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NF96-258 Subsoiling in Nebraska

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Subsoiling in Nebraska

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Deep tillage or subsoiling is a field operation usually performed to break up compacted layers of soil at depths of 10 to 20 inches. This operation requires very high energy inputs. Thus, it is important that all equipment is properly adjusted and matched to the correct size tractor to ensure a cost-effective operation.

Should I Subsoil?

Because subsoiling is a high energy and expensive operation, evaluate compaction in several areas of the field before deciding to subsoil. A decision to subsoil should be based on the depth and severity of compaction. The evaluation can be accomplished using a handheld soil probe, soil penetrator, a truck-mounted soil probe, shovel, post hole digger or backhoe. The upper and lower boundary of the compacted zone and the abundance of roots growing in the compacted zone need to be identified (see NebGuide G87-831 *Identification of Soil Compaction and Its Limitations to Root Growth*).

Soils which are slightly compacted will have numerous roots growing into and through the compacted zone while moderately compacted soil will have fewer roots growing into and through the compacted zone. Slight and moderately compacted soils typically do not need subsoiling. Severely compacted soils prevent roots from growing into the compacted zone. Severe compaction has the potential to limit crop yields and will likely require subsoiling.

Once a soil evaluation is completed and a severely compacted zone identified, a farmer may still be unsure of the benefit from subsoiling. If so, side by side test strips of subsoiled and nonsubsoiled land should be established (see NebGuide G84-723 *Maximizing the Use of Farm Strip Plots*.). A yield check of these strips will provide additional quantitative information to help with future decisions about subsoiling. Crop yield information, however, should never be substituted for soil evaluation.

Power Requirements and Performance

Several types of subsoilers have been manufactured which adequately shatter the soil to break up compaction. Subsoiler shanks may be parabolic (curved) shaped or straight and with or without wings. In general the power required to pull a parabolic shank is less than a straight shank. The addition of wings to either parabolic or straight shanks increases the power requirement.

A straight shanked subsoiler without wings has been used in Nebraska studies. The power requirement per shank for different soils is illustrated in *Table I*. For severely compacted soil, the power requirement to break up compaction can be as high as 45 drawbar HP per shank.

Table I. Speed, power requirement, and depth of subsoiling for Nebraska soils.

Soil Series	*Speed MPH*		*HP/Shank*				*Depth of Subsoiling*	*County*
			PTO		*Drawbar*			
	Min	*Max*	*Min*	*Max*	*Min*	*Max*	*inches*	
Hastings	2.7	3.2	36	47	27	35	15	Platte
Moody	2.6	3.8	37	60	27	45	20	Madison
Sharpsburg	3.1	4.0	44	54	33	41	16	Lancaster
Laretto	2.0	3.3	30	33	23	25	16	Madison
Hastings	3.0	3.8	35	51	26	38	15	Fillmore
Pawnee	2.4	3.7	39	53	29	40	15	Johnson
Wymore	2.1	3.0	37	51	27	38	20	Lancaster

PTO HP × 0.75 = Drawbar HP

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Variation in power requirements depends on subsoiling depth, soil water conditions and the amount of compaction. The large differences between minimum and maximum power requirement for some Nebraska soils illustrate that not all portions of a field require the same energy input for deep tillage or possess the same degree of compaction. When selecting a tractor for subsoiling, some consideration must be given to the highest power requirement that may be encountered in order to do an effective job of subsoiling all parts of the field.

Subsoiling can be performed efficiently if the tractor is properly ballasted and has sufficient power to pull the subsoiler. About 75 percent of the PTO HP rating is available as drawbar HP under firm soil conditions. A properly ballasted tractor should weigh from 100 to 120 lb/PTO HP; thus, a 150 HP tractor should weigh between 15,000 and 18,000 pounds. Distribution of the ballast will depend upon tractor type and whether the subsoiler is mounted or towed.

A two-wheel drive tractor with a mounted subsoiler should have more static weight on the front axle to ensure steering capability; less static weight is needed over the front axle if the subsoiler is towed because there is little weight transfer from the implement. Even greater proportions of the static weight should be over the front axle for front wheel-assist and full size four-wheel drive tractors. Recommendations for weight distribution are provided in *Table II*.

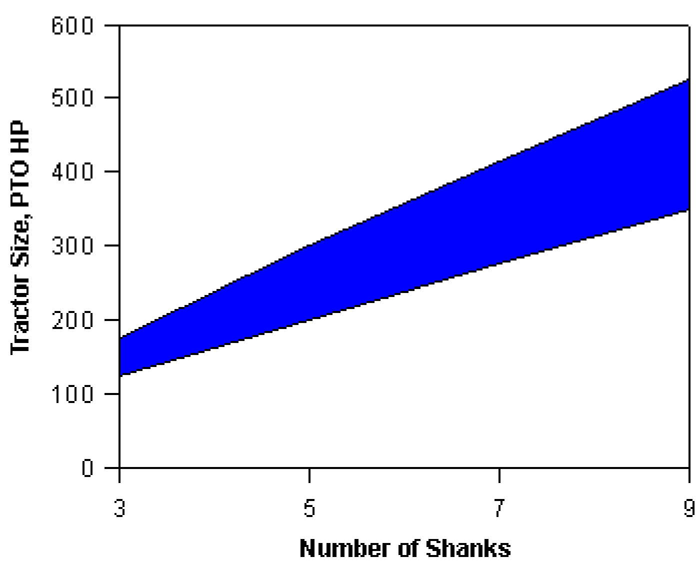
Table II. Tractor weight distribution for efficient operation.

Tractor	*Implement*	*Weight distribution (Front:Rear)*
2 WD	Mounted	35:65
	Towed	25:75
Front wheel assist	Mounted	40:60
	Towed	40:60
4 WD	Mounted	60:40
	Towed	60:40

Power to pull a subsoiler will depend on the number of shanks being pulled and tractive conditions. For most soil conditions optimum tractive efficiency can be obtained in the 10 to 15 percent slip range. If slip is more than 15 percent or less than 10 percent, ballast should be added or removed, respectively.

Total drawbar power requirements for subsoiling are illustrated in *Figure 1* for subsoilers having three to nine shanks. Deep subsoiling and very compacted soils can be expected to require about 45 drawbar HP per shank or more, while subsoiling at shallower depths and on less compacted soils will require less.

Figure 1. Tractor size needed to pull a subsoiler.



Field Management After Subsoiling

Subsoiling is a short term solution to the compaction problem. If management practices causing compaction continue to be used after subsoiling, severe compaction can easily redevelop. For example, trafficking and/or tilling wet soils can recompact them tighter than they were before subsoiling. As a result, post-subsoiling bulk density and soil strength will be greater than for pre-subsoiling conditions.

Subsoiling, combined with the adoption of new management practices that minimize and reduce compaction, contribute to a long-term solution to the compaction problem. These same new management practices also are useful in reducing slight and moderate levels of compaction without subsoiling.

Soils that have been subsoiled should be managed so that further compaction is minimized. The best way to minimize compaction is to limit the number of field operations. When field operations do occur, limit wheel traffic to the same row middles/furrows for each field operation. This can be accomplished for most operations except combining. Other beneficial options include staying off wet soils, rotating crops, adding organic matter in the form of animal waste or green manure crops, till soil deeper in dry years when tillage is needed and adopt conservation practices which reduce tillage (see NebGuide G89-896 *Management Strategies to Minimize and Reduce Soil Compaction*).

Additional Reading

- NebGuide G84-723 *Maximizing the Use of Farm Strip Plots*. University of Nebraska Cooperative Extension.
- NebGuide G87-831 *Identification of Soil Compaction and Its Limitations to Root Growth*. University of Nebraska Cooperative Extension.
- NebGuide G89-896 *Management Strategies to Minimize and Reduce Soil Compaction*. University of Nebraska Cooperative Extension.

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