

## University of Missouri Extension

G1231, Reviewed October 1993

# Are Radial Tractor Tires Cost Effective?

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When Pirelli Co. developed the first radial tractor tire in 1957, the company claimed it would develop 20 percent greater traction with less slippage at equal load than an equivalent bias-ply tire. (Forrest, et al. 1962) Subsequent research has confirmed that radial tires have the advantage in tractive efficiency. H. Erdal Ozkan, state extension specialist at Ohio State University, has reviewed all available research results related to field performance of tractors equipped with radial and bias ply tires.

Author	Increase in tractive efficiency for radials
Seleznev and Kovalez (1968)	13 percent
Bohnert and Kenady (1975)	7 percent
Hoffman (1983)	8 to 9.5 percent
Hausz and Akins (1980)	7 to 13 percent

In most cases, the research was done with the same wheel slip for radial and bias tires. This may have kept the radial tires from reaching the predicted 20 percent advantage.

Drawbar pull tests were reported as follows:

Author	Wheel slip	Soil	Advantage of radial
Forrest (1962)	less than 15 percent	Sand Loam Clay	8 percent 23 percent 21 percent
Thaden (1962)	16 percent		29 percent
Mumgaard and Rudakov (1975)	15 percent	Firm	15.5 percent

Bohnert and Kenady (1975)		Tilled Sod	14.6 percent 18.8 percent
Gee-Clough (1977)	20 percent		5-8 percent

Field capacity and fuel consumption were studied:

Author	Increase in field capacity for radials	Reduction in fuel consumption for radials
Seleznev and Kovalez (1986)	10.7 percent	13 percent
B.F. Goodrich Co. (1981)	12.3 percent	12.8 percent
Bohnert and Kenady (1975)		16.4 percent
Hauck and Kucera (1983)	2.1 percent	6.5 to 8.1 percent
Hausz and Akins (1980)	5 to 7 percent	6 to 10 percent

Conditions used by investigators were not constant, and results cannot be directly compared. Radial tires, however, do seem to have the advantage in every category except purchase price. Resistance to abrasive wear seems about the same for radial and bias tires, but radial tires have much longer tread life than bias tires. Radial tires will have service life 25 to 40 percent longer than equivalent bias tires (Ozkan, 1986).

Ownership cost usually includes depreciation, interest on investment, tax, shelter and insurance. For a comparison of tires, the difference in tax, shelter and insurance cost was thought to be negligible and was omitted. The capital recovery factor was used to estimate ownership cost because it accounts for both depreciation and return on investment.

To compute annual tire ownership cost; unit tire cost; fuel cost for radial and bias tires; labor cost for radial and bias tires; and total savings per hour and hours use required to break even, use the following equations:

## Equations

### Equation 1

$$TOC = \frac{TP(IR(1 + IR)^n)}{(1 + IR)^n - 1}$$

**TOC = Tire ownership cost (\$)**

**TP = Tire purchase price (\$)**

**IR = Annual interest rate (decimal)**

<sup>n</sup> = Average service life (years)

## Equation 2

$$UTC = \frac{TOC}{AU}$$

**UTC = Unit cost (cost per hour)**

**AU = Annual tire use (hours per year)**

Fuel cost for radial and bias tires may be computed using Equations 3 and 4.

## Equation 3

$$F_B = GPH \times UFC$$

**F<sub>B</sub> = Fuel cost for bias tires (cost per hour)**

**GPH = Fuel consumption for bias tires (gallons per hour)**

**UFC = Unit fuel cost (cost per hour)**

## Equation 4

$$F_R = F_B (1 - RF)$$

**F<sub>R</sub> = Fuel cost for radial tires (cost per hour)**

**RF = Reduction in fuel consumption for radial tires (decimal)**

Labor cost for radial and bias tires may be estimated as follows:

## Equation 5

$$L_R = \frac{L_B}{1 + IFC}$$

**L<sub>R</sub> = Labor cost for radial tires (cost per hour)**

**L<sub>B</sub> = Labor cost for bias tires (the assumed hourly wage rate)**

**IFC = Increase in field capacity for radial tires (decimal)**

Total savings per hour and hours required to break even are computed as follows:

### Equation 6

$$NSH = (F_B \times F_R) + (L_B - L_R) - (UTC_R - UTC_B)$$

**NSH = Net savings per hour (cost per hour) for radials**

**UTC<sub>R</sub> = Unit ownership cost for radial tires (cost per hour)**

**UTC<sub>B</sub> = Unit ownership cost for bias tires (cost per hour)**

### Equation 7

$$BE = \frac{TP_R - TP_B}{NSH}$$

**BE = Tire use required for radial cost to break even with bias cost (hours)**

**TP<sub>R</sub> = Tire purchase price for radial tires (\$)**

**TP<sub>B</sub> = Tire purchase price for bias tires (\$)**

## Example calculations

Assumed input data:

Tractor maximum PTO power = 150 hp

Tractor annual use = 625 hours

125 hours stationary (tires not used)

500 hours mobile (tires used)

Diesel fuel cost = \$1 per gallon

Cost for 2 radial tires = \$1,500

Cost for 2 bias tires = \$1,000

Expected bias tire life = 2,500 hours (5 years)

Labor cost = \$5.20 per hour

Increase in field capacity for radial tires = 10 percent

Expected increase in life for radial tires = 30 percent

Expected fuel saving for radial tires = 6 percent

Average interest rate = 9 percent

Fuel efficiency for tractors with bias tires = 14 hp-hours per gallon

**Annual tire ownership cost (using Equation 1)**

$$TOC_B = \frac{1000 (0.09(1 + 0.09)^5)}{(1 + .09)^5 - 1} = \$257.09 \text{ per year}$$

$$TOC_R = \frac{1500 (0.09(1 + 0.09)^5)}{(1 + 0.09)^5 - 1} = \$385.64 \text{ per year}$$

**Unit tire cost (using Equation 2)**

$$UTC_B = \frac{\$257.09 \text{ per year}}{500 \text{ hours per year}} = \$0.51 \text{ per hour}$$

$$UTC_R = \frac{\$385.64 \text{ per year}}{500 \text{ hours per year}} = \$0.77 \text{ per hour}$$

**Fuel cost (using Equations 3 and 4)**

Fuel efficiency with bias tires (given) = 14 hp-hours per gallon

$$\text{Fuel consumption} = \frac{150 \text{ hp}}{14 \text{ hp-hours per gallon}} = 10.71 \text{ gallons per hour}$$

$$F_B = 10.71 \text{ gallons per hour} \times \$1 \text{ per gallon} = \$10.71 \text{ per hour}$$

$$F_R = 10.71 (1 - 0.06) = \$10.07 \text{ per hour}$$

**Labor cost (using Equation 5)**

$$L_B = \$5.20 \text{ per hour}$$

$$L_R = \frac{L_B}{1 + IFC} = \frac{5.20}{1 + 0.10} = \$4.72 \text{ per hour}$$

**Total savings per hour (using Equation 6)**

$$NSH = (10.71 - 10.07) + (5.20 - 4.72) + (0.77 + 0.51) = \$0.86 \text{ per hour}$$

## Use required to break even (using Equation 7)

$$BE = \frac{1500 - 1000}{0.86} = 581.39 \text{ hours}$$

$$\frac{581.39 \text{ hours}}{500 \text{ hours mobile use per year}} = 1.16 \text{ years}$$

## References

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