Using crop modelling to supplement crop trial data for land capability assessment in Cambodia

Wendy Vance[1], Richard Bell[1] and Seng Vang[2]

[1] School of Environmental Science, Murdoch University, Murdoch, Western Australia
[2] Cambodian Agricultural Research and Development Institute , Phnom Penh, Cambodia

Abstract

Land capability assessment is being developed to support the expansion of cropping in uplands of Cambodia. DSSAT (The Decision Support System for Agrotechnology Transfer), an agroecosystem model, was used to determine potential yields of field crops in Cambodia to assist in the rating land capability. This paper reports preliminary testing of the model with maize and soybean under Cambodian conditions.

Key Words

Cambodia, crop modelling, DSSAT, maize, soybean

Introduction

To assist in the assessment of land capability, crop yield trials were completed from 2003 to 2005 with maize, mung bean, peanut, sesame and soybean in three districts of Cambodia, on representative soil types in the early wet season and main wet season. However, more research is needed to establish the potential yields achievable on key soils across the country, through improved nutrient management and cultivars and better water and pest management. To determine potential yields of field crops in Cambodia and assist in the rating of land capability, crop growth was modelled using the agroecosystem model, DSSAT (The Decision Support System for Agrotechnology Transfer) (Jones et al. 2003). The model is being tested with maize and soybean for Cambodian conditions to:

1. Assess yield differences from different sowing dates and with different limitations to plant growth due to soil type.

2. To establish a realistic potential yield for the study environments.

Method

Soybeans and maize production was modelled for one year using the DSSAT program. DSSAT requires inputs of soil chemical and physical properties, daily weather data, species cultivar coefficients and crop management.

Two soil types were used in this experiment. These included a sand from the Prey Khmer Group and a clay from the Kampong Siem Group. Soils were classified using the Cambodian Agronomic Soil Classification (White et al. 1997). These soils would be classified as (Dystric) Fluvisols (occasionally Arenosols) and Vertisols respectively using the FAO/UNESCO soil classification system (FAO 1974). The weather data used in the model was from Pochentong airport in Phnom Penh for the year 1998. This data included daily measurements of maximum and minimum temperature, rainfall and sun hours. The sun hours were converted to solar radiation values using the Weatherman application in DSSAT.

Management of the crop mimicked field trials using fertiliser recommendations for each of the soil types and conventional sowing depth, seed rate and row spacing. Seasonal differences and the effect of sowing dates was incorporated into the model by simulating 14 sowing dates starting from the 15th of March to the 15th of September. This covers both the early wet season, April to June (EWS) and the main wet season, July to October (MWS) in Cambodia.

Results

The highest yield of soybeans was sown at the 30th May on Kampong Siem soil (2.9 t/ha) and 1st July in Prey Khmer soil (2.5 t/ha) (Figure 1). Normal farmer practice is to sow soybean in July which is the MWS, however sowing dates which covered the EWS, were successful in simulations with the 1998 weather data. Actual yields of soybean crops produced in the 2004 trials are available for the Prey Khmer soil types and Kampong Siem soil types. We were unable to simulate the 2004 year due to a lack of available weather data. The 1998 simulations cannot be compared to the actual yield from 2004 due to the different climate conditions between 1998 and 2004. However, the yields of soybeans in 2004 trials across the soil types and sowing dates were from 0.08 to 1.4 t/ha in the EWS and 1.1 to 3.3 t/ha in the MWS and cover the range of simulated yields using 1998 weather data (Figure 1).

The highest simulated yield of maize was on the Kampong Siem soil with a 1st July sowing (6.1 t/ha). The highest simulated yield (5.1 t/ha) on the Prey Khmer soil occurred with the 1st May sowing. The 15th of March sowing date had no yields, this was due to the seeds not germinating within 15 days of sowing. The outputs from the simulation model include information on soil water, soil and plant nitrogen, plant growth parameters and weather parameters. These outputs can be examined to determine what is limiting crop growth for different sowing dates and for the simulation of the maize crop may explain the different responses between the two soil types.

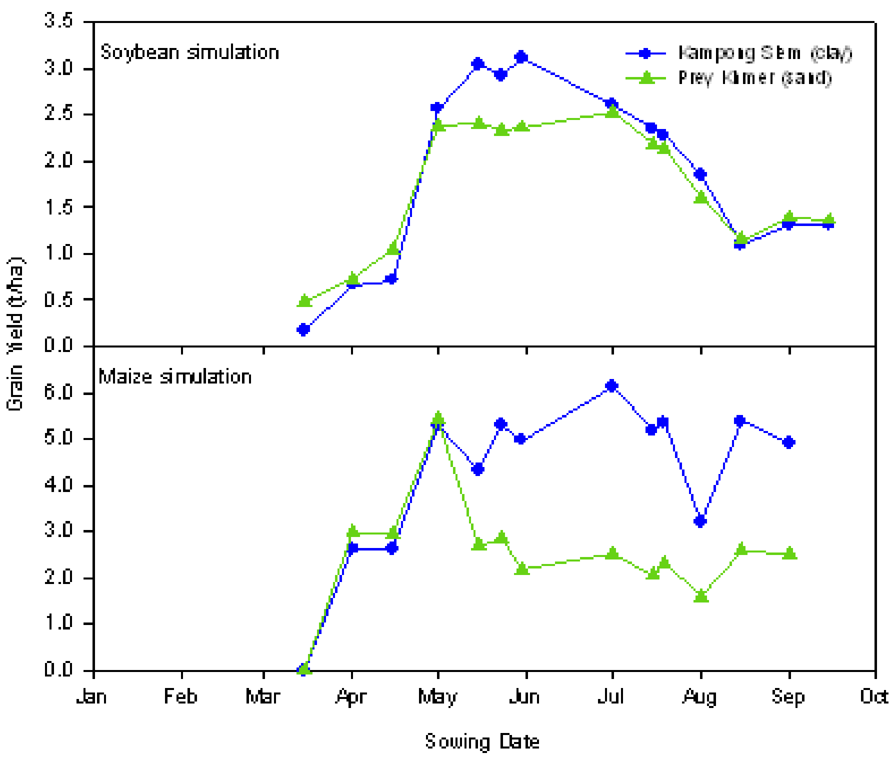

Figure 1. Simulated grain yields for soybean and crops maize sown on 13 different sowing dates from the 15th March to the 15th of September.

Conclusion

The success of field crops in current trials in Cambodia has ranged from failed crops to grain yields of 3.3?t/ha for soybeans and 4.4 t/ha for maize. The simulation of crop growth using the DSSAT model indicates that the maximum yields of soybeans reach the maximum yields of trials and that maize yields have been simulated up to 2 t/ha higher than trial results. However, the lack of available daily weather data and information on local soil physical properties means it is difficult to directly compare simulated results to trial results. Cambodia is a relatively data-poor environment from which to develop the inputs of soil, weather and crop management required for the model. Continued crop trials in Cambodia will allow collection of parameters of plant growth, soil physical properties and daily weather data which will enable calibration of the model for each crop. This will then allow the model to be used with confidence to predict potential yields of soybean and maize in Cambodia for different soil types and environments.

References

Food and Agriculture Organization (FAO) (1974). FAO-UNESCO soil map of the world.1:5,000,000. Vol. 1, Legend. UNESCO, Paris.

Jones JW, Hoogenboom G, Porter CH, Boote KJ, Batchelor WD, Hunt LA, Wilkens PW, Singh U, Gijsman AJ and Ritchie JT (2003). The DSSAT cropping system model. European Journal of Agronomy. 18, 235-256.

White PF, Oberthur T, and Pheav S (1997). The Soils Used for Rice Production in Cambodia. A Manual for their Identification and Management. International Rice Research Institute, Manila.