Direct Seeding in the Inland Northwest

MELVILLE FARM *case study*

Location: Enterprise, OR

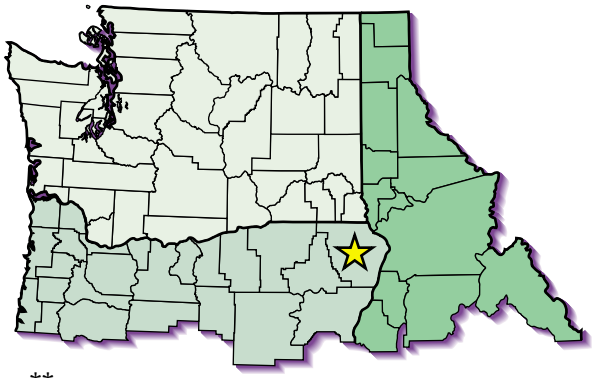
Annual rainfall: 10-26 inches; 100% supplemental irrigation

Elevation: 3,800 to 4,800 feet

Drill types: Yielder® and Concord®

Crop rotations:
Spring wheat/Spring barley/Peas
Spring barley (3 yr.)/Alfalfa (5 yr.)*
Spring wheat/Spring barley(Clover)/Clover**

*for frost-prone ground; **for higher elevations



BACKGROUND

Kevin and Kurt Melville, 26 and 24, are part of a new generation of farmers for whom direct seeding is second nature. It is the way their father has farmed for as long as they have helped him. It is the way they are farming as they continue to work with him and on their own.

Their father, Tim Melville, has 18 years of direct-seeding experience. Today, he (in center of photo) and his sons (Kevin on the left and Kurt on the right) farm a total of 2,000 acres in the Wallowa Valley, all of it direct-seeded. They grow spring wheat, spring barley, winter wheat, peas, canola, alfalfa and white Dutch clover, all under irrigation. Over the years they have learned how to handle many of the challenges of direct seeding, such as managing diseases, weeds and residue, by choosing the right crops and the right rotations.

"It was economics, that's why I started—to be able to plant quicker and easier, and to get rid of the plowing and rock picking. ... I wanted to try to grow as good a crop as I was doing conventionally with less cost. That was the whole goal.

~Tim Melville

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A NEW WAY OF FARMING

Tim Melville started direct seeding in 1979 to increase the efficiency of his operation at a time when commodity prices were low. He rented a no-till drill from the Soil Conservation District his first year. The next year he bought his own no-till drill, a Yielder®.

Tim's first experiences with direct seeding weren't all successes, but they did convince him that the concept worked. "When I first started, I could see it did work sometimes. But it didn't over here. So there was the drive to figure out why it didn't work." Not finding many other direct seeders in the area, Tim went on the road to seek out information and ideas. He visited other growers' farms and attended no-till seminars held by the Yielder Company and other groups. Tim also custom-seeded for about 6 months of the year to help pay for his new drill, gaining experience from Walla Walla, Washington to Paso Robles, California. "I got in a lot of seeding and learned a lot of things." But Tim says, "I don't think I really learned about our crops until I came home and just concentrated on them." Around 1986, he started direct seeding 100% of his acres.

The Melvilles made a number of significant changes over the years as they gained experience and confidence. They switched from growing only wheat and barley to rotations that include legumes, canola, and sod crops. "Rotation, by far, has been the change to give us the best results." Other changes include narrowing up the row spacing on their Yielder, seeding directly into herbicide-killed sod crops and, recently, adding a wider no-till drill.

Tim was concerned only about reducing costs when he first decided to try direct seeding. He was pleasantly surprised after a few years when he began noticing improvements in the soil. First he noticed his direct-seeded soils could take in more water. He had been accustomed under conventional tillage to seeing a steady stream of water running off his fields during center pivot irrigation, even when he ran the pivots at the fastest travel speed (an 8-hour cycle). In contrast, no water ran off under direct seeding; all of it was absorbed into the ground. Today, his pivots run on a 4-day cycle, with no runoff. Improvements in water infiltration and tilth of their soil, improvements that can translate into better crops and greater yields, have strengthened the Melvilles' commitment to direct seeding.

CURRENT DIRECT-SEED SYSTEM

Crops and rotation

Rotation is now the foundation of the Melvilles' direct-seed operation. When the Melvilles first started direct-seeding, they grew mostly winter wheat rotated with barley, or straight barley, but, after a few years, they noticed yields were declining. Tim explains what happened. "Dwayne Beck [of the Dakota Lakes Research Farm in South Dakota] said during the first few years of direct seeding you can get away with a lot of stupid tricks. That's what we did. We didn't know we were getting away with wheat/barley/wheat/barley. We weren't having any problems. Then after a few years, not using rotation caught up with us. All those root diseases built up in the soil and, with the straw mat, it reached back and got us. Our wheat yields were down. As soon as we went to rotation, they boomed."

The Melvilles' approach is to use rotation as a tool to solve certain problems. "You look at your problem and ask: 'What can we grow that will solve that problem?'" In the situation above, rotating out of cereals was enough to break certain disease cycles. Another problem they have tackled with rotation is how to come out of bluegrass or alfalfa sod. "One of the lessons we learned the hard way is absolutely do not try to plant wheat or barley into bluegrass sod that has not been treated several weeks, or preferably months, ahead. Orchardgrass and other grasses are very tough to kill with just one shot of Roundup in the spring. We try to spray in the fall and then again in the spring. Also, we try to plant a broadleaf crop into grass sod so we can come back during the growing season and hit it with Assure II or Poast."

The Melvilles' currently have eight different crop options: spring wheat, winter wheat, spring barley, peas, canola, alfalfa, clover, and bluegrass. When deciding which crop to grow on a particular field, they consider the market for the crop, any weed or disease problems, and the type of ground they will be seeding. They will grow a lower-value crop if it will help solve a particular problem compromising the yield of a more profitable crop, such as the grass weeds on Kevin's sod ground. "I'm going to use canola the first year on that to control my grass weeds even though the canola is not going to be a big money maker." Because the Melvilles farm such variable land, they also make sure to match the crops to the type of ground. "We have some ground

near the valley floor where you we can get killing frosts the last of June or the first of August. So we have to stick more with alfalfa. No wheat. Those fields are basically in five years of alfalfa and then three years of barley."

Residue management

The Melvilles use straw choppers and spreaders, as well as after-market chaff spreaders on their combines, to evenly distribute straw and chaff over the header swath. This residue management practice was sufficient until their spring wheat yields started increasing to 90 to 100 bushels per acre and they began having trouble seeding into this heavy residue. They tried using a lighter tine-tooth harrow to incorporate some of the residue, but it balled up and left piles. "Two or three years ago we bought a Morris heavy harrow and we started harrowing things in the fall. After you grow a 100- or 110-bu wheat crop, you harrow twice in the fall. The next spring, it's like, instead of drilling into 100-bu wheat stubble, you're drilling into 50- or 60-bu wheat stubble because you destroy some residue. You're breaking it up and getting it on the soil surface where it decays over the winter." In addition, harrowing facilitates weed control by getting weed and crop seeds in contact with the soil so they will germinate.

THE MELVILLES' NO-TILL DRILLS

The Melvilles bought their Yielder drill in 1980, one year after starting to direct-seed, and have used it almost exclusively since then. In 1993, the Melvilles replaced the original seed openers with "N-P" openers that changed the seed-row pattern from 5-inch paired seed rows on 20-inch centers to a 4-inch band of seed (ribbon seeding) on 10-inch centers. They like this spacing better because it distributes the seeds more evenly. For the Melvilles, the main advantages of their Yielder are its ability to place fertilizer in relation to the seed and its durable opener design. The major drawback of the Yielder: its narrow width limits the number of acres they can seed in a timely manner.

During the winter of 1997-98, the Melvilles began looking for a wider no-till drill that could cover more acres in a day and had good fertilizer placement capability. They bought a Concord. After one spring's experience they prefer the Concord over the Yielder for seeding into heavy wheat stubble but said the Yielder does a better job seeding into killed alfalfa, bluegrass, and clover sod. The drills perform equally well seeding into moderate residues such as pea or barley residue. One drawback of the Concord: the hoe-type opener pulls up some rocks.

Yielder® 13-20

- 13-foot width.
- 4-inch wide seed rows on 10-inch centers.
- "N-P" openers have single cutting disk set at a slight angle. Smaller seed openers on either side of this disk place seed and starter fertilizer 1 to 2 inches deep. A liquid fertilizer direct-injector follows immediately behind the disk placing aqua ammonia in a 4-inch deep-band.

Concord® 3010 with a 2400 aircart

- 30-foot width.
- 4- to 5-inch wide seed rows on 10-inch centers.
- Hoe-type opener places seed and starter fertilizer together as well as deep-band fertilizer 1.5 to 2 inches below the seed.

Melvilles' Yielder no-till drill seeding peas into grazed barley stubble, with inset of N-P opener (top), and their Concord no-till drill seeding spring wheat into spring barley stubble.

To use this system of residue management, "you need to know the limitations of your drill. You have to be able to go out there in the fall after harvest and look at this field and say 'all right, we're coming in here next year with this crop. How much residue do we want to deal with?' And different soil types change that. On the soil up here on the slope, you can have heavy residue and drill right into it. When you're done drilling it looks like you conventionally plowed it. That soil just destroys residue. It's amazing." The Melvilles emphasize that the harrowing must be done in the fall, "right after harvest when it's real hot and dry. The hotter and dryer the better." If the straw isn't still stiff and well-rooted it will tend to ball up, even with the heavy harrow.

Fertility

Early on Tim recognized one of the advantages of direct seeding with the Yielder is its fertilizer placement capabilities. "The key is to get that fertilizer between and below the seed rows, and some with the seed." Their typical fertility program for spring wheat and barley includes 120 lbs of N, as aqua, and 20 lbs of sulfur in the deep band, and 75 lbs of 11-52-0 with the seed. Spring wheat actually requires more N than spring barley, but receives its extra N from the preceding pea crop. The Melvilles fertilize peas according to their contract requirements, which could be no fertilizer, or 250 lbs of 11-52-0 with the seed, depending on the pea company.

Weed management

To manage weeds in direct seeding, Tim says, "Rotation is the big secret—getting away from just cereals, and into broadleaf crops. Then we can kill grassy weeds during the growing season with some chemicals. We're really sold on rotation."

Like most direct seeders, the Melvilles rely on a nonselective herbicide to kill weeds and volunteers between annual crops. However, they only make one application in the spring because harsh winters in their area usually kill whatever germinates in the fall. For in-crop control of weeds in peas, they add Pursuit to the spring Roundup application, which goes on 1 to 2 weeks before seeding. Rains and a postseeding harrowing incorporate the Pursuit. For spring wheat and spring barley, they use an in-crop application of Harmony Extra, Assert and Avenge. If the barley is serving as a nurse crop to establish alfalfa or clover, they treat it with Buctril and Hoelon.

The Melvilles use a special program, recommended to them by Great Western Malting, for fighting intense infestations of wild oats. They direct-seed an early maturing variety of barley, and spray an in-crop wild oat herbicide for a head start on the weeds. The wild oats are headed out but the oat seed is still green or in the milk stage when the barley is almost ready to harvest. At this stage, the Melvilles swath the barley and combine it 5 to 10 days later. The wild oat, prevented from producing mature seed, will regrow, but the Melvilles return with an application of Roundup. Three straight years of this program have cleaned up wild oat-infested fields.

Harrowing pea residue in the fall with a Morris heavy harrow (above) is not something the Melvilles will do again; the light pea residue, detached from the soil surface, blew off the field during the winter. Harrowing cereal residue, however, is one of their principal residue management techniques. Barley residue is shown before (top right) and after (bottom right) heavy harrowing in the fall.

DIRECT-SEEDED SOILS: ARE THEY DIFFERENT?

The Melvilles' decision to direct-seed was originally motivated by economics. After observing changes in their direct-seeded soils, most notably increased rates of water infiltration, they now are primarily interested in the soil improvement benefits of direct seeding. It is also a primary interest of researchers from the USDA and Oregon State University. These researchers are comparing soil in long-term direct-seeded plots with soil in plots converted to direct seeding in 1997 and with conventionally tilled plots (plowed and rodweeded) (Wuest et al., 1999). All plots are in a winter wheat/fallow rotation. By following the plots over the next several years, the researchers plan to document soil quality changes during the transition to direct seeding. The first set of soil quality measurements, taken in 1997 and 1998, point to distinct differences among the soils. However, the researchers caution against drawing conclusions from just one year of data.

Soil strength refers to difficulty in penetrating a soil, which can have implications for crop root growth and water infiltration. In this experiment, soil strength was measured using a cone penetrometer, in mid-October, 1997. Conventional plots had the softest soils and first-year direct-seed the hardest (Fig. 1). Tillage in the conventional system breaks up the soil and reduces soil strength. This tillage must be repeated to maintain a softer soil, as evidenced by the greatly increased soil strength after only one year without tillage (first-year direct seed). Yet, apparently, if tillage is not performed for many years, natural soil processes loosen the soil, improve its structure, and decrease its strength. The long-term direct-seed soil more closely resembled the conventional soil than the first-year direct-seed soil.

Carbon loss as carbon dioxide (and organic matter). Differences in CO^2 evolution between the conventional and long-term direct-seed plots suggest that tillage greatly increases loss of carbon (Table 1). In the absence of tillage, less CO^2 is released from the soil, indicating slower breakdown of organic matter, and organic matter may be allowed to increase. Organic matter of the long-term direct-seed soil measured 2.07% as compared with 2.02% for the conventional soil.

Earthworms are generally beneficial to soil quality. They mix, aggregate, and aerate soil through feeding and tunneling, thereby improving soil structure and increasing soil penetrability and water infiltration rates. Long-term direct-seed plots had 17 times the number of earthworms present in the conventional plots. Tillage creates an environment inhospitable to earthworms.

Water infiltration rates. Just as the Melvilles witnessed on their land, water infiltration rates were dramatically greater in the long-term direct-seed plots than in the conventionally tilled plots. Increased organic matter content and improved soil structure can influence water infiltration, as can larger, more continuous pores created by earthworm and insect tunneling, and by plant rooting. Left undisturbed, these pores and channels are pathways for water to flow into the soil. Even just one year of leaving the soil undisturbed increased infiltration, suggesting the importance of these pathways.

From: Wuest, S., P. Rasmussen, C. Douglas, R. Rickman, S. Albrecht, D. Wilkins and R. Smiley. 1999. Documenting soil quality changes in the transition to no-till: 16 years no-till versus first year no-till and conventional tillage near Pendleton, Oregon. p. 74-76. In R. Veseth (ed.) Northwest Direct Seed Cropping Systems Conference Proceedings. Spokane, WA. Jan. 5-7, 1999.

Figure 1. Index of soil strength in fallow soil under three different tillage histories.

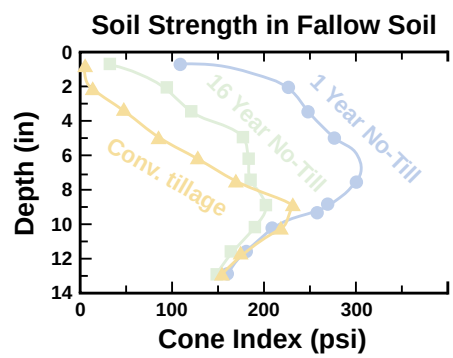

Table 1. Soil quality characteristics under 16-year direct seed, 1st year direct seed, and conventional tillage.

Treatment	Carbon dioxide evolution[1] (lb CO^2/ac/day)	Earthworms[2] (worms/ft^2)	Water Infiltration Rate[3] (in/hour)
16-yr. direct seed	19	8.50	5.10
1st-yr. direct seed	14	0.25	1.10
Conventional tillage	60	0.50	0.04
LSD[4]	***3***	***6.30***	***2.80***

[1]Average rate from measurements taken June-Oct. 1998; [2] Sampled April 30, 1998; [3]Measured March 18, 1998. [4]Least Significant Difference among values within a column.

Peas or canola can be substituted for barley one of those years because of the herbicide options available for these non-cereal crops. Tim is pleased with system. "We used to be afraid of wild oats. Now we're not. We believe wild oat can be beaten easier with direct seeding than with conventional tillage."

Disease management

The Melvilles don't worry about diseases carrying over from one crop to the next on live weeds and volunteer plants. "We don't usually have a green bridge problem because almost nothing winters-over here." They have encountered other disease problems, such as net blotch on barley and take-all. They use rotation to control these. "You learn to use your crops in situations where you want to control something," says Kevin. For instance, "if you're getting take-all root rot real bad, you might want to put in alfalfa for several years to make sure you wipe out all of the grasses. Then there is no place for that take-all to continue to live."

Seeding strategy

Seeding into heavy residue is a challenge for the Melvilles but is manageable if they choose the right crop to seed. "It's a lot easier to plant a pea crop than a barley crop into a real heavy residue situation because we put peas in deeper. If you have that much duff on top and you're trying to put a seed an inch deep, you need something to cut against. But if you're trying to push pea seeds 2 or 3 inches deep, then you're really slicing through things to begin with." Tim doesn't worry about seeding peas too deeply because the soils in the valley are warm. Tim's also learned to treat wheat and barley differently when direct-seeding. "Wheat does not do near as well unless you get real good soil contact, whereas barley is real forgiving. There are all kinds of tricks."

The Melvilles tend to seed earlier than their conventional neighbors because they do not have to prepare a seedbed. They seed spring cereals as early as they can get on the ground but wait for the soil to warm up to plant peas.

ADVANTAGES THEY SEE

Increased cost efficiency. Making fewer passes over the ground, the Melvilles' direct-seeding system requires less labor and fuel than a comparable conventional system. They also save $10 per acre per year by not having to pick rocks from their ground. They may have to pick some as they start using their new chisel-type no-till drill. Tim feels the increased efficiency of direct seeding gives them an advantage in low-price years. He warns against switching to direct seeding to save the farm in desperate times, as initial years of direct seeding can be financially challenging. For a current economic summary, see "The Bottom Line" sidebar.

Soil conservation. The Melvilles stopped erosion on their ground by keeping the residue on the soil surface. Kurt explains, "We get a lot of freak thundershowers. You can watch 2 to 3 inches of topsoil leave a field in a matter of hours. Now [with direct seeding], I think we are actually building soil rather than losing it.

Improved water infiltration and moisture availability. "You get your soils to act like a sponge and keep every drop of rain that falls on your ground, so you're going to increase yields dramatically," says Tim. "It doesn't matter how much rainfall you get, it's how much goes in the ground." Kurt notes that the increased ability of their soils to absorb and store water buffers the effects of wet and dry years on yields. "No-till makes things more consistent." It has also made it easier for them to keep to an optimal irrigation schedule.

Increased soil biological activity. "We've seen earthworms come back, tremendously." The Melvilles think greater soil-life activity increases water infiltration and speeds up residue decomposition.

Increased wildlife. Kevin says, if you enjoy wildlife on your farm, direct seeding has its advantages. "Pheasants love no-till. Hungarian partridges too. When I was a kid there was hardly a pheasant on this ranch. Now when we cut a field, especially if it's one of the last fields of the year, we're chasing pheasants everywhere. They have cover, the straw, and a food source—the kernels left on the ground. Those used to be destroyed every year when we conventionally tilled."

Content landlords. Some direct seeders talk about the difficulties of convincing landlords to allow direct seeding on their land. Kurt says they have had the opposite experience. "People come to us specifically because we no-till, and they like the way it looks."

Content farmers. The Melvilles enjoy farming using their direct-seeding system. Kurt says, "I love the challenge of no-till. There are always more variables we can try out." Tim adds, "When you succeed, it is very satisfying."

CHALLENGES THEY SEE

Residue management. "The number one challenge is getting good seed-to-soil contact in heavy residue to get a good stand," says Tim. Another aspect of this challenge is getting weeds to germinate so they will winter kill or can be sprayed in the spring. Harrowing helps with this problem.

Disease management. "It seems you have more disease [with no-till], especially diseases related to crop residue—take-all, root rot," says Kurt. "So you really have to have a rotation. You have to get out of cereals and into canola or some kind of legume at least every third year."

THE BOTTOM LINE

The Melvilles consider increased economic efficiency a primary advantage of direct seeding. They worked with Washington State University economists Oumou Camara, Doug Young, and Herb Hinman to estimate the costs and returns of their direct-seed system. The study was part of a larger project by the economists investigating the production efficiencies of established direct-seed operations in the Inland Northwest*. Table 2 shows typical production costs for each phase of their 3-year rotation, as well as average yields and costs per bushel (total costs divided by average yield). By these estimates, the Melvilles' costs per bushel (the bottom line in Table 2) are below 5-year average market prices** of $3.74/bu and $113/ton for soft white spring wheat and spring malting barley, respectively. The Melvilles' seed peas are sold on contract.

Table 2. Estimated costs per acre, average yields, and costs per bushel for the crops in the Melvilles' standard spring wheat/spring barley/spring pea rotation.

	Spring wheat		Spring malting barley		Spring seed pea	
	Variable[1]	Fixed[2]	Variable	Fixed	Variable	Fixed
Cost components			($/acre)			
Irrigation[3]	49.00	0.00	43.00	0.00	41.00	0.00
Harrowing	0.00	0.00	0.43	1.63	0.00	0.00
Herbicide	35.52	0.00	35.52	0.00	10.76	0.00
Insecticide	0.00	0.00	0.00	0.00	1.77	0.00
Spray application	0.78	0.92	0.78	0.92	0.78	0.92
Seed	16.80	0.00	16.80	0.00	30.00	0.00
Fertilizer	41.90	0.00	41.90	0.00	45.00	0.00
No-till planting[4]	4.49	7.90	4.49	7.90	4.49	7.90
Harvest[5]	6.60	18.26	6.60	18.26	6.60	18.26
Land	0.00	65.00	0.00	65.00	0.00	65.00
Interest on op. capital	5.77	0.00	6.14	0.00	5.00	0.00
Other[6]	11.47	3.92	11.34	3.92	10.94	3.92
Total	172.33	96.00	167.00	97.63	156.34	96.00
Total costs	**268.33**		**264.63**		**252.34**	
Average yield	105[7] (bu/acre)		2.37 (ton/acre)		2600 (lb/acre)	
Break-even prices to cover:						
Variable costs[8]	1.64 ($/bu)		70.46 ($/ton)		0.06 ($/lb)	
Total costs[9]	2.55 ($/bu)		111.66 ($/ton)		0.10 ($/lb)	

[1]Variable costs include materials, services, labor, and machinery fuel, lube, and repairs.
[2]Fixed costs include machinery depreciation, interest, insurance, taxes, and housing.
[3]Landlords pay the fixed costs for irrigation.
[4]No-till planting cost includes no-till drill and hauling seed. Excludes seed and fertilizer.
[5]Harvest cost includes combine and hauling.
[6]Other costs include taxes, utilities, trucks, and miscellaneous.
[7]105 bu/acre is average spring wheat yield following peas. Average yield following spring barley is 85 bu/acre.
[8]= Variable costs divided by yield.
[9]= Total costs divided by yield.

*Enterprise budgets by Camara, Young, and Hinman for high and low rainfall region no-till growers are published by WSU Cooperative Extension in the Farm Business Management Report series (EB1885 and EB1886). They include only nonirrigated operations. The Melville's irrigated budgets appear only in this case study.
**Average market prices are for marketing years 1993-94 to 1997-98 for spring wheat and 1992-93 to 1996-97 for malting barley.

Getting started. The Melvilles warn that the first few years of direct seeding can be financially difficult. Expenses may be up when purchasing a no-till drill, and revenues may be down if yields suffer during the time it takes to learn what works best on your farm (rotation, weed control, varieties, etc.) They suggest starting on a small piece of land until reaching a comfortable level with direct seeding.

ADVICE TO NEW DIRECT SEEDERS

Give direct seeding a "fair shake." The Melvilles suggest committing a small field for a number of years—"A good quality field, not something infested with weeds or something else. Give it a fair shot. Sit down with the extension people or somebody like myself. Line up a prearranged rotation. Get a broadleaf in there instead of just wheat and barley. Go at it for a minimum of 5 years, and start comparing things, like what your economic benefit was for that time." They also suggest having an experienced direct seeder custom-seed for the first few years to increase your chance of success.

"Get a residue management plan going. ...Start with the combine." What you do after that "all depends on what you're going to grow the next year."

Choose the right drill. "Get a drill that will place the seed in relationship to the fertilizer. That's very important."

Custom fit a system to your farm. "Work out your own rotation, your own piece of equipment. One guy can get away with a big heavy Yielder drill and the next guy is going to bury that thing in the spring because his ground is so soft."

Go for it. "You just have to go at it, and try. Learn. And talk to as many local guys as you can."

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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