

Conducting Root Digs for Corn Rootworm in Corn

- Root digs are an important part of managing corn rootworm (CRW) because they help to evaluate CRW pressure and compare different control measures.
- To help maximize the usefulness of the information captured, root digs should take place at the optimum time and the Iowa State University 0 to 3 Node-Injury Scale (NIS) should be used.

TIMING

1. Root damage is greatest when the majority of larvae have completed the 3rd instar (larval stage). Often this is around tasseling and falls in July or August. It can occur as early as June with above average temperatures in spring and early summer.
2. Digging roots too early can underestimate the amount of damage that will be present.
3. Roots dug after the majority of the adults emerge are often more difficult to wash and rate due to root regrowth.
4. Usually there is a 2 to 3 week window that is optimum for digging roots.

DIGGING

1. In 3 random locations per treatment, 5 consecutive root balls should be dug.
2. Digging roots from an area with no biotech trait to control CRW and/or no soil insecticide can help determine the overall CRW pressure.
3. If the CRW larvae pressure is light in this 'untreated' area, it is likely that feeding differences will be minimal in the other treatments and further digging may not be warranted.
4. Removing the upper portion of the plant about 1 to 2 feet above the root mass can help make handling (hauling out of the field, soaking, etc) much easier.
5. Label the root masses with the appropriate treatment. Permanent marker on duct tape placed a few inches below where the stalk was cut works fairly well, but there are several other methods.
6. Instead of digging the plants individually, it is often easier to dig in a large oval shape around all five plants. Loosening the soil around the 5 plant area, can help keep the root masses intact and still allow separation of the plants.

WASHING

1. Washing roots immediately after digging may remove some of the smaller roots with the soil, therefore roots should be soaked in a tub of water for 30 minutes or more to help remove soil from the roots before washing.

2. If rootworm larvae or pupae (Figure 1) are present in the root ball, they may float to the top of the water while soaking.
3. Roots should be washed carefully using a pressure washer or strong hose. To avoid unwanted injury, the pressure washer should be on low. After washing, roots are ready to be rated.

RATING

1. When rating roots, carefully pull back at each node to allow for easier inspection of rootworm scarring and root pruning.
2. Three nodes should be evaluated, starting with the uppermost node which has all of the roots at least 1.5 inches into the soil.
3. Later in the season, it is likely that brace roots will be the first one or two nodes that will need to be evaluated. When evaluating brace roots, the 1.5 inch parameter becomes relative to the soil line instead of the crown.
4. To assign a damage rating, assess the root pruning and scarring using the 0 to 3 NIS scale (Table 1 and Figure 2).
5. If regrowth is extensive, consider removing it to more accurately assess damage to original root system.

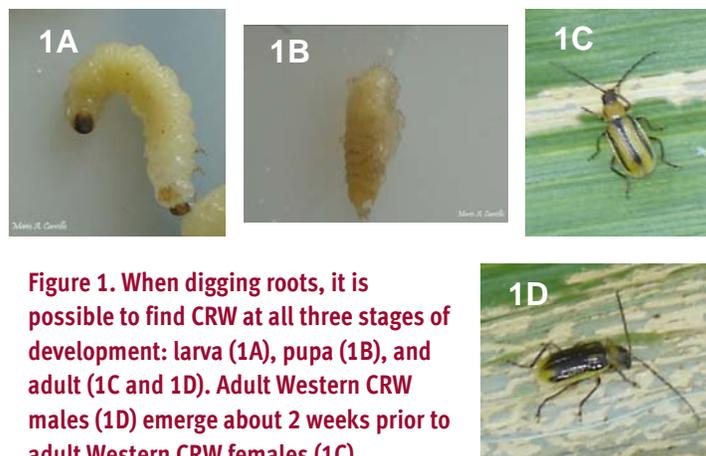


Figure 1. When digging roots, it is possible to find CRW at all three stages of development: larva (1A), pupa (1B), and adult (1C and 1D). Adult Western CRW males (1D) emerge about 2 weeks prior to adult Western CRW females (1C).

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ROOT RATINGS FOR MANAGEMENT DECISIONS

1. Generally under good growing conditions, an NIS rating of 1.0 is when considerable economic damage is likely to occur. Under adverse conditions, especially drought conditions, an NIS rating of 0.25 can be enough to cause economic damage.
2. It is important to consider the average NIS rating and consistency when evaluating options for managing CRW.
3. Consistency of protection refers to the percentage of NIS ratings that are less than 0.25, the economic threshold under droughty conditions.

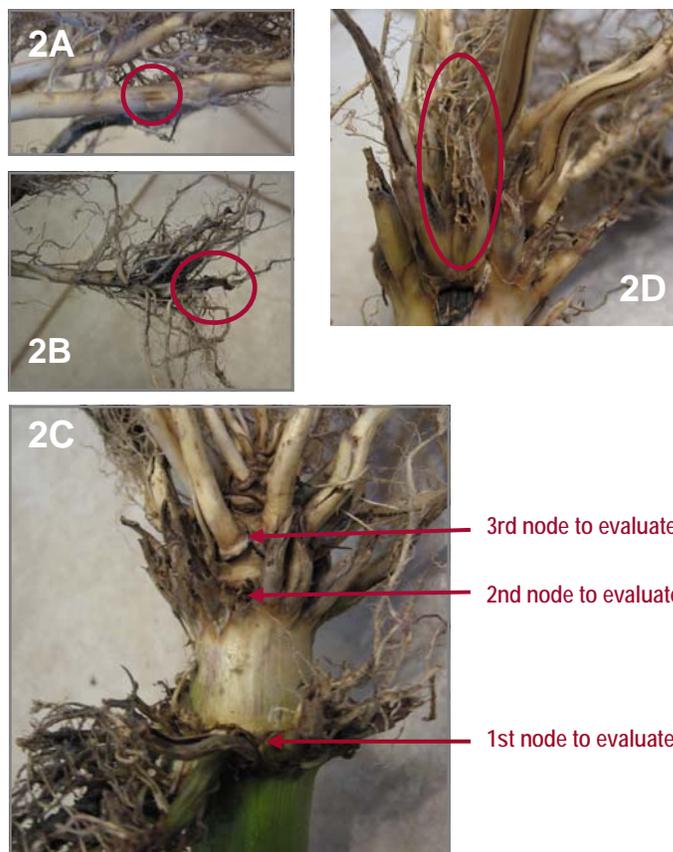
Table 1. Examples of NIS ratings and their descriptions.

NIS Rating	Root Injury Description
0.01	No visible root injury
0.05	Root scarring
0.08	Severe root scarring or root tips pruned beyond 1.5 inches of crown
0.10	10% of a node pruned (often 1 root) within 1.5 inches of crown
0.25	25% of a node pruned within 1.5 inches of crown
0.75	75% of a node pruned within 1.5 inches of crown
1.0	A full node pruned within 1.5 inches of crown
1.5	One full node and 50% of another node pruned within 1.5 inches of the crown
2.0	Two full nodes pruned within 1.5 inches of crown
3.0	Three full nodes pruned within 1.5 inches of crown (maximum value)

Note: Scales modified slightly from the one described in the source from James D. Oleson.

Figure 2. Corn rootworm injury.

- Feeding scars appear as small brown lesions (2A). If the feeding shown in Figure 2A was the extent of the damage on the root mass, it would receive a NIS rating of 0.05.
- Extensive feeding can cause tunneling, which is NOT shown here.
- Figure 2B shows a root tip that has been eaten by CRW. The root is longer than 1.5 inches. If that was the extent of the injury on the root mass, it would receive an NIS rating of 0.08. If this root had been pruned within 1.5 inches of the crown, it would receive an NIS rating of 0.1. Note the characteristic prolific regrowth of roots just above the injury.
- Figure 2C shows the 3 nodes that are used for evaluation. On the 1st node, approximately 75% of the roots were pruned within 1.5 inches of the crown. On the 2nd node, 100% of the roots were pruned within 1.5 inches of the crown. On the 3rd node, 0 roots were pruned. The NIS rating for this root was 1.75.
- Figure 2D shows heavy feeding from CRW. The appearance of this type of feeding is different from the visual effects of mechanical injury that might occur during the digging process.



Source: Oleson, J.D. et al. 2005. Node-injury scale to evaluate root injury by corn rootworms (Coleoptera: Chrysomelidae). Journal of Economic Entomology. 98 (1) 1-8.

Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible. **ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS.** Genuity® is a registered trademark of Monsanto Technology LLC. Leaf Design® is a registered trademark of Monsanto Company. All other trademarks are the property of their respective owners. ©2014 Monsanto Company. 07122013JMG, 06102014SMK