ASSESSMENT OF SOIL COMPACTION CAUSED BY COTTON PICKERS

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Our Fibre. Our Focus. Our Future

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Aim

To quantify and explain patterns of soil compaction caused by cotton pickers and to develop a set of practical recommendations for minimising soil damage during harvesting operations.

Materials and Methods

Soil bulk density (SBD) and cone index (CI) measurements were determined for three different traffic treatments performed on a black Vertosol: zero-traffic (control), single pass of a JD7760 fitted with single tyres (front: 620/70-R42, rear: 520/85-R34) inflated to the manufacturer's recommended pressure and driven over previously non-wheeled soil (moisture content: 24.3±2.6% w w^{-1}), and permanent (15 years old) traffic lanes representative of controlled traffic systems. Soil cores (0 to 700 mm depth range) were taken from four positions: two on the shoulders of the rut and two on either side of the centreline. Cone index was measured by pushing a cone (125 mm^2 base area, 30° apex) into the soil to a depth of 500 mm and digitally recording the required force at 25 mm depth increments. A higher CI infers higher resistance to penetration. Readings were taken perpendicular to the direction of travel every 100 mm spacing, and in three positions along the field at 20 m spacing. Soil bulk density and cone index measurements were replicated three times (n=3) for all treatments.

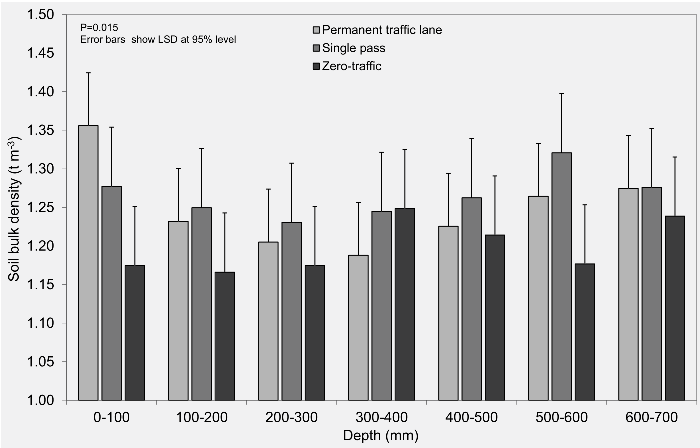

FIGURE 1. Soil bulk density observed for the three traffic treatments.

Results and Conclusions

Figure 1 shows SBD data recorded for the three traffic treatments. Overall, there were significant differences ($P<0.05$) in SBD between wheeled (≈1.26 t m^{-3}) and non-wheeled (≈1.20 t m^{-3}) soils. The single pass treatment exhibited similar ($P>0.05$) SBD to that of the permanent traffic lane. A single pass of the picker increased SBD by about 6% on average over the measured depth compared with the non-wheeled soil. Changes in SBD on the single pass treatment were greater between 200 and 400 mm deep (range: 7.5% to 13% increase relative to non-wheeled soil). Overall, there were significant differences ($P<0.001$) in CI between traffic treatments; the zero-traffic treatment showed lower CI (≈4000 kPa) compared with the single pass treatment (≈4660 kPa), and the permanent traffic lane (≈5534 kPa). Under the wheel, CI increased significantly ($P<0.001$) toward the centreline of the rut, which agrees with previous studies (Antille et al., 2013). There was also a small increase (<10%) in CI recorded at locations laterally outboard of the wheeling, which is attributed to lateral soil displacement induced by traffic with the picker. These results confirm the importance of controlled traffic in minimising soil compaction. Without controlled traffic, varied equipment track widths translate into random traffic patterns which cover up to 85% of field area each time a crop is produced (Tullberg, 2010). Studies are being conducted on irrigated and dryland cotton farms in Queensland to determine soil moisture deficit thresholds for limits to trafficability with cotton pickers.

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