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

- **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.
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- **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.
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.
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.
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.
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.
**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.
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.
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.
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.

**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.

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**Source:** “Wheat Disease Identification”, USDA-NIFA Extension Integrated Pest Management Program, 2011

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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 rounded, and cause less tearing of the leaf tissue than those caused by stem rust.

Management: Genetic resistance, foliar fungicides.


Notes on slide
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 spots 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.

Notes on slide
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.
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.


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
Crown rust is the primary disease problem in Michigan oats.

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.
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.
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"
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

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

Notes on slide
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.
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.
The Minnesota small grain scouting calendar combines growth stage, agronomic scouting tasks, weed/insect/disease scouting tasks.
Sample small grain scouting from Cornell University, New York
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.

- **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.
THANK YOU

Additional photo credits:
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