Performance of two wheat crop models compared with the Australian wheat field trial database.

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As part of a programme whose objective is the development of an improved Australian wheat crop model (1), two models, OLEARY (2) and SIMTAG (3), were tested against the Australian wheat field trial database (AWFTDB) (4). This comparison was made to assess how well they could predict several variables under a wide range of edaphic, climatic and cultural conditions at sites scattered across the Australian wheatbelt. OLEARY and SIMTAG represent two classes of wheat model. OLEARY is a simple model which predicts dry-matter production (DMP) from crop transpiration estimates using a transpiration efficiency coefficient, while SIMTAG is more complex and predicts DMP from intercepted solar radiation using a light-use efficiency coefficient.

Simulations

A total of 53 simulations were carried out against data collected for experiments covering 8 cultivars grown at 11 sites on 15 soil types between 1978 and 1984. The climates at each site ranged from sub-tropical, with a summer rainfall peak at Dalby, Qld., through temperate, with almost uniformly distributed rainfall at Wagga Wagga, NSW, to quasi-Mediterranean, with a slight winter rainfall peak at Horsham, Victoria. Data for soil water-holding and cultivar characteristics, meteorological conditions and management practice were used to drive the models. The corresponding predictions of final grain yield (FGY), sequential above-ground dry-weight (AGDW) and leaf area index (LAI), along with change in total soil water content (DTSWC) and the dates of phenological events (PHEN) were compared with field measurements from AWFTDB.

Table 1. the coefficients of determination (r^2) for predictions of Fgy, Agdw, Lai, Dtswc and Phen by Oleary and Simtag versus real data from Awftdb. the number of points are shown in brackets.

	FGY	AGDW	LAI	DTSWC	PHEN
OLEARY:	.38(42)	.51(210)	.22(141)	.11(52)	.90(90)
SIMTAG:	.36(46)	.72(225)	.37(169)	.00(53)	.95(90)

Table 1 shows that whilst both models predicted the dates of phenological events very well and AGDW reasonably well, they performed poorly with respect to the other variables. This suggests that there are problems with the water balance submodel and in the functions used to calculate LAI. These could stem from deficiencies in the models and in the input data. The more detailed DMP and canopy morphology submodels of SIMTAG predicted AGDW and LAI better than those of OLEARY. One reason for this apparent failure to predict DTSWC lies in the specification of the lower limit of soil water extraction by the root system (LOL) (5). AWFTDB contains data for laboratory-measured permanent wilting point (PWP) which had to be used as the LOL and it is known that the LOL may be significantly lower than PWP, depending upon soil physical and chemical properties and the wheat cultivar. Because OLEARY and SIMTAG do not account for soil nitrogen, unknown variation of soil nitrogen levels between trials could also be a problem.

1. McMahon, T.A. (ed.) 1983. Agric. Eng'g. Rep. No. 67/83. Melb Univ.

2. O'Leary, G.J., Connor, D.J. & White, D.H. 1985. Agric. Systems. 17 1-26.

3. Stapper,. M. 1984. Model Documentation. University of New England.

4. Rimmington, G.M., Connor, D.J. & McMahon, T.A. 1987. Agric. Eng'g. Rep. No. 1/87. Melb. Univ.

5. Cassel, D.K., Ratliff, L.F. & Ritchie, J.T. 1983. Soil Sci. Soc. Am. J. 47 764-769.