DIRECT SEEDING

Making the switch . . . or NOT

by Tom McCoy

One of the most important changes I've witnessed in 35 years of farming in eastern Oregon is the steady reduction in tillage—both its amount and intensity. When my father began teaching me to farm in 1975, he was moldboard plowing every acre. I now spray glyphosate to kill grassy weeds and use a rotary chopper to manage stubble. Tillage is used only to conserve seedbed moisture in summer fallow. In many crop-years, I work fields only twice—once with a chisel plow and once with a cultivator. When late season rains cause broadleaf weeds to germinate, I also use a rodweeder once or twice during the summer or early fall. In those years, I employ as many as four tillage operations. Seedbed moisture would be almost as good if I reduced tillage even more and switched to an "undercutter" for primary tillage.

Although I've greatly reduced tillage, I haven't followed the lead of some of my neighbors who have eliminated tillage and switched to direct seeding on chemical fallow. When chemical summer fallow (chem-fallow) is used, weeds are controlled by spraying chemicals rather than using tillage. "Direct seeding" (also called "no-till") means seeding crops directly into the residue from the previous crop without any tillage. In this article I will explain why I believe some tillage is still important for good crop yields in the dry parts of eastern Oregon.

DRY SUMMERS AND WET WINTERS

The equipment and much of the philosophy behind direct seeding was developed in the midwest. The rainfall in the parts of North America located east of the Rocky Mountains occurs primarily in the summer, when storms link up with moisture from the Gulf of Mexico. This summer rainfall pattern allows farmers in the midwest to grow corn, soybeans and other warm-season grasses.

The rainfall pattern west of the Rocky Mountains is quite different. Most of the rainfall occurs during winter months. Lack of reliable summer and early fall rainfall means that most of the crop rotations used in the midwest are not feasible in the Pacific Northwest (PNW). Dry periods lasting for several months (or longer) are common in the PNW in the summer and fall. Winter wheat that emerges in the early fall is one of the few crops able to develop the deep root system necessary to survive these extended dry periods.

Extended dry periods in the summer and fall also mean that lack of seedbed moisture can be a serious problem in establishing fall-seeded crops. Most of the unique farming methods and farming equipment developed in the PNW over the last 100 years have been aimed at conserving seedbed moisture and placing wheat seeds deep enough to reach that moist soil so crops will emerge in the early fall—even after extended dry periods (see Schillinger and Papendick's article *Then and Now,* in the November 2008 issue of *Wheat Life*).

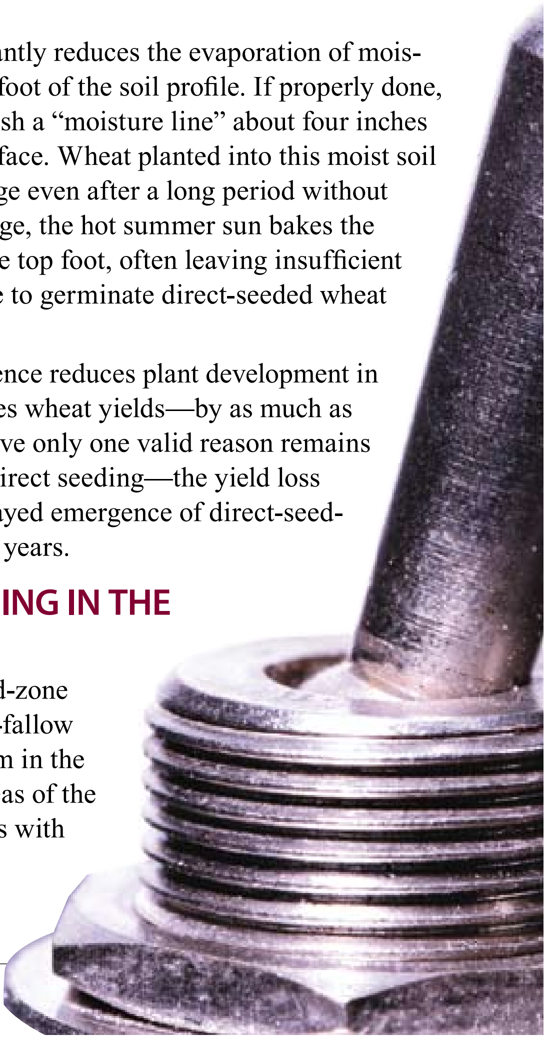
EFFECT OF TILLAGE ON SEED-ZONE MOISTURE

Tillage significantly reduces the evaporation of moisture from the top foot of the soil profile. If properly done, tillage will establish a "moisture line" about four inches below the soil surface. Wheat planted into this moist soil will usually emerge even after a long period without rain. Without tillage, the hot summer sun bakes the moisture out of the top foot, often leaving insufficient moisture available to germinate direct-seeded wheat seeds.

Delayed emergence reduces plant development in the fall and reduces wheat yields—by as much as 30 percent. I believe only one valid reason remains for not adopting direct seeding—the yield loss caused by the delayed emergence of direct-seeded wheat in many years.

DIRECT SEEDING IN THE PNW

The lack of seed-zone moisture in chem-fallow is less of a problem in the higher rainfall areas of the PNW, and in areas with steep hills. Direct seeding should be

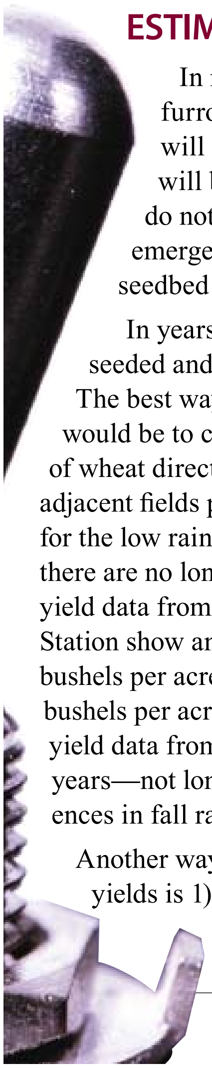


more widely adopted in these areas. All parts of the Pacific Northwest receive most of their rainfall in the period from November through April. However, the higher rainfall areas (those averaging more than 16 inches per year) generally receive enough summer and early fall rainfall so that dry seed beds are not a problem in most years.

Steep hillsides have little to lose when they are chem-fallowed and direct-seeded. Deep-furrow drills have a shank opener to place the seed into moisture that is four or five inches below the soil surface. A large press wheel behind the opener keeps the furrow from collapsing and leaves about two or three inches of soil to cover the seed. Less soil over the seed reduces emergence time and increases the ability of the plant to push through surface crusting caused by rain showers.

Deep furrow drills work well on flat land or when pulled up or down hills. They do not work well when pulled across a steep slope because the press wheels slide down the hill and cause more soil to be piled over the seeds instead of less. If the moisture is four or five inches deep, an added two or three inches of soil from a sliding press wheel makes good emergence unlikely. Deep furrow drills have never been used in areas of the PNW where fields are too steep to be farmed up and down the hills.

In areas with very steep hills, the benefits of tillage in conserving seed-zone moisture become less important, and the primary disadvantage of direct seeding is greatly reduced.



ESTIMATING YIELD LOSS

In many of the dry parts of the PNW where deep furrow drills are used, switching to direct seeding will cause a decline in average wheat yields. Yields will be reduced in years when significant fall rains do not arrive until October or November, and the emergence of direct-seeded wheat is delayed by lack of seedbed moisture.

In years when fall rains start early, yields of direct-seeded and deep furrow-seeded fields should be similar. The best way to determine the size of the average yield loss would be to conduct a long-term study comparing the yield of wheat direct-seeded on chem-fallow fields, with the yield of adjacent fields planted on tilled summer fallow. Unfortunately for the low rainfall areas (those averaging less than 12 inches), there are no long-term studies and little side-by-side data. The yield data from the long-term plots at the Sherman Experiment Station show an average 12 percent yield reduction—60.2 bushels per acre for conventional fallow compared with 52.7 bushels per acre for direct seeded chemical fallow. However, yield data from these plots has been available for only three years—not long enough to average out the big yearly differences in fall rainfall.

Another way to estimate the effect of direct seeding on yields is 1) to use long-term precipitation records to estimate the percentage of crop years that wheat emergence is likely to be delayed under direct

seeding; and 2) combine these estimates with the results of experiments measuring the effects of planting delays on yield.

ESTIMATING EMERGENCE DELAY

I examined precipitation records from the Sherman Experiment Station over the last 30 years and divided the 30 years into three groups:

1. Normal years—when at least .51 inches of rainfall occurred in either August or September or both. I assumed that the emergence and yield of direct seeded and tilled fallow fields would be similar during these "normal years."
2. Dry years—when less than .51 inches of rainfall occurred in both August and September, but more than .5 inches of rainfall occurred in October. I assumed that in dry years the emergence of direct seeded wheat would be delayed until late October.
3. Very dry years—when less than .51 inches of rainfall occurred in August, September, and October. I assumed that in very dry years the emergence of direct seeded wheat would be delayed until late November.

In the 30-year period between 1979 and 2008, there were 15 normal years, 10 dry years (1980, 1989, 1991, 1994, 1999, 2000, 2003, 2005, 2006, and 2007), and 5 very dry years (1987, 1993, 1998, 2002, and 2008).

ESTIMATING YIELD REDUCTION FROM DELAYED EMERGENCE

Three studies have examined how delayed planting affects yields in the dry areas of the PNW. The first and most recent study is Dr. Mike Flowers' experiments conducted over the last three years at the Sherman Experiment Station. Dr. Flowers planted 6 wheat varieties at several different dates in the fall of 2005, 2006, and 2007. I focused on the most common seeding dates from Dr. Flowers' trials. I assumed that the optimum seeding date was October 3, and that during "dry years" and "very dry years" the emergence of direct-seeded wheat would be delayed until October 27 and November 20, respectively. The planting dates for 2007 don't match the planting dates in the first two years of Dr. Flowers' study, so I could not simply average the data across years. Hence, I ignored data from the early September seeding date and used regression analysis to combine the remaining data and obtain estimates of the average yield reduction caused by delayed emergence. (Table 1.)

The second study was conducted by Russelle and Bolton at the Sherman station. I used a similar method to summarize the data. (Table 2.) I ignored the dates before September 30, and used regression analysis to combine 2 years of data and obtain estimates of the average yield reduction caused by delayed emergence.

The last study was done by Donaldson, Schillinger, and Dofing at the Lind Experiment Station. The annual rainfall at the Lind station averages about an inch and a half less than at the Sherman station, and seeding in the surrounding area normally starts about a month earlier. Hence, I moved the yield data from the Donaldson, Schillinger, and Dofing study back a month to better match the other two studies. (Table 3.)

When the yield reductions from all three studies are averaged, the overall estimate yield reduction for direct-seeded wheat is 13.1 percent. In addition to reducing average yield, switching to direct seeding will increase yield variability and the number of years with much-below-average yields. While these estimates need additional refinement, they give an indication of the size of the effect, and the kind of additional information needed to calculate yield reduction from direct seeding more precisely.

The estimated yield reduction would mean that switching to direct seeding reduces a farm's average gross revenue by approximately: 13.1 percent x 50 bushels per acre x $5 per bushel = $32 per acre. ■

The complete version of this article, including references and appendix can be downloaded from Tom McCoy's website at www.tomccoy.com. McCoy's e-mail address is tmccoy@gorge.net.

Table 1. Predicted Yield Reductions

Sherman Station

Planting date	Predicted yield (bu/ac)	Pct. reduction from 10/3
October 3	73.1	0
October 27	59.8	18.2
November 20	46.5	36.4

Author's direct seeding yield reduction estimate: [(15 years x 0%) + (10 years x 18.2%) + (5 years x 36.4%)] ÷ 30 = 12.1%

Table 2. Predicted Yield Reductions

Sherman Station

Planting date	Predicted yield (bu/ac)	Pct. reduction from 10/3
October 3	55.7	0
October 27	39.0	29.9
November 20	22.4	59.7

Author's direct seeding yield reduction estimate: [(15 years x 0%) + (10 years x 29.9%) + (5 years x 59.7%)] ÷ 30 = 19.9%

Table 3. Predicted Yield Reductions

Lind Station

Planting date	Average yield (bu/ac)	Pct. reduction from late Sept.
Late September	61.2	0
Mid-October	56.3	8.0
Mid-November	43.7	28.6

Author's direct seeding yield reduction estimate: [(15 years x 0%) + (10 years x 8.0%) + (5 years x 28.6%)] ÷ 30 = 7.4%