

ABSTRACT

Wet zone of Sri Lanka together with the Western Ghats of India is listed as one of the 25 biodiversity hotspots of the world. A considerable land area of the wet zone of Sri Lanka is under paddy cultivation and therefore is an important land use type to be considered in conservation of biodiversity. The cultivation of rice is characterized by the coexistence of both traditional and modern agricultural practices. Traditional rice cultivation has been carried out using organic based methods while agro-chemicals are highly used in modern rice cultivation. The traditional methods of rice cultivation enables stable and balanced relationships to evolve between rice insect pests and their natural enemies while chemical based methods lead to the destruction of natural enemies causing the resurgence of several primary and secondary pest species and the development of insecticide-resistant pest populations. Therefore, a considerable variation of faunal diversity is expected within organic and inorganic based rice cultivation systems. To date studies on the biodiversity of rice fields mainly deal with agronomic aspects while comparative studies on agricultural practices on biodiversity of rice fields are scarce. Therefore, the overall objective of this study is to document and compare the faunal diversity that exists in an organically grown and inorganically grown rice field in the wet zone of Sri Lanka.

An organic and inorganic based rice field was selected in Matara district. The study was conducted over four consecutive rice cultivation cycles. Each cultivation cycle was divided into four stages, vegetative, reproductive, ripening and fallow. Information on the occurrence and abundance of selected taxa of invertebrates and vertebrates were collected using a variety of sampling techniques over these four cultivation cycles and an inventory of fauna was compiled for each of the two sites. Information on faunal species richness, density, similarity, diversity

and evenness as well as about the faunal feeding guilds was analyzed using various statistical methods.

A total of 134 species of invertebrates (11 species of annelids, two species of mollusks, one species of crab, eight species of arachnids, two species of myriapods, 110 species of insects) and 95 species of vertebrates (seven species of fish, seven species of amphibians, 16 species of reptiles, 54 species of birds and 11 species of mammals) were recorded from both rice fields. There was a significant difference ($P = 0.003$; $F = 9.75$) in the faunal species richness between the two rice fields. All invertebrates except crustaceans showed a significant difference ($P < 0.05$) in their densities in between the two rice fields. Of vertebrates, mammals only showed a significant difference ($P = 0.025$; $F = 10.0$) in their densities within the rice cultivation phases. Insects represented the highest species density in both organic based rice field as well as the chemical based rice field while annelids was represented by the least number of species in both rice fields. Of the vertebrates, fish showed the highest density while the lowest density was recorded for mammals. The density of birds was not recorded due to the technical difficulties encountered during the sampling. When the two fields are considered as a whole the density of vertebrate species in the chemical based field was slightly lower than the organic based rice field however it was not significantly different ($P > 0.05$).

The guild structures of both rice fields were quite similar. However the individual density of the guilds varied between the two fields. The number of pest species in the chemical field was higher during the fallow and reproductive phase while in the other two phases the number of pest species was higher in the organic field.

In the chemical based rice field the insect diversity fluctuated rapidly in correspondence with the chemical application. Birds on the other hand were not affected by biocides and showed a similar pattern as was observed in the organic based rice field. No clear pattern could be discerned for other taxonomic groups unlike the insects and birds. The faunal diversity in the two rice fields was significantly different ($P = 0.034$; $F = 4.71$) for every taxonomic group where the organic field demonstrated a higher diversity compared to the chemical field.

Apart from annelids other taxonomic groups showed a high degree of similarity for the two rice fields. Generally, evenness was significantly higher ($P = 0.006$; $F = 4.89$) in both rice fields during the four cultivation cycles indicating that species assemblages are not dominated by few species. The highest similarity was observed during the ripening phase followed by the vegetative phase while the lowest similarity was observed during the fallow phase. The variation of species similarity in between the two rice fields was not significant ($P = 0.170$; $F = 1.94$).

The climatic factor that showed most amount of variation during the study period was rainfall. A clear correlation was not observed between the changes in the species diversity with that of rainfall or other climatic parameters.

The yield received from organic based rice field was 1.4 times greater than the yield received from the chemical based rice field ($P = 0.000$; $F = 24.50$). It was also observed that even though the chemical field had high biocide inputs the number and density of pest species did not reduce appreciably. Furthermore, in both rice fields the pest species were outnumbered by beneficial and neutral species by a ratio of 1:3 and therefore application of non-target specific biocides will destroy these beneficial insects and prevent the farmer from obtaining their services.

According to this study organic farming is better than chemical based methods as it provides a higher yield, has better economic returns, while being environmentally friendly. In addition to that, there is a growing demand for organic rice so that, cultivation of organic rice should be encouraged.