Improving plant management through modelling plant/environment interactions

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Modelling and simulation can assist plant management by revealing strengths and weaknesses of alternative strategies. Modelling offers a step by step method to link soil/plant/animal processes with the environment and computer simulation provides rapid traces through 'time' of plant/animal responses to inputs such as weather changes and management actions.

The strength of the modelling/simulation philosophy motivated the authors to adopt this technique in the following plant management areas:

- Effects of planting time on sunflower yield and oil quality.
- Integration of pastures in beef production.
- Cropping and irrigation strategies for shallow storage dams.

The unifying link in this set of diverse problems lies in the common approach adopted in model development. Simulation models which approach biological systems at a detailed physiological level meet with limited application because the level of information required is generally not available. The approach developed here is to use our understanding to firstly identify the essential features of each system and then to establish simple yet biologically meaningful relationships for use in simulation. In the examples above. simple dominating empirical relationships were established from experimental data. Often these relationships could not be derived directly from measured variables but were established using a simulation/modelling procedure:- (i) Sunflower yield was related to a moisture stress index around the time of flowering. This index was derived from simple water balance. Flowering time was predicted from heatsum and daylength. Oil quality was related to temperature during seed filling. (Hammer et al. 1978). (ii) Animal production for native and sown pastures was related directly to a weather derived growth index based on temperature response of pasture species and a soil moisture index from a water balance model. (iii) Water balance models are central to the irrigation study and approaches similar to those above were used to model the yield of grain sorghum, forage sorghum, oats and Mitchell grass. Catchment run-off was related to daily rainfall, antecedent moisture and an index of pasture biomass.

The relationships accounted for a high proportion of variation (typically 70-80%) and using simple accurate models such as water balance models, long term strategies and day to day management practices have been evaluated against long term meteorological data.

Hammer, G.L., Goyne, P.J. & Woodruff, D.R. (1978). Proc. 8th International Sunflower Conf.