Direct Seeding in the Inland Northwest

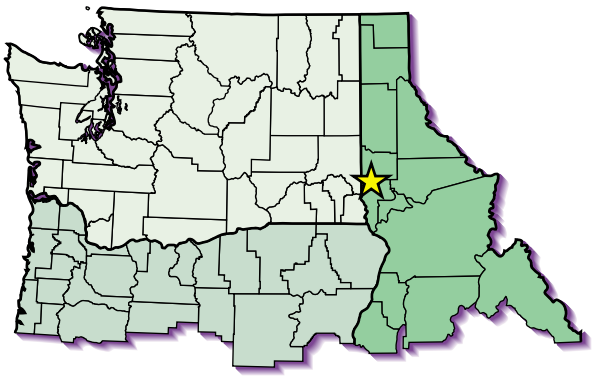
ZENNER FARM
case study

Location: Latah and Nezperce Counties, ID

Annual rainfall: 22 inches

Drill types: John Deere® 455 and 1860

Crop rotations: Winter wheat/Spring cereal/Spring pulse crop



BACKGROUND

Russ Zenner is a recognized leader in conservation farming in the high rainfall, annual cropping regions of Idaho and Washington. Twelve years on the Latah County Soil Conservation District Board early in his farming career exposed him to many of the issues surrounding soil conservation and firmed his commitment to preserving soil resources. He started reducing tillage and increasing soil surface residue levels in the early 1970s. He has been on a gradual and methodical path towards less tillage and higher residue systems ever since. In 1997, he began direct-seeding spring pulses, and more recently, spring cereals.

The 3,300 acres Russ farms ranges from ground in the rim area of Clearwater River, near Lewiston—gently sloping land with southern exposure and deep loam soils—to typical Palouse terrain near Genesee, Idaho—rolling hills having exposed clay on the ridges and deep loam soils elsewhere. Russ grows a diversity of crops including winter wheat, spring wheat, spring barley, garbanzos, lentils, peas, oilseeds, and grass seed. He has maintained certified seed production throughout his transitions to higher residue systems.

"I have been working towards decreasing, and hopefully eliminating, tillage for a long time. Every step of the way I am looking at enhancing profitability in addition to addressing the environmental and soil quality issues."

~Russ Zenner

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Russ actively participates in the larger agricultural community. He was Chairman of the USA Dry Pea and Lentil Council Research Committee from 1997 to 1999, and served as a Council board member from 1987 to 1999. In 2000, he was elected President of the newly formed Pacific Northwest Direct Seed Association. He also participates in a group of innovative growers in northern Idaho and eastern Washington—the ClearWater Direct Seeders—who hold monthly breakfast meetings in the winter and field tours during the growing season to exchange experiences, ideas, and encouragement about direct seeding. Russ received the 1995 Latah County Conservation Farmer of the Year award, and a Merit Award from the Inland Empire Chapter of the Soil and Water Conservation Society in 1990.

A NEW WAY OF FARMING

Russ Zenner began looking for ways to decrease tillage and increase residue levels as soon as he returned to farming in the early 1970s. "I was convinced we had to reduce soil erosion. I also could see if we could maintain yields while we reduced tillage, our equipment requirements and times over the ground would be less, and we would be more profitable." Russ's first step away from the conventional moldboard plow farming method was to develop a "shank and seed" system for establishing winter wheat on pulse crop ground. This system, which involves using a heavy-duty shank fertilizer applicator as the only form of tillage before seeding, is now a common practice in his area for planting winter wheat following pulse crops. Russ also was one of the first growers in his area to buy a hinge-back plow for uphill plowing after winter wheat, a practice that leaves more residue on the soil surface than conventional plowing and helps move soil upslope. These became Russ's standard practices in his winter wheat/pulse crop rotation.

Increasing residue on the soil surface presented some disease challenges. "I had impact from Cephalosporium stripe (and probably from other less obvious diseases) in some of the reduced tillage, higher residue fields because I did not have a long enough rotation." Russ expanded his rotation to include spring grains after attending a field day for the Integrated Pest Management (IPM) Conservation Cropping Systems research project conducted by the USDA-Agricultural Research Service, Washington State University, and the University of Idaho from 1984 to 1991. "They had a 3-year rotation that was successful in maintaining yields, and in controlling weeds and disease, without using the moldboard plow. They also had very similar soil and climate to what we have on our farm. I already had started moving toward a 3-year rotation on a limited basis, but the IPM project convinced me I needed to do it on the whole farm. It convinced me my crop rotation is a key part of making a reduced tillage system successful."

Russ's next big change was purchasing a set of three Great Plains® end wheel minimum-till drills in 1988. "Generally speaking, we could do a decent job with the conventional drill in the shank and seed system, but when we started getting into higher residue spring crop planting, the conventional drills began failing in terms of stand establishment. Buying the Great Plains drill was my first step in phasing out the plow and working toward less tillage for the spring crops." It also was his first step toward developing what he calls a "scratch and seed" minimum tillage system for spring crops (see "Residue Management"). Later, Russ would replace the Great Plains drill with a set of John Deere® 455 minimum till drills capable of penetrating more residue.

Russ's transition to 100% minimum till has been gradual and cautious. "I wasn't interested in sacrificing yields to make this work. In fact, one of my goals was to have yields that compare with the best conventional tillage, since that is what many farmers look at. I also did not want to sacrifice our certified seed production. I tried many different things and just expanded the acreage on those that were successful." This approach has paid off. Russ says, "I definitely have not sacrificed yields—if anything, they have improved for some crops—and I have maintained good profitability in my operation. The last few years have been some of the most profitable we've ever had, and that has me excited. I feel good about the direction I'm going." Russ is now using this same methodical approach to work on reducing tillage even further using direct seeding.

As he shifts into even less tillage and more direct-seeding, Russ's primary reasons for moving in this direction, and for encouraging others to do so, are basically the same as when he started on this path over two decades ago—soil conservation and production efficiency. These motivations, however, have become more urgent as farmers in the region feel increasing competitive pressure on a national and global scale to maintain productivity and to reduce costs. Russ notes an addi-

tional motivating factor—increasing pressure to reduce the potential offsite impacts of farming. "We need to continue to address the environmental issues: air quality in terms of burning, and water quality in terms of sedimentation [transported soil and accompanying pesticides and fertilizers]." Russ now sees direct seeding as a key to the survival of his and other farms in the region. "In the long run, I don't think we will have much choice—we will have to make this work."

CURRENT DIRECT-SEED SYSTEM

Crops and rotation

"Rotation and crop diversity lessen the long-term economic risk of farming," says Russ. "They give you tools to control diseases, insects, and weeds—you break pest life cycles and you can rotate herbicides. You also put your eggs in many different baskets in terms of marketing and Mother Nature (e.g., winter injury or timing of heat)." Russ used a 3-year rotation of winter wheat/spring grain/spring broadleaf crop for the last 10 years. "Within every leg of that rotation, I have quite a bit of diversity." He explains, "For the winter wheat leg, I have soft white, club, and hard red varieties, and certified seed production. For the spring grain leg, I have grown durum, soft white, hard white, and hard red wheat varieties, malt and feed barleys, and corn. For the broadleaf crop leg, I have Austrian winter peas, spring yellow and green peas, garbanzos, Pardina lentils, and oilseeds. My goal is to have every crop I raise add to the yield potential of the following crop, and, hopefully be profitable on its own. A number of different factors determine where I plant different crops, including soil type, potential markets, and spreading the planting and harvesting workloads. It's a challenge to grow all those different crops, but I think the diversity has added to our profitability. Every year some crops have done exceptionally well, even in poor marketing years."

One alternative crop that has done well for Russ is durum wheat. Russ notes, "It is a higher risk crop. You have higher quality standards with a major discount for falling below those standards. Durum wheat also has higher fertility requirements than soft white wheat, and generally higher seed costs. But it has the potential to give significantly greater returns." An added bonus for direct seeding, durum wheat produces much less stubble for the same amount of grain than do soft white spring wheat varieties. Russ grows durum on 25% to 30% of his spring grain acreage.

For the last 4 years, Russ has experimented with yellow mustard, corn, and winter Canola. He says, "mustard is a little easier to raise than Canola. It has the same fertility requirements but since insects don't bother it nearly as much, it is a cheaper crop to raise. It also seems to emerge better than Canola." Russ mentions another potential advantage. "As a Brassica crop, it might have some soil fumigation capabilities to improve the yield potential of the following crops, but we are just beginning to learn about that." He has grown between 20 and 100 acres of yellow mustard with yields ranging from 1,200 to 1,800 pounds per acre. "I would hope we could be over 1,500 pounds consistently, and over a ton in good years, to make it work financially, but we haven't done that yet. I don't know whether we need to fine tune the genetics or the management."

Modified John Deere 1860 air seeder (top) planting garbanzos after corn that was direct seeded into 100 bu/A winter wheat stubble; and early stand of garbanzos in June (bottom).

As for corn, Russ sees a variety of potential advantages. "Corn helps spread the workload because it is planted and harvested later than everything else. It allows us to use a whole gamut of herbicides different from those we use on our small grains. And it has good local markets, so its price is about as good here as anywhere else in the U.S." Russ has grown between 1 and 40 acres of corn, yielding between 50 and 90 bushels per acre. He notes, "Of the 4 years I raised corn, only one did not have some kind of extreme weather, and that was the year the corn yielded 90 bushels." He has noticed corn is sensitive to extremely wet (poorly drained) or dry ground, "so some of its success may depend on picking the right ground." Another challenge, in Russ's area, is "being too far from a major corn growing area to have access to equipment and expertise."

While Russ has considerable diversity in the crops he is growing, he is keenly interested in adding winter broadleaf crops having good market potential to his rotation. "As we have expanded the rotation, all of the crops we have added have been spring crops. One of the things I see as a missing link in this high-production region is a consistent and profitable fall-seeded broadleaf crop so we can get away from having to plant so much crop in the spring. It is easier in our region to direct-seed in the fall, versus in the spring when we have a shorter seeding window and more problems with cool, wet soils that compact easily. Plus, in our area, winter crops have a greater yield potential if we can get them to survive over the winter." Direct seeding can provide an ideal growing environment for winter crops. Standing stubble and other residue trap snow, increasing moisture reten-

ZENNER'S NO-TILL DRILL

Russ Zenner owned a set of John Deere® 455 minimum till drills, is part owner of a John Deere 1860 air-seeder, and rented a Great Plains® 3010NT no-till drill in 2000. The 455s replaced his Great Plains minimum-till drill in 1995, and did almost all of the seeding on his farm until recently. "They have been an important part of my transition to higher residue and direct seeding, allowing me to seed into higher residue than my original end wheel Great Plains drills on 7-inch row spacing. They have better penetration due to more down pressure and wider row spacing (10 inch). But there is a limit to the amount of residue they can handle, and they don't deep-band fertilizer."

In 1997, Russ and three other farmers jointly bought a John Deere 1850, and then upgraded to an 1860 the following year. He and his partners chose the John Deere 1850/1860 because it is an "ultra low disturbance drill" providing good seed placement. Russ says, "To me, seed placement is the most critical aspect of a drill. I want consistent, uniform stands in all conditions. Fertilizer placement has been secondary." The 30-foot drill seeds on 10-inch rows using angled single-disk openers. Russ and his partners added a starter fertilizer system to the drill. Since it doesn't have deep-banding capabilities, Russ's primary use for this drill has been direct seeding spring pulse crops in one pass, and small grains in a two-pass system.

Russ also is experimenting with other drills that can deep-band fertilizer to use for one- and two-pass systems for seeding small grains and Brassica crops after winter wheat. He and his drill group leased a Flexi-Coil 8000 in 1999 and a Great Plains NTA3010 air-seeder for 2000. Russ also leased a Great Plains 3010NT no-till box drill on his own in 2000. For 2001, Russ traded his JD 455s for a JD 1860 that will be set up similar to the partnership 1860. He will seed all his crops with either the JD 1860 or the Great Plains NTA3010 air seeder.

Zenner's modified John Deere 1860 no-till air seeder (left) planting garbanzos into 70 bu/A durum wheat stubble. Close-up of the single-disk opener and packer wheel system (right).

tion, and insulating the crop and soil surface from the extreme temperature fluctuations that cause frost heaving. Improved moisture infiltration and internal drainage, often associated with less disturbed soils, prevent soil water logging, and also are beneficial to winter survival. Breeding work is underway at the University of Idaho and USDA-ARS to develop winter oilseed and winter legume crops that are adapted to annual cropping and direct seeding, and that have highly marketable characteristics. Russ is actively cooperating in these efforts by hosting test plots on his farm.

Residue management

Russ farms in one of the top dryland winter wheat producing regions of the world, which means managing residue from high-yielding grains is an important issue for direct seeders. "I made the decision early in my career not to use grain stubble burning as a residue management tool because I did not think it would be a long-term option, especially if the total burn acres increased. This has slowed my short-term progress in eliminating tillage. …Now there is talk of baling off straw [for strawboard production] to minimize residue, but I am not yet looking at doing that either. My view is the more residue we leave in the field, the faster we will improve soil quality. We need to find the fine line between leaving as much residue as we can and not creating too much of a problem for direct-seeding the following crop."

Russ's residue management strategy varies depending on the type of crop residue. All crops are harvested using combines equipped with straw choppers and chaff spreaders to evenly distribute combine residues. This is the extent of Russ's residue management for pulse crops. He then establishes winter wheat using a 2-pass, "shank and seed" system. He places fertilizer with a heavy-duty shank fertilizer applicator and seeds using his John Deere® 455 drills or, more recently, a John Deere 1860 air-seeder.

Cereal residues require more management. For starters, Russ says, "it is impossible for combines to do the chaff spreading you need in all conditions," particularly with thick or lodged straw. In those cases, Russ has found it worthwhile to use a heavy tine harrow after harvest. However, he warns, "harrowing stubble ground is one of the most unpredictable operations I've seen. The timing is critical [in terms of temperature and humidity], but you can cover a lot of ground in a hurry." Russ then primarily uses what he calls a "scratch and seed" minimum tillage system to establish his spring crops. "I chisel plow or direct shank fertilizer in the winter wheat stubble ground (depending on cereal residue levels) in the fall. Then, in the spring of the year, rather than cultivate 3 or 4 inches deep, I just harrow or cultivate about 1 or 1.5 inches deep, basically scratching the surface just enough to enable a minimum-till drill to place the seed. In this system, I seed deeper than I till in the spring. Because I go shallow with the harrow or cultivator, I can get over wetter ground without ruining it as compared with conventional spring tillage." Russ adds "some of the reason I chisel plow right now is to smooth out the terracing we did by moldboard plowing. I use a chisel plow with 3-inch twisted points and a mounted sabertooth harrow. It moves quite a bit of dirt, but that is what I need to level the ground."

Part of Russ's motivation for leveling the ground is to prepare it for direct seeding. In 1998, he and three other growers jointly purchased a John Deere 1850 air seeder (see "Russ's No-till Drills"), which Russ has used to direct-seed an increasing num-

Early June stand of direct-seeded spring dry pea after spring wheat.

Early April stand of direct-seeded winter Canola after spring wheat.

ber of acres of spring pulse crops into standing spring cereal stubble. In 1999 they traded it in for an 1860 without the seed cart. They mounted a seed box and air delivery system on the drill. In 2000, Russ began leasing a Great Plains no-till drill that has deep banding capabilities, allowing him to start experimenting with one- and two-pass systems for seeding spring grains following winter wheat. He also will use it to begin direct seeding winter wheat after pulse crops.

Fertility

Russ bases his fertilizer rates on soil tests and expected yields. He increased nitrogen rates as he moved to higher residue situations (by 10 to 15 lbs per acre for winter wheat, for example), but is "still well within the university guidelines." He typically shanks anhydrous, and liquid phosphorus and sulfur into the soil in the fall before planting winter wheat, spring durum wheat, or dark northern spring wheat (DNS). Winter wheat receives additional nitrogen via topdressing the following spring. Russ used to shank in additional nitrogen for the spring wheat in the spring before seeding, but his recent leasing of a no-till drill will allow him to deep band fertilizer at seeding.

Weed management

"Some weeds seem easier to control as we have reduced tillage. But in wetter years we have seen higher populations of prickly lettuce in our pulse crops, and more bedstraw in all crops," says Russ. When Russ began reducing tillage, he also began using a nonselective herbicide (glyphosate) as aid-to-tillage, and later as a preplant treatment. Switching to a 3-year rotation that includes 2 years of spring crop allows him to spray out winter annual and early germinating annual weeds before seeding. "When I started reducing tillage, I did not want to sacrifice my certified seed production. …The fact that I've used [a nonselective herbicide] in combination with spring crops for so long is now helping me immensely—I just don't have goatgrass, and very little downy brome. As I do less tillage, I have had situations of significantly less weed pressure. That is exciting to me. …In 1998, I had some direct-seeded peas that only required a preplant application of Roundup—I didn't have to do any broadleaf weed control or postemergence grassy weed control. I've never done that in a conventional tillage system."

Russ (left) at a July field tour describing his field of corn direct seeded after 100 bu/A winter wheat.

Wild oat has been more of a challenge for Russ under reduced tillage. "We have had problems with wild oat control in spring wheat where we were not using a soil-incorporated wild oat herbicide. However, several new postemergence herbicides for wild oat seem to be working well, so maybe we are over that hump." Russ is concerned that almost all of these herbicides have the same mode of action, "herbicide resistance could become a problem."

As Russ has decreased tillage, he has increased his reliance on postemergence herbicides for in-crop control of both broadleaf and grass weeds in the pulse crops, a change that has drawbacks. "The postemergence broadleaf herbicides we have right now are fairly sensitive to environmental conditions. Where we rely more on postemergence herbicides, the timing becomes more critical, and the capability to get over the ground in a timely fashion becomes more critical. A good sprayer is a very important part of a direct-seed system."

Disease management

"Rotation and green bridge management are the two most valuable tools for managing diseases in minimum tillage and direct-seed situations." Managing the green bridge refers to creating a weed- and volunteer-free period between crops to eliminate live hosts for Rhizoctonia and other root pathogens. Russ achieves this with one or two applications of a nonselective herbicide (such as glyphosate) between crops. For winter wheat, Russ makes one postharvest application, waits 1 to 2 weeks, shanks in fertilizer, and seeds. This sequence of operations gives him as much time as possible between spraying and seeding to allow soilborne pathogen levels to die back. The fertilizer shanking may thin out later germinating weeds or volunteer crop.

For spring crops, Russ prefers to apply his first application of glyphosate in the fall if enough weed and volunteer growth occurs. "If you have good germination and growth in the fall, and kill that growth, the green bridge pressure in the spring will be minimal, even if you have more germination over the winter. We end up respraying most of what we spray in the fall again in the spring, but we can go with lower rates. We also can seed sooner afterwards because we don't have to worry about the green bridge effects." If not enough growth occurs to warrant a fall application (about 20% of the time), Russ applies glyphosate at the first opportunity in the spring. He uses a higher rate "because the plants are usually bigger and there are more of them to kill. "I try to spray as early as I can and wait as long as I can to seed following the spray job."

Seeding strategy

Achieving a good crop stand is critical to the success of any farming system. Russ learned this early in his transition to higher residue when pushing the limits of his conventional drills. "You just can't use a conventional drill in a minimum till system and expect to get the stand establishment that you need." Beyond having the appropriate drill for the residue conditions, Russ has found his seeding techniques—timing, depth, and rates—have not changed much from his conventional techniques. Sometimes he increases his seeding rate "depending on the residue conditions and seed-to-soil contact I'm getting." He also notes in a higher residue system, "spring seeding generally happens later than in a conventional tillage system."

ZENNER'S ADVANTAGES

Labor and equipment efficiencies. "The growers who have successfully made the transition to direct seeding will be able to survive low grain prices because they have lower costs of production."

Soil quality. In 1997, Chilean direct-seed grower Carlos Crovetto spoke in Pullman describing improvements in soil quality after 19 years of no-tilling on his farm. These include: a quadrupling of organic matter (from about 1.5% to about 6%) in the top 8 inches of soil, an accompanying increase in available water in that horizon, and improvements in bulk density in the rooting zone (Crovetto, 1998). Although the climatic conditions in Chile are more conducive to increasing soil organic matter than in the Northwest, the potential benefits for this region are encouraging. "That talk convinced me we too can make a significant improvement in soil quality in this region over time with a continuous no-till system. In the long term, improved soil quality will improve our yield potential and translate into higher profitability."

Environmental benefits. "I'm talking about water quality, sedimentation, nutrient management, those types of issues. Any time soil leaves our farms, any herbicides or fertilizers we applied go with it."

ZENNER'S CHALLENGES

Residue. "A lot of our crops, especially the high-yielding grain crops, produce excessive residue for the planting technology and the cropping systems we have. It is a major challenge."

Risk of trying something new. "Without adequate knowledge of what you are doing, there is potential for yield reductions. You are dealing with a different soil environment and different equipment. It takes a while to learn how to manage those."

Stress of spring work. "As we've gone from a 2-year to a 3-year rotation, we've gone from seeding half of our farm in the spring to seeding two-thirds of it in the spring. Getting all of that done can be challenging, especially in a year when the soils stay cold and wet. As we get farther into this, it will be easier because direct-seeded ground will support the equipment better. In transition, these soils are tougher to manage—they stay wetter and cooler longer. It takes a lot of patience."

ADVICE TO NEW DIRECT SEEDERS

Visit direct-seed operations in the Dakotas. "The thing that has probably had the most impact on growers in our area is that trip to the Dakotas where they saw with their own eyes the implementation and success of direct seeding on a large scale. The growers in our area who have gone on that trip have come home and done something. When you see some of these big farms without much equipment, and you think about all of the

iron you're pulling around to do fewer acres, you realize those Dakota farmers are going to survive in a lower price environment than you will. The most convincing thing is to believe you have to do it—that the way you have done things in the past is not going to be a long-term option, whether it be environmental issues, regulatory issues, or just financial survival."

Join/form a direct-seed support group. "You can feel like you are going out on a limb, just waiting for someone to chop it off, so it's good to have others to share experiences. In my area, we have a direct-seed group that meets once a month in the winter. Everybody in the group is pretty much going in the same direction."

Start small and share equipment. "Most growers do not have the knowledge base to convert their entire farm to direct seeding overnight. It is just too risky financially. Plus, the new equipment is very expensive. Starting on part of the farm, and sharing equipment are smart ways to move into direct seeding. Sharing equipment can give you access to better equipment than you might have on your own, as well as the opportunity to share experiences with the different farmers using that equipment. It's just a matter of identifying people you can trust to share information, and who have a different enough season so your seeding times don't overlap too much."

Rotate. "The first thing to start with is rotation. The traditional 2-year rotation in the higher rainfall region (winter wheat/pulse crop) has disease problems that intensify as tillage is reduced and soil surface residue levels increase. If you want to minimize disease and pest problems associated with startup, go to 3-year rotation. It takes much of the risk out of the transition."

Make seed placement a priority when choosing a drill. "Use a drill capable of accurately placing seed in whatever conditions you are working." Russ says, unfortunately, it is still a challenge to find equipment to consistently give good seed-to-soil contact under high residue and on steep ground.

Reference: Crovetto, C.C. 1998. No-till development in Chequén Farm and its influence on some physical, chemical and biological parameters. Journal of Soil and Water Conservation. 53(3): 194-199.

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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