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NF96-300 Selecting and Sizing Combine Drive Tires

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Selecting and Sizing Combine Drive Tires[1]

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This NebFact assists in selecting and sizing combine drive tires for proper load carrying capacity as well as selecting tire widths for controlled traffic systems.

Several variables should be considered when selecting combine drive tires for controlled traffic systems, including the maximum load expected, tire size, ply-rating or symbol markings and desired traffic lane width within the furrows. Tire selection could be influenced by such things as operating on a hillside or transport speed. It is critical inflation pressure be properly adjusted to meet these requirements.

Controlled Traffic

Controlled traffic is defined as the field situation where vehicle wheel spacing is arranged so all wheels run between the crop rows (interrows/furrows/row middles) and the wheel tracks are in the same positions each year. The maximum advantage of controlled traffic occurs when the operating widths of all equipment are matched (or the same) and wheels are arranged to minimize the number of traffic lanes created.

From controlled traffic research, the first pass of a vehicle on tilled soil can cause 70 to 80 percent of the wheel compaction. Once a traffic lane has been driven on, subsequent passes with similar or lesser loads have little additional effect on the amount of soil compaction.

Controlled traffic lanes improve traction, soil load bearing and timeliness of planting and harvesting operations while minimizing potential yield reduction from compaction. While compaction is managed, not eliminated, the area subjected to compaction is minimized. The idea is to separate traffic zones from root zones. Controlled traffic keeps compaction where it is less detrimental to root development and uptake of nutrients and water. Fertilizer placement and furrow irrigation practices can be modified as these traffic zones are established and the traffic lanes are known.

Wheel tracks become compacted even when relatively light machinery is used. Without using some traffic control plan, random traffic could cover and compact 75-90 percent of the field after only a few years. Review NebGuide 89-896, *Management Strategies to Minimize and Reduce Soil Compaction* for additional details. To develop a controlled traffic plan, review Extension Circular 96-780, *Equipment Wheel Spacing for Ridge-Till and No-Till Row Crops*.

Tire Width Compatibility

Tire width compatibility is compounded by the tire size and row spacing (tire width versus ridge spacing/ridge profile). Figure 4 of Extension Circular *EC96-780, Equipment Wheel Spacing for Ridge-Till and No-Till Row Crops* shows several tire profiles in ridges. As a guideline for ridge-till practices, the maximum tire width should be 8 to 10 inches less than the row spacing. While for no-till, tires a little wider are acceptable and should be 4 to 5 inches less than row spacing.

A wheel spacing slightly wider than ideal may be perfectly acceptable. For example, 18.4 or 20.8 tires could be used with 30-inch rows in ridge-till, but in such a situation wider tires such as 23.1 or 24.5 tires are unacceptable. In 30-inch rows (even with 18.4 tires or 20.8 tires), the wheel spacing should center tires exactly between ridges in order to minimize trafficking on the ridge side.

When considering combine tires and wheels that match the row spacing, use a taller but narrower single tire (to maintain load carrying capacity) or straddle duals if single tires are too wide.

Load Carrying Capacity

Figures 1 and *2* are charts of the maximum load and inflation pressure relationships of both bias-ply and radial tires. These figures show alternatives for properly sizing tires for combines. Combine tires experience cyclic loading and most of the critical maximum loads are during harvest (when speeds are < 5 mph). The maximum expected load is important for both proper tire selection and setting the proper inflation pressure. Weigh the combine drive axle with the header in the transport position and the grain tank full. Divide the axle weight by the number of tires on the axle to find the maximum load for a single tire. For dual tires, divide the axle weight by 4 (number of tires on the axle) and then divide this answer by 0.88.

Several tire characteristics need to be considered. Check the tire designation on the side wall to determine whether a tire is radial or bias and identify the ply-rating or radial symbol. To determine the "correct" inflation pressures for this tire, select the maximum expected load, tire size, rating and identify the minimum inflation pressure (*Figures 1* and *2*).

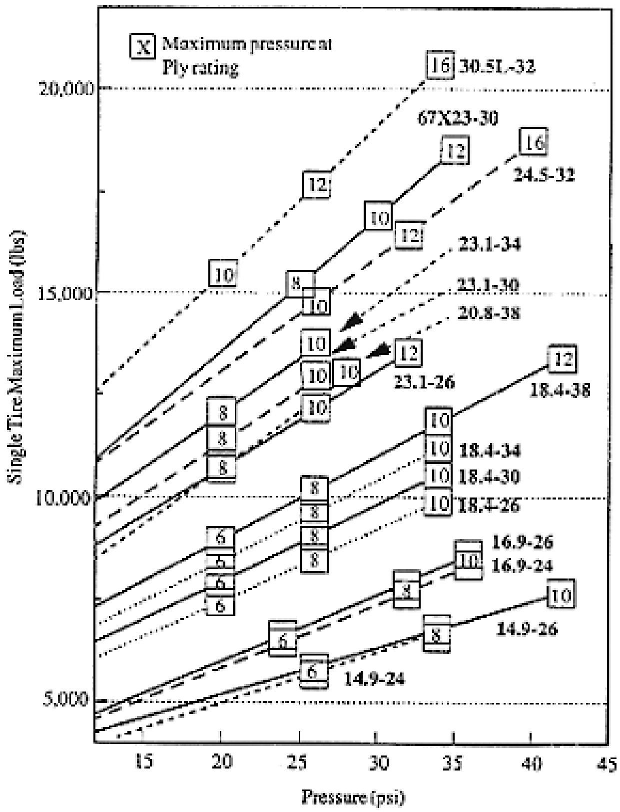

Figure 1. Bias-ply combine drive tire loading and inflation pressure relationship for a single tire. The loads given are for the combine driving at field speeds (5 mph) and fully loaded (header off the ground and a full grain tank). The numbers in the square denote tire ply rating and are located at the maximum inflation pressure. For dual application, use 88 percent of the above loads with no change in inflation pressure. For highway transport at speeds up to 20 mph, use 59 percent of the above loads.

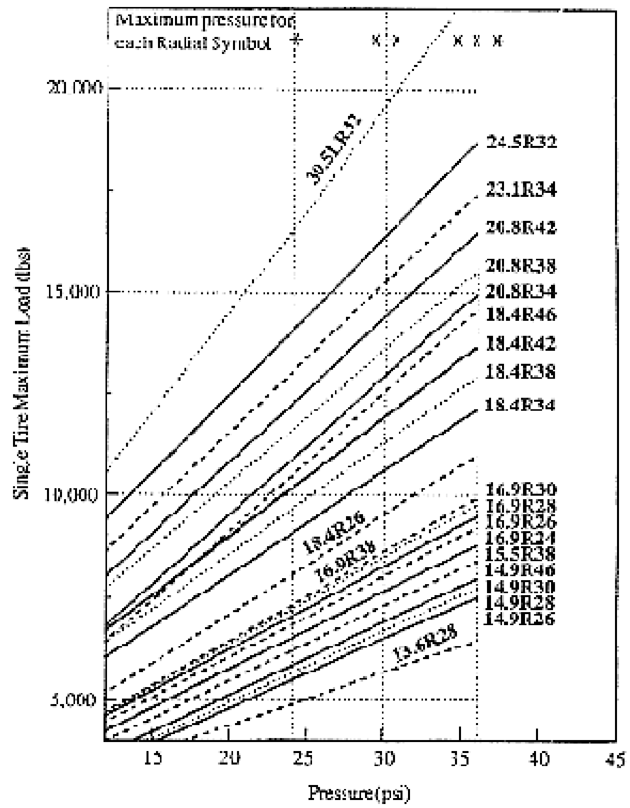

Figure 2. Radial combine drive tire loading and inflation pressure relationship for a single tire. The loads given are for the combine driving at field speeds (5 mph) and fully loaded (header off the ground and a full grain tank). Radial tires use a "*" symbol for tire markings. If a "*" symbol is designated, 24 psi is the maximum inflation pressure. If a "" symbol is designated, 30 psi is the maximum inflation pressure. If a "***" symbol is designated, 36 psi is the maximum inflation pressure. For dual application, use 88 percent of the above loads with no change in inflation pressure. For highway transport at speeds up to 20 mph, use 63 percent of the above loads. For highway transport at speeds up to 25 mph, use 59 percent of the above loads.**

Most combines drive tires should be set at maximum inflation pressure for the ply-rating or radial symbol marking. Over-inflating, which is not recommended, will cause a tire to "balloon" and results in a close fit between the ridges. Over-inflation also can cause impact breaks and tire bruises. On the other hand, always maintain at least the minimum inflation pressure, as under-inflation can cause excessive tire wear and side-wall punctures.

Correct tire inflation is important during transport. The load on the tire is less during transport because little or no grain is carried in the grain tank. Some operators will carry the header on a trailer. However, transport speeds are much faster than field operations and adjustments may be needed. Weigh the combine in the typical transport mode. Next, divide the weight by the number of tires. If using duals, divide by 88 percent. Identify the transport speed correction factor in the figure caption and divide the load by the appropriate factor. Using this corrected load, consult the appropriate load and inflation pressure chart and check if the inflation pressure is higher than the inflation pressure for field operation. If it is higher, use it for the minimum inflation pressure.

When considering a tire substitution, such as using a narrower tire or straddle duals, always check with the combine and/or tire manufacturer. Combine tire width can be reduced by two methods. First, replace a wider, single tire with a narrower single tire that is taller and has equal or more capacity (Example 1). Second, replace a wider single tire with two narrower (straddle duals) tires (Example 2).

Example 1. Suppose a combine has a maximum drive axle load of 25,000 pounds and is currently equipped with 23.1R34 single "*" rated tires and operated at 24 psi. The desire is to replace the wider tire with one that has a narrower footprint and would work in 30-inch rows for a ridge-till system. Figure 4 in *EC96-780, Equipment Wheel Spacing for Ridge-Till and No-Till Row Crops*, shows the 23.1 tire is within 3 inches of the crop or top of the ridge. This tire probably will cause ridge damage. The figure also indicates that 20.8 or 18.4 tires have footprint widths 8 and 10 inches narrower than the row spacing.

Since the combine drive axle load is 25,000 pounds, the minimum load capacity for a single tire is at least 12,500 pounds (25,000 lb/2 tires per axle). Using the load and inflation pressure chart (*Figure 2*), several alternative tires can be used, as seen in *Figure 3*. There are three 20.8 radial tires (34-, 38-, 42-inch) that could be used and all have a "**" rated tire which is operated at 30 psi. There are also three 18.4 radial tires, 38-, 42- and 46-inch, that could be used in this application. One 18.4 tire, 18.4R46, will need to be rated as "**" and operated at 30 psi. The other two 18.4 tires will need to be rated as "***" and operated at 36 psi.

The solution could be any one of these six tires. Which tire is selected also depends on rim and tire cost as well as limitation of the tire-combine interface (such as rim configuration and tire height). Comparing footprint width reduction, the 20.8 tires are 10 percent narrower than the 23.1, while the 18.4 tires are 20 percent narrower. This means less ridge damage but also less flotation for the same tire height. If the tire height is a consideration (*Table I*) then the 20.8R38 and 18.4R38 tires are the closest to the overall diameter of the original tire. If cost is not a factor, the 18.4R46 tire would make a good narrow tire with good load carrying capacity for this application. The final choices should be confirmed by the tire and/or combine manufacturer. When using taller tires on the drive wheels, taller tires may be required on the rear so that the combine is level and the header runs at the proper angle.

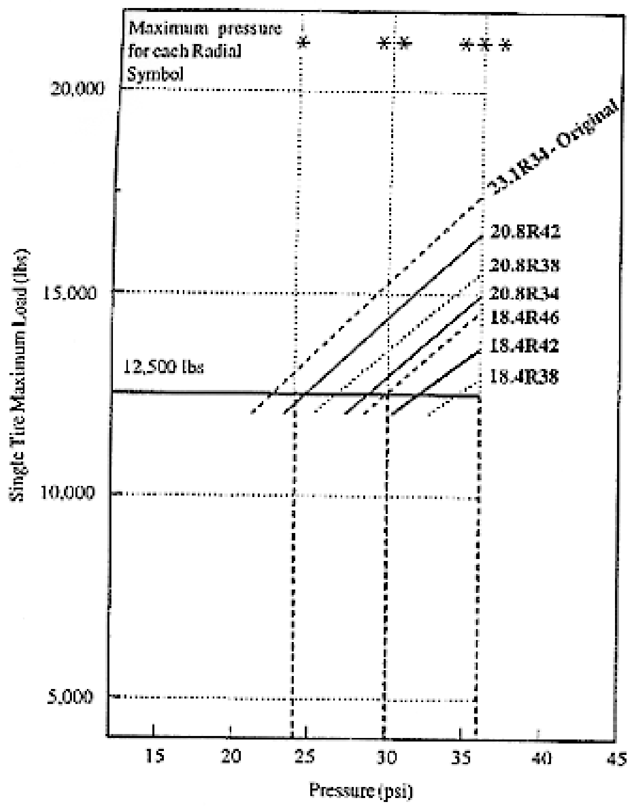

Figure 3. Example of using the radial tire load and inflation pressure chart to select a substitute tire that will have a narrower footprint.

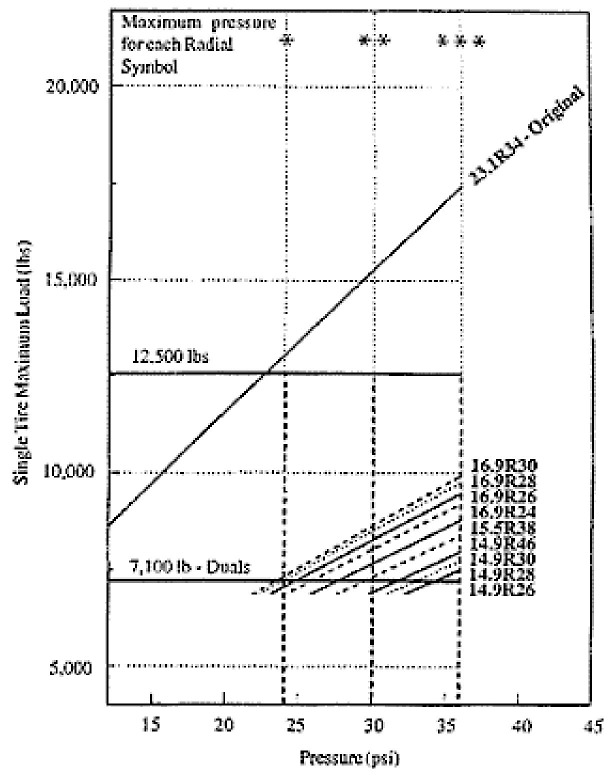

Figure 4. Example of using the radial tire load and inflation pressure chart to select substitute tires that can be used as straddle duals will have a narrower footprint.

Example 2. Suppose a combine has a maximum drive axle load of 25,000 pounds and is currently equipped with 23.1R34 tires with a "*" rating and operated at 24 psi. The combine will be used in 30-inch rows for ridge-till crop production. With wider rows, the 23.1R34 tires has about 6 inch clearance for the ridges which may not be sufficient in most conditions. The desire is to both increase flotation and equip the combine with straddle duals.

Since the combine drive axle load is 25,000 pounds, the single tire load capacity needs at least a 12,500 pound load carrying tire (25,000 lb / 2 tires per axle). The load and inflation pressure chart (*Figure 2*), indicates other single tires that could be used (as discussed in Example 1). For dual application, an adjustment is needed before consulting the chart. Dual applications require the loads reflected in the charts to be reduced by 88 percent.

For this application, the load capacity for dual tires should be 7,100 pounds ((25,000 lbs/4 tires per axle)/0.88). *Figure 4* shows several tires available for use as straddle duals. All the 16.9 radial tires, 24-, 26-, 28- and 30-inch, could be considered with a "**" rating and operated at 30 psi. A 15.5R38 tire could be used as a "**" rating and all of the 14.9 radial tires, 26-, 28-, 30- and 46-inch, could be used at a "***" rated tire and operated at 36 psi. This would give a total of 9 tires to consider.

In this example, tire height is the key factor. The only tire close to the original overall diameter (*Table I*) is the 14.9R46. The remaining tires are 10 to 20 inches shorter, which could reduce the head adjustment range and combine clearance by 5 to 10 inches. The 14.9 tire has a 35 percent reduction in footprint width per interrow over the 23.1 tire and increases the flotation by 29 percent due to tire contact with duals. The final choices should be confirmed with the tire and/or combine manufacturer.

Table I. The section width, overall diameter and minimum spacing between duals for radial and bias-ply drive tires (tires shown in *Figures 1* and *2*).

	Radial			Bias-Ply		
Section Width (inches)	Radial Tire Size	Overall Diameter	Minimum Dual Spacing	Bias-Ply Tires Size	Overall Diameter	Minimum Dual Spacing
		———-(inches) ——— -			———-(inches) ——— -	
13.6	13.6R28	51.6	17.5			
14.9				14.9-24	49.8	17.9
14.9	14.9R26	51.8	18.9	14.9-26	51.8	17.9
14.9	14.9R28	53.8	18.9			
14.9	14.9R30	55.8	18.9			
14.9	14.9R46	71.8	18.9			
15.5	15.5R38	61.8	19.6			
16.9	16.9R24	52.5	21.1	16.9-24	52.5	20.1
16.9	16.9R26	54.5	21.1	16.9-26	54.5	20.1
16.9	16.9R28	56.5	21.1			
16.9	16.9R30	58.5	21.1			
16.9	16.9R38	66.5	21.1			
18.4	18.4R26	57.1	22.7	18.4-26	57.1	21.7
18.4				18.4-30	61.1	21.7
18.4	18.4R34	65.1	22.7	18.4-34	65.1	21.7
18.4	18.4R38	69.1	22.7	18.4-38	69.1	21.7
18.4	18.4R42	73.1	22.7			
18.4	18.4R46	77.1	22.7			
20.8	20.8R34	68.2	25.4			
20.8	20.8R38	72.2	25.4	20.8-38	72.2	24.4
20.8	20.8R42	76.2	25.4			
23.1				23.1-26	63.2	26.9
23.1				23.1-30	67.2	26.9
23.1	23.1R34	71.2	27.9	23.1-34	71.2	26.9
23.1	24.5R32	71.0	29.5	24.5-32	71.0	28.5
28.1				28L-26	63.6	32.4
30.5	30.5LR32	71.6	36.1	30.5L-32	71.6	35.1

Data from the 1995 Tire and Rim Association.

[1]Manuscript adopted from: Parson, S.D. 1984. Wheel spacings of self-propelled combines - compatibility with ridged crops. Purdue University, Cooperative Extension. AE-120. 24 pgs.

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