Direct Seeding in the Inland Northwest

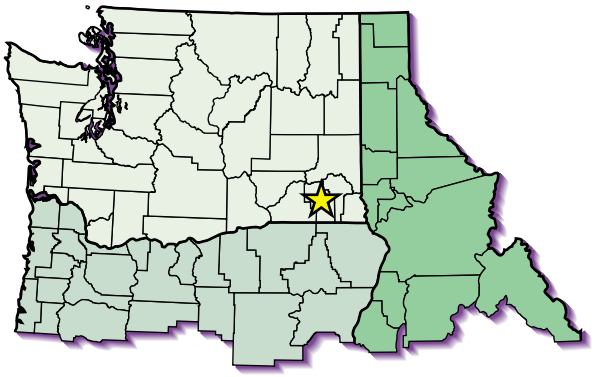
BARKER and SHOUN *case study*

Location: Columbia County, WA

Annual rainfall: 18 inches

Drill type: Yielder® (rent Cross Slot™)

Crop rotation:
Winter wheat/Spring cereal/Peas



BACKGROUND

Pat Barker and Steve Shoun are among the earliest and most innovative direct seeders in their county. "They've always been one step beyond what we thought, at any given time, were the limits of direct seeding," said WSU Cooperative Extension agent, Roland Schirman, in Columbia County. They direct-seed all of their crops, both fall and spring, on 2,800 acres in the higher rainfall area west of Dayton. Soils are Athena silt loams with slopes ranging from 0% to 50%. Although Pat and Steve rely on burning when residue loads are too heavy for their Yielder® no-till drill, they are actively seeking alternatives to burning, including using a Cross Slot™ no-till drill. Pat and Steve also support new direct seeders in their area by custom-seeding 600 acres each fall and by making their machinery shop available to modify or develop direct-seed equipment. In 1998, Pat and Steve were co-elected Columbia County Conservation Farmer of the Year.

Pat Baker (left) and Steve Shoun (right)

"Direct seeding is not just using a different drill. It is a puzzle with a lot of pieces. Unless you have all the pieces in place, you're not done with the puzzle."

~Pat Barker

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A NEW WAY OF FARMING

Pat and Steve were not new to direct seeding in 1992, the year Pat bought a Yielder drill, and they began farming together. In the 1980s, Pat had experimented with a direct-seed winter wheat/chemical fallow system near Lyons Ferry, WA, but found chemical fallowing cost-prohibitive. Steve, farming with his father near Eureka, WA, experienced root disease troubles as did many new direct seeders in winter wheat/fallow systems.

When Pat moved to the higher rainfall area of Dayton, WA, he saw a new opportunity to direct-seed, this time in an area ideally suited to annual cropping. Nonselective herbicide costs had come down, and research had revealed ways to manage some root disease problems. General farm profitability was declining. "What we wanted to do when we went into no-till was to lessen our costs. We saw costs increasing and prices staying steady. We didn't think we would survive unless we made a change." So change they did, and their operation has been in constant motion ever since.

Pat says, "I bought the drill mostly because we were starting to move from wheat/fallow into a wheat/pea rotation and direct seeding looked like a way to cut costs by seeding that pea ground. That's all we were going to use it for." But as they gained confidence, they began experimenting and adding new pieces to their direct-seed "puzzle." Almost immediately, they added the 3-year rotation. Then, they gradually developed other pieces—residue management, disease and weed management, seeding depth—that allowed them to begin direct-seeding spring cereals and, finally, peas. (See Table 1.)

Steve says the biggest hurdle in their transition to direct seeding was "developing the confidence to go out there and do what we thought we needed to do. That was a big step." He also emphasizes that their "transition" to direct seeding is far from over. "We feel we're just starting to no-till after 8 or 9 years. Finally the ground is starting to come around and things are starting to fall in place. But in many ways we are still in transition because we are trying to move toward even lower-disturbance, no-burn systems."

Table 1. Pat Barker and Steve Shoun gradually expanded their direct-seed system as they gained experience. Here is a chronology of the methods they have used to establish the crops in their 3-year rotation and the experiences that led them to make the changes.

	ROTATION		
	WINTER WHEAT →	SPRING CEREALS →	SPRING PEAS
seeding system 1992	**Direct seed**	**Conventional seed**	**Conventional seed**
Experience: Used NT drill to seed spring barley on 17 acres of disked-only ground in 1992. Best barley crop that year. Repeated next year, again with success. Began using min. till system for all spring cereals.			
seeding system 1993 and 1994	**Direct seed**	**Fall disk & harrow/ Direct seed**	**Conventional seeding (some Direct seed)**
Experience: Left one field in stubble over winter in 1994, burned in spring and seeded barley with no-till drill. It was a dry year. Barley after burning yielded 3950 lb/ac (48 lb/bu test weight). Min. till barley yielded 3200 lb/ac (42 lb/bu test weight). Concluded they had lost valuable moisture through tillage.			
seeding system 1995	**Direct seed**	**Spring burn/ Direct seed**	**Conventional seeding (some Direct seed)**
Experience: After three years of unsuccessful attempts, realized direct-seeded peas should be seeded shallower than conventional peas. Soil is warmer near the surface and hasn't lost moisture from tillage.			
seeding system 1996-1999	**Direct seed**	**Spring burn/Direct seed (No burn/Cross Slot drill)**	**Spring burn/Direct seed (No burn/Cross Slot drill)**
Experience: Three years of seeding directly into heavy residue with Cross Slot drill in the spring on limited acreage has convinced them crops can handle the residue if they have the right drill.			

CURRENT DIRECT-SEED SYSTEM

Crops and rotation

Pat and Steve believe "rotation is synonymous with direct seeding." Pat explains, "With the crop choices we have in our area, to rotate you have to put in spring crops. And to grow spring crops, you need to direct-seed them (See "Advantages: Yields"). But then, to direct-seed, you have to rotate. It goes around in a circle."

Pat and Steve's 3-year rotation (winter wheat/spring barley/peas) was inspired by the Integrated Pest Management Study, conducted from 1984 to 1991 by USDA-ARS, Washington State University and the University of Idaho. Pat and Steve felt the rotation would help them manage weeds and diseases while allowing them to intensify their cropping (less fallow). This rotation also minimizes market and weather risks. Each year, they can market three different crops, noting, "weather that affects a winter crop won't affect a spring crop, and vice versa."

Pat concedes not every crop in their rotation is always profitable, but explains, "You need to look at a rotation as a whole. What do all three crops do for you? Sometimes barley is a loser, but look at what weeds and diseases it allows you to control. Overall, the rotation can be a winner even though parts may lose some of the time."

Residue management

Pat and Steve have straw choppers, and straw and chaff spreaders on their combine to spread crop residue evenly over the fields. They seed directly into pea residue in the fall, but cereal residues from

BARKER AND SHOUN'S NO-TILL DRILLS

1615L Yielder® No-till Drill

The drill is 16 feet wide with paired seed rows 5 inches apart on 15-inch centers. It places anhydrous ammonia and dry fertilizer between and below the paired seed rows. Dry fertilizer can also be placed with the seed, but Pat and Steve put all their fertilizer in the deep band. They modified the ground-engaging tools to make them more rugged and the seed-depth adjustment device to make it easier to switch between peas and cereals. They run the drill between 7 and 9 mph and can seed 100 to 150 acres per day. Pat and Steve say the advantages of the Yielder are it can place fertilizer, it's durable, and it's inexpensive to operate. The major disadvantage is it can not seed through heavy residue, forcing them to burn (or till) residue of crops exceeding 70 bushels per acre.

Yielder 1615L no-till drill seeding winter wheat into pea residue.

Cross Slot™ No-till Drill

In an effort to eliminate tillage and burning from their operation, Pat and Steve began experimenting with a Cross Slot drill in 1996 (see "Direct Seeding into 100-Bushel Wheat Straw"). The Cross Slot has a single-disk opener with wings that run perpendicular to the disk and place fertilizer and seed on opposite sides of the main slot. It can seed through heavy residue with very little disturbance. Pat and Steve have been greatly encouraged by its performance, but find the openers don't stand up well to heavy use. Steve says, "It's a great concept drill—it has the most potential of any drill I've seen—but it needs new machining to make it more durable."

Cross slot drill, with inset of the Cross slot single-disk opener.

high yielding cereals pose problems for their Yielder no-till drill. Pat says, "The equipment we have isn't built for the kinds of residue load we need to go through, so we end up having to burn some. The burning is a short-term solution—I don't think it's where we need to be—but at this point I'd rather burn than till." Ultimately, they hope to direct-seed after high-residue crops without burning or tilling. They tried baling one year but decided they would rather leave the residue in the field to replenish the soil, especially since baling didn't seem economically feasible. The best tool so far for dealing with high residue has been the Cross Slot no-till drill, which causes very little soil disturbance. (See "Direct Seeding into 100-Bushel Wheat Straw".)

Pat and Steve also have tried alternative crops and varieties to handle residue challenges. They planted corn for three seasons using a no-till corn planter equipped with row cleaners. In addition to providing residue management benefits, corn is a good rotation crop for breaking disease cycles, and, because it is a late-season crop, for providing opportunities to manage late-germinating weeds and spread the workload. While Pat and Steve were able to plant through high amounts of residue with the corn planter, they were disappointed with their corn yields. They have stopped growing corn for now.

Semi-leafless peas, having fewer leaves and more tendrils than standard varieties, hold immediate promise for their direct-seed system. Ordinary peas lie down as they mature, presenting problems in direct-seeding. The pea bar, used to pick up the peas during harvest, can catch and drag residue left by a previous crop. Semi-leafless peas remain standing at maturity due to more interlocking tendrils. Steve and Pat planted two fields of semi-leafless peas in 1998 and harvested them using a regular grain header, leaving 8-10 inches of standing pea stubble. Their yields were slightly lower than yields from their standard varieties (2300 vs. 2500 lbs), largely due to shattering loss, preventable by harvesting earlier. Steve says another advantage of the easier harvesting semi-leafless peas is "we didn't have to take the whole plant at harvest, so we didn't have to spread the whole plant." Pat and Steve also have more residue left after harvest—standing pea stubble and previous crop residue—to protect the ground and trap winter snow.

Fertility

One benefit of direct seeding, according to Pat and Steve, is the ability of many no-till drills to place fertilizer below the seed, readily accessible to crops' developing roots. Pat and Steve use anhydrous ammonia and dry fertilizer, the cheapest and lightest materials available—all of it in the deep band. Winter wheat receives 120-140 lbs of nitrogen (N), 20 lbs of phosphorus (P_2O_5), 15 lbs of sulfur (S), and chloride (for physiological leafspot). Spring barley receives 100 lbs of N, 20 lbs of P_2O_5, and 15 lbs of S. Peas receive 50 lbs of 16-20-0-14. These direct seeders use more fertilizer during the transition to direct seeding than they would in a conventional system, since they are not releasing nutrients through tillage-induced oxidation of organic matter.

Weed and disease management

Steve and Pat combine rotation, fall and spring applications of a nonselective herbicide, low soil disturbance, and conventional postemergence herbicides to manage weeds in their direct-seed system. Rotation allows them to vary the in-crop herbicides—controlling broadleaf weeds during the cereal crops and grass weeds during the broadleaf crop. Spring crops allow them to let weeds germinate and to apply a nonselective herbicide (glyphosate) before planting. This effective strategy eliminates winter-annual grasses and makes seeding winter wheat easier, says Pat. "Now we don't worry about waiting to spray for downy brome in the fall. If the drill's ready to go, we go seed our winter wheat. We don't worry about downy brome and the diseases in it because we've cleansed the ground."

Pat and Steve have seen the decline of two perennial weeds. "Field bindweed and Canada thistle don't like direct seeding. There's less spreading without tillage. We're also spraying them with Roundup (glyphosate). That's pretty hard on thistles and bindweed. Finally, intensive cropping in our rotation creates more competition for those weeds."

One weed they continue to struggle with is wild oat. "You spray early in the spring for spring crops, and then another flush of wild oat always comes up when you seed. It doesn't hurt much in peas because you have good chemicals that will take wild oat out, but it is a problem in spring barley. This is why we'd really love to have corn or some other late-planted crop." However, they see fewer problems with wild oat than they would under a conventional system. Lower disturbance prevents buried wild oat seeds from germinating, or at least encourages more even germination. "If they all start from 1/2 instead of 3 inches deep, hopefully you'll get an even flush of them someday and you can kill them."

Pat and Steve's primary disease management tactics are rotation and green bridge control. Controlling the green bridge refers to creating a weed- and

volunteer-free period between crops to eliminate live hosts for Rhizoctonia and other root pathogens. This is achieved with one or two applications of a burn-down herbicide between crops. They spray glyphosate once, 2 to 3 weeks before planting winter wheat. They generally spray land going to spring crops twice. They make the first application in the fall or early spring, and the second, as needed, in the spring closer to seeding. Steve and Pat stress the importance of applying a nonselective herbicide treatment in the fall if any green growth appears. Pat says, "It's not quite as important if you're going to burn because that helps control disease, but if you're seeding into stubble, then it is paramount." Steve quantifies Pat's statement,"A $7 per acre Roundup application in the fall can make a difference of 25 bushels in the spring."

Pat and Steve's direct-seed system puts greater demands on the spraying operation; accuracy and field capacity are extremely important. They bought a new sprayer in 1998, a 1500-gallon Flexi-coil with an 80-foot boom and a rate controller for accuracy. It is equipped with foam markers. Disk markers

DIRECT SEEDING INTO 100-BUSHEL WHEAT STRAW

Pat and Steve recognized early on that one of the greatest challenges of direct seed is getting a good stand in heavy residue without prior tillage or burning. In a proactive approach to addressing this issue, they designated a 120-acre experimental area and haven't burned or tilled it for the last 7 years. In the beginning it was in continuous spring cereals, but that created a wild oat problem. They switched to the 3-year rotation they have on the rest of their farm. That solved the weed problem, but soon they ran into difficulty seeding spring cereals back into heavy winter wheat residues with the Yielder. In the 1980s they both had seen a drill, the Cross Slot no-till drill, that could seed directly into heavy residue with very little disturbance. They asked Gus Williamson to use his Cross Slot drill to custom-seed their piece (see "Barker and Shoun's No-Till Drills"). Steve said, "In 1997 we seeded spring barley into 100-bu wheat straw. We didn't know if we could do that agronomically, let alone physically. But we got a good stand and it yielded over 2 tons." They have continued to use the Cross Slot drill on this experimental field (see photos below) as well as on other parts of their farm (see photos on page 7).

Pat says their experience on this experimental area, and most recently with the Cross Slot, has taught them residue isn't the problem to getting good stands; it is lack of appropriate technology. "It's only 120 acres so we've been able to bull our way through and put up with equipment that isn't very reliable just to see how it works. And it works. We've done it long enough now I'm not afraid of the residue anymore. It's our friend. But it will be our enemy until we get a piece of machinery that can accurately seed through that residue."

Semi-leafless peas seeded with a Cross Slot drill directly into residue from a 2-ton per acre barley crop in 1998 (left). Peas were harvested with a regular grain header, leaving 8 to 10 inches of standing stubble (inset). Winter wheat was direct-seeded into the pea stubble using the Cross Slot drill (right). Pea and winter wheat yields were 2350 lbs/acre and 81 bu/acre, respectively.

create dust that inactivates certain herbicides and leave hard-to-see marks in high residue.

Seeding strategy

One of the most important lessons Pat and Steve learned during their early years of direct seeding came from figuring out how to direct-seed peas. Long-time pea growers in the area said "peas don't like no-till"; they like being planted deeply into soft, tilled, and warm soil. After several years, Pat and Steve decided to try direct-seeded peas anyway. Neither of them had much experience with peas, so they direct-seeded them as the local growers seeded conventional peas—deep. The first and second years their pea crops lived up to others' predictions—they emerged late and yielded only 800-1,000 lbs. Pat and Steve wondered, "Were their direct-seed soils too hard? Were they too cold?" The next spring they took soil temperatures in adjacent conventionally tilled and standing-stubble fields. The temperature at 3 inches, where they were seeding peas, was 2 to 3 degrees colder in the stubble ground. But the temperature at 1 inch was the same. That year they seeded shallow and had a great crop of peas. They realized peas need to be seeded deeply only in a conventional system, because the top layer of soil has dried out from tillage. In direct seeding, moisture is closer to the surface where the soil is warmer. They now seed peas 1 to 1.5 inches deep and cereals 0.5 to 1 inch deep. Pat draws a larger lesson from this experience. "We had a problem no-tilling peas because we were trying to apply a tillage-based technique to no-till farming. That doesn't work. You have to make a whole-system change."

ADVANTAGES THEY SEE

Pat and Steve started direct-seeding to reduce cost and erosion but found many other benefits. The advantages listed come from their whole system—direct seeding and rotation combined.

Soils improve. "Before we started direct-seeding we didn't think about the soil very much, just about the soil surface. As you get into a direct-seed system, you realize what is underneath the surface is just as important." Pat and Steve are observing more changes as their soils are continually direct-seeded. Improved water infiltration has allowed them to get on their fields sooner in the spring. Steve tells the classic direct-seed story: while spraying in early spring, going to turn around in a neighbor's conventional field and just barely making it back onto their direct-seed field without getting stuck. The soil also has mellowed noticeably. Where they used 200 to 300 lbs of down-pressure to seed winter wheat, they now run the drill on float and even have started worrying about seeding too deeply. Soil tests show soil organic matter levels have risen from 1.2%-1.5% to 2.0%-2.3%. (Pat and Steve question if the organic matter has actually increased this much, doubting the accuracy of the tests, but they are convinced the trend toward increasing organic matter is real.) They notice more earthworms. "When I first heard people talk about earthworms I thought they were crazy. What's the big deal about little earthworms? They are an impor-tant part of what we do as direct seeders. They are little, natural tillers, doing all the work for us."

Reduced disease. Pat and Steve's rotation and their elimination of the green-bridge have effectively managed diseases, providing unexpected benefits. The stand height of their cereals is more even, allowing them to cut higher at harvest—saving time and giving cleaner grain samples subject to less dockage. Pat says, "If we're rotating properly, we don't have disease pressure so we can use the higher-yielding varieties. For instance, instead of using Madsen, we use Stephens because we don't have Cephalosporium stripe and we don't have foot rot pressure. We don't have to plant a lower yielding variety to hedge against diseases."

Increased yields. "We thought we would try no-till and if we got equal yields, great. But we got better yields," said Steve. This has been the case for spring crops especially. Better water infiltration and conservation led to greater and more consistent spring crop yields. "Before, our yields fluctuated more with the weather. Under direct seeding our yields are steadier because it's a more consistent environment—every crop is a good crop." Pat adds, "I think one of the reasons we can spring crop is because we are direct-seeding. On the really good years when a lot of rain falls, I don't think no-till has any great advantage. But on the dry years it does because we're not losing moisture by stirring the soil. Direct seeding allows us to be more consistent with our spring crops; we don't feel like we're gambling so much."

Controlling erosion without strips or divided fields. Pat says, "Since we went to no-till we've been able to transform our fields into large, solid fields and still control erosion better than if we were in strips. I like what strips do for erosion, but they are inefficient and cause weed problems."

Reduced costs. No costly strips needed for erosion control, no ditches to increase equipment repair costs, less labor and equipment needed, less fuel used, easier and faster harvesting—all these add up to reduced costs. "If I'm producing as good a crop, and I'm producing it cheaper, and my system is better for the soil, then I'm winning," says Pat.

More enjoyable. "I wouldn't go back to my old way of farming. I'd rather quit." When Pat was farming conventionally he felt everything was negative. They were barely making a profit, their soil organic matter was decreasing, soil was eroding, and they were constantly fighting nature. He talks of the frustration of breaking crust on a newly seeded field that had been rained on, only to have it rain and crust over again. Now, as a direct seeder, he feels much more positive. The soil organic matter has increased, as have yields, costs are lower, profitability is higher, they've never had to break crust, and "there's less mindless work and more attention work. Direct seeding is more challenging, and, for me, more rewarding."

CHALLENGES THEY SEE

Finding a drill that can seed into heavy residue. Handling heavy residue is a challenge, but to them it is a mechanical challenge, not an agronomic one. Finding the drill that can do a good job seeding into heavy residue and cover the acres is the most important piece missing from Pat and Steve's direct-seed puzzle.

Fall Roundup application. Pat says switching to direct seeding means switching to a whole new set of worries. They used to watch the weather and worry about planting fall wheat. Now they always plant fall wheat. They watch the weather and worry about spraying Roundup in the fall for the next spring crop. "Do you do it early and risk another greenup, or do it late and risk never getting the right weather to spray?" The timing and accuracy of the burn-down application is critical.

Compaction. Steve says compaction can be an issue due to the weight of no-till drills and trying to get on fields early in the spring. "Compaction is more evident early on before having a soil structure that will handle it better. Without tillage it takes longer for compaction to disappear so you really have to be careful. We have flotation tires on our drill and we try not to push it in the spring."

Change in mindset. One of the greatest challenges of direct seeding may be psychological. Steve says, "I used to look at conventional fields and think they looked 'pretty.' It took me awhile to get used to our fields not looking 'pretty' like a conventional field."

Landlords. Pat and Steve's landlords have been very supportive of their switch to direct seeding, but they recognize that's not always the case. "I think one of the biggest problems people face in our area is a lot of the farms now are not owned by the farmer."

ADVICE TO NEW DIRECT SEEDERS

Be committed and patient. If you really want to see what direct seeding can do, you have to commit to making it work. Pat suggests farmers who want to try direct seeding should "take a piece of land, whatever you think you can afford, say 50 or 100

It is difficult to see any seed rows where the Cross Slot drill, a low-disturbance no-till drill, has seeded barley directly into the residue from a 118-bu/acre winter wheat crop (right photo). The 1999 barley crop, shown 1 1/2 months after seeding (far right), yielded 2.25 tons per acre.

acres, get it into a rotation in a direct-seed system, and give it a try. But do things right. Make sure you have your green bridge taken care of. Manage your residue. Seed the correct depth. Do all of those things and don't judge it after just one pass. Do it for 5 years on the same piece of ground, then you will start seeing some of the benefits. Another thing is, we've been farming conventionally for 100 years and we still have seminars on how to do it, so don't expect to figure out how to direct-seed in one year. It's not that complicated, but it takes experience."

Copy successful direct seeders. "Don't try to reinvent the wheel. If someone in your area is successfully direct seeding, do what he does for awhile. Tap into what other direct seeders have already learned. There's no use repeating the mistakes they made. Then, when you get your feet firmly on the ground, you can branch off and do what you want. I think that's the safest and easiest way."

Hire skilled labor. "If you are going to no-till and you can't do it all yourself, then the person you let behind the wheel has to be sharper than average. When you're out there spraying, it has to be done right. When you're out there seeding, you get only one chance. Direct seeding is not a butcher approach; it's a surgeon approach. It requires less labor, but more skilled labor."

"**Go do it**...Direct seeding is only complicated because we choose to make it complicated. There are a few basic things we have to address with the technology we have right now." Pat says these are rotation, green bridge management, straw management, and seeding depth. "If you address those, the rest falls in place."

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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The "Direct Seeding in the Inland Northwest" series project was made possible by a grant from the USDA Western Region Sustainable Agriculture Research and Education Program with additional funds from STEEP III (Solutions to Economic and Environmental Problems).

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