shoot:** The primary shoot that emerges first from the soil and from which tillers originate.



Terms needed to discuss small grain development and condition.

SMALL GRAIN VOCABULARY

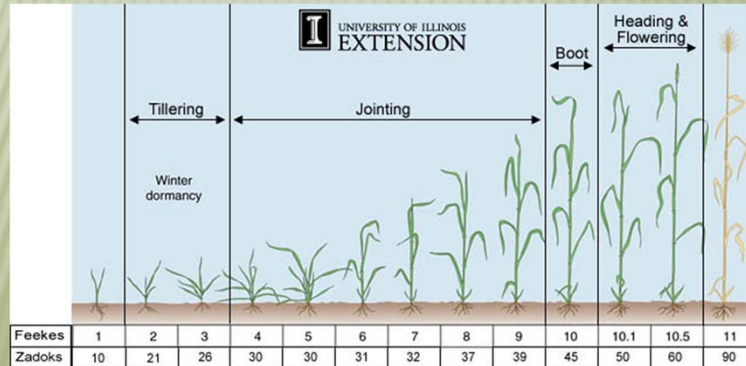
- + **Node (Joint):** A region on the stem where leaves are attached.
- + **Peduncle:** The top section of the stem between the flag leaf and the head.
- + **Penultimate leaf:** First leaf below the flag leaf.
- + **Seminal roots:** Roots arising at the level of the seed.
- + **Spikelet:** The flower of a grass consisting of a pair of glumes and one or more enclosed florets.
- + **Tiller:** A shoot originating from the base of the plant.



Terms needed to discuss small grain development and condition.

SMALL GRAIN SKILLS FOR SCOUTING

- ✘ Small grain growth stages
 - + Feekes growth stages
 - + Zadoks growth stages



Familiarity with the growth stages of small grains is important in accurate scouting. The 2 most commonly used scales are Feekes and Zadoks. They are general scales for cereal grains and can be applied to wheat, oats, barley and other small grains.

SMALL GRAIN SKILLS FOR SCOUTING - WHEAT

× Insects

- + Aphids
- + True armyworm
- + Cereal leaf beetle
- + Grass sawfly
- + White grubs
- + Grasshoppers
- + Wireworms

× Diseases

- + Powdery mildew
- + Stagonospora leaf and glume blotch
- + Septoria leaf spot
- + Leaf rust
- + Stem rust
- + Stripe rust
- + Fusarium head blight (scab)
- + Barley yellow dwarf virus
- + Take-all

Many insects and diseases have the capability to damage small grains in Michigan. These are few of the more common ones. Levels of infestation will vary widely from year to year and across locations in Michigan.

SMALL GRAIN INSECTS - APHIDS



Photos U. of Arkansas

- Aphids and green bugs...
 - Carry BYDV (red-leaf)
 - Cause direct plant damage
 - Prior to heading, examine 20 stems in each of 5 locations.
- ✗ Treatment threshold to prevent direct damage
 - Seedling stage: 30 aphids/stem
 - Boot to heading stage: 50 aphids/stem
 - ✗ Light-heavy infestation can result in severe red-leaf damage in oats, only heavy infestation cause yellowing and browning
 - + Once noticed, it is too late to treat for prevention

Type of Damage: Sucks plant sap from leaves and stems. Heavy infestation may lead to yellowing/browning, stunting, curling of new leaves, and general weakening of plants. Aphids are also virus vectors.

Scouting: See MSU Bulletin E-2549, Insect Management in Wheat and Other Small Grains, for details on the presence/absence scouting method and decision table.

Management: Biological = natural enemies (ladybugs, lacewings, and wasps) and diseases generally keep populations in check

SMALL GRAIN INSECTS – TRUE ARMYWORM



Photos Chris DiFonzo

True Armyworm ID:
Stripey body, may be dark or light in color
Distinct DARK BARS on the PROLEGS
Reticulated head capsule (looks like paving stones)



× Threshold

- + *Before heading*: 4 or more larvae/ square foot
- + *At heading*: 2 or more larvae/ square foot

× When not to treat

- + If larvae are already large (+1.5 inches), they are ready to pupate and will stop feeding shortly. Spraying probably will not pay at this point.

Life cycle: Likely migrate to Michigan each spring. Eggs are laid on the surfaces of grasses, especially the headlands of small grains. Two to three generations per year, the first generation in late May to early June.

Type of damage: Defoliation by larvae, first generation most damaging. Larvae eat leaves, stems, and sometimes the heads of small grains.

Scouting: Mainly active at night and during overcast days. During the day, larvae can be found at the base of plants and under debris.

SMALL GRAIN INSECTS – CEREAL LEAF BEETLE



Photos Chris DiFonzo



CLB larvae feed by scraping the leaf surface. Feeding gives leaves a white appearance. Typical CLB feeding in Michigan is light and involves a few plants or a small hot spot in a field.

Avoid unnecessary insecticide applications to small grains for CLB, aphids, and other insects because broad-spectrum insecticides kill the parasitoids that are responsible for most of the control of CLB in Michigan.

- ✘ Threshold early in season: is 3 or more eggs and/or larvae per plant.
- ✘ Threshold on larger plants: 1 or more larvae per flag leaf.

Type of damage: Usually begins on field borders of winter grain, then goes to the preferred spring grain. Defoliation by chewing between leaf veins. Larvae feed on the surface of leaves, while adults feed on the whole leaf. This damage gives a “frosted” appearance to a severely infested field.

Scouting: Begin when temperatures reach 60 degrees. Check 20 stems in five areas of the field.

Management: Cultural- Hairy varieties are less likely to be infested. Biological- wasp parasitoids, lady beetles and various other natural enemies.

SMALL GRAIN INSECTS – GRASS SAWFLY



Photos Chris DiFonzo

Outbreaks usually occur after an abnormally warm spring creates ideal egg-laying conditions.

reduced and no-till acres in ag production may favor its survival

It is important to catch sawflies early before they clip heads. Scout wheat in early May by shaking stems so larvae drop, then examine the ground for both armyworms and sawflies. If larvae are present, then do a more thorough examination of the field to determine # of larvae per square foot. Use one of the guidelines above to make a spray decision.

- × Simple threshold: Apply the at-heading threshold for armyworm (2 per square foot) to mixed populations of armyworm and sawfly.
- × More exact threshold: Larvae are smaller than $\frac{3}{4}$ inch AND number more than 0.4 per linear ft of row or 0.7 per square ft

Grass sawflies can occur at the same time, and in the same fields, as true armyworm, but the two pests differ in color, number of prolegs (true armyworm = 5 pairs, *Pachynematus*= 8 pairs), and activity time. Armyworms are most active at night and on cloudy days, while sawflies feed during the day. Sawfly larvae feed on leaves of small grains, but more importantly they clip heads. In Michigan in 2010, an increase in head-clipped wheat was attributed to sawflies. Even in mixed populations of armyworm and sawfly, sawflies appeared to be responsible for most of the clipping. One sawfly larva may clip 10 to 12 heads before it matures and drops to the ground.

SMALL GRAIN INSECTS – OTHER INSECTS

Grasshoppers

Photo Wikipedia



Treat when there are 8 grasshoppers or more per sq yd in small plants (less than 6 in tall), or 16 or more per sq yd in taller plants.

White Grubs

4 per square foot can reduce stand, tillering and yield in wheat



Photo Chris DiFonzo

Wireworms

1 or more wireworms per bait trap one week before planting.



Photo Capital City Organic Gardeners

Information on wire worm traps:
<http://www.ipm.iastate.edu/ipm/icm/node/1958/print>

Grasshoppers:

Type of damage: Defoliation (chewing) by nymphs and adults.

Conditions favoring damage: Unplowed or fallow areas next to fields are preferred egg-laying sites, and may contribute to populations in a nearby field. Dry, warm weather often enhances survival of nymphs.

Management: Cultural- plowing and cultivation to destroy eggs. Biological – a fungal pathogen can kill many eggs and nymphs under wet spring conditions. Natural enemies include birds, rodents, amphibians, parasitic wasps, and ground beetles.

White grubs:

White grubs, particularly European chafer, are a localized problem, often depending on soil type.

White grubs build up in undisturbed soil and are damaging to crops planted in fields broken from sod. European chafer, an introduced grub species, has a history of infesting winter wheat planted after soybean. MSU field trials suggest that a grub density of 4 per square foot reduces stand, tillering, and yield of winter wheat. No insecticides are labeled for white grub control in small grains. Fall and spring plowing of old pasture or other established grasses with a season of clean fallow before a crop is planted is recommended.

Wireworms:

Type of damage: Feeds on germinating seed.

Sampling/ scouting: Scout for wireworms with a bait trap

(<http://www.ipm.iastate.edu/ipm/icm/node/1958/print>) at least one week before planting.
Management: Cultural – spring and fall plowing of established sod is recommended before crop planted, where practical.



Powdery mildew

Powdery mildew causes white lesions on leaves and leaf sheaths. Glumes and awns also can be infected when disease is severe. Fungal growth is largely limited to outer plant surfaces and can be easily wiped away by rubbing a finger across affected areas. Mature lesions may have dark, reproductive structures mixed with the white, cottony growth of the fungus.

Management: Genetic resistance, foliar fungicides.

WHEAT DISEASES


Source: "Wheat Disease Identification", USDA-NIFA Extension Integrated Pest Management Program, 2011

Foliar diseases like powdery mildew and rusts should be noted at all growth stages, but are most damaging to wheat yield and quality when the flag leaf is affected.



Stagonospora nodorum blotch
The lesions of Stagonospora leaf blotch are normally brown or tan, surrounded by a thin, yellow halo. Lesions caused by Stagonospora leaf blotch are more irregular in shape and often have a darker color than those of tan spot. The presence of small, honey-colored fungal reproductive structures is diagnostic for Stagonospora nodorum blotch; however, these reproductive structures are only visible with considerable magnification.

Management: Genetic resistance, foliar fungicides, crop rotation, fungicide seed treatment.



WHEAT DISEASES

Source: "Wheat Disease Identification", USDA-NIFA Extension Integrated Pest Management Program, 2011

Notes on slide

WHEAT DISEASES

Septoria tritici blotch

This fungal disease causes tan, elongated lesions on wheat leaves. Lesions may have a yellow margin, but the degree of yellowing varies among varieties. The dark, reproductive structures produced by the fungus are key diagnostic features and can often be seen without magnification. This disease is also known as speckled leaf blotch.

Management: Genetic resistance, foliar fungicides, crop rotation.



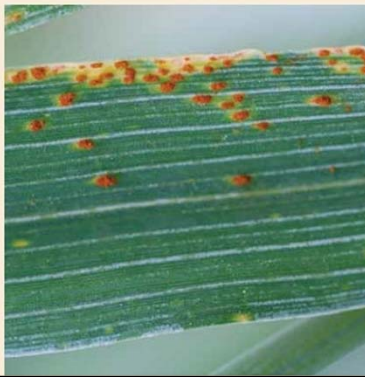
Source: "Wheat Disease Identification",
USDA-NIFA Extension
Integrated Pest
Management Program,
2011

Notes on slide

Leaf rust

Small, orangish-brown lesions are key features of leaf rust infections. These blister-like lesions are most common on leaves but can occur on the leaf sheath, which extends from the base of the leaf blade to the stem node. Lesions caused by leaf rust are normally smaller, more round, and cause less tearing of the leaf tissue than those caused by stem rust.

Management: Genetic resistance, foliar fungicides.



WHEAT DISEASES

Source: "Wheat Disease Identification", USDA-NIFA Extension Integrated Pest Management Program, 2011

Notes on slide

WHEAT DISEASES

Stem rust

Stem rust causes blister-like lesions on leaves, leaf sheaths, and stems. Infection of glumes and awns is also possible. The reddish-brown spores of the fungus cause considerable tearing as they burst through the outer layers of the plant tissues. Mature stem rust lesions are more elongated than those of leaf rust.

Management: Genetic resistance, foliar fungicides.



Source: "Wheat
Disease Identification",
USDA-NIFA Extension
Integrated Pest
Management Program,
2011

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Stripe rust
Stripe rust causes yellow, blister-like lesions that are arranged in stripes. The disease is most common on leaves, but head tissue also can develop symptoms when disease is severe. Outside the United States, this disease is sometimes referred to as yellow rust.
Management: Genetic resistance, foliar fungicides.





WHEAT DISEASES

Source: "Wheat Disease Identification", USDA-NIFA Extension Integrated Pest Management Program, 2011

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Fusarium head blight
Symptoms of Fusarium head blight include tan or light brown lesions encompassing one or more spikelets. Some diseased spikelets may have a dark brown discoloration at the base and an orange fungal mass along the lower portion of the glume. Grain from plants infected by Fusarium head blight is often shriveled and has a white chalky appearance. Some kernels may have a pink discoloration.

Management: Avoid the most susceptible varieties and planting into corn residue, foliar fungicides.



WHEAT DISEASES

Source: "Wheat Disease Identification", USDA-NIFA Extension Integrated Pest Management Program, 2011

Fusarium head blight impact both yield and quality. The grain infected contains DON, or vomitoxin, and can be docked or rejected when tested at point of sale.

A graphic titled "WHEAT DISEASES" on the right side. It features three images: a field of wheat with yellow and red streaks on the leaves (top left), a close-up of a wheat leaf showing a yellow and red streak (middle right), and a circular inset showing a close-up of a wheat leaf with several small, dark aphids feeding on it (bottom left).

Barley yellow dwarf

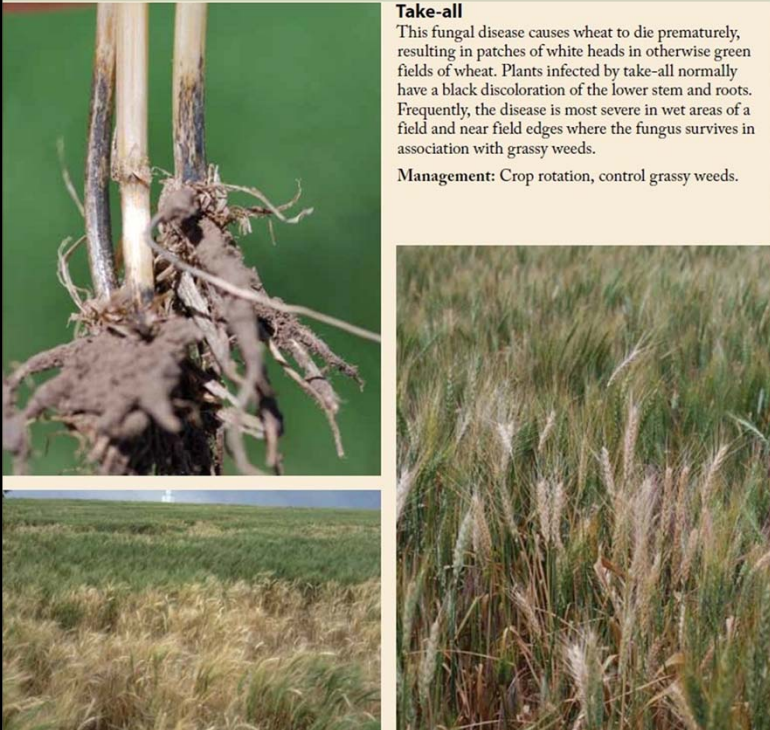
This viral disease causes wheat leaves to have a yellow or red discoloration. The discoloration is often more intense near the tip of affected leaves, giving them a flame-like appearance. Barley yellow dwarf often occurs in patches within a field. The size and distribution of these patches depends on the feeding activity of aphids, which spread barley yellow dwarf virus. Infected plants within these patches may be shorter than neighboring healthy plants.

Management: Genetic resistance, delayed planting date, insecticide seed treatment.

WHEAT DISEASES

Source: "Wheat Disease Identification", USDA-NIFA Extension Integrated Pest Management Program, 2011

BYDV is also referred to as 'red leaf' in oats.



Take-all
This fungal disease causes wheat to die prematurely, resulting in patches of white heads in otherwise green fields of wheat. Plants infected by take-all normally have a black discoloration of the lower stem and roots. Frequently, the disease is most severe in wet areas of a field and near field edges where the fungus survives in association with grassy weeds.

Management: Crop rotation, control grassy weeds.

WHEAT DISEASES

Source: "Wheat Disease Identification", USDA-NIFA Extension Integrated Pest Management Program, 2011

Notes on slide

WHAT'S DIFFERENT FOR OATS?

× Insects

- + Similar to wheat

× Diseases

- + **Crown rust**
- + Barley yellow dwarf virus
- + Powdery mildew
- + Septoria leaf spot

Self-explanatory

OAT DISEASES

Crown Rust



Photos: USDA ARS Cereal Disease Laboratory

The disease spreads from leaf to leaf as pustules release spores. Under conditions ideal for the disease, new pustules can form in 7 to 10 days. Damage to the oat plant is due to leaf damage, especially the flag leaf, or top leaf on the plant. This results in decreased photosynthesis and interference with grain fill. Moderate infection can reduce yields by 10 percent. As the severity increases, losses will increase, with crop failure possible if a susceptible cultivar is grown and conditions are ideal for the disease

Crown rust is the primary disease problem in Michigan oats.

WHAT'S DIFFERENT FOR BARLEY?

× Insects

- + Similar to wheat

× Diseases

- + **spot blotch**
- + **net blotch**
- + powdery mildew
- + Septoria leaf blotch
- + Barley yellow dwarf virus
- + Fusarium head blight (scab)
- + Leaf rust
- + Stem rust

Barley is susceptible to most wheat disease problems. Net blotch is specific to barley. Wheat and other cereal crops are affected by spot blotch, but to a lesser extent.

BARLEY DISEASES



Symptoms of Spot Blotch on barley

Spot Blotch

Symptoms

Elongated brown spots, 2 to 10mm in length appear on the leaves and stems. Brown areas are surrounded by yellow tissue.

Caused by: *Bipolaris sorokiniana*

Control measures:

- Resistant varieties
- Reduction of continuous barley
- Reducing infected stubble
- Use of fungicides

Source: North Dakota State
University Dept of Plant
Pathology "Barley Project"

Notes on slide

BARLEY DISEASES

Net Blotch

Symptoms

Light brown spots with distinctive, dark brown net-like patterns appear on the leaves. As they enlarge they join to form dark-brown stripes in a 'net' formation that distinguishes it from spot blotch.

Caused by: *Pyrenophora teres*

Control measures:

- Resistant varieties
- Reduction of weed hosts
- Reduction of continuous barley
- Reducing infected stubble
- Use of fungicides



Symptoms of Net Blotch on barley

Source: North Dakota State
University Dept of Plant
Pathology "Barley Project"

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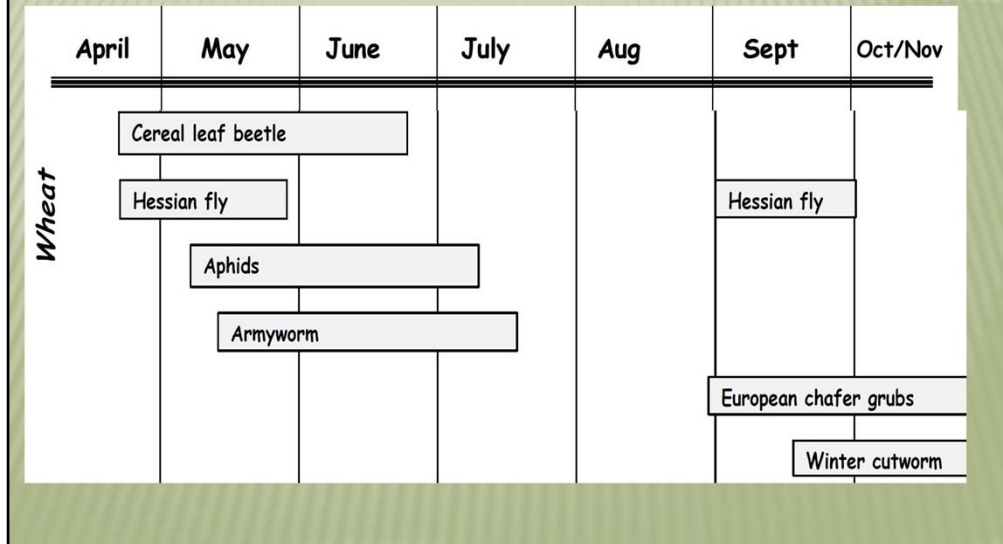
SMALL GRAIN SKILLS FOR WEED SCOUTING

- × Broadleaf and annual grass weeds can be controlled with herbicides in wheat between 1 leaf and flag leaf emergence.
- × Weed control in barley and wheat can be controlled between emergence and flag leaf emergence.
- × Correct weed ID and treatment of small weed seedlings results in best control

Weed scouting is included in a different segment of the program. Management details can be found in the MSU Weed Control Guide for Field Crops.

SMALL GRAIN SCOUTING CALENDAR

✘ Michigan wheat insect scouting calendar



This chart gives a good idea about the times to be alert for particular insect problems. Times will vary between southern and northern parts of the state.

SMALL GRAIN SCOUTING CALENDAR

× Sample insect scouting calendars

Small Grains Scouting Calendar

April	May	June	July	Aug	Sept	Oct
	ARMYWORM					
	CHINCH BUG					
	GRAIN APHIDS				GRAIN APHIDS	
	HESSIAN FLY				HESSIAN FLY	
	CEREAL LEAF BEETLE					
OCCASIONAL PESTS						

Purdue

Timing Stage	Growth Stage (Zadoks)	Agronomic	Scouting Activities Weeds	Scouting Activities Insects	Diseases
2-Leaf Stage	12	Stand Count	Scout for Weeds	--	--
4-5 Leaf Stage	14-15	Est. yield (if jointing has started)	Scout for weeds	Scout aphids & Grasshoppers	Scout for leaf diseases (powdery mildew)
Flag Leaf Emergence	37	--	--	Scout for aphids & other insects (army worms)	Scout for leaf diseases
Anthesis	60	Estimate Yield	--	Scout for OWBM	Evaluate need for FHB treatment
Physiological Maturity	90	--	Evaluate for pre-harvest herbicide	--	--

University of Minnesota

Note:
 OWBM = Orange wheat blossom midge, a problem in N. Dakota - not currently an issue in Michigan

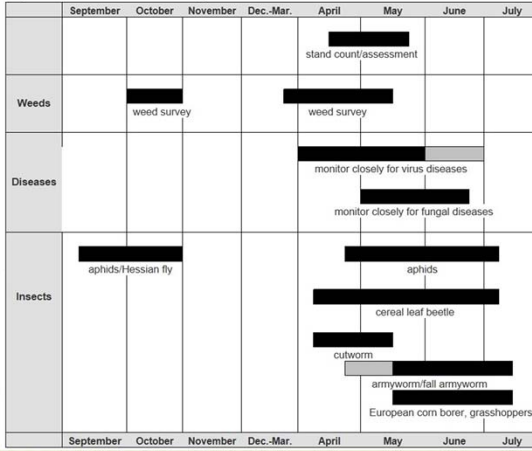
The Minnesota small grain scouting calendar combines growth stage, agronomic scouting tasks, weed/insect/disease scouting tasks.

NEW YORK SMALL GRAIN SCOUTING CALENDAR

Table 5.6.1. Winter wheat pests and crop monitoring activities.

Routine	Occasional
Planting to Freeze Dormancy Weed survey, stand count, establishment problems, seed diseases/damping off (Phyllum, Phytophthora, Rhizoctonia), aphids, Hessian fly, watch for "occasional" pests/problems	Planter problems, poor seed germination, poor soil conditions, vertebrate damage (birds, rodents), herbicide injury, cereal leaf beetle
Early Spring (break dormancy to tillering) Stand count, overwintering problems, weed survey, virus diseases (soil borne viruses, wheat spindle streak mosaic, yellow dwarf), eyespot, powdery mildew, white grub, wireworm, aphids, cutworms, armyworms, cereal leaf beetles, vertebrate damage (geese), watch for "occasional" pests/problems	Snow mold, herbicide injury, hail, frost/freeze, drought
Stem extension (jointing to boot stage) Leaf spots (Septoria nodorum blotch, tan spot, powdery mildew, leaf rust), cereal leaf beetles, watch for "occasional" pests/problems	Herbicide injury, hail, frost/freeze, drought, armyworm, aphids, cutworms, fall armyworm, grasshoppers
Flowering to Grain Ripening Root and crown rots, cutworms, armyworm, Fusarium head blight / scab, viruses, bunt, smut, leaf spots (powdery mildew, Stagonosporanodorum blotch, Tan spot, leaf rust), cereal leaf beetles, watch for "occasional" pests/problems	Wind, excessive nitrogen, lodging, nutrient deficiency, stripe rust, armyworm, stalk borer, European corn borer, fall armyworm, wheat stem sawfly, grasshoppers, white grub, wireworm, flea beetles

Figure 5.6.1. Winter wheat IPM scouting calendar.



Source: *Crop and Pest Management Guidelines, Cornell Cooperative Extension*

Sample small grain scouting from Cornell University, New York

SMALL GRAIN SCOUTING CALENDAR

- × 5 wheat growth stages most important for scouting
 - + 2 leaf stage: stand counts, weeds and diseases should be assessed
 - + 4-5 leaf stage: fields should be scouted again for weeds, diseases, stand, color and insects
 - + Flag leaf: The crop will be monitored for weeds, insects and diseases
 - + Flowering stage: conditions relating to Fusarium Head Blight (FHB) should also be assessed at this time
 - + Physiological maturity: weeds may need to be controlled by a pre-harvest herbicide treatment, timing for harvest and/or other issues that could become a problem in the next crop.

Basing scouting activities on growth stage makes sense and can be applied in any location. These are the 5 growth stages most important for scouting.

THANK YOU

Additional photo credits:

Purdue University
North Dakota State University
Manitoba Ministry of Agriculture
Oregon State University
University of Minnesota Extension