Ceres sorghum (sat): a model of sorghum growth and development in the semi-arid tropics

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Models of crop growth, development and yield have been published for a number of crops (1). They have been developed for various reasons including farm decision making, interpreting experimental results, focussing research on knowledge gaps and risk analysis associated with crop production. The complexity of the model is usually dictated by the objectives of the modeller and the uses to which it will be put.

A recent addition to the range of models is CERES-Sorghum (SAT). This model of grain sorghum growth and development in the semi-arid tropics (SAT) was adapted from CERES-Maize (SAT) (2), a similar model of maize. CERES-Sorghum (SAT) is a mechanistic model and should be less sensitive than a regression model to location, provided sound data on inputs for latitude, climate (rainfall, temperature, radiation), soil (water content at saturation, drained upper limit, and lower limit of plant extractable water, root distribution coefficient and soil surface characteristics - albedo, curve number for runoff calculation), and genetic characteristics (thermal duration of phenological development stages, photoperiod sensitivity coefficient, potential grain number per plant and potential grain growth rate) are available. The model was developed using data from grain sorghum research with cultiyar Dekalb DK55 at Katherine, N.T., considered to represent the SAT. When tested against independent data sets from the Katherine trials, its performance has been highly satisfactory (Table 1), with errors generally within 10-15% of observed values.

Table 1. Root mean square deviation (RMSD) values for prediction of of grain sorghum by CERES-Sorghum (SAT) for 20 data sets (except as shown in parenthesis).

Variable	RMSD
Days from sowing to anthesis (d)	3.0
Dry weight at anthesis (kg ha^{-1})	1274
Leaf area index at anthesis	0.9 (12)
Leaf number	1.5 (18)
Days to maturity (d)	6.3
Grain yield (kg ha^{-1} dry weight)	971
Individual seed weight (mg)	3.8
Biomass at maturity (kg ha^{-1})	1658

Some aspects of the model need further development including the addition of a tillering routine (for higher latitude and lower temperature areas), inclusion of a modifier to alter phenological development in response to water stress, improvements to prediction of leaf number and the development of an equation to predict thermal duration from sowing to emergence. The extension of the use of the model to other genotypes depends on the availability of appropriate genetic information. Relevant research to improve the model is currently under way at Katherine and Gatton, Qld.

1. Joyce, L.A. and Kickert, R.N. (1987). in Plant Growth Modelling for

2. Resource Management. Ed. Wisiol, K. and Hasketch, J.D. (CRC Press). Carberry, P.S., Muchow, R.C. and McCown, R.L. (1988). Field Crops Res. (in press).