# Evaluation of controlled traffic farming operations for efficient soil management in row cropping operations using subsurface drip and centre pivot irrigation

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Various types of irrigation systems are used to satisfy plant water requirements for row cropping in northern Victoria and the Riverina. For more precise water application subsurface drip and sprinkler application are favoured, whilst border check and furrow are used in more conventional sites. Guidance is achieved using Controlled Traffic Farming technology. This complements the irrigation system and guarantees precise placement of crop inputs whilst combining machinery mass to defined wheel tracks. CTF allows yield potential to be realised by making the most efficient use of space and water, providing accurate placement of inputs and machinery implements. Soil management operations which CTF allows precision placement of inputs and use of implements include:

- cultivation and discing, where traffic remains aligned on defined wheel tracks
- deep ripping soils around subsurface drip tape to shatter aggregates in massively structured and or compacted formations. These formations result from water logging which causes soil to slake and disperse with irrigation or rainfall
- ripping in the vicinity of the plant root zone to counter soil dispersion resulting from ingress of low electrolyte concentration rainfall
- shoulder busting, to alleviate compaction on the outside of raised beds
- exact placement of seed, fertilizer and pesticides
- "fluffing"(aeration) of soil in the planting line, rather than in the surrounding zone in order to disadvantage weeds
- employment of "Robocrop" technology, providing mechanical weed control.
- positioning of pipes, cables and conduits

Compaction of soils within CTF systems is restricted to the wheel tracks whilst soil modification of the cropping zone seeks to minimise blunt blade contact with the soil at times when compaction of the bed is enhanced. It is well understood that every soil has a compaction characteristic whereby the maximum dry density for a designated pressure is achieved at a specific moisture content called the Optimal Moisture Content (OMC). CTF practice relies on avoidance of implement contact to soil at or near the OMC. Ideally, contact of soils using implements at dry of OMC will facilitate the shattering of soil and the creation of aggregates. Compaction of the bed shoulder due to force applied to the side of the bed at or near the OMC by machinery wheels is a continuous problem requiring seasonal rectification. On the contrary, compaction of the wheel tracks is favoured for all weather management.

Soil and irrigation factors contributing to consolidation within row cropping systems using CTF include slaking, dispersion and waterlogging. These factors can destabilise and destroy aggregates, consolidate soil and contribute to anisotropy. Non-uniform wetting of bypass flows result whilst root development is hindered by poor aeration and particle size which form barriers to root exploitation, limiting water and nutrient during peak irrigation. The need to maintain a wetted annulus around conduits and tapes can render subsurface drip more susceptible to this form of root zone instability than other types of irrigation systems. Surface crusting of susceptible soil under sprinkler irrigation and heavy rainfall can limit ingress of water to the rootzone. Well graded and even coarse textured soils are prone to damage and a

reduction in water holding capacity due to particle realignment and the clogging of voids. Impeded germination of direct seeded crops is a major threat. Knowledge of the susceptibility of a soil to crusting is vital and CTF can provide a measure of amelioration without exacerbating damage.

No irrigation system is without limitations and all can have a detrimental impact on soil which might be steady and insidious. Management of soil related problems out-of-season and within crops using fluid based ameliorants thorough irrigation systems or using CTF technology requires further research. Adequate levels of investigation and soil amelioration are vital for optimal soil condition prior to development to minimise overlap between soil types with significantly different physical and chemical characteristics.