Studies on Seasonal Abundance and Correlation of Major Groups of Insect-Pests and their Natural Enemies in Rice Ecosystem

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Abstract

Studies on seasonal abundance of major insect pests and their natural enemies was carried out at three different altitudes viz. lowland, foothill and upland during September 2002-August 2004. A mean total of 2173.7, 1114.1 and 525.7 of major insect pests were recorded respectively from lowland, foothill and upland rice ecosystems. Natural enemies were recorded with a mean total number of 727, 538.4 and 257.8 from the three respective rice fields. The major seasonal abundance of the major insect pests were most active from the month of May-November while minimum was recorded mostly during January-March in al the three ecosystems, with temperature record of 31.8°C (max.) and 12.2°C (min.). The temperature plays an important role as it affects the activities of Arthropods, causes increase or decrease their population size. The correlation coefficient value (r) had revealed a positive effect of natural enemies on all the population of major insect pests.

1. Introduction

Rice is the staple crop grown in Nagaland which is traditionally cultivated in Jhum land as well as in upland and wetland (rainfed) during *kharif* season. In Nagaland, during 2009-10, the total area of 1,68,570 ha was brought under rice cultivation (Anonymous, 2010). The agro-climatic condition of the region is very conducive for growth and multiplication of both insect pests and their natural enemies (Anonymous, 2006). Usage of pesticides by the farmers are very meager for which the natural enemies are found in abundance mainly of the orders Coleoptera, Odonata, Hymenoptera, Dictyoptera, Dermaptera, Diptera, Orthoptera and Araneida. Those were mostly dominated by carabid beetles, tiger beetles, dragonflies, damselflies and spider species viz. *Tetragnatha* spp., *Lycosa* spp., and *Oxyopes* spp. particularly in rice ecosystem. They play an important role in regulating the pest population, thus, safeguarding the ecosystem. The insect-pests population found in rice fields which causes economic losses are included under the orders of Orthoptera, Hemiptera, Lepidoptera and Isoptera. Despite the great current interest and the importance of growers on the status of pests and the presence of their natural enemies in an important crop ecosystem as rice, no such information is available in the state on the seasonal abundance of major groups of rice pests and their relationship with the natural enemies. Keeping this importance in view, the present study was undertaken.

2. Materials and Methods

The experiments were conducted during September, 2002-August, 2004 at three different farmers' field located at lowland (260 m MSL) in Dimapur, foothill (310 m MSL) at Medziphema and upland (1094 m MSL) at Kohima, having 1 hectare area in each location. The seasonal abundance of both natural enemies and insect pests such as soil surface dwellers, night active and foliage dwellers were recorded by pitfall traps, light traps and net sweep method respectively.

15 pitfall traps were installed randomly below the soil surface at a distance of 10 meters. Each pitfall unit consisted wide mouthed transparent bottle with 12 cm in length 4 cm in diameter. The mouth of each trap was covered with a flat stone placed above 2 cm from the mouth of the trap to protect from rain water and unwanted particles falling into it. Each pitfall bottles were supplied with 100 ml of 10% formalin solution which was also refilled weekly when necessary. The soil surface dwellers arthropods were recorded fortnightly. Three electrical light traps with 100 watt bulb were installed at a distance of 60m to record night active arthropods. Light was kept on from 6:00 PM-6:00 AM and the night active Arthropods were collected at weekly interval. However, in upland rice field where electric-

ity was not accessible, hurricane lamp was used by following the same procedure of electrical light trap. Foliage dwellers were collected fortnightly by net sweeping (3 sweeps m^{-2}) at 5 randomly selected places throughout the vegetation.

All the collected specimens were brought to the laboratory, counted and preserved. The spiders were preserved in glass vials containing 87 parts ethyl alcohol, 5 parts glycerin and 8 parts glacial acetic acid, whereas, the other specimen were pinned properly dried and kept in insect boxes by putting carbon tetrachloride as preservative.

3. Results and Discussion

The two years pooled data on the seasonal abundance of insect pests and natural enemies recorded from lowland rice ecosystem revealed a mean total population of 2173.7 and 727.0 respectively.

At lowland, the major insect pests belonged to three orders, Orthoptera, Hemiptera and Lepidoptera while natural enemies were mainly found in Coleoptera, Odonata and Araneida (figure 1). Similar results on the occurrence of natural enemies of paddy pests belonging to such orders was also reported by Tiwari et al. (2001). The insect pests' population was found to be most abundant during August. The group of natural enemies were also found maximum (138.0) during the month of August and its least population (7.2) was recorded during February both insect pests and natural enemies population were recorded maximum during the tillering stage of the crop, similarly the temperature also recorded maximum 32.8°C and minimum 26.3°C during the peak period of Arthropod population. Hemiptera, the most dominant order was recorded maximum in the month of August followed by in June, July with their respective mean total of 421.0, 208.5 and 202.4 (figure 2).

Their population declined to lowest during January-February with 6.9 and 4.4 respectively. Similar observations were recorded by Atwal and Dhaliwal (1997). Unlike other groups, the most abundant period for Lepidopterans (mostly moths) was found in February with mean population of 96.4 while lowest (15.4) was recorded in November. However the population remains almost constant throughout the year.

The most abundant period for Orthoptera was recorded during October with mean population of 29.5 followed by in August with 27.0 while it was least abundant during January-March. Majer and Koch (1982), Reddy and Alemla (1995) also recorded high number of Orthoptera during spring and summer.

Study on the correlation coefficient values (table 1) revealed a positive and highly significant effect of the ground beetles on the population of Orthoptera and Hemiptera at 1% level of significance whereas it was significant at 5% level of significance with Lepidoptera. Odonata had exhibited significant correlation with the population of Orthoptera and Lepidoptera at both 1% and 5% levels. However, no significant effect was shown by Araneida with all the studied groups of pests.

At foothill, the abundance of insect pests was recorded with a mean total population of 1114.1 from four dominant groups of Hemiptera, Lepidoptera, Orthoptera and Isoptera. The insect pests population appeared high during the month of October with mean population of 335.2 and lowest (19.3) in the month of February. The seasonal abundance of natural enemies was recorded with mean total population of 538.4 belonging mainly to Coleoptera, Odonata and Araneida (figure 3).The population peaked in August with 155.4 and lowest (6.8) was recorded in the month of January. Among the individual groups of insect pests, Hemipterans were the most dominant group exhibiting its most abundance in the month of October and November with its mean population of 279.6 and 150.7 respectively. Their population decreased drastically from December-March

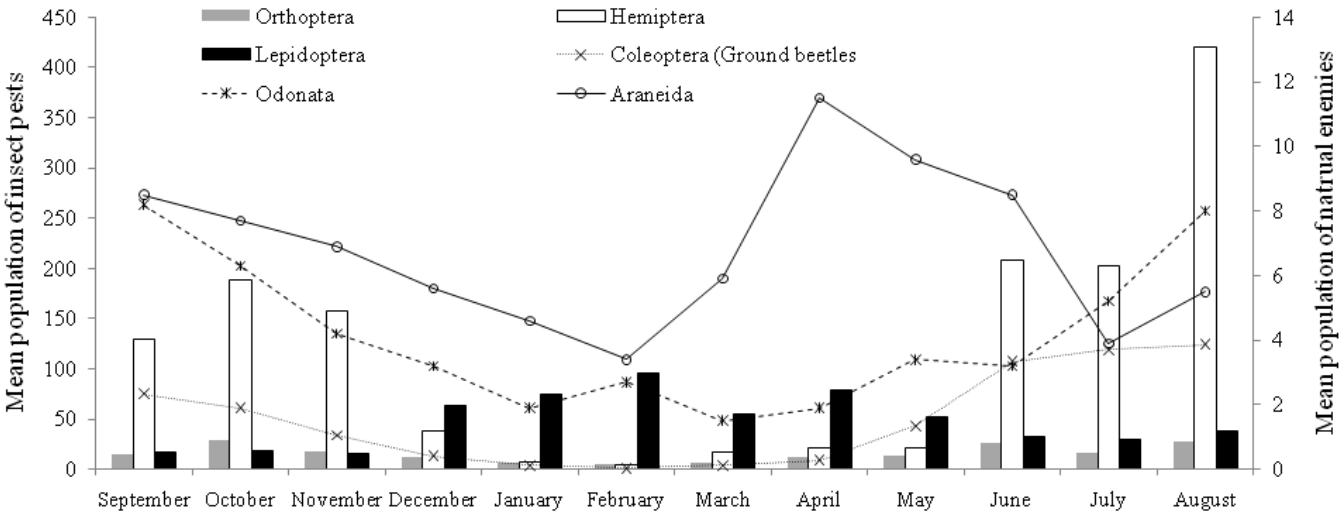

Figure 1: Mean composition of insect pests and natrual enemies at lowland rice ecosystem

Table 1: Correlation coefficient values (r) of major groups of insect pests and their natural enemies

Natural enemies	Insect pests								
	Lowland			Foothill				Upland	
	Orthoptera	Hemiptera	Lepidoptera	Orthoptera	Isoptera	Lepidoptera	Hemiptera	Hemiptera	Orthoptera
Coleoptera (Ground beetles)	0.7627**	0.8722**	0.6661NS	0.4575NS	0.0622NS	0.5138NS	0.1205NS	0.7220**	0.4119NS
Odonata	0.6558*	0.7557**	0.6894*	0.8320**	0.0812NS	0.6303*	0.5897*	0.8246**	0.0708NS
Araneida	0.2742NS	0.0909NS	0.1843NS	0.7204**	0.2430NS	0.6082*	0.2340NS	0.4338NS	0.8175**

*Significant at 5%; **Significant at 1%; NS: Non-Significant

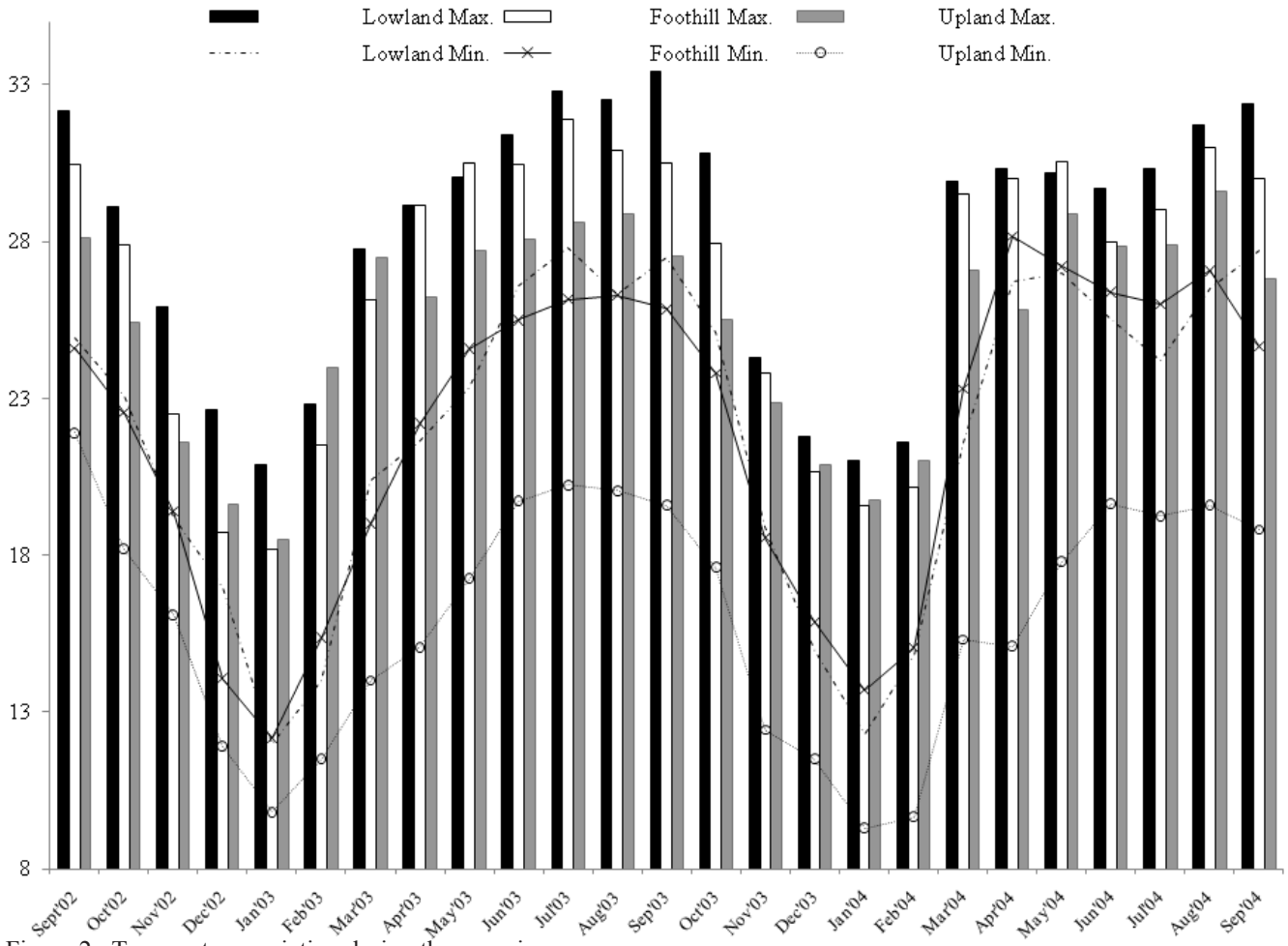

Figure 2: Temperature variation during the cropping season

with the lowest ebb being recorded in February. Lepidopteran population almost remained constant throughout the observation period but there was an increase with a mean number of 30.4 and minimum abundance (10.5) was recorded in January. The next abundant group was found in the order Orthoptera with maximum number (20.1) being observed in November and minimum (5.1) recorded in February. The most active period for Isoptera was observed in April with mean population of 17.9 and their population was very meager during November-March.

Analysis on the correlation coefficient between the groups of predators and insect pests (table 1.) had shown that ground beetles of Coleoptera did not have any significant effect on the population density of all the studied groups of pests. Besides, no significant relationship was observed between the groups of natural enemies and Isoptera. However, there was a highly

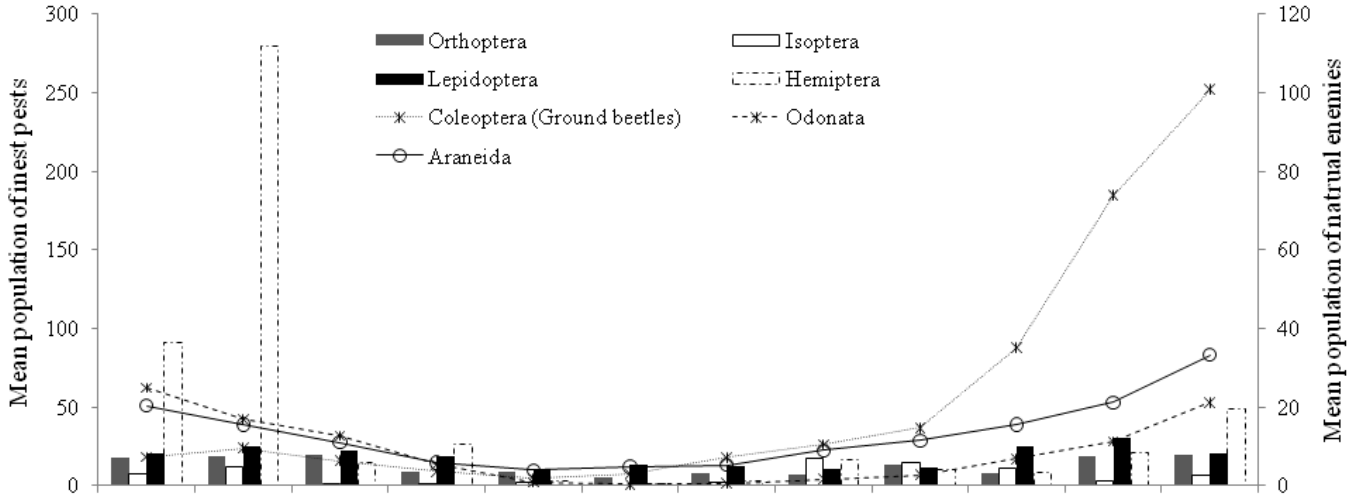

Figure 3: Mean composition of insect pests and natrual enemies at foothill rice ecosystem

significant relationship between Odonata and Orthoptera at 1% level of significance while with Hemiptera and Lepidoptera, Odonata had a significant influence at 5% level. Araneida has also maintained a significant relationship with Lepidoptera and Orthoptera at 5% and 1% level of significance respectively but was non significant with Isoptera and Hemiptera. Similar relationship between Lepidopteran pest *Cnaphalocrosis medinalis* and predatory spider is also made by Kumar et al., (1996)

At upland, the dominant insect pests were recorded from two orders of Hemiptera and Orthoptera with their total mean population of 525.78. These pests showed highest population density during the month of May with 117.0 and lowest was observed between January-February with 5.74 and 6.06 respectively. However, a constant population was recorded during June-September. The abundance of natural enemies were recorded with total mean population of 257.87 and their peak activity was observed during August-September with 43.6 and 46.4 while less population was found during the month of January-February with 3.33 and 3.65 respectively. Among the two groups of insect pests, the most dominant group belonged to order Hemiptera with maximum mean population level of 76.6 recorded in September, while minimum population of 4.9

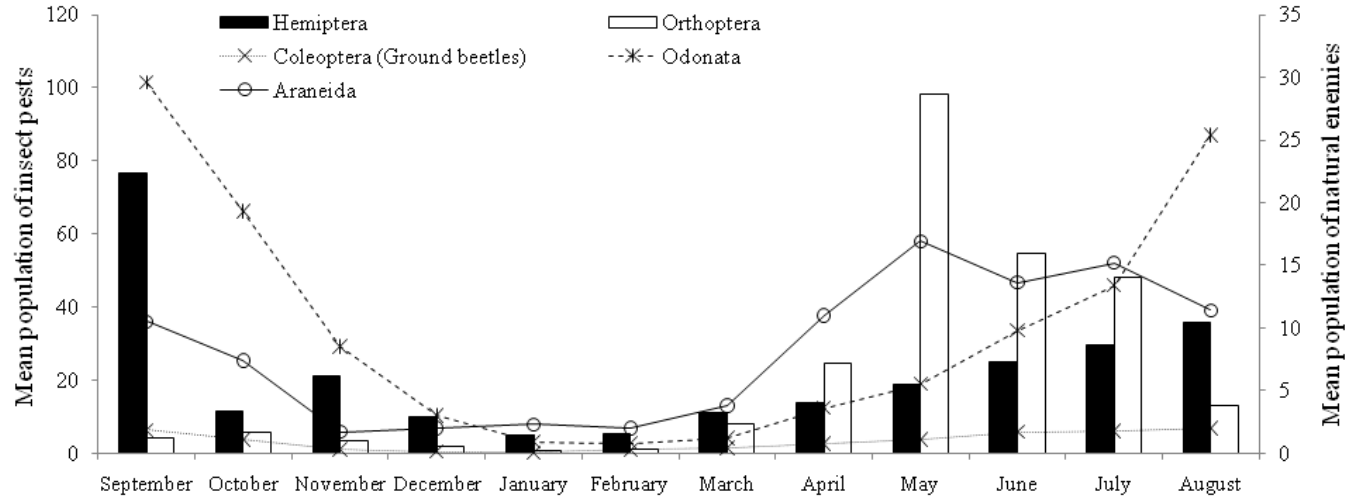

Figure 4: Mean composition of insect pests and natrual enemies at upland rice ecosystem

was found in the month of January. The next dominant group of Orthopterans was recorded in abundance in the month of May with 98.1 and less number of population was shown during the months of December-February. Ground beetles, Odonata and Araneida represented the groups of natural enemies (figure 4). The correlation coefficient (table 1) revealed a significant positive influence on the Hemiptera population by both ground beetles and Odonata at 1% level but was non significant with Araneida. Kaushik et al., (1986) also reported positive correlation of Hemipteran pests with spider *Lycosa pseudoannulata*,. Ground beetles and Odonata were positively correlated but non significant with Orthoptera, however, it had shown a positive and highly significant correlation with Araneida at 1% level of significance. Ground beetles and Odonata were positively

correlated but non significant with Orthoptera, however, it had shown a positive and highly significant correlation with Araneida at 1% level of significance. Study on the correlation between the important group of rice pests and their natural enemies were also carried out by several workers viz; Heong et al., 1990, Kaushik et al., 1986) and Abdullah et al. (1998) who also reported that the plant hopper populations were kept in check by combination of Arthropod predators mainly dragonflies and spiders.

4. Conclusion

The present finding clearly indicates that there is definite correlation between natural enemies and the pest population density. The predatory fauna and their correlation with major insect pests in rice fields will help the farming community in identifying them and their potential role in regulating the pest population density for a sound eco-friendly and sustainable pest management in future.

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