

# Take The Pressure Off Your No-Till Soils

Ag engineer Randy Raper offers some helpful hints for no-tillers wanting to tread more lightly for compaction prevention and management.

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SOME THINGS, LIKE coal, do their best work under pressure; soils, however, do not. Compaction causes a laundry list of troubles, including ponding water, reduced nutrient availability, erosion, poor root development and the list goes on.

Avoiding compaction is an essential part of any production plan in order to get the most out your acres.

"Compaction is essentially a reduction in soil pore space," says Randy Raper, an ag engineer with the National Soil Dynamics laboratory in Auburn, Ala. "You squeeze out all the air space where water and roots reside in the soil."

And, Raper told attendees of last January's National No-Tillage Conference, tractor size isn't helping the situation.

"If you look at the Nebraska Tractor Test, you'll note that in 1948 the largest vehicle tested weighed about 10,000 pounds. In 2000, the largest vehicle weighed 55,000 pounds and that's still only on two axles," he says. "Axle load can be really damaging when it comes to subsoil compaction."

## 8 Compaction-Management Strategies

1. Only traffic when soil moisture is low.
2. Include cover crops in your no-till rotation.
3. Control traffic.
4. Use the smallest vehicle possible.
5. Opt for radial tires.
6. Minimize radial tire inflation pressure.
7. Reduce contact pressure by using duals or tracks.
8. If necessary, use in-row or bent-leg subsoilers to remove existing compaction.

There are plenty of other ways to develop compaction problems in a field, including livestock traffic and even natural settling of the soil. Raper offers the following tips for preventing and managing compaction where you can.

**Watch Soil Moisture.** "Only traffic when soil moisture is low," Raper says. "That is one of the most critical rules for avoiding compaction. If you can do that, then you're always going to be in pretty good shape."

As soil moisture increases, soil strength decreases, making soils more vulnerable to compaction, Raper says. Tillage also decreases soil strength by reducing density.

**Use Right-Sized Vehicles.** Pressure from heavy axle loads is what creates subsoil compaction, Raper says.

"The damaging part of subsoil compaction is that we really can't get it out and it's going to be there causing ill effects on the crop for 6 to 7 years," he says. "If we want to minimize subsoil compaction, axle loads should be limited to 6 to 7 tons per axle."

According to research, in a moist, arable soil, 4.4 tons per axle compacts to a depth of 12 inches; 6.5 tons reaches to 16 inches; 11 tons per axle compacts to 20 inches; and 16.5 tons per axle compacts to 24 inches or deeper, Raper says.

A 100-horsepower, 2-wheel-drive tractor weighs in at around 4 tons per axle, while a 320-horsepower, 4-wheel-drive tractor hits 9 tons per axle. A full 12-row combine is a hefty 26 tons per axle.

Equipment	Axle Load (Tons/Axle)
100 HP 2WD Tractor	4
200 HP 2WD Tractor	8
320 HP 4WD Tractor	9
6-Row Combine (Empty)	11
12-Row Combine (Full)	26
Single-Axle, 27-cubic-yard Grain Cart (full)	22
Double, Dual-Axle, 50-cubic-yard Manure Tanker (full)	35 (rear) 13 (front)

“An empty combine is heavier than what we want to see. When you get a full combine, you’re way above the limits. Grain carts and manure tankers easily get above any practical axle load limits we would set,” Raper says. “So, once again, we have to look at soil moisture.

“When you’re above the weight we want to have in the field for axle loads, only operate in the fields when soil moisture allows it. If you can operate in drier conditions, you should be in good shape.”

**Evaluate Tires.** “You want to minimize tractive element-tire contact stress, or, in other words, spread the load as much as possible,” Raper says.

No-tillers can achieve this, he says, by increasing tire size by height or by width. And, when purchasing a new tractor or changing out tires, he says radials are the way to go.

“Radials may cost twice as much as bias-ply tires, but you’re going to save more money in the long run,” Raper says. “Believe me, it’s worth it.”

But, Raper says, inflation pressure is very important with radial tires and has to be monitored. When comparing a radial tractor tire inflated to 6 psi with the same tire inflated to 18 psi in the lab, Raper says the properly inflated radial will exert the most compaction in two narrow strips along the outside of the wheel. The over-inflated radial tire compacts the soil across the width of the entire tire.

“We saw that more compaction was being caused at the higher inflation pressure,” he says.

The footprint — the area of the tire resting on the ground at any given time — also is longer on the radial tire when it is correctly inflated, which further spreads the axle load and gives a traction advantage.

Raper’s data shows that a 5,700-pound tractor can pull better than 2,500 pounds of net traction with the radial tires inflated at 6 psi. The same tractor was only able to pull 1,700 pounds of net traction with the radial tires over-inflated to 18 psi.

“If you over-inflate your tires, you just lost about 25% of the capability of your tractor,” he says. “That can affect the speed of your operation, fuel use and more. There are just a lot of benefits with radial tires if you use them properly.

"You need to operate tires at the minimum inflation pressure."

To further spread axle loads and reduce compaction, Raper suggests taking advantage of duals or tracks.

**Control Traffic.** Limiting the total area vulnerable to compaction by putting all machinery on the same, wide wheel spacing and using controlled traffic is another option. And, Raper says, auto-steer can take compaction management prevention to the next level.

"Automatically steered vehicles may be one of the best things for compaction management since the introduction of radial tires," Raper says.

He especially sees an advantage for auto-steer in strip-tillage.

"In strip-till, you create a zone. When you come back with the planter unit, it can be slightly off without guidance and you end up not putting the seed where it needs to be," Raper says. "You also create compaction in that tilled zone."

In strip-tilled cotton, Raper says research shows a 16% yield reduction when the row was misaligned by only 2 inches.

Conventional tillage is the perfect system to create the most compacted conditions possible, Raper says. No-till, however has an advantage.

"In a conservation ag system, we tend to have greater soil strength in the row middles," Raper says. "To take advantage of that, I recommend that producers implement controlled traffic wherever they can to plant into the old row."

**Remove Existing Compaction.** Cover crops are one way to alleviate compaction and they can help boost yields, Raper says, by allowing the soil to store more moisture.

Another way to address existing compaction, he says, is through subsoiling. But it has to be done right to preserve conservation-tillage efforts.

"There are effective methods of removing compaction," Raper says. "You can use strip-till, in-row subsoiling or non-inversion subsoiling."

Raper recommends bent-legged shanks, which he has observed leave more residue on the soil surface. And he says producers need to find the compaction layer to determine depth for subsoiling.

"Measure how deep the compaction layer is and then go about 1 inch below that," Raper says. "It's possible to go too deep. You want to go just deep enough to pull the compaction out."

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