Seed Success
A **fact sheet** communicating the results of pasture seeds R&D

Drop tubes lift efficiency

Key points

- Lucerne seed growers, primarily based around Keith in South Australia, needed to investigate alternative irrigation systems to border check, in response to a water resource declining in quality and availability, and changing allocation policy.
- Lucerne hay and seed production were similar under drop tube centre pivot and border check irrigation systems.
- Production costs and returns per hectare were similar for each irrigation system, despite differences in individual components of the costs.
- Drop tube irrigation was significantly more water efficient than border check, using considerably less water per hectare, and returning over 120% more profit per megalitre pumped.
- Lucerne production was not affected by drop tube irrigation with highly saline water (4700 ppm).

The issue

In response to a decline in the quality and availability of irrigation water, and changing water allocation policy, the lucerne seed industry recognised the need to evaluate alternative irrigation systems.

Border check is the conventional irrigation system for lucerne seed production in the Keith region of South Australia, however increasingly lucerne seed is grown under drop tube centre pivot irrigation. The common belief was that sprinkler irrigation uses less water to achieve the same yield as flood irrigation, i.e. it is more efficient, but that premise had not been substantiated for lucerne seed production.

The majority of the Australian lucerne seed crop, grown around Keith, is irrigated with saline groundwater (typically 4000–8000 ppm across 70% of the region). The impact of irrigating a lucerne seed crop with water exceeding 4000 ppm salinity using a drop tube system had not been evaluated.

Research was conducted to understand the production potential and returns on water for sprinkler and flood irrigation. While directly relevant to the Keith area, the results also can be applied to other lucerne seed growing areas in Australia.

Researcher James De Barro showed 120% more profit per megalitre with drop tube irrigation compared with border check. Image courtesy of Coretext.

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The research

Two 30-hectare blocks of lucerne, west of Keith, were compared. One was irrigated by border check, the other by drop tube centre pivot. The blocks were located in adjacent paddocks. The soil was a sandy loam over limestone rubble and marl, and also identified as non-wetting sand.

Soil moisture was recorded at both sites with a continual logging C-probe to detect the appropriate refill point and determine the timing of irrigation events. A prescribed volume of water was determined for the drop tube site. Irrigation was applied in the second half of the second hay crop, as well as to the seed crop; typical of management in the district in an average season. In 2005, oats were over-sown on the drop tube block to increase hay production for the initial hay cut.

The actual income and expenditure associated with lucerne hay and seed production for each block was examined over two consecutive seasons. Management and production for each system was recorded and the net profit per megalitre pumped (efficiency) was calculated.

Infrastructure payments (e.g. interest) for either system were not calculated, as this would confound the results. The final calculation of efficiency ($ return/ML pumped) would enable a seed producer to evaluate the actual cost of a system and returns on investment, for individual financial scenarios.

Benefits of drop tube irrigation

In comparison with conventional spray irrigators, drop tube systems:

- can irrigate with saline water with reduced adverse effects on seed and forage yield
- have less impact on infrastructure
- operate more efficiently in windy and hot weather.

Drop tube outlets on sprinkler irrigation systems have several advantages over conventional sprinkler systems.

Table 1. Details of the trial blocks

	Drop tube	Border check
Irrigation system	Valley® towable pivot, drop tube system installed in 2004 75% Senninger® LDN bubbler pads & 25% Senninger® Quadspray emitters	Laser levelled in 1988, typical of 1000s of hectares of irrigated lucerne crops in the research area
Variety*	Flairdale sown in 2001	Aurora sown in 2002
Plant count (2005)	23.2 plants/m^2	23.8 plants/m^2
Water salinity (March 2005)	4700 ppm	4000 ppm
Irrigation delivery	average 75–125 mm/ha (to overcome effect of non-wetting sands)	average 120 mm/ha

**Both varieties have yielded similarly at the research site, and for the purposes of the research it was accepted the differences between the hay or seed production potential were not significant. Both varieties have a world activity rating of 6.*

The findings

The 2005–06 season was considered an average season and was more productive than the drought-affected 2006–07. In October 2006, both blocks were grazed with sheep before being closed up, however the grazing proved too hard and significantly affected seed production. Low rainfall in 2006–07 limited growth, which could not be regained with saline irrigation water.

A key finding of the research was that there was no discernible difference between border check and drop tube centre pivot irrigation, in terms of production and net profit per hectare.

In 2005–06 the overall expenditure for both forms of irrigation was similar, despite some variances in the components making up the costs (Table 2). In the drop tube block, there was more expenditure due to sowing oats, to produce 44% more hay compared with the border check block. The labour requirement for border check irrigation (i.e. irrigation gate changes) was greater than for the drop tube system.

In 2006–07 (Table 2) the total expenditure was greater for the border check irrigation due to more labour for irrigation management. The hay yields and returns were similar. Net profit was greater for border check due to higher seed yield, which reflected greater lucerne vigour and production in that system, as a consequence of the grazing management leading up to the seed crop phase. Net profit for both systems was reduced compared with the previous season.

The drop tube system used at least 50% less water per hectare than the border check system.

In 2005–06 the drop tube system used 4.16 ML/ha of irrigation water, which was 50% less water (ML/ha) than the border check at 8.26 ML/ha. More water was pumped in both systems in 2006–07 due to dry weather conditions. However the drop tube systems was still more water efficient, using 68% less water than the border check.

The drop tube irrigation returned over 120% more net profit per megalitre pumped than the border check.

The drop tube system required much less water to generate a similar amount of production and profit, which in the terms of this research translated to much greater efficiency – i.e. net profit per megalitre pumped.

The non-wetting sandy soil of the site responded best to large applications of water (75–125 mm/irrigation event) under the drop tube centre pivot, reflecting the traditional success of border check in the region.

Table 2 summarises the cost, returns and efficiency of the two irrigation systems over the two seasons of the trial.

Table 2. Income and expenditure for lucerne seed production, under drop tube and border check irrigation systems for two consecutive seasons

	Season 2005–06		Season 2006–07	
	Drop tube	**Border check**	**Drop tube**	**Border check**
Total expenditure*	**$1034.40/ha**	**$1003.40/ha**	**$820.55/ha**	**$1057.70/ha**
Production				
First hay cut	4.2 t/ha - $630/ha	2.3 t/ha - $420/ha	0.93 t/ha - $280/ha	1.15 t/ha - $344/ha
Second cut hay	1.4 t/ha - $252/ha	2.0 t/ha - $360/ha	–	–
Seed crop	713 kg/ha@$3.00/kg =$2139.00/ha	587 kg/ha@3.40/kg =$1995.80/ha	318 kg/ha@$5.00/kg =$1590.00/ha	437 kg/ha@5.00/kg =$2185.00/ha
Total income	**$3021.00/ha**	**$2775.00/ha**	**$1870.00/ha**	**$2529.00/ha**
Net profit	**$1986.40/ha**	**$1771.60/ha**	**$1049.45/ha**	**$1471.30/ha**
Water pumped (entire season)	**4.16 ML/ha**	**8.26 ML/ha**	**5.32 ML/ha**	**16.50 ML/ha**
Efficiency (net profit per ML pumped)	**$477.50/ML**	**$214.48/ML**	**$197.27/ML**	**$89.17/ML**

**The full break down of production costs can be found in the RIRDC research publication referenced at the end of this fact sheet.*

Implications for seed producers

The research provides numbers and observations on a 'real life' comparison of drop tube centre pivot and border check irrigation of lucerne seed production systems. The information gained can be used by growers to evaluate their current irrigation methods and assess future investment in the conversion of existing irrigation systems or the development of new irrigation fields.

The production and profit results for each block indicate that neither irrigation system had an agronomic advantage. One of the aims of the research was to determine if drop tube irrigation with saline water would have any adverse impacts on lucerne production.

The research showed that drop tube irrigation is a suitable irrigation method when using saline water.

The findings are supported by anecdotal experience that saline water can be applied at the commencement of irrigation using the drop tube system, without adverse effects on the crop.

The research did not attempt to determine returns on investment because of the widely varying nature of individual circumstances. The objective of the research was to compare the two systems in terms of productivity and profitability, so that irrigators could then assess their own financial ability and production capacity to capitalise on their irrigation allocation.

The results clearly showed that the drop tube system was significantly more efficient than border check, i.e. the net profit per megalitre used was 120% greater for the drop tube block in both seasons.

The significant efficiency of drop tube irrigation is critical knowledge when considering capital investment.

In the trial, irrigation events were managed by measuring soil moisture levels. Soil moisture monitoring will be an increasingly important part of the production operation, so that the right amount of water is applied at the right time, in order to optimise irrigation efficiency.

In a future of declining water availability and rising water values, maximising production and returns per megalitre will be essential for irrigators.

Increased efficiency with drop tube centre pivot irrigation compared with border check irrigation was achieved and demonstrated in this field trial, and the results are important for seed producers in the research region and elsewhere in Australia.

Research details

RIRDC project: DEB-6A — An Alternative to Border Check Irrigation: Comparison of border check to drop tube centre pivot irrigation for lucerne irrigated with saline water

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Publication details

An Alternative to Border Check Irrigation: Comparison of border check to drop tube centre pivot irrigation for lucerne irrigated with saline water (RIRDC publication no. 08/014)

Download the publication for free from the RIRDC website at https://rirdc.infoservices.com.au/items/08-014

Hardcopies can be purchased for $25 from the website or from the RIRDC bookshop on telephone 1300 634 313

RIRDC publication no. 11/152

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