Direct Seeding in the Inland Northwest

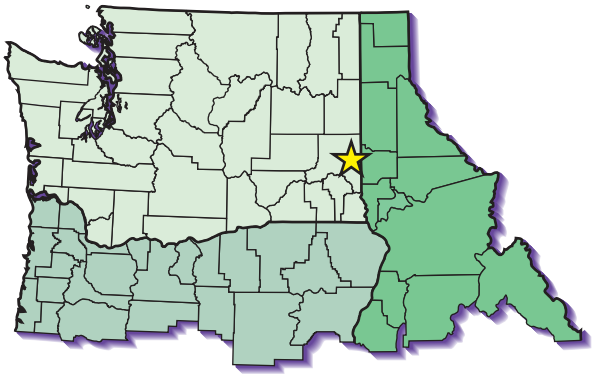
FRANK LANGE FARM
case study

Location: Whitman County, WA

Annual rainfall: 17-20 inches

Drill type: Palouse Zero-till (Custom seeder)

Crop rotations: Winter wheat/ Spring wheat/Spring lentils



Frank Lange has been direct-seeding for as long as he's been farming. He regularly seeds directly into "50- to 100-bushel" undisturbed stubble. Some of the land that Frank farms has been direct-seeded continuously for 25 years, probably the longest of any land in the Inland Pacific Northwest.

INTRODUCTION

When Frank started farming in 1986, he experimented with direct seeding by having a field custom seeded by Mort Swanson, innovator of the Yielder® no-till drill. Two years later, in 1988, Frank leased the 1,200 acres that Swanson had farmed near Palouse, WA. Swanson had direct-seeded that land for about 15 years. When Frank took over its management, he continued using direct-seeding techniques. Frank says, "Mort was showing that you could economically direct-seed. The real turning point came when Roundup became affordable."

Today, Frank farms 2,100 acres, including the Swanson farm, in the Palouse-Colfax area, all direct-seeded. He raises winter wheat, spring wheat, and lentils in a 3-year rotation. Except for harrowing after lentil seeding, Frank performs no tillage operations. Although his lease agreement with the Swansons specifies he must use direct-seeding practices, that isn't the major reason why Frank continues to direct-seed. Frank says he does it primarily because direct seeding allows him to farm

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2,100 acres by himself. His direct-seeding system requires relatively few field operations, and he can custom-hire the most labor-intensive of them, the seeding and harvesting. "I guess it's as much of a labor thing as anything. The farm is almost twice as big as when I started. In my mind, it's more beneficial to have the farm custom-seeded than it is to have a year-round hired man."

CURRENT DIRECT-SEED SYSTEM

Crops and rotation

Until recently, Frank had 2-year rotations: winter wheat/lentils, and winter wheat/spring wheat. "Being in the [government commodity] program made a big difference in rotations. We had a large wheat base. Where we had winter wheat/spring wheat, we had disease problems, but then, with the government program [payments], it averaged out." When "Freedom to Farm" began (the phase-out of the government commodity support program), Frank switched to a 3-year rotation: winter wheat/spring wheat/lentils. He's noticed already that his disease incidence is less. Weeds are also easier to control (see "Weed management"). "I think we've reached an equilibrium since I've gone away from that 2-year rotation. That helped." And in terms of winter wheat yields, "if you're comparing it to winter wheat/spring wheat, the 3-year rotation is definitely better." On the downside, "spring crop doesn't pay what the winter wheat does." In general, Frank favors longer rotations, but realizes they are not always economically feasible. "I don't think there is any doubt that if you stretch (the rotation) out you are going to grow better crops. But the problem is, are your alternate crops going to be worth anything?"

Residue management

Residue management is critical to Frank's operation because he does not use any tillage and rarely burns off the stubble. His residue management starts with his choice of cultivars before the seed is placed in the ground. "We really dislike the taller plants. Unfortunately, Madsen is one of the better yielding varieties. You can have too much of that Madsen straw to seed a spring wheat crop into. Cashup has been a good wheat for us because it's shorter and the straw breaks down." As the crop is harvested, Frank tries to spread the straw evenly over the field using choppers and chaff spreaders on his combines. He has one home-built spreader and one after-market spreader, both of which spread harvest residue about 20 feet wide. His combine headers are 25 and 27 feet wide. Frank notes newer after-market spreaders can spread wider, but he gets by with his current ones.

Frank benefits in terms of residue management by having a dense broadleaf crop, lentils, in his rotation. Residue tends to decompose quickly in the cool moist conditions under the lentil canopy cover. "It breaks down. It amazes me still. ...It's got a little bit of straw there [after lentil harvest] but not much more than a conventional field. ...It just disappears." The harrowing Frank does after seeding lentils to knock down the straw for harvesting probably helps in the degradation process. However, Frank advises against harrowing too much. "The less you harrow, the better off you are. Your weed problems will be more localized."

Fertility

On winter wheat, Frank puts down aqua ammonia at 50-60 gallons per acre (76-91 lbs N/acre) in a deep band 3-4 inches below the seed, and 16-20-0-14 starter fertilizer at about 100 lbs per acre with the seed (16 lbs N/acre, 20 lbs P_2O_5/acre, and 14 lbs S/acre). Soft white spring wheat and dark northern spring wheat receive aqua ammonia at 45-50 and 55-60 gallons per acre, respectively, and both receive 16-20-0-14 at 100 lbs per acre. Frank applies no fertilizer to his lentils.

Frank Lange direct-seeds hard red spring wheat on his upper slopes (right) where conditions are more conducive to producing high protein wheat. He direct-seeds soft white spring wheat on other areas (left). Residue level seen between the two wheats is representative of the whole field.

Weed management

Frank combines cultural practices (rotation and narrow row spacing) with chemical treatments (preplant Roundup applications and a conventional postemergence herbicide program) to manage weeds in his direct-seed system.

Switching from a 2- to a 3-year rotation helped bring some persistent weed problems under control. "We're battling cheatgrass (downy brome), so a 3-year rotation gives us a whack at that and several other grassy weeds. And I think it's better for thistles. ...You get a pretty good look at them in the spring wheat." Frank also had problems with volunteer lentils in his winter wheat and subsequent lentil crops. With the 3-year rotation "you get some kind of phenoxy programs in your winter wheat and your spring wheat, so you get 2 years of phenoxy. Lentils might not sprout the first year but they will sprout by the second year. What's left is not very viable."

Frank attributes the success of direct seeding to the development of herbicides to control weeds without tillage. "What really has made this work is the herbicides. I don't think we'd be in the position we are if we didn't have the chemicals to use." Frank stresses that the switch to a herbicide-based weed

NO-TILL DRILL — CUSTOM SEEDING

Since 1996, Frank has hired his seeding custom done with a Palouse Zero-till MV240 drill. By hiring out this labor-intensive operation, Frank can farm 2,100 acres by himself. "My job is to spray and harrow. I have to keep ahead of the drill with the sprayer and keep caught up behind it with the harrow. It's worked out well in the past."

Frank is pleased with the performance of the Palouse Zero-till drill for a number of reasons. For one, it's lighter than the Yielder® drill Frank used before, which is an advantage for spring seeding. In fact, the fertilizer section of the Palouse Zero-till drill can be removed for seeding lentils. "That's pretty neat because we can seed places where you shouldn't even be driving your tractor." It also makes seeding much faster. "No-till seeding, for the most part, is about half as fast as conventional seeding. But with lentils, I don't know if there's much difference." Frank also likes the narrower 7 1/2-inch row spacing. He's not convinced narrower rows have any effect on yield, but he does think they are important in terms of rapidly establishing crop canopy cover to suppress weeds. Finally, the disc-opener version of this drill seeds successfully into the heavy residue in his fields. He's also tried the shank-opener version of this drill, but found it less satisfactory in heavy residue. "Anything that rolls will handle the straw because, if you think about it, it doesn't matter how tall the straw is if it's attached to the ground."

The double discs on the Zero-till openers are not offset and are positioned closer together than on other openers. This is possible because the bearings grab from the outside of the opener; there is no center post. The result, says Martin Anderson, who builds and operates the Zero-till drills, is an opener that disturbs soil less, pulls more easily, and suffers less wear on the bearings. Fertilizer openers are spaced on 15-inch centers, between every other pair of seed rows, and place fertilizer 3 to 4 inches deeper than the seed.

One possible disadvantage of having fields custom seeded is the grower doesn't have as much control over when seeding is done. "Timing is very important. They have to be there when it's time to seed, and I can't tell them much in advance what day that is. It depends on the weather, so the availability is very important."

Frank has considered buying a no-till drill but says he prefers waiting since "The jury is still out on what we're going to be using down the road."

Palouse Zero-till drill seeding into winter wheat stubble.

management system, where "You replace your cultivator with your sprayer," requires more management. "The timing is more critical with no-till than it is with conventional. You've got a smaller hammer and you've got to hit it just perfect. Those guys (conventional-tillage farmers) have a big hammer and they've got 2 weeks either side of ideal to hit it."

Frank generally sprays Roundup two times before planting his spring crops. "If it were a perfect world, I would spray in the fall, like about the middle of October. But if we don't have a lot of growth after harvest—if we don't have more than 2 inches of growth from the volunteer—then I don't spray it." He also won't fall spray volunteer spring wheat. "I very rarely spray spring wheat stubble in the fall because you stand a good chance of it freezing out in the winter." If he hasn't fall sprayed, Frank tries to spray as early as he can in the spring. He says he can get out onto his direct-seeded fields earlier than on conventional fields because the ground is firmer. Frank uses a home-built sprayer (consisting of a spray boom mounted on a truck with flotation tires) to apply Roundup to minimize dust, which deactivates the herbicide.

Frank often applies a second spray a couple of weeks before planting. "We've skipped (that second spray.) When you're getting $3.00 wheat you're tempted to skip it. But you don't get 100% kill the first time. Let's say you get 99%. Well, then 1% of the goatgrass survives. It seems crazy to spend $3.50/acre for 1% of the goatgrass, but I'm pretty sure that's the way to keep it down." If he's seeding lentils, Frank will put on Pursuit with his second application of Roundup. Spring rains carry the herbicide into the soil. "What really made no-tilling lentils work was Pursuit. Before Pursuit we were losing the battle to bedstraw."

Frank has noticed two weeds in his direct-seeded fields that do not appear to be in neighboring conventional fields (California brome and another brome species), but he hasn't had to take any special control measures for these weeds. Periodically, he has experienced strong jointed goatgrass pressure. He brings these areas under control by burning in the spring before planting a spring crop.

Disease management

Frank's disease-control strategy involves three main tactics. First, he uses a 3-year rotation, including 1 year of a noncereal, to help break disease cycles. When he was concerned about maintaining base acres for the farm program, Frank used 2-year rotations. He noticed more disease, but farm program payments compensated for the wheat yield lost to disease.

Second, Frank chooses disease-tolerant crop varieties, having learned from experience. "We stuck with Stephens wheat about 2 years too long. The reason we did it was that its straw was short and broke down easy. It really fit no-till well. But we didn't realize we were inoculating the ground with Cephalosporium-infested straw. I was slow to learn and that was expensive." Frank now pays careful attention to the disease tolerance of different varieties, especially their tolerance of Cephalosporium stripe. Cashup has been a good choice because it is more tolerant of Cephalosporium stripe, and its straw breaks down easily (see "Residue management" above.)

Third, Frank is careful to control the "green bridge," green growth of volunteer crop and weeds that can harbor diseases, enabling them to move from the previous crop to the new crop. Frank uses Roundup to establish a vegetation-free period of at least 2 to 3 weeks between crops.

Direct-seeded spring wheat in mid-May (left) and early July (right) with direct-seeded lentils on background hill. See back page for close-up of lentils.

Seeding strategy

Frank is one of the few growers in his area seeding directly into the previous crop's residue without tillage or burning. "Everybody's concerned about the stubble. It looks impossible, and I must admit there are days in the spring when you're out there seeding and you think, 'Jeez, is this gonna work'?" But it has worked for Frank. "I haven't failed to get a stand in the spring. There have been some thin stands, but I think everybody can say that."

Frank generally waits for the soil to warm up in the spring to ensure rapid germination of his crop. However, he will seed a little early if he thinks the weather will stay warm. "Once you go over the ground with the drill, the sun warms up the soil. If you wait for the soil temperature to hit 50 degrees and you have 55-degree days, the soil may never warm up at that pace. But if you seed it, get a little black soil (you stir up a little soil with the no-till drill), you open the soil up some, and if the air temperature is warm, it warms up faster after you seed it than if you leave it untouched." The risk with this strategy, Frank points out, is if a cold wet spell sets in, the soil stays cool and weeds will germinate before the crop.

To make seeding easier, Frank prefers to seed into standing stubble. "It looks ugly until the crop grows above the stubble but that's the way to do it." Frank increases the seeding rate to compensate for any straw tucking. "We bump the seed rate up because we know we're not getting seed contact with the ground all of the time." He typically seeds 120 pounds of wheat per acre. If he's seeding spring wheat, he'll seed "as shallow as possible but with dirt over it. ...Don't plant too deep or it takes forever to come up. It's cold deeper."

Frank doesn't harrow after seeding grains for two reasons: 1) "The harrow will pull the straw out of the seed row and then the seed is on top of the ground," and 2) harrowing can distribute weeds around the field.

Frank does harrow, at least two times, after seeding lentils to smooth out the residue for harvesting. "If you don't get it harrowed, then you've got lentils growing up the stubble. The lentils like it—it's almost like a trellis—but the pea bar, it can make a grown man cry trying to harvest that. You need some pretty warm, dry weather to harrow it. If the straw is damp, then it rolls up like cigars and you've got these huge straw clumps that are hard to harvest. You need a 60-degree day. ...If you get the warm days and the harrow through it, then most of the straw is 4 to 5 inches long and that's manageable." Frank seeds lentils about 2 inches deep, "that way we don't harrow the lentils out of the straw tucking. And actually, if you seed deep, the straw tucking is not that bad of a problem."

BENEFITS

Low capital requirements. Frank sees direct seeding as a feasible way to enter into farming with less capital because it requires fewer field operations and less machinery than conventional farming. "The one thing about no-till farming that is different than conventional farming from the business point of view is, if you put aside all the agronomy, the worms, and all the water and soil savings, you can be a checkbook farmer and be a no-tiller, and it will work because you can hire the seeding, you can hire it harvested. ...You could actually farm it yourself with a checkbook. Whereas, it's almost impossible to do that conventionally because there are so many different passes."

Erosion control. In addition to maintaining stubble cover to protect the soil against water and wind erosion, direct seeding eliminates field operations that might cause tillage erosion. Frank related an experience of disking after not having done it for years. "I hadn't pulled a disk for so long, I had to ask my brother how. I disked along a sidehill and the dirt was moving down the hill, just like, phooom... Growing up I drove tractor with conventional equipment, but, wow, when you don't see the soil movement for awhile, it's just amazing. Every time you go across that hill it's just whoosh. I mean, that in itself, if you can come anywhere close to breaking even, that's enough reason to switch for me."

Improved profitability. "I think that you can save money. ...I don't like to stand up on top of a box and say 'Hey, you're going to make more money if you no-till.' But, in my case it's right. I'm not going to tell you it's right for you."

More consistent yields. "You can get some pretty violent yield swings with the conventional system. We get swings but not nearly as bad." Frank has compared his crops with neighboring crops. "Sometimes the other crop will fold and you're just hanging in there." Speaking about one case in particular, Frank said, "I'm sure it was a moisture difference. We had just a little bit more moisture."

CHALLENGES

Timing of spring seeding. According to Frank, there is a delicate balance between seeding early enough to ensure a good crop, and waiting long enough to prevent soil compaction due to cold, wet soils and to get rapid enough crop germination to beat out emerging weeds. (See "Seeding strategy," above.)

Grassy weed control. Frank says it's hard to control grassy weeds without tillage. Fall tillage knocks seeds to the ground and incorporates them into the soil, encouraging them to germinate. With direct seeding, Frank sees grassy weeds, such as downy brome, germinate gradually over time. Frank has moved to more spring crops that give him the opportunity to spray out late-germinating weeds before seeding the crop.

Herbicide failures. "Misses with the chemicals has been the biggest problem. And you do occasionally miss." Whether it be operator error or a problem with the chemical product, herbicide misses can be more of a problem in direct seeding because it lacks tillage as a back-up control measure. "Roundup has to work; you have to use it right. I guess the real trick of no-till is getting everything killed and getting a clean seedbed."

DIRECT-SEEDED SOILS: ARE THEY DIFFERENT?

Experienced direct-seed farmers often talk about how their soils change under direct seeding, saying, for example, that these soils now take in and store more water, can be driven on earlier in the spring, seed more easily, and are generally more "mellow." A team of soil scientists from Washington State University and the University of Idaho are documenting some of the soil changes that occur under direct seeding by comparing direct-seeded fields to neighboring, conventionally farmed fields at six sites in southeastern Washington. One of these sites is the land that Frank Lange farms. The team is comparing soil from one field direct-seeded for over 20 years with soil from a field conventionally farmed until 1996. The researchers are measuring a wide array of soil characteristics. Some of their results appear below.

Organic Matter and Microbial Biomass Carbon

The organic matter content in Frank's direct-seeded soil was significantly greater, at all measured depths in the top 10 inches than in the conventionally farmed soil (Figure 1A). The difference was greatest in the top 2 inches (a 64% increase!) due to lack of incorporation and reduced decomposition of crop residues. The direct-seeded soil also had higher organic matter levels at lower depths, presumably from the lack of disturbance, which tends to oxidize organic matter.

Microbial biomass carbon, an indicator of the biological activity of a soil, often parallels organic matter content since organic matter supports microbial life. Frank's direct-seeded soil had three times the microbial biomass carbon in the top 2 inches than did the conventionally farmed soil (Figure 1B). At lower depths the two soils had similar levels.

pH

Soil pH levels were generally lower in the direct-seeded field, but were especially low at the 2- to 4-inch depth (Figure 1C). This pattern probably reflects long-term placement of fertilizer in this zone ("deep-banding") and the lack of soil redistribution from tillage. Ammonia-based fertilizers acidify the soil when ammonia is converted to nitrate during nitrification.

Soil Strength and Soil Water

Soil impedance measures the strength of a soil; a stronger soil is harder to penetrate. Frank's direct-seeded field showed a zone of higher soil strength at 3 to 6 inches (Figure 2). This layer, created by the combination of heavy machinery use (especially in the early spring) and not breaking up the soil with tillage, does not appear to be restricting water infiltration or crop rooting. On the contrary, water infiltration was greater into the direct-seeded soil (6.9 vs. 5.9 cm/hour). Under direct seeding, tunneling of earthworms and insects and rooting of plants create larger and more continuous pores. Left undisturbed, these pores and channels facilitate crop rooting and water infiltration even in areas of higher soil strength.

The soil scientists also have begun to measure the water holding capacity of the different soils and the water-use efficiency of the crops grown on those soils. Results from these comparisons are not yet available.

Frank's Comments

The soil organic matter and microbial biomass carbon data did not surprise Frank—he's noticed the mellower nature of his direct-seed soils. But he did not expect some of the other results. "I thought it pointed out two potential problems. The pH was lower than I expected. Is that going to bite us somewhere down the road? And then the compaction layer was quite a bit shallower. I thought that was really good information to know. Can you do anything about it? I guess that's the next question." Frank isn't too worried about the impedance data, given the high water infiltration results. As for the soil pH, he said he would consider using a different, less acidifying type of fertilizer if he knew the lower pH values were causing yield loss. The researchers are now working on this question.

The results from the first two years of this study are published in the 1997 and 1998 STEEP III Progress Reports (below). For additional information, contact Dr. David Bezdicek, Crop and Soil Sciences Dept., WSU, Pullman, WA 99164-6420, phone: (509) 335-3644.

References:

Bezdicek, D., J. Hammel, M. Fauci, D. Roe and J. Mathison. 1997. Impacts of long-term no-till on soil physical, chemical and microbial properties. p. 11-18. In STEEP III 1997 Annual Report. University of Idaho, Oregon State University, Washington State University and USDA-Agricultural Research Service.

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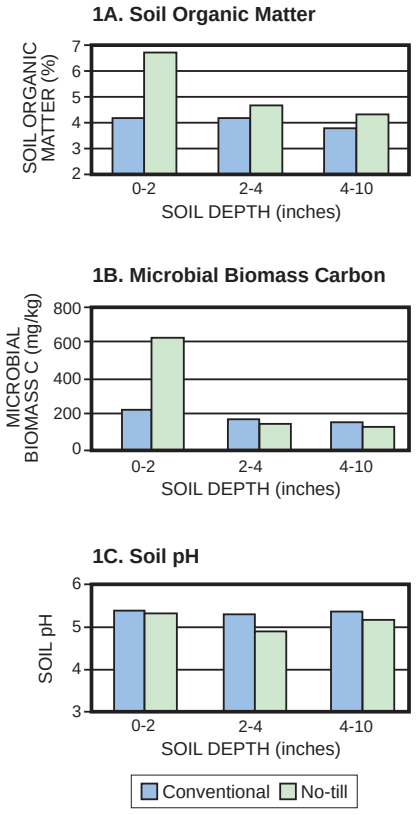

Figure 1: Soil organic matter (A), microbial biomass carbon (B), and pH (C) at different soil depths in a long-term direct-seeded field at Lange's and in a neighboring conventionally farmed field . (Bezdicek et al., 1998)

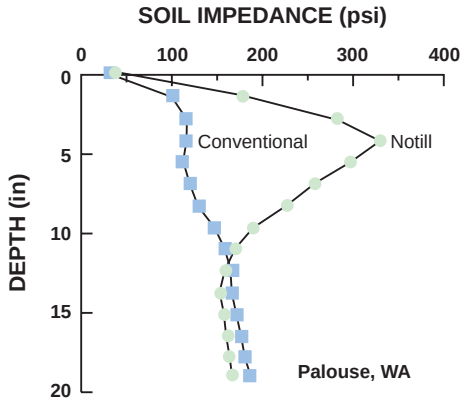

Figure 2. Soil impedance at different depths in a long-term direct-seeded field at Lange's (No-till) and in a neighboring conventionally farmed field. (Bezdicek et al., 1998)

THE BOTTOM LINE

Direct seeding provides many benefits, but is economic efficiency one of them? A study by WSU agricultural economists of six leading no-till farmers (including Frank Lange) in the 18- to 22-inch precipitation zone showed that no-till production, properly managed, is economically competitive. The no-till growers' total production costs per bushel or pound for five crops (winter wheat, spring wheat, spring barley, peas and lentils) were lower than the 5-year average market price for those crops, and lower than the production costs in Extension's 1995 conventional enterprise budgets for Eastern Whitman County.

Final enterprise budgets by Camara, Young, and Hinman for Lange and other high rainfall region no-till growers will be published in winter 1999 by WSU Cooperative Extension in the Farm Business Management Report series.

Direct-seeded lentils in spring wheat stubble in mid-May.

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 <http://pnwsteep.wsu.edu/dscases>

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