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CC278 Farm Energy Tips - Use Energy Wisely - Tractor Ballasting

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USE ENERGY WISELY

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Tractor Ballasting

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Tractor fuel prices are increasing and will continue to do so. It is important to use fuel efficiently.

The pull a tractor can deliver depends on tire efficiency, which depends on tractor weight.

Tractors with proper ballast are able to use the maximum available drawbar horsepower to pull an implement. Other factors need to be considered, depending on the situation. The most important of these include:

1. Drive wheel slippage.
2. Load rating of tires.
3. Load rating of Roll-Over Protective Structure (ROPS).
4. Type of implement to be used.
5. Type of soil to be worked.
6. Type of operation being performed.
7. Avoidance of excessive soil compaction.

Weight controls slippage, and the greater the ballast or weight the less the slippage. As illustrated in Figure 1, the amount of allowable slippage to develop maximum available drawbar horsepower varies from 10 percent in a firm soil to 15 percent in a sandy soil. Drawbar horsepower is reduced if wheels slip too much or too little. Furthermore, reducing slippage below 10 percent for large horsepower tractors used for high draft operations can produce high stresses. This may reduce the life of the transmission and drive train of the tractor.

It is easy to determine the amount of slippage occurring with any drawbar load. The tractor can then be ballasted to provide the best tire efficiency. To determine percent slippage, you need two people, paint, tape, or chalk, and two marker stakes.

Now, follow these six steps:

1. With paint, tape, or chalk, make a reference mark on the sidewall of the rear tire.

2. While the tractor is performing a heavy draft operation at field speed, place the first stake to mark the spot where the tire mark meets the soil.

3. Walk alongside the tractor counting 10 revolutions of the wheel.

4. Use the second stake to mark the spot where the tire mark again meets the ground on the tenth revolution.

5. Take the implement out of the ground, (no load), and again run the tractor between the two stakes. Count the number of rear wheel revolutions for the tractor to cover the staked distance. Estimate the fraction of the last wheel revolution to the nearest 1/10 revolution.

6. Calculate the slippage as follows:

$$\% \text{ Slip} = \frac{(10 - \text{the no load revolutions}) \times 100}{10}$$

Example: If 8.5 revolutions occurred for the staked distance with no load, the % slip would be:

$$\% \text{ Slip} = \frac{(10 - 8.5) \times 100}{10} = 15\%$$

Use Table 1 as a guide for the addition or removal of ballast.

Table 1. Criteria for addition or removal of weight.

% Slip	*Result*
0 to 5	Remove weight
10 to 15	Proper weight
20 to 25 (or more)	Add weight

Keep in mind that a towed implement requires more ballast than a mounted implement. The mounted implement provides weight transfer to

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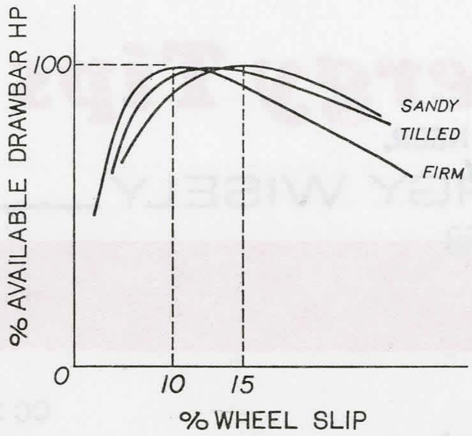

Figure 1. Percent available drawbar horsepower as a function of wheel slip for three soil types.

the rear tires that acts as additional ballast which helps to control slippage.

Estimating Tractor Weight

Total tractor weight for ideal slippage can be estimated starting with the maximum PTO horsepower of the tractor. It is assumed that about 75 percent of the total weight should be on the rear wheels of two-wheel drive tractors.

Table 2 provides numbers to multiply times the power takeoff horsepower to obtain an approximation of the best tractor weight. The lighter the soil, the greater the ballast required to limit wheel slippage.

Table 2. Numbers to multiply times PTO hp to obtain pounds of tractor weight for typical Nebraska soils.

Operation	Multipliers Firm or tilled soils	Sandy soils
Light draft high speed (6 mph)	120	170
Average draft average speed (5 mph)	140	200
Heavy draft slow speed (4 mph)	175	240

Examples: How much should a tractor with a 100 PTO horsepower rating weigh for performing a light draft operation in tilled soils? How much should it weigh for performing a heavy draft operation in sandy soils?

For tilled soils and a light draft, the tractor should weigh about 12,000 pounds (120 x 100).

For sandy soils and heavy draft, the tractor should weigh about 24,000 pounds.

Remember, about 75 percent of this weight should be on the rear wheels when using a towed implement. For a semi-mounted implement, 70 percent of the weight should be on the rear, and 65 percent for mounted implements.

Once the tractor has been ballasted to this estimated weight, the wheel slippage should be determined while the tractor performs the desired operation. The weight should then be adjusted, if needed, according to the guidelines in Table 1.

Be careful that the maximum allowable loads of the ROPS and the tires are not exceeded. The ROPS load rating can be determined from a plate or decal on the structure itself. Refer to Table 3 to determine allowable loads for the commonly used tractor tires.

Table 3. Tire load capacities and inflation pressures.[a/]

	Single		Dual	
Tire size	*Minimum recommended pressure (PSI)*	*Maximum load capacity per tire at minimum pressure (lb)*	*Minimum recom-mended pressure (PSI)*	*Maximum load capacity per tire at minimum pressure (lb)*
15.5-38	14	3160	12	2540
16.9-30	16	3900	--	---
16.9-34	16	4140	12	3080
16.9-38	16	4380	12	3260
18.4-30	16	4680	--	---
18.4-34	16	4970	12	3700
18.4-38	16	5250	12	3910
20.8-34	16	6010	12	4470
20.8-38	16	6360	12	4730
23.1-26	16	6280	12	4670
23.1-30	16	6700	12	4980
23.1-34	16	7110	12	5290
24.5-32	18	8180	12	5680
28L-26	16	7280	12	5410
30.5L-32	16	9120	12	6780

[a/] *All loads are given for individual tires based on Tire and Rim Association standards.*

By properly ballasting your tractor, you will be "Using Energy Wisely." You will also be getting the maximum usable drawbar horsepower from your tractor and the most for your fuel dollars.

Table 4. Appropriate metric conversion factors.

Multiply	*by*	*to obtain*
Speed:		
miles per hour (mph)	1.609	kilometers per hour (kph)
Power:		
horsepower (HP)	0.746	kilowatts (kW)
Weight:		
pounds (lb)	0.454	kilograms (kg)
Pressure:		
pounds per square inch (PSI)	6.895	kilopascals (Kilopascals (kPa)

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