Estimated potential of cotton grown under trickle irrigation

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Trickle irrigation has experienced an enormous increase in commercial significance over the last fifteen years. In flood irrigation, the soil experiences cycles of saturation and then drying, subjecting crops to stress conditions, initially from waterlogging and then due to lack of water. By using trickle irrigation, it is possible to at least reduce stress due to lack of water and therefore increase yields(1).

In order to examine the potential for trickle irrigation in north western NSW and to quantify its potential in terms of cotton yields, a simulation model was constructed based on the work of Constable and Hearn(2). Three main functions were used:- leaf water potential (as a function of soil water deficit and age); nitrogen uptake (a function of initial N levels, applied N, stress and waterlogged days); and yield (as a function of stress during the periods of first flowering, peak flowering and early and mid boll maturation, waterlogging and nitrogen uptake). Daily potential leaf area expansion was defined by a compound growth function in which maximum leaf area (4.8) was attained at 1380 accumulated day degrees (above 12) from emergence. Actual expansion was then derived by adjusting this potential for waterlogging, stress and N uptake. The leaf area calculated was an important determinant of actual daily evapotranspiration, as used in the soil moisture balance model(3).

Daily climatic data for the period 1971 to 1981 for Narrabri was used to drive the model. Evaporation data was not available for 1974. In the results reported here (Table 1), the crop was assumed to be planted on October 7 with usage of 160 kgN/ha during the season. Two levels of trickle irrigation were examined: available volumetric soil moisture was allowed to fall to 70% before watering occurred, or daily watering took place to avoid stress. These results are compared with the actual yields of a local grower whose yields are above the district average and theoretical maximums for flood systems as calculated by Constable and Hearn(2). It can be observed that by reducing the allowed trickle irrigation soil water deficit (SWD) in both periods 1 and 4 for SWD30%, it should be possible to bring yields closer to the theoretical optimum yields that could be achieved with no deficit whilst maintaining substantially lower water requirements than those usually required under flood irrigation.

Table 1. Comparison of Cotton Yields from Flood and Trickle Irrigation

Year	Type	Yield (bales/ha)				Water Use Data for SWD 30%					
		Flood		Trickle		Water Use ML	Water Logged Days	Stress Period 1 (Days)	Stress Period 2 (Days)	Stress Period 3 (Days)	Stress Period 4 (Days)
		Grower	Potential	SWD0%	SWD30%						
1971	Wet	3.40	8.16	10.10	8.47	6.83	6	3	0	3	7
1972	Dry	5.93	7.26	9.77	9.48	4.26	9	4	0	0	7
1973	Av	3.48	9.15	9.99	9.70	2.83	7	4	0	0	1
1974	-	-	-	-	-	-	-	-	-	-	-
1975	Av	3.94	6.60	10.43	8.86	4.31	3	10	1	2	3
1976	Av	4.45	7.98	9.31	8.90	2.97	12	4	1	0	1
1977	Wet	3.50	7.80	10.32	9.29	2.93	4	9	2	1	0
1978	Av	6.92	8.79	10.32	7.64	3.75	4	12	0	3	10
1979	Dry	7.41	8.13	10.32	8.35	4.24	4	5	3	2	7
1980	Dry	7.41	9.57	10.65	7.75	6.69	1	21	1	2	7
1981	Dry	7.16	9.90	10.65	6.92	4.13	1	15	0	6	8
Mean		5.36	8.33	10.19	8.64	4.29	5.1	8.7	0.8	1.9	5.3

1. Birch, C.A. and Bright, N.J. 1985. Proc. 3rd Aust. Agron. Conf. Hobart p290

2. Constable, G. and Hearn, A. 1984. Irrigation Science 5 75-87

3. King, G.W. 1973. Unpublished Ph.D Thesis, University of NSW