Application of Crop Simulation Model in Peanut Breeding

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Abstract

The ability of crop simulation models to simulate growth and yield of crop cultivars in different growing environments make them an attractive tool for crop improvement. Potential breeding applications of these models include assisting multi-environment evaluation of crop breeding lines, understanding the nature of genotype by environment (G x E) interactions and identification of desirable traits leading to plant-type design. All of these applications have been investigated at Khon Kaen University for peanut breeding using the CSM-CROPGRO-Peanut model.

Model application in assisting multi-environment evaluation of peanut breeding lines was first evaluated with 12 large-seeded and 13 small-seeded advanced breeding lines tested in 12 and 3 environments, respectively. The results showed that the model could predict all the 6 top yielding lines in the large-seeded group (upper 50 %) and 5 out of the 7 top yielding lines in the small seeded group, and also could provide good assessment of yield stability of these advanced peanut lines. A subsequent study with 13 diverse peanut lines tested at 11 environments also confirmed these results. The limitation for this model application is the extensive data collection in the cultivar coefficient determination experiment. We found that experimental data for two seasons are sufficient to accurately derive the cultivar coefficients for breeding application, and further reduction in the number of plant sampling is also possible.

Applications of the CSM-CROPGRO-Peanut model in investigating G x E interactions that have been done or are underway include examination of the dynamic of genotype x year (G x Y) and genotype x location (G x L) interactions, determination of patterns of G x E interactions, evaluation of environmental factors and crop traits responsible for G x E interactions, determination of mega-environments in Thailand for targeting the peanut breeding program and determination of test locations for a more effective evaluation of peanut breeding lines.

An attempt in model application for ideotype design was also made on designing the peanut ideotype for Khon Kaen province. More than 70 % of yield improvement over the current cultivar KK 5 was obtained from the derived ideotype.

Key words: Crop model; Varietal evaluation: G x E interaction; Plant type design