11-29-82
New
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FACT SHEET

RADIAL TRACTOR TIRES

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The power developed by any tractor engine is largely utilized in four areas: rolling resistance, wheel slippage, action of tire lugs on the soil and tractor-drawbar resistance. The most efficient tractor is one in which the first three factors are low, so that the net power available at the drawbar is as high as possible.

Consider radial ply tractor tires when looking for ways to increase traction efficiency and get more power to the ground.

Ply Rating of Tires

The Tire and Rim Association and the Rubber Manufacturers Association have defined ply rating as: "The term used to identify a given type of tire with its maximum recommended load, when used in a special service. It is an index of tire strength and does not necessarily represent the number of cord plies in the tire." The ply rating for agricultural tractor tires ranges from two to 12 depending on the type of service.

Conventional Tire

The body of a conventional (bias) tire consists of layers, or plies, set diagonally to the tread and criss-cross at an angle called a bias angle. The cords are arranged in two or more plies, depending on the strength needed. The bias ply has a relatively stiff sidewall to provide stability.

Radial Tire

Radial tires have plies that run at right angles to the tread and may have one or more layers or plies. A belt around the radial ply tire gives it stability and strength. This design, with plies running 90 degrees to the tread, lets radial sidewalls flex more than bias tires and produces a larger, more stable ground contact area.

Test Results

North Dakota State University (NDSU) has conducted field tests to compare radial-ply to bias-ply tractor tires. The tires were both manufactured by the same company. Tires tested were 18.4-38, 6-ply, inflated to 14 PSI, with no liquid ballast. A 112-horsepower tractor was used to pull an 18-foot cultivator with spike teeth. The cultivator was

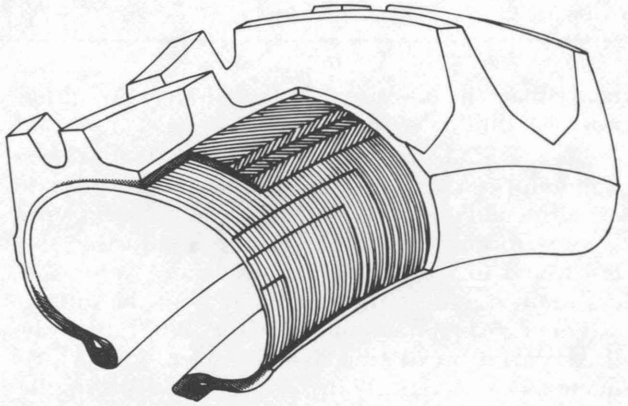

Figure 1. Fabric cords in a conventional tire are in diagonal layers.

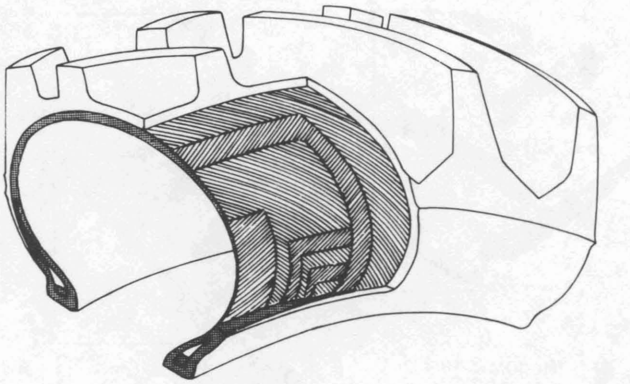

Figure 2. Cords in a radial-ply tire are in parallel layers with belts under the tread area.

adjusted to run at a constant depth during all tests. Tests were conducted on Fargo clay soil in two separate summer fallow fields. Each test consisted of five rounds on one-half-mile-long fields. The tractor was run at full throttle in the same gear for all tests. Each test was repeated twice.

The results (Table 1) indicate radial-ply tires reduced fuel consumption 7.25 percent. Slippage was reduced from an average of 13 percent for conventional tires to an average of 9.75 percent for radial-ply tires. Radial-ply tires increased the effective field capacity from 9.23 acres per hour to 9.62 acres per hour, an increase of 4.2 percent.

Similar tests conducted by a major tire manufacturer under several soil conditions (Table 2) indicate that the radial ply tire performed slightly

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Table 1. Results of field tests conducted by North Dakota State University to compare radial-ply and bias-ply tractor tires.

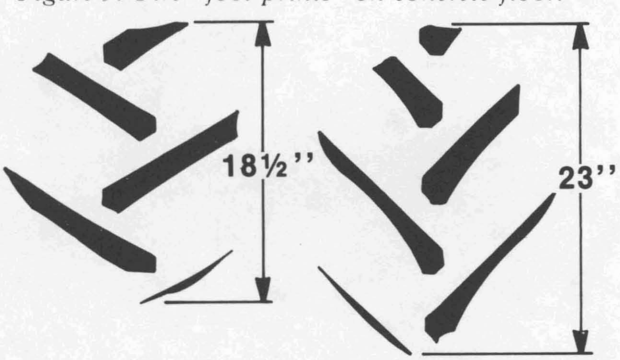
Field and tire	Fuel consumption, gallons/acre	Effective field capacity, acres/hour	Percent slippage
Loose Fallow			
Conventional	0.62	9.00	14.6
Radial ply	0.58	9.57	10.3
Firm Fallow			
Conventional	0.62	9.47	11.4
Radial ply	0.57	9.67	9.2

better than the bias tire on a large four-wheel-drive tractor with dual wheels.

The USDA National Tillage Machinery Laboratory compared a smooth (no tread) experimental tractor tire of radial construction with a conventional bias tire. Engineers conducting the test found that the radial tire was more stable and maintained more uniform contact with the soil.

The increased traction efficiency of the radial-ply tire is partially explained by the longer "foot print" made by the radial-ply tire (Figure 3) which results in more tire soil contact.

Figure 3. Tire "foot prints" on concrete floor.



BIAS (Regular) 18.4-38, 6 ply, 14 psi, load 3,500 lb, W16L rim

RADIAL 18.4-38, 6 ply, 14 psi, load 3,500 lb, W16L rim

Cost of Radial Tires

The major limiting factor of radial tractor tires is cost. The average retail price for a pair of 18.4-38 eight-ply tires in September 1981 at Lubbock was approximately $400 more for the radial ply tires than for similar conventional bias tires. More material, labor, and production costs are required in manufacturing radial tires.

Assuming a fuel cost of $1.10 a gallon (diesel) and using the NDSU field data, the following economic analysis can be made:

Fuel Cost Per Acre

Bias tire .62 gallons/acre × $1.10/gallon = $0.682/acre

Radial ply tire .58 gallons/acre × $1.10/gallon = $0.638/acre

Fuel cost savings with radials $0.044/acre

Acres Covered to Recover Higher Cost

$$\frac{\text{Added investment of radials (\$400)}}{\text{fuel cost savings with radials (\$0.045/acre)}} = 9091 \text{ acres}$$

Hours of Operation Required to Recover Higher Cost

$$\frac{\text{Acres covered to recover higher cost (9091 acres)}}{\text{field capacity with radials (9.62 acres/hour)}} = 945 \text{ hours}$$

In reality, both heavier (moldboard plowing, chisel plowing, etc.) and lighter (drilling, harrowing, etc.) field operations are conducted during a typical year. Therefore, using figures from test work involving the use of an average drawbar load such as a field cultivator should give close estimates.

Equipping larger tractors with dual radials or four-wheel-drive units with light radials will increase the investment. However, fuel cost savings also increase with larger tractors that use higher rates of fuel while covering more acres per hour.

Increases in both field capacity and tire life are other factors to be considered. Both time and fuel savings are achieved with less slippage when operating with radials. Less slippage means less tire wear, which should give longer tire life. Putting a price on these factors may help to offset the higher initial cost of radials even more.

A reduction in slippage may be achieved more economically by the addition of weight to bias tires. However, when the optimum tractor weight level is reached, additional weight will result in increased soil compaction and an increase in rolling resistance. More weight requires additional power to move the tractor across the field, causing a reduction in usable horsepower.

Table 2. Comparison of bias and radial tires on a large four-wheel-drive tractor.

Test Comparison	Statistic Load		Travel reduction		Maximum drawbar horsepower		
	Front axle lb	Rear axle lb	Sod %	Disked Soil %	Sod hp	Disked Soil hp	Clay track hp
18.4 — 38, 6 ply, R-1 bias, dual.	19,500	11,500	12.2	12.2	171	154	154
18.4R — 38, 6 ply, R-1, radial, dual.	19,620	11,670	10.1	9.0	172	160	168

Cooperative Extension Work in Agriculture and Home Economics, The Texas A&M University System and the United States Department of Agriculture cooperating. Distributed in furtherance of the Acts of Congress of May 8, 1914, as amended, and June 30, 1914.
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