A MODEL TO EVALUATE BIOLOGICAL PRODUCTIVITY OF RUBBER, PINEAPPLE AND BANANA INTERCROP

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Introduction

Every year some 40,000-50,000 ha of rubber smallholdings are being felled and replanted. one of several cropping systems being practised is the intercropping of the young rubber with short term perennials with the aim of generating income to the smallholders during the immature phase of rubber and to diversify their crop base. The performance of this and similar cropping systems in terms of yield and productivity, efficiency of water use, effects on soil erosion and soil fertility is little known. Additionally, an infinite number of soil types, weather and agricultural practice combinations are possible. Thus, the aim of this study was to develop a dynamic simulation model of rubber intercropped with pineapple and banana and to use this for evaluating the biological productivity of the intercropping system.

Materials and Methods

An FST (Fortran Simulation Translator) rubber stand alone model that simulates, among other variables, dry matter accumulation, tree girth and rubber production on a daily basis is being developed. An intercrop model INTERCOM (Kropff et al. 1994) will be used as a framework to incorporate pineapple or banana in combination with the rubber model. This will enable a representation of the competition for light, which is the main limiting factor in the biological production of the system under study. Various crop data were collected in the field and from the literature to obtain crop parameters for the model. A smallholder intercropping of rubber with pineapple and banana in Jelai, Taiping was chosen as the site for obtaining some of the crop data and for the field evaluation of the model. For the latter, leaf area indices for the three crops in addition to girth and height of rubber are being monitored on a regular basis. Weather data for the last 10 years recorded at two nearby stations (Lubok Merbau and Mardi Kuala Kangsar) were obtained for use as driving variables in the model.

Results and Discussion

The rubber growth model has been written and is undergoing sensitivity analysis. Data acquisition is still underway. Results from data of photosynthetic studies in the field showed initial light use efficiency (PLEI) values of 0.48 and 0.54 kg CO_2 ha^{-1} h^{-1}/J m^{-2} s^{-1} for banana and rubber respectively. Maximum leaf photosynthetic rates (PLMX) obtained were 28.6 and 23.5 kg CO_2 ha^{-1} h^{-1} for banana and rubber respectively. These results are consistent with the range of values typical for C_3 plants (Penning de Vries et al. 1989). PLEI for pineapple was 0.113 kg CO_2 ha^{-1} h^{-1}/ J m^{-2} s^{-1} and PLMX 1.4 kg CO_2 ha^{-1} h^{-1}. This is typical of CAM (crassulacean acid metabolism) plants like pineapple which have values about one tenth that of C_3 or C_4 rates (Sale and Neales, 1980). Leaf area studies show a progressive increase in LAI, which is consistent with that in the literature for the crops under study. However, rubber showed low LAI, which was due to leaf fall. Girth and height measurements for rubber, which is important for estimating growth, show an initial fast growth in the first two years and a slower growth in the following two years. The early fast growth is known to be the case during the juvenile phase of rubber. The results obtained so far with subsequent ones from data to be collected will be used to validate the model.

Conclusions

The model so far developed serves as a step towards the use of INTERCOM for inclusion of banana or pineapple to complete the objectives of this study.

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