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# Diversity analysis of coccinellids in *Kharif* Rice

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**Abstract**

Insect pests and diseases impede the attainment of higher yields by conventional transplantation methods in rice crop. However, planting methods ence, different planting methods *viz*., broadcasting and drumsowing and plant protection methods *viz*., organic protection practises are gaining popularity in our country. However, the effect of such planting methods and plant protection practices on various predators in the field has to be assessed. Since literature on the effect of different planting methods and plant protection methods on Coccinellid predators is scant, the present study was undertaken to understand the impact of these methods on the abundance and diversity of Coccinellids. The experiment was laid out in College Farm, Rajendranagar during kharif 2014-15 and 2015-16 with three main treatments *viz*., Transplanted rice, broadcasted rice and drumsown rice. Under each module, three types of plant protection measures *viz*., organic protection, farmers' practices and "no protection". Six species of Coccinellids were recorded during the study, *viz*., *Micraspis*, *Harmonia*, *Cheilomenes*, *Propylea dissecta*, *Coccinella* and *Scymnus*. Population of Coccinellids was more in organic protection plots and 'no protection' plots compared to farmers' practices plots. Similarly, broadcasted plots recorded higher populations of beetles than transplanted and drumsown plots in general, though interaction effects were also significant. Diversity study of Coccinellids revealed that species richness was 7 in all the varied cultivation methods and plant protection practices and it seemed to be least affected by the main treatment (cultivation type) or the sub-treatment (plant protection practises) followed. Shannon's species diversity index however, varied among cultivation techniques and the plant protection practices and it ranged between 0.91 -1.14 indicating a fairly stable population, though not very stable.

**Keywords:** Diversity analysis, coccinellids, *Kharif* Rice

## Introduction

Rice is the stable food for millions all over the world and is also one of the major crops in Telangana state. In the state of Telangana, rice was grown in an area of 9.50 lakh hectares in the *kharif* season and 6.5 lakh hectares in the *Rabi* season of 2018-19. During the last two decades, wide adoption of high-yielding, semi-dwarf varieties, increased use of chemical fertilizers and improved package of cultural practices in rice and wheat has considerably increased pest problems (Atwal and Dhaliwal, 2009). Conservational biological control is an important method to manage pests successfully with least damage to the environment. Spiders, Coccinellids, Mirids, rove beetles, mantids and dragon flies are a few predators commonly found in the rice ecosystem.

Coccinellids offer very good natural control as they predate upon all the stages of Hemipteran pests and can be recommended for their management. The overall impact of a multispecies predator community can be reliably predicted from the average performance of the component species in monoculture, but will vary based on the identities of the species present in a diverse community of a particular species composition (Sokol-Hessner and Schmitz, 2002; Straub and Snyder, 2006) [10, 11]. The diversity and composition of predator assemblages and their impact on prey suppression may also vary spatially (Tscharntke *et al*., 2007) [12]. Even within a habitat, structural complexity can mediate the intensity of interactions among predators (Finke and Denno, 2002, 2006; Hughes and Grabowski, 2006) [2, 3, 4], and bottom-up effects of plant diversity can mask the significant effects of changing predator diversity (Aquilino *et al*. 2005) [1].

## Materials and Methods

The experiment was laid out in a split plot design in 1500 sq. m. at College farm, Rajendranagar for two years, *kharif* 2014 and *kharif* 2015 with rice variety BPT 5204. There were three main modules, each of 36m X 12m size with different establishment technique *viz*., Transplanted rice, broadcasted rice and drumsown rice.

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In farmers' practice, carbofuran 3G granules were applied to the crop one week before pulling of nursery applied at the rate of 200 g/cent of nursery in the transplantation module plots. In the broadcasted and drumsown rice, carbofuran granules were applied at 30 days after sowing at the rate of 10 kg/ acre. In addition, foliar sprays of chlorpyriphos @ 2.50 ml/L water were given when the pests crossed the Economic Threshold Level (ETL) once at 36 SMW and again at 69 SMW. No protection measures were taken up in the untreated control.

## Observations on beetles
Weekly observations on populations of Coccinellids were recorded in each of the treatment plots in the morning hours between 7.00 a.m. and 9.00 a.m. in five quadrats (1m X 1m)/ each treatment plot from 34 to 47 standard weeks coinciding with 30 days after transplantation (DAT) to 120 DAT. In each plot, a metal quadrat was placed in the four corners and in the centre to get a uniform count of the insects in that plot.

## Diversity Indices
Diversity parameters of spiders were worked for the pooled data of two years using the software BIODIVERSITY PRO 2.0.

a. Species richness: Species richness (S) = number of species/genera collected.
b. Species diversity (H') was computed using Shannon index of species diversity (Shannon and Weaver,1949)
c. Pielou's Evenness Index or equitability (E) was calculated using the following formula (Pielou,1966)
d. Total predator density was calculated using the formula

$$\text{Density} = \frac{\text{Total no. of predators recorded}}{\text{No. of quadrats observed}}$$

## Results
### Abundance of Coccinellids
Results revealed that population of Coccinellids was more in organic protection plots and 'no protection' plots compared to farmers' practices plots. Similarly, broadcasted plots recorded higher populations of beetles than transplanted and drumsown plots, though interaction effects were also significant.

Among different treatments higher populations of *Micraspis* were recorded in broadcasted organic practices plots (32.41 beetles/quadrat), while transplanted no protection plots recorded 30.48 beetles/quadrat and broadcasted farmers' practices registered least population 16.10 beetles/quadrat. *Harmonia* sp. was found to be significantly abundant in drumsown organic plots (52.10 beetles/quadrat and least in drumsown farmers' practices (41.79 beetles/quadrat). *Coccinella sp* was found to be in significantly higher numbers in broadcasted 'no protection plots' (9.94 beetles/quadrat), while least population was noticed in transplanted farmers' practices (6.05 beetles/quadrat) *Propylea dissecta* was found to be significantly more in numbers (1.93 beetles/quadrat) in broadcasted 'no protection ' plots while least population 0.3 beetles/quadrat) was seen in drumsown farmers' practices, while numbers in the other treatments ranged in between 0.76-1.80 beetles/quadrat. *Cheilomenes sexmaculata* was found to be in significant large numbers (3.87 beetles/quadrat) in transplanted 'no protection' plots, while significantly minimum number (1.48 beetles/quadrat) were recorded in drumsown organic protection plots. *Scymnus* sp. was found to the most abundant genus with population ranging between 94.25 - 133.21 beetles/quadrat among all Coccinellids recorded. Among various treatments, higher numbers of beetles 133.21 beetles/quadrat were recorded in broadcasted 'no protection' plots, while 94.25 beetles/quadrat were recorded in the drum sown farmers' practices plots.

### Diversity of Coccinellids
Results revealed that species richness was 7 in all the varied cultivation methods and plant protection practices and it seemed to be least affected by the main treatment (cultivation type) or the sub-treatment (plant protection practises) followed. Shannon's species diversity index however, varied among cultivation techniques and the plant protection practices and it ranged between 0.91 -1.14 indicating a fairy

stable population, though not very stable. This could be because the pest spectrum was dominated by Hispa beetle, leaf folder and stem borer with lesser sucking pests on the crop both the years of study. Such a fairly stable population faces the risk of being wiped out in numbers if any adverse climatic conditions occur or adverse agronomy practices are carried out in the field. The population has to be conserved following safer plant protection practices. Pielou's Evenness Index was found to range between 0.47-0.59 indicating that the spread of the beetle genera in the crop ecosystem was even ensuring good levels of natural control. Coccinellid density was however found to be between 23.67 - 24.90 beetles/quadrat in the farmers' practices plots of transplanted, broadcasted and drumsown establishment methods, while in the organic protection plots and 'no protection' plots it ranged between 29.63-31.77 beetles/quadrat proving that insecticidal sprays in farmers' practices affected their abundance.

**Discussion**

Our study focussed on the abundance and diversity of Coccinellids in kharif rice crop. Results revealed that 38-41 standard weeks recorded maximum diversity and numbers of coccinellids as this stage coincided with the tillering and flowering stage in rice. Similar results were reported by Kandibane *et al*. (2006) [6] who recorded greater diversity of coccinellids during tillering and flowering stages of rice crop however with lesser diversity at initial and maturity stages of rice crop. Joshi and Sharma (2008) [5] collected Coccinellids from different ecosystems of Haridwar out of which *Micraspis discolor, Illeis cincta* and *Cheilomenes sexmaculata* were predominant. Rekha *et al*. (2009) [8] documented total number of species collected in Madurai to be seven and six in Alagarkovil districts of Tamil Nadu. Species richness was more in Madurai recording 3.29 and less in Alagarkovil (3.11), while the species evenness and species diversity were more in Alagarkovil recording the values of 1.06 and 0.89, respectively as compared to Madurai (0.90 and 0.76).

**Conclusion**

The present study indicated that Coccinellid population was higher in the organic plots and "no protection" plots compared to the farmers' practices plots showing their susceptibility to farmers' practices. Moreover, beetle diversity, evenness and richness were found to be fairly good and such community needs to be conserved using eco-friendly practices of pest management which can help to utilize them as important tools of natural control.

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