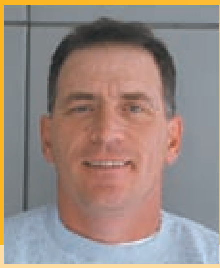

Managing Wet Soils

Jim Millar (interview)

TECHNIQUE

Millar is a soils consultant at Redfield, SD, previously a scientist with NRCS.

Jim Millar is now an independent consultant (Precision Soil Management) based at Redfield, SD, working primarily in soil testing and developing fertilizer plans by zones and soil type. Previously, Millar worked for NRCS as a soil scientist for 20 years (Millar has a Master's in Agronomy from SDSU). Millar is excited about all the things he's learned in recent years, and about his new career allowing him to work closely with the most advanced producers in his area: "You can do more outside the government than inside." The following is a March '09 interview of Millar for Leading Edge.

Matt Hagny: You're in an area with significant no-till adoption, with some producers having had the whole farm in no-till for 20 years already. What do you see as the biggest challenges and opportunities for improvement for the top no-till farmers in your region?

Jim Millar: The biggest obstacle is wetness, and will always be wetness. Corn into wheat stubble has the most trouble, especially in conjunction with cool weather. You just don't want to look at the no-till corn in May or early June—it's pale and it's slow.

> **We put the brassicas down one rank of the drill, and the lentils down the other rank.**

In no-till, we can do so much better of a job of getting water into the soil profile. We had monsoon rains in 2007, and it was just amazing the infiltration in the long-term no-till. The trouble is *subsoil* permeability: we don't do as good a job of moving the water into the subsoil. That's when we get over-saturated and problems show up. We don't see this on conventional-till because they don't have the infiltration—half that water runs off.

Photos by Jim Millar.

Why strip-till is a poor answer to the problem of wet soils. This is a disaster, not only wrecking the corn stand and causing hundreds of tons of soil to move downslope and/or off the field, but further requiring full-width tillage to smooth it up for future cropping. When confronted with this, strip-till proponents reply that you must strip-till on the contour. Talk about loss of efficiency! Cover-cropping makes a lot more sense.

To address the wet soils issue, lots of producers have gone to strip-till, because that's what the co-ops are pushing. Some have gone to 'light' tillage—heavy, deep tillage is a thing of the past around here. But what we [of the no-till mindset] are doing is the cover-crop concept. Use up the extra water, and—at the same time—add some organic matter, cycle some nutrients, remove some compaction, and improve the subsoil permeability! And it's really caught on—the acreage of cover crops has just exploded. No-till took off in this region for the simple fact that it made more money: All we needed to do was show that cover crops made you more profitable, and the interest was there.

MH: For corn following wheat, which cover crops have worked the best?

Millar: We like the winter canola—it's a small seed, it's a cheap seed. Also, the 'tillage' radish. The taproots on both of these are good at breaking up compaction. I like having a legume in the mix. Currently, it's Indianhead lentil. I would like to find something more aggressive for a legume—the lentil gets crowded out by the canola and radish by fall. To help with this, we put the brassicas [radish and winter canola] down one rank of the drill, and put the lentils down the other rank. This gives the lentils a [chance], but they're still overrun by the canola and radish late in the season.

For the manured fields, we don't even put legumes in the mix. If you do manure application [onto no-till], it's a no-brainer to use cover crops. Until we started looking at the data, we had no idea—we were losing way too much N. The soils stayed moist, and we had lots of decomposition of the manure, and therefore lots of N release. We found that a cover crop will pay for itself many times over in this situation, just on the N savings in that system.

The standard, non-saline-soil cover-crop mix for us is the canola and radish, plus lentil. Our mix for mildly saline soils is canola plus sugar beet. For more serious salinity, it is barley plus sugar beet. Of course, if the salinity is so bad that kochia and foxtail barley won't grow, there's nothing else that's going to grow either!

Photos by Jim Millar.

Corn in 2006 near Redfield, SD. The extremely pale corn (left photo) was following a cover-crop cocktail of canola + lentil + clover, put in after '05 wheat harvest. The healthy corn was in the same field and treated exactly the same, except no cover crop was grown. Plant tissue testing revealed acute sulfur deficiency in the pale corn (S levels in the plant were 0.13%, which is very deficient, and the N:S ratio in the plant was 31:1, indicating an acute deficiency since anything over 18:1 is considered S deficient.) *So, despite brassicas taking up enormous quantities of S, and the brassica residue no longer being visibly identifiable at the time of corn planting, the nutrients hadn't yet released.* Apparently the microbes had flourished on the decaying plant material and were still using the nutrients.

Turnip is nice fit for the livestock guys who want some forage. Of course, they have all sorts of options.

Cover crops really took off up here in '07 with all the "prevented-plant" acres [cropland never seeded to a grain crop due to rain delays and a short growing season].

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MH: What methods have the farmers in eastern S. Dakota been using for getting the cover crops established? You mentioned broadcasting in your presentation in Salina [at the No-till on the Plains Winter Conference].

Millar: We've done [broadcasting] successfully a number of times, although we increase the seeding rate by 25 – 50%. It does rely on a rain, and it definitely relies on having enough residue covering the soil. We've had failures with broadcast seeding after corn silage, simply because there wasn't any residue to hold moisture.

Our preferred method is something in the ground, be it a drill or a planter.

We've tried flying the cover-crop seed onto wheat at heading. You usually get a nice stand if it rains. But if the wheat is slow ripening, you can lose the cover crop—it turns white from lack of sunlight. It's a much better fit for North Dakota than for South Dakota—a few hundred miles north of here, there just isn't much time for growing a cover crop, so flying it onto the wheat gains them a couple extra weeks that they really need.

We've tried the Phoenix harrow, or even just the regular straight-tooth harrow. It's just not as consistent as a drill, and you're still relying on a rain.

Some guys with 20-inch planters are going to put cover crops in with the planter since they can run it cheaper than the drill.

Cover crops don't grow as well in the stripper-harvested wheat stubble. Sometimes you have both sickles and stripper heads running in the same field, and you can see right to the line. I think it's just sunlight; it's most noticeable in the really heavy 80- to 100-bu/a wheat stubble. Brassicas don't like shade.

MH: What have we learned about nutrient cycling with cover crops, and the effects on the following grain crop?

Millar: The first thing we learned with the brassicas is that they pull a lot of sulfur out of the ground. In '05 where we had the cover-crop brassicas, we saw [sulfur deficiency] in the '06 corn. We're starting to see more sulfur deficiency all the time anyway, even without cover crops. But we learned that we'd better be putting sulfur down for corn following a cover crop. (*Editors: And in a plant-available form, i.e., sulfate.*)

In '08 we saw a lot of nitrogen deficiency in the cover crop following wheat. In '09, we are going to start fertilizing the cover crop. But we're not so much fertilizing the cover crop as we are fertilizing the following corn crop: We're just putting it out earlier.

For cover-crop establishment, we've tried the Phoenix harrow, or even the regular straight-tooth harrow. It's just not as consistent as a drill, and you're still relying on a rain.

We need at least 50 lbs/a of N available for the brassicas to get good growth. Brassicas grown where there was 94 lbs/a of nitrate versus 44 lbs produced 25 – 65% more biomass.

We definitely need to do more studies to find out how much N is being released by the cover crop and available for the corn later in the growing season. But we do know there's no N left in the profile following the cover crop. That's a good thing, because it's not leaching or denitrifying. So the two nutrients we're most concerned about early in the season for corn are S and N. For the brassicas grown in the fall, we're not getting the nutrients back in May or June [when the corn is seedling-stage]; it obviously hasn't completed its cycle yet, even though you can't see the brassica residues anymore by spring. But we do get it back later in the season.

I've often found over 100 lbs/a of N sequestered in the aboveground biomass of a brassica cover. My rule of thumb is to credit about half of that to the following corn crop. Where we've had manure application, the brassica cover may scavenge up 200 lbs/a of N.

MH: Any other nutrients that are borderline low, where the sequestering by the brassica tips the balance into a full-blown deficiency for corn early in the season?

Millar: The standard practice around here is putting some zinc with the 10-34-0 pop-up on corn. Most guys have been doing that for years. We usually have soil test levels well over 1.0 ppm Zn [DTPA extraction]. So we don't have much problem there. We haven't detected any other problems, but we're looking.

MH: So what's the final word then on the economics of cover crops?

Millar: We've documented both yield increases and yield decreases in the following grain crop. But we have yet to lose yield due to lack of moisture [from the cover crop's water extraction]. The occasional yield drag we sometimes see is most likely due to nutrient deficiencies, such as sulfur. Over the long term, I think we can better maintain soil productivity with cover crops, and we can do a better job of cycling the nutrients. The trick is learning how to manage the cover crops.

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MH: What experiences have you had with saline seeps?

Millar: No-tillers are more severely affected. You're putting extra moisture into the soil, and if you're not managing the water extraction, you'll have problems. The saline seeps started showing up in the late 1990s, following a series of wet years. It was more prevalent in no-till, although they weren't the only ones seeing the problem. It was small nuisance areas, insignificant. Nobody did anything.

In many cases the salt-affected area grew from an acre or

Photos by Shannon Osborne & Dan Forgey.

Cover-crop canola after wheat harvest in S. Dakota in 2007, in a study by Shannon Osborne (USDA-ARS) looking at effects on the following corn crop at Cronin Farms (see results on p. 513). In this case, sufficient N was left over from the wheat crop to grow the brassica quite nicely. Often it will be necessary to apply small amounts of fertilizers to a non-legume cover crop following wheat to get maximum growth. For comparison, the inset is a brassica (+ oats) cover crop that apparently has all the nutrients it wants, here following field pea grain harvest on the fertile soils at Cronin Farms (Dan Forgey).

two—in a quarter-section—to 5 or 10 acres—and sometimes 25 acres. It blew up quickly.

It got bad, and now we're starting to address it. I'm thoroughly convinced that cover-cropping reduces saline area growth. And we can make some progress reclaiming some of those areas, especially with the brassica tuber creating a big macropore: If we can get water moving down, we can get salts moving down. (*Editors: Salt problems in eastern S. Dakota, as well as Nebraska, Kansas, Oklahoma, and Texas, are primarily calcium and sodium cations, and the anions chloride and sulfate, and commonly forming compounds such as calcium sulfate [gypsum]. Occasionally, magnesium and borate are also involved. Some of the problem soils in eastern S. Dakota have sodium-dispersed claypans forming impermeable layers. Note that appropriate use of S and Cl materials for crop nutrition contribute very little to salt-afflicted areas; they are almost entirely due to inadequate vegetative removal of soil moisture, which results in those minerals moving downslope with percolating water, and coming to the soil surface when saturation occurs.*)

The ultimate is still a perennial tallgrass. Once you've got a bad saline area, where not even foxtail barley will grow, your hands are tied for annual grain crops. On these bad seeps, you're then forced to go to western wheatgrass or tall wheatgrass to get anything to grow. We've had good luck with that, whether it's as part of the CRP program, or guys just doing it on their own. At first, the wheatgrass only grows on the edges of the seep, but it gradually moves into the middle of the seep. After it's established, the cattle guys can take some forage or whatever.

MH: You do a lot with soil sampling by zone, and variable-rate fertilizer prescriptions. What's next?

Millar: We have the capability to do VR cover crops, for instance. You could put a more aggressive cover-crop mix in the low-lying areas that always stay wet in the spring, maybe including something that overwinters. On the clay knobs that dry easily, you could drop out some of the cover crops in the mix, using only the ones that winterkill. Or you could vary the species based on saline tolerance. Everyone who's now using auto-steer also has the ability to plant the corn directly on top of the old cover-crop row, or beside it—whatever we figure out is best.

I'm very frustrated with the soil test for sulfur—it's very poor at predicting where we'll have deficiencies in the crop.

On the soils end, I'm very frustrated with the soil test for sulfur—it's very poor at predicting where we'll have deficiencies in the crop. And following cover crops, we can't use the soil nitrate test for anything, because there's never anything left in the soil, it's all in the cover-crop biomass. I'd like to get to the point where we use the amount of biomass in the cover crop to predict N fertilizer needs for the next corn crop—say that you have two feet of brassica growth, and that gives us X amount of N credit [late in the corn crop's life cycle]. And we need to do a better job with the equations as to mineralization of N from these higher soil organic matter levels.

We'll definitely be doing more tissue testing. We're trying to fine-tune: The soil test gives us some measurements, but are we getting the nutrients into the plant?

We are definitely getting more efficient on N use in corn. I've studied that a lot, and have it dialed in pretty good. On the right soils, on a good growing year, many farmers are consistently getting 200 bu/a corn off of 120 lbs/a of N fertilizer. So, 0.7 lb of N per bushel. *On the right soils*, we can get this tightened-down tight. We can do the same for phosphorus.

Photo by Jim Millar.

Saline seep in eastern S. Dakota. These are getting much larger in Kansas, too, and sometimes at a rapid rate. The land above the seeps needs more aggressive vegetation extracting water, or else the seeps will continue to enlarge and intensify. Says Millar, "I'm thoroughly convinced that cover-cropping reduces saline area growth."