ON-FARM CONTROLLED TRAFFIC SYSTEMS FOR IMPROVING BENEFITS OF DEEP TILLAGE WITH BROADACRE CROPPING IN WA;

WITH COMMENTS ON CHOICE OF TRACTION SYSTEMS AND APPLICATION TO NO-TILLAGE

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INTRODUCTION

There has been no deliberate research of controlled traffic in WA broadacre cropping before 1990. On-farm investigations have come from the inventiveness of two innovative farmers in the Northern Wheatbelt (Boyle, 1991). Vic Vlahov, of Yuna, had noticed crop growth patterns in his sand paddocks which corresponded to the tractor tracks at seeding. He then adjusted his spray width to match the spray tracks with the seeding tracks and invent his own controlled traffic system in a wheat/blue lupin pasture rotation. I began research on his farm four years after he began the method, especially to improve the long term benefits of deep ripping the compact layers of the sand.

Graeme Malcolm is chairman of the very active Koolanooka-Bowgada Landcare group south of Morawa. On hearing of Vic's system at landcare meetings he decided to try it for his sandy loam soil to improve any long term benefits of breaking up traffic pans. Compaction layers are found in both soils at about 20-30 cm depth. Deep ripping is expensive, but has usually provided yield benefits in the sand, though not so reliably in the heavier textured soils (Perry and Hillman, 1991). Avoidance of recompaction by controlled traffic and direct drilling seemed a sensible strategy to improve the benefits of deep ripping.

With little more than fuel costs, the use of a penetrometer and a weighing trailer, much on-farm collaboration and regular hospitality we have been able to establish that broadacre controlled traffic is practical, can help benefits of deep ripping last at least three years for improved production from the sand, as well as improved structure of the sandy loam. Fitting these systems into the timeliness pressure of the northern wheatbelt is difficult, as well as maintaining convenient matching of machinery.

Interest in the work from the University of Western Australia and CSIRO Division of soils also helped to understand the magnitude of stresses beneath rubber tyred or tracked tractors for the seeding operation. No-till farming is being rapidly adopted in WA, this may increase the risk of accumulated compaction and encourage more rapid development of controlled traffic systems for no-till cropping. There are many interesting possibilities for technical development in this area, especially in relation to compatibility with timeliness; the R&D future looks very stimulating.

METHODS

locations, landscapes and soils; Vic's farm is NE of Yuna, mainly sand, with about 300mm annual rainfall on the eastern, dissected edge of the Victoria sandplain, overlooking the broad Irwin and Greenough valley system. Wind erosion and compaction are the principle land degradation problems. Graeme's farm, south of Morawa, is mainly loam soil and has about 350mm annual rainfall. It lies among the lower valley systems which drain into chains of salt lakes; salinisation, water erosion and compaction are the main land degradation problems.

Methods, Equipment & Techniques.

Vic has the larger farm, larger paddocks and larger seeding equipment. We used a 21m wide seeding bar with 'Thomas' tines for seeding depth control, and a 500HP Steiger Tiger tractor at the time of the research (1990-1993). Graeme has many smaller paddocks and contour banks to negotiate, thus a smaller, 14m wide seeder and a 350 HP Steiger Panther tractor. The sand at Yuna was deep ripped in the winter of 1990, while in pasture, while the loam at Morawa was deep ripped in autumn 1991, before seeding. Extra ripping was also done at Yuna in 1991, before seeding. Crop was sown in the unwheeled and wheeled zones behind the tractor used at seeding. The system formed a more compact traffic lane about 5m wide in every seeding run. Both farms had spray booms that matched or could be adjusted to match the seeding width. Graeme's modification of the sprayer was most inventive. Two 20c coins and multigrip pliers closed off the excess nozzles at one end of the boom. Guidelines for the spraying were by a missing central crop row at Yuna, or the central ridge left by the pairs of prickle chains at Morawa. Parts of or half of paddocks were ripped to 30cm with deep rippers in 1990 and 1991 at Yuna and Morawa respectively. Table 1 is a brief cropping history.

Table 1. Summary of the cropping history at both sites during the research.

	Yuna (ripped 1990)		Morawa (ripped 1991)	
year	rainfall, mm	crop	rainfall, mm	crop
1990	334	pasture	-	-
1991	324	wheat	249	wheat
1992	429	pasture	449	wheat
1993	314	wheat	321	peas

Measurements of soil penetration resistance and water content were made each winter to document gross structure in the unripped, ripped unwheeled and ripped wheeled areas. Yield was measured with weighing trailers and small headers in the unripped, ripped unwheeled and ripped wheeltrack zones in 1991 and 1993 at Yuna and in 1991 and 1992 at Morawa.

RESULTS

Strength responses and their persistence.

Soil strength during drained periods of the winter showed the usual clear effects of ripping the hardpan on the sand. Measurements in 1993 at Yuna (Figure 1) revealed these effects has persisted over 3 years, where wheeling had been avoided. The benefits of lower soil strength from ripping had been removed by wheeling.

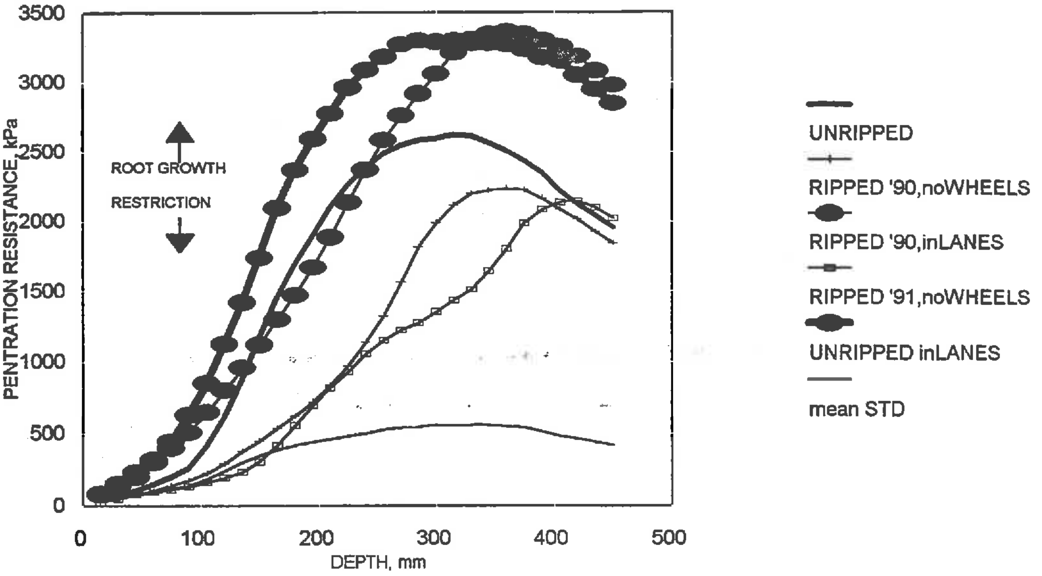
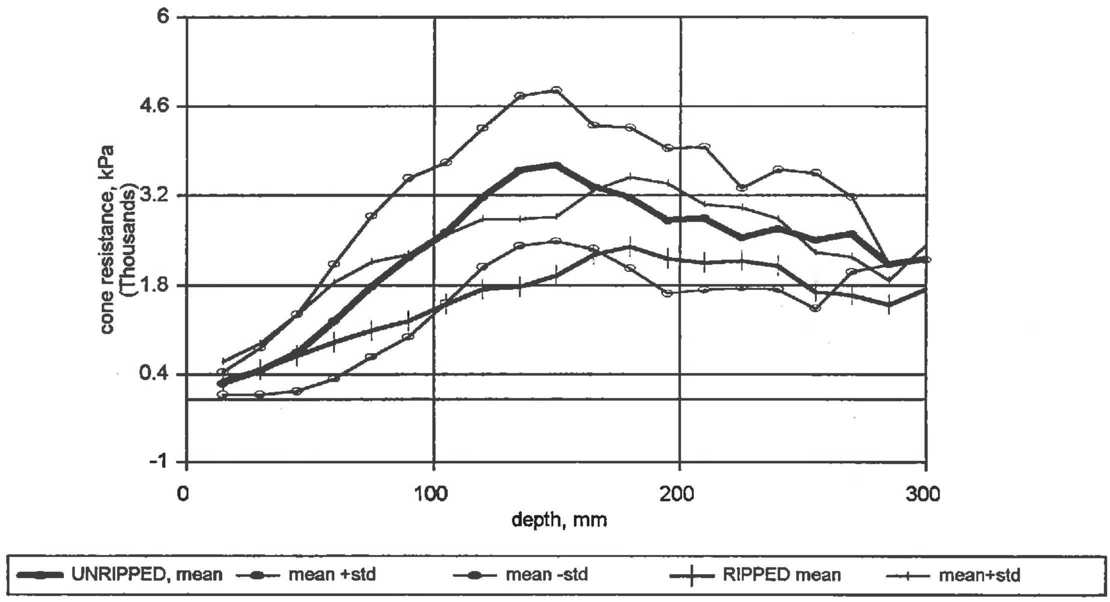


Figure 1. Soil Penetration resistance in winter 1993 at Yuna.

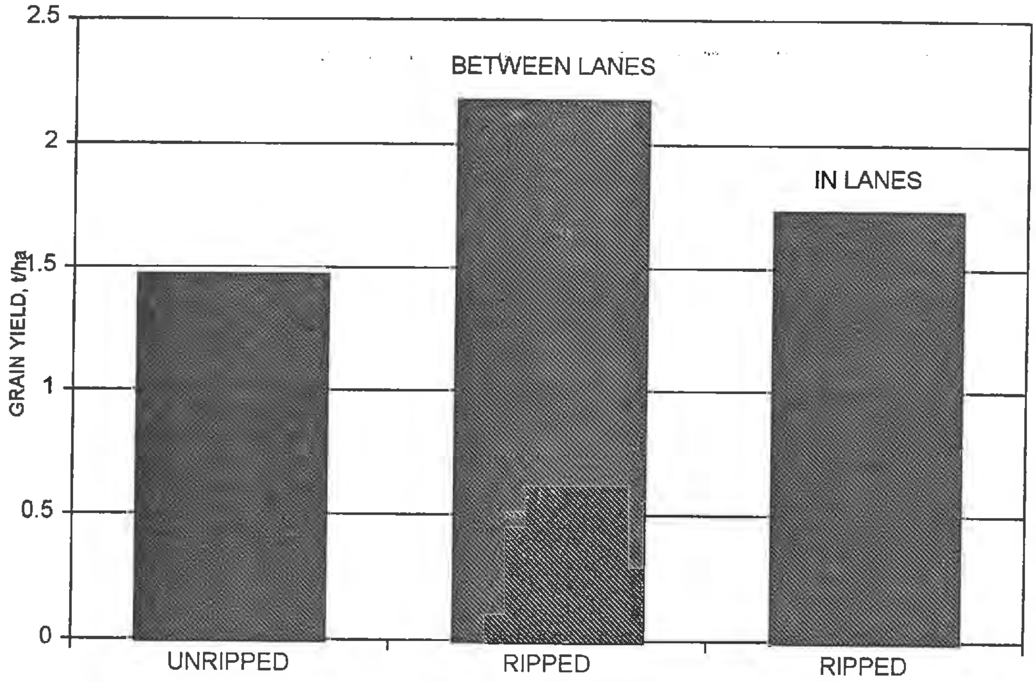
At Morawa the effects on ripping on soil strength of the loam where not so large as for the sand at Yuna. There was also much more variance in the soil strength measurements (Figure 2). The variance corresponded with the more structured soil with peds from remanent fragments of the ripped soil. The benefits to soil strength could be seen after two years, but not confidently after three years. However there was still visible evidence, in 1994, of a better, more permeable structure, of the loam four years after ripping.

Figure 2. Penetration resistance in unwheeled soil ripped or unripped at Morawa in 1993. The soil was ripped in 1991.



Yield responses and their persistence.
The initial yield response to ripping without wheeling the sand at Yuna was large, approximately 700kg/ha (Figure 3). Yield benefits of unwheeled ripping persisted from 1991 to 1993 at Yuna (Figure 4), but were not as large as in earlier seasons, or from later ripping. Wheeling would obviously reduced these benefits had it not been controlled to regular 'lanes' because most recompaction comes from the first wheeling by such heavy tractors on ripped soil.

Figure 3. The yield response at Yuna in 1991 in the first year after ripping.



Crop ripening was also slower in the wheeltracks, but produced a useful yield and better weed control than would have happened with bare wheel tracks. However, the main constraint to sandplain farming in low rainfall areas is timeliness of seeding. Any new systems such as controlled traffic must be very easy to use and not slow down the rate of a seeding program once suitable conditions prevail.

Yield improvements at Morawa were smaller than at Yuna and less consistent. There was a maximum yield benefit of about 200kg/ha in the first season.
Traction on the loam soil at Morawa was markedly improved for spraying the ripped soil, both pre or post seeding. Any major deviation from the traffic lanes resulted in considerable wheel sinkage and almost immobilisation.

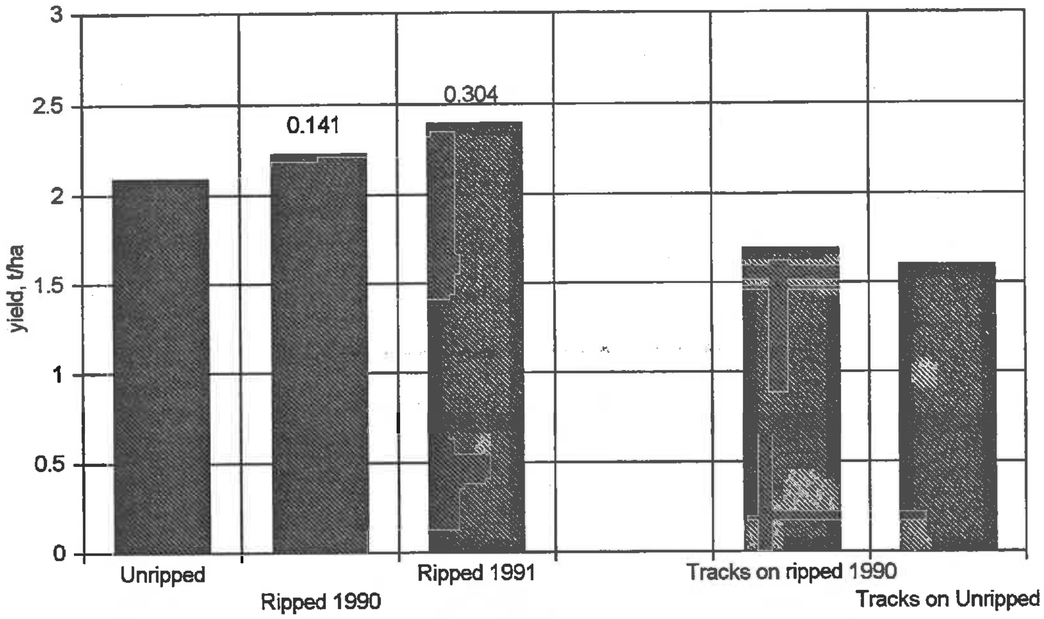


Figure 4. Yield responses at Yuna in 1993, three years after ripping.

DISCUSSION and CONCLUSIONS

Yield benefits from ripping sandplain soil could persist at least 3 years with these on-farm controlled traffic systems. More research and development is needed to make these systems even more practical and acceptable for sandplain farming in low rainfall areas. The yield benefits of controlled traffic on the heavier texture soils of the low rainfall wheatbelt of WA are smaller than for the sand. However there are obvious benefits for improved traction and maintaining structure for better infiltration and drainage.

TRACTION SYSTEMS.

Part of the research at Yuna and Morawa looked at the difference between wheels (dual tyres) or rubber tracks for the seeding tractor. Observations on-farm mainly found the tracks had an advantage of a smaller controlled traffic track width. Further studies of soil stresses beneath the same vehicles used at Yuna (Blunden et al., 1994) showed benefits to tracks for reducing vertical soil stresses, but shear stresses may be increased. This helps to explain why compaction beneath dual tyres and tracks, for the same tractor mass, is often similar in the subsoil. Thus the main benefits of tracks over tyres for controlled traffic is in reduced width of compaction.

NO-TILL

Reduced soil disturbance for erosion protection, with sufficient disturbance for crop production, is being developed in new No-Till systems in WA. These may increase the opportunities for subsoil compaction and Controlled Traffic with No-Till may be the better system design. This needs more research to clarify such ideas more confidently.

ACKNOWLEDGMENTS

Use of Agrowplow by Doug Brenkly, use of Ausplow by Macintosh's and John Ryan. Use of Cat 64 Challenger by Westrac. Assistance of Grant Morrow, Heiko Daniel, Steve Vlahov, Kim Malcolm.

REFERENCES

Blunden B.G., McBride, R.A., Daniel, H. and Blackwell, P.S. 1994. Compaction of an earthy sand by rubber tracked and tyred vehicles. AJSR 32; 1095-1108.

Boyle, S. 1991. Green Light for Controlled Traffic. Kondinin Group Talk.

Perry, M and Hillman B. 1991. The Wheat Book, Technical Bulletin 4196, Western Australian Department of Agriculture.