Background to Project

Most of the Australian cotton crop is grown on the alkaline, self-mulching, heavy clay soils in north western New South Wales and southern Queensland. In these soils the yield of lint is limited by the supply of soil nitrogen, although the limitation can be overcome to some extent by the application of fertilizer nitrogen. The highest yields of lint were obtained by drilling anhydrous ammonia or urea into the hill in the month before sowing (Constable et al. 1991). However, even when fertilizer nitrogen is applied at the optimum time, recovery of the applied nitrogen by cotton is poor. Farmers in Australia apply between 80 and 200 kg N ha^{-1} to cotton, but the apparent recovery of the applied nitrogen is only about 40% and seldom exceeds 50% (Hearn 1986; Constable and Rochester 1988; Constable et al. 1991). The fate of the remainder of the fertilizer nitrogen is not known, but much of it is probably lost from the system by gaseous emission of ammonia, nitrous oxide or dinitrogen, by leaching or run-off. As cotton growers currently spend in excess of $20 million on fertilizer nitrogen to supply the needs of the crop it can be seen that the losses in excess of $10 million are of tremendous economic significance.

In order to make more efficient use of the fertilizer nitrogen, to prevent contamination of the ground water and atmosphere, information is required on the fate of the added nitrogen, the amounts lost by the various processes and the timing of the loss. With this information it should be possible to design more effective management practices and save the industry up to $10 million each year.

More efficient use could be made of the nitrogen fertilizer if the computer based crop management system SIRATAC could be modified to include advice on nitrogen fertilization. Incorporating nitrogen into the fruit model has not been as successful as the work with water. The main problem is estimating nitrogen uptake. The first

approach was to follow other workers and estimate uptake as a function of the concentration of mineral nitrogen in the soil solution and the transpiration rate. The result was an underestimate. The second approach was to develop a rate equation in which uptake was limited by concentration in the soil at low levels, but approached an asymptote at high levels. The resulting function was site specific and therefore not general.

When the problem of stimulating uptake has been overcome, nitrogen can be included in the fruit model. The SIRATAC pest management system can then be applied more confidently when nitrogen is limiting. More important, the fruit model will be developed in conjunction with appropriate soil and plant tests to monitor and manage nitrogen through the season. The SIRATAC system provides a means of making the results of past and present nitrogen research available to the grower.