APPLICATION OF THE CROPGRO-SOYBEAN MODEL TO PREDICT SOYBEAN YIELD

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Crop models are available for almost all economically important crops and on many occasions they have been successfully used in research. During the past 25 years, numerous crop models have been developed to characterize growth and yield as a function of environmental conditions and to quantify the interactions that occur between plants and biotic stresses, such as diseases, insects, and weeds.

Recently, there has been increased interest in modeling soybean plants in order to predict vegetative and reproductive development of different cultivars under various crop management and environmental conditions. Predicting yield potential is difficult because of the wide ranges in yields, growth habits, and reproductive development of soybean cultivars. In soybean, number of pods is a critical yield component; however, some cultivars can initiate a large number of pods and yet not produce high yields. In fact, shedding of growing pods during shell enlargement, seed abortion, or non-optimal seed growth may reduce yield potential. Environmental stresses due to temperature and water availability cause pod and seed losses. Thus, it is important to simulate in detail the dynamics of pod and seed setting and to specify the effects of genetic and climate factors on each yield component.

One of the most complex and sensitive soybean growth models is the CROPGRO-Soybean model. The CROPGRO-Soybean model is a mechanistic crop growth model that predicts daily photosynthesis, growth, and partitioning to leaf, stem, root, pod, and seed yield in response to daily weather inputs, soil traits, crop management, and genetic traits. The objective of this research project was to use the CROPGRO-Soybean model to determine if growth pattern differ between old and new cultivars, and whether there is a linkage between cultivars and yield response to stress.

The experiment was conducted under five different management systems in Wisconsin from 1997 to 2000 for a total of 20 environments with three cultivars (two modern cultivars versus one old cultivar) and two planting dates (early May versus late May). Simulated yield responses for the three cultivars were variable and ranged from 39 to 85 bu $acre^{-1}$ across years, management systems, and planting dates.

Results indicate that new cultivars have improved stress tolerance associated with earlier planting and the ability to utilize more favorable growing conditions such as adequate moisture. Averaged across all management systems and years, new soybean cultivars were associated with earlier podset, longer time from seed to physiological maturity, longer seed fill duration, and higher leaf photosynthesis. It was concluded that the CROPGRO-Soybean model could be used to quantify attainable soybean yields and to explain the expression of physiological traits. In the future, models may be useful for improving the efficiency and stability of agricultural systems and could be a tool for farmers to better understand how management practices can be altered to reduce crop stress and improve the profitability on their farms.

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