APPLICATIONS OF CROP-WEED COMPETITION MODELS FOR OPTIMISING EFFICIENCY OF WEED MANAGEMENT IN RICE PRODUCTION

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Introduction

Systems approaches in agricultural development have in recent years drawn considerable attention. The rationale as well as the advantages in improving cultural and other management practices through systems analysis, in the context of sustainable production practices with minimal inputs, have been well documented in the literature (Kropff and van Laar, 1993). Many crop-weed competition models have been developed for crops such as maize, soybeans, rice, pineapples and other field crops. Crops vary in their cultural requirements and competitiveness. Optimising crop growth under different weed scenarios with single and multispecies situations requires a thorough understanding of the complex factors that determine competitiveness between the interacting species. Competitive ability of plants vary depending on initial seed weight, earliness of emergence, relative growth rate, photosynthetic rate, plant height incremental rate, leaf angle and water and nitrogen use efficiency. Weed-Crop competition models can be useful as a quantitative tool in understanding the competitive mechanisms between species, both under homogeneous as well as patchy weed distribution often encountered in the field. Analysis and identification of parameters that significantly influence competitive ability of species under various scenarios that maybe readily simulated could provide useful information to breeders in their search for more efficient plant types. Validated models are also useful for predicting crop losses as well as designing improved crop management practices.

Materials and Methods

Two field experiments and two tank experiments were initially conducted to collect data on the effects of competition by barnyardgrass (*Echinochloa crus-galli* (L.) Beauv. var. *crus-galli*) on rice (*Oryza sativa* cv. MR84). In the first set, rice was sown at different densities (50, 100, 150 kg/ha), while in the second set sowing dates of rice for the three densities were varied (delayed) in relation to emergence date of the weed. Parameters collected include data on growth parameters such as dry matter partitioning, height increments, leaf area development and yield component analysis. Data from earlier experiments were used for parameterisation and preliminary validation of the model (Rajan, 1991; Rajan et al. 1995). Additional field experiments also gave information on weeds dominant in direct-seeded field situations in the major rice growing areas in Peninsula Malaysia. Hence, data on characteristics of two other major weeds were also included for study, i.e. *Leptochloa chinenesis* and *Fimbristylis miliaceae*. Additional experiments were subsequently conducted to use the data to validate the improved model for applications in plant breeding and under different weed scenarios.

Results and Discussion

Results of all validation experiments showed that the developed model can accurately simulate and explain yield loss, leaf area development and enhancement or delay in maturation due to differences in crop density effects, weed density effects, emergence times, sowing dates, vegetative and reproductive development rates, and temperature effects. The most sensitive parameters in the model are seedling vigour (or relative growth rate) and height growth parameter. The model can be easily adapted for studying competition effects of other weeds where minimum data sets for the critical variables were available. The ability of the model to identify key traits with respect to competitive ability makes it a useful tool for designing new crop ideotypes (Bastiaans et al. 1997).

Conclusions

These competition models are available for use by students and researchers in the field of crop-weed ecology. The models are useful for training students in ecology. They can be used as quantitative tools by extension specialists for training farmers on impact of weeds on crop loss and recommending appropriate cultural practices for specific weed situations.

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