Title	**Controlled traffic and raised bed farming**
Description	**Research Update - Southern Region - 2001**
Key Words	**Controlled Traffic, Raised Beds, Soil Compaction, Efficiency**
***GRDC Codes**	**Program 3.1 Soil and Water Management**
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***Note - this report may contain independently supported projects which complement the work in this GRDC research program.**

Latest Information

- **15% improvements in yield have been measured in SA as a result of reduced soil compaction.**
- **Many soils in SA are prone to compaction with current farming systems.**
- **Trials conducted in the early 1990's at Roseworthy demonstrated the benefits in yield and improvements in soil properties under controlled traffic systems.**

- **Physical ripping and summer crops ("biological rippers") will assist in overcoming compaction.**
- **Significant operational efficiency benefits exist with controlled traffic systems compared with our conventional minimum and no- tillage systems.**
- **New technology with respect to guidance equipment and a considerable reduction in the cost of such technology increases the economic viability of introducing controlled traffic systems.**
- **Many farmers require only a few modifications to plant to implement controlled traffic systems.**
- **Raised beds reduce the risk of waterlogging and crop failure and improve trafficability in wet conditions**

Background

Farmers in the southern region of Australia are less efficient and suffering yield loss by not adopting controlled traffic systems.
Yield improvements of around 15% have been recorded on a range of soil types across Australia where controlled traffic systems have been introduced. These responses have been due to the reduction of compaction occurring across the paddock where wheeled traffic passes during conventional seeding operations. Locally, research at Halbury in the

mid north of SA has demonstrated a response of 17% where the hardpan was destroyed by several deeper passes over a three year period with narrow points.

Root zone compaction has been found to limit plant root growth. Soil strength greater than 3 MPa will limit root development and therefore restrict water and nutrient availability to the plant. Rainfall infiltration and soil biological activity are also reduced as the size and numbers of soil pores are reduced through the compaction process.

Significant fundamental changes have occurred to farming systems in SA which now make controlled traffic a serious consideration:

- **Livestock enterprises (sheep and wool production) have reduced significantly. This reduction has reduced the amount of compaction to paddocks as stock graze paddocks during the wet winter months.**
- **Without sheep, fences are not required. Fence lines are being removed from properties allowing more efficient cropping operations to occur.**
- **Many farmers are now practising no till systems. However, even under conventional tillage systems, controlled traffic can still offer some significant advantages.**

Benefits of controlled traffic

- **Reduced costs. Considerable savings occur with fuel, seed, chemical and fertiliser. Reduced overlapping can reduce fertiliser, seed and spray applications by 4%.**

Where wide row spacing crops are sown (beans and summer crops), inter-row spraying can reduce chemical applications by 66%.

- **Reduced draft requirements. Smaller tractors are being used, as less power is required to pull the same machine at sowing. In heavy clays, power requirements can be reduced by as much as 50% with normal seeding moisture. This results in significant reductions in fuel use.**
- **More timely operations. Herbicide and fertiliser applications can occur at more appropriate times due to increased traffic ability in wet conditions. Crucial operations such as fungicide application to coincide with rainfall events can take place sooner, reducing disease levels. Post seeding fertiliser applications can occur during wet periods, increasing the efficiency of these applications.**
- **Reduced fertiliser and herbicide application costs. Applications can be made with farmer equipment rather than relying on contract operators. Better weed and disease control is likely with higher water rates being used with ground application units. Less over and underdosing results in less crop damage and fewer weed escapes.**
- **Better placement of seed and fertiliser. Plant emergence is more even and uniform and combined with more accurate fertiliser placement results in increased plant nutrition and better plant growth.**

- **More accurate sowing systems allow for more accurate herbicide and fertiliser placement. Between row weed control is already practised in wide row spacing summer crops. A combination of between row covered spray units and guidance equipment may allow the use of non - selective herbicides for weed control in winter crops. This will delay the development of herbicide resistance to selective herbicides. Side dressings of fertiliser may also be possible - placing post crop emergence fertiliser alongside plant roots and not in the inter-row where they will stimulate the germination of weeds.**

Raised beds

In the 500 mm + annual rainfall farming regions where land is relatively flat causing poor surface drainage, raised beds offer some significant advantages. The system is a form of controlled traffic, which also improves water drainage.
Raised beds can improve the use of low value land previously only capable of livestock production into high value land suitable for crop production (often < half $ cost). Costs of implementing raised beds are approximately $250/ha to form the beds, interceptor drains and water removal or storage systems. There are also the additional costs of wheel track modification of equipment.
With the use of raised beds, there is a low risk of crop failure as there is generally very reliable rainfall in the 500 mm + annual rainfall regions. By elimination of the

waterlogging risk, frost becomes the next greatest risk to crop production. Raised beds offer significant opportunity for grain yield improvement as often waterlogging can result in 100% crop loss. Although much of the farmer experience with raised beds has not found massive improvements in grain yields in the relatively dry seasons to date, grain yield improvements similar to those in controlled traffic are feasible.

Benefits of raised beds

- **Improved soil drainage and aeration**
- **Reduced soil compaction**
- **Improved trafficability in wet conditions**
- **Reduced risk of waterlogging and crop failure**
- **Improved grain yield and input and labour cost**

Conclusions

The benefits of controlled traffic and raised bed systems offer wide ranging and significant benefits to the agricultural industry. Overcoming compaction limitations, and significant improvements in trafficability, soil water use and drainage, fuel, fertiliser and herbicide efficiency are the obvious benefits.
Many farms require only a few modifications to plant to adopt a basic controlled traffic system. Many now have for example 12m seeding equipment with 24 or 36m

boomsprays which can spray along every second or third sowing run. Adoption to specialised new equipment will take time however as a significant financial outlay may be required to match machinery in some circumstances. This is certainly more the case with raised beds. Farmers require an opportunity to assess for themselves, the benefits of such a system change from an agronomic viewpoint to assist in the changeover.

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Disclaimer

Title	**Raised Bed Farming Systems**
Description	**Research Update - Southern Region - 2002 (High Rainfall)**
Key Words	**raised beds, advantages, disadvantages, costs, trial results**
***GRDC Code**	**MFM1**
Author	**Jen Lillecrapp, PIRSA, Trent Potter and Wayne Hawthorne, SARDI**
Presented	**Kangaroo Island, SA**

***Note - this report may contain independently supported projects, which complement the work in this GRDC research program.**

Key Points

- **The application of raised bed farming systems will be determined by soil type, slope and water management plans.**
- **Surveying for designing paddock layout and drainage and water management plans are critical.**
- **Results from demonstration sites in the South East have been variable. Generally, the yields from the raised beds have been less than conventionally farmed comparative treatments.**
- **Machinery modifications have been identified as a major factor limiting adoption.**

Advantages

- **Improved drainage reducing waterlogging**
- **Increased crop options and extension of rotation**
- **Controlled traffic**
- **Reduced soil compaction and improved soil structure**
- **Increased root penetration**
- **Timeliness of paddock operations**
- **Reduced tillage requirements**
- **Reduced risk and improved financial returns**

Disadvantages

- **Cost of modifying machinery**
- **Ineffective where slope or high watertables limit drainage**
- **Sowing depth control and seed placement**
- **Management of drainage water**
- **Potential for pesticide contamination into waterways and leaching into the watertable**
- **Stubble handling and fodder conservation**
- **Reliance on herbicide for weed control**

- **Firefighting and mustering livestock**
- **Inefficiencies of machinery**
- **Weed control in furrows**

Costs

	$/ha
Surveying	15
Drainage	20
Chisel ploughing/tillage	50
Forming of raised beds	50
Total	135

Annual cost of $10 to 15/ha for the maintenance of raised beds.

Results

Site Location	Year	Crop	Raised Beds (t/ha)	Conventional (t/ha)
Pooginagoric	1999	Canola	1.5	1.7
	2000	Soft wheat	4.9	4.9
	2001	Faba beans		
Mundulla	1999	Canola	0.3	0.6
	2000	Barley	5.7	6.2

	2001	Faba beans	4.8	5.9
Frances	1999	Wheat	2.1	3.3
	2000	Oats	3.4	3.2
	2001	Canola		
Kybybolite	1999	Triticale	2.8	2.3
	2000	Barley	4.3	3.8
	2001	Canola	2.2	2.5
Conmurra	1999	Canola	2.5	1.8
	2000	Wheat	1.0	1.1
	2001	beans		

Small Plot Trial Results - 2001

Trials were sown to compare the relative performance of a number of pulse, oilseed and cereal varieties on raised beds at Frances on a red gum site. The beds were prepared in time for early June sowing, but then wet conditions prevented sowing until late in June. Representative varieties were selected to ensure that a range of maturities was sown within each crop type. The trial was sown on 29 June, relatively late for winter sown crops, and 6 September for spring sown crops. Conditions at both times of sowing were wet, particularly in the furrows and drains. The spring pulse sowing was inundated with approximately 50mm of rain two days after sowing.

The yield limiting factors in the beans were late sowing and bird damage reducing plant populations. Lentil yields were reduced by poor nodulation and a thin stand. Peas, wheat and barley grew exceptionally well. The spring-sown pulses were limited by weed infestation that could not be controlled pre-emergence because of the wet and windy conditions. Canola yields were limited by blackleg, despite more resistant types being sown, a legacy of sowing canola on a canola stubble from the previous year.
In most crops, one or two varieties stood out from the remainder. Valuable lessons were learnt in terms of crop management and conducting variety trials on raised beds, particularly with crops that are not considered ideally suited to the soil type (lentils, beans) or wet conditions (lentils, chickpeas). The establishment of all crops was excellent considering the wet conditions at sowing and soon after.

Crop Type	Best Yield (t/ha)	Mean Yield (t/ha)
Barley	5.82	4.53
Canola	3.21	2.26
Chickpeas (spring)	Not available	Not available
Lentils	1.25	0.93
Lentils (spring)	0.66	0.60
Peas	4.92	3.84
Peas (spring)	2.40	2.18

Beans	**1.91**	**1.75**
Wheat	**4.03**	**3.65**

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Good Enough to Eat: Raised-bed farming serves heavily populated China well

By CHRIS SMITH

SPECIAL TO THE POST-INTELLIGENCER

Today's column is a departure from the usual how-to format. Having returned recently from a trip to China, I'd like to share a few observations about gardening and farming in the most populated country in the world. My impressions are gleaned from the windows of the trains, buses and boats we traveled on and supplemented by three trips into the countryside with English-speaking guides.

For more than 25 years I've done some of my vegetable gardening in raised beds, following the advice of Peter Chan in his book "Better Vegetable Gardens the Chinese Way" (Graphic Arts Center, 96 pages, originally $4.95 but currently out of print). So I was curious to see if the Chinese really gardened in raised beds.

It didn't take long to find out. Less than an hour after arriving at Shanghai's Pudong Airport, we were on our way into the city by taxi. From the car's windows, Ann and I could see acre after acre of food crops, most of them grown on small plots and in raised beds. The Chinese, it appeared, didn't just garden in raised beds; they farmed in them too.

I expected to see raised beds in China. In a country with a huge population to feed, a gardening system that uses space efficiently and captures a little extra heat in the cool seasons makes sense. What was surprising to me was the prevalence of plastic. In clear and black, it was used for mulch. And clear plastic structures ranging from foot-high and crawl-through cloches to stand-up-inside greenhouses were scattered through the fields. Apparently heat capture for an extended growing season is a major feature of Chinese farming.

Interspersed among the farm and garden plots were ponds, canals and ditches. In fact, throughout the portions of the Yangtse River Delta we saw, and that included Suchou and Hangchou, water was as common a feature as cropland. It was apparent some of the canals and ditches simply drained the land enough that it could be cultivated. And having all that water nearby would certainly be handy if irrigation was needed during a dry season or flooding for rice crops. I wondered whether any fish farming was going on in the ponds until I saw a few old men with lines in the water.

Seeing farming and gardening from windows made me itchy to get on the ground for a closer look and a talk with the folks growing the crops. We got the first chance during our visit to Chongching. Connie (Gan Li), a guide from China International Travel Service, met our plane and took us into the city to our hotel. Our party of four (my brother and his wife traveled with Ann and me) liked her immediately, so we asked if she was available the next day to take us to a Buddhist grotto with a stop along the way back to look at agriculture. She agreed.

On the way back from the grotto, the driver of our van stopped beside a farm or collection of farms. There wasn't a soul in sight. Apparently Friday afternoon starts the weekend in rural China. Nonetheless, my brother and I scrambled down the road embankment and into the fields. Soon we were walking along a dike below that ran several inches of malodorous, brown water. As far as we could see stretched small plots of yellow blooming mustard for canola oil, fava beans, peas, onions and leaf cabbages of many varieties. Plastic structures out in the mud sheltered still other crops. All the plants looked green and vigorous.

Connie met us coming back, and indicating the brown water, asked us if that was what we called manure. We nodded vigorously. All of us agreed it seemed to grow healthy crops. Out of a certain delicacy, we didn't ask her the source of the manure. Historically, Chinese farmers have used what's delicately called night soil as fertilizer.

Next week I'll continue with the story of our trip to farming villages near Wuhan and Guilin, attempt to describe the most amazing farmers market I've ever seen and wrap up my observations of Chinese farming and gardening.

Chris Smith, who lives in Port Orchard, is a Master Gardener and is retired from the WSU Cooperative Extension. His columns appear in the P-I garden pages on Thursday. Send questions to P.O. Box 4426, South Colby, WA 98384-0426.