Direct Seeding in the Inland Northwest

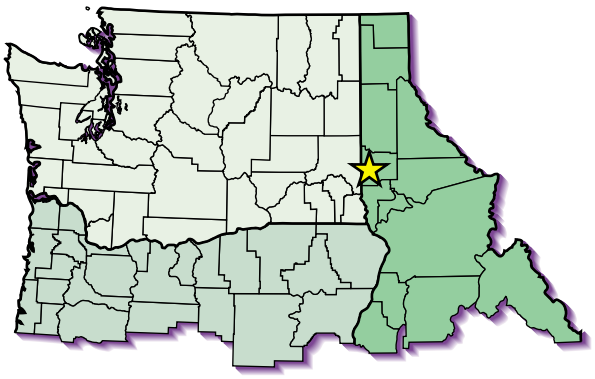
JENSEN FARM *case study*

Location: Latah County, Idaho

Annual rainfall: 22 inches

Drill types: Yielder® and John Deere® 1860

Crop rotations: Winter wheat/ Spring cereal/Spring dry peas



BACKGROUND

Wayne Jensen farms in the high rainfall area of the Palouse. He is one of an increasing number of growers developing spring direct-seeding systems that rely on minimal fall tillage after winter wheat, instead of burning, to reduce residue loads to manageable levels. For now, Wayne is focusing his efforts on a part of his farm that is "wetter, cooler, and more erodible" than his other acres. "Rather than jump in and direct-seed my whole 3,300 acres, I want to make it work on that 1,000 acres for 4 or 5 years, first. I'm already implementing what we are now real comfortable with on the rest of the farm. I'll continue to do that. It's mostly a risk decision to keep losses from mistakes manageable." On the rest of his acres, Wayne uses a mix of direct seeding, minimum tillage, and conventional tillage. He raises winter wheat, spring cereals, lentils and peas, as well as grass seed and Canola.

"The only way we are going to control erosion in this area is with some sort of direct seeding; or go back to prairie, and that's not an option. My whole goal with direct seeding is to stop erosion and stay in business."

~Wayne Jensen

A commitment to soil conservation originally motivated Wayne to start direct seeding. This, and his devotion to agriculture in general, have moved Wayne and his wife, Jacie, to host a farm day every year for Palouse fourth graders. For this program, they received the 1999 Idaho

Governor's Award for Excellence in Agricultural Education/Advocacy. More than 200 students visit their farm during the course of the day to learn where their food comes from, the business of farming, and the importance of soil conservation. "We put three pallets of soil on a flatbed truck: one with bare soil, one covered with stubble, and one with a growing crop on it. We tilt them up and spray them with a garden hose and, of course, the water just pours off black from the bare soil. Water from the stubble one runs off clean. If we can just plant our crops through that residue, then the soil is protected for the whole year. I know it will work—it's just a matter of getting there."

A NEW WAY OF FARMING

Wayne began direct seeding in the early 1980s by sowing winter wheat into undisturbed pea residue. "That's the easiest way to start," he said. I've maintained the direct seeding of winter wheat on the pea ground, which is a slam-dunk. I used that to learn about drills and find the best machinery out there." He tried a variety of no-till drills during his first years, but wasn't fully satisfied with any (see "Jensen's No-Till Drills"). In the late 1980s, he switched to a "shank and seed" system to plant winter wheat, using a McGregor Ripper Shooter® fertilizer machine to deep-band fertilizer, followed by a set of low-disturbance drills (John Deere® 8300s). "That raises a good wheat crop, but I knew that I wanted the next step up in drills, one that could place fertilizer and seed in one pass. I ended up buying a Yielder®…and that's what I'm still running."

In the mid-1990s, Wayne began experimenting with direct seeding spring cereals. "I wasn't winning the battle with erosion on that more erodible ground. I wanted to try something more, do more." In addition, Wayne said a number of developments improved the potential for direct-seeded spring crops: "cheaper Roundup, in-crop herbicides that take the grasses out of broadleaf crops, and better equipment." He moved cautiously into direct-seeded spring crops. "The first year I did 50 acres and it worked well. So the next year I did 200 and the year after that, 600 acres." In 1998, "we did all our spring grains (800 acres) with the Yielder. It just takes a while to get comfortable. …Now I've gone together with three other farmers and we bought a John Deere® 1850 (now 1860) with air delivery system," mostly for direct-seeding spring legumes. (See "Jensen's No-Till Drills.")

Wayne belongs to a group of innovative growers in northern Idaho and eastern Washington—the ClearWater Direct Seeders—who hold monthly breakfast meetings in the winter and tour each others' fields during the growing season to exchange experiences, ideas, and encouragement about direct seeding. He is quick to say he is "a ways off" from a complete direct-seed system; he still faces major challenges. However, he already has seen benefits, such as less erosion, improved soil health, and successful crops on eroded areas; and he expects other benefits, such as improved efficiency and yields. "It's the potential that keeps me going. If we can get all the pieces together, then I think direct seeding will work, and we'll be much better off."

CURRENT DIRECT-SEED SYSTEM

Crops and rotation

"When we first started direct seeding we were in a winter wheat/pea rotation, just the two crops. Back then, we didn't know what Cephalosporium stripe was, or that cheatgrass is a winter annual. We figured out we need 2 years out of winter wheat to control these problems. Now, what crops can I grow? It's all an evolution."

Wayne switched in 1984 to a 5-year rotation of winter wheat/peas or lentils/winter wheat/spring cereal/peas or lentils. "It allowed me to keep up my base acres of wheat, when we had the government programs, and get the advantages of a 3-year rotation." After almost three times through that rotation, Wayne says, "It did help some with the cheatgrass (downy brome) and the Cephalosporium stripe, but it's not enough. We need to go a little further to get rid of cheatgrass and Italian ryegrass." Wayne is switching to a 3-year rotation: winter wheat/spring cereal/peas or lentils. "I think there's a yield advantage to being out of fall wheat for 2 years, I'm more comfortable raising spring wheat."

Wayne also is considering a 4-year rotation, "but I'm not sure what that fourth crop would be. I'm

JENSEN'S NO-TILL DRILLS

Wayne Jensen learned what to look for in a no-till drill during his first 10 years of direct seeding. He used a variety of drills, including a Melroe, Haybuster™, John Deere® 750 and an AgPro. Certain features became important to him: durable seed openers that can slice through residue and penetrate hard soils in the fall; ability to seed at a consistent rate and depth at all positions on the landscape; capacity to place fertilizer in a deep band; and good separation between the seed and the deep-band fertilizer to avoid burning the seedlings.

In 1992, Wayne bought a used 16-foot Yielder® (16-15/20) no-till drill, which has all these features. In addition, the Yielder plants paired seed rows 5 inches apart, on 15-inch centers, and places deep-band fertilizer in the middle of each pair of seed rows so both seed rows are close to the deep band. Wayne likes this configuration because the fertilizer is directly in the path of the seedlings' primary roots. He says, "The biggest cons with the Yielder are its width and weight, and they work together. You have to wait longer to be out there with the drill because it's heavy, which narrows your seeding window. But you're only 16-feet wide and doing only 80 to 100 acres a day." Other disadvantages: parts are not readily available since the drill is no longer manufactured; it doesn't seed at a consistent depth on rough ground because "the depth wheel is a little too far away from the seed opener;" and it can't seed through heavy residue loads (from a winter wheat crop exceeding 80 bu/acre). "However," says Wayne, "I still think the Yielder raises the best spring cereals I've ever raised because of the fertilizer placement."

Wayne and three other farmers jointly bought a John Deere 1850 in 1997, then upgraded to an 1860 in 1998. "I was mostly looking for a way to seed our spring legumes. If we can figure how to fertilize with it, we'll possibly use it for spring grains too." The 1860 is 30 feet wide and has 10-inch row spacing and angled single-disk openers. Wayne and the others added a starter fertilizer system, but it still doesn't have deep-band fertilizer capability. They also added an adjustable hydraulic hitch to keep the drill from tailing on sidehills. Wayne says, "The seed placement is excellent and it's probably the best drill I've used for getting through the residue." On the downside, "we had to mount our own seed delivery system, which still needs some perfecting."

Wayne says, "The nice thing about getting the 1860 with the other guys is we all have the benefits of learning and nobody has to own it alone." The growers' farms range from the rim of the Snake River to northeast of Genesee, so their seeding times are slightly staggered. But Wayne says they chose each other based on "interest level and trustworthiness. We're all friends. We trust each other and knew we could work together." The group also leased and experimented with a Flexi-Coil 8000 in 1999. Wayne says many improvements have come along in no-till drills since he started using different ones, but "I don't think the perfect drill has been made yet."

Yielder drill direct-seeding winter wheat into pea stubble.

John Deere 1860 air drill seeding spring wheat without any prior spring tillage. Stubble from the previous 90-bu winter wheat crop was fall disk-ripped and fall fertilized.

thinking it will be Canola or mustard, but those aren't proven yet." He started experimenting with mustard in 1998, but has a longer history with Canola. He began growing it in the mid-1980s to satisfy the set-aside requirements of the government commodity programs. "I hated summer fallowing, so we planted Canola instead to protect the ground. I've kept growing roughly 80 acres of Canola every year since, trying different things to get it to work. It seems like such a good fit for us, rotation-wise." As a broadleaf crop, it helps manage certain cereal weeds and diseases. Its deep taproot also can break up plow pans and increase water infiltration. However, Wayne says either Canola yield or price will need to improve to make it profitable for him.

In addition to his annual crops, Wayne grows 100 to 300 acres of grass seed crops (brome grass, wheat grass, and bluegrass) each year. He establishes these crops by direct seeding into barley stubble using John Deere® 455 drills. He uses the grass seed crops to improve poorer fields and to spread out his workload.

Residue management

Winter wheat on the Jensen farm typically yields about 90 bushels per acre. That is more residue than his drills can handle—to place seed at a consistent depth in good contact with the soil. Burning the residue is one solution to this problem, but Wayne says, "I've pretty much told myself I am not going to burn. Number one, it's not a viable, long-term option. If everybody were doing it, it would be shut down. Number two, why would I want to give up all those nutrients and organic matter in the straw? I just need to learn to deal with it." Wayne's solution has been to do minimal tillage of cereal residues in the fall "just to get a little soil on top of the residue so it decomposes some over the winter. Then I just spray and seed in the spring. I'm still in the learning stages" for what fall tillage works best. "I do whatever it takes to get through it in the spring. It depends on what level of residue I have and how brave I am, and I'm getting braver every year as far as leaving more straw. That's a learning thing."

Wayne's latest practice has been to chisel-plow winter wheat stubble, followed by one pass using a cultivator or a harrow to level the ground. "One of the first mistakes I made was leaving those chisel-plow ridges in the fall and then coming back and trying to level them out in the spring before I seeded. First, you bounce your sprayer all over and tear it up. Second, you waste all that moisture when you're leveling the ground. One of our primary strategies now is to level up in the fall and leave enough straw to protect the ground." He manages spring cereal stubble for the next pea crop similarly but with less tillage. "I chisel the heavier straw in the bottoms lightly, just run the tips of the chisel plow on it, and on other parts I leave standing stubble. Then I level it up with a cultivator or a harrow." In some cases, "depending on the mat of straw and how good a job of

Winter wheat direct seeded using the Yielder drill into spring canola stubble on June 1 (left) and June 29 (center). Spring barley (right) on June 1 seeded with the John Deere 1860. Stubble from the previous 95-bu winter wheat crop was fall flailed then spring fertilized with a coulter-knife one-pass fertilizer applicator and harrowed after spring seeding.

spreading we did," he will forego the chisel plowing altogether, only cultivating, harrowing, or leaving the stubble standing.

Wayne is trying many alternatives to the chisel-plow/cultivator system. He's been pleased with the results of flailing and cultivating heavy residue. Flailing shortens the straw length, allowing him to leave more on the soil surface, but it is an expensive operation. Wayne has been less pleased with the performance of a disk-ripper for fall tillage. "The thing I dislike most about it is the tillage erosion. It moves the soil down the hill. I'd rather plow uphill than do that. Also, it leaves the ground kind of wavy." Wayne has 1 year of experience using a heavy harrow on winter wheat stubble. He wants to find a residue management operation to disturb the residue more than the heavy harrow, but less than the flail/cultivator.

Wayne also manages residue indirectly. When selecting crop varieties he takes the residue characteristics into consideration. He uses 'Cashup' instead of 'Madsen' winter wheat because the straw degrades more readily. In 1998, he planted 'Meltan' barley because it has shorter straw than other varieties, such as 'Baronesse,' but it turned out to be slower to degrade and harder to seed through. He also sees an opportunity to manage residue with certain broadleaf crops, such as Canola. "There's something about that thick canopy over the stubble that makes it disappear. It's a great environment for decomposition. That's one reason I'm still working with the Canola."

Fertility

Wayne has not altered his fertility program significantly for direct seeding. Fertilizer rates, based on fall soil tests and expected crop yields, haven't changed, and remain fairly consistent from year to year. He does place the bulk of the N fertilizer for winter and spring cereals seeded with his Yielder drill in a deep band between and below the seed rows at seeding. Starter fertilizer is placed with the seed. He considers fertilizer placement a major advantage of this drill. "The plants come up erect and green, with no yellow color to them. Then about a week later the roots hit the deep band and they just go, where with the conventional wheat, you see streaks. The plants are healthier and bigger where your fertilizer shanks went, but yellow and smaller elsewhere."

Weed and disease management

Wayne relies on applications of a nonselective herbicide (glyphosate) to manage weeds and volunteers between direct-seeded crops. He stresses the importance of these treatments for overall weed control. "I can trace a downy brome problem in a field to a bad Roundup job 4 years ago." For in-crop weed control, Wayne has switched from preplant residual herbicides that require incorporation to in-crop herbicides. He finds this

Spring pea stand on June 1 seeded with the John Deere 1860 into a killed brome grass seed field. The grass residue was baled and tine-harrowed in the fall, then tine harrowed again after seeding.

Late June flowering stage of both spring peas and spring Canola direct-seeded in the brome grass field (described above) with the John Deere 1860.

Wayne points out the improved soil tilth after a grass crop and 4th year of direct seeding with this spring Canola crop.

change requires more careful timing because the window of opportunity for spraying is shorter, as is the effective time of the herbicides.

Using nonselective herbicides for early elimination of the green growth between crops, known as the "green bridge," has disease as well as weed management benefits. This practice prevents the carryover of pathogens that cause root diseases from one crop to the next. Until recently, Wayne made his first nonselective herbicide application in early spring. He then waited 2 to 3 weeks to let inoculum levels of the pathogens die back and sprayed again before seeding if more weeds appeared. Now he's learned "if there are any grassy weeds at all, I need to spray first in the fall. …Then I can spray (for a second time) any time in the spring" and not worry about the green bridge. Wayne relies on rotation to manage other types of diseases. "With rotation, I think the disease issue will take care of itself. Whether we need a 3- or 4-year rotation, I don't know yet."

Wayne says having a good sprayer is critical for weed and disease control with direct seeding because of the greater reliance on herbicides than on tillage. In 1998, he bought a new air-assist sprayer because he was getting inconsistent performance on grassy weeds with Roundup and Hoelon. He says, "The jury is still out regarding the sprayer's effectiveness."

Seeding strategy

Wayne has adapted to direct seeding in a number of ways. First, he tends to seed the direct-seed fields later than his conventional ground—when the soil is warmer and dry enough to avoid problems with compaction and slicking of the seed furrow. "I wait until I can't stand it any more and then I wait another 2 days." He has noticed he can direct-seed ground too wet to cultivate. "If you just roll over it once with a drill, there's a lot of spring action in the soil and it will come back, where three passes with a cultivator will do damage."

Second, Wayne seeds more shallowly when using a no-till drill. "We place the seed just deep enough to get it in the moisture"—close to the surface since he does no spring tillage. "We leave the residue on top to protect the moisture." On more eroded soils, he harrows after seeding to ensure a fine layer of soil covering the seed. Wayne sometimes increases the seeding rate by 10%, depending on residue and soil conditions, and on his confidence with the seed placement.

JENSEN'S ADVANTAGES

Erosion control. "My primary motivation to start direct seeding was to prevent soil erosion."

Farming clay knobs. "We see a big advantage in establishing a stand on eroded knobs more consistently. Spring tillage is really tough on eroded knobs. It brings up clay ribbons that get hard. Once you do that you're done for the year. A no-till drill is perfect. It just makes a slit, puts the seed in and puts a mulch back over it without tearing up the ground. We can grow a crop on that ground and start building it back up."

Efficiency. "It's a big issue for me. Hired help and equipment are expensive so I want to keep them to a minimum. Otherwise, I don't see a lot of opportunities to cut costs." Direct seeding can reduce labor and machinery costs.

Taking out divided slopes. "With all direct seeding, I could take out the divided slopes. That would also increase efficiency."

Moisture savings. "Our soil is saturated probably 9 out of 10 springs in this area, so I think we all start out with the same amount of moisture in the spring. But I believe I'm better off using direct seeding because I'm not losing moisture to evaporation by tilling and leaving the soil bare and hot. I retain more spring moisture and whatever comes will soak through the straw and stay there."

Soil structure. "Our long-term no-till field (8 years of bluegrass followed by 4 years of direct seeding) has a totally different soil than the ground in transition. We had a solid mat of stubble on that field, and I still got a good stand. The soil has enough humus and structure to it that, even with a little straw tucking, I can still get good seed-to-soil contact."

Yields. "I can't compare yields because the ground where I direct-seed the most is poorer than my other ground, but I think the yields are going to maintain or improve over what I used to raise up there. I'm fairly confident of that. I'll get better stand establishment in the spring because I don't have to pull a cultivator over that land. I think I'll have better wheat crops with the rotation and with more residue on top of it to protect the wheat from frost heaving."

DIRECT-SEED THE PEAS PLEASE

The Question. Direct seeding winter wheat into pea or lentil residue was the first well-accepted use of no-till drills in the Palouse region. Many direct seeders, such as Wayne Jensen, cut their direct-seed "teeth" on this practice. Ironically, soil erosion still can be a serious problem with this system. Tillage typically is performed not only to prepare a seedbed for the legume crop, but also to incorporate preplant herbicides and to facilitate harvesting with a pea bar. This tillage buries the residue of the previous cereal crop, leaving the soil vulnerable to spring and early summer rains in the legume crop. Grain legumes produce little dry matter, which breaks down rapidly and provides very little erosion protection during a following winter wheat crop. Late planting of winter wheat helps to avoid a number of pest problems associated with early fall seeding but results in small overwintering wheat plants that provide little soil erosion protection.

The key to making the grain legume/winter wheat sequence resistant to erosion is to carry over the residue from a previous cereal crop. Eliminating or reducing preplant tillage in the pea year is critical. Fortunately, this may be possible due to the recent developments of effective postemergence herbicides (e.g., Assure II, Basagran) and of semi-leafless, self-standing pea varieties that can be cut with a standard combine header without the pea bar. The question remains: Is it possible to eliminate erosion throughout the grain legume/winter wheat sequence without sacrificing yield of either crop?

On-farm trials. University of Idaho and Washington State University researchers teamed up with direct-seed growers, including Wayne Jensen, to answer this question. Eight on-farm trials, conducted from 1997 to 1999, compared various intensities of tillage and residue management for establishing spring pea in a cereal/pea/winter wheat rotation. The cooperating growers established and managed the large-scale trials using their own field equipment. They replicated treatments four times in each trial.

Wayne compared two tillage treatments for spring dry pea following a hard white spring wheat crop that yielded 70 bu/acre. The treatments were 1) fall moldboard plowed with trash boards, spring-applied Pursuit herbicide, cultivated 2X, and seeded; and 2) fall chisel-plowed, late-fall cultivated, spring applied Roundup/Pursuit herbicide, and direct-seeded. Both treatments were seeded using a John Deere 455 offset double disk drill, and followed by a soft white winter wheat crop, direct-seeded with a Yielder double disk drill.

Conclusion. In Wayne's trial, minimum fall tillage/spring direct seeding provided significantly greater residue groundcover and better protection against soil erosion in both the pea crop and the following winter wheat crop than did the fall plow/spring cultivate/seed treatment, while achieving equal pea and winter wheat yields (Table 1). At the other sites, direct seeding also achieved substantially greater amounts of surface residue and equal or higher pea yields compared with more intensive tillage systems. The results from these on-farm trials demonstrate that direct seeding increases the retention of surface residue and, therefore, erosion control and potential water conservation, through the cereal/grain legume/winter wheat sequence while maintaining or increasing pea yield. Profitability also may be enhanced by reducing tillage costs.

Table 1. Comparison of two tillage practices following 1996 soft white winter wheat through 1997 spring pea and 1998 soft winter wheat crops at the Jensen farm.

Treatment	Residue cover before planting peas	Residue cover after planting peas	Spring pea emergence	Pea yield	Residue cover after pea harvest	Residue cover after winter wheat planting	Winter wheat yield
	(%)	(%)	(plants/ft^2)	(lb/ac)	(%)	(%)	(bu/acre)
Fall Plow–Sp. Cult.–Seed	1 b	6 b[1]	10.0 a	2870 a	32 b	30 b	109 a
Fall Chisel/Cult.–Sp. Direct Seed	47 a	34 a	9.5 a	2630 a	50 a	47 a	108 a
LSD (5%)	29	8	NS	NS	14	13	NS
C.V. (%)	6	17	7.6	5	15	15	2

Values followed by different letters within a column are significantly different at the 95% confidence level.
[1]The increase in measured residue cover after planting may be due to the return of residue to the surface during the planting operation, measurement error, or both.

Reference: Veseth, R., S. Guy, D. Cox, D. Thill, J. Hammel, T. Fiez, and J. Yenish. 1999. Direct Seed Systems for Grain Legumes-Pursuing Improved Erosion Control, Water Storage, Yields and Profitability. Pacific Northwest Conservation Tillage Handbook Series 26 in Chap. 2. Pacific Northwest Extension publication in Idaho, Oregon, and Washington. (On Internet at http://pnwsteep.wsu.edu).

JENSEN'S CHALLENGES

Residue. "Planting a spring crop on winter wheat residue is still our biggest challenge." It can fail due to "poor seed-to-soil contact, poor growing conditions in cool wet soil, and possibly a disease carry-over when going from fall wheat to spring wheat."

Equipment for side hills. "Our side hills make direct seeding difficult in this area." Not many drills are designed to seed consistently on slopes. "Equipment is my biggest drawback right now."

Rotation. Wayne knows a longer rotation using more broadleaf crops would help manage weeds and diseases, as well as residue, but finding profitable crops to fit into that rotation is still a challenge.

Relying on Roundup. "My Roundup spray job is too inconsistent yet. That has to be foolproof because it's the only shot I have. It has to be another one of those slam-dunk operations."

Risk. "A lot of risk is involved. Your chances of failure trying something new are greater than if you do it the old way. "

Appearances. "It's frustrating, looking at crops with all that residue—you look at your neighbor's field and it's nice black ground where every row shows up, and yours is coming up through the straw and you still can't see it. It's probably every bit as good but you just can't see it. And then it can be tough to deal with the neighbors' perception. You have to have thick skin."

Slow transition. "One frustration I have is how long it takes to get comfortable doing something. …I know where I want to be, but I need to take it easy and stay in business while I get there. I'm frustrated with how slow it goes."

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Authors: *Ellen B. Mallory*, Washington State University associate in extension and research; *Roger J. Veseth*, WSU and University of Idaho Extension conservation tillage specialist; *Tim Fiez*, WSU Cooperative Extension soil fertility specialist; *R. Dennis Roe*, NRCS resource conservationist; and *Donald J. Wysocki*, Oregon State University Extension Service soil scientist, Columbia Basin Agricultural Research Center. **Photos** by *Ellen B. Mallory*.

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