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SAVING TIME AND FUEL DURING TILLAGE

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There are many ways to save fuel in tillage field operations: not tilling, choosing a minimum tillage operation over a heavier one, and ensuring your tractor and implement are set up properly.

As with any farm operation, the value of tillage must be weighed against its cost. The first costs to consider are labor, fuel and machinery. These costs are estimated to range from $9 to $19 per acre, depending on the field operation and equipment used [1]. Additionally, tillage can increase costs of subsequent field operations as loose soil reduces tractive efficiency adding further cost to operations such as planting. Finally, some tillage costs are harder to quantify, including the risk of soil erosion and nutrient loss. Conversely, tillage can have many positive impacts on crop production. These impacts can include remediating soil compaction, managing crop residues and providing favorable spring planting conditions.

Tillage is one of the least fuel-efficient field operations. It's estimated that only 20% of the energy in diesel fuel is available at the tractor's drawbar depending on engine and transmission setup [2]. Furthermore, only 2% of that energy is converted into turning the soil. Combining those two efficiencies tells us that only .4% of the energy in diesel fuel is actually converted into breaking up the ground! Therefore it is important to properly manage your tractor and implement setup to get the most out of tillage operations.

The first step to improving your tractor's efficiency starts before heading out to the field. Proper ballasting and tire pressure are critical to ensure your tractor is efficiently transferring power to your implement. First, start with ballast (weight). Over-ballasting a tractor increases rolling resistance, drive train wear and soil compaction. Rolling resistance is increased as the tractor sinks into the ground and consequently must use more energy to climb out of its tracks. Under-ballasting leads to excessive tire slip as the tractor struggles to grip the soil. The amount of ballast needed depends on the draft requirement of the field operation, but a general rule is 120, 145 and 180 lb per hp for light (greater than 6 mph), moderate (5-6 mph) and heavy (less than 4 mph) draft loads, respectively for two-wheel drive (2WD) or mechanical-front-wheel-drive tractors (MFWD). This rule of thumb is logical because increased field speed generally means the operation you are conducting requires less weight [4]. Additionally, at higher speeds soil mechanical properties can withstand only so much force before giving way, leading to wheel slip.

The second part of ballasting is to have the weight distributed on the tractor properly. Each tractor design (2WD, MFWD, FWD) and implement hitch point (mounted, semi-mounted, towed) requires a different weight split between the front and rear axle. Your tractor's operator's manual will provide the split needed to get the most out of your setup [4].

After the tractor is completely ballasted and hooked up, it's time to check tire pressures. Lower pressures can increase tractive efficiency but can also lower the load rating of the tire. Follow the load and inflation tables provided by your tire manufacturer to ensure you meet their specifications. If you're considering running on the minimum pressure, weigh each axle and divide by the number of tires to be sure the actual weight per tire is what you expect.

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Wheel slip is a good measure of how well your tractor is set up for tillage conditions. Optimal wheel slip ranges from 10 to 15% depending on soil conditions [5]. The optimal slip is on the low end of that range for firm soils and higher for tilled and sandy soils. For a quick check in the field, observe that a properly-ballasted tractor will show deformation in the center of the lug track.

Fuel can be also conserved by matching the power output of the tractor's engine to the power needed by the tillage operation. This is known as the "gear up throttle down" practice [3]. The idea is to select the gear and throttle position that will load the engine sufficiently while maintaining the desired speed for the field operation. This technique is useful where the implement doesn't demand too much power from the tractor, such as disking or situations where the tillage tool is undersized for the tractor. One must take care not to overload the engine when practicing this technique. Most diesel engines can operate efficiently at 20 to 30% of their rated engine RPM, but consult the operator's manual for your specific machine. Black smoke and poor engine response to changes in throttle position are common signs of an overloaded engine.

The final strategy for conserving fuel is to minimize overlapping passes. Strategies for minimizing overlap can range from taking breaks so that you can be more attentive as an operator or employing a guidance (e.g., lightbar, automatic steering) system.

I hope these strategies, (1) only till when necessary, (2) optimize ballast and tire pressure, (3) gear-up throttle down, and (4) stop covering the same ground, can save you time and fuel.

References

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