

APSIM + GrazPlan: versatile software for simulating grain-grazing systems

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GrazPlan is a whole-farm simulation model for grazing enterprises in the temperate areas of southern Australia. APSIM is a model developed for cropping systems research in northern Australia where management of the water and nitrogen cycles is often problematic. Most farms in both regions produce both crops and livestock. There is a need for a model that can simulate integrated systems. This poster reports the marriage of APSIM and GrazPlan to do this.

GrazPlan provides a model of pasture growth and a model of ruminant feed intake and nutrition based on the Australian feeding standard. The pasture growth model is designed to simulate annual and perennial species in multi-species swards. Animal intake and production varies with the amount, digestibility and protein content of the herbage on offer, which is represented as a distribution of digestibility classes. GrazPlan can deal with sheep and/or cattle, with multiple paddocks and with stores of supplements.

APSIM simulates crop production, soil erosion, and changes in soil organic matter and structure. A key feature is that the central algorithm pertains to soil responding to weather, management and crops rather than a crop responding to resource supplies. While this achieves a sound logical structure for improved simulation of soil management and long-term change in the soil resource, it does so without loss of crop yield prediction ability by retaining proven models of specific crops. This concept is efficiently implemented using a program structure in which all modules communicate only through a central module server. Using a standard interface design, this hub-satellite design enables easy addition or exchange of modules without disruption. This benefits simulation of cropping systems in several ways: simulation of different crop/pasture sequences is achieved merely by managing connection of crop growth modules to the module server; effects of crops and pastures on soil is dynamic and cumulative.

Three main changes were required to combine GrazPlan and APSIM. First, a new interface makes the pasture model of GrazPlan into a module for APSIM. Radiation, temperature, water, and nitrogen information driving growth of pasture is passed from the appropriate APSIM module *via the* module server. Second, APSIM had to be generalised to be able to represent multiple paddocks. Third, the management routines in GrazPlan and APSIM were combined. This was helped by the similar (event-oriented) approaches taken to specifying the rules which determine when, in the course of a simulation, various actions are taken. APSIM's rules mainly concern planting and soil management operations in relation to the states of soil variables. GrazPlan's management actions (such as purchase and sale of stock, moving stock between paddocks, reproductive management, supplementary feeding, shearing, and irrigation) are taken in response to state variables, e.g. weight of a given class of stock, pasture biomass.

The development of APSIM+GrazPlan has been prompted by the need for a model to complement and support experiments in three GRDC projects spanning all three GRDC Regions. The experiments (some old, some new) provide the basis for model testing and improvement in each region. The models provide a means of integrating information and taking results beyond the confines of the experiments both locally and nationally.