FINAL REPORT 2013/803

Advancing Australian sugarcane farming systems: final report 2013/803

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Research organisation(s):	New South Wales Farming Systems Group
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Key Focus Area (KFA):	Farming systems and production management

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SRDC Capacity Building Project
Final Report

Project title:

Advancing Australian Sugar Cane Farming Systems.

SRDC project number:

CPB1205

Participating people and/or organisation(s):

Mark North – Member NSWFSG – Condong farmer – Point of Contact.
Alan Munro – NSWSMC Director – FSG Secretary - Harwood farmer.
Nathan Ensbey – Chairman NSWFSG – Farm Manager NSWSMC – Harwood farmer.
Shane Causley – Member NSWFSG – Harwood farmer.
Carson Wiedeman – Member NSWFSG – Condong farmer – American citizen.
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Project contact(s): Mark North – Member NSWFSG – Condong farmer – Point of Contact.

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Summary:

- Project objective/s
  - Overcome the inability to direct drill sugarcane into heavy clay soils in raised bed farming system.
  - Eliminate the need for intensive cultivation practices between the soybean harvest and cane planting phase.
  - Gain first-hand experience with reduced tillage systems and machinery in the US grain belt.
  - Use this knowledge gained to develop machinery for the new farming system in NSW.
  - Promote outcomes from this research through the Australian Sugar Industry.

Overview of key learnings, achievements and/or knowledge gained

Vertical Tillage Principles
Vertical tillage principles were discussed vigorously at each strip tillage company visited. Most notably the presentation given by Jerry Hatfield from Iowa State University gave the group a thorough understanding of why growers in the American Mid-West were implementing vertical/strip tillage systems.

Vertical tillage is a relatively new trend. The main objective of using vertical tillage is to break up surface soil compaction, or smooth out areas in a field with shallow (200mm-300mm) drills from water erosion or ruts and tire tracks from tractors, combines, grain carts, trucks, and other equipment. It also is used to help improve rainfall penetration by breaking up crusts.

Vertical tillage means that the ground engaging components of a given tool enter the soil in a vertical rather than horizontal fashion. Conventional "horizontal" tillage implements, such as disk harrows and field cultivators, create horizontal compaction or stratification layers in the soil. These density changes inhibit root growth, impacting crop stand ability and yields. Machines that utilize straight/wavy coulters running in the same direction of the machine essentially create no stratification layer.

Vertical tillage equipment is used to lightly till the soil and cut up residue, mixing and anchoring a portion of the residue into the upper few inches of soil while still leaving large quantities of residue on the soil surface. This action helps speed residue decomposition. Vertical tillage is also described as a form of mulch-till, as it generally leaves more than 30 percent residue on the soil surface, yet creates nearly full-width disturbance on the soil surface.

If intensive rainfall occurs after the vertical tillage operation in a low-residue environment, it could have the opposite effect. vertical tillage should only be used when the soil is dry enough to shatter; otherwise, it may create shallow compaction. This type of equipment tends to leave the soil somewhat fluffy, but not to the extent that more aggressive inversion cultivation equipment will.

Offset discs are primarily used as primary tillage tools and tandem disks are usually used as a finishing tool. In contrast, most vertical tillage implements are used as a one-pass operation directly on crop residues prior to planting.

One of the physical differences between the two types of implements is that tandem disc blades are more curved, go a little deeper into the soil profile, and turn up some soil as they go across the field. This process cuts and inverts the soil vertical tillage blades are generally straighter, more like coulters, and are often fluted. In fact, many manufacturers refer to the blades on vertical tillage implements as coulters. The degree of curvature and amount of fluting on the coulters varies by manufacturer, as does the angle of the gangs.

Strip Tillage Timing Trying to strip till when soil moisture is not right can lead to issues. If the soil is too wet any strip-till componentry can cause sidewall smearing. The additional soil compaction effects from sidewall smear and pulling heavy equipment over wet soil will likely negate any gains in yield from strip-tilling. If compaction layers exist in the soil profile it is important to set up your strip-till rig to alleviate this prior to planting. We need to remember this is a tillage pass. On the flip side as experienced by the NSW Farming systems group strip-tilling when the soil is too dry can lead to difficulties in soil penetration and a reduction in soil tilth.

When referring to the timing of strip tillage soil tilth and season play an important role. Some growers in the Mid-West have fallen into the trap of leaving the soil too fine prior to winter. Heavy rainfall or rapid snow melt can lead to further compaction of the strip and soil erosion. As with our soybean/ cane cycle in NSW the Americans are aiming for a strip of chunky rough soil before winter and then using weather to break down the strip through this period prior to spring. **Natural weathering of the soil is one way of assisting in getting adequate soil tilth on heavy clay soils prior to spring.**

Strip-Till Componentry

Several companies manufacture vertical tillage equipment, and none of the implements is exactly the same, although there are common features. From a distance, many vertical tillage tools look similar to disks in that there are a series of round blades in a gang on a toolbar. However, some models have blades individually mounted on springs, similar to a field cultivator.

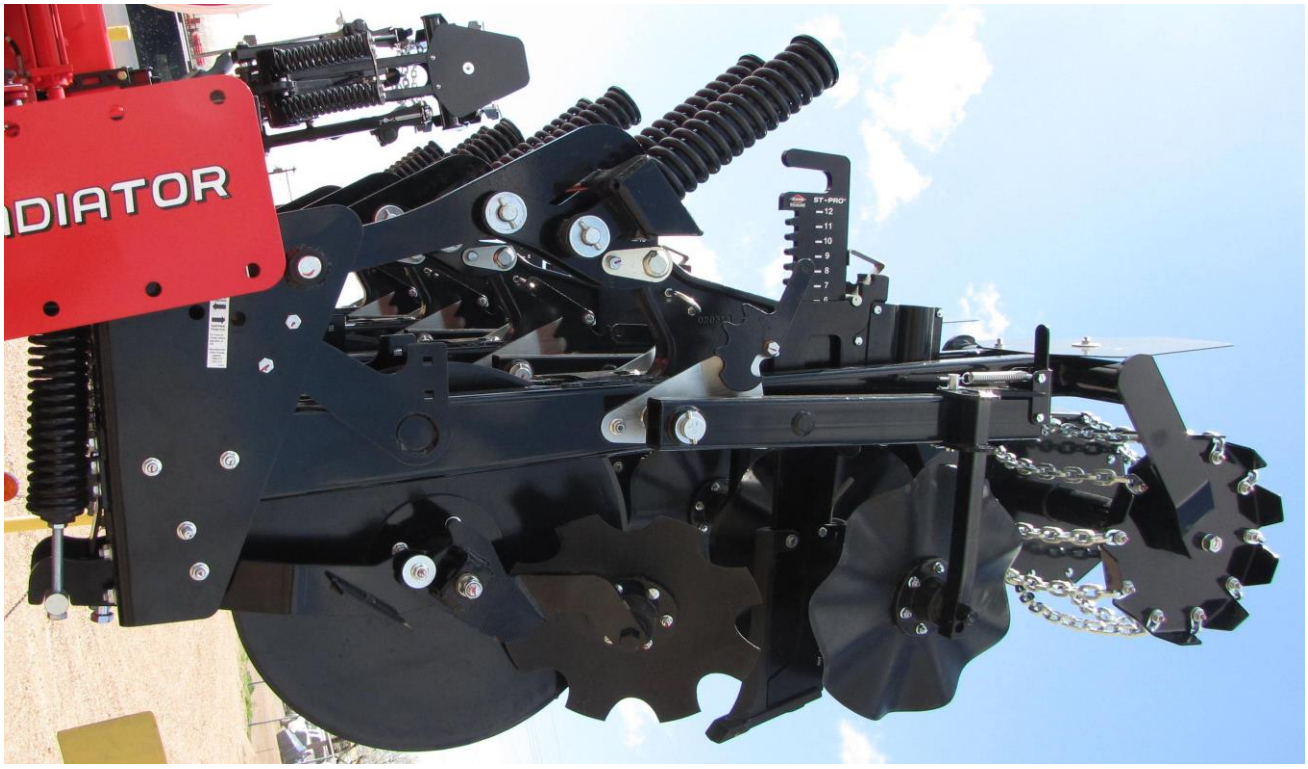

Figure 1. The Kuhn Krause "Gladiator" Strip-Tiller.

Typical strip-till units that were viewed in the Mid-West include:

- Initial cutting discs that cut through the soil and residue, preparing the soil for ripping.
- Trash wipers clearing the 'burm' of all heavy residues.
- Low impact shank which is adjustable for depth control. The design of these shanks is such that they maximise compaction layer busting whilst minimising the breakout of clods on the soil surface. The shanks come in different configurations allowing busting compaction layers in differing formations.
- Wavy coulters are then used for soil tilth. As previously described the use of wavy coulters for soil tilth is dependent on the season. Wavy coulters can also be used on an angle to build up the berm which increases the soil temperature of the strip allowing an earlier plant.
- Finishing equipment usually involves the use of crumble rollers. Again the use of crumble rollers needs to be linked with seasonality. Rollers are more frequently used in the final pass when a fine soil tilth is required.

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Figure 2. “Nifty Reaper”. Three of these units were ordered by group member for testing.

- Summary of implications and recommendations resulting from project

A number of companies were visited throughout the Mid-West explaining an assortment of tooling concepts that are leading edge componentry, especially for strip tillage farming practices. These unique practices are recognized as the new standard for conservation tillage in the United States mid-west grain belt. Members of the NSWFSG that travelled the Mid-West identified manufacturing companies we believe to have their own unique approach to strip tillage, and the success of the project will be a combination of some of these concepts. Previous attempts to gain the necessary knowledge and implementation procedures have proven to be insufficient through correspondence alone.

The NSWFSG has been successful with $15k funding for NSW CMA to build a strip tillage machine based on this U.S. research trip. Observations on the most effective componentry have been used by the NSWFSG to develop a prototype minimum-tillage machine for heavy clay soils. This prototype will be used to establish demonstration sites and be available for grower loan.

Itinerary (if relevant):
Project Itinerary:

Iowa State University (Iowa)
- Met with Jerry Hatfield.

Kansas City (Kansas)

- Environmental Tillage Systems
- manufacture Soil Warrior machine which has wavy coulter componentry for strip tillage to 150mm depth and was the basis for the wavy coulter machine developed in NSW five years ago
- now produce a machine, based on a "cog wheel", for zonal tillage 200 – 300 mm deep, instead of a tyne used on most other zoned tillage machines

Concordia (Kansas)

- Sunflower Manufacturing
- Dean ….. Yetter Farm Machinery
- Professional Strip-cat Tiller

Salina Kansas

- **Great Plains**
- Produce a range of vertical tillage broadacre machines such as Turbo-**Chopper**, Turbo-Max, Turbo-Till and Ultra Till
- All machines based on Turbo Coulter, but have different degrees of aggressiveness, depending on additional componentry used and the farmer's requirements
- Australian distributor, for seeders, to date no tillage equipment

Hutchinson Kansas

- Kuhn Krause

Hudson Illinois

- Kongslide Progressive Farm Machinery
- Strip Cat Tiller
- Rich Former (Agronomist and Mechanical Technical Advisor)
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Galesburg Illinois

- Steven Peterson, Nifty Ag. Manufacturer of Predator strip tiller.

Summary of conferences attended or meetings held, including persons met and summary of discussions and outcomes (if relevant):

- NSW Sugar Agricultural Services – Power Point presentation delivered.
- NSW Farming System Group – Power point presentation given.

Economic, Environmental and/or Social benefits to the Australian sugar industry, the community and/or the participants that will accrue from the project:

Economic

- The successful development of a minimum tillage implement will eliminate the need for intensive cultivation prior to planting which will provide massive savings in labour and fuel requirements.
- More efficient land preparation at planting will enable growers wanting to expand their operations to do so without being slowed by inefficient high impact cultivation.
- Increased adoption of the new farming system on farms with heavy clay soils.

Environmental

- A reduction in soil degradation by moving from intensive cultivation techniques to a highly efficient minimum tillage operation.
- Improved infiltration of rainfall prior to planting as opposed to a hard raised bed that sheds high % of rainfall.

Social

Having a highly efficient tillage operation prior to planting reduces work load for farmers in a very hectic time of the season.

Means of communicating the findings of the project to relevant stakeholders. (Include copies of any articles, press releases, etc. that have been prepared):

- Presentations in local area
- Presentations at future Give conferences
- The group will send FSG reps to the next GIVE conference to highlight findings and demonstrations carried out by the group. This material will be provided to SRDC and made available on their website.

Recommendations on how knowledge or information gained can be used or transferred to projects or the industry (at a local and/or industry-wide level):

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NSWFSG is currently working with Hodge Industries, Mackay. On a three row production unit based on the groups work

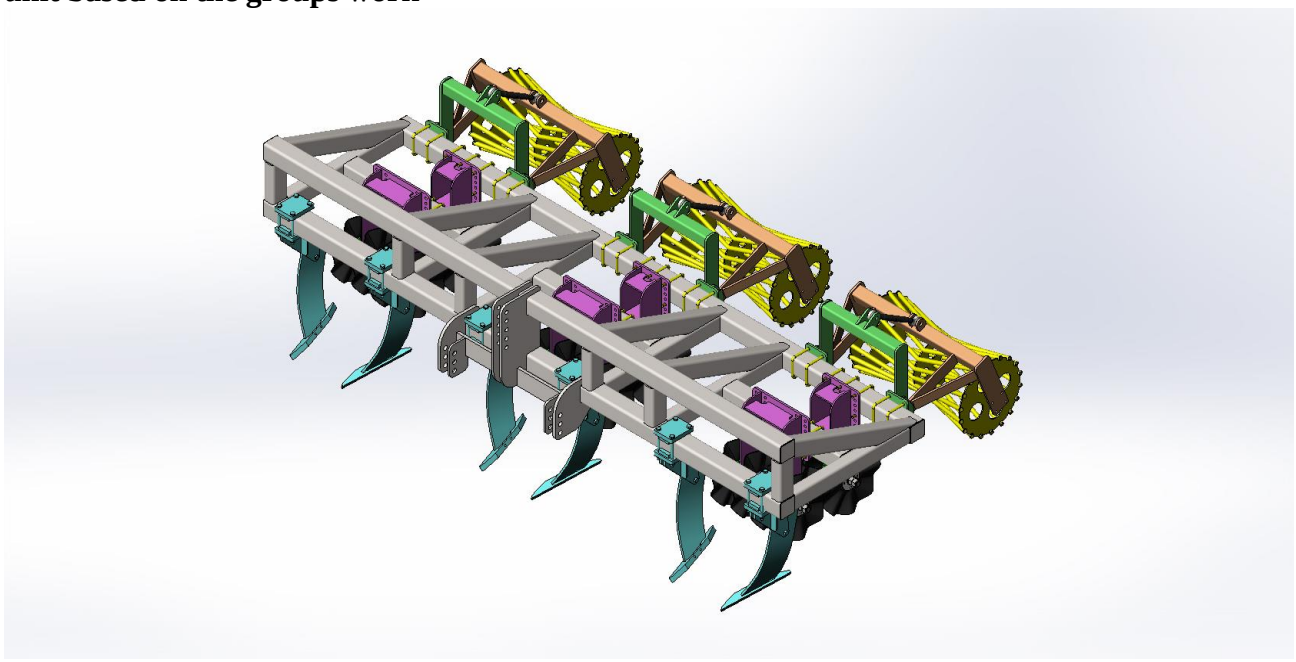

Figure 1

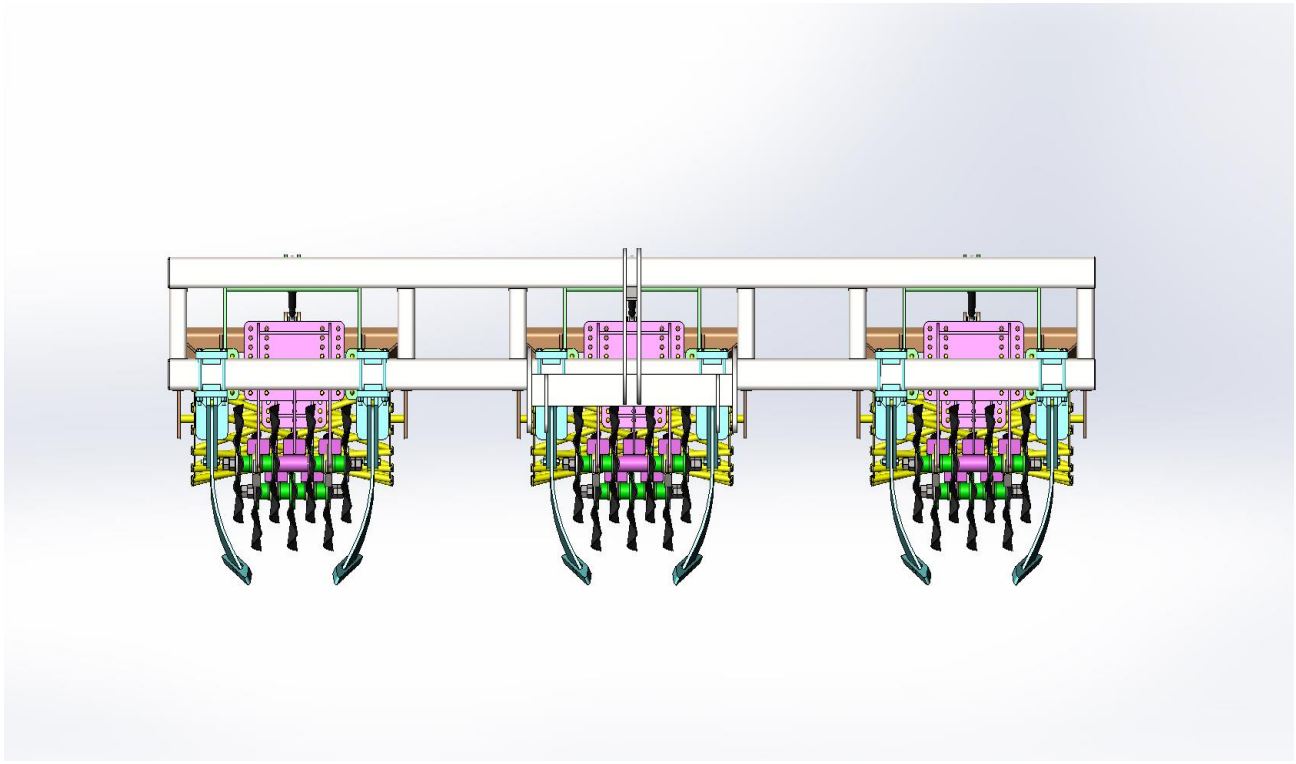

Figure 2