TECHNICAL NOTES

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AGRONOMY TECHNICAL NOTE NO. 39

SOIL DISTURBANCE IN NO-TILL AND DIRECT SEED PLANTING SYSTEMS

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Wheat growers in Idaho, Oregon and Washington are rapidly adopting new technology to plant spring and fall crops in their winter wheat based crop rotations. One of the most significant changes are one and two pass tillage and planting systems to complete seedbed preparation, planting and fertilizer placement. These systems are commonly referred to as no-till, direct seed, slot-plant, row till or strip till. In the Pacific Northwest the most common terms used by growers are direct seed and no-till.

Each of these systems also disturbs a different percentage of the field surface and buries different amounts of the previously untilled crop residue. The combinations of openers, coulters, seed and fertilizer placement, points, seed row spacing, seed row cleaners and packer wheels used in these planting systems seems limited only by the desire of equipment manufactures and growers to find the "best setup" for their particular situation.

DIRECT SEED vs. NO-TILL/STRIP-TILL

While both no-till and direct seed appear the same, there are differences. In a no-till system planting is usually but not always, the only operation that disturbs the soil. Typically only 25 to 35 percent of the row width is disturbed. No-till aims to minimize soil disturbance and maintain as much crop residue on the soil surface as possible. Both direct seed and no-till can be equally effective in reducing water and wind erosion. There may be some moisture conservation advantages with no-till where row disturbance is 30 percent or less of the row width. Higher row disturbance in direct seed may leave more disturbed soil area where weed seed can germinate. Higher disturbance usually means more soil engagement with the drill or seeder, which may mean more fuel per acre with a direct seed system. Lower soil disturbance and high surface residue after planting may also equate to less CO_2 release and a higher level of carbon storage in the soil. These differences do not mean that one system (no-till or direct seed) is necessarily better than the other is. Both are effective at reducing soil erosion, improving soil quality and conserving soil moisture in specific situations.

NRCS recognizes these differences in the general criteria section of the Residue Management, No-Till/Strip-Till 329A and Residue Management, Direct Seed 777, conservation practice standards. NRCS uses the amount of drill row disturbance in relation to drill row or row width spacing to help define no-till and direct seed. In no-till, "seedbed preparation, planting and fertilizer shall disturb no more than one third of the row width". Direct seed in turn disturbs from "between one third and two thirds of the row width". More than two-thirds disturbance of the row width to full tillage of the field surface is considered, Residue Management, Mulch Tillage 329B. These criteria define the differences between what NRCS considers no-till/strip-till and direct seed. However, they are not the only criteria used to determine if a particular planting system meets the 329A or 777 standard. Other general and additional criteria for specifically identified conservation purposes must be addressed to develop a site specific practice specification for the grower. **Figure 1**. **Row Width and Soil Disturbance** illustrates and defines row width and width of disturbance.

LOW DISTURBANCE vs. HIGH DISTURBANCE

In practical terms no-till and direct seed systems are probably best placed into two categories, those that are low disturbance or high disturbance. A review of information available on no-till and direct seed definitions from the mid-west, Northern Great Plains, Canada and the Pacific Northwest found that definitions vary. But an average of 40% row disturbance or field surface disturbance is a common break that defines high and low disturbance systems. Information from Alberta provided the following descriptions for low disturbance, high disturbance and no-till.

- "With *low disturbance* direct planters, less than 40 per cent of the original soil surface is physically worked up by the openers, to form the furrow for seed placement. Some soil from the opener's action may be deposited between furrows, giving the appearance of more soil disturbance. Low soil disturbance can be expected from a 75-mm (3-inch) wide opener spaced 225mm to 300 mm (9-12 inches) between opener centres. Soil firmness, moisture conditions and planter speed may affect the amount of soil disturbance. Low disturbance seeding systems are very much like no-till systems except that some tillage options remain available in direct seeding."

- *"High soil disturbance* direct planters disturb more than 40 per cent of the soil surface. If fall tillage was done, planting is into loosened soil and results in most of the surface being disturbed. Ground openers wide enough to overlap will disturb the entire soil surface to some degree. Sweep openers produce high disturbance. They give varying degrees of weed control, so a pre-seeding herbicide application may not be needed. However, they may also create a seedbed for weed seeds and volunteer seeds from the previous crop. High disturbance openers may require additional seedbed finishing to cover seed and to improve weed control."

- "In a no-till cropping system, planting is the only operation which disturbs the soil. Only 25 to 35 per cent of the soil surface is disturbed. Most openers require that much disturbance to place the seed and fertilizer into a seedbed. Many farmers, however, strive for less than 25

per cent disturbance. No-till is similar to low disturbance direct seeding except that direct seeding systems allow some tillage to deal with unusual conditions."

Closer to home, information in the Pacific Northwest Conservation Tillage Handbook (STEEP) suggests definitions with the addition of "descriptive categories" to further define the system. The suggested definitions are:

- **Low-Disturbance Direct Seeding** – "Narrow knives, single discs or double discs (standard or offset with one leading edge) only disturb a narrow strip of soil between openers retaining nearly all of the residue on the surface. This would be the same as the traditional no-till, zero-till or slot-till definitions."

- **High-Disturbance Direct Seeding** – "Hoe or sweep openers, disturb more of the soil between openers, though usually not full-width tillage, and still retaining much of the crop residue on top. With some flatter sweep blades, the surface soil and residue disturbance can be minimal even though much of the surface layer is undercut with the opener. Obviously, the furrow size soil disturbance and residue retention will vary with opener designs, speed, soil moisture and other factors."

- **One-Pass or Two-Pass Direct Seed Systems** – "Growers can choose between one-pass direct fertilizer and seed systems and two-pass systems with direct fertilizing and direct seed in separate operations."

Descriptive categories can help further define the particular system used by a grower. "Two examples are one-pass, high disturbance direct seed systems, and two-pass, low disturbance direct fertilize and direct seed."

ROW WIDTH DISTUBANCE
FIELD MEASUREMENTS and OBSERVATIONS

There is very little field data in the Pacific Northwest to document soil disturbance by the various direct seed and no-till planting systems. **Table 1, Estimated Soil Disturbance of Seeded and Fertilized Rows, Whitman County Washington**, provides some information collected by NRCS in the Palouse region in the fall of 1999. The Tri-State Natural Resources Team and conservationists from several field offices made measurements and observations on a limited number of direct seed and no-till systems. This information provides a guide to evaluate as to whether a planting system is high disturbance or low disturbance and if it will meet the NRCS criteria for Residue Management, No-Till/Strip-Till, 329A or Residue Management, Direct Seed 777.

CONCLUSION

It is not realistic to require NRCS to make field measurements to determine the area of soil disturbance in the drill or seed row for every grower that is assisted with direct seed or no-till. It is however, realistic to assume that a good evaluation of the system being used is made to develop a sound estimate of the row width that will likely be disturbed under average to normal

conditions that are site specific to the grower's field conditions. If these technical judgements are soundly applied, and adjustments made as experience is gained, it should be adequate to properly address the disturbance criteria in the No-till/Strip-till and Direct Seed standards. It is important to remember that the same piece of equipment may achieve very different results depending on soil conditions, slope and how it is operated.

To meet both technical and program responsibilities NRCS must be able to identify the differences between seeding and planting systems. We need to assist growers plan and apply Resource Management Systems (RMS) which include direct seeding and no-till/strip-till according to criteria in the conservation practice standards. We also have a responsibility for the Environmental Quality Incentives Program where incentive payments can be used to encourage growers to adopt improved residue management practices. Finally, there is initial evidence from research that indicates there may be differences in carbon sequestration between low disturbance and high disturbance direct seed and no-till/strip-till systems. It will be important to have criteria that are based on these differences in resource benefits to separate direct seed and no-till/strip-till.

This technical note will be updated periodically as more technical information on row disturbance, and carbon sequestration becomes available or when the Residue Management conservation practice standards are revised.

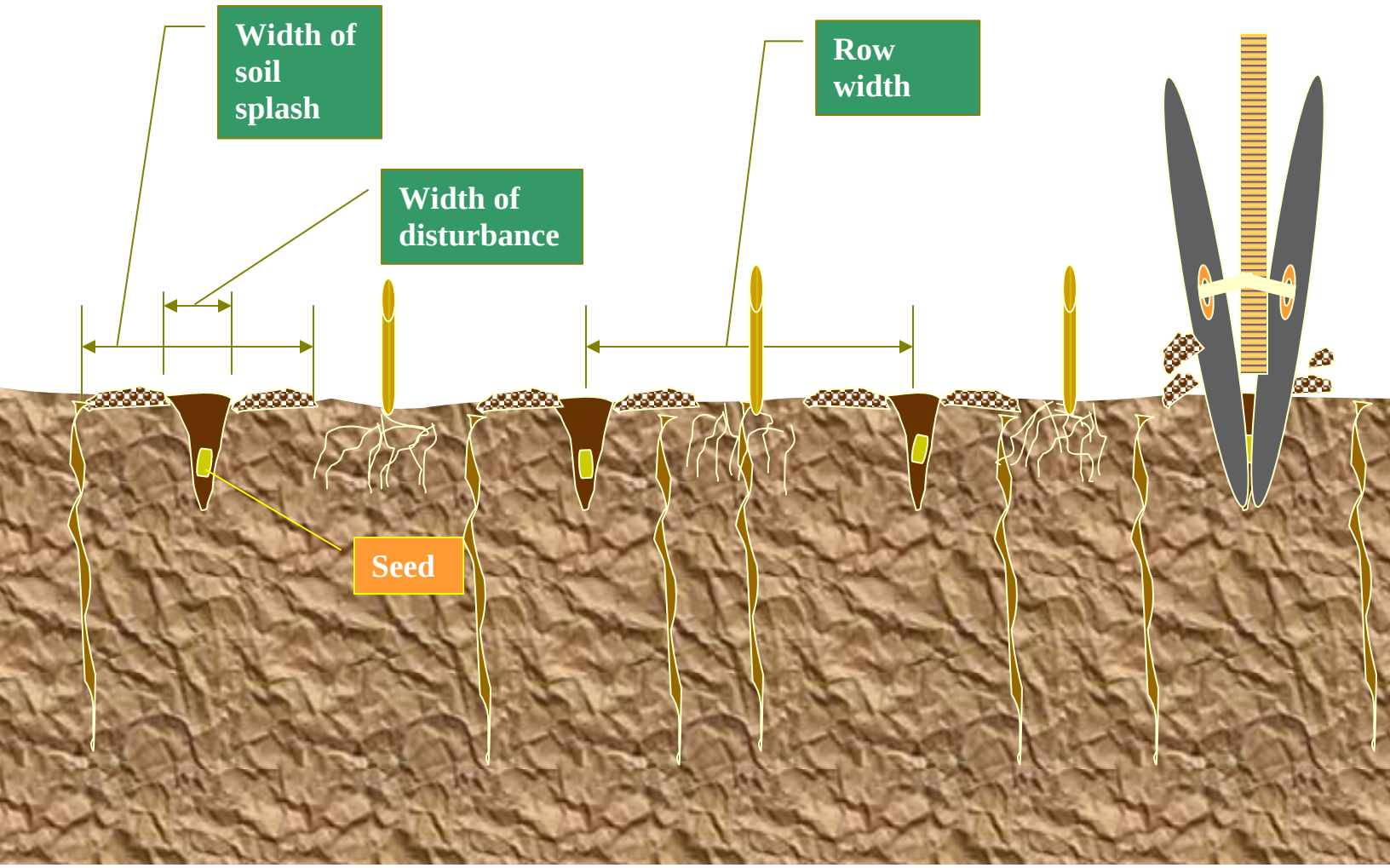
REFERENCES

Alberta, Agriculture, Food and Rural Development, Direct Seeding Systems: Terms and Definitions and Explanations, April 1999, (http://www.agric.gov.ab.ca/agdex/500/).

Direct Seeding or No-Till .... What's the Difference? Pacific Northwest Conservation Tillage Handbook, Series No. 23, Chapter 2 – Conservation Tillage Systems and Equipment, May 1999. Authors: Roger Veseth, WSU/UI Extension Conservation Tillage Specialist, Moscow Idaho; and Russ Karow, OSU Extension Cereal Specialist, Corvallis, OR. (http://pnwsteep.wsu.edu/Tillage_Handbook/contents.html)

No-Till/Strip-Till – When it is and when it is not. White Paper by David L. Schertz, National Agronomist, USDA Natural Resources Conservation Service, Washington, DC.

FIGURE 1. ROW WIDTH and SOIL DISTURBANCE



The area of soil disturbance is considered that portion of the soil that is disturbed (loosened or mixed) by the implement as it passes through it. As tillage tools pass through the soil, some soil will "splash" to one or both sides of the area where the tool passed through. This "splash" area should not be considered soil disturbance because the soil and roots below it have not been disturbed.

TABLE 1.

ESTIMATED SOIL DISTURBANCE
OF SEEDED AND FERTILIZED ROWS
WHITMAN COUNTY, WASHINGTON
Fall 1999

Ranges of Row Disturbance by Precipitation Zone

	10-15 inch rainfall area spr. seed	15-22 inch rainfall area spr. seed	15-22 inch rainfall area fall seed	22-30 inch rainfall area spr. seed	22-30 inch rainfall area fall seed
Heavy Duty 26 inch dia. 9 in. seed rowspacing	40 – 60%	40 – 70%	40 – 60%	35 – 70%	30 – 60%
Med. Duty 17 inch. dia. Double Disk 10 in. seed rowspacing	30 – 40 %	35 – 60%	30 – 40%	30 – 50%	25 – 40%
Hoe/shovel 4 in. wide 10 in. seed rowspacing	50 – 60%	50 – 70%	50 – 70%	50 – 70%	40 – 60%
Hoe/shovel 2 in. wide 10 in. seed rowspacing	30 – 40%	35 – 60%	30 – 40%	30 – 50%	25 – 40%
Med. Duty 17 in. dia. Single disk 7.5 in. seed rowspacing	25 – 30%	25 – 30%	15 – 25%	25 – 30%	15 – 25%
Corn Plant 16 in. dia. Single disk 30 in. seed rowspacing	N/A	10 – 15%	N/A	10 – 15%	N/A

Note: **Lowest % for not to exceed 3-inch depth @ 3 mph @ no slope**
Highest % for not to exceed 5-inch depth @ 5 mph @ 20% slope
Soil disturbance may increase with successively more years of direct seed or no-till/strip-till