Lucerne benefits from subsurface drip irrigation

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- Productivity and water efficiency of lucerne can be improved by 20–30% with subsurface drip irrigation (SDI)
- The first four cuts of first-season lucerne under SDI averaged 3.3 t/ha/cut with a water use efficiency (Nov–Feb) of 2.1 t/ML or 50 mm of water per tonne of hay
- SDI systems must be fine-tuned to the soil type and climate for maximum productivity and efficiency

In an effort to make better use of declining water resources and to improve productivity and profitability, Ron and Deid Schlitz of Uondo Pastoral Company at Kerang in Victoria, are trialling subsurface drip irrigation (SDI) under lucerne. This method of irrigation is a relatively new technique for lucerne in Australia.

Despite the higher cost of purchasing and installing SDI, compared with other irrigation systems, Ron and Deid figured they would reduce their irrigation costs and workload, and make more from their lucerne. After the first year the Schlitzs have learnt a lot and are more than happy with the system. However, there have been some problems and some soil types are performing better than others.

The pros and cons of SDI

Subsurface drip irrigation has several advantages over traditional irrigation systems. Its main selling point is the potential to improve yield and water use efficiency. Improvements of 20–30% are possible by direct delivery of water to the roots and reduced evaporation from the soil surface.

Well maintained SDI systems can last for 15 years or more and the labour savings can be considerable. The system can be turned on manually, by timers or it can be integrated with computer scheduling programs. Fertiliser can be delivered to the crop in the irrigation water.

The top 10 cm of the soil remains dry with SDI, therefore weed growth is reduced, machinery is better able to access the field, and there is less compaction from grazing animals.

On the negative side, setting up SDI can be expensive ($3500–$7500/ha) and an alternative irrigation source may be needed for the establishment phase of lucerne. Roots, algae, insects and mice can block up or damage tape/drippers if a regular maintenance program is not adhered to.

Setting up SDI at Kerang

The Schlitzs set up their SDI lucerne block as co-operators in a project investigating SDI under forage crops. The project was led by irrigation consultant Lauren Thompson from Moama. The Schlitzs' neighbour Louis Chirnside had considerable experience and success using SDI for tomatoes while another grower, Ray Sellwood from Undera near Shepparton, had achieved good results with lucerne under SDI. Together, Lauren, Louis and Ray accessed funds from the Gardiner Foundation (an R&D fund for the dairy industry) to set up a project on the Schlitzs' property to monitor the productivity and water use of lucerne under SDI.

The soils on the Schlitzs' property are typical of those around Kerang in the Murray-Goulburn irrigation area. They range from clay loam with salt and sodicity problems on the lower lying areas, to sandy soils underlain by hard pans on the rises. Irrigation in the area is dominated by flood systems.

Subsurface drip irrigation was installed on 24 ha, split into four blocks for ease of management. The dripper tapes were spaced 1.5 m apart and buried 250–300 mm deep, with emitters spaced at 500 mm, to provide a flow of 1–2 mm/h.

Water use in the first season was about 200 mm/cut (or 2 ML/ha/cut). The Schlitzs are continuing to fine tune the water application rate to supply what the plant needs, so there is no water wasted or lost downwards below the active root zone, to maximise productivity and water use efficiency.

The Schlitzs believe they will pay for the SDI system in four to six years at current water and lucerne prices. The actual payback period will depend on yields in the second year and beyond.

Lucerne on SDI

Irrigated lucerne is an important part of the crop production system in the Kerang area. It produces valuable saleable fodder, provides a weed and disease break for other irrigated crops and helps to leach salt from the soil profile.

Most lucerne in the area is currently irrigated by flood or spray.

Lucerne adapts well to SDI. Its deep rooting habit allows it to access water from below the soil surface and its roots tend not to engulf the emitters as much as other more fibrous-rooted species. Since it is a perennial, it will keep growing as long the weather is warm and there is plenty of water. However, periods of waterlogging or moisture stress will set the plant back. Subsurface drip irrigation can supply adequate water without these restrictions to plant growth, so yields are potentially higher than with flood irrigation which usually has waterlogged periods.

An added bonus with SDI is that the soil surface remains dry, so irrigation does not interfere with haymaking operations. Machinery can get onto lucerne paddocks sooner because the surface is not wet, resulting in more cuts per season. There is also no delay in watering after a cut, so the plant does not run into moisture stress.

Multileaf Generation lucerne (highly winter active) was sown in mid-August 2004, and first cut in mid-November. In the first season to mid-February, four cuts yielded 13 t/ha of hay (averaging 3.3 t/ha/cut). The Schlitzs expect to get two more cuts for hay this season and turn a seventh into silage. In the longer term, they aim to produce 25–30 t/ha of hay from seven cuts for another three to four years.

Average yields for lucerne irrigated by surface flood on similar soils in the area are 2.7–3.0 t/ha/cut. The best soils in northern Victoria have yielded 5.0 t/ha/cut during the peak summer period under SDI and Lauren Thompson expects that yields of 3.5–4.0 t/ha/cut should be quite achievable on a regular basis under SDI on the Schlitzs' soils.

Water does not move laterally at the same rate in all soils, so strips of varying lucerne growth appeared in the first year, especially on the sandy soils, indicating that the drip lines were spaced too far apart. These differences have become less obvious as the plants have grown and developed more extensive root systems, enabling them to tap into all the available moisture. However, at this stage of the project, the sandy soils are not achieving the same yields as the clay soils. Growth is uneven and the Schlitzs have discovered a hard pan below the surface which is restricting root growth.

Water use of lucerne

Lucerne is a high water user. A full canopy can transpire 10-13 mm water per day during summer and a total season's irrigation requirement can be 10-16 ML/ha. In this trial 518 mm (5.2 ML) (from irrigation and rainfall), plus some stored soil moisture, was used in the three months between 20 November and 20 February.

Lucerne can use 40–70 mm of water (0.4–0.7 ha) to produce one tonne of hay. An efficient irrigation system can produce 13–20 kg hay per mm of available water (rainfall plus irrigation) or 1.3-–1.7 t/ML. In this trial, during the first irrigation season, the average water use efficiency (WUE) of lucerne (from November to February) was 50 mm water per tonne of hay or 2.1 t/ML. We could expect that as the weather cools and the plant stand thins, less production will occur for the same amount of water, so the efficiency will drop off.

Matching water to crop demand

With flood and spray irrigation there are some delivery losses and periods of waterlogging can restrict plant growth. Subsurface drip irrigation can supply the right amount of water to meet crop demand without losses and stress periods. Water is used more efficiently, so in effect you can either produce more from the same amount of water, or use less water to produce the same yield. Lauren Thompson expects a water efficiency gain of 20–30% with SDI.

By monitoring soil moisture and recording weather information, irrigation can be matched to the plant growth demands. These vary according to soil type, season, weather and stage of plant growth (eg sandy soils have a lower water holding capacity, so will require more water than clays).

Further information

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Figure 1 *Lucerne under SDI can achieve 20–30% increases in productivity and water use efficiency*

Figure 2 *Uneven growth can occur if the drip line spacing is not matched to the soil characteristics*