Mark Bauer's custom built 16-row Soil Warrior combines fall and spring tillage into one machine, including dry fertilizer application.

A massive 34-in. dia. primary coulter on each row unit has 5-in. long ductile iron bits. Two 26-in. following coulters fold soil into a neat berm.

By Lorn Manthey

"Soil Warrior" Creates Seed Zones And Applies Fertilizer in One Pass

There's a growing array of equipment on the market for vertical tillage or strip tillage but we've never seen anything like the "Soil Warrior" built by Mark Bauer of Faribault, Minn. Bauer's rig combines a massive 6 by 8-in. main frame cart that carries 8 tons of dry fertilizer with a twin frame toolbar that pulls 16 row units on 30-in. centers. The whole rig lifts and folds together and rides on four giant 18.4 by 26-in. straddle dual wheels.

The Soil Warrior has a dual purpose: first it creates 7 to 9-in. deep zones in the fall while applying and incorporating dry fertilizer. Second, it can make a shallow pass in the spring across the same zones, incorporating a dry nitrogen fertilizer and creating a gently tilled seedbed for planting.

"I tried different types of conservation tillage, vertical tillage and strip tillage on my farm with a variety of equipment, and none of it seemed to be the right answer," says Bauer. "The equipment either wasn't built strong enough, wouldn't incorporate dry fertilizer, wasn't capable of handling corn stalks, or worked the ground in slots that turned into washouts."

After numerous drawings and plywood models, Bauer built a single row unit and mounted it on an old toolbar in 2003. "We tested that first row unit in the worst conditions we could find," Bauer says, "which wasn't too difficult because it was the middle of winter. We ran it through partially frozen corn stalks and sod field roads, down gravel township roads and across soybean stubble. It did what we wanted it to do, so we built 16 rows and mounted them on a toolbar from a strip-till machine." Bauer liked the seedbed results and his crop started fast, but he was frustrated with weak components and problems with the toolbar.

He answered those frustrations and challenges by building his own machine from the ground up. He and his wife along with his brother and a few close friends spent hundreds of hours designing, building and perfecting the multi-purpose machine. He worked about 3,000 acres in the fall of 2004, and covered many of those same acres in the spring and fall of 2005. At this juncture Bauer feels the machine does exactly what he wants it to. Better yet, it folds down to 13 1/2 ft. tall and less than 17 ft. wide, so it easily travels down country roads and fits into his machine shed or shop.

"When I started this process in 2003 people thought I had lost my mind," says Bauer. "Neighbors thought I had quit farming because my cornstalks were standing, my bean ground was untouched and my machine shed was nearly empty. My shop was surrounded with scrap metal and the lights were on way past midnight every night."

Building the Soil Warrior was a family affair, with Mark and his wife joined by Mark's brother Jay and acquaintances who know their way around a farm shop. Two machine shops handled the large fabricating work after Jay designed it on a CAD system. One of Mark's older hog buildings became the assembly shop.

Persistence paid off for Bauer and his crew, because his Soil Warrior now meets all of the objectives he laid out in the beginning:

• It tills zones that are 6 to 9 in. deep in any type of soil, without creating smooth sidewalls and pulling up huge clumps of soil. Tilling is accomplished by a massive 34-in. coulter on each row unit. The case hardened 3/8-in. thick coulter has 10 integral ductile iron cutting bits that are 1 1/4 in. thick and 5 in. long. The bits create a spoon-like cutting action that slices through residue and digs deep into any type soil, creating a U-shaped zone of aerated soil. Two 26-in. coulters with a unique "saw blade design" are mounted behind the primary coulter. They float free without down pressure to gather soil and form it into a neat berm. This row unit is so unique that Bauer has applied for a patent on the design.

• It has uniform down pressure and infinite depth control on the row units. Each row unit has a 16-in. air bag similar to those used for air ride suspension on over-the-road trailers. The air bag creates down pressure on the primary coulter, which is mounted on parallel linkage to the toolbar. The 7 by 7-in. toolbar also acts as a full-width air chamber. It is pressurized by Bauer's CAT tractor compressor system. Turning a dial on the controller regulates pressure from 5 to 60 psi. Lower psi is used in softer conditions and higher psi when soils are compacted or dry. One large gauge wheel maintains depth control.

• It works in any type of crop conditions, in any type of residue, without plugging. The 34-in. primary coulter on each row unit is sharpened and has large deep cuts similar to a serrated knife. Those features, combined with the 10 cutting bits, make short work of residue and tend to pulverize compacted soils.

• While creating the zones, it thoroughly incorporates dry fertilizer to a depth of 4 to 8 in. Crop producers have struggled for years to get the right amount of fertilizer in the right place at the right time. Says Bauer, "The Warrior applies dry fertilizer in the zone, in the fall or in the spring. We've had university and independent people check our zones and the dry fertilizer and residue has been uniformly mixed in. We've been told this is the ideal method of incorporation…creating a nice strip or zone with uniform fertility so the roots have nutrients in all directions."

• The zones are slightly raised and incorporate a small amount of crop residue, but not long stalks and ball roots. Some strip-till machines cut residue or just move it aside with trash whippers, but Bauer has the Warrior set up to cut residue and incorporate small pieces into the zone. He says this mixture creates a wicking action that moves air and moisture throughout the zone, generates greater microbial action, and allows the zone to warm up fast in the spring.

• The machine that creates the zones in the fall is also used to dress up and condition the zones in the spring. Says Bauer, "I wanted a dual purpose machine that would replace three implements…a stalk chopper, a chisel plow and a field cultivator, and that's exactly what the Soil Warrior does." Prior to spring work, Bauer replaces each primary 34-in. coulter with two 20-in. wavy coulters. The smaller coulters run in the same zones created in the fall. They cut up residue, break up chunks and create a nice berm of soil for planting. "In the spring I run the row units very shallow, only 2 to 3 in. deep, and drive in the same wheel tracks as the fall, and the seedbed is just wonderful. The residue incorporated into the zones eliminates crusting if we get heavy rains."

• The machine's coulters run in oil bath bearings, so they don't need greasing. "I've had chisel plows and other equipment that took an hour to grease, and that's a waste of valuable time especially when the fields are ready," says Bauer. "So we designed these coulters to run in oil bearings, which are good for 10,000 acres. With this design, we will change the oil once every couple years, during the off season."

• Row markers assure uniform spacing. Because 75 percent of Bauer's 1,500 crop acres lay on contours and in rolling and uneven shaped fields, he designed the Warrior with hydraulic markers that are easily activated when needed. He can also use the machine with a guidance system to create uniform row spacing on regular shaped fields.

Bauer also made sure the Soil Warrior was built for tough conditions and high horsepower tractors. The cart has an 8 by 6 by 1/2-in. double reinforced mainframe. The dual frame toolbar is 7 by 7 by 1/2 in. on front and 5 by 7 by 1/2 in. on the back. The toolbar and row units rotate up and fold around the cart and fertilizer tank on huge 2-in. hinge pins.

There are 14 hydraulic rams and more than 800 ft. of hose on the Warrior, but multi-function controllers allow all hydraulics to be cycled on three remotes. The fourth remote operates the fertilizer pump and distribution system.

Bauer's original desire was to put together a custom machine for his own farm, but as word got out about the unique design and how well it performed, he now thinks the machine has commercial potential.

Air bags provide uniform down pressure to each row unit. The main toolbar serves as the air chamber, and pressure is regulated from 5 to 60 psi by a dial in the tractor cab.

Weigh wagon results in 2005 from his plot showed that his two-pass system (fall and spring) had corn yields that were 7 bushels better than a single pass strip-till approach, 7 to 12 bushels better than no-till, and comparable to a chisel plow/field cultivator approach.

Experts agree that conventional row crop tillage needs to change to improve soil conservation efforts. Bauer, however, feels that his machine creates even more benefits, especially cost savings. Even though the Warrior will probably cost more than other strip-till and zone-till machines on the market, Bauer is quick to point out that the machine merges fall tillage, spring tillage and fertilizer application into one rig.

"We built a 16-row Soil Warrior just like ours for Jeff Steinacker of Appleton, Wis. in the fall of 2005," says Bauer. "He ran the machine across 4,000 acres in about a month, putting in fall zones and applying dry fertilizer. Next spring he will cover those same acres for seedbed preparation and then plant. He didn't have to use a chisel plow last fall and he won't have to make two passes with a field cultivator in the spring. He told me it took about half the time and half the amount of fuel last fall to cover those acres compared to chisel plowing."

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