

3. MATERIALS AND METHODS

3.1 Experimental System

The field investigation was conducted during June–November 1992, at the Multiple Cropping Center, Chiang Mai University. A randomized complete block design was employed for this experiment. Each plot was 48 m² (8 X 6 m) and separated from neighboring plots by a 2.5 m fallow ground. All plots had four replicates for each of five treatments: (1) mungbean monoculture and mixed culture mungbean intercropped with (2) upland rice, *Oryza sativa* Linneaus, (3) corn, *Zae mays* Linneaus, (4) sesame, *Sesamum indicum* Linneaus, and (5) sorghum, *Sorghum bicolor* Linneaus. Monoculture plots were composed of mungbean (variety Kampangsaen 1) only whereas mixed culture plots contained alternating rows of upland rice (variety R-258), corn (variety NS 1 CA), sesame (variety Nakorn sawan) and sorghum (variety KU. 439). The plots were planted on July 15, 1992. All plots were fertilized with compound fertilizer (15-15-15) at the rates of 187.5 Kg per hectare for mungbean, upland rice and sesame but 250 Kg per hectare for field corn and sorghum (Suthat, 1991 personal communication). Half of the fertilizer was separately applied before sowing and the rest at flowering stage of each crop. Crop spacing was 25 x 50 cm for mungbean, 25 x 25 cm for upland rice and sesame, and 50 x 50 cm for corn and sorghum respectively. The upland rice, sesame, sorghum, corn were planted simultaneously with mungbean. The arrangement of field crop in mixed culture of this

experiment is similar to what has been practiced in Vietnam. No insecticide treatments were applied. The fields were irrigated when necessary. Hoe weeding was done twice a month. The areas between the plots were kept free of vegetation by frequent harrowing.

3.2 Estimation of Herbivorous Insect Species Diversity

Herbivorous insects feeding on mungbean were monitored using sweep sampling. Foliage insects were collected by sweep-netting in the late morning (8-10 a.m) after the foliage has lost most of its surface moisture. A standard sweep net of 38 cm in diameter and about 75 cm deep and 90 cm length of hardwood handle as described by Kogan and Pitre (1980) was employed to sample pendulum sweeps. The pendulum sweeping procedure is similar to the "lazy 8" method the surveyor hold the sweep net like an oar, the hoop was kept about 30-35 cm within upper canopy of the plants. The net was moved forward along one row, and when it reached the maximum length of handle the net was turned 180 degree with a quick twist of handle and the backward stroke began the next step. The procedure was repeated with each stroke of the net counted as one sweep. Twenty-five sweeps per mungbean crop were done in each test plot. In most cases 100 sweeps were collected and bagged in lots of 25 sweeps to allow construction of "species sweep" curve presenting cumulative species richness as a function of sample size. All insects were sorted out, identified to family, counted and labelled as morphospecies as suggested by Jansen and Schoener (1968). Trophic position was assigned

by using food habit information from Borror et al. (1976). Cases where a family contained representatives of more than one trophic role was resolved by further keying or by the designation "miscellaneous". All plots were sampled at weekly interval on seven time periods: 4, 5, 6, 7, 8, 9, 10 weeks after planting. The number of phytophagous species per 25 sweeps was recorded during each sampling period. Analysis of variance method was used for the statistical analysis of the data obtained from this experiment. It was followed by Least Significant Different (LSD) to compare differences between means. The seasonal abundance of herbivorous insects on mungbean throughout the season was then determined. The index of species diversity was estimated using the Shannon-Wiener function (H'), as suggested by Begon et al. (1990). The pattern of distribution of individuals between the species (equitability, J) and species richness (rma) component of species diversity were quantified using the formula of Pielou (1969) and Allan et al. (1975), respectively.

3.3 Estimation of Natural Enemy Species Diversity

The pendulum sweeping procedure was used to sample insect species. All insects per 25 sweeps on mungbean of each test plot were brought to laboratory for identification of the particular species of insects. These insects were counted and labelled as morphospecies as suggested by Jasen and Schoenet (1968). All plots were sampled at weekly interval (4, 5, 6, 7, 8, 9, 10 weeks after planting). The number of entomophagous species per 25 sweeps was recorded each sampling period.

Statistical analysis was calculated as described previously for sampling the populations of phytophagous species. Taxonomic composition, species diversity and/or in some cases trophic composition was quantified.

3.4 Arthropod Species Diversity Assessment

Arthropod species (insect and non-insect species) were collected on mungbean in various test plots by using the pendulum sweeping procedure. All arthropods caught per 25 sweeps were sent to laboratory for identification of insects and morphospecies as well. The number of arthropod per 25 sweeps was recorded during each sampling period. All plots were sampled at weekly interval on seven time periods: 4, 5, 6, 7, 8, 9, 10 weeks after planting. The index species diversity and statistical analysis were calculated as described previously for sampling populations of phytophagous and entomophagous species.