

Short Communication

VALIDATION OF AGRICULTURAL PRODUCTION SYSTEMS SIMULATOR MODEL FOR MUNG BEAN [*VIGNA RADIATA* (L.) R. WILCZEK] IN THE DRY ZONE OF SRI LANKA

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INTRODUCTION

Mung bean [*Vigna radiata* (L.) R. Wilczek] is an important pulse crop grown in Sri Lanka under traditional farming system mainly in the dry and intermediate zones. Mung bean is a vital source of vegetable protein, vitamin and minerals particularly in developing countries. It is a short duration legume, hence grown as sole crop as well as inter and multiple cropping systems under rainfed and irrigated conditions and increases farmer income and improves the soil fertility through symbiotic nitrogen fixation (Malik, 1994). In Sri Lanka, mungbean is cultivated about 11,840 ha and annual production is about 14,352 mt (Agstat, 2014). The importation of mung bean in the year 2014 was 5,075 mt and amount of export was 2,973 mt, which shows the production is insufficient for the country. Among all other field crops, mung bean recorded the highest wholesale and retail price in Sri Lanka. Therefore, mung bean is considered as a valuable other field crop in Sri Lanka. Simulation models are useful tools to assess the performance of agricultural systems under different scenarios. The Agricultural Production Systems Simulator (APSIM) is a farming systems model that simulates the effects of environmental variables and diverse management decisions on production (crops, pasture, trees, and livestock), profits, and soil condition (Keating *et al.*, 2003). The model can be used to analyze risks and explore alternative management options such as irrigation management, crop choice, planting date, and fertilizer rate using local climate and farm-specific soil data. The present study was conducted to testing and validate APSIM model in the Dry Zone of Sri Lanka for mung bean.

MATERIALS AND METHODS

Parametrization of mungbean module in APSIM

The APSIM-mung bean module in APSIM version 7.5 was used to parameterize the phenology and growth of mung bean variety, MI 6. Required phenology and growth

data for MI6 data for were collected from the available literature (Amarasingha *et al.*, 2016).

Model testing and validation

Study area: The APSIM mung bean module testing and validation were done at the Angunakolapelessa (Lat:6 ° 90” Log:80°54”), Aranaganwila (Lat 7°57”: Log:81°16”) and Mahailuppallama (MI) (Lat: 8° 00”E: Log: 8°02”N).

Soil data: Soil physical and chemical properties were collected from the fact sheets of benchmark soils of the Dry Zone of Sri Lanka published by the soil science society of Sri Lanka (Mapa *et al.*, 2010).

Weather data: Daily weather data from January 2013 to December 2015 were collected from the Grain Legumes and Oil Crops Research and Development Centre Angunakolapalassa Field crops Research and Development Institute, Mahailuppallama and Regional Agricultural Station, Aralaganwila were used for the simulation. Maximum and minimum temperatures, rainfall and sunshine hours were available on a daily basis. Daily incoming radiation (MJ/m²) was calculated using sunshine hours and location specific information such as latitude and longitude, solar elevation and angstrom coefficients.

Model testing

Crop and management data: The primary data collected from Angunakolapellessa, secondary data collected from Field crops Research and Development Institute, Mahailuppallama and Regional Agricultural Station, Aralaganwila on planting date and yield were used to test the model. Crop management strategies were adjusted in the model simulations as collected from the field trials which are followed by the Recommendations of the Department of Agriculture. The simulated yields were used to compare the observed and predicted values once simulated using the appropriate weather data.

Model validation

Crop yields collected from published literature (secondary data) were used to validate the model both qualitatively (graphical) and quantitatively (statistical). The zero origin (1:1) graphs of the relationship between model simulated and field observed data (field measured data) were plotted to identify the difference/similarity between predicted and observed values. The statistical expressions were used for comparing the simulated and field measured data were average error basis (AE), coefficient of variance (CV), root mean square error (RMSE) and co efficiency of residual mass (CRM) presented as:

$$\text{Coefficient of Variance (CV)} = 100 \times \frac{\left[\frac{1}{n} \sum_{i=1}^n (P_i - O_i)^2 \right]^{0.5}}{O_m}$$

$$\text{Root Mean Square Error (RMSE)} = \left[\frac{1}{n} \sum_{i=1}^n (P_i - O_i)^2 \right]^{0.5}$$

where P_i is simulated values; O_i is measured values; O_m is mean of measured values and n is number of the observation.

RESULTS AND DISCUSSION

The APSIM could simulate the observed mung bean yields with a coefficient of determination of 0.97 and co-efficiency of variation of 6.9%. Therefore, the parameterised and validated APSIM model is strong. Department of Agriculture annually conduct large number of yield trials such as PYT, MYT, NCVT and VAT under their varietal releasing programmes. Therefore, models such as this can be used in evaluating the performance of mung bean in different locations and seasons under diverse management conditions.

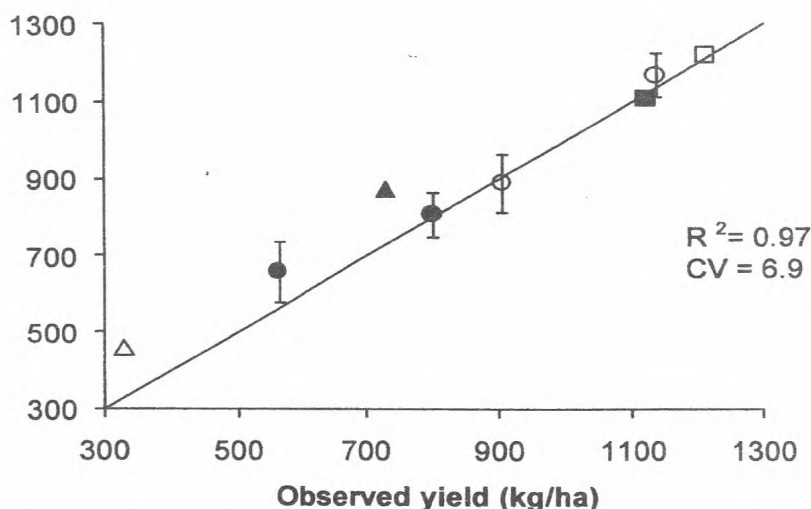


Figure 1: Observed and simulated yield for variety MI 6 mung bean varieties grown during Yala (unfilled) and Maha (filled) season in Mahailuppallama (squares), Angunakolapelessa (circles) and Aralaganwila (triangular).

CONCLUSION

With these results APSIM model can be suggested as a tool to forecast yield of mung bean variety *MI6* and could be applied for other field crops such as maize. After model testing and validation for each crop and variety without conducting on farm trials and it would shorten the time of releasing a variety.

ACKNOWLEDGEMENT

The authors are greatly acknowledge AusAID-CSIRO project on “Improve climate forecasting to enhance food security in Indian Ocean rim countries (AUSAID Agreement 59553) through the Agriculture Education Unit (AEU) of the Faculty of Agriculture ,University of Peradeniya, Sri Lanka and Miss Priyanthi Kumararathne, ADA (Research) Field Research and Development Institute, Mahailuppallama, Miss Chandrika Hitinayaka (ADA Research), Regional Agricultural Station, Aralaganwila, Punya Delpitiya (ADA Research) for the supplying of data.

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