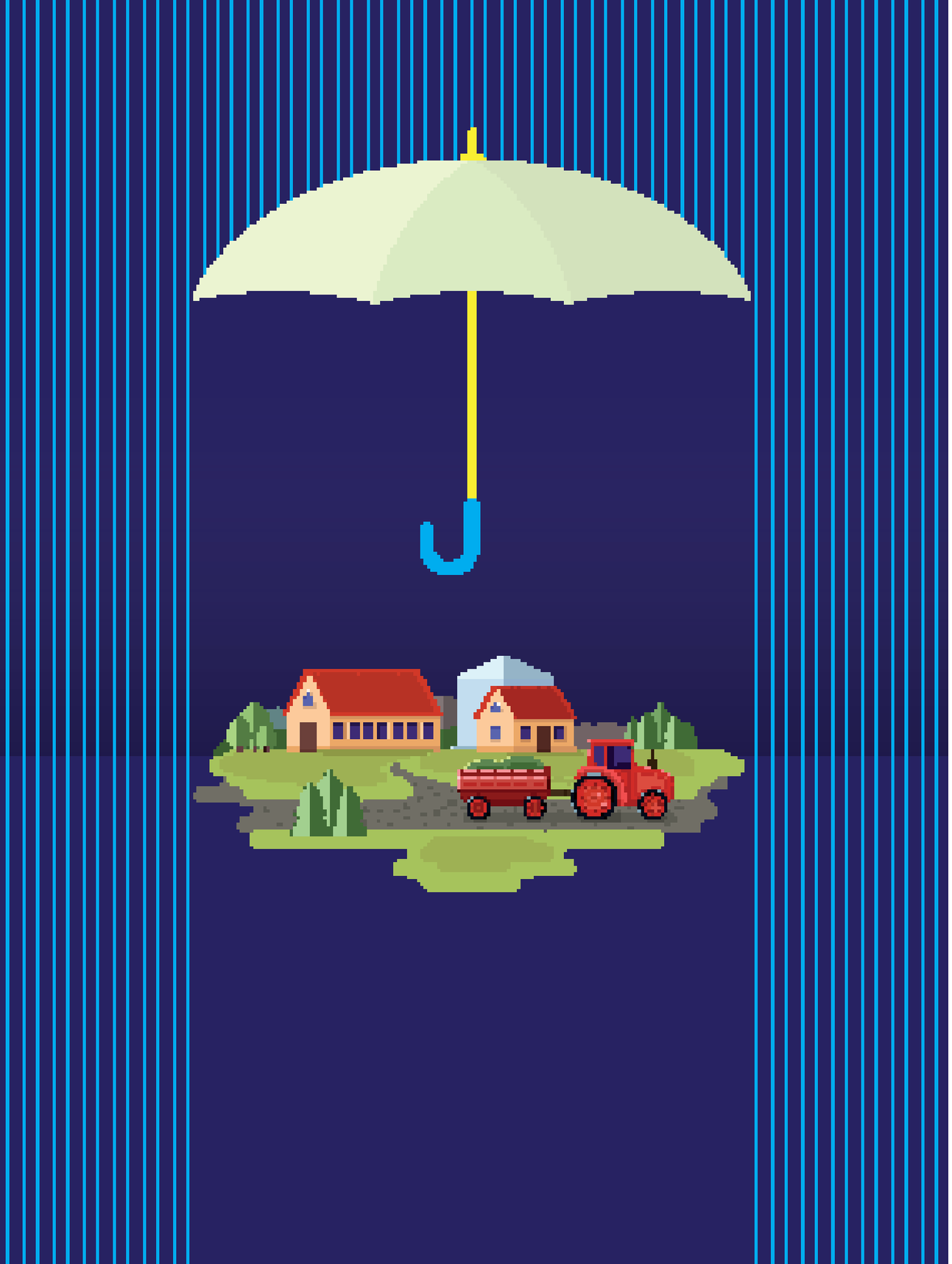

HOW TO WEATHERPROOF YOUR FARM

(SORT OF)

HINT: IT STARTS WITH THE SOIL

BY GIL GULLICKSON, CROPS TECHNOLOGY EDITOR

JIM CARRINGTON EYES A SPREAD OF FLOWERS, FORBS, AND GRASSES THAT GREETS VISITORS TO THE DONALD DANFORD PLANT SCIENCE CENTER IN ST. LOUIS.

"THIS SIMULATES THE MISSOURI TALLGRASS PRAIRIE," SAYS CARRINGTON, THE CENTER'S PRESIDENT. UNDISTURBED FOR TENS OF THOUSANDS OF YEARS, THESE NATIVE PLANTS SURVIVED EXPLOSIVE RAINFALLS, BONE-CHILLING WINTERS, AND BLISTERING HOT SUMMERS.

"SO, HOW DO WE TRANSFER THAT RESILIENCY TO CROPS?" CARRINGTON ASKS.

WELL, YOU DON'T HAVE THE LUXURY OF THE CENTURIES MOTHER NATURE HAD TO WEATHERPROOF THE RESILIENT NATIVE PRAIRIE. YOU CAN MIMIC IT, THOUGH.

That's because much of the answer lies below your feet. Resilient native prairie soils:

- **Built rich reservoirs of carbon and organic matter that help store moisture and nutrients.**
- **Contained soil microbes that enabled plant roots to better absorb nutrients.**
- **Supported vegetation that protected the soil surface from wind and water erosion.**

Compare that with modern agriculture, where soils are often tilled and host annual crops – at most – seven months out of the year. This system:

- **Starves beneficial microbes by removing living roots after harvest.**
- **Shatters water-infiltrating macropores carved by earthworms and other organisms. Tillage also destroys these soil pathways where excess rainwater can be stored for crops to tap during future droughts.**
- **Leaves soils exposed to erosion once cash crops are removed.**

There's good news, though. The same soil that helped the native prairie thrive for centuries can also help your crops endure rough weather patterns.

"It took a community of plants and (soil) microbes working together for the native prairie to survive," says Carrington.

Maybe you can't weatherproof your farm like the native prairie. It's possible, though, to improve soil resiliency that will help you cope with weather extremes.

HERE'S HOW.

1. NIX TILLAGE.

Justin Knopf's thinking about tillage changed when a friend at Kansas State University (KSU), Andy Holzwarth, told him how no-till had changed farming around his South Dakota hometown of Gettysburg.

"One day, we loaded up three vanloads of students and headed up there," says the Gypsum, Kansas, farmer. One of their visits was with Dwayne Beck, manager of the Dakota Lakes Research Farm in nearby Pierre.

"Beck hits you right between the eyes when he talks," Knopf says. Beck views tillage as a cataclysmic event that destroys soil pathways, microbes, ground cover, and other vital components crops need to thrive.

"At the same time, I was taking a soil microbiology class from Dr. Charles Rice at KSU," he says. "I learned about soils' physical properties and the balance of soil air and water, and how important organic matter is for water infiltration. It was clear that this was the direction we needed to move."

Encouraged by their father, Jerry, Knopf and his brothers, Jeff and Jay, fully made the no-till switch by 2003 for the winter wheat and alfalfa they raised.

No-till curbed wind and water erosion and began to build soil carbon and organic matter. A 1% increase in soil organic matter, which consists of 58% carbon, can key a $24 per acre value boost ▸

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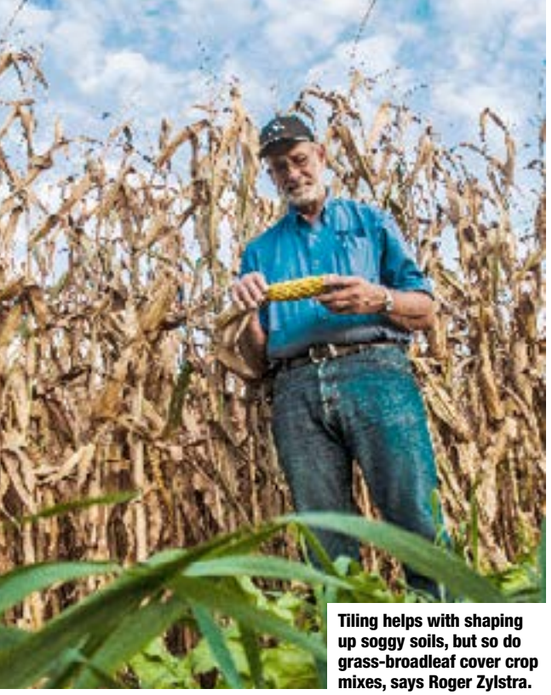
Compilation and design: Chad Owen.



Tiling helps with shaping up soggy soils, but so do grass-broadleaf cover crop mixes, says Roger Zylstra.

TEAM TILING WITH OTHER TOOLS

Roger Zylstra points to 40 acres that were once swampy before they were first tiled in 1948. Over time, the tile deteriorated.

"So, we went in and pattern-tiled the lowest and wettest areas on tile spaced 50 feet apart," says the Lynville, Iowa, farmer. "I spent over $20,000 to do it, but I got my investment back quickly. We had four really wet years in a row, and my yields in those areas went from 100 bushels to 210 bushels per acre."

Still, tiling is a tool – not the complete answer – in dealing with excessive water resulting from weather extremes and climate change. Zylstra also teams this strategy with no-till and cover crops in his soil-resiliency strategy.

"We have just 4 to 10 inches of medium-brown topsoil and a clay base under it," says Zylstra. "So it is really critical to maintain what we have and to increase organic matter and water infiltration."

Machinery management also helps Zylstra cope with tight planting windows caused by prolific spring precipitation. He retained an old planter that enables him to plant soybeans when corn is normally planted. He figures planting soybeans in late April spurs a 5- to 7-bushel-yield boost over planting later in May. A 5-bushel-per-acre-yield increase at $9-per-bushel soybeans nets him an extra $45 per acre with no extra cost.

Tiling also won't work everywhere, such as on sodic soils in the Dakotas and Minnesota.

"The restricted soil layers of these soils won't be helped by tile," says Tom DeSutter, a North Dakota State University (NDSU) soil scientist.

Tiling often costs $700 to $1,000 per acre, too. "That's hard to justify at today's prices," says Kelly Cooper, who manages the Conservation Cropping Systems Project at Forman, North Dakota.

"It's a lot like making chili," adds Aaron Daigh, an NDSU soil scientist. "Instead of peppers and meat, you might add things to drainage like cover crops and no-till. When you put things together, you can speed things up to where you want to go." SF

in increased nutrients and water infiltration, says Jason Miller, an NRCS agronomist from Pierre, South Dakota.

However, the Knopfs found no-till is just one step in building resilient soils.

"We had an abnormally wet planting season during one of those first few years," says Justin Knopf. "So while our neighbors tilled and planted, we waited for the muck to dry out under our heavy wheat-residue ground."

2. INTENSIFY ROTATIONS.

Buffering your farm against weather extremes via no-till only goes so far. The Knopfs' no-till system thrived once they rotated winter wheat and alfalfa with grain sorghum, soybeans, and corn.

"The soil then became more efficient at collecting and storing water," says Justin Knopf.

More intense rotations can be unnerving in often-arid areas like central Kansas.

"Short term, we were taking more risk with crops that needed more water," he says.

Over time, though, Knopf says the more intense rotations enable soils to better capture and store water. Improving soils by boosting organic matter 1% mimics adding 1 acre-inch of water to the landscape, says Don Reicosky, a retired USDA-ARS soil scientist from Morris, Minnesota. This enables warm-season grass crops like corn to better endure drought.

Not every diverse rotation works. One rotation tested at the Dakota Lakes Research Farm alternated broadleaves like soybeans every other year with grasses like wheat.

Although this rotation controlled weeds, it didn't generate enough soil carbon, says Beck. Instead, rotations with 70% to 80% high-carbon crops (corn or wheat) provide sufficient carbon to rebuild soils and to mimic the native prairie, he says.

3. DON'T FARM NAKED.

The final step in mimicking native prairie resiliency is covering soil year-round. Enter cover crops. The Knopfs began planting them in 2010 on a share of their farm.

Justin Knopf, Gypsum, Kansas, plants fall cover crops like sunflowers, sunhemp, and cabbage after soybean harvest.

They plant summer cover crop mixes containing sunflowers, sunhemp, millet, and forage sorghum midsummer after wheat harvest. Meanwhile, they seed fall cover crops like cabbage, triticale, rapeseed, winter peas, vetch, mustard, rye, and barley after corn or soybean harvest in early October.

Cover crops don't always boost yields.

"In dry years, there's a chance our yields could be hurt due to a lack of moisture," says Knopf. "In an average year, we will be OK. In wet years, we are thankful to have the cover crop in order to cover the soil and conserve moisture."

Economic challenges exist, as a cover crop seeding can cost up to $30 per acre. The Knopfs balance short-term economics vs. long-term benefits by simplifying mixes in order to cut seed costs.

"We're also selective on which farms we plant them," says Knopf.

Long term, the Knopfs believe better soil resiliency through no-till, diverse rotations, and cover crops will help them better endure weather extremes.

"We want to capture water efficiently and not have it move off our fields during a heavy rainfall event," he says. "We, instead, want to store it and have it available when it's needed.

"I think the prairie ecosystem was resilient for our climate," he adds. "Trying to mimic this while still maintaining a productive agricultural system is the goal we have in mind." SF

2 & 9

The number of inches (2) that can fall in minutes (9) without runoff due to a no-till-intense rotation-cover crop system at the Dakota Lakes Research Farm in Pierre, South Dakota. This is due to no-till and soil armor that keep soil macropores open.

CORN BELT CROP DIVERSITY

Corn and soybeans are king in the Corn Belt. So why diversify?

In Dwayne Beck's eyes, the corn-soybean rotation is "whack-a-mole farming." Its lack of diversity does little to deter pests, says Beck, who manages the Dakota Lakes Research Farm near Pierre, South Dakota. Meanwhile, its soybean component does little to boost beneficial soil carbon.

There's no easy answer when it comes to a third crop. Still, a 2006-2012 Iowa State University (ISU) comparison of three rotations showed there may be some viable options. The following rotations had the following net return per acre to labor and management.

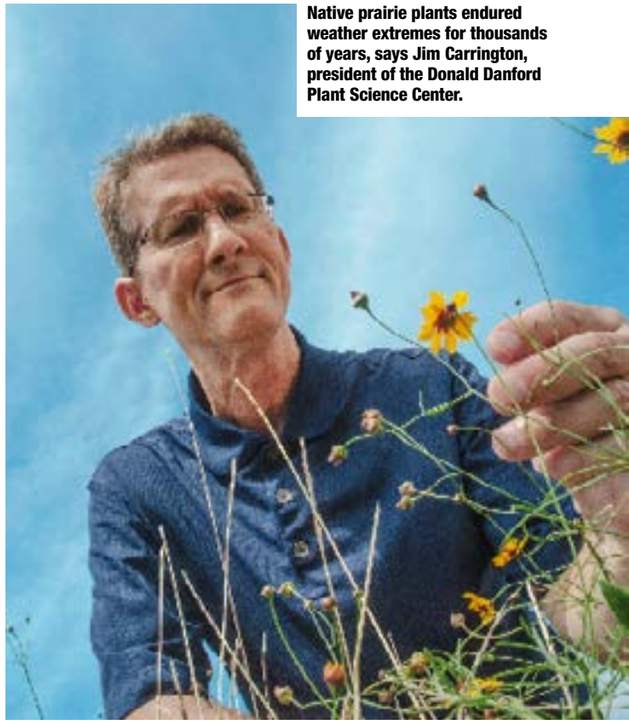
- **Corn-soybeans: $404**
- **Corn-soybeans-oats/red clover: $407**
- **Corn-soybeans-oats/alfalfa-oats: $399**

"Diversity is a good thing," says Matt Liebman, an ISU agronomist who led the study. The more diverse rotations lowered commercial fertilizer applications. Diverse rotations can also help slow the spread of herbicide-resistant weeds through cultural practices and use of herbicides with different sites of action.

There's a catch, though. You need a market for additional crops. More labor is also required for these rotations.

"If labor is a major constraint on your farm, additional crops with higher labor demands may not fit well," says Liebman. SF

Photography: Gil Gullickson



Native prairie plants endured weather extremes for thousands of years, says Jim Carrington, president of the Donald Danford Plant Science Center.

CLIMATE-SMART FARMING

If you're an Iowa farmer thinking that springs are getting wetter, you're right.

Chris Anderson, an Iowa State University climatologist, analyzed Iowa weather records dating back to 1893. Prior to 1981, just 5% of years had intense spring and summer rainfall patterns, where May and June precipitation could tally up to 13 to 14 inches. Now, such years occur one in every three. Atlantic Ocean warming is spurring this weather pattern.

"The general trend is there will be more heavy spring rain days and more summer droughts in Iowa," says Anderson. This trend through 2045 will mean 10% to 15% fewer suitable fieldwork days for Iowa farmers. This pattern has also curbed corn yields by 4% to 5% and soybean yields by 1% to 2% on average across the state since 1981.

Climate change will aggravate such weather patterns, says Jerry Hatfield, director of the USDA-ARS National Laboratory for Agriculture and the Environment. Precipitation pattern disruption and rising minimum temperatures that boost plant respiration have decreased Kansas and Oklahoma wheat yields by 1 bushel per acre annually since 2000, he says.

"Climate disruption has increased in the past 40 years, and it is projected to increase even more over the next 25 years," says Hatfield.

Good news exists, though. Boosting a soil's ability to absorb and store more water may help offset short-term water stress that curbs Midwestern row crop yields.

"By improving nutrient cycling and water-holding capacity, we can increase the profitability per acre by $75 to $100 per acre," he says. "It is smart business to be smart about climate change." SF