Direct Seeding in the Inland Northwest

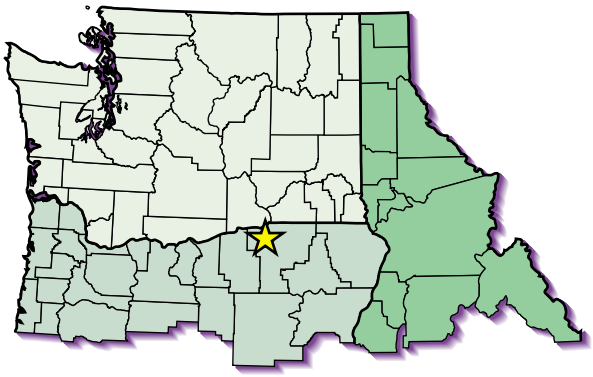
MADER/RUST FARM *case study*

Location: Morrow and Umatilla counties, OR

Annual rainfall: 8-10 inches

Drill types: Yielder®

Crop rotations: Winter wheat/ Chemical fallow; some Spring wheat



BACKGROUND

The Frank Mader and Tim Rust families have used a chemical fallow/direct-seed system to control wind erosion for more than a decade. Recognized for their early conservation efforts, they received the 1987 Morrow County Conservation Farmer of the Year and 1988 Oregon Conservation Farmer of the Year awards. They farm 12,900 acres on their "Ranch 66" located between Hermiston and Pendleton, Oregon. Frank's son Kirk is also involved in the farming operation. Seventeen hundred acres are under center pivot irrigation, cropped every other year because the ranch is in a restricted groundwater use area. Although relatively flat, 90% of the land is considered highly erodible due to wind. The soil is a light silt loam, high in very fine sand, and about 3 feet deep.

Chemical fallow works for the Maders and Rusts because they experience little to no yield penalty for seeding winter wheat in October and even into early November in their area of Oregon. This allows them to wait for rain before seeding since fall seed-zone moisture is usually marginal or lacking after chemical fallow. Planting later also allows them to spray downy brome before establishing their fall crop. A consistently warmer

Tim Rust (left) and Frank Mader (right)

"We've got to do something to keep the plow out of the field if we want to continue farming ground that blows easily."

~Tim Rust

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climate than Washington's cooler wheat/fallow regions supports a later seeding date for the Maders and Rusts. Another factor contributing to their success using chemical fallow may be the light-textured soils, which do not crack and lose as much subsurface moisture as do soils having higher clay content.

A NEW WAY OF FARMING

The Maders and Rusts had several reasons to buy a no-till drill in 1986. Tim Rust recalls, "Frank decided we ought to chemical fallow one of our fields because of the amount of soil blowing. We needed a drill for seeding into chemical fallow. That's where it all started. Then we needed something for spring seeding in years too dry to seed in the fall. The Yielder® had shown it could produce a good spring crop. We also thought we could use the Yielder for fertilizer placement on our irrigation circles. We felt those three things justified having a no-till drill."

It didn't take long for them to see switching to a chemical fallow/direct-seed system on their erosion-prone ground was a good decision. Tim said, "After that first year, we knew it was really the thing to do for erosion. Since then, we've never tilled that field." Frank adds, "It has always been one of our highest yielding, even though it's a poorer field. You have to figure it's the direct seeding." They soon discovered another justification for their no-till drill. "That same field had a pretty bad morning glory (field bindweed) problem that basically disappeared. We could control by not tilling it—not spreading the roots around—especially if we sprayed it a couple of times. So not only were we saving the topsoil, but also we were helping out our morning glory problem."

The Maders and Rusts now typically use their chemical fallow/direct-seeded winter wheat system on about one-fourth to one-third of their dryland acres, selecting fields prone to wind erosion or those having field bindweed problems. They direct-seed spring cereals on another one-tenth to one-third of their land. On the remainder of their dryland acres, they use a trashy fallow/winter wheat system because fall seeding is faster using wider conventional drills, and in some cases, trashy fallow is cheaper than chemical fallow. They continue to use their Yielder to seed all of their irrigated fall wheat. The Maders and Rusts remain efficient using more than one seeding system because they farm so many acres.

THE MADERS and RUSTS' NO-TILL DRILL

The Maders and Rusts have put about 50,000 acres on their Yielder® drill since 1986. "It has been a good drill for us. We've never had a wreck with it," says Tim. "I like the paired rows and especially the fertilizer placement." The paired seed rows are 5 inches apart with 10 inches between pairs. Anhydrous fertilizer is placed in a deep band on 15-inch centers between and 4 to 5 inches below the seed rows. The 20-foot drill originally had "scuffers" that moved residue out of the seed row, but Tim says they removed them. "It's a good concept, getting the residue out of the way, but they are not ideal. They add a lot of weight to a drill that doesn't need any more weight, and you have to use a wider row spacing."

The Maders and Rusts think Yielder seeding seems slow with only a 20-foot width, and the openers tuck some straw in heavier residue. In 1997, they rented a Concord® drill to try on heavier residue (chemical fallow that followed a 70-bu winter wheat crop), and to help finish other fall seeding. "We thought we'd be a lot better off with the Concord because it is a 48-foot hoe drill. It didn't tuck straw and got through the residue without plugging where we had harrowed it. But when all was said and done, the Yielder could seed almost as many acres in a day as the Concord because we were able to go a little bit faster with the Yielder. On good firm ground we pulled the Yielder at 7.5 mph versus about 5 mph for the Concord."

Yielder drill direct-seeding winter wheat into chemical fallow

CURRENT DIRECT-SEED SYSTEM

Crops and rotation

The Maders and Rusts raise primarily winter wheat, alternated with fallow, on their dryland acres but substitute spring wheat in two situations: 1) if not enough fall moisture is available to establish winter wheat (see "Seeding strategy"), or 2) if they want to address a grassy weed problem using fall and spring applications of a nonselective herbicide (see "Weed management"). They try to limit themselves to about 1,000 total spring acres. Any more than that and "it's pretty hard to get it all sprayed and seeded, and do a good job."

Residue management

Spreading straw and chaff evenly over the field at harvest is essential in the Maders and Rusts' chemical fallow system. "The combines we use have to have chaff spreaders." They like to make a straw mulch for their chemical fallow. "The true direct seeders say to leave the stubble standing, but for us, a heavy harrow on a real hot day after harvest works pretty well. It breaks up the straw so it's not quite so long and puts a mulch over the ground." The Maders and Rusts think this mulch improves moisture conservation. They observe more moisture retention after chemical than after conventional fallow. "If you brush that mulch away, that's where you find the moisture is the best." The harrowing also knocks downy brome seed and other weed seeds to the ground where they can germinate and be controlled.

Tim says it took time to learn how to use the heavy harrow effectively (a spring-loaded, tine harrow with 27-inch-long x $^{9}/_{16}$-inch-diameter tines). "We hadn't had it very long, we were doing stubble and it was leaving piles anywhere there was much trash. We were going 6 or 7 mph, and that was a rough ride. I called the implement representative, who told me we needed to be going 12 mph—so the rodeo's on! The harrow is 70 feet wide and if you're going 12 mph you can cover some country."

Fertility

"Fertilizer placement is one of the biggest assets of direct seeding," says Frank. On their ranch, winter wheat on chemical fallow is larger and more vigorous going into the winter than wheat on conventional fallow. Mader and Rust attribute this to placing fertilizer close to the developing seedling roots. Easy access to fertilizer is especially important when seeding later in the fall. In 1996, they seeded two fields late in October. Frank recalls, "I seeded the conventional ground with an HZ drill and, at the same time, Tim used the Yielder to seed the adjoining field into chemical fallow with the same variety of wheat. What I seeded made about 30 bu., and what he seeded made 60 bu. That's as dramatic a yield difference between the two types as I've ever seen." Tim explains, "The conventional wheat just sat there after emerging. It didn't have enough time to get into any kind of summer preplant fertilizer and it never did stool. Whereas, the direct-seeded wheat found concentrated fertilizer right away and was healthy going into the winter."

Frank and Tim base fertilizer rates on soil tests and yield goals, generally applying 50 lbs of nitrogen, as anhydrous ammonia, in the deep band and 70 to 80 lbs of dry starter fertilizer (16-20-0-14) with the seed. They place the deep-banded fertilizer 5 to 6 inches deep between and 4 to 5 inches below

Direct-seeding winter wheat in chemical fallow in October using the Yielder drill (top) and wheat stand in April (above), showing the pairs of rows 5 inches apart and 10 inches between pairs.

The Maders and Rusts use a heavy harrow (left) when it is hot and dry after harvest to break up the straw and to create a straw mulch over the ground for improved water conservation. They also put a hood on their sprayer (right) for more timely spraying in windy conditions.

the paired seed rows to keep nitrogen available even if the top few inches of soil dry out.

Weed management

An unexpected benefit of chemical fallow for the Maders and Rusts is being able to clean fields infested with field bindweed. Field bindweed is difficult to control using cultivated fallow because tillage spreads the weed around the field. Chemical fallow leaves field bindweed undisturbed but usually sprayed twice using a nonselective herbicide. The Maders and Rusts now consider chemical fallow as valuable for managing field bindweed as for preventing erosion.

Russian thistle has become a greater problem under chemical fallow. The lack of residual herbicides for chemical fallow and the tendency of Russian thistle to germinate over an extended period, make timing of herbicide applications extremely difficult. Tim says, "I don't know any strategies against thistles other than try not to let them go to seed, whether using herbicides or by cutting them off after harvest." After wheat harvest, they spray thistles with a nonselective or broadleaf herbicide (Surefire, Landmaster or 2,4-D), or undercut them using a chisel plow with sweeps (18-inch sweeps on 12-inch spacing) or a Noble blade. "Undercutting is less expensive than spraying, and it works great, cuts them right off, but we hate to use it because there is that much more dust to mess up our Roundup job in the spring. It's better to keep the ground firm."

Downy brome has neither increased nor decreased under chemical fallow—it just continues to be a challenge. Until recently, no selective herbicides could take downy brome out of a wheat crop. The primary strategy is to seed later on problem fields to allow for an application of a nonselective herbicide. Ideally, they wait for downy brome to germinate in the fall, spray it, and then seed. However, Tim says, "Around here we can't get downy brome to germinate until late. In that case, we just go for it. If it does show up, we'll try to spray it by air (using a nonselective herbicide) before the crop emerges." If a field is seriously infested with the weed, they hold it over the winter and plant spring wheat. That gives them two springs in a row to kill out the weed using nonselective herbicides or tillage. They are optimistic about new herbicides that may allow them to stay in winter wheat and still control downy brome.

Dust is the Maders and Rusts' most serious impediment to effective weed control when using glyphosate (their primary nonselective herbicide), because dust deactivates the herbicide. They have trouble achieving "a good kill" later in the fallow season when conditions are dustier, especially in the wheel tracks. To address this problem, they have mounted a short boom with nozzles aimed forward in front of the tractor wheels. They placed higher-volume nozzles directly behind the wheels on the rear boom. While this has helped, they still rely mostly on aerial spraying for their second chemical fallow application when it is particularly dry and dusty. They also added a hood to their sprayer for more timing flexibility in windier conditions.

Disease management

The Maders and Rusts grew continuous spring wheat for 5 or 6 years but saw yields steadily decline due to a complex of diseases, and Hessian

fly, identified by Dr. Richard Smiley of the Columbia Basin Agricultural Research Center, Oregon State University. The disease complex included take all, Rhizoctonia root rot, Fusarium foot rot, and barley yellow dwarf. Dr. Smiley has been conducting field trials on their ranch since 1996 to determine if different management strategies (variety choice, seed treatments, and starter fertilizer below the seed) could minimize root-disease damage, improve yields, and improve the profitability of continuous spring cropping in this area. While variety choice and starter fertilizer improved spring wheat yields somewhat, continuous spring wheat still did not appear economically competitive with winter wheat/fallow. The Maders and Rusts do not plan to try continuous spring wheat again until viable disease management strategies are developed. In their winter wheat/fallow system, they raise mostly Stephens wheat, which is resistant to stripe rust, but highly susceptible to Cephalosporium stripe.

Seeding strategy

The Maders and Rusts' chemical fallow/direct-seeding system has given them more flexibility in their fall seeding. "Direct seeding gives you an opportunity to seed later. The fertilizer placement lets you go later and still get a good stand and good yield." There is also the option of waiting until spring if moisture comes too late in the fall. "That is one of the advantages with direct seeding—you can wait and seed in the spring."

On the other hand, they depend more on fall rains in their chemical fallow/direct-seeding system. They can not "go deep after the moisture" with their Yielder drill, as they can with conventional, deep-furrow drills. Seeding is shallower (1 to 3 inches), especially if they are seeding into heavier residue. Tim says, "That's okay if you're in a field that doesn't have downy brome pressure. The crop will germinate when you get a rain. But if you're fighting downy brome, the crop and the downy brome will germinate at the same time." They also have found seeding into dry ground can create an erodible situation. "We tried seeding when it was too dry once and paid for it. The tire tracks left from the Yielder drill blew out because the wheat didn't come in those tracks. We ended up with a blowing problem in a no-till situation. We feel we need to seed into moisture, good moisture." They will seed in early September if they have the moisture. In most years they start about October 10th. What is not seeded by the first week of November, they usually hold over until the spring.

Chemical fallow

The Maders and Rusts generally spray herbicides two times during spring-summer chemical fallow on their dryland acres, in addition to spraying once postharvest the previous fall for Russian thistle. "We like two; three is costly." They use Roundup (glyphosate) for their first spring herbicide application and start spraying toward the end of March. "We need to be finished spraying by the first part of April because that's when the cheatgrass heads out." For their second herbicide application, which occurs in June, they use Landmaster (glyphosate and 2,4-D) specifically to control Russian thistle and field bindweed. "We want to make sure the field bindweed is up and blooming. Most of the time we'll have the herbicide flown on because we seldom get a decent rain to settle the dust. If we go in there and do it with a ground rig, we just have a hard time with the wheel tracks." The next operation is seeding winter wheat, "unless we have a good rain and downy brome germinates. Then we'd spray again and seed right after it died down. But I can't remember the last time we did that."

ADVANTAGES THEY SEE

Erosion control. The Maders and Rusts' chemical fallow system has allowed them to turn a severely eroded dryland field into one of their most productive and to protect it from further wind erosion.

Field bindweed control. Chemical fallow has become their primary tool for managing field

A field of the Maders and Rusts' chemical fallow to the left of the road, and their traditional tillage fallow on the right.

"FARMING WITH THE WIND"

Wind erosion is a major concern throughout the Inland Northwest. It eats away at the production potential of agricultural land through loss of soil and degrades air quality. A 1998 Washington State University publication (MISC0208), *Farming with the Wind: Best Management Practices for Controlling Wind Erosion and Air Quality on Columbia Plateau Croplands*, describes the factors that control wind erosion, the research to date on predicting soil loss, and best management practices to prevent that loss.

From a grower's standpoint, the most practical strategies for protecting the soil against wind erosion are managing surface residue cover and soil roughness (cloddiness). Both create drag for the wind, slowing it down at the soil surface. Figure 1 shows curves estimating the effect of flat residue cover on a soil-loss ratio for three different levels of soil roughness (low, medium, and high). The soil-loss ratio compares soil lost at a percentage of surface cover and random roughness, and soil lost from bare, unprotected soil (near zero cover and roughness). For instance, a soil with medium soil roughness and 10% cover would have a soil-loss ratio of 0.4, meaning it would lose about 40%, or less than half, of the soil lost from an unprotected soil. As roughness and percentage of cover increase, the soil-loss ratio decreases. Wind erosion essentially stops when flat residue cover is greater than 40%, regardless of soil cloddiness.

The Maders and Rusts found the fields with low organic matter and fine sandy soil the most susceptible to wind erosion. These soils, by nature, do not form or maintain aggregates easily and almost always have low surface roughness. Fine sand-sized particles often contribute as catalysts of wind erosion. For such soils, growers like the Maders and Rusts must rely solely on surface cover to prevent wind erosion. Within a wheat/fallow rotation, chemical fallow retains the greatest surface cover to protect the ground through the fallow period and during the fall and winter after winter wheat seeding.

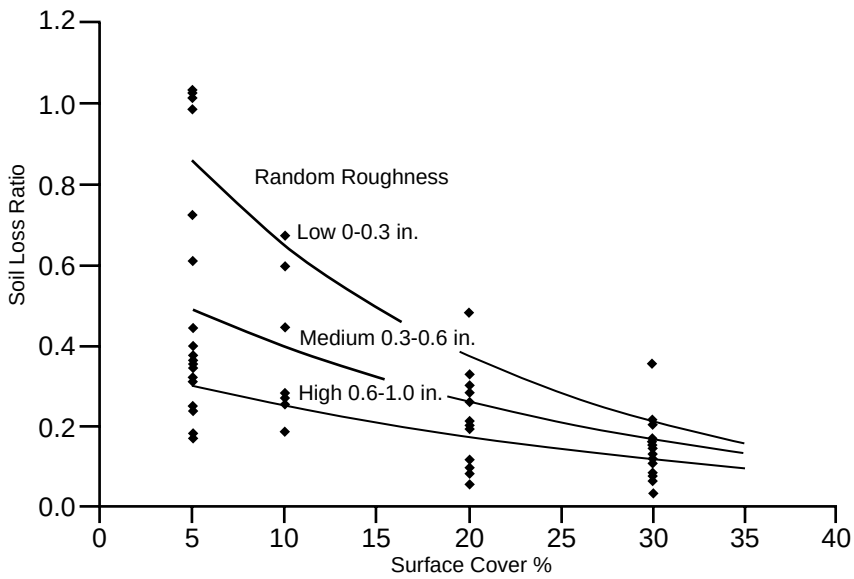
Two factors the graph does not account for are standing stubble and soil crusting. Stubble left standing creates more drag for wind than flat residue. The graph assumes the stubble is flat on the ground, which is partially the case in the Maders and Rusts' chemical fallow fields. They harrow postharvest to knock down much of the straw and to create a moisture-conserving mulch over the soil surface. The graph also ignores crusted soils resisting wind erosion more than loose ones. Crusts may form when moderate to heavy rainfall seals the soil surface. In a chemical fallow situation, the majority of the soil surface is left undisturbed. A crust remains throughout the fallow period, except where broken by wheel traffic while spraying. Decreasing field operations and crust disturbance can reduce susceptibility to wind erosion for any system.

Farming with the Wind outlines a step-by-step process for estimating the pounds of surface residue and percentage of surface residue cover remaining after seeding winter wheat, given a previous crop's yield and subsequent field operations for fallowing and seeding. Using this process, a typical 40-bu winter wheat crop on the Maders and Rusts' farm would produce about 3600 lbs of surface residue. Of this amount, an estimated 1440 lbs would remain after one harrowing, natural overwinter degradation, chemical fallowing, and seeding of a subsequent winter wheat crop.* This translates into an estimated 50% residue cover the Maders and Rusts can rely on to protect their soil after planting winter wheat. Using the same method for estimating, traditional tilled summer fallow** would result in about 25% cover, while a minimum tillage fallow*** would leave about 35% cover.

While chemical fallow is clearly an effective way to maintain surface residue and to protect silt loam and fine sandy loam soils from wind erosion in a wheat/fallow rotation, the authors of *Farming with the Wind* caution chemical fallow can present challenges. First, chemical fallow can be more expensive than tilled fallow. Increased herbicide costs depend on the number of applications required, summer precipitation events, types and populations of weeds present, and other factors. Second, the depth to adequate soil moisture for wheat germination tends to be deeper in the soil at typical fall seeding times, requiring growers to wait for fall rain before seeding. This is possible in the Maders and Rusts' area where less yield penalty occurs for seeding in November. (See "Advantages" and "Challenges.") Third, hard soil conditions in the start of direct seed systems can require a heavy duty drill to seed and deep-band fertilizer. After several years of direct seeding, soils generally become mellower and have lower power and equipment weight requirements. Bearing these challenges in mind, the authors conclude that "with judicious chemical use and proper application methods the practice should be encouraged in wheat-fallow systems where wind erosion potential is particularly high, e.g., fine sandy textured, poorly aggregated soils that do not readily form and retain clods, and where only small quantities of surface residues are available."

"FARMING WITH THE WIND" continued

Figure 1. Effect of flat cereal residue cover on potential wind erosion. The soil-loss ratio for a given percentage of cover at three different levels of random roughness is the ratio between the soil lost at that percentage and the soil lost with near zero residue cover. Developed from research conducted by USDA and WSU scientists using a portable wind tunnel at two dryland cropping sites in Washington, one near Lind and one near Prosser. (From: Papendick, 1998, p.26.)



*Based on the following operations: postharvest spraying for Russian thistle, postharvest harrow, spring and summer herbicide sprays (2x), and heavy double disk no-till drill.
**Traditional tilled fallow assumes the following operations: fall V-blade sweep, 2x spring chisel plow (10" sweeps, 12" spacing), rodweeder, shank fertilizer applicator, rodweeder, rodweeder, and deep furrow drill.
***Minimum tillage fallow assumes: postharvest spraying for Russian thistle, spring herbicide spray, chisel plow (10" sweeps, 12" spacing), cultiweeder, rodweeder with fertilizer applicator, rodweeder, and deep furrow drill.

Sources:

McCool, D.K. 1999. Personal communication, December 1999.
Papendick, R.I. (ed.) 1998. *Farming with the wind: Best management practices for controlling wind erosion and air quality on Columbia Plateau croplands.* MISC0208. College of Agriculture and Home Economics, Washington State University, Pullman.

bindweed-infested fields. In 1997, they chemically fallowed 2,100 acres for this reason alone.

Fertilizer placement. Tim says, "One of the biggest assets of direct seeding is placing the fertilizer where the seedling's primary roots can get to it, whether with a Yielder or another drill."

Later fall seeding. The Maders and Rusts feel they can seed later and still have as vigorous an over-wintering crop and as good a yield as earlier conventionally seeded wheat due to appropriate fertilizer placement.

Greater moisture. The Maders and Rusts have repeatedly observed more spring soil moisture in fields of winter wheat following chemical rather than conventional fallow. "In the spring of 1999 we had a chemical and a conventional fallow field within 1/4 of a mile of each other, and it was unbelievable the difference in moisture left in the profile," says Tim.

Improved yields. "Most years, yield increases about 7 to 10 bushels over chemical fallow versus regular fallow," notes Frank. The Maders and Rusts attribute this yield boost to improved fertilizer placement and moisture conservation under chemical fallow/direct seeding.

CHALLENGES THEY SEE

Slower seeding. The Maders and Rusts do not chemical fallow/direct-seed all of their dryland acres because the direct-seeding operation is slower than seeding with a wider conventional

drill into tilled fallow. They feel it is important to get as much winter wheat planted and emerged as possible while seed-zone moisture is adequate.

More seeding-time stress. "There's a little more pressure when you're direct-seeding a crop because you're doing everything at once. You can't afford to have something go wrong like a fertilizer plug up or a seed disk not turning. You've got to be looking. That's why I've always had a thing about not going too fast and monitoring the drill," says Tim.

Cost. Chemical fallow has been more expensive than conventional fallow for the Maders and Rusts, but Frank says, "we just hope it pays off over the long run in less soil loss and more moisture." He adds, "My feeling is, because a lot of our ranch is a field bindweed ranch, we have to spray at least once during fallow to control it, whether we're chemical fallowing or not. If you have that problem, the chemical is a given, and regular fallow is as expensive as chemical fallow."

Residue. Achieving good seed placement in heavy residue is a challenge. Their drill tends to tuck straw into the seed row, preventing good seed-to-soil contact. To minimize straw tucking, they seed at a slight angle to the previous crop rows.

Inconsistent herbicide performance. Using herbicides to control weeds has been less predictable than tillage. Sometimes they can pinpoint the problem, such as dust, but other times they can't. Tim says, "We don't know why, but it seems like sometimes we go to one field and think, 'This is the answer,' and then we go to the next field, sprayed a day later and it looks like a wreck. There's just no rhyme or reason."

Mental adjustment. One of the strongest impediments to direct seeding is just getting used to a new way of farming. "I think it's mostly mental," comments Tim. "Folks say, 'Grandpa never did it like that. We've been plowing for years. Why change?'"

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