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# INCIDENCE OF BIOAGENT COMPLEX OF RICE INSECT PESTS UNDER EASTERN UTTAR PRADESH CONDITIONS

**Gyan Prakash Morya and Rajnish Kumar**
*Department of Entomology, B.R.D P.G. College, Deoria, U.P. India*
*Corresponding Address :* gyanprakash978@gmail.com, rajnishkumar.rk1@gmail.com

## ABSTRACT

A study was conducted on the incidence of bioagent complex of rice insect pests under eastern Uttar Pradesh to surveillance the bioagent species of rice insect pest complex associated with rice fields in 3 administrative divisions (Gorakhpur, Basti and Azamgarh) of eastern Uttar Pradesh (India) for two consecutive years (2014 and 2015). During the study period, there were several species of predators and parasitoids observed under 3 rice growth stages (Seedling, Transplanting and Flowering). There were 41 bioagent species observed for sum of both the years 2014 and 2015, comprise of 13 bioagent groups (spiders, coccinellids, cicindelids, carabids, odonates, orthopterans, mantids, mirids, staphylids, dermapterans, neuropterans, dipterans, and hymenopterans) under 3 rice growth stages (seedling, transplanting, and flowering). Among different growth stages of rice, the highest abundance of ground beetles at seedling stage, lady bird beetles and spiders at transplanting stage and mirid bugs at flowering stage were observed respectively. Spiders and coccinellid beetles abundant over other groups of predators and hymenopteran parasitoids dominant over dipteran parasitoids were observed during study. The ranking of bioagent complex prevalent over rice insect pests as the number of bioagent species were, hymenopterans > spiders > coccinellids > carabids > cicindelids > odonates > orthopterans > dermapterans > dipterans > mantids > mirids > neuropterans > staphylids for bioagent groups and parasitoids > predators for most bioagent groups respectively. The surveillance for screening of bioagents incidence prevalent over insect pests of rice was conducted as per methodology of agroecosystem analysis (AESA) (Pontius *et al*., 2002) modified as accessibility. Taxonomic identification was verified with texts of reference, *i.e*., Dale (1994), Barrion and Litsinger (1994), Pathak and Khan (1994), David and Ananthakrishnan (2004); Rice knowledge management portal (RKMP); and Subject experts respectively.

***Key words :*** *Bioagent complex, rice insect pests, incidence, Eastern Uttar Pradesh, India.*

Rice is most important staple food of the world as well as India. Rice shares 27 % of the world food grain production and occupies second position after wheat and 56 % of the India food grain production and occupies first position. India shares 21 % of the world rice production and occupies second position after China. Uttar Pradesh shares 15 % of the India rice production occupies second position followed by West Bengal (17%) and first in rice production area. Despite this above proud credentials, Uttar Pradesh is not appearing leading position in rice production. The main cause of low productivity is traditional and ill cultivation practices by losses 65% yield of the highest productivity and shares 42.1% losses by plant ailments and 25% losses caused by insect pest of rice in India itself. (Pathak and Khan, 1994; Maclean *et al*., 2002; Viraktamath, 2013; Morya *et al*., 2015).

Rice is grown mostly under middle-gangetic plain zone of India, which is widely distributed in Uttar Pradesh. The zone is mostly a warm humid environment conductive to the survival and proliferation of arthropods biodiversity. About 250 insect pest species associated with rice crop in India and about 20 of them are major economic significance. Out of 20 major insect pests of rice, 12 of national significance and 08 of regional significance have been recognized respectively. The insect pests of rice infest all parts of the plant at all growth stages and transmit few viral diseases of rice. %. (Pathak and Khan, 1994; Oerke, 2006; Dhaliwal *et al*., 2015; Fahad *et al*., 2015; Morya *et al*., 2015).

About 550 arthropod bioagent species associated with rice insect pests in India and among them are 185 bioagents against yellow stemborer, 104 against green leafhoppers, 54 against leaffolder, 18 against gall midge, 50 against army worm and 05 against rice hispa respectively. There have been 20 arthropods bioagents recognized as major economic significance. Bioagents are natural enemies, which attack various life stages of insects to kill as a prey or host to complete their life cycle. They are silent suppression factors of insect pests in rice ecosystem. Predators, parasitoids and pathogens are groups of bioagents. Predators and parasitoids are major groups of arthropod bioagents against rice insect pests. Predatory insects, Spiders & predatory mites are groups of predators, whereas parasitic wasp and flies are groups of parasitoids. Predators and parasitoids are varying in feeding and egg laying potential, which have been playing significant role in biological insect pest management. (Pathak and Khan, 1994; Ooi and Shepard, 1994; David

**Table 1 :** List of Bioagent Complex for Rice Insect Pests (Sum of 2014 & 15).

| Bioagent Groups | Bioagent Species | | | Growth Stages of Rice | | |
|---|---|---|---|---|---|---|
| | Common Name | Scientific Name | Order : Family | Seed-ling | Trans-planting | Flower-ing |
| 1. Spiders | 1. Field wolf spider | *Lycosa pseudoannulata* | Araneae: lycosidae | ✓ | ✓ | ✓ |
| | 2. Ground wolf spider | *Pardosa sumatrana* | Araneae: lycosidae | ✓ | ✓ | ✓ |
| | 3. Common lynx spider | *Oxyopes javanus* | Araneae: Oxyopidae | ✓ | ✓ | ✓ |
| | 4. Foliage jumping spider | *Phidippus indicus* | Araneae: Salticidae | ✓ | ✓ | ✓ |
| | 5. Tropical jumping spider | *Plexippus paykulli* | Araneae: Salticidae | ✓ | ✓ | ✓ |
| | 6. Field longjawed spider | *Tetragnatha maxillosa* | Araneae: Tetragnathidae | ✓ | ✓ | ✓ |
| | 7. Brown longjawed spider | *Tetragnatha bengalensis* | Araneae: Tetragnathidae | ✓ | ✓ | ✓ |
| | 8. Common grasscross spider | *Argiope catenulata* | Araneae: Araneidae | ✓ | ✓ | ✓ |
| 2. Coccinelids | 1. Common ladybird beetle | *Micraspis discolor* | Coleoptera: Coccinellidae | ✓ | ✓ | ✓ |
| | 2. Transverse ladybird beetle | *Cheilomenes sexmaculata* | Coleoptera: Coccinellidae | ✓ | ✓ | ✓ |
| | 3. Red ladybird beetle | *Micraspis inops* | Coleoptera: Coccinellidae | ✓ | ✓ | ✓ |
| | 4. Banded ladybird beetle | *Coccinella septempunctata* | Coleoptera: Coccinellidae | ✓ | ✓ | ✓ |
| | 5. Zigzag ladybird beetle | *Coccinella transversalis* | Coleoptera: Coccinellidae | ✓ | ✓ | ✓ |
| 3. Cicindelids | 1. Undulate tigerbeetle | *Cicindela undulata* | Coleoptera: Cicindelidae | ✓ | ✓ | ✓ |
| | 2. Melancholic tigerbeetle | *Cicindela melancholica* | Coleoptera: Cicindelidae | ✓ | ✓ | ✓ |
| 4. Carabids | 1. Common groundbeetle | *Ophionea nigrofasciata* | Coleoptera: Carabidae | ✓ | ✓ | ✓ |
| | 2. Spotted groundbeetle | *Ophionea indica* | Coleoptera: Carabidae | ✓ | ✓ | ✓ |
| 5. Odonates | 1. Wandering dragonfly | *Pantala flavescens* | Odonata: Libellulidae | - | ✓ | ✓ |
| | 2. Wandering damselfly | *Agriocnemis pygmaea* | Odonata: Coenagrionidae | - | ✓ | ✓ |
| 6. Orthopterans | 1. Longhorned grasshopper | *Metioche vittaticollis* | Orthoptera: Gryllidae | ✓ | ✓ | ✓ |
| | 2. Common field cricket | *Conocephalus longipennis* | Orthoptera: Tettigoniidae | ✓ | ✓ | ✓ |
| 7. Mantids | 1. Common praying mantis | *Mantis religiosa* | Dictyoptera: Mantidae | ✓ | ✓ | ✓ |
| 8. Mirids | 1. Common green miridbug | *Cyrtorhinus lividipennis* | Hemiptera: Miridae | ✓ | ✓ | ✓ |
| 9.Staphylids | 1. Common rice rovebeetle | *Paederus fuscipes* | Coleoptera: Staphylinidae | ✓ | ✓ | ✓ |
| 10. Dermepterans | 1. Common field earwig | *Euborellla stali* | Dermaptera: Carcinophoridae | ✓ | ✓ | ✓ |
| 11. Neuropterans | 1. Common green lacewing | *Chrysoperla carnea* | Neuroptera: Chrysopidae | - | ✓ | ✓ |
| 12. Dipterans | 1. Rice tachinidfly | *Argyrophylax nigrotibialis* | Diptera: Tachinidae | - | ✓ | ✓ |
| 13. Hymenopterans | 1. Field hunterwasp | *Goniozus indicus* | Hymenoptera: Bethylidae | - | ✓ | ✓ |
| | 2. Yellow braconidwasp | *Macrocentrus philippinensis* | Hymenoptera: Braconidae | ✓ | ✓ | ✓ |
| | 3. Rice hispa braconidwasp | *Scutibracon hispae* | Hymenoptera: Braconidae | - | ✓ | ✓ |
| | 4. Euparasitic braconidwasp | *Cotesia flavipes* | Hymenoptera: Braconidae | - | ✓ | ✓ |
| | 5. Spottedwing braconidwasp | *Stenobracon nicevillei* | Hymenoptera: Braconidae | ✓ | ✓ | ✓ |
| | 6. Common rice braconidwasp | *Bracon brevicornis* | Hymenoptera: Braconidae | ✓ | ✓ | ✓ |
| | 7. Common rice chalcidwasp | *Brachymria lasus* | Hymenoptera: Chalcidae | ✓ | ✓ | ✓ |
| | 8. Common rice eulophidwasp | *Tetrastichus schoenobii* | Hymenoptera: Eulophidae | - | ✓ | ✓ |
| | 9. Common rice scelionidwasp | *Telenomus rowani* | Hymenoptera: Scelionidae | - | ✓ | ✓ |
| | 10. Common field scelionidwasp | *Telenomus remus* | Hymenoptera: Scelionidae | - | ✓ | ✓ |
| | 11. Common ichneumonidwasp | *Xanthopimpla punctata* | Hymenoptera: Ichneumonidae | ✓ | ✓ | ✓ |
| | 12. Yellow rice ichneumonidwasp | *Xanthopimpla flavolineata* | Hymenoptera: Ichneumonidae | ✓ | ✓ | ✓ |
| | 13. Common trichogrammidwasp | *Trichogramma japonicum* | Hymenoptera:Trichogrammatidae | - | ✓ | ✓ |
| | 14. Polyphagous trichogrammidwasp | *Trichogramma chilonis* | Hymenoptera: Trichogrammatidae | - | ✓ | ✓ |
| Total | 41 | — | — | 29 | 41 | 41 |

**Table 2 :** Population of Bioagents under Growth Stages of Rice (Sum of 2014 & 15).

| Observation Years | Growth Stages of Rice | Administrative Divisions of Eastern Uttar Pradesh (India) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Number | | | | Percentage | | | |
| | | Gorakhpur | Basti | Azamgarh | Total | Gorakhpur | Basti | Azamgarh | Total |
| 2014 | Seedling | 68 | 75 | 66 | 209 | 7.32 | 8.07 | 7.10 | 22.49 |
| | Transplanting | 135 | 137 | 129 | 401 | 14.53 | 14.74 | 13.88 | 43.16 |
| | Flowering | 108 | 107 | 104 | 319 | 11.62 | 11.51 | 11.19 | 34.33 |
| | Total | 311 | 319 | 299 | 929 | 33.47 | 34.33 | 32.19 | 100 |
| 2015 | Seedling | 72 | 73 | 76 | 221 | 7.22 | 7.32 | 7.62 | 22.16 |
| | Transplanting | 139 | 136 | 137 | 412 | 13.94 | 13.64 | 13.74 | 41.32 |
| | Flowering | 124 | 119 | 121 | 364 | 12.43 | 11.93 | 12.13 | 36.51 |
| | Total | 335 | 328 | 334 | 997 | 33.60 | 32.89 | 33.50 | 100 |
| 2014 and 2015 | Seedling | 140 | 148 | 142 | 430 | 7.26 | 7.68 | 7.37 | 22.32 |
| | Transplanting | 274 | 273 | 266 | 813 | 14.22 | 14.17 | 13.81 | 42.21 |
| | Flowering | 232 | 226 | 225 | 683 | 12.04 | 11.73 | 11.68 | 35.46 |
| | Total | 646 | 647 | 633 | 1926 | 33.54 | 33.59 | 32.86 | 100 |

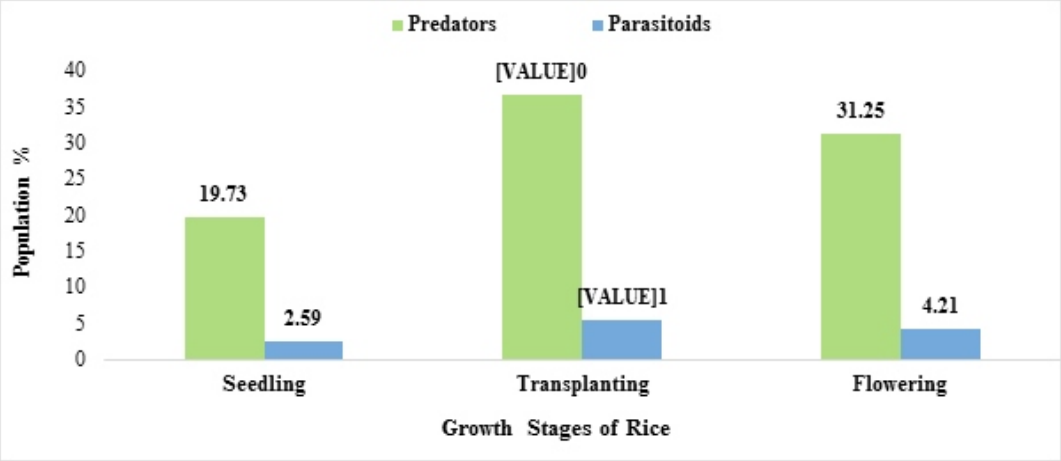


**Figure 1 :** Population of Bioagent Groups under Growth Stages of Rice (Sum of 2014 & 15).

and Ananthakrishnan, 2004; Prakash *et al*., 2014; Fahad *et al*., 2015).

## MATERIALS AND METHODS

The bioagent complex of rice insect pests were observed under rice fields of Eastern Uttar Pradesh conditions for two consecutive years (2014 and 2015) to surveillance their incidence. The observation was surveyed in all 10 districts of 03 administrative divisions of Eastern Uttar Pradesh, *i.e*., Gorakhpur (Gorakhpur, Deoria, Kushinagar and Maharajganj), Basti (Basti, Santkabirnagar and Siddharthnagar) and Azamgarh (Azamgarh, Mau and Ballia) under 03 growth stages of rice, *i.e.,* seedling, transplanting and flowering. The samples were taken randomly for concerned districts of all 03 administrative divisions for each growth stage of rice for consecutively two years. There was each field selected at each division per growing stages for each year. There were 5 samples collected per field at the plot size of 100 $m^2$. Therefore, during the entire crop period a total of 90 samples (3x3= 9x5= 45x2= 90) collected from 3 divisions for consecutive two years respectively. All 90 samples were converted average total of 18 samples (3x3= 9x2= 18) of all 03 divisions for two years. Samples were taken 03 times at interval of 20 days after sowing (20 DAS) for seedling stage, 30 days after transplanting (30 DAT) for transplanting stage and 60 DAT for flowering stage respectively. Each plot was selected 5 spots (4 in the corner at least 60 cm inside the border and one in the center) to collect samples at 0.25$m^2$ /spot for seedling stage and at 01 hill/spot for transplanting and flowering stage to observe abundance of bioagents, and also at each plot, 05 net sweeps were made randomly at every 05 steps to observe abundance bioagents for all 03 growth stages of rice. The size of sweep net were 25 cm diameter and 70 cm handle and made up of nylon. The timing of sampling was 9.30 A.M. to 12.30 P.M. respectively. Each observation was recorded abundance of bioagents to calculate total bioagent species and most bioagent groups prevalent over insect pests of rice. Surveillance was conducted as per methodology of agroecosystem analysis (AESA) (Pontius *et al*., 2002) modified as accessibility.

Taxonomic identification was verified with texts of reference, *i.e.*, Dale (1994), Barrion and Litsinger (1994), Pathak and Khan (1994), David and Ananthakrishnan (2004); Rice knowledge management portal (RKMP); and Subject experts respectively.

## RESULTS AND DISCUSSION

There were 41 bioagent species observed for sum of both the years 2014 and 2015, comprise of 13 bioagent groups (spiders, coccinellids, cicindelids, carabids, odonates, orthopterans, mantids, mirids, staphylids, dermapterans, neuropterans, dipterans, and hymenopterans) under 3 rice growth stages (seedling, transplanting, and flowering). The spiders comprise 8 species, the coccinellids comprise 5 species, the cicindelids, carabids, odonates and orthopterans comprise 2 species each, the mantids, mirids, staphylids, dermapterans, neuropterans and dipterans comprise 1 species each, and the hymenopterans comprise 14 species respectively. The seedling stage comprises 29 species, the transplanting stage comprises 41 species, and the flowering stage comprises 41 species. The groups of bioagent species were also grouped into two most bioagent groups, namely predators (spiders, coccinellids, cicindelids, carabids, odonates, orthopterans, mantids, mirids, staphylids, dermapterans, and neuropterans) and parasitoids (dipterans and hymenopterans) respectively (Table-1).

Of the total observed population of bioagents for growth stages of rice of two consecutive years 2014 and 2015, the number and percentage were 68(7.32%), 75(8.07%), and 66(7.10%) from Gorakhpur, Basti and Azamgarh in seedling stage for year 2014 and 72(7.22%), 73(7.32%), and 76(7.62%) for year 2015; 135(14.53%), 137(14.74%), and 129(13.88%) form Gorakhpur, Basti, and Azamgarh in transplanting stage for year 2014 and 139(13.94%), 136(13.64%), and 137(13.74%) for year 2015; and 108(11.62%), 107(11.51%), and 104(11.19%) from Gorakhpur, Basti, and Azamgarh in flowering stage for year 2014 and 124(12.43%), 119(11.93%), and 121(12.13%) for year 2015 respectively. Of the total observed population of bioagents (1926) for sum of both the years 2014 and 2015, the number and percentage were 430(22.32%), 813(42.21%), and 683(35.46%) for seedling stage, transplanting stage, and flowering stage; and 646(33.54%), 647(33.59%), and 633(32.86%) for Gorakhpur, Basti, and Azamgarh respectively (Table-2).

Of the total observed population of bioagents (8728) under most bioagent groups with all growth stages of rice for sum of both the years 2014 and 2015, the population of bioagents were varied among all growth stages of rice. The population of both the predators and parasitoids were trend similar for each growth stages of rice. The population of both the predators and parasitoids were observed lowest abundance (19.73% and 2.59%) in nursery stage, while in transplanting stage and flowering stage, the population of both the predators and parasitoids were observed highly (36.60% and 5.61%) and moderately (31.25% and 4.21%) abundance respectively (Figure-1).

The present study was concluded in the form of ranking of bioagent complex prevalent over rice insect pests as the number of bioagent species were, hymenopterans > spiders > coccinellids > carabids > cicindelids > odonates > orthopterans > dermapterans > dipterans > mantids > mirids > neuropterans > staphylids for bioagent groups; parasitoids > predators for most bioagent groups; flowering stage > transplanting stage > seedling stage for growth stages of rice; and Basti > Gorakhpur > Azamgarh for administrative divisions of Eastern Uttar Pradesh and 2014<2015 for observation years respectively. Among different growth stages of rice, the highest abundance of ground beetles at seedling stage, lady bird beetles and spiders at transplanting stage and mirid bugs at flowering stage were observed respectively. Spiders and coccinellid beetles abundant over other groups of predators and hymenopteran parasitoids dominant over dipteran parasitoids were observed during study. The present findings have been found similar with reported studies of Pathak and Khan (1994), Ooi and Shepard (1994), Bhattacharyya *et al.* (2006), Fahad *et. al*. (2015) and Chakraborty *et al*. (2016) respectively.

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