Longterm performance of EM38 zones

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Because relative yield differences between zones in a paddock can switch in some seasons, the combination of field results and modelling is needed to determine the longer-term economics of zone management. Crop modelling with the Agricultural Production Systems sIMulator (APSIM) is being used to look at the variation in crop yield and fertiliser response between EM38 based zones over a large range of season-types.

In this example, using simulation and the long term weather records sourced from Carwarp in the northern Victorian Mallee, wheat growth in each year for the period 1957 to 2006 was modelled on the unconstrained and constrained soils (Figure 2 page 10). The effects of rainfall, evaporation, drainage and water extraction by the crops were all calculated by the model, with starting soil nitrogen and organic matter assumed to remain the same in all years.

In the simulations, wheat (cv Yitpi) was sown between April 25 and July 15 with sowing dates triggered by 10mm rain over 5 days and the soil profile had to contain at least 10mm of available soil water. Separate simulations were done for nitrogen (N) fertiliser rates of 0, 15, 30 and 60 kg/ha applied at sowing.

In the zero nitrogen simulations, grain yields rarely exceeded 1.2t/ha and the constrained zone usually out yielded the unconstrained zone by a small margin. This simulation represents a paddock that is very low in available nitrogen and indicates that the earlier and faster growth of wheat on the unconstrained soils results in more nitrogen stress later in the life of the crop.

In the simulations where nitrogen is applied at 30kg/ha at planting, there are large responses to nitrogen fertiliser in most seasons and the unconstrained zone now out yields the constrained zone in most seasons (Table 1).

'Flip-flops', or seasons where the constrained zone out-yields the unconstrained zone, occur where there is good spring rainfall (soft finishes). The constrained zone out-yielded the unconstrained zone in only 10% of years.

Where higher rates of nitrogen were applied in the simulations, the responses in yield and the nitrogen fertiliser use efficiency (NUE) were highest in the unconstrained zones (Table 1). For example, applying 30 or 60kg/ha of nitrogen to the unconstrained zone in the 51 seasons between 1956 and 2006 resulted in 67% and 45% of seasons respectively, with an NUE of more than 20kg grain/kg N. In the constrained zone, applying 30 and 60kg/ha of nitrogen resulted in only 35% and 17% of seasons respectively with an NUE of more than 20kg grain/kg N.

Zone management, especially in relation to fertiliser application, can be an opportunity to reduce inputs in the constrained zones and capitalise on the performance of less constrained zones. This is especially important in the seasons where there is some stored soil moisture, the stage of the crop is responsive to nitrogen and the seasonal outlook for rain is positive eg. a consistently positive Southern Ocilation Index (SOI) after July 1.

On typical Mallee soils, EM38 is a very useful and readily available tool for helping to define management zones.

Table 1. The percentage of seasons between 1956 and 2006 that nitrogen use efficiency (NUE) was less than 10, 10-20 or more than 20kg grain/kg of nitrogen applied at sowing.

NUE	Unconstrained zone			Constrained zone		
(kg grain/kg N)	15N	30N	60N	15N	30N	60N
less than 10	16	18	35	53	55	63
10-20	6	15	20	10	10	20
more than 20	78	67	45	37	35	17

For more information

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