Direct Seeding in the Inland Northwest

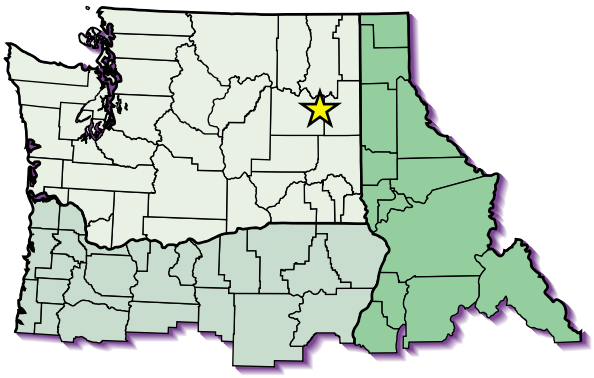
PAUL WILLIAMS FARM
case study

Location: Lincoln and Spokane counties, WA

Annual rainfall: 15-18 inches

Drill types: Yielder® and Versatile®, leased Bourgault®

Crop rotations: Winter wheat/ Spring barley/Spring barley or Chemical fallow
Also grows canola, mustard, and sunflower



Paul Williams has one of the longest histories of direct seeding in Lincoln and Spokane counties. He eliminated conventional summer fallow from his operation 12 years ago and uses chemical fallow or recrops with direct seeding to raise winter cereals. (Photo shows winter wheat seeded into chemical fallow.) For the last 8 years he has used direct seeding and minimum tillage to establish his spring crops.

BACKGROUND

Paul Williams and his foreman, John Bennett, farm roughly 3,500 acres near Davenport, Reardan, and just east in Spokane County, WA. The soils on the Spokane County and Davenport farms are shallow, rocky, and "lighter" textured in contrast to the deeper soil on Paul's Reardan farm. Paul grows winter and spring wheat, winter and spring barley, and spring canola. In recent years, he has begun experimenting with mustard and sunflower.

A NEW WAY OF FARMING

Paul inherited a concern for conserving soil resources from his father. In the early 1960s, Earl Williams began using "trashy fallow," instead of clean fallow, to leave more residue cover and

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thereby reduce erosion from his fallow and winter wheat fields. In 1977, he took this one step further and tried direct seeding using a rented, British-made no-till drill. "He seeded 75 acres of winter wheat on barley stubble and ended up harvesting cheatgrass because he hadn't applied a burndown herbicide."

Paul did the next direct seeding on the Williams farm in 1986 when he began sowing winter wheat after chemical fallow. Four years earlier, Paul had used his conventional double-disk Versatile® drill to seed spring wheat directly into a field of winterkilled winter wheat. That successful experience made him think he might be able to use his drill to direct-seed winter wheat in the fall and eliminate tillage. "My whole goal at that point was not to increase yields, but just to keep them the same while I decreased inputs and protected the soil." He modified the drills to deep-band fertilizer, and he began chemical fallowing instead of conventional fallowing. "I have not had conventional summer fallow on any of the farms since then. We just quit tilled fallow." In 1988, the winter wheat froze out again in his area, but this time Paul's direct-seeded winter wheat survived. (Northwest research has shown surface residues reduce the frequency, depth and duration of soil freezing.)

Paul began renting a Yielder® no-till drill after two seasons of direct seeding because hard fall soil conditions were taking their toll on the Versatile® drill (see "Williams' No-till Drills"). In addition, he had started direct seeding into higher residue situations—fall and spring recrop. As he increased his acreage in direct seeding, Paul began phasing out fall subsoiling on ridges and clay knobs, relying instead on surface residues to increase infiltration and protect the soil. Paul bought his own Yielder in 1993. For the past few years, he has been direct-seeding about 25% of his spring crops and 100% of his winter cereals. In 1999, motivated partly by low crop prices, he switched to 100% direct seed for spring crops too. To help get spring seeding done, he leased a Bourgault® air-seeder.

After more than a decade of direct seeding, Paul has been impressed by how his direct-seed soils have changed—"They have mellowed." When they first started using the Yielder they were applying 500 to 600 lbs of down pressure on the seed openers to seed in the fall (300 lbs in the draws); now they don't use any down pressure. In fact, "the way my ground is changing, with it softer now, I can use my Versatile® drill again."

In 1999, Paul began using his Versatile® drill, modified to place deep-band fertilizer, to seed after low or rapidly degrading residue crops such as canola and mustard.

CURRENT DIRECT-SEED SYSTEM

Crops and rotation

Paul's basic rotation on the "lighter" textured soils is winter wheat/spring barley/chemical fallow. He is testing mustard as an alternative crop for this system. On the "heavier" textured soils, where he can count on more moisture, his cropping is more intensive. There, his basic rotation is winter wheat/spring barley/spring barley followed by either chemical fallow, canola, or, most recently, sunflowers. Previously, Paul avoided direct-seeding spring wheat because it was not compatible with the wider row spacing of his Yielder (15" between paired rows). Now, as his soils mellow, presenting the possibility of using his Versatile® drill (8" between rows) on some ground, spring wheat may find a place in his system, given new spring wheat varieties such as Alpowa and Wawaiwai that tiller more.

Paul's rotations are by no means rigid. He will recrop winter wheat after barley to take advantage of a wet fall, grow a spring crop instead of winter wheat in the event of a dry fall, and use chemical fallow instead of a spring crop if spring soil moisture is low. Basing seeding decisions on available soil moisture (and commodity prices) at the time of seeding, called "flex cropping," is a strategy to meet the often opposing goals of maximizing water use efficiency and minimizing risk (see "Seeding strategy").

Paul has grown a number of alternative crops and would like to include more of them in his rotation because he thinks they would allow him to expand his direct-seed operation. Alternative crops can spread out seeding and harvesting workloads. Broadleaf crops in particular facilitate control of grass weeds. Paul has been growing between 150 and 300 acres of spring canola for the last 5 years. It has been a good crop for "cleaning up" fields with wild oat problems and for creating a low residue situation for recropping. Originally, he intended to grow canola in place of chemical fallow, but canola depletes soil moisture from the

WILLIAMS' NO-TILL DRILLS

Yielder® 1520 no-till drill.

Paul's Yielder, 15 feet wide and typically run at 6 mph, can seed 80 to 90 acres a day. Paired rows are on 20-inch centers with 5 inches between rows. The drill places both liquid and dry fertilizer in a deep band between the seed rows and 5 inches below them. It places dry fertilizer with the seed. It is equipped with an electronic monitoring system to control seed and fertilizer rates.

Pros and Cons according to Paul:

- **+** Very durable.
- **+** Can seed into hard ground.
- **+** Can seed directly into 65-80 bushel stubble.
- **+** Has many fertilizer options.
- **+** Works well for seeding sunflowers (20" rows, 8" between seeds).
- **-** Lower field capacity. Only 15 feet wide, but can seed at 6 mph.
- **-** Not suited for canola, mustard or low-tillering spring wheat due to wide row spacing.

Modified Versatile®.

Paul runs this 30-foot-wide drill at about 4 mph. The rows are 8 inches apart with a deep band of fertilizer between every other row (16-inch spacing). Paul explains how he originally modified the drill for direct seeding. "We added a bar out in front of the seed box that raised with the disks, and we put Yetter openers on the bar to deep-band between the rows. They were adjustable; you could get them pretty deep so you knew your aqua was down and out of the way of the seed. We could still put dry fertilizer down with the seed."

Pros and Cons according to Paul:

- **+** Higher field capacity.
- **+** Narrower row spacing good for canola, mustard, and spring wheat.
- **-** Lighter drill, not originally intended for seeding into unworked ground.

Yielder drill seeding into canola residue (top) and Bourgault drill seeding into barley residue (bottom) in the spring of 1999.

Bourgault®

Paul began leasing this 30-foot wide air-seeder in 1999 and says, "The Bourgault is one of the most advanced drills I've ever used." Narrow shanks on 8-inch spacing place seed and fertilizer. Large 18-inch coulters, "Mid Row Banders," run between every other seed row to deliver fertilizer to a deep band. Paul used the air-seeder to seed spring and winter wheat, barley, mustard, canola, and alfalfa. He was very pleased with the drill's performance and now considers it an integral part of the 100% direct-seed operation. He only had good things to say about the drill.

Pros according to Paul:

- **+** Higher field capacity (150 acres per day).
- **+** "Mid Row Bander" places fertilizer deep and away from the seed.
- **+** Half of coulters are angled slightly to the right, half to the left, which helps keep the drill from tailing on hillsides.
- **+** Has many fertilizer options.

Photos by Paul Williams

whole profile, making it difficult to get a good stand of winter wheat in dry falls. Now he follows canola with a spring cereal if fall rains are light. Paul says canola has not made him a lot of money, but it is a better option than barley, given recent prices and canola's rotational benefits. On his "lighter" textured soils, he has begun testing mustard, which is more heat- and drought-tolerant than canola (see "The Mustard Alternative"). For Paul, mustard has the same benefits as canola (wild oat control and rapidly degrading residue) and then some. It emerges and grows faster than canola, and shows resistance to insects. Unlike canola, mustard is not susceptible to shattering. It can be direct-cut instead of swathed. However, Paul says mustard contract prices are currently about 3 to 4 cents lower per pound than for the specialty canola he grows.

Sunflower is another alternative crop Paul has been trying; he planted 60 acres in both 1998 and 1999. "The real advantage with sunflowers is they can be seeded into heavy residue because they are on 20-inch rows. [Paul uses his Yielder drill with every other row plugged.] They also are planted late and harvested late, spreading the workload." Because of its late harvest date (September or later) and substantial use of soil water, Paul has ruled out fall recropping and plans to follow sunflower with a spring cereal. He experienced crop damage from birds in 1998, but was assured by Dakota farmers that bird damage is minimal where acreage is higher. The local market for sunflower in the Spokane area is small. Paul says while sunflower, canola, and mustard have important potential benefits for his direct-seed system, "the feasibility of all these alternative crops is based on market and price."

Paul is experimenting with alternative crops, such as these sunflowers, to spread out the workload and to facilitate weed and disease control.

Residue management

Paul does not worry much about reducing residue loads since his Yielder no-till drill usually can seed through the residue his crops produce (e.g., 60 to 80 bushel average winter wheat yields). Rather, he's more concerned with distributing the straw evenly over the field. On one combine, a New Holland, "twin rotors chop the straw, and chaff and straw go out through the spreader. On our other combines we have extensions on the choppers, and we throw it as wide as we can, about 25 feet." Headers are 30 feet wide. After harvest, Paul uses a five-bar tine harrow to lightly harrow most of the ground that will go to spring crops. He travels 5 to 6 mph, running perpendicular to the combine tracks to further distribute the residue. He notes harrowing leaves the straw standing. Before harrowing, Paul flail chops heavier winter wheat stubble to reduce straw length and facilitate seeding. He also chops taller canola stubble to prevent pieces of the canola stubble from con-taminating the grain of a succeeding wheat crop and causing dockage.

Fertility

Paul has not changed his fertility program for direct seeding. He typically applies 60 lbs of nitrogen (N), 5 to 10 lbs of phosphorus (P_2O_5), 8 lbs of potassium (K_2O) and 10 lbs sulfur (S) for winter wheat; and 60 lbs of N, 10 lbs of P_2O_5 and 10 lbs of S for spring cereals. Canola receives 60 lbs of N and 15 lbs of S. Paul bases his fertilizer rates on fall or spring soil test results. He usually has 40 to 50 lbs of residual N in the top 3 feet of soil. Lately he has noticed soil phosphorus levels increasing, which he says will allow him to reduce phosphorus applications in lean years. He uses a combination of aqua ammonia and dry (16-20-0-15) fertilizer. All of the aqua with S and about 45% of the dry fertilizer go in the deep band. He places the rest of the dry fertilizer with the seed. If he has fall moisture, Paul may fall-fertilize his spring crops-applying 70 lbs of N and 10 lbs of S using a chisel in the fall and then follow by adding 12 lbs of N and 15 lbs of P_2O_5 with the seed when direct-seeding in the spring.

Weed management

Paul manages weeds in his direct seedings through a combination of crop rotation, preplant nonselective herbicide applications, and a conventional in-crop herbicide program. Two years out of a winter crop allows him to control winter-annual weeds, such as downy brome, using spring and fallow applications of Roundup, sometimes in combination with 2,4-D for broadleaf weed control. "Whether it be direct-seed or conventional, the less winter wheat you have the better for downy brome control. It's really helped our downy brome problem." Paul would do an application of Roundup in the fall before spring crops, but fall rains come too late in his area to bring about a good "greenup" of weeds and volunteer plants before winter. Instead, he does just one application in the spring before seeding. He says the spring application of a nonselective herbicide, if timed correctly, also can reduce the need for in-crop applications. "Our in-crop herbicide spraying has been reduced by waiting long enough in the spring to let the weeds green up, spraying, and putting barley in." But the drawback to this method is "I just can't get over the acres I need to if I wait and wait in the spring." This is where broadleaf crops, such as canola, come in. "We

THE MUSTARD ALTERNATIVE

Photo by Jack Brown

Paul Williams and many other direct seeders will tell you rotation is a key to successful direct-seed systems, replacing tillage as a tool to help control weeds and diseases. The problem is finding viable alternative crops to use in a rotation. Dr. Jack Brown, University of Idaho plant breeder, says, "There are three things you need for an alternative crop to be viable in a given area: adaptation, rotational benefits, and positive economics." Brown thinks yellow mustard has all of these factors and is a good fit for the intermediate to high precipitation zone where Paul farms.

Adaptation

Mustard evolved in desert conditions. Therefore, it is well-adapted to low-rainfall areas, more so than canola. Like canola, it taps into water deep in the soil profile, but it also can tolerate high temperatures during flowering and seed fill. Mustard also establishes quickly and reaches full canopy faster than canola. This makes it compete aggressively with weeds. It is not susceptible to insects that can plague spring canola. Mustard appears adapted to high residue situations. According to a survey conducted by the University of Idaho, among 16 conventional, 27 minimum-tillage, and 11 direct-seed mustard growers, the highest average seed yields were obtained using direct seeding.

Rotational benefits

As a broadleaf, mustard is an excellent crop to break cereal disease cycles and provide an opportunity to control difficult grass weeds, such as wild oat. The deep taproot penetrates compacted soil and provides a way to break plowpan without subsoiling. It can also access water and nitrates unavailable to other crops. Mustard produces a substantial amount of biomass, yet aboveground residue decomposes rapidly, making it easy to direct-seed the following crop.

Positive economics

Yellow mustard is a low-cost crop when compared with spring wheat or canola. It often can be grown without herbicides, or using grass herbicides, which can be cheaper than the available options for cereal crops. Mustard does not require insecticides or fungicides. Because it can tap into residual nitrates deep in the profile, it may require less N fertilizer than spring wheat. Yields in Paul's area are typically 700 to 900 lb/acre, but can reach 1,400 lb/acre. Contract prices were 10.5 cents per pound in 1999.

Considerations and constraints

Yellow mustard, grown predominately for condiment use, has a limited market. Brown estimates U.S. domestic consumption could be satisfied with only 250,000 annual acres. Markets could be developed in Pacific Rim countries, and mustards could be developed to yield other products. For instance, Brown currently is breeding a mustard variety that produces an industrial-grade oil.

Sources: Dr. Jack Brown, University of Idaho, Moscow, ID, and Dan McKay, McKay Seed Co., Almira, WA.

can really clean our fields up with broadleaf crops because of the grass herbicides we can use on them," such as Poast. On the other hand, using different broadleaf crops in his rotation, Paul has had to be cautious about the herbicides he chooses. "We basically don't use anything that has a carry-over. In the rare cases we do, we are very careful about what we plant next."

Wild oat is the most challenging weed for Paul, limiting the number of acres he direct-seeds. This annual weed has a wide germination period in the spring, making it difficult to control with nonselective herbicides before seeding spring crops. To control wild oat in direct-seeded spring cereals, Paul's standard program has been broadcasting Far-Go from the front of the Yielder. It is incorporated into the soil by the openers and by a five-bar harrow attached to the back of the drill. However, he is not satisfied with the performance of this system and, until recently, he used minimum tillage in some fields specifically to incorporate wild oat herbicide. (See "Conservation tillage system.") Growing canola and mustard, which can be sprayed with grass herbicides, has helped, but he only grows so many acres of those crops due to a limited contract market. Fortunately, new in-crop wild oat herbicides are available for spring grains. Although these products are more expensive than Far-Go, Paul says the overall cost is the same once you figure in the cost of tillage to incorporate Far-Go. [Note: Many in-crop grass herbicides share the same mode of action even though the chemicals may be different. To prevent weed resistance, rotate herbicides with different modes of action. See PNW437 *Herbicide-Resistant Weeds and Their Management*.]

Disease management

Paul's rotation is his first line of action against disease. The rotation breaks disease cycles by including different cereal crops, chemical fallow and especially broadleaf crops. Since extending his rotation from winter wheat/fallow, he has seen a dramatic decrease in strawbreaker (*Pseudocercosporella*) foot rot, which causes wheat to lodge. Paul says pressure from other diseases also is low. He typically waits 3 to 7 days between applying a nonselective herbicide and seeding in the spring. If root diseases were more prevalent, and if more spring weed and volunteer crop growth existed to host pathogens, he would wait longer between spraying and planting his spring crop to allow pathogen inoculum levels to die back.

Seeding strategy

Paul feels one of the major benefits of direct seeding is seeding according to weather conditions instead of a predetermined plan, since he doesn't have to do any seedbed preparation. He has learned to be flexible with fall recropping. "The only times I've ever had low yields from direct seeding occurred in years when I didn't have enough moisture and recropped winter wheat." He won't "dust in" winter wheat due to risk of poor germination and stressed seedlings if rains are not abundant and timely. If he hasn't received enough moisture by mid-October he will wait until spring to seed. "I have the ability to say 'no, I'm just going to wait and put it back to spring wheat because we need moisture.'" If he doesn't have enough moisture in the spring, he will make chemical fallow. On the other hand, "if the rains keep coming in the fall, we can just keep seeding," Paul notes. This type of flexibility is impossible in a tillage-based system.

Chemical fallow

Paul says, "Over the years, we've averaged two to three sprayings for chemfallow. I've never been able to get by with one, even on a real dry year. Basically, it's two in dry years and three in wet years." The first application occurs "after all the spring work is done, and we think every single cheatgrass and any other broadleaf is up and going. That's about the end of May. We hit it pretty heavy with Roundup and 2,4-D, and then we wait and wait and wait. This year we're trying to decrease the Roundup or decrease the 2,4-D—depending on whether we have grass or broadleaf weeds." The second spray usually goes on at the end of June or beginning of July. If summer rains occur, another application is made before seeding. "We like to seed between the 5th and 15th of September, depending on when harvest is over." Paul has found the soil moisture for seed germination seems to be deeper in chemical fallow than in conventional fallow during the summer, but "when the soil cools off in the fall, the moisture starts back up and, I think, recovers faster."

Conservation tillage system

Paul used a conservation tillage system on parts of his farm until 1999. His system consisted of fertilizing in the fall using a chisel and then coming back in the spring with one cultivation and one combination harrowing and Far-Go application.

Spring crops were then seeded using a 150 International hoe drill or his Versatile® double-disk drill. He used this system for mainly three reasons: 1) to incorporate Far-Go, 2) to seed spring wheat, canola, and mustard on 8" row spacing (only his conventional drills had 8" spacing), and 3) to seed the spring acres he couldn't get done with his one Yielder drill. Paul says these constraints no longer exist. Now he plans to use in-crop wild oat herbicides, direct-seed with his Versatile® on "mellower" ground, and lease an air-seeder to speed up direct seeding in the spring. Paul isn't selling his chisel and cultivator yet, but he doesn't plan to use them.

ADVANTAGES WILLIAMS SEES

Reduce costs. Paul's biggest cost savings are for labor, fuel, and machinery maintenance. He says he now farms 1,000 more acres with the same expenditures for those three items as he spent when farming conventionally. His largest cost increase has been for herbicides, but it has never exceeded the cost savings. In fact, he finds his herbicide costs decreasing as Roundup becomes cheaper.

No erosion or soil crusting. Surface residues and improved soil structure prevent wind and water erosion, and soil crusting. "I know when I leave the field it can rain on it, or it can rain while I'm seeding it, and I won't have soil crusting over or seedlings curling. That issue went away when I started leaving the residue on the surface," Paul says.

Improved soils. "Initially my ground would bake hard in a dry year. It was difficult to seed in the fall. You'd look behind the drill and the seed wasn't covered; we'd only managed to smash the clods. Then sometimes the soil would dry out before the seed could get up and going. The fact that we can now come back in the fall after a dry year and place the seed so easily into moisture shows how much my soils have mellowed. It is much easier to get a crop up, established, and growing because the ground has improved," Paul says. As the structure of his soil improves, "I also am beginning to see that I'm retaining more moisture. I've had neighbors get off their tractor and walk across to the fence and say to me, 'My goodness, I cannot believe how wet your field is.' One of those neighbors is direct-seeding now."

Yields. Paul's yields didn't change during his first years of direct seeding, but given time "they have increased mainly because the soil is improving. In 1998, we averaged 65 bu over the whole entire farm. So, in a dry season our yields were up there, and I think they can do nothing but continue to improve as we continue direct seeding." Paul attributes any yield increases to improved moisture storage and healthier root systems.

Seeding flexibility. (See "Seeding strategy.")

CHALLENGES WILLIAMS SEES

Wild oat control. Paul is still searching for a way to clean up wild oat infestations without using tillage to stimulate the weeds to germinate. Expanding his rotations to include alternative broadleaf crops holds some promise because effective selective in-crop grass herbicides are available.

Alternative crops demand more management. "The alternative crops can spread out my harvesting, are good tools for weed control, and may have soil benefits, but they do require more management. I have to watch the rotation more, and new issues come up—like different insect pests, or what my neighbors might be aerial spraying." Paul also notes marketing alternative crops takes more planning. "You can't just haul them to the grain elevator. You have to have a contract, which is a good thing, but you also have to worry about transportation."

Learning curve. "Everybody needs to realize when you start changing your farming methods, you're going to have a wreck of some sort. I keep telling my neighbors who are just getting into direct seeding just not to worry about it though. It's part of the learning curve. I had my wrecks in the dry season when I pushed the window and put fall wheat back on ground that just didn't have the moisture there. But otherwise, my yields did not decrease."

Mindset change. "You have to get used to your fields looking different, looking not so pretty. You also have to get over wanting to be out there all the time in the tractor seat. That can be tough."

Constantly changing. "We just keep learning and changing as we learn. As our soils continue to

change, we keep changing our system. That's why I don't have an absolute pattern yet, even though I've been doing it so long."

ADVICE TO NEW DIRECT SEEDERS

Make a commitment. "You need to make a commitment to this. Don't just try direct-seeding one year, and when you don't see much of a yield increase, quit. Focus at first on getting equal yields instead of better yields. Then stick to it for 3 to 5 years because that's when it will start taking off. It takes time for the soil changes to occur and the benefits to develop."

Stay with traditional crops, but rotate. "Rotation is very important because we're faced with weed control and disease. But when starting out, stay with your traditional crops—the ones you know how to grow—and then go from there."

Educate yourself. "Talk with neighbors who are direct-seeding, go to the Direct-Seed Conference and field days, and tap into university information."

What is a direct-seed case study? Each case study in the Direct Seeding in the Inland Northwest series features a grower(s) who has substantial experience with direct seeding. They provide a "snapshot" description of the direct-seed system in 1998-1999, as well as the growers' experiences, evaluations, and advice. The cases are distributed over the range of rainfall zones in the wheat-producing areas of Washington, Oregon, and Idaho. They also cover a variety of no-till drills and cropping systems. Information presented is based on growers' experience and expertise and should not be considered as university recommendations. To order this and other case studies in the series, contact the WSU Cooperative Extension Bulletins office—1-800-723-1763; the University of Idaho Cooperative Extension System Ag Communications Center—208-885-7982; or Oregon State University Extension and Experiment Station Communications—541-737-2513. For more information, please contact WSU Cooperative Extension in the Department of Crop and Soil Sciences—509-335-2915, or visit our web site at <http://pnwsteep.wsu.edu/dscases>

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