Technology Development & Agronomy by MONSANTO

Agronomic SPOTLIGHT

Managing Soil Crusting with a Rotary Hoe

- Soil crusting may impede crop emergence, resulting in poor and uneven plant stands.
- Soils that are fine-textured, have poor soil structure, are low in organic matter and crop residue, or are conventionally tilled are more vulnerable to soil crusting.
- A rotary hoe is a useful tool for reducing soil crusting to increase crop emergence.

Background

Soil crusting occurs when fine soil aggregates are broken down into individual soil particles by heavy rain or flooding. In soils with poor soil structure, wet soil particles can compact together on the soil surface. Once the soil dries out, the compacted soil seals and forms a hard crust. Soil crusts may range from a few tenths of an inch to 2 inches in thickness.

Soils that are naturally low in organic matter, or fine-textured, like silts, loams, and clays are more likely to develop soil crusts than sandy soils. Weather conditions may also contribute to soil crusting if a heavy rain period is followed by direct sun and warm temperatures, drying out the compacted soil surface. Management practices that reduce soil organic matter like heavy tillage, crop removal, and leaving soil bare can increase soil crusting, especially on soils that are already prone to crusting problems.[1]

Effect of Soil Crusting on Crop Growth

Soil crusting can create a physical barrier between a germinating seed and aboveground emergence. Impeding germination may result in poor crop stand and uneven emergence, leading to crop management problems like incomplete canopy coverage, and reduced yield potential. Soybean plants tend to have more difficulty than corn when trying to germinate in crusted fields. The hypocotyl of the germinating soybean seedling may be broken if pushing against a dense crust (Figure 1). In addition, soybean cotyledons can be damaged or completely removed when penetrating compacted soil.[2] Although corn tolerates soil crusting better than soybean, corn emergence may also be negatively impacted. When corn seed is trapped under the soil crust, the coleoptile may not be able to push through the hard layer of soil. This can result in the formation of a twisted mesocotyl during elongation, and cause leafing out to occur underground (Figure 2).

Figure 1. Soybean plants struggling to emerge through crusted soil.

Figure 2. Corn plants leafing out below the soil surface due to soil crusting.

Soil crusting may also reduce water infiltration and increase runoff. Additionally, soil crusts can have a lower soil temperature than non-crusted soils as the smooth crust may reflect sunlight away from the soil. Lower soil temperatures can further reduce germination.[1]

Management

A rotary hoe can alleviate emergence problems due to soil crusting. Proper timing, soil moisture, and speed are all critical to realize the benefits of using a rotary hoe. A rotary hoe should be used after determining that a soil crust has actually formed and sealed the soil surface, but before crop emergence. Soybean plants are particularly vulnerable to damage from a rotary hoe when the crook is emerging. In areas of the field not impacted by crusting, plants may have already emerged, creating an opportunity for leaf damage to healthy plants.

Managing Soil Crusting with a Rotary Hoe

Soil moisture should be just above field capacity. This may be determined by taking a handful of soil and applying pressure to it. If the soil crumbles easily and leaves moisture on the palm, then the soil is at the correct moisture. Using a rotary hoe in these soil moisture conditions can reduce additional soil compaction and damage to emerging seedlings.

Figure 3. A tractor quickly pulling a rotary hoe across a crusted field.

Finally, rotary hoes should be used at relatively high field speeds of 8-10 miles per hour (Figure 3).[3] Work the soil just deep enough to break the crust. Periodically, stop and check behind the rotary hoe to evaluate crop damage and stand loss. Speed may be reduced if greater than 3-5% of plant damage is observed. Also, avoid using a rotary hoe in the morning when seedlings may be more brittle. Seedlings are generally more pliable later in the day.[2]

Figure 4. A rotary hoe consisting of dozens of finger-like tines made to disturb the soil surface.

Using a rotary hoe to break up soil crusting is a method of rescuing a crop, and should be used only after careful consideration of potential crop damage. A slight loss in stand should be expected when using a rotary hoe, but loss may be negligible in heavy soil crusting conditions. Regular scouting of field conditions may help determine if or when a rotary hoe should be used, especially in fields prone to soil crusting.[3]

Long-term management of soil crusting begins with improving soil structure and organic matter. Using no-till or reduced tillage helps to encourage soil aggregate formation. Retaining crop residue not only shields the soil surface from the impact of heavy rainfall, but also increases soil organic matter. Reducing soil crusting can help increase water penetration into the soil profile, which may also reduce water runoff and ponding.[1] Good soil structure can lead to strong root development, better nutrient retention, and an overall vigorous plant.

For additional agronomic information, please contact your local seed representative.

Sources:

[1] USDA Natural Resources Conservation Service. 2008. Soil quality indicators: soil crusts. USDA. http://www.nrcs.usda.gov/.

[2] Boring, T. 2011. Soil crusting from rapid drying may cause emergence issues. Michigan State University Extension. http://msue.anr.msu.edu/.

[3] Al-Kaisi, M. and Hanna, M. 2009. Pay attention to soil crusting after heavy rain events. Iowa State University Extension. Integrated Crop Management News. http://extension.iastate.edu/.

Web sources verified 02/27/15.