# Irrigated lucerne production above a shallow saline watertable

**John Thompson & Sam North**
NSW DPI, Deniliquin

## in a nutshell

- An experiment was conducted at Deniliquin to determine levels of lucerne production above a shallow saline watertable
- Lucerne production was substantially reduced when irrigation intervals were extended to encourage water use from a saline watertable
- Production of 19–20 t/ha was achieved when the irrigation interval was reduced to an appropriate 60 mm of $ET_o - R$
- This level of production from its fifth and sixth season was excellent, especially given the presence of the shallow saline watertable
- Active depletion of soil water only occurred to a depth of 60 cm; any applied water used from below this depth was replenished from the watertable

***What level of production can be expected from irrigated lucerne growing above a shallow saline watertable? Will the lucerne access any of the groundwater?***

The irrigation interval (frequency) required for irrigated lucerne to produce at its maximum level has been thoroughly researched in southern NSW and northern Victoria. The weather (potential evapotranspiration: $ET_o$) less rainfall (R) is the main driver but soil type also has some influence.

Lucerne has a deep root system and can access water from the watertable where it is within the root zone of the plant. However, its ability to utilise the groundwater for production and/or survival had not been assessed.

The ability of saltbush (Old Man) plantations to use water from a saline watertable has been examined. Stands at Tullakool and Bunnaloo were studied. It was concluded that, at most times of the year, saltbush used shallow water sources derived mainly from rainfall. However up to half its water use at the driest time of the year (March in the Riverina) was derived from groundwater. Its capacity to use saline groundwater was small relative to recharge from irrigation and rainfall.

## The Deniliquin experiment – first phase

Peter Slavich investigated the effect of irrigating lucerne with channel water and with saline-sodic groundwater over three seasons (1990–1991 to 1992–1993). Lucerne (cv. Aurora) was established in October 1989 with only channel water being used during the establishment phase.

Following establishment, lucerne production was measured and changes in soil physical and chemical properties were monitored. The soil was a red-brown earth with 10–15 cm of clay loam topsoil. There was a watertable at approximately 1 m and the groundwater below the site was very saline. The 'control' plots were irrigated only with channel water. The irrigation interval chosen for this work was much longer than recommended for commercial lucerne hay production on this soil type (50–60 mm of evapotranspiration less rainfall ($ET_o$ – R). The longer intervals were chosen to see if the lucerne would access the watertable for some of its water requirement. The average interval was 150 mm in 1990–1991, 110 mm in 1991–1992, and 90 mm in 1992–1993.

Production (five cuts in each season) ranged from 13–15 t/ha from those plots that were irrigated only with channel water.

Monitoring indicated that there was little change in soil moisture content below 60 cm. At the relatively long intervals used during the experiment some of the crop's water requirement was met by upward capillary flow from the watertable. The crop displayed visible signs of water stress indicating that capillary flow from the watertable could not sustain potential $ET_o$ and thus production was reduced.

Salt accumulated in the root zone of the lucerne as a result of direct uptake of groundwater from the shallow watertable at 1 m. It was concluded that the use of saline-sodic groundwater for irrigation will quickly lead to yield losses where direct water uptake from the watertable also occurs and should be avoided where the watertable maintains a capillary fringe within the depth of rooting.

This work indicated that lucerne production was reduced at relatively long irrigation intervals. If the grower is interested in obtaining greater production can this be achieved by irrigating more frequently?

We decided to undertake further work on the same site. How much production would be realised at an irrigation interval of 60 mm of $ET_o$ – R?

The new treatments were assigned to specific plots so as to minimise any carryover effects from the previous experiment. There were eight replications of three irrigation intervals. Production (six cuts per season) was measured during 1993–1994 and 1994–1995.

## Treatments for the second phase

1. Irrigation interval – 60 mm of $ET_o$ – R
2. Irrigation interval – 120 mm of $ET_o$ – R
3. Irrigation interval – 180 mm of $ET_o$ – R

The longest interval was included to 'force' the lucerne to access water from the watertable. All plots were irrigated with channel water.

### Production

Production during the first season from the 60, 120 and 180 mm irrigation intervals totalled 20, 15 and 14 t/ha respectively (Table 1). In the second season production totalled 19, 14, and 12 t/ha for the three irrigation intervals. Except for the first cut in the first season, when all three treatments produced a similar amount, irrigating at 120 mm produced an average of 28% (range 17–38%) less than those plots irrigated at 60 mm. For five of the twelve cuts taken over both seasons, production from the 180 mm interval was significantly lower than 120 mm.

Reducing the irrigation interval to 60 mm of $ET_o$ – R increased production by 4–5 t/ha (approximately 25%) compared to the production from the first phase of the experiment. The level of production achieved was very satisfactory considering the shallow saline watertable and that the stand was in its fifth and sixth year.

Plant density (no. of crowns per unit area) was also reduced at the longest interval. Surprisingly, plant density actually increased at the 60 mm interval.

***Table 1: Lucerne production (t/ha) above a shallow saline watertable.***

| Irrigation interval | Growing season 1993–94 | 1994–95 |
|---|---|---|
| 60 mm ETo – R | 20 | 19 |
| 120 mm ETo – R | 15 | 14 |
| 180 mm ETo – R | 14 | 12 |

### Water extraction

As measured in the first phase, active depletion of soil water only occurred to a depth of 60 cm. Below this depth any water used by the lucerne was 'replaced' by capillary rise from the watertable.

Extending the interval out to 180 mm (approximately every 35 days) led to visible signs of severe water stress before each irrigation. This confirmed the earlier conclusion that, under the conditions imposed by the soil type and the saline watertable, the lucerne could not obtain sufficient water to maintain production.

## Conclusion

Lucerne produced well at an appropriate irrigation scheduling interval for this soil type (60 mm $ET_o$ – R). It was reluctant to produce when 'forced' to use the saline water from the watertable.

### Acknowledgements

*Funding for this work was provided by NSW DPI (then NSW Agriculture). Don Griffin and Jim Small assisted with measurement of lucerne production.*

### Further information

*John Thompson*
*T: 03 5881 9928*
*E: john.thompson@dpi.nsw.gov.au*

### Further reading

'Effects of irrigation water salinity and sodicity on infiltration and lucerne growth over a shallow watertable' (2002) PG Slavich, GH Petterson & D Griffin, *Australian Journal of Experimental Agriculture* **42**: 281-289

'Water use of grazed saltbush plantations with saline watertable' (1999) PG Slavich, KS Smith, SD Tyerman & GR Walker. Agricultural Water Management **39**: 169-185

***Figure 1: Lucerne growing above a shallow saline watertable produced well at an appropriate irrigation scheduling interval for this soil type (60 mm $ET_o$ – R) but it was reluctant to produce when 'forced' to use water from the saline watertable. Photo M. Lattimore.***