UNDERSTANDING THE JD7760 ROUND MODULE PICKER IMPACTS

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Summary

This paper communicates further the findings, pertaining to the John Deere 7760 (JD7760) round module picker, of the Cotton Growing Practices 2013 industry survey and current research at the National Centre for Engineering in Agriculture. The grower data is used to highlight decision making processes used and provides insight into potentially latent impacts on system components, particularly the land resource. Adoption drivers and considerations are discussed against machine potential, the Australian picker market and the potential for soil compaction is demonstrated to contrast considerations.

Introduction

The inception of the John Deere 7760 on board module picker (JD7760) has seen what is generally agreed as the fastest uptake of cotton system technology in Australian cotton industry history. In the season picked in 2013, 82% of cotton was picked (entire industry average) using the JD7760, while John Deere reports that the current supply of this picker to the Australian market is capable of picking 125% of the industry cotton produced (Pers. Comm. Broughton Boydell). This papers reports on the harvesting section of the Cotton Growing Practices 2013 survey (Bennett 2013) and uses this information to highlight impacts of the JD7760 on the Australian cotton industry, with a particular focus on the land resource and future decision making processes.

Method

The primary data for this paper was obtained from a grower survey conducted by Roth Rural (2013) on behalf of the Cotton Research and Development Corporation (CRDC). The survey was mail-based and included the survey, a quick response sheet for those not wanting to complete the survey and a stamped self-address envelope. There was opt-in ability through cotton research and development officers. The total number of surveys sent out was 1000 and the effective sample size was reduced to 837 by removing a portion of respondents who indicated they didn't grow cotton, had not grown cotton that year, return to sender mail-backs,

and duplicate addresses. From the valid responses (165), this represented a 20% return rate and approximately 23% and 27% of the irrigated and dryland cotton area grown in 2013. Non-response was not assessed for bias.

Through grower consultation at regional discussion groups and through face-to-face discussions with field trial participants in early 2013 a cotton system impacts framework was constructed to display the identified impacts of the JD7760. A total of 12 growers attended the discussion groups held in Dalby, Goondiwindi, Narrabri and Warren with a further 8 extension and industry staff attending. Face-to-face discussions were held with a further 8 growers. These and the survey data were used to draw out potential latent impacts.

Soil propagation stress diagrams were drawn using Matlab from SoilFlex (Keller *et al.* 2007) output. Input variables used in SoilFlex were provided by John Deere scale drawings and specifications, while tyre inflation pressures and characteristics were used as those recommended by John Deere. Soil pre-consolidation stress was taken from the average of 18 Vertosols in the Australian cotton industry for a range of moisture contents (air-dry to saturation) provided by Kirby (1991). This data was used on the basis it provided an estimate of a likely soil moisture and pre-consolidation stress likely to be encountered by the industry on average for at least one soil depth under the influence of JD7760 propagation stress.

Results and discussion

Motivations to switch to the JD7760 were primarily driven by decrease in labour requirement for picking (76% selecting defining (D) or major (M) motivation), ability to pick cotton crops more quickly (75% selecting D and M motivation), and decreased WH&S risk (64% selecting D and M motivation). Whilst there was an industry response suggesting that the JD7760 system cost as much to run as previous basket system (Fig 1), 52% of growers had adopted the JD7760 with the view they would be saving money. The decision to adopt was indicated as being an on-farm, or individual, decision with growers indicating 16% and 6% M and D motivation due to discussions with neighbours or a dealer, respectively. Hence, it is highlighted that a sound economic understanding of the technology integration into the current system should be undertaken. To address this, we developed the impact framework in Fig 1 to demonstrate the findings from interaction with the Australian cotton industry and available literature.

Supply chain impacts such as gin pressure and picker transport (not identified due to being largely dealt with) have been acted upon by the industry quickly, which is a testament to the Australian industry ability to deal with rapid change. However, some of the more latent impacts have been identified as a possible over supply of the JD7760 to the Australian market and soil compaction ramifications such as energy consumption during field preparation for subsequent crops.

Adding emphasis to the John Deere estimation that 125% of Australian cotton could be picked with the current supply of JD7760 machines, it was observed that the average area being picked by these machines (excluding contract picking) was 650 ha, although some growers indicated picking almost twice that. This suggests that these machines are being underutilised, which is something that 61% of growers owning/leasing their machine sought to offset by contract picking. However, whilst more growers
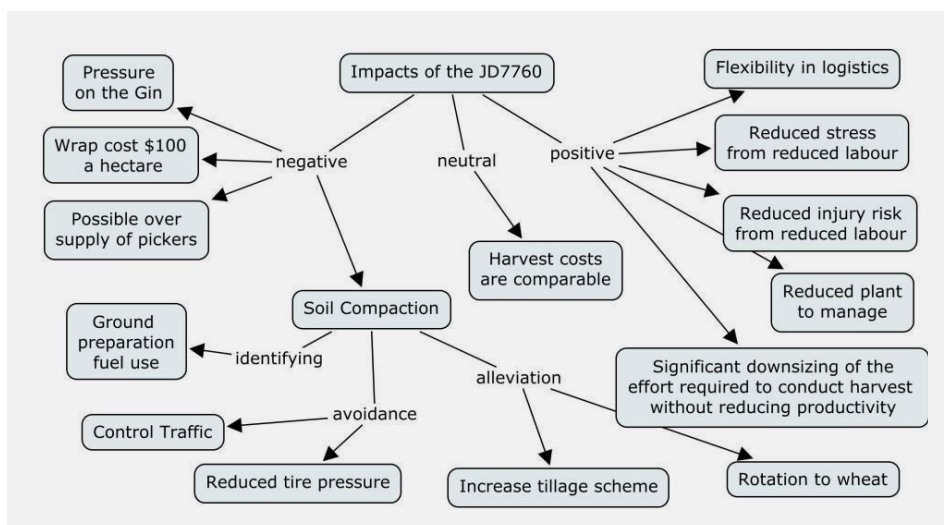

FIGURE 1. Framework of impacts of incorporating the JD7760 into the Australian cotton system drawn from Australian perspective and literature. Components of "identifying", "avoidance" and "alleviation" were inferred from literature and face-to-face follow up discussion, not the survey data.

indicated using a contractor with a JD7760 than using an owned/leased JD7760, contractors picked less cotton area. This certainly seems to suggest that the contract picking market is becoming saturated and that contract picking may not be a viable way to pay off the JD7760 investment into the future.

When asked about operational factors that were considered immediately prior to the point of purchase it was found that the major considerations were the ability to get the machine serviced, cost of module wrap, availability of parts, as well as machine and module transport. Consideration of soil compaction or the machine weight was low in comparison and the ability for the machine to integrate into a controlled traffic system even less so (15% of growers believing this was a M or D consideration). Whilst growers did indicate that getting cotton out of the field is priority, they also suggested that traversing soil at undesirable soil moisture content would be avoided where possible.

Given the weight of the machine and the specified standing wheel loads at their maximum under machine standard conditions (Front 5432 kg; Rear 8441 kg) it becomes apparent that soil compaction is inevitable if soil moisture conditions are not soundly adhered to. To demonstrate this here we have produced Fig 2 whereby a single pre-consolidation stress (P_c)

is used based on average data (P_c=99 kPa) of Kirby (1991) and SoilFlex wheel propagation stress (Keller *et al.* 2002). At stresses above the P_c soil compaction is permanent, while at imposed stress less than the P_c the effects of stress are more tolerable and will rebound to a certain extent. Tillage can help to shatter compacted layers, but the soil structure is effectively permanently altered at stress above the P_c.

For the single wheeled basket system it can be seen that compaction effects are limited, with every row afforded an equal amount of white space, which can be thought of as undeterred access to water and nutrients, all other things equal. On the other hand, two out of every set of six rows are impeded by the dual wheel system and white space is reduced. Whilst the blue zones (propagation stress<P_c) rebound and don't undergo permanent compaction, they do undertake some modification of soil structure that may compound throughout subsequent seasons.

The point of this demonstration is not to suggest that a reversion to the basket system should be made, but to highlight the importance of considering the effects on the soil resource when adopting large machinery. Anecdotal discussions with growers suggest that they have incurred a greater cost in terms of energy use

when tilling post JD7760 use. Hence, it will be important to continue to understand management considerations and strategies to minimise the risks of soil compaction. Current investigations through the CRDC NEC1301 project include the use of a single wheel on the front of the JD7760, planning plant date for a drier pick, changing compaction depth via manipulating tyre and inflation characteristics, later defoliation to dry down profile, as well as the ability to use existing soil models to predict soil compaction in Australian Vertosols as a decision aide for growers.

Conclusion

With the rapid adoption of the JD7760 picking system has come a series of supply chain impacts, as well as some more latent impacts associated with the soil resource and ability to offset the investment cost. The initial perception of financial savings by changing systems motivated about 50% of the industry to adopt the JD7760 system, but industry feedback suggests this saving is not real. The bulk of operational considerations were machine related, which, while understandable, masked consideration of how the soil resource might be impacted. It was also apparent that the decision to purchase the JD7760 was primarily an on-farm decision. Hence, there will be value in continuing to synthesise the information currently available and to further investigate and quantify soil resource impacts to generate some guideline prompts for consideration prior to adoption of other significant machinery.

References

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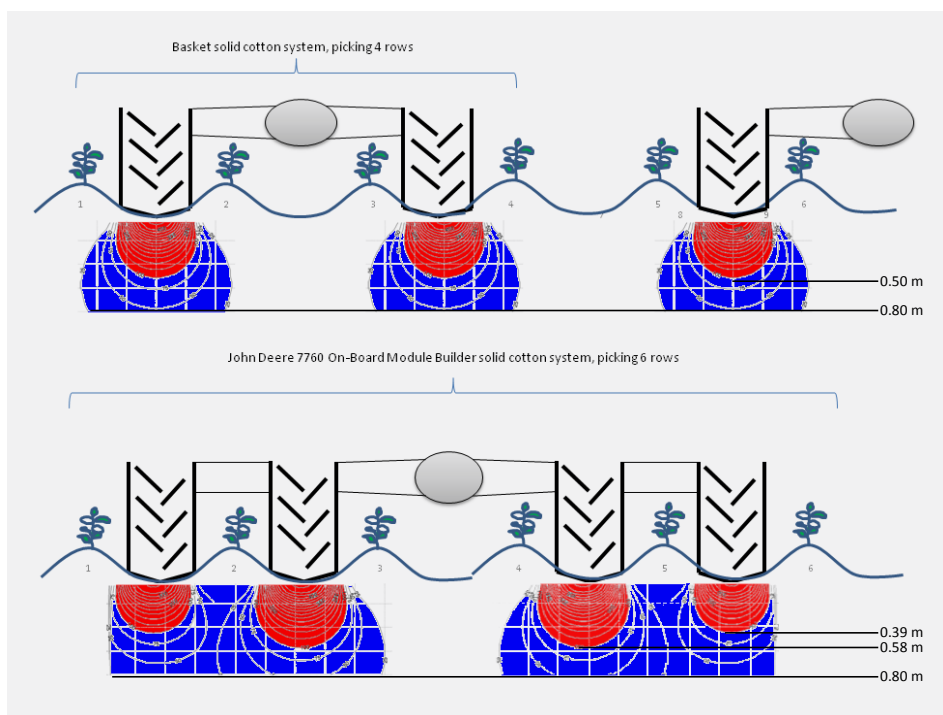
FIGURE 2. Diagrammatic representation of compaction potential under four row basket and six row JD7760 picking systems for a set of six rows. Red represents stress propagation greater than the pre-consolidation stress (irreversible), while blue represents stress propagation less than the pre-consolidation stress (somewhat reversible). Maximum depth shown is 0.8 m and propagation stress <25 kPa is not shown. Propagation stress diagrams are to relative scale, while the depiction of the rows, crop and machines are not. The pre-consolidation stress used is 99 kPa for a moisture content of 32% with uniform moisture content throughout the full soil profile assumed.

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