

ABSTRACT

The present study was undertaken to evaluate the traction potential of bias-ply tyres used in agricultural tractors in the country. The study was conducted in two phases. In the first phase the deflection and contact characteristic of four bias-ply tyres (12.4×28, 13.6×28, 14.9×28 and 16.9×28 all with 12 ply rating) were studied on a hard surface. The normal load on the test tyres was varied from 5.89 to 19.13 kN and inflation pressure from 69 to 234 kPa. Based on the test observations, three empirical models were developed to predict deflection, ground contact area and ground pressure of the bias-ply tyres. These models were also compared with a few existing models and were found to perform well. The developed deflection model was used to determine possible combinations of normal load and inflation pressure to achieve desired deflection of 18, 22 and 26 per cent for each tyre.

In the second phase of the study the traction performance of the same test tyres were evaluated under controlled laboratory soil bin conditions. The experimental set-up consisted of a soil bin filled with lateritic sandy clay loam soil, a single wheel test rig for mounting the test tyres and a loading device for varying the drawbar pull. A torque sensor was used to measure the torque input to wheel axle and a ring transducer was used to measure the drawbar pull. A zero condition test was conducted on a hard surface to determine the theoretical rolling radius of each wheel. The wheel slip was calculated by determining the theoretical and actual velocities of the wheel. The tests were conducted under three different soil conditions in the cone index range of 600-700 to 1700-1800 kPa. The deflection of each tyre was varied from 18 to 26 per cent by varying normal load and inflation pressure. The test observations were used to calculate coefficient of traction and tractive efficiency at different values of wheel slip under varying test conditions. The curves were plotted to study the variation of tractive efficiency and slip with coefficient of traction under varying soil cone index, normal load and tyre deflection. Finally the test data were utilized to develop models for prediction of gross traction ratio and motion resistance ratio in terms of wheel, soil and system parameters. The developed models were compared with some of the existing models and were found to perform well. Based on the developed models a tractive efficiency design curve has been constructed. This curve will help to achieve optimum performance parameters for a traction wheel under given soil condition, which can be adopted for economic operation of agricultural tractors in the field.

Key words: Bias-ply tyre, normal load, deflection ratio, ground pressure, zero condition, wheel slip, drawbar pull, wheel sinkage, cone index, torque ratio, gross traction ratio, motion resistance ratio, coefficient of traction, tractive efficiency, traction model, Pi terms, Brixius number.