Simulation of lablab pastures

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Introduction The potential of legume-based pastures to address declining soil nitrogen on marginal cropping soils is increasingly recognised in northern Australia, as such there is a need for cost benefit analysis of pastures and crops in a mixed farming system. In highly variable rainfall environments, biophysical modelling may be the best way of identifying and quantifying interactions with mixed crop-livestock systems on a seasonal basis. This paper describes a case study where both animal productivity and lablab pasture production is simulated. Lablab (*Lablab purpureus*) is an annual tropical legume widely used as a short-term legume phase in crop-pasture rotations, providing high quality forage for animal production and a low risk nitrogen input for crop production.

Materials and methods A simulation capability for lablab growth was developed using the APSIM-Legume model framework (Agricultural Production Systems simulator; Robertson et al., 2002). The lablab model was tested for its ability to predict leaf biomass (the portion of lablab that is consumed by animals) against measured data from northern Australia. Using daily weather records from 1957 to 2004 the production of leaf biomass was simulated each season for annual lablab on a 150 cm deep Vertosol at Gayndah, Qld, Australia (25°39'S 151°45'E). A relationship between lablab leaf biomass and liveweight gain (LWG) of *Bos indicus* steers was derived by running simulations of the GrazFeed animal biology model (Freer et al., 1997) with increasing leaf weights. This relationship was used to predict a range of LWG over the seasons.

Results An example of the model's ability to simulate leaf biomass at Gatton, Qld, is shown in Figure 1. The long-term simulation of lablab production under dryland conditions at Gayndah indicates that at least 1000 kg/ha of leaf biomass will be produced in 50% of years, and at least 500 kg/ha will be produced in 80% of years (Fig. 2). This corresponds to a LWG of at least 0.75 kg/head/day in 80% of years assuming a stocking rate of 1 steer/ha (Fig. 3). At a stocking rate of 2 steers/ha, and assuming that steers were consuming approximately 10 kg lablab/day, this rate of LWG could be maintained for 25-100 days depending on biomass produced.

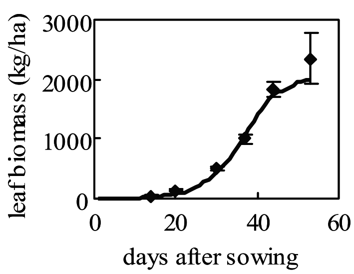

Figure 1 Measured values of biomass at 14, 20, 30, 37, 44 and 53 days after sowing (± s.e.m.) and the simulated leaf biomass of lablab

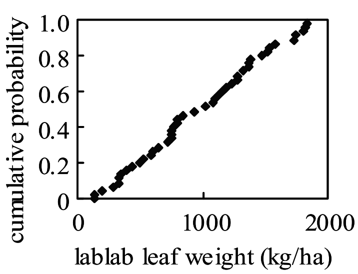

Figure 2 Cumulative distribution function for seasonal lablab leaf production at Gayndah (1957-2004)

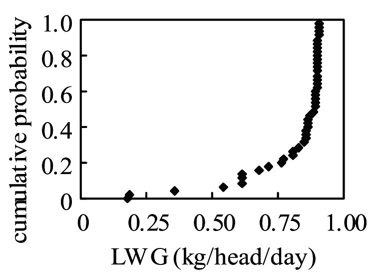

Figure 3 Cumulative distribution function for a range of LWG (1957-2004)

Conclusions The APSIM lablab model was able to simulate leaf biomass production with a high degree of precision. The long term simulation of lablab production under dryland conditions indicated a low risk of crop failure, and the potential for relatively high rates of LWG of *Bos indicus* steers. The persistency of animal productivity will depend on subsequent rainfall, plant regrowth and stocking rates. Work is currently in progress to link the GrazFeed and APSIM models in order to simulate lablab production and animal production dynamically with a daily time step.

References

Freer, M., A.D. Moore & J.R. Donnelly (1997). GRAZPLAN: Decision support systems for Australian grazing enterprises II. The animal biology model for feed intake, production and reproduction and the GrazFeed DSS *Agricultural Systems*, 24, 77-122.

Robertson, M.J., P.S. Carberry, N.I. Huth, J.E. Turpin, M.E. Probert, P.L. Poulton, M. Bell, G.C. Wright, S.J. Yeates & R.B. Brinsmead (2002). Simulation of growth and development of diverse legume species in APSIM. *Australian Journal of Agricultural Research*, 53, 429-446.