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# A Survey Study of Insect Pest Diversity within Rice Crop Fields of North Bihar, India

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**Abstract:** In the present study different crop field of random blocks chosen of Madhepura (Site-I), Saharsa (Site-II), Purnea (Site-III) and Araria (Site-IV) districts were surveyed for the prevalence of insect pests of paddy crop. Rice is one of the staple food of Indian and sub-continental populations. Rice is traditionally cultivated in water laden areas. Bihar is one of the major Rice producers of India. A part of the cultivated rice or paddy crop is lost at Pre-harvesting, harvesting and post-harvesting conditions. The different insect pests are responsible for the considerable loss of paddy crop productivity at pre-harvesting period. Population dynamics of different insect pests within paddy crop field is influenced by the frequencies of different insect pests. Some common pests of paddy found throughout the north India and some are occasional pests. All together their population parameters may varies as per the seasonal variations and the use of enormous amount of pesticides and fertilizers that changes the usual population dynamics of the insect species present in the paddy crop fields.

**Keywords:** Rice, Insect pest, Pre-harvesting period, Population dynamics, Paddy crop field

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## Introduction

Bihar's entire geographical area is around 94,163km$^2$, including the net cultivated land area of 56.03 lakh hectares and gross cultivated area of 79.46 lakh hectares (Haris *et al.*, 2013). The main crops cultivated include rice, wheat, maize, and legumes (ICAR-IGFRI, 2022). Most important cash crops of Bihar include potato, sugarcane, oilseeds, tobacco, chillies, onion, and jute. About forty three lakh hectares gross area is irrigated via various sources. Bihar has a designated forest area of about six thousand km$^2$, accounting for 7.1% of the total area. The state is endowed with an abundance of natural resources, including fertile land and groundwater. The state's unique agro-climatic zones allow the development and cultivation of varied types of commercial crops, vegetables, and fruits. Bihar has recently begun producing flowers on a significant scale for both

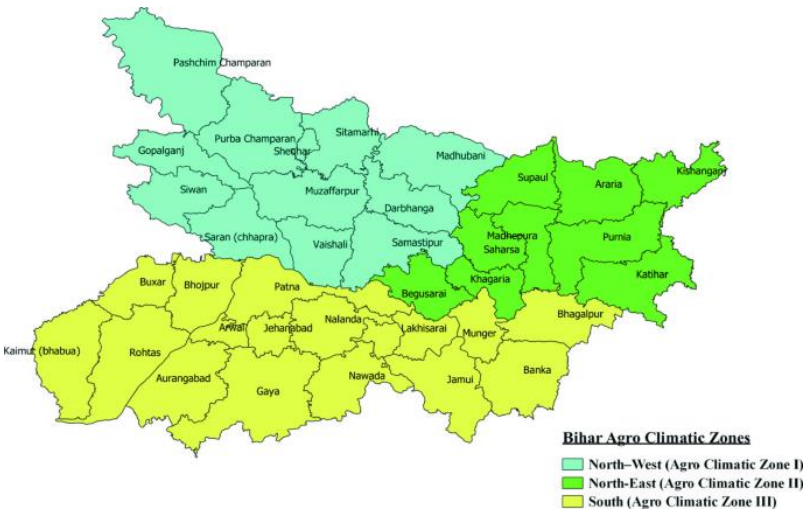


Fig. 1: Different Agro-Climatic zones of Bihar.

home and international markets. The state received the Krishi Karman Award for rice output in 2013 and maize production in 2016. However, factors such as high rural population density and year-to-year change in rainfall have created instability in agricultural growth and proved to be a barrier to agricultural diversification. Bihar is divided into three primary agro-climatic zones (Fig. 1), identifying them based on soil properties, rainfall patterns, temperature, and topographical features. The areas include Zone I, the North Alluvial Plain; Zone II, the North East Alluvial Plain; and Zone III A, the South East Alluvial Plain along with Zone-III B, the South West Alluvial Plain; each offer unique opportunities.

The primary crops include paddy, wheat, jute, maize, and oil seeds. The state produces a variety of vegetables such as cauliflower, cabbage, tomatoes, radishes, carrots, and beets. Sugarcane, potatoes, and barley are some of the non-cereal crops that are grown. The agricultural activities are divided into two distinct crop seasons known as Kharif and Rabi. The Kharif season commences in the third week of May and extends until the end of October, paving the way for the Rabi season.

Insect pests inflict major harm to agricultural items used for human consumption and animal feed. In addition to direct losses to plant systems, fruits, and seeds, insects create indirect losses by contaminating food with body pieces or exoskeletons, insect eggs, and off-odors. There are around six million insect species, yet just few of them are serious agricultural pests. Pests that target agricultural and horticultural crops include a vast range of insects, mites, nematodes, and gastropod molluscs (Alford *et al.*, 2014). The damage they cause results from the direct harm inflicted on plants and the indirect consequences of spreading fungal, bacterial, or viral diseases (Macfadyen and Kriticos, 2012). Plants have their own defences against these attacks, but they can be overwhelmed, especially in stressed-out environments or when pests have been introduced mistakenly and have no natural adversaries (Dhaliwal *et al.*, 2010). The majority of tree pests are insects, many of which have been introduced mistakenly and lack natural adversaries, and others have spread new fungal diseases with disastrous consequences (Srivastava, 1993).

Paddy is a key component of the diet for a large portion of the population, often accompanied by other types of cereals (Burlando and Cornara, 2014; Sen *et al.*, 2020). Paddy is grown in 37 districts of Bihar. Among these, 25 districts are part of the low productivity category, representing 63% of the total 36. 57 lakh hectares of land used for paddy cultivation in the state. Only Rohtas district comes under high productive zone for

paddy cultivation (> 2500 kg/Ha). According to Pathak and Khan (1994), different insect pests damage paddy by different mode which affect plant either directly or indirectly. Common insect pests of the paddy include Yellow Stem borer (*Scirpophaga incertulas*), Green Leaf hopper (*Nephotettix virescence*), Brown Plant hopper (*Nilaparvata lugens*), Leaf folder (*Cnaphalocrosis medinalis*) and Gall midge (*Orseolia oryzae*).

In the present study different crop field of random blocks chosen of Madhepura (Site-I), Saharsa (Site-II), Purnea (Site-III) and Araria (Site-IV) districts were surveyed for the prevalence of insect pests of paddy crop.

## Materials and Methods

### *Study Area and collection of insect pests*:

The survey of different insect pests in a particular crop field was done in 4 different districts (Madhepura, Saharsa, Purnea and Araria) for equal sampling areas, survey work started from dawn to dusk period. The number of insect pests were counted and recorded for their occurrence in a particular area. The sampling was done through quadratic method.

The Net trapping and hand picking methods were performed during the early morning and evening to collect different insect pests. The method of Aberdeen (1958) was performed to estimate the insect pests species distribution and for the study of associated population dynamics of paddy fields.

### *Species Distribution*:

The species distribution of different insect pests among their respective cross were analysed for the estimation of distribution pattern among themselves.

## Results and Discussion

The different insect pests collected during the survey were identified and depicted in the Figure 1. The insects were brought to the laboratory in pre-sterilized poly bags for their identification and then stored at 4 °C for their further experimental use. The insects of different sites were collected in the same season of a year.

Table 1 depicts the presence of the insect pests at different collection sites. Higher frequencies of occurrence were shown by the higher number of + signs. Each and every species were collected with each sites with higher and lower frequencies.

Quadratic method of sampling was performed during the specimen collection at each site. The total specimen collected (No.) with coverage (C) in quadratic sampling (Q) were recorded for each collection site (Table 2). A total of 3541 specimens were collected from Site-I having coverage area of 247.4 in 51 quadrate samplings. Similarly, site –II, III and IV accounts for the total sample collection of 3318, 2897 and 2339 specimens, respectively with their respective coverage area accounting for 231.5, 215.2 and 203.7, respectively for the 51 quadrates studies for each site.

Table 3 and Figure 2 show the results of distributions parameters of different insect pests at different survey sites as Madhepura (Site-I), Saharsa (Site-II), Purnea (Site-III) and Araria (Site-IV). The average maximum % coverage (28.73) was estimated for *Stenchaetothrips biformis* at all the four collection sites. The least % coverage (1.78) was shown by the *Scotinophora coarctata* on an average followed by *Scotinophora coarctata, Brevennia rehi* and *Leptocorisa acuta* species. The density (Den), Relative density ($R_D$), Frequency (Freq) and relative frequency ($R_F$) were estimated as maximum for the *Stenchaetothrips biformis* species and minimum for *Scotinophora coarctata*.

Global yield losses caused by insect pests were estimated to be around 5.1% in the pre-green revolution era, but they rose to 9.3% in the post-green revolution of the 1990s, as reported by Dhaliwal *et al.* (2010). The paddy growing regions under survey showed the significant presence of number of different insect pests of varied groups. One insect pest *Stenchaetothrips biformis* (Thrips) is found to be very high in their occurrence and therefore controlling the dynamics of other pests also. A

| | |
|---|---|
| **Thrips** *Stenchaetothrips biformis*  | **White backed plant hopper** *Sogatella furcifera*  |
| **Green Leaf hopper***Nephotettix virescens*  | **Rice Earhead Bug** *Leptocorisa acuta*  |
| **Green Leaf hopper** *Nephotettix nigropictus*  | **Mealy Bug** *Brevennia rehi*  |
| **Green Leaf hopper** *Nephotettix cincticeps*  | **Rice Black Bug** *Scotinophora lurida*  |
| **Brown Plan hopper** *Nilaparvata lugens*  | **Rice Black Bug** *Scotinophora coarctata*  |

Fig. 1: Insect Pests of Paddy Crop Fields.

total of 10 insect pests were identified in this particular survey at all the sites under study. Among the all surveyed sites the least frequency of pests found on an average includes the species of *Scotinophora lurida* (Rice Black Bug), *Scotinophora coarctata* (Rice Black Bug), *Brevennia rehi* (Mealy Bug), and *Leptocorisa acuta* (Rice Earhead Bug). The pattern of their distribution may vary according to the dominating pest insect (Aslam *et al.*, 2005; Philips *et al.*, 2007). The ecology and niche speciation among different interacting species also restrict their population which are greatly influenced by both biotic and abiotic factors prevailing at that particular crop season (Akhtar, 1971; Alford *et al*., 2014).

Several researchers conducted surveys and observations on insects, yet there is no available data regarding the correlation between the rate of

Table 1: Distribution of different insect pests in Paddy crop field area (100 $m^2$)

| S. No. | Scientific Name | Site-I | Site-II | Site-III | Site-IV |
|---|---|---|---|---|---|
| 01 | *Stenchaetothrips biformis* | ++ | +++ | +++ | +++ |
| 02 | *Nephotettix virescens* | ++ | +++ | ++++ | +++ |
| 03 | *Nephotetti xnigropictus* | ++ | +++ | ++++ | ++++ |
| 04 | *Nephotettix cincticeps* | +++ | +++ | +++ | ++++ |
| 05 | *Nilaparvata lugens* | +++ | ++ | +++ | +++ |
| 06 | *Sogatella furcifera* | +++ | +++ | ++++ | ++++ |
| 07 | *Leptocorisa acuta* | ++ | +++ | +++ | ++++ |
| 08 | *Brevennia rehi* | ++++ | +++ | ++++ | +++ |
| 09 | *Scotinophora lurida* | +++ | ++++ | +++ | +++ |
| 10 | *Scotinophora coarctata* | ++++ | +++ | +++ | ++++ |

Table 2: Quardate wise distribution of insect pests in different sampling zones

| S. No. | Scientific Name | Site-I | | | Site-II | | | Site-III | | | Site-IV | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. | C | Q | No. | C | Q | No. | C | Q | No. | C | Q |
| 1 | *Stenchaetothrips biformis* | 1102 | 57.2 | 08 | 982 | 51.8 | 08 | 724 | 49.7 | 08 | 688 | 42.1 | 8 |
| 2 | *Nephotettix virescens* | 654 | 24.6 | 06 | 532 | 27.6 | 06 | 461 | 24.4 | 06 | 441 | 22.5 | 6 |
| 3 | *Nephotettix nigropictus* | 534 | 21.4 | 06 | 407 | 24.1 | 06 | 387 | 19.5 | 06 | 276 | 16.3 | 6 |
| 4 | *Nephotettix cincticeps* | 381 | 31.1 | 06 | 354 | 29.9 | 06 | 387 | 28.7 | 06 | 158 | 12.2 | 6 |
| 5 | *Nilaparvata lugens* | 282 | 22.7 | 05 | 387 | 22.2 | 05 | 328 | 20.1 | 05 | 235 | 20.6 | 5 |
| 6 | *Sogatella furcifera* | 205 | 20.3 | 05 | 286 | 18.6 | 05 | 161 | 15.4 | 05 | 204 | 20.7 | 5 |
| 7 | *Leptocorisa acuta* | 106 | 18.5 | 04 | 119 | 19.4 | 04 | 243 | 21.5 | 04 | 148 | 21.8 | 4 |
| 8 | *Brevennia rehi* | 83 | 16.2 | 04 | 137 | 21.1 | 04 | 84 | 16.1 | 04 | 108 | 19.5 | 4 |
| 9 | *Scotinophora lurida* | 111 | 17.8 | 03 | 68 | 8.2 | 03 | 107 | 17.2 | 03 | 58 | 9.6 | 3 |
| 10 | *Scotinophora coarctata* | 83 | 17.6 | 04 | 46 | 8.6 | 04 | 15 | 2.6 | 04 | 83 | 17.6 | 4 |
| | **Total =** | **3541** | **247.4** | **51** | **3318** | **231.5** | **51** | **2897** | **215.2** | **51** | **2339** | **203.7** | **51** |

Table 3: Different distribution parameters of Insect pests of paddy crop fields of Site-I, II, III and IV

| | | Mean of all four sites (I,II.III & IV) Total Area = 1000$m^2$ (10m X 10mX 10m) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| S. No. | Scientific Name | $A_i$ | %C | Den | $R_D$ | Freq. | $R_F$ | Quadrat |
| 1 | *Stenchaetothrips biformis* | 874 | 28.73 | 3.59 | 0.211 | 0.15 | 0.163 | 8 |
| 2 | *Nephotettix virescens* | 522 | 17.15 | 2.85 | 0.167 | 0.11 | 0.119 | 6 |
| 3 | *Nephotettix nigropictus* | 401 | 13.18 | 2.19 | 0.128 | 0.11 | 0.119 | 6 |
| 4 | *Nephotettix cincticeps* | 326 | 10.71 | 1.78 | 0.104 | 0.11 | 0.119 | 6 |
| 5 | *Nilaparvata lugens* | 308 | 10.12 | 1.68 | 0.098 | 0.09 | 0.097 | 5 |
| 6 | *Sogatella furcifera* | 214 | 7.05 | 1.41 | 0.083 | 0.09 | 0.097 | 5 |
| 7 | *Leptocorisa acuta* | 154 | 5.07 | 1.26 | 0.074 | 0.07 | 0.076 | 4 |
| 8 | *Brevennia rehi* | 103 | 3.38 | 0.84 | 0.049 | 0.07 | 0.076 | 4 |
| 9 | *Scotinophora lurida* | 86 | 2.83 | 0.94 | 0.055 | 0.05 | 0.054 | 3 |
| 10 | *Scotinophora coarctata* | 54 | 1.78 | 0.44 | 0.025 | 0.07 | 0.076 | 4 |
| | **Total=** | **3042** | **100.0** | **16.98** | **0.994** | **0.92** | **0.996** | **51** |

Ai = No. of Insect, %C = Percentage Coverage, Rc = Relative coverage, $R_D$ = Relative Density, Feq = Frequency and $R_F$ = Relative Frequency.

insect population growth alongside rice development and the associated climatic conditions. This observation shed light on the gradual progression of insect infestation on different stages, along with how their population fluctuates in response to weather conditions (Singh and Singh, 2017). The number further rises as the crop progresses into the vegetative phase. The fluctuation in population is observed alongside shifts in meteorological conditions. The

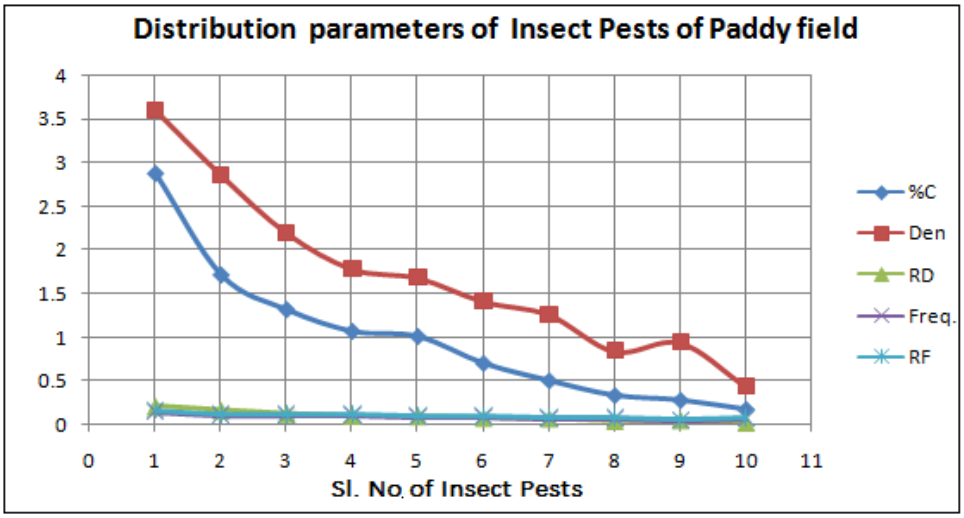


Fig. 2: Distribution parameters of different insect pests of the paddy fields of Madhepura, Saharsa, Purnea and Araria districts.

diseased plant exhibits a gently arched form, commonly known as the "parrot-beak" shape. The impaired plant diminishes its photosynthetic capability, impacting the fertility rate according to Noeli (2013) and Buffon *et al.* (2018). During the vegetative stage, crops usually have the ability to bounce back from damage. However, if leaf folders infest during the reproductive phase, the impact can be significant from an economic standpoint (Panithavalli *et al.*, 2011; Sulagitti *et al.*, 2018).

Therefore, considering the phenology of the paddy field crops, the thrips are found to be more invasive species and may have high resilience with respect to other insect pests, as reflected by the distributions parameters (Michaud *et al.*, 2013). The survey work should be carried out after certain time durations to know the current status of insect pest distribution pattern of paddy crop fields.

## Conflict of Interest

The authors declare no conflicts of interest.

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