

ANNUAL RESEARCH REVIEW WORKSHOP 2023-24



XI: ENTOMOLOGY DIVISION



BANGLADESH RICE RESEARCH INSTITUTE
GAZIPUR-1701

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List of Abbreviation

ALART – Advanced Lines Adaptive Research trial	LST – Line Stage Testing
AYT – Advance Yield Trial	MRL – Maximum Residue Limit
BCR – Benefit Cost Ratio	MRM – Multiple Reaction Monitoring
BPH – Brown Planthopper	NE – Natural Enemy
CDB – Carabid Beetle	OYT – Observational Yield Trial
CRD – Complete Randomized Design	PCR – Polymerase Chain Reaction
CRISPR – Clustered Regularly Interspaced Short Palindromic Repeats	PQR – Premium Quality Rice
CTP – Chlorantraniliprole	RB – Rice Bug
DAF – Days after Flowering	REY – Rice Equivalent Yield
Dam. Fly – Damsel Fly	RLR – Rice Leafroller
DAT – Days after Transplanting	RL Rice – Rainfed Lowland Rice
ESI – Electrospray Ionization	RS – Regional Stations
ETL – Economic Threshold Level	RYT – Regional Yield Trial
EU – European Union	SES – Standard Evaluation System
FAW – Fall Armyworm	SGH – Short Horn Grasshoppers
FW – Fresh Windowpanes	SPD – Spider
GH – Grasshopper	SSB – Striped Stemborer
GLH – Green Leafhopper	STPD – Staphylinid Beetle
GMB – Green Mirid Bug	STR – Salinity Tolerant Rice
HAS – Hours after Spray Management	THM – Thiamethoxam
HQ – Head Quarter	WBPH – White-Backed Planthopper
IPM – Integrated Pest Management	WH – White Head
IRR – Insect Resistant Rice	WLH – White Leafhopper
IRRI – International Rice Research Institute	WM – Whorl Maggot
LBB – Lady Bird Beetle	YSB – Yellow Stem Borer
LC-MS/MS – Liquid Chromatography and Tandem Mass Spectrometry	ZER – Zinc Enriched Rice
LHC – Long Horned Cricket	

SUMMARY

- Short horned grasshopper (SHG), green leafhopper (GLH) and white leafhopper (WLH) were the most abundant pests and found in all habitats (seedbed, ratoon, grass fallow, grass bund, irrigated rice, rice bund and upland rice) during reporting year.
- The highest number of insect pests and natural enemies were observed in Gazipur and followed by Barishal, Habiganj, Rajshahi, Sonagazi, Cumilla and Rangpur respectively in light trap catch.
- Survey of insect pests of rice in Sylhet, Rangpur, Cumilla, Barishal, Rajshahi and Habiganj region during T. Aman 2023, Khulna, Rangpur, Cumilla, Habiganj and Jashore during Boro 2023-24 season revealed that insect pests infestation was below the ETL in all the region. Yellow stem borer (YSB), Leafroller (LR), green leafhopper (GLH), short horned grasshopper (SHG) were the major insect pests and found highest in Sylhet, Rangpur and Barishal respectively. Among the natural enemies spider, carabid beetle (CBB), Damsel fly, Green mirid bug (GMB), lady bird beetle (LBB), Dragon fly and parasitic wasp (PW) were found highest in Rajshahi, Rangpur, Barishal and Sylhet respectively.
- The range of Fall Armyworm (FAW) moth catches was 0.02 to 0.33/trap/day and YSB catches was 0.04 to 0.74/trap/day in pheromone trap placed in different locations of Bangladesh. Highest FAW moth catches were observed 0.33 moths/trap /day at the farmers field of Kaliganj, Jhenaidha. Highest YSB moths and damages were observed at Batiaghata, Khulna
- The growth duration of different developmental stages of rice leafroller (RLR), *Cnaphalocrosis medinalis* from egg to adult has shown differences in changing temperature in the growth chamber. Overall, in lowest temperature (20°C), egg incubation period to adult longevity duration was higher compared to 25°C and 30°C and they completed their life cycle for 34 days which was higher from 25°C and 30°C.
- Species composition of stem borer species at BRRI farm Gazipur during T. Aus and T. Aman 2023 showed that in Aus, dark headed borer (DHB) was the dominant species followed by striped stem borer (SSB). In Aman yellow stem borer (YSB) was the dominant species followed by SSB and DHB.
- Insect pests status remained below the economic threshold level (ETL) both in Eco-engineering plots (T₁) and insecticide treated plots (T₂). Highest beneficial insects, predator and parasitoid were observed in rice field with nectar-rich flowering plants on bunds (Eco-engineering). However, least natural enemies and parasitism were found in farmer's practice rice field where 3-4 times insecticides were applied. Moreover, rice equivalent yield (REY) was higher in eco-engineering field compared to farmers practice field (insecticide application).
- Attempts have been made to rear green mirid bug on different hosts eg., Corcyra egg and larva, flowers of bottle gourd and other flowering plants but found no success.
- A total of 188, 45 and 14 commercial formulations of insecticides were evaluated and 96, 13 and 09 were found effective against BPH, YSB and rice weevil (RW) respectively.
- Silica (SiO₂) nanoparticles showed 74.0% and 73.0% mortality against BPH nymph at 94 and 72 hours after spray (HAS) respectively in 1000 ppm concentration. Mortality rates increased over time, with higher concentrations exhibiting the highest rates of mortality.
- Highest rice weevil insect mortality was found in neem oil (85%), followed by biskatali plants powder (75%), neem leaf powder (61.67%) and mahogany seed kernel powder (60%).
- Temperature effect on the growth and survival rates of *Sitophilus oryzae* showed that hundred percent mortality of rice weevil were found in -80°C, -20°C, 4°C and 50°C treatments. There was no mortality observed in 25°C treatments.
- To determine the susceptibility of more than eighteen generations green leafhopper (GLH) to six insecticides, a bioassay experiment was conducted at six different concentrations for each insecticide. The lethal dose (LD₅₀) were found 48.44 for Mipcin 75WP, 360.32 for

Dursban 20EC, 8.19 for Confidor 70WG, 216.41 for Suntap 50SP, 24.78 for Award 40SC and 0.91 for Nitro 505 EC.

- Total natural number of NE and other non-pest, comparable with control were found in fipronil, cartap, tetraniliprole+ fipronil, Abamectin and *Celastrus angulatus* among eight commercially registered insecticides for rice tested in the trial. So, these insecticides may be considered as safer for NE.
- Insecticide residue tests on polished rice grain showed no pesticide presence or were below the detection level when applied with standard dose of chlorantraniliprole and imidacloprid. The detection concentration for double dose application was 0.018 mg kg⁻¹ for chlorantraniliprole and 0.029 mg kg⁻¹ for imidacloprid, which was below the Maximum Residue Limit (MRL: 0.05 mg kg⁻¹ for chlorantraniliprole and 0.21 mg kg⁻¹ for imidacloprid, EU).
- Multiple insecticide residue tests in polished rice found no residues or were below detection level.
- A total of 15 insecticides determination methods namely carbofuran, chlorantraniliprole, chlorpyrifos, isoprocarb, thiamethoxam, malathion, diazinon, dinotefuran, imidacloprid, pymetrozine, nitenpyram, carbaryl, carbosulfan, cypermethrin, and fipronil were standardized by Shimadzu LCMSMS 8050.
- Analysis of 16 rice samples collected from different regions of the country showed that no pesticide residue was found in any sample other than chinigura rice samples. Though very little amount of insecticide residues found in chinigura rice which was less than the EU, MRL.
- Among the 100 germplasms, three germplasms munsur, dighi baul and kalosaitta showed moderately susceptible reaction (score 5) against BPH in T. Aman 2023 season.
- All of the Twenty RYT advanced breeding lines of rainfed lowland rice (RLR) showed susceptible reaction (score 7&9) against BPH.
- In drought tolerant rice (DTR) trial, one breeding lines IR127009-B-8-2-1-2, out of Eight showed moderately susceptible (score 5) reaction against BPH.
- All of the eight zinc enriched (ZER) lines of Regional Yield Trial (RYT) during the evaluation at green house showed susceptible reaction (score 7&9) against BPH
- Among four ALART Antioxidant enriched rice materials one ALART material BR12836-4R-312 showed moderately susceptible reaction (score 5) against BPH.
- Most of the entries of three ALART (SD) favorable boro rice (FBR), two ALART (LD) FBR, six ALART (LB) FBR, four ALART cold tolerant rice (CTR), three PVT (Fertilizer Management) FBR breeding lines showed susceptible reaction (score 7 & 9).
- In FBR cold tolerant rice, one entry IR17A2922 showed moderately resistant reaction (score 3) and four entries BR12676-4R-392, BR13138-5R-141, IR17A2917 and IR12A173 out of 188 entries showed moderately susceptible reaction (score 5) against BPH.
- All of Twelve ALART boro lines, fifteen disease resistant rice, nine RYT-1of premium quality rice (PQR), eight RYT-2 PQR, thirteen RYT-3 PQR, nine RYT zinc enriched rice (ZER) entries showed susceptible reaction (score 7&9) against BPH.
- Among 76 FBR (BPH 17 and BPH 32) BPH gene rice, two entry BR13418-5R-81 and BR13418-5R-93 showed moderately resistant reaction (score 3) and thirteen entries BR13418-5R-3, BR13418-5R-6, BR13418-5R-8, BR13418-5R-26, BR13418-5R-37, BR13418-5R-40, BR13418-5R-47, BR13418-5R-51, BR13418-5R-53, BR13418-5R-76, BR13418-5R-78, BR13418-5R-82 and BR13418-5R-100 showed moderately susceptible reaction (score 5) against BPH.
- Among 62 FBR lodging tolerance trial, one entry IR17A2922 showed moderately resistant reaction (score 3) and three entries BR12676-4R-392, BR7528-2R-19-16-RIL-59 and IR12A173 showed moderately susceptible reaction (score 5) against BPH.

- Among 352 OYT insect resistant rice (IRR) lines, one entry BR13482-4R-202 showed moderately resistant reaction (score 3) and ten entries BR13466-4R-10, BR13466-4R-42, BR13467-4R-208, BR13471-4R-88, BR13472-4R-1, BR13472-4R-6, BR13472-4R-124, BR13480-4R-29, BR13482-4R-54 and BR13482-4R-115 showed moderately susceptible reaction (score 5) against BPH.
- Two entries out of 84 PYT insect resistant rice lines, BR12678-4 R-187 and BR12685-4 R-251 showed moderately susceptible reaction (score 5) against BPH.
- All of 45 AYT insect resistant rice (IRR) entries showed susceptible reaction (score 7&9) against BPH.
- Irrespective of locations and rice varieties the insect pests were remain below the economic threshold level (ETL) both in IPM practiced (T_1) and farmers practiced field i.e., insecticide application (T_2) during Boro 2023-24. Benefit cost ratio (BCR) analysis was done on full cost basis and were found always higher in T_1 compared to T_2 .
- Newly developed burrows became inactive (dead) surrounding the 50m dia of watching tower set in BRRI Gazipur field indicating activity of Owl at night to control rat in rice.
- Fifteen experiments were conducted in different farmer's fields during Boro 2023-24 season which covered PARTNER Project targeted nine upazilas of six districts and three divisions of Bangladesh to reduce insecticide use in rice production and increase farmers income.
- Irrespective of locations and rice varieties the insect pests were remain below the economic threshold level (ETL) both in Research practiced field (T_1) and farmers practiced field i.e., insecticide application (T_2) during Boro 2023-24. But natural enemies were found highest in Research practiced field (T_1) compared to farmers practiced field. Six different pesticide were used in farmers practiced field but no pesticide used in Research practice field.
- The ranged of grain yield were 6.74 to 8.69 t/ha in Research practice field and 6.75 to 8.60 t/ha in farmers practiced field.
- A total of 39 and 25 biopesticide, new and combination formulations insecticides were evaluated against BPH and YSB respectively. Among them 08 and 05 were found effective against BPH and YSB respectively during T. Aman season. During Boro season, 77 and 08 bio, new and combination formulations insecticides were evaluated against BPH and YSB respectively. Among them 56 and 04 were found effective against BPH and YSB respectively.
- Four field day programme on 'Insect pest management without or less use of insecticide in rice production' were conducted at Bahubal, Habiganj, South Surma, Sylhet, Fulbari, Kurigram and Pirganj, Rangpur. More than 100 farmers were presented in each field day programme. Again, twelve batch farmers training (30 farmers in each batch) on 'Integrated pest management (IPM) in rice' were also conducted in the farmers periphery in collaboration with BRRI regional station along with respective DAE personnel with financial support of PARTNER Project.

PROJECT I: SURVEY AND MONITORING OF RICE ARTHROPODS

Expt. 1.1 Pest and natural enemy incidence at BRRRI farm, Gazipur

Objective: To study the pest and their natural enemy incidence patterns in rice and to create a data base.

Materials and Methods: Populations of rice insect pests, their natural enemies (NE) and crop damage intensities in seven habitats including seedbed, rice ratoon, grass fallow, grass bund, irrigated rice, rice bund and upland rice were monitored weekly at BRRRI research farm, Gazipur with sweep net (40-cm diameter) in all plots. One hundred (100) complete sweeps (CS) were taken in each habitat at every standard week to record the insect pest and NE's population. The collected insects were kept in labeled bags and brought to the laboratory for sorting, identification and quantification. Damage intensity due to some major insect pests and their populations were also estimated by observing 20 hills randomly in each habitat at every week.

Many insect pests and NE's were observed including brown planthopper (BPH), carabid beetle (CDB), caseworm, damsel fly, dark headed borer (DHB), grasshoppers (GH), green leafhopper (GLH), gall midge, green mirid bug (GMB), lady bird beetle (LBB), long horned cricket (LHC), orange headed leaf hopper (OHLH), pink borer (PB), rice bug (RB), rice leafroller (RLR), spiders, staphylinid beetle (STPD), tiger beetle (TB), white backed planthopper (WBPH), white leafhopper (WLH), yellow stem borer (YSB), zigzag leafhopper (ZLH), short horn grasshopper (SHG), long horn grasshopper (LHG), mole cricket (MC), field cricket (FC), swarming caterpillar (SCP), ear cutting caterpillar (ECC), and earwig in rice ecosystem. However, only major and dominant insects and natural enemies are presented here which were observed frequently in each habitat at all rice growing seasons.

Results: Overall insect pest incidence was low in the reporting year. Green leafhopper (GLH), white leafhopper (WLH) and short horned grasshoppers (SHG) were the most abundant pests and found almost in all habitats. Highest number of SHG was found in seedbed followed by grass fallow, transplanted rice, grass bund and broadcast rice (Fig. 1). Higher numbers of natural enemies were found in the seedbed, grass fallow and ratoon. Green mirid bug (GMB), ladybird beetle, spider, damsel fly (Dam. fly), spider and carabid beetle (CDB) were the dominant predators in almost all the habitats of the reporting year (Fig. 2).

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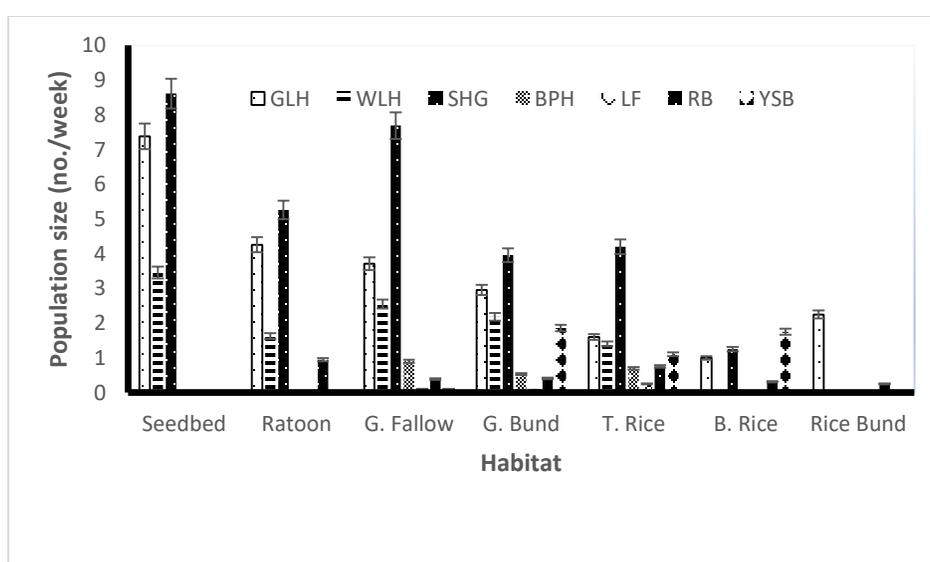


Fig. 1. Incidence of insect pest in different habitats at BRRRI farm, Gazipur

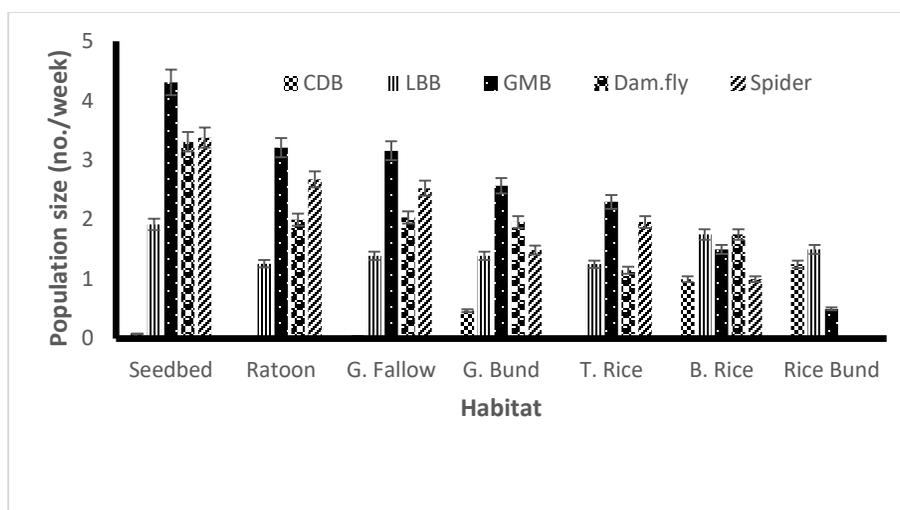


Fig. 2. Incidence of natural enemies in different habitats at BRRRI farm, Gazipur

Expt. 1.2. Insect pests and natural enemy status in light trap

Objective: To study the insect pests and their natural enemy incidence patterns in rice fields and to create a database to develop a forecasting system.

Materials and Methods: Pennsylvanian light trap was installed at BRRRI, Gazipur and six BRRRI regional stations including Barishal, Cumilla, Rajshahi, Habiganj, Rangpur and Sonagazi from July 2023 to June 2024. Insect pest and natural enemies captured in each light trap were collected in every morning. Trapped insects were sorted, identified, counted and analyzed.

Result: The highest numbers of total insect pests were found in Gazipur followed by Barishal, Habiganj, Rajshahi, Sonagazi, Cumilla and Rangpur. The abundance of GLH and YSB was observed all the seven locations (Table 1). The prevalence of BPH, WBPH, RLF were also found almost all locations except BPH at Sonagazi, WBPH Sonagazi, Habiganj and RLF at Habiganj. The highest number of GLH and BPH were found in Gazipur followed by Habiganj and Barishal. The highest number of YSB was observed in Barishal followed by Gazipur and Rajshahi. Among the major insect pests, highest number of BPH was observed during the month of November followed by December, May and July at Gazipur. The highest abundance of WBPH was observed in November at Barishal followed by Gazipur. The highest peak of YSB was observed at BRRRI RS Barishal in November followed by October, March and April (Fig. 3). Usually stem borer shows two peaks in a year- one in April-May and the other in October-November. Higher populations of GLH was found in the month of November at BRRRI RS Habiganj (Fig. 3). Highest number of green leafhopper (GLH) was found in May at Habiganj followed by Gazipur and October at Gazipur. The abundance of rice leaffolder was found highest in October followed by November at Barishal. In conclusion, higher peak of insect pests was found in October-November and May to June across the locations (Fig. 3).

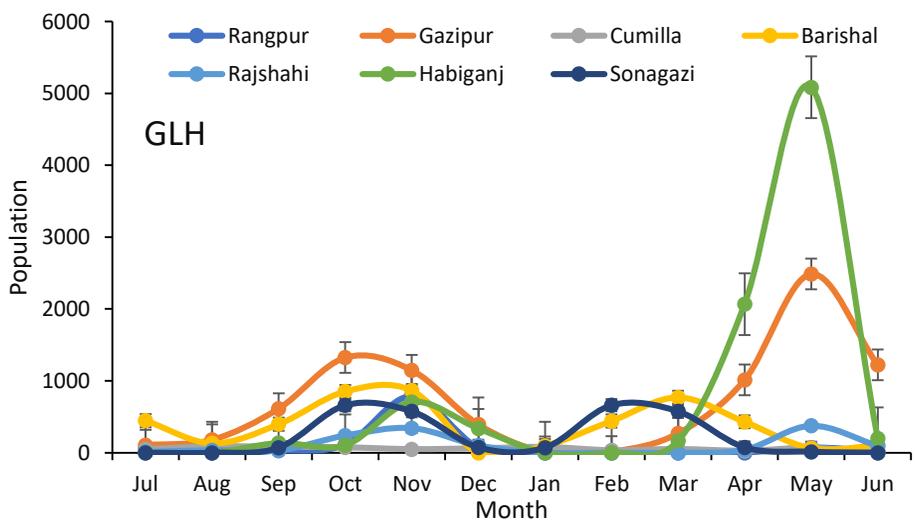
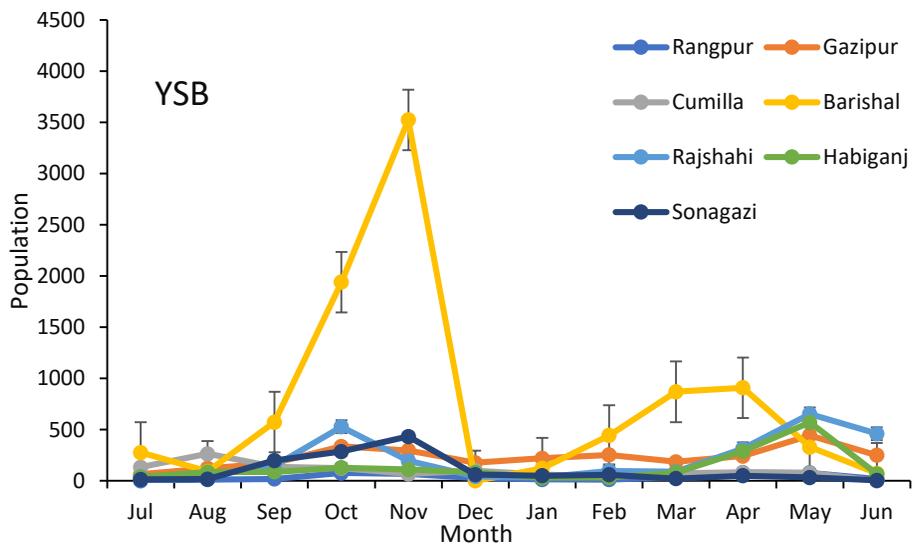
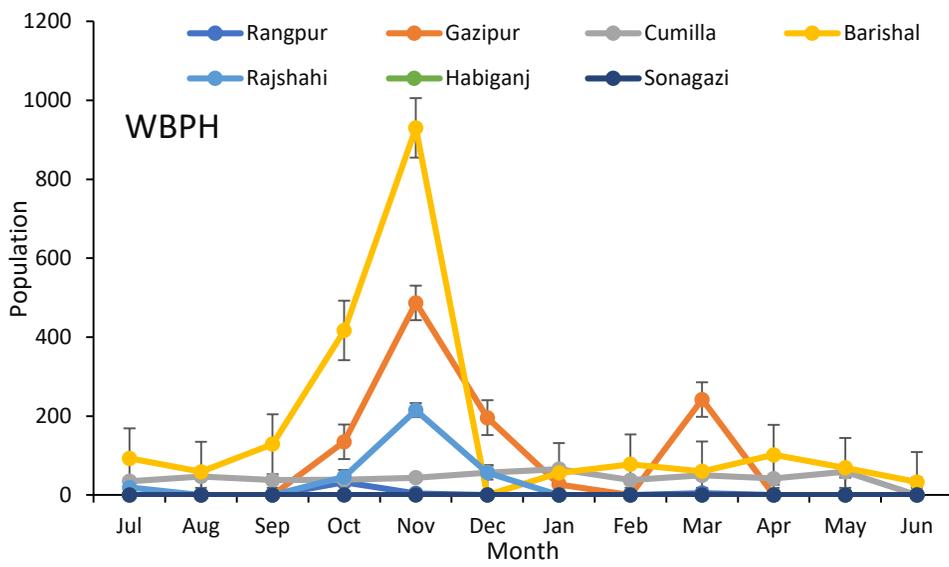
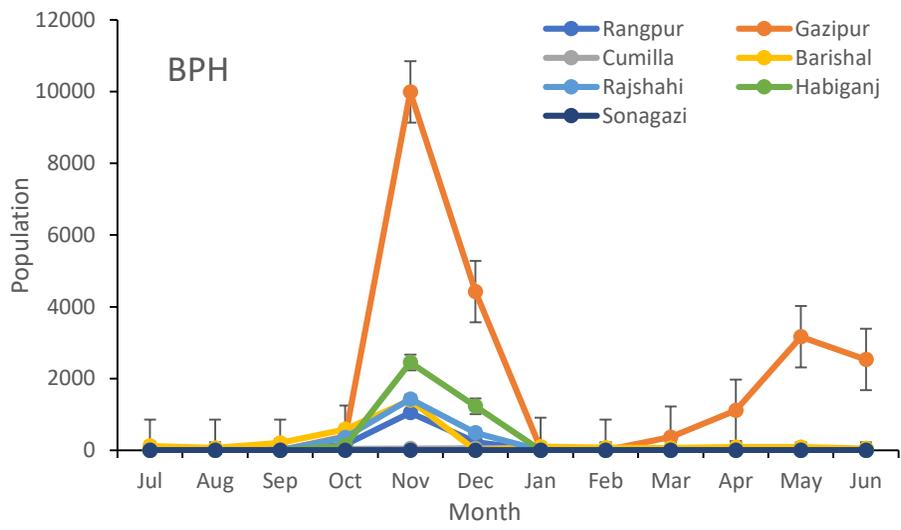
Total number of natural enemies was found highest in Gazipur followed by Barishal, Habiganj, Cumilla, Sonagazi, Rajshahi and Rangpur (Table 1). Green mirid bug population of Gazipur was higher than those of other stations. The highest peak of GMB was observed in the month of November followed by December at Gazipur, and Barishal in November. The highest number of LBB was found in May at Habiganj and February at Barishal. Carabid beetle showed the highest population at Barishal in April, October in Gazipur and November in Habiganj (Fig. 4). Similarly, in contrast, several peaks of STPD were observed at Barishal but highest was found in the month of January (Fig. 4). A small peak of STPD was observed in the month of August and May at BRRRI, Gazipur. Among natural enemies, highest peak was found in April to May and October to November for CDB, November to January for GMB, February and May for LBB and January for STPD (Fig. 4).

Table 1. Insect pests and natural enemies caught in light trap at BRRF Farm, Gazipur and R/S July 2023- June 2024

Insect pests	Gazipur	Cumilla	Barishal	Rajshahi	Sonagazi	Habiganj	Rangpur	Total
GLH	8791	655	5810	1277	1481	8805	1145	27964
WLH	5322	0	1938	2627	0	0	0	9887
OHLH	0	0	17	0	0	0	0	17
ZLH	3802	0	924	286	0	0	30	5042
Emposca	0	0	0	626	0	0	0	626
BPH	22024	506	3367	2278	0	3811	1440	33426
WBPH	1087	515	2373	337	0	0	41	4353
YSB	2758	1153	9903	2648	1220	1596	440	19718
DHB	0	0	348	20	0	0	0	368
PB	0	0	0	347	0	0	0	347
GM	0	0	0	11	0	0	0	11
RLF	113	702	1507	353	169	0	78	2922
CW	839	596	135	745	692	0	0	3007
Naranga	0	0	711	0	0	0	0	711
GH	0	502	23	0	0	0	0	525
SHG	156	0	355	32	7	225	6	781
LHG	56	0	23	23	50	0	3	155
LHC	127	0	274	6	1217	0	19	1643
MC	45	0	272	17	0	0	2	336
FC	221	0	40	54	884	0	0	1199
SCP	491	0	221	0	0	0	0	712
RB	535	0	111	153	56	0	229	1084
SBPH	526	0	0	6	0	0	0	532
St.B	25	0	0	221	0	0	0	246
Pygune GH	85	0	0	2	0	0	0	87
Total	47003	4629	28352	12069	5776	14437	3433	115699

Natural enemies	Gazipur	Cumilla	Barishal	Rajshahi	Sonagazi	Habiganj	Rangpur	Total
CBB	1794	623	1330	48	12	678	77	4485
LBB	43	645	1018	188	354	3526	0	5774
STPB	12252	0	6142	291	11	10	34	18706
GMB	2322	0	2560	9	6	36	4	4933
Dam. Fly	1	0	387	21	41	0	3	450
SPD	12	0	316	33	148	0	0	509
EW	420	0	957	22	0	0	0	1399
TB	0	0	947	4	0	0	0	951
EB	0	0	0	0	0	0	0	0
Drag Fly	9	0	294	3	0	0	0	306
Ant	0	0	0	0	0	0	0	0
Parasite	0	0	0	0	0	424	0	424
Pygmic	513	0	0	0	0	0	0	513
GB	0	0	0	0	434	0	0	434
Total	17366	1268	13951	619	1006	4674	118	38450

In case of natural enemies, the highest catch of natural enemies in light trap was recorded at Gazipur followed by Barishal and Habiganj.



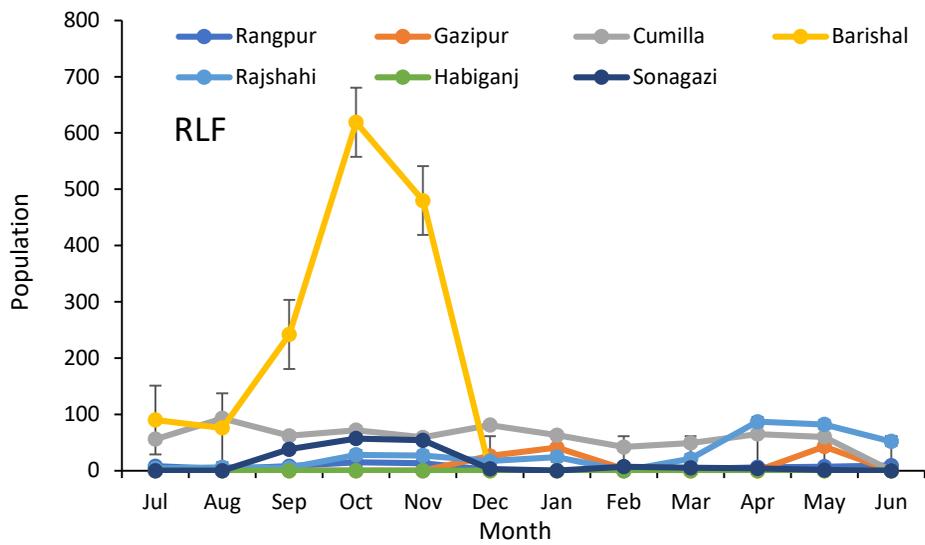
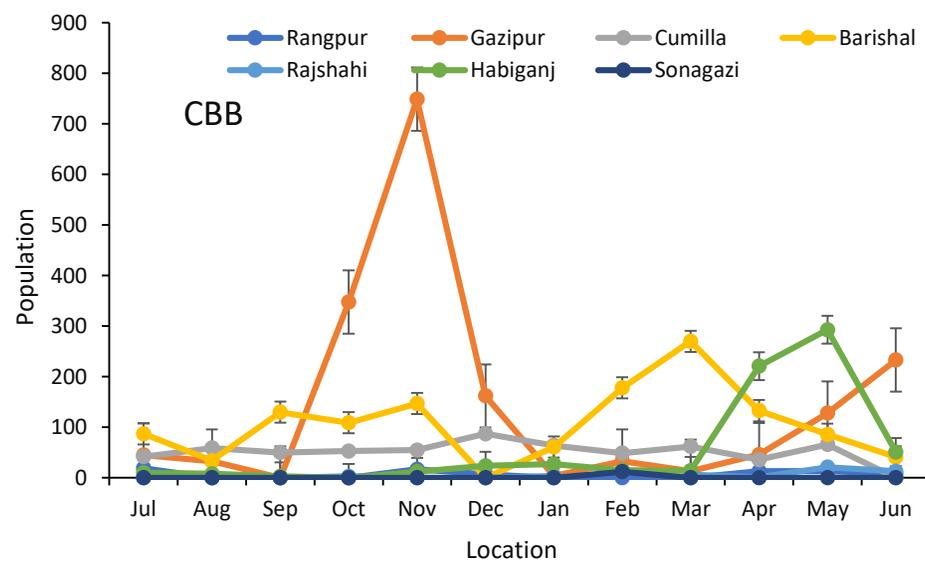
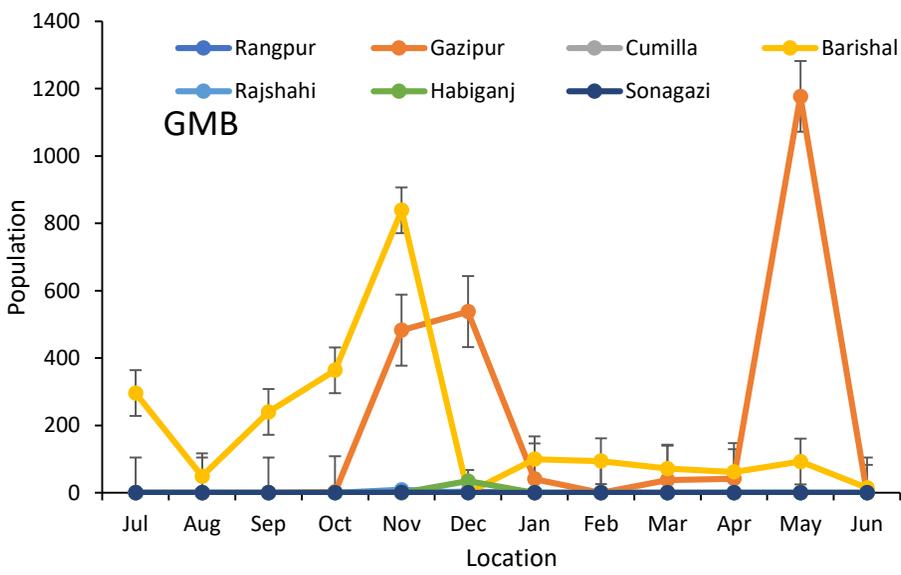


Fig. 3. Incidence pattern of major insect pests in light trap, BRFI Gazipur and regional stations, July 2023- June 2024



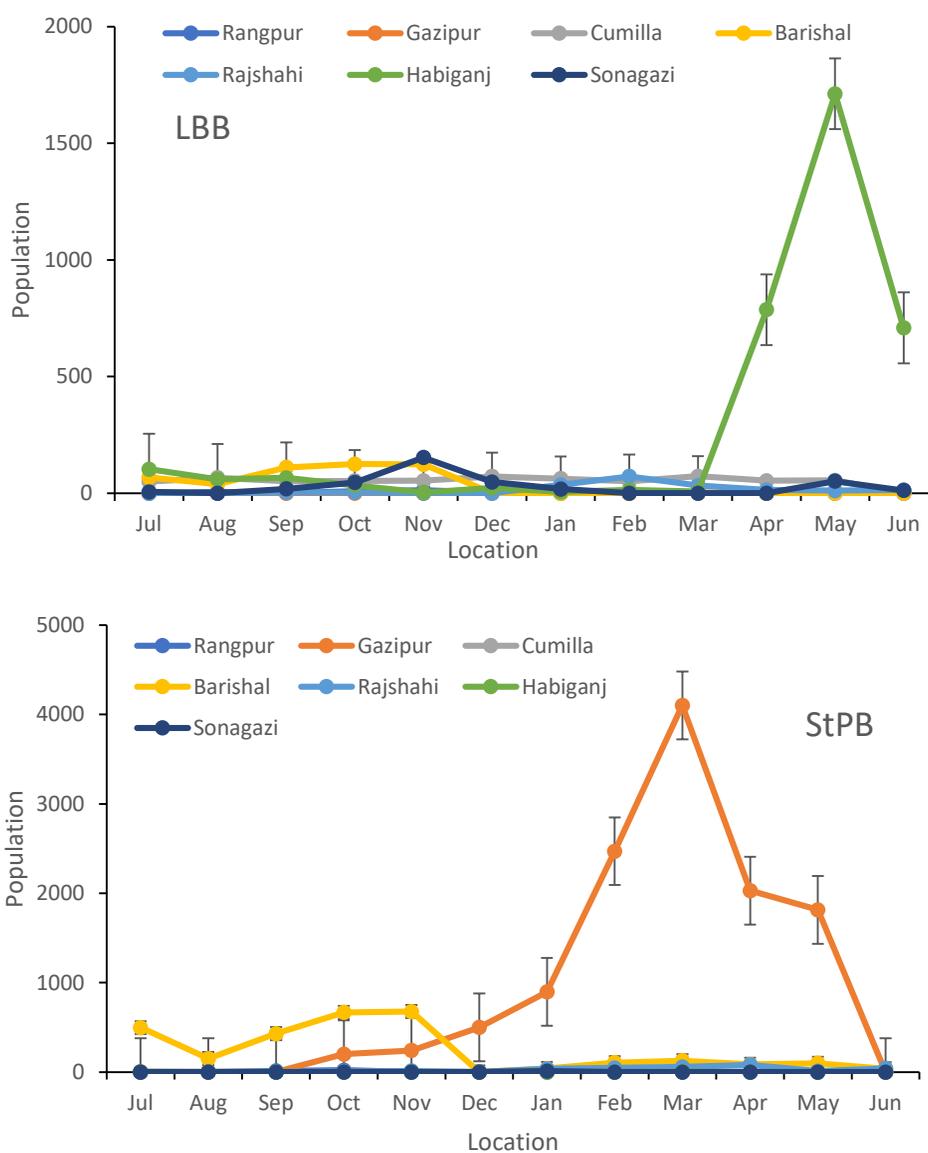


Fig. 4. Incidence pattern of natural enemy in light trap, BRRRI Gazipur and regional stations, July 2023- June 2024

Expt. 1.3. Survey and monitoring of rice arthropods in different Agro-ecological zones (AEZ's) of Bangladesh

Objectives:

- i. To find out the incidence patterns of major insect pests and their natural enemies in different AEZ's of Bangladesh.
- ii. To examine the relationship between biotic and abiotic factors on their incidence.
- iii. To create a data base of insect pests and natural enemies.

Materials and Methods: The insect pest population, their damage intensities and abundance of the natural enemies were surveyed during T. Aman 2023 in transplanted rice field of Sylhet, Rangpur, Cumilla, Barishal, Rajshahi, and Habiganj region during T. Aman 2023 and Khulna, Rangpur, Cumilla, Habiganj and Jashore during Boro 2023-24 season. At least 20 survey spots were selected randomly on different locations of Sylhet (AEZ 20), Rangpur (AEZ 03), Cumilla (AEZ 16), Barisal (AEZ 13), Rajshahi (AEZ 25) and Habiganj (AEZ 19-22), Khulna AEZ (11-12) and Jashore (AEZ 11, 14). Sweeping was done with a sweep net of a diameter of 12 inches with a handle, one meter long. Insect pests and their natural enemies were collected separately from each location by 20 complete sweeps and were sorted, identified and counted.

Results:

T. Aman 2023: Insect pests were below the economic threshold level (ETL) during T. Aman 2023 and Boro 2023-24. Highest yellow stem borer (YSB) found in Barishal (5.03/20 sweep) followed by Rangpur (1.59) and Sylhet (1.44) and Rajshahi (1.41/20 sweep). The lowest was observed in Cumilla 0.17/20 sweep (Fig. 5). Leafroller (LR) population found highest at Sylhet (4.74/20sweep) followed by Barishal (2.02/20sweep) and Rangpur (1.47/20 sweep). Abundance of GLH was found highest in Rangpur (3.87/20 sweep) followed by Cumilla (3.55/20 sweep) and Sylhet (2.37/20 sweep). Among the all-insect pests short horned grasshopper (SHG) found highest in Sylhet

(10.85/ 20 sweep) followed by Barishal and Cumilla (each of 5.50 /20sweep) and Rangpur (5.05/20sweep) and lowest SHG was observed in Rajshahi, 1.69/20 sweep (Fig. 3). Brown planthopper (BPH) and white backed planthopper (WBPH) were found highest in Sylhet (9.33 and 2.74/20 sweep respectively). The range of BPH and WBPH were 0 to 0.84 and 0 to 0.42 respectively /20 sweep in other locations (Fig. 3). Some other insect pests like long horned grasshopper (LHG), long horned cricket and caseworm (CW) remained very lowest in number (0 to 0.6/20 sweep) during T. Aman 2023 (Fig. 5).

Irrespective of locations spider populations was found highest than other natural enemies except Rangpur. Highest spider (8.56/20 sweep) was found in Rajshahi followed by Sylhet (7.52/20 sweep), Barishal (2.93/20 sweep) and lowest in Cumilla (1.68/20 sweep). Among the natural enemies carabid beetle (CBB) and staphylinid beetle (STPD) were remarkably highest in Rangpur (27.42 and 3.7/ 20 sweep respectively) than other locations (Fig. 6). Damsel fly (Dam.fly) found highest in Rajshahi(3.84/20 sweep) followed by Sylhet (2.85/20 sweep) and Rangpur (1.2/20 sweep). Green mirid bug (GMB) and parasitic wasp (PW) were found highest in Sylhet, lady bird beetle (LBB) in Rangpur and Dragon fly (Drag. fly) in Barishal during T. Aman 2023 (Fig. 6).

PI: Md. Nazmul Bari, **CI:** All entomologist, **PL:** Sheikh Shamiul Haque

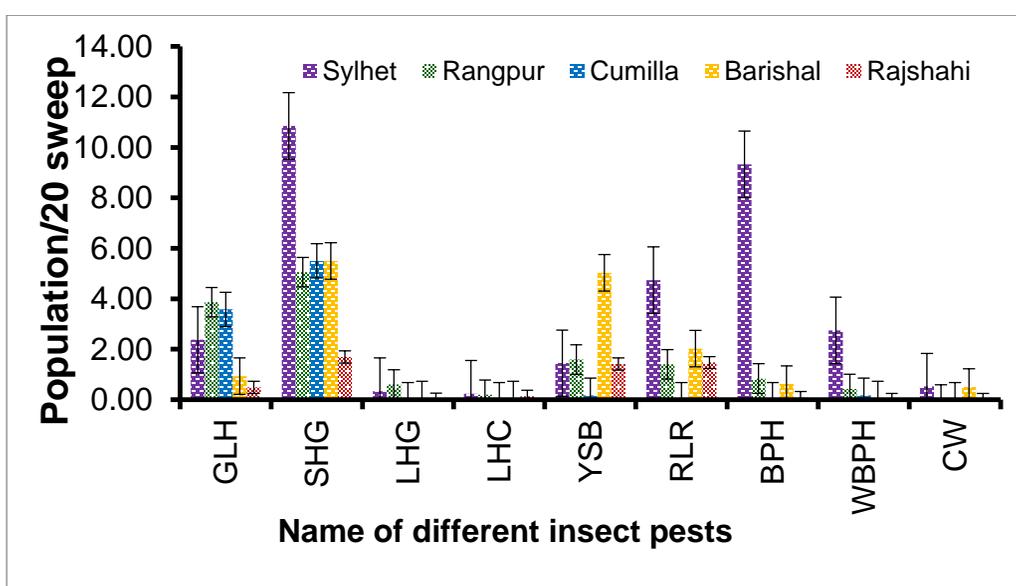


Fig. 5. Rice insect pests status in different AEZ's of Bangladesh during T. Aman 2023

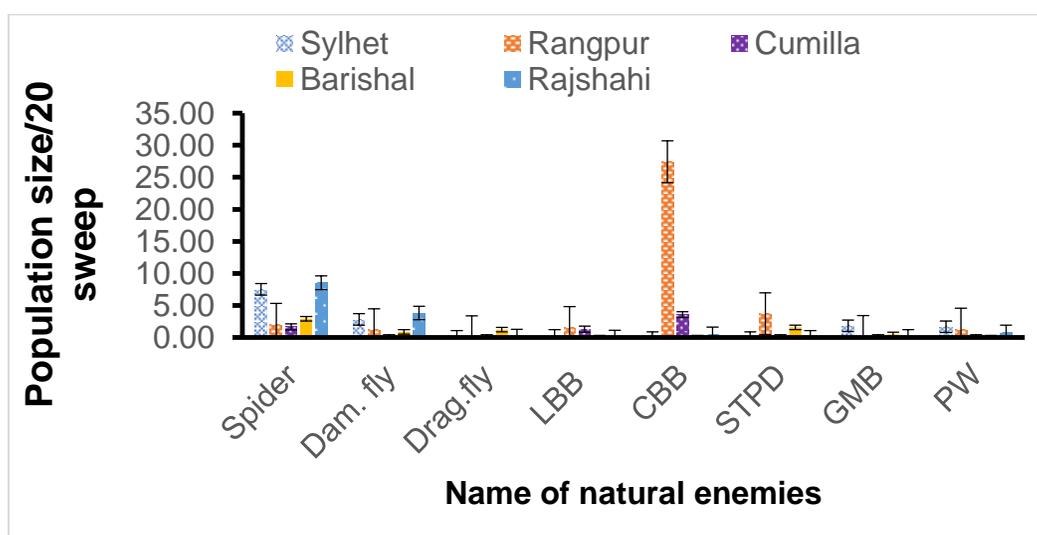


Fig. 6. Natural enemies of rice insect pests in different AEZ's of Bangladesh, T. Aman 2023

Boro 2023-24: Insect pests were below the economic threshold level (ETL) during Boro 2023-24. Highest yellow stem borer (YSB) was found in Khulna (3.5/20 sweep) followed by Jashore (0.83/20 sweep). The ranged of other natural enemies were (0 to 0.67/20 sweep) during Boro season (Fig. 7). Rice leafroller (RLR) population found highest in Khulna (1.33/20sweep) followed by Jashore (1.0 /20sweep). The ranged of RLR in other locations were (0.0 to 0.33/20 sweep), Abundance of GLH was found highest in Cumilla (3.80/20 sweep) followed by Habiganj (2.75/20 sweep). Among the all-insect pests short horned grasshopper (SHG) found highest in Cumilla

(19.22/ 20 sweep) followed by Habiganj and Rangpur (3.5 and 2.03/ 20sweep) and lowest SHG was observed in Khulna and Jashore each of 1.50/20 sweep (Fig. 7). Brown planthopper (BPH) and white backed planthopper (WBPH) were found highest in Cumilla and Khulna respectively (4.22 and 1.83/20 sweep) respectively (Fig. 7). The ranged of BPH and WBPH were 0.04 to 1.58 and 0 to 1.67 respectively /20 sweep in other locations during Boro 2023-24 (Fig. 7).

Irrespective of locations spider populations was found highest than other natural enemies except Cumilla. Highest spider (5.75/20 sweep) was found in Habiganj followed by Cumilla (4.22/20 sweep) and Khulna (3.33/20 sweep) and lowest in Jashore (2.83/ 20sweep). In case of other natural enemies i.e., parasitic wasp (PW) and staphylinid beetle (STB) were found highest (5.67 and 3.47/ 20 sweep respectively) in Rangpur region and Damsel fly (Dam. fly) in Habiganj (3.27/20 sweep) during Boro 2023-24 season (Fig. 8).

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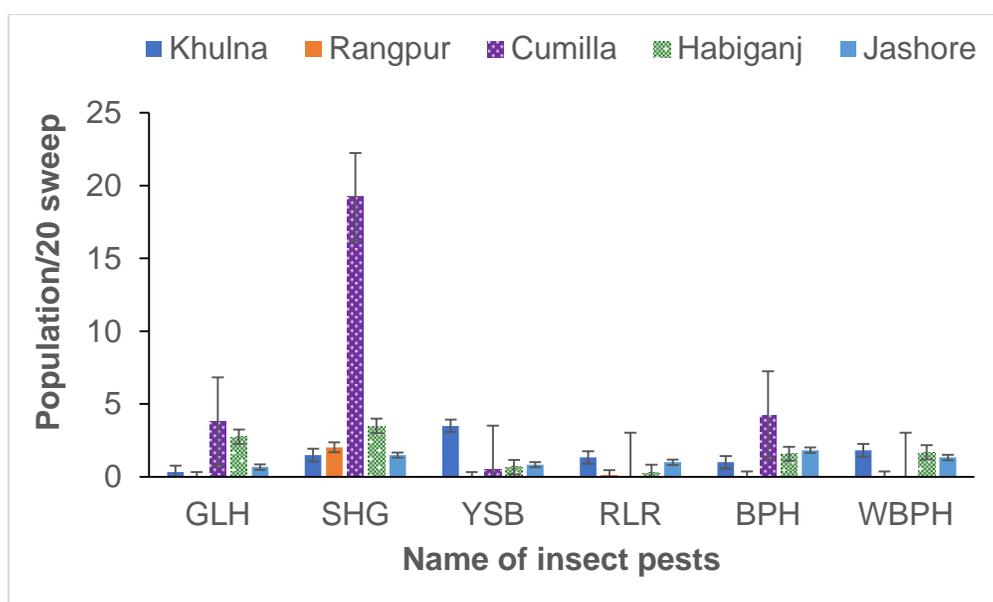


Fig. 7. Rice insect pests status in different AEZ's of Bangladesh during Boro 2023-24

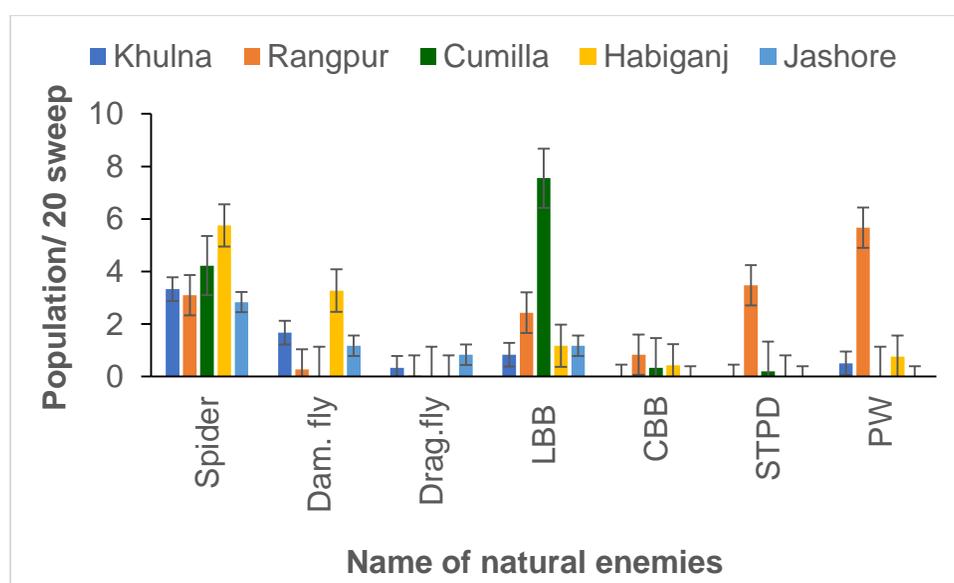


Fig. 8. Natural enemies of rice insect pests in different AEZ's of Bangladesh, Boro 2023-24

Expt. 1.4. Fall Armyworm (FAW) and Yellow stem borer (YSB) monitoring through pheromone trap

Objective: To survey and monitoring of FAW and YSB through pheromone trap in different locations of Bangladesh

Materials and Methods: Each of four FAW and YSB pheromone trap were set up in all seven experimental plot for monitoring and control purpose respectively. Trapped catch data were taken on an average 08 weeks in different locations.

Results: The ranged of FAW catches was 0.02 to 0.33/trap/day and YSB catches was 0.04 to 0.74/trap/day (Fig. 9). Highest FAW moth catches was observed 0.33/trap /day at the farmers field of Kaliganj, Jhenaidha (Fig. 8). That might be happened as maize field was remained adjacent to the trial field. Incase of FAW, no fresh window panes (WP) and infested plants (WP) were found during scouting. Again no dead hearts and white heads were observed incase of YSB except Batiaghata, Khulna. Highest yellow stem borer populations and damages were observed at Batiaghata, Khulna and it is obvious that YSB status remain highest in the coastal belt of Khulna, Bangladesh due to vast fallow areas remain in those areas after T. Aman cultivation. So diapausing YSB remain highest in that areas. Farmers used 3 times insecticides to control the YSB without considering economic threshold level.

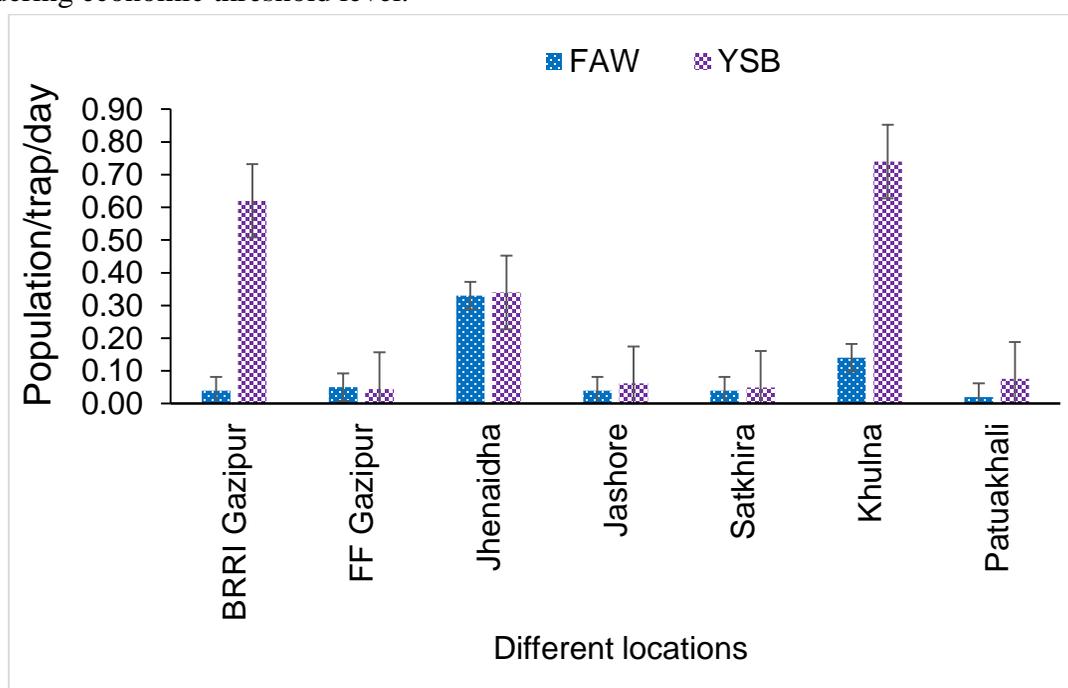


Fig. 9. Catches of Fall Armyworm (FAW) and yellow stem borer (YSB) status in pheromone trap in different locations of Bangladesh, Boro 2023-24

PROJECT II: BIO-ECOLOGY OF RICE INSECT PEST AND NATURAL ENEMY

Expt. 2.1. Title: Effect of temperature on the biology and life cycle of rice leafroller, *Cnaphalocrosis medinalis*

Objective: To know the effect of temperature elevation in the life cycle of rice leafroller

Materials and Method: Rice leafroller colony was maintained on BR3 plants under greenhouse conditions at BRRI, Gazipur to know the impact of elevated temperature on the development of rice leafroller. Ten pairs of adults were collected from rice fields and released for oviposition on 40 to 45-day-old plants covered with fine mesh nylon net cage (45 cm height and 14 cm diameter). Sufficient number of newly laid eggs were transferred to Petri dishes and kept them in a constant temperature and humidity controlled growth chamber. Response to temperature was assessed by exposing *C. medinalis* eggs to different constant temperatures (20, 25 and 30°C) in separate experiments and allowing the eggs to develop into adults.

Result: Egg incubation period was significantly higher in 20°C compared to 25°C and 30°C. Larval period was significantly different in 3 different temperatures. In lowest temperature (20°C), the duration was higher compared to 25°C and 30°C. Pupal duration was completed quickly at 30°C than 20°C and 25°C (Fig. 10). Adult longevity was more in 25°C temperature compared to 20 and

30°C temperature (Fig. 11). The growth duration from egg to adult was decreases by increasing temperature. Highest growth duration 34 days was found at 20°C and that was 26 and 20 days in 25°C and 30°C respectively (Fig. 12).

PI: Sanjida Akter **PL:** Sheikh Shamiul Haque



Photo 1. Different growth stages of RLR in growth chamber in specific temperature and humidity

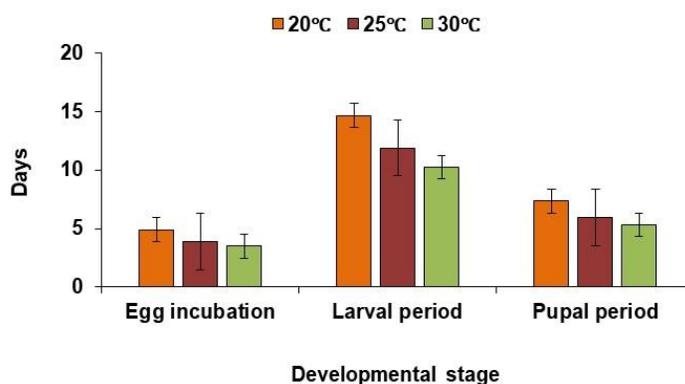


Fig. 10. Effect of temperature on the growth duration of rice leafroller.

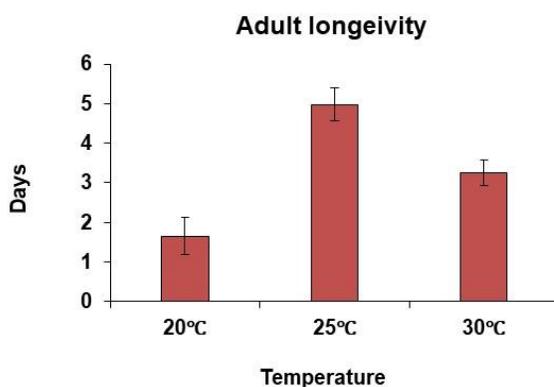


Fig. 11. Adult longevity of rice leafroller in different temperature

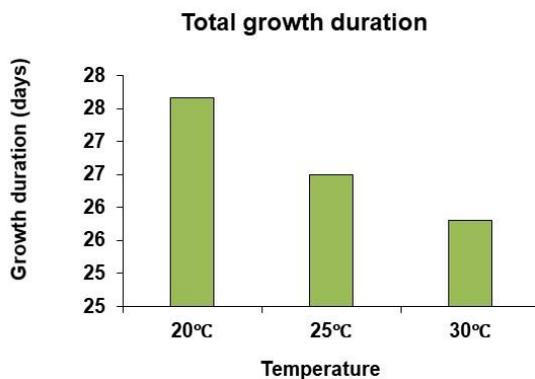


Fig. 12. Total growth duration of rice leafroller in different temperature

Expt. 2.2. Effect of temperature on growth and development of *Sitophilus oryzae* L. on polished rice

Objectives: To investigate the growth and survival rates of *Sitophilus oryzae* in different temperature

Material and Methods: The experiment was conducted in a complete randomized design (CRD), with three replications in the laboratory of Entomology division, BRRRI from October to December

2023. The experiment consisting of eight treatments ($T_1 = -80^\circ\text{C}$, $T_2 = -20^\circ\text{C}$, $T_3 = 4^\circ\text{C}$, $T_4 = 20^\circ\text{C}$, $T_5 = 25^\circ\text{C}$, $T_6 = 35^\circ\text{C}$, $T_7 = 40^\circ\text{C}$ and $T_8 = 50^\circ\text{C}$). Twenty gram of fresh rice was taken in Petri dishes. Ten pairs of rice weevils introduced in each replication of each treatment. Then the petri dishes were kept at room temperature for 7 days for mating and egg laying. After 7 days, treatments were applied according to design. Weevil mortality was recorded after 24 hours after treatments (HAT) and the adult weevils were removed and treated as designed treatments for 24 hour. All data were subjected to statistical analysis separately by using the analysis of variance technique by R software (versions 2024.04.1).

Results: Hundred percent mortality of rice weevil were found in T_1 , T_2 , T_3 and T_8 treatments. There was no mortality observed in T_5 treatments (Table 3). Rice weevils could not be sustain at very high temperature as well as low temperature. Although there were 100% mortality observed in T_3 and T_8 treatments but F_1 adults emergence found there. Which indicated that, these temperature could be lethal for adult rice weevils but egg could be survive. The highest number of F_1 adult were emerged in T_5 treatments which was statistically different from others followed by T_4 . There were no single F_1 adult emerged in T_1 and T_2 . The highest (%) of grain weight loss was observed in T_6 and lowest was in T_1 , T_2 and T_8 .

Table 2. Mortality (%), F_1 adult emergence and weight loss (%) of different treatments infested by rice weevils.

Treatment	Mortality (%)	F_1 Adult emergence	Weight Loss (%)
$T_1 (-80^\circ\text{C})$	100 a	0.00 e	2.71 e
$T_2 (-20^\circ\text{C})$	100 a	0.00 e	3.79 e
$T_3 (4^\circ\text{C})$	100 a	3.33 de	16.81 d
$T_4 (20^\circ\text{C})$	5.00 c	24.67 b	29.20 b
$T_5 (25^\circ\text{C})$	0.00 d	44.33 a	32.83 a
$T_6 (35^\circ\text{C})$	6.67 c	9.00 c	30.79 ab
$T_7 (40^\circ\text{C})$	86.67 b	5.00 cd	19.07 c
$T_8 (50^\circ\text{C})$	100 a	1.33 de	3.42 e
Levels of Sig.	***	***	***
LSD	4.99	4.34	2.23
CV	4.63	22.89	7.44

PI: Tapon Kumar Roy; PL: Sheikh Samiul Haque

PROJECT III: BIOLOGICAL CONTROL OF RICE INSECT PESTS

Expt. 3.1. Conservation of natural enemies through eco-engineering

Objective(s):

- i. To conserve natural enemies through ecological engineering approaches.
- ii. To reduce insecticide use and it's environmental pollution in rice production.

Materials and methods: The experiment was conducted with BRR1 dhan103 at BRR1 farm Gazipur during T. Aman 2023 season. A large field (one acre) was divided into two blocks for two treatments. The treatments were T_1 =Rice field with flowering plants (sesame and cosmos) on bunds (to provide food and shelter for different parasitoids). T_2 =Farmers practice i.e. prophylactic insecticide use. Insecticide applied three times Vayego Superb 1.0 GR (tetraniliprole + fipronil) @ 10.0 kg/ha for one time and Virtako 40WG (chlorantraniliprole+thiamethoxam) @ 75g/ha for 2 times) in T_2 at 15 days interval after Vayego superb 1.0 GR used. Vayego superb 1.0G was used with 1st top dressing of urea fertilizer followed by Virtako 40WG at 15 days interval. Twenty complete sweeps were taken from both the blocks 3 days after insecticide used in T_2 . Insect pests and natural enemies' number of all sweeps from both blocks were counted and recorded separately. Egg parasitism of yellow stem borer (YSB) was determined through retrieval method and natural parasitism of rice leafroller (RLR) larvae was also determined.



Photo 2. Eco-engineering rice field at vegetative to ripening stage, BARRI, Gazipur, T. Aman 2023

Results: Insect pests status remained below the economic threshold level (ETL) in both the treatments. Highest number of short horned grasshopper (SHG) was found in T₁ (5.83/20 sweep) followed by green leafhopper (2.0/20 sweep) and whorl maggot (1.0/20 sweep) during T. Aman 2023 (Fig. 12). The (1.75/ 20 sweep), white leafhopper (WLH) and (1.5/20 sweep) (Fig. 13). The ranged of other insect pests like, yellow stem borer (YSB), brown planthopper (BPH), white backed planthopper (WBPH) rice bug (RB) and rice leafroller (RLR) was found (0.33 to 0.67/20 sweep) in T₁ (Fig. 13). Short horned grasshopper also found highest (4.17/20 sweep) in T₂ followed by GLH (1.33/20 sweep) and white leafhopper (WLH) and WM both of 1.0/20 sweep in T₂. The ranged of other insect pests were (0.5 to 0.83/20 sweep in T₂ at BARRI Gazipur (Fig. 13).

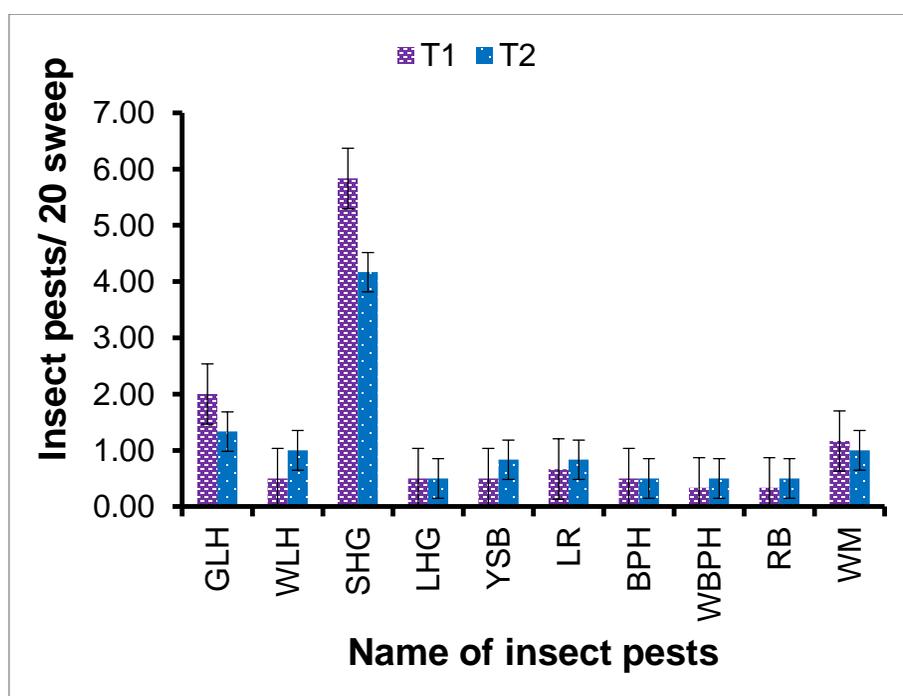


Fig. 13. Insect pests number per 20 complete sweep in different treatments during T. Aman 2023, BARRI, Gazipur
(T₁=Rice field with flowering plant on bunds, T₂= Farmers Practice)

Among the natural enemies highest numbers of natural enemies were found in T₁ where insecticide was not used. Number of lady bird beetle (LBB), spider (SPD), damsel fly (Dam. fly) and parasitic wasp (PW) were found highest 2.33, 2.17, 1.67 and 1.00 per 20 complete sweep respectively in T₁ compared to T₂ (0.0 to 1.0 /20 sweep) at BRRI farm, Gazipur (Fig. 14).

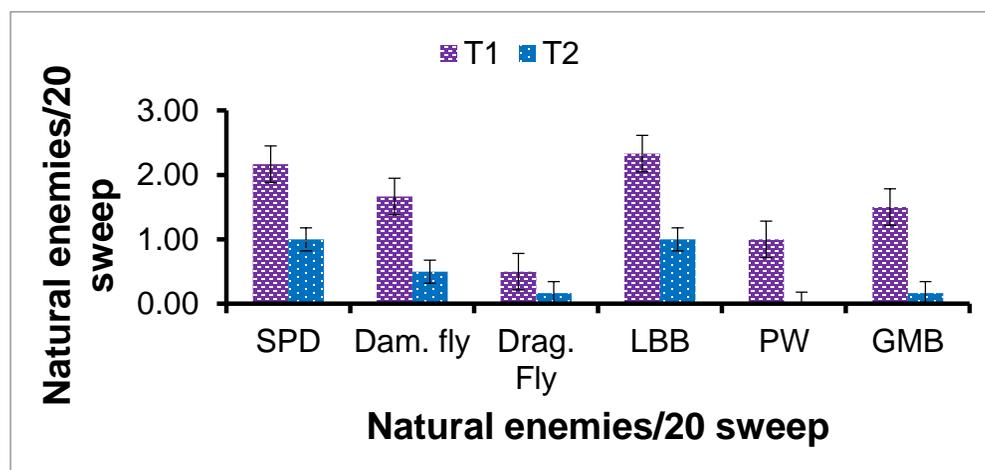


Fig. 14. Natural enemies number per 20 complete sweep in different treatments during T. Aman 2023, BRRI, Gazipur
(T₁=Rice field with flowering plant on bunds, T₂= Farmers Practice i.e., insecticide application).

Rice leafroller larval parasitism and YSB egg parasitism observed highest in T₁ (27.5 and 44.31 % respectively) compared to T₂ (2.26 and 6.87 % respectively). Though grain yield was observed similar both in T₁ and T₂ (5.88 and 5.9 t/ha respectively) but additional sesame was produced in T₁ which increase the rice equivalent yield (REY) to 6.13 t/ha. As a result, 3.75 % additional yield obtained in T₁ compared to T₂ (Fig. 15).

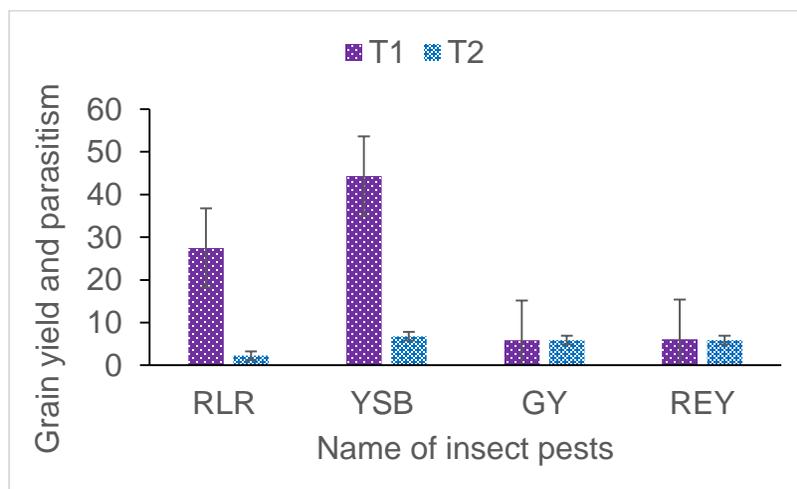


Fig. 15. Rice equivalent yield (REY) and % parasitism of YSB egg and RLR larvae during T. Aman 2020, BRRI Gazipur.
(T₁= Rice field with flowering plant on bunds, T₂= Farmers Practice i.e., insecticide application).

PI: Md. Nazmul Bari, **CI:** Farzana Nowrin, **PL:** Sheikh Shamiul Haque

Expt. 3.2: Study on the biology of green mirid bug, an egg predator BPH

Objective: To know the biology and life cycle of green mirid bug and to identify alternate host for rearing.

Materials and methods: The green mirid bug, *Cyrtorhinus lividipennis*, is a plant-feeding and predatory insect, prefer-ring plant-and leafhopper eggs and young nymphs (Shepard et al 1987). It is now one of the important predators of brown planthopper (BPH) *Nilaparvata lugens* and whitebacked planthopper (WBPH) *Sogatella furcifera* (Heong et al 1991). Adult green mirid bugs were collected from light trap, vegetable flowers and BPH infested fields. Initially the population were reared in caged rice plants having BPH eggs-and adults. After having a good numbers of population attempts were taken to determine the food habit of the insect. The test food materials

were different vegetable flowers, nectar, honey solutions, sugar solutions and eggs of moths specially the *Corcyra cephalonica*.

Results: Attempts were made to rear green mirid bug on different hosts e.g., *Corcyra* egg and larva, flowers of bottle gourd and other flowering plants but with no success. GMB didn't complete life cycle on the above-mentioned hosts. Further research with new hosts will be needed.

PROJECT IV: CROP LOSS ASSESSMENT

Expt. 4.1. Stem borer species abundance and assessing yield losses in rice

Objective: To study the relative abundance of different species of rice stem borers and to determine the yield loss due to their damage.

Materials and methods: A total of 50 to 100 typical dead hearts (DH) and white heads (WH) were collected randomly once in a week from BRRI farm, Gazipur for relative abundance study. In total of 599 dead heart /white head tillers were collected from BRRI farm Gazipur during T. Aus and T. Aman 2024 season. Stem borer larvae were dissected out and their numbers were recorded species-wise. For yield loss study four hills was selected diagonally from each plot of BRRI dhan87 and infested with the 1st instar larvae of one egg mass after 35 days after transplanting (DAT). The larvae along with the selected hills was covered by mylar film cages for about 2-3 days. Another four hills from the same plots were also selected as control. Tiller number/hill was counted before releasing the larvae of the infested and healthy hills. Each hill was treated as a replication. The dead heart, tiller/hill was counted at 20-30 days after infestation and whitehead after flowering. The rice yield and yield component data from the marked hills (infested and un-infested) were recorded.

Results: In Aus DHB was the dominant species followed by Striped stem borer (SSB). In T. Aman YSB was the dominant species followed by SSB and DHB. Total 37 stem borer larvae were found from 93 tiller dissection in Aus and 167 stem borer larvae were found from 506 tiller dissection in T. Aman season. Yield loss was occurred 42% in stem borer infested hills when deadheart found around 23% . It's a small-scale data. More data needed for a conclusive result.

PI: Md. Mosaddeque Hossain, **CI:** A B M Anwar Uddin **PL:** Sheikh Shamiul Haque

PROJECT V: EVALUATION OF CHEMICALS AND BOTANICALS AGAINST RICE INSECT PESTS

Expt. 5.1. Test of different insecticides against major insect pests of rice

Objective: To evaluate the effectiveness of commercial formulations of different insecticides against major insect pests of rice.

Materials and Methods: Brown Planthopper (BPH)- The field trials were conducted in a completely randomized design (CRD) with 4 replications. A large rice field was divided into unit plots. Each plot measuring 4m×5m (20 m²) and the variety was BRRI dhan87 in T. Aman season and BRRI dhan89 in Boro season. In each unit plot a test insecticide was applied with standard doses and four hills was selected randomly from each plot. Each hill was representing a replication. One hour after spraying of test insecticides, ten 3rd-4th instar BPH nymphs of greenhouse populations were confined by mylar film cages on each of four randomly selected rice hills. Another plot of same size was used as control without insecticide application. Four hills were select randomly from the control plots and same number of test insects was confined with the same procedure. The granular formulation insecticides were broadcasted one day before infestation and other formulation insecticides were sprayed one or two hours before insect release. Mortality of insects were counted both from treated and untreated plots at 24 and 48 hours after treatment (HAT) and the results were adjusted by Abbott's formula.

Yellow stem borer (YSB): The field trial was conducted in a completely randomized design (CRD) with 4 replications. A large rice field was divided into unit plots. Each plots measuring 4m×5m (20 m²) and the variety BR3 was used in this study. The adult female moths of the insects were captivated in a wire mesh net cage (1.8m × 0.6m) and allowed to lay eggs on potted BR3 plants. After 4-5 days, each egg mass containing rice leaves was cut into a piece and placed separately in a 5 mm glass vials with few drops of water in it. After 6 to 7 days when the egg masses started to hatch, each of the four randomly selected rice hills/plot was separately infest

with the 1st instar larvae emerging from one egg mass. Test insecticides was applied one to two hours after infestation. The hills were again infested with new larvae at 48 hours after spraying (HAS) or broadcasting. Another plot of same size in each replication was used as control without applying of any insecticide. The dead hearts were counted at 7 and 14 days after insecticide application both from infested and control plots. Percent dead heart reduction over control was estimated by using the formula of Gomez (1994).

Rice Weevil: The trial was conducted in a completely randomized design (CRD) with 4 replications in green house condition. Two hundred fifty kilogram (250Kg) of rice was stored in a drum. Then the drum was kept in a room. Ten adult rice weevils put into a test tube and the tube with rice weevil was placed into rice grain. Open end of the test tube was covered by fine mesh white net. One tablet of each aluminum phosphide was released into individual drum. Each drum was filled with rice. After placing the aluminium phosphide tablet into rice, drum was sealed with cover and sealed the edges. The variety BRRI dhan89 was used in this study. One drum was used as control without aluminum phosphide. Mortality of insects was counted both from treated and untreated drum at 72 hours after treatment (HAT) and the results were adjusted by Abbott's formula.

Results: Evaluation of the effectiveness of commercial formulations of different insecticides against major insect pests of rice was performed in field and storage condition. A total of 188, 45 and 14 commercial formulations of insecticides were evaluated against brown planthopper (BPH), yellow stem borer (YSB) and rice weevil (RW) respectively. Among them 96, 13 and 09 insecticides were found effective against BPH, YSB and RW respectively (Fig. 16).

PI: Md. Nazmul Bari, **CI:** Farzana Nowrin, **PL:** Sheikh Shamiul Haque

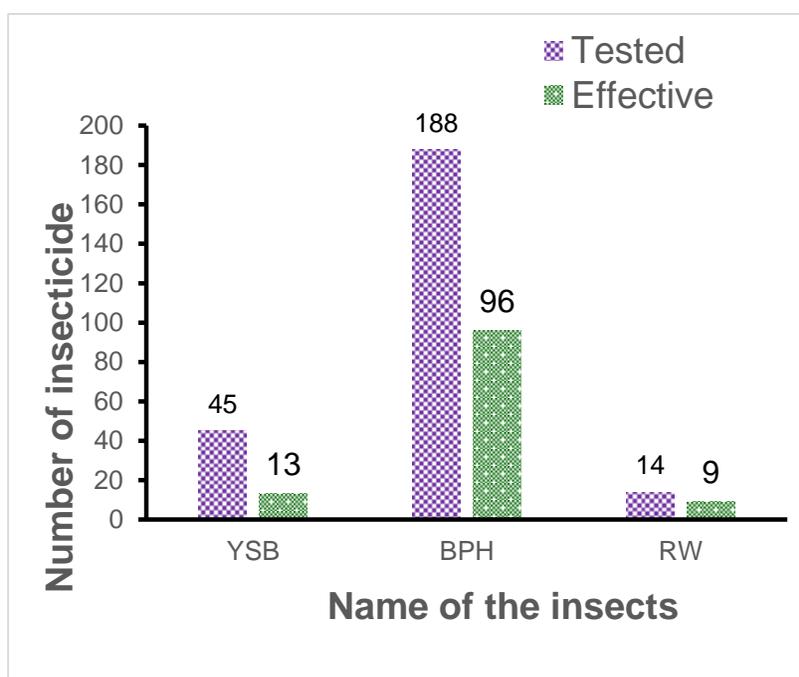


Fig. 16. No. of tested insecticides against major insect pests

Table 3. List of commercial formulation of insecticide tested against brown planthopper (BPH) during T. Aman 2023

Sl no.	Name of the insecticide	Dose (f) /ha)	Mortality at 48 HAT*(%)
1.	Pure Zine 80WDG (nitenpyram 20% + pymetrozine 60%)	60g	84.21 94.59
2.	Thaimectrin 40WDG (thiamethoxam 20% + emamectin benzoate 20%)	125g	86.68 84.21
3.	Etap 95SP (cartap 92% + acetamiprid 3%)	150g	31.58
4.	Temper 60WDG	75g	36.84

Sl no.	Name of the insecticide	Dose (f) /ha)	Mortality at 48 HAT*(%)
	(dihalopyrazole amide 40% + thiamethoxam 20%)		
5.	Pairam 80WDG (pymetrozine 60% + nitenpyram 20%)	60g	21.05
6.	Lufetinzoate 50WDG (lufenuron 40% + emamectin benzoate 10WDG)	125g	18.62
7.	Random Star Plus 70WG (pymetrozine 50% + thiamethoxam 20%)	220g	31.59
8.	Arasturan 80WDG (dinotefuran + fipronil)	500g	28.95
9.	Newron 50WDG (emamectin benzoate + lufenuron)	125g	44.74
10.	Vine 30FS (thiamethoxam 30FS)	300 ml	94.74 91.89
11.	Coculi 20SP (acetamiprid 20%)	125 g	94.59 86.32
12.	Fatek 5EC (thiamethoxam 5%)	600 ml	76.32
13.	Pillu 20SP (acetamiprid 20%)	125g	89.19 86.32
14.	Holdup 30FS (thiamethoxam 30FS)	300 ml	86.84 80.32
15.	Cargil 50WDG (cartap 47.5% + fipronil 2.5% WDG)	750g	81.95 82.62
16.	Pytrozine 80WDG (pymetrozine 60% + nitenpyram 20%)	60g	65.78
17.	Mix killer 80WDG (pymetrozine 60% + nitenpyram 20%)	60g	65.79
18.	Shifametrozine 80WDG (dinotefuram + pymetrozine)	80g	44.74
19.	Dhumketu 5%GR (clothidin 5%)	28kg	23.68
20.	Needzoate 10WDG (emamectin benzoate 10% WDG)	500g	31.58
21.	Astroprid 70WDG (imidacloprid 70%)	35.7g	65.79
22.	Hot killer 80WDG (fipronil 40% + imidacloprid 40%)	75g	63.16
23.	Acitap 95SP (acetamiprid 3% + cartap 92%)	150g	76.31
24.	Cross Over 25WDG (emamectin benzoate 10% + lufenuron 20%)	250g	21.05
25.	Mariclean 5WSG (emamectin benzoate 5%)	1.0 kg	26.31
26.	Sakam 80WDG (pymetrozine 60% + nitenpyram 20WDG)	60g	71.05
27.	Hamdan Taponil 50WP (cartap 47.5% + fipronil 2.5% WP)	0.75kg	27.78
28.	Champion 80WDG (imidacloprid 40% + fipronil 40%)	75g	22.22
29.	Pickup 75WDG (imidacloprid 70% + emamectin benzoate 5%WDG)	35.7g	63.89
30.	Trident 10.5EC (abamectin 0.3% + pyridaben 10.2%)	450 ml	86.11 84.21
31.	Nandan 50WDG (lufenuron 40% + emamectin benzoate 10%)	125g	88.89 94.74
32.	Fazil 1.8EC (abamectin 1.8%)	1.0 L	69.44
33.	Ateen 5SG	1.0 kg	41.67

Sl no.	Name of the insecticide	Dose (f) /ha)	Mortality at 48 HAT*(%)
	(emamectin benzoate 10% SG)		
34.	Thamide 24SC (thiacloprid 24%)	1.0 L	84.21 81.58
35.	Ibda-Plus 50WDG (emamectin benzoate 10% + lufenuron 40%)	125g	33.33
36.	Sari 85WP (carbaryl 85%)	1.5kg	38.89
37.	Tista Peet 70WDG (imidacloprid 70%)	35.7kg	83.33 89.47
38.	ONTO 10WDG (lufenuron 5% + emamectin benzoate 5%)	0.5kg	25.0
39.	L-Acetap 95SP (cartap 92% + acetamiprid 3%)	150g	40.54
40.	Waldo 25SC (flonicamid 25%)	300 ml	89.19 83.78
41.	Cross 50WDG (clothianidin 50%)	600 g	18.92
42.	Quiz Extra Plus 70WDG (pymetrozine 50% + thiamethoxam 20%)	220g	83.78 94.59
43.	Marvel XL Plus 70WG (pymetrozine 50% + thiamethoxam 20%)	220 g	86.49 97.29
44.	Crop Guard 80WDG (pymetrozine 60% + nitenpyram 20% WDG)	60 g	56.76
45.	Safe Giard 80WDG (pymetrozine 60% + nitenpyram 20%)	60 g	70.27
46.	Byran 70WDG (pymetrozine 50% + dinotefuran 20%)	200g	86.49 83.78
47.	Evablast 1.8EC (Abamectin)	1.0 L	70.27
48.	Tap-2 95SP (cartap 92% + acetamiprid 3%)	150g	59.46
49.	JN-ABA 1.8EC (abamectin)	1.0 L	89.19 83.78
50.	Naina 80WDG (dinotefuran 20% + pymetrozine 60% WDG)	80g	32.43
51.	Rigid 80WDG (pymetrozine 60 + nitenpyram 20 WDG)	60g	37.84
52.	Khalis 50WG (flonicamid 50%)	150g	27.78
53.	Perfect 80WDG (pymetrozine 60% + nitenpyram 20%)	60g	30.55
54.	Rype 80WDG (dinotefuran 20% + pymetrozine 60%)	80g	75.00
55.	Legend Hit 50WDG (lufenuron 40 + emamectin benzoate 10WDG)	125g	66.67
56.	Tatanil 80WDG (dinotefuran + fipronil)	500g	22.22
57.	Savana 80WDG (nitenpyram 20% + pymetrozine 60%)	60g	36.11
58.	Jatuyer 5GR (clothianidin)	28kg	52.78
59.	Utthan 80WDG (nitenpyram 20% + pymetrozine 60%)	60g	83.33 91.89
60.	Aciprid 20SL (imidacloprid)	125ml	88.89 97.30
61.	Hifi 80WDG (pymetrozine 60% + nitenpyram 20%)	60g	88.89 83.78
62.	Hogol Bogol 80WDG	500g	86.11

Sl no.	Name of the insecticide	Dose (f) /ha)	Mortality at 48 HAT*(%)
	(fipronil 40% + dinotefuran 40%)		83.78
63.	Cidial 5G (phenthoate 5%)	10.0kg	83.78 88.89
64.	Agri Gold 80WDG (fipronil 40% + dinotefuran 40%)	500g	88.89 94.59
65.	Lord 40WDG (emamectin benzoate 20% + thiamethoxam 20%)	125g	84.21 94.59

Table 4. List of commercial formulation of insecticide tested against Yellow Stem borer (YSB) during T. Aman 2023

Sl no.	Insecticides	Dose (f)* / ha	% deadheart reduction over control
01	Agronil 3GR (fipronil 0.3)	10.0 kg	53.97
02	Dimension 20SC (dihalo-pyrazoleamide 20%)	100 ml	44.25
03	Lipel (Bacillus thuringensis var kurstaki 18000 IU/mg)	1.5 kg	49.20
04	Calprid 95SP (cartap 92% + acetamiprid 3%)	150 g	52.29
05	Ulematum 93 WP (acetamiprid 3% + monomehypo 90%)	450 g	93.76 93.03
06	Monotup 50SP (monosultap 50%)	1.5 kg	52.18
07	Methotin 10SC **(methoxyfenozide 8% + abamectin 2%)	375 ml	55.44
08	Java Plus 80WDG (fipronil 40% + imidacloprid 40%)	75 g	66.22
09	Ombra 95SP (cartap 92% + acetamiprid 3%)	150g	80.59 80.69
10	Adbhatap Plus 95SP (cartap 92% + acetamiprid 3%)	150g	66.32
11	Amenities 15SC (chlorfenapyr 10 % + emamectin benzoate 5%)	125ml	66.35
12	Pran Power 50WG (chlothianidin 50% WG)	600g	63.59
13	Expert Plus 48SC (flubendiamide 24% + thiacloprid 24%)	250ml	80.38 80.00
14	Royal Killer 95SP (cartap 92% + acetamiprid 3%)	150g	46.41
15	Delegate 11.7SC (spinetoram)	375ml	90.10 83.62
16	Atom 80WDG (dinotefuran 40% + fipronil 40%)	500g	81.40 80.31
17	Spark 95SP (cartap 92% + acetamiprid 3%)	150g	72.07
18	Lufen 20WDG (emamectin benzoate + lufenuron)	150g	64.88
19	Hopper Killer 80WDG (pymetrozine 60% + nitenpyram 20%)	60 g	70.91
20	Kritap Gold 60WP (cartap hydrochloride 50% + buprofezin 10% WP)	750 g	52.04
21	Vita-SUPER 0.5GR (clothidin 0.5%)	28 kg	87.43 80.31
22	Batil 95SP (cartap 92% + acetamiprid 3%)	150 g	27.75
23	Imo 60WDG	1.0 kg	91.07

Sl no.	Insecticides	Dose (f)* / ha	% deadheart reduction over control
	(imidacloprid 2 % + monomehypo 58%)		83.62
24	Faitap 50WP (cartap 47%+fipronil 3%)	0.75 kg	57.36
25	Agro Gold Plus 50SC (fipronil 5%)	500 ml	51.44
26	Eco Gold 50SC (fipronil 5% SC)	500 ml	35.56
27	Oscar 30SC (chlorantraniliprole 10% + thiamethoxam 20%)	250ml	64.77
28	Bt-Gold 32WP (<i>Bacillus thuringensis</i> 32000 iu/mg WP)	1.5 kg	47.79
29	Biometrine 0.5% SL (matrin 0.6%)	1.0 L/ha	39.71
30	Rimitap Sumper 78SP (cartap hydrochloride 75% + acetamiprid 3%)	150 g	14.03
31	Acecat 95SP (cartap 92% + acetamiprid 3%)	150 g	52.89
32	Tapnil 80WDG (cartap+ fipronil)	375ml	31.25
33	Benfuron 50WG (emamectin benzoate 10%+ lufenuron 40%)	125g	40.31

Table 5. List of commercial formulation of insecticide tested against brown planthopper (BPH) during Boro 2023-24

Sl no.	Name of the insecticide	Dose (f) (Kg or Lt./ha)	Mortality at 48 HAT*(%)
66.	Impulse 20SL (imidacloprid 20%)	125ml	94.12 85.29
67.	Emagen 5WDG (emamectin benzoate)	1kg	25.00
68.	Farmtap 90SP (monomehypo)	750g	88.57 91.18
69.	Try Max 1.8EC (abamectin)	1.0L	88.57 86.11
70.	Mybin 80WP (carbaryl 80% WP)	1.5kg	27.78
71.	Finzan 40SC (dimethoate)	1.12L	30.56
72.	Hamda 1.8EC (abamectin 1.8%)	1.0 L	86.11 88.57
73.	Biomectin 1.8EC (abamectin)	1L	75.00
74.	Kedin 50WDG (clothianidin)	600g	33.33
75.	Easidin 10GR (diazinon)	16.8kg	91.67 83.33
76.	Ricoprid 20SL (imidacloprid)	125ml	27.78
77.	Wonder Plus 10WG (emamectin benzoate 10%)	500g	25.00
78.	Tytin Plus 5ME (abamectin 5%ME)	150ml	91.67 88.89
79.	MMI-Tufan 70WDG (imidacloprid)	35.7g	80.56 85.91
80.	Winprid 70WDG (imidacloprid)	35.7g	88.78 85.18
81.	Salfidor 70WDG	35.7g	80.56

Sl no.	Name of the insecticide	Dose (f) (Kg or Lt./ha)	Mortality at 48 HAT*(%)
	(imidacloprid)		85.91
82.	Salmec 1.8EC (abamectin)	1.0 L	88.89 94.50
83.	MMI-Hadiya 10SC (emamectin benzoate)	500 ml	88.89 83.05
84.	Emagen 5WDG (emamectin benzoate)	1kg	25.00
85.	Nice 50WDG (clothianidin 50WDG)	600g	13.89
86.	China-Thoate 40EC (dimethoate)	1.12L	83.33 83.05
87.	Sulvo Plus 20SP (acetamiprid)	125g	83.33 80.18
88.	Winner 70WDG (imidacloprid 70%)	35.7g	82.86 88.23
89.	Vision 1.8EC (abamectin 1.8% EC)	1.0L	81.58 80.56
90.	Enfuran 3GR (fipronil)	10kg	94.44 86.11
91.	Radi 75WP (acephate 75%)	750g	94.44 86.11
92.	Protect 1.8EC (abamectin 1.8%)	1.0L	94.29 88.23
93.	Impact 20SL (imidacloprid 20SL)	125ml	94.44 86.11
94.	ATTACK 1.8EC (abamectin 1.8EC)	1.0L	94.74 83.33
95.	Setara 95SP (cartap 92%+acetamiprid 3%)	150g	91.18 85.29
96.	Nodi 50WDG (lufenuron 40+emamectin benzoate 10)	125g	19.44
97.	Prime Net 80WDG (nitenpyram +pymetrozine)	60g	22.22
98.	Laha 5SG (emamectin benzoate 5% W/W)	1kg	85.29 82.35
99.	Jastin 50WDG (emamectin benzoate 10% + lufenuron 40%)	125g	76.47
100.	Jast Pai Gold 80WDG (pymetrozine 60%+nitenpyram 20%)	60g	85.29 82.35
101.	Avi Rate 80WDG (fipronil 40%+dinotefuran 40%)	500g	76.47
102.	Takbir 80WDG (fipronil 40%+dinotefuran 40%)	500g	85.29 82.35
103.	Winner plus 80WDG (pymetrozine 60+nitenpyram 20)	60g	88.23 85.29
104.	Prozine 80WDG (pymetrozine +nitenpyram)	60g	19.44
105.	Prosper Plus 80WDG (pymetrozine 60%+nitenpyram 20%)	60g	16.67
106.	Alben 50WP (cartap 47.5+fipronil 2.5 WP)	750g	22.22
107.	Boss Plus 10WDG (emamectin benzoate 10% W/W)	500g	82.35 85.29
108.	Cutprid 95SP (cartap 92%+acetamiprid 3%)	150g	76.47
109.	Rupai 80WDG	500g	88.23 85.29

Sl no.	Name of the insecticide	Dose (f) (Kg or Lt./ha)	Mortality at 48 HAT*(%)
	(fipronil 40%+dinotefuran 40% WDG)		
110.	Rico-Metzin 80WDG (pymetrozine+nitenpyram)	60g	22.22
111.	Saleha 50WDG (lufenuron 40+emamectin benzoate 10WDG)	125g	27.78
112.	Shifen 50WDG (lufefuron +emamectin benzoate)	125g	16.67
113.	Zet Shot 80WDG (dinotefuran +pymetrozine)	80g	94.11 88.23
114.	Maburi 80WDG (fipronil +dinatefuran)	500g	82.35 82.35
115.	Malaka 80WDG (pymetrozine +nitenpyram)	60g	83.33 82.86
116.	Selfie 80WDG (fipronil 40%+dinotefuran 40%)	500g	83.78 82.86
117.	Motion 60WG (dinotefuran 40%+flonicamide 20%)	200g	88.89 88.57
118.	Lufectin 50WDG (emamectin benzoate 10%+lufenuron 40%)	125g	25.00
119.	Shikor 70WDG (pymetrozine 50%+thiamethoxam 20%)	90g	80.55 82.86
120.	Dindu 50WDG (dinotefuran 30%+thiamethoxam 20%)	120g	94.44 86.11
121.	Acetap 95SP (cartap 92%+acetamiprid 3%)	150g	88.89 82.86
122.	Jaba 50WDG (lufenuron 40% + emamectin benzoate 10%)	125g	81.78 85.71
123.	Niltap Plus 50WP (cartap 47.5% fipronil 2.5%)	750g	91.67 91.43
124.	New Fresh 80WDG (pymetrozine 60%+nitenpyram 20%)	220g	88.22 82.43
125.	Sunami 80WDG (pymetrozine+nitenpyram)	60g	80.55 80.00
126.	Current Link 80WDG (dinotefuran 20%+pymetrozine 60%)	80g	94.44 94.28
127.	Tapnil 50WP (cartap 47.5% fipronil 2.5%)	750g	83.33 85.71
128.	Krishi-Super 40WDG (emamectin benzoate+thiamethoxam)	125g	91.67 88.77
129.	Impel Cupokat 80WDG (pymetrozine+ nitenpyram)	60g	88.89 83.05
130.	Lufen 40WDG (lufenuron+thiamethoxam)	125g	88.89 83.05
131.	Farmsave 95SP (cartap+ acetamiprid)	150g	83.33 80.18
132.	Sygma 40WDG (emamectin benzoate + thiamethoxam)	125g	88.89 85.91
133.	Sulvo Plus 70SP (acetamiprid+pymetrozine)	300g	75.00
134.	Uni-Super 40WDG (emamectin benzoate+ thiamethoxam)	125g	88.23 82.14

Sl no.	Name of the insecticide	Dose (f) (Kg or Lt./ha)	Mortality at 48 HAT*(%)
135.	Current 80WDG (pymetrozine 60%+clothianidin 20%)	60g	83.14 89.41
136.	Ecomite 1.8EC (abamectin 1.8% EC)	1.0 L	85.71 88.23
137.	Finil 80WDG (imidacloprid 40%+fipronil 40%)	125g	88.57 91.18
138.	NiKola 80WDG (pymetrozine 60% +clothianidin 20%)	225g	94.29 85.29
139.	Click 50WP (cartap 47.5+ fipronil 2.5)	750g	80.00 94.12
140.	Kick 80WDG (pymetrozine 60%+nitenpyram 20%)	60g	88.14 82.35
141.	Power Plus 7.6SC (lufenuron 50 g/l+ emamectin benzoate 26 g/l)	125ml	85.71 85.29
142.	Hyper 80WDG (pymetrozine 60%+nitenpyram 20%)	60 g	82.86 82.35
143.	SK-Pyzin 80WDG (nitenpyram+pymetrozine)	60 g	91.43 85.29
144.	Picktime 50WDG (emamectin benzoate+ lufenuron)	125g	86.11 81.58
145.	SK-Tap 95SP (acetamiprid 3% + cartap 92%)	150g	97.37 97.22
146.	Point 40WDG (thiamethoxam+emamectin benzoate)	125g	94.44 86.11
147.	Armguard 50WDG (emamectin benzoate 10%+lufenuron 40%)	125g	83.33 88.57
148.	Valor 23WDG (chlorfenapyr +emamectin benzoate)	30g	94.44 86.11
149.	Impel Don 29SG (acetamiprid+emamectin benzoate)	135g	75.00
150.	Progati Metzin 80WDG (pymetrozin+nitenpyrum)	60gm	83.33 81.58
151.	R-Nuron 50WDG (lufenuron+emamectin benzoate)	125g	88.89 86.11
152.	Tab-Metzin 80WDG (pymetrozine+nitenpyram)	60g	75.00
153.	Easi-Supper 40WDG (emamectin benzoate+thiamethoxam)	125g	94.44 86.11
154.	Power 80WDG (pymetrozine+nitenpyram)	60g	88.89 83.33
155.	N-Jhulik 80WDG (pymetrozine+nitenpyram)	60g	77.78
156.	Rigal 80WDG (monosultap 75% + chlorantraniliprole 5%)	400 g	94.44 91.67
157.	KG-Imid 70WDG (imidacloprid 70%)	35.7g	86.11 80.56
158.	KG-Pyram 70WDG (dinotefuran 20%+pymetrozine 50%)	200g	97.22 83.33
159.	Torino 35SC (flonicamid 125g/l+chlorfenapyr 225g/l)	650 ml	72.22
160.	Prozin 25SC (buprofezin 22% + fipronil 3%)	500ml	27.78

Sl no.	Name of the insecticide	Dose (f) (Kg or Lt./ha)	Mortality at 48 HAT*(%)
161.	Zom Red 80WDG (dinotefuran 40+ fipronil 40 WDG)	500g	94.44 86.11
162.	Bytin 3.2EC (abamectin 3.2%)	500 ml	19.44
163.	Isabela 20SL (imidacloprid 20% SL)	125ml	91.67 86.11
164.	Mitbo 1.8EC (abamectin 1.8% EC)	1.0L	86.11 86.11
165.	Kick Out 28SC (abamectin 4%+spiroticlofen 24% SC)	1.0L	94.44 80.56
166.	Tekka 45.5WDG (hexythiazox 3.5% + diafenthiuron 42% WDG)	200gm	94.44 88.89
167.	Guerilla 95SP (acetamiprid 3%+cartap 92% SP)	150gm	94.44 88.89
168.	Target 25WDG (indoxacarb 17%+emamectin benzoate 8%)	125g	22.22
169.	Loreto 80WDG (pymetrozine60%+nitenpyram20%)	60g	86.11 88.89
170.	Ulka 38.5 EC (emamectin benzoate 3.5%+phenthoate 35% EC)	500 ml	88.89 80.56
171.	Oratop 95SP (cartap 92%+acetamiprid 3%)	150g	22.22
172.	Current Shot 80WDG (pymetrozine60%+nitenpyram20%)	60g	88.89 91.67
173.	Commando 80WDG (fipronil 40%+dinotefuran 40%)	500g	72.22
174.	Hunk 95 5G (acephate)	592g	91.67 83.33
175.	Attack 80WDG (pymetrozin+nitenpyram)	60gm	75.00
176.	Zinia Plus 10SG (emamectin benzoate)	500g	86.11 80.56
177.	Vider 40WDG (acetamiprid 40% WDG)	125g	19.44

Table 6. List of commercial formulation of insecticide tested against Yellow Stem borer (YSB) during Boro 2023-24

Sl no.	Insecticides	Dose (f)*/ ha	% dead heart reduction over control
01	Classic 38.5EC (chlorpyrifos 35% + fipronil 3.5%)	1.25L	80.05 80.35
02	U-Gent 0.3G (fipronil 0.3%)	10 kg	34.38
03	Matrix 1.7SL (matrine)	675 ml	29.84
04	Fixam 30SC (fipronil 10% + thiamethoxam 20%)	250 ml	53.37
05	Monomy Gold 60WP (imidacloprid + monomehypo)	100 g	63.53
06	Vendora 0.4G (chlorantraniliprole)	10.0 kg	87.54 80.00
07	KG-Tara 10SC (methoxyfenozide 8% + abamectin 2%)	900 ml	52.04
08	Valenter 4GR (chlorantraniliprole 4%)	10.0 kg	86.41 80.31

09	Oncol 5G (benfuracarb 5% G)	12 kg	87.54 80.00
10	Maco 0.3GR (fipronil 0.3%)	10.0 kg	85.03 80.31
11	Fidan 50SP (cartap 47% + fipronil 3%)	750 g	74.31
12	Fiprotap 50SP (cartap 47% + fipronil 3%)	750 g	86.41 80.72

*f= Formulated

Table 7. List of commercial formulation of insecticide tested against rice weevil (RW) during Boro 2023-24

Sl no.	Name of the insecticide	Dose (f)* / ton	% mortality
01	Aritop 57TB (aluminium phosphide)	4 tab	92.31 94.87
02	Astoxin 57TB (aluminium phosphide 57%)	4 tab	71.79
03	L-Toxin 57TB (aluminium phosphide 57%)	4 tab	87.18 89.74
04	Jinath 57TB (aluminium phosphide 57%)	4 tab	76.32
05	Jeophos 56% (aluminium phosphide 56%)	4 tab	97.44 97.37
06	Jala 56% Tab (aluminium phosphide 56%)	4 tab	87.18 84.21
07	Leadphos 57TB (aluminium phosphide 57% W/W)	4 tab	66.67
08	Siamphos 57TB (aluminium phosphide 57%)	4 tab	74.36
09	Siam Fied 57TB (aluminium phosphide 57%)	4 tab	82.05 84.21
10	Suaminium 57% (aluminium phosphide 57% W/W)	4 tab	87.18 89.47
11	Close 57TB (aluminium phosphide 57% TB)	4 tab	97.44 97.37
12	Maxfume 57TB (aluminium phosphide 57%)	4 tab	66.67
13	Toxinil 56TB (aluminium phosphide)	4 tab	92.31 92.31
14	Siam phos 57TB (aluminium phosphide 57%)	4 tab	94.87 89.74

*f= Formulated

Expt. 5.2. Use of nanoparticle to control rice insect pests

Objective(s):

- i. To develop nano-particle based pest management in rice.
- ii. To reduce chemical pesticide load in environment.

Materials and Methods: The effectiveness of biosynthesized silica (SiO₂) nanoparticles against BPH was evaluated at four concentrations (1000, 750, 500, and 250 ppm), prepared by diluting with distilled water and adding an adhesive solution (Promoter Plus, ACI Ltd.). Distilled water served as the negative control. The nanoparticle solutions at different concentrations were sprayed on 15-day-old rice seedlings. Twenty 2nd to 3rd instar nymphs of BPH were introduced into each treatment and maintained at room temperature (Photo 3) within separate Mylar cases. Insect mortality was recorded at 24, 48, 72, and 96 hours post-spray. Nymphs were deemed dead if they did not move when gently touched with a camel hair brush. The percentage of insect mortality was calculated using the corrected Abbott's formula.



Photo 3. The application of silica nanoparticle used in this study

Result: Silica (SiO_2) nanoparticles demonstrated significant efficacy against BPH nymphs, with 74% mortality observed at a concentration of 1000 ppm after 96 hours of application, followed by 73% mortality at 72 hours post-application (Fig. 17). Conversely, the control group showed the lowest mortality at 24 hours post-application. Mortality rates increased over time, with higher concentrations exhibiting the highest rates of mortality. Further experiments are planned to test newly synthesized nanoparticles at various concentrations against different insect pests affecting rice.

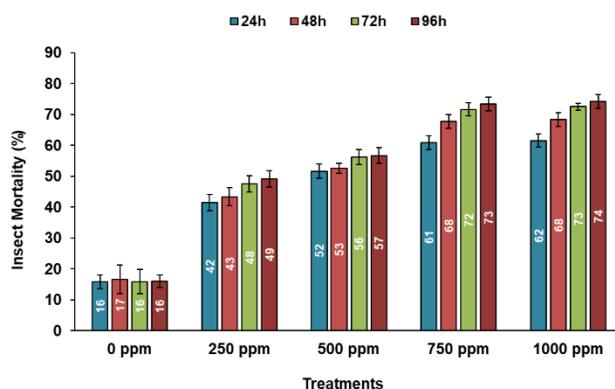


Fig. 17. Effect of SiO_2 nanoparticle on the mortality of brown planthopper (BPH)

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Expt. 5.3. Use of nanoparticle to control stored grain rice insects

Objective(s):

- i. To develop nano-particle based pest management in rice.
- ii. To reduce chemical pesticide load in environment.

Materials and Methods: The effectiveness of biosynthesized silica (SiO_2) nanoparticles against rice weevil was evaluated at 9 different concentrations.

- T₁: 0 ppm
- T₂: 100 ppm
- T₃: 150 ppm
- T₄: 250 ppm
- T₅: 300 ppm
- T₆: 400 ppm
- T₇: 500 ppm
- T₈: 600 ppm
- T₉: 750 ppm
- T₁₀: 1000 ppm

The concentrations were prepared by diluting with distilled water and adding an adhesive solution (Promoter Plus, ACI Ltd.). Distilled water served as the negative control. The nanoparticle solutions at different concentrations were sprayed on 25 gram rice which was sterilized at 50°C for 48 hours. Ten adult insects were infested into each treatment and maintained at room temperature in petridishes. Insect mortality was recorded at 24, 48, 72, 96 and 120 hours post-spray. Insects were deemed dead if they did not move when gently touched with a camel hair brush. Dead insects were removed after recording the data. Data will be recorded of F₁ generation from every treatment. The percentage of insect mortality was calculated using the corrected Abbott's formula.



Photo 4. The application of silica nanoparticle used in this study

Result: Silica (SiO_2) nanoparticles demonstrated significant efficacy against rice weevil, with 67% mortality observed at a concentration of 1000 ppm after 120 hours of application, followed by 59% mortality at 96 hours post-application (Fig. 18). Conversely, the control group showed the lowest mortality at 24 hours post-application. Mortality rates increased over time, with higher concentrations exhibiting the highest rates of mortality.

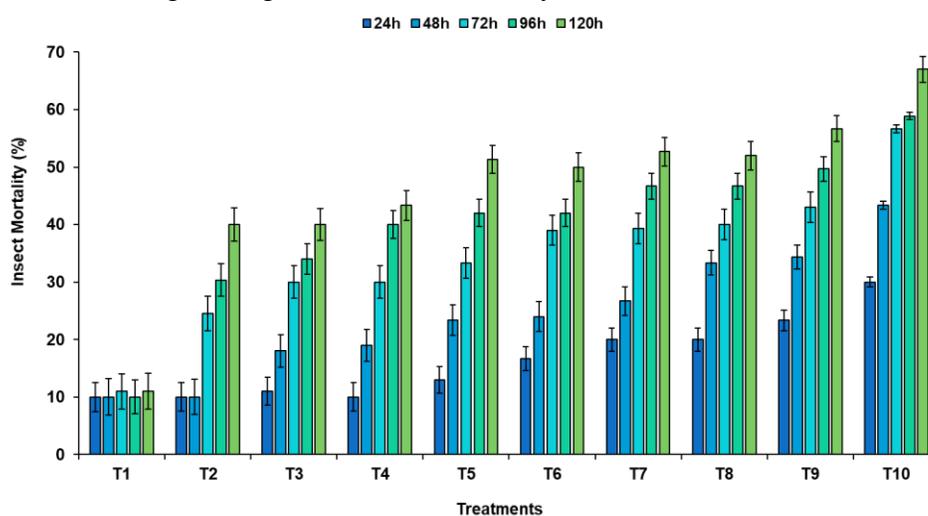


Fig. 18. Effect of SiO_2 nanoparticle on the mortality of rice weevil

PI: Sanjida Akter; **CI:** Tapon Kumar Roy, Md. Ashiq Iqbal Khan

Expt. 5.4. Pesticidal effect of different botanicals against Rice weevil (*Sitophilus oryzae* L)

Objective: To assess the effectiveness of different botanicals for the management practices of Rice weevil.

Materials and Methods: This experiment, conducted from September 9 to December 25, 2023, at the Bangladesh Rice Research Institute's (BRI) entomology division. The study employed a completely randomized design (CRD) with three replications to assess the efficacy of different botanicals for managing rice weevils in stored rice. The treatments included T₁=Neem oil, T₂=Mahogany seed kernel powder, T₃=Neem leaf powder, T₄=Biskatali plants powder and T₀=Control (untreated).

Fresh leaves of neem and biskatali, along with mahogany fruits, were collected from BRI, Gazipur, and prepared by washing, drying, and grinding into powder. These powders were stored in airtight bags for future use, while neem oil was sourced locally. Rice weevils, cultured on BRI dhan89 rice, were used for the study. Sterilized BRI dhan87 rice was placed in containers, treated with the extracts, and then introduced to 10 pairs of adult weevils per container. The containers were covered with netting to ensure proper aeration, and the conditions were maintained at $65 \pm 2\%$ relative humidity and $25 \pm 2^\circ\text{C}$ temperature. Insects mortality data at 24, 48, 72 and 96 hours after treatment, number of F₁ adult emergence, weight loss percentage and germination percentage data were recorded. All data were subjected to statistical analysis separately by using the analysis of variance technique by R software (versions 2024.04.1).

Results: The rice weevil is a significant pest of stored grain, leading to substantial quantitative and qualitative losses. Conventional methods involving chemical insecticides, such as fumigants, pose environmental hazards and health risks. The result indicated statically significant difference

of rice weevil mortality at 24 HAT, 48 HAT, 72 HAT except 96 HAT (Fig. 19). The highest number of rice weevil mortality was found in T₁ at 24 HAT and 48 HAT followed by T₄. But T₄ showed highest mortality after 72 HAT. The results (Fig. 21) also showed that the highest insect mortality (%) was in T₁ (85%), followed by T₄ (75%), T₃ (61.67%), and T₂ (60%). The high mortality in T₁ resulted in the lowest emergence of F₁ progeny compared to the other treatments, indicating its effectiveness in reducing the reproductive capacity of rice weevils (Fig. 20). Additionally, T₁ exhibited the least weight loss (%) of grain, followed by T₂, T₄, T₃, and T₀ (Table 8). Regarding seed germination, T₄ had the highest germination rate (94%), followed by T₃ (90%), T₂ (89.67%), T₁ (88%), and T₀ (80.67%). The findings indicate that the use of synthetic insecticides can be effectively minimized by using neem oil and Biskatali plant powder for rice weevil management in stored rice. This approach not only reduces environmental and health risks but also maintains the quality and germination potential of stored rice.

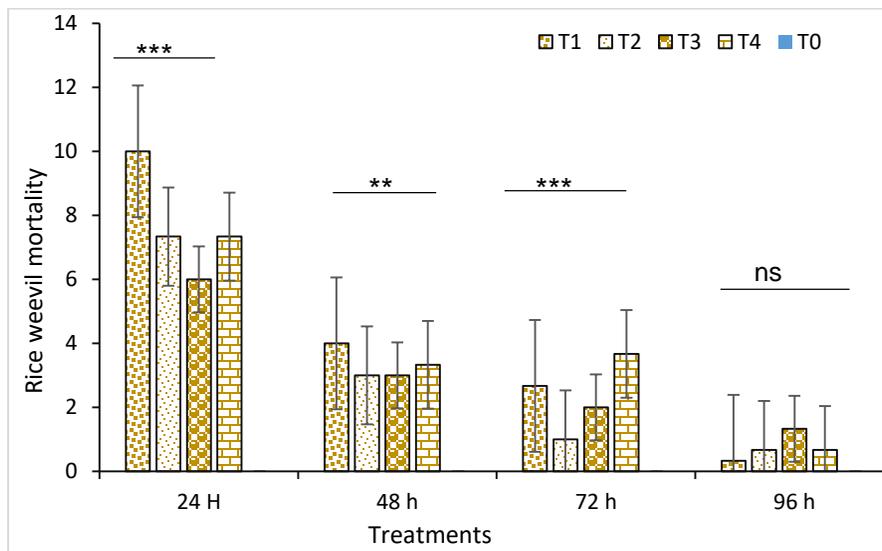


Fig. 19. Mortality of rice weevil at different hours after treatment

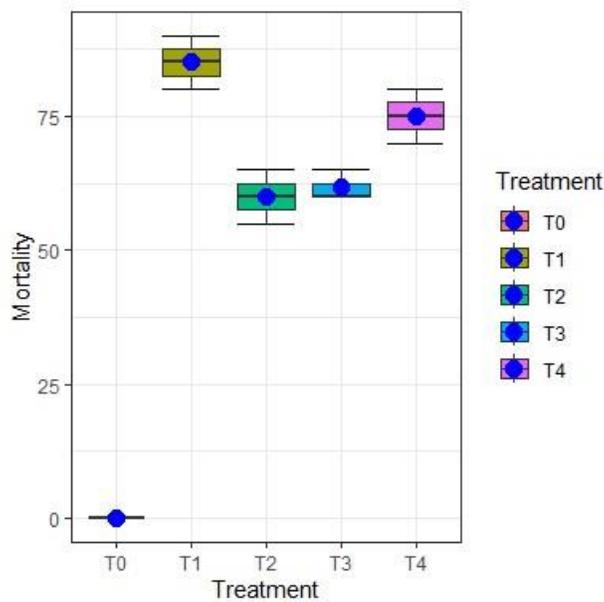


Fig. 20. Effects of botanicals on mortality percentage of rice weevil

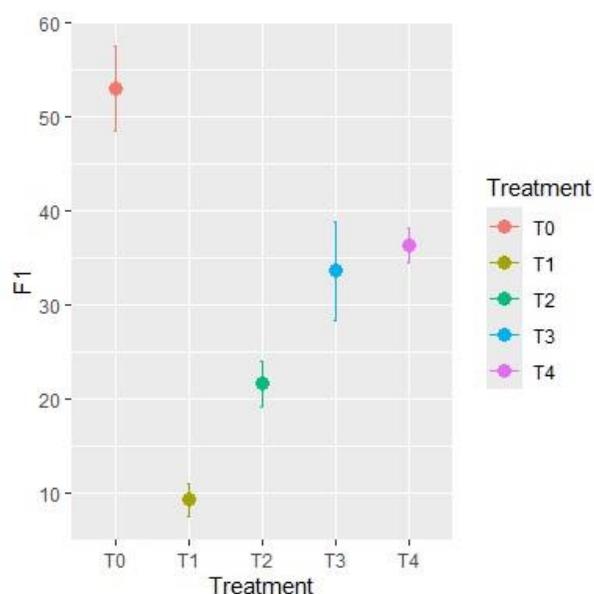


Fig. 21. Effects of botanicals on number of F₁ adult emergence of rice weevil

Table 8. Effects of botanicals on weight loss of grains (%) and seed germination (%) against rice weevil

Treatments	Percentage weight loss of grains	Percentage of germinated seeds	Seed germination percentage over untreated control
T ₀ (Untreated control)	32.97 a	80.67 c	-
T ₁ (1ml neem oil)	11.03 d	88.00 b	9.08
T ₂ (2 g mahogany seed powder)	19.14 c	89.67 b	11.16
T ₃ (2 g neem leaf powder)	21.81 b	90.00 b	11.56
T ₄ (2 g biskatali powder)	21.41 bc	94.00 a	16.52
Level of significance	***	***	-
LSD	2.54	3.79	-
CV%	6.56	2.35	-

PI: Tapon Kumar Roy **CI:** Sanjida Akter, Mir Moniruzzaman Kabir

Expt. 5.5. Effect of different insecticides on susceptibility of green leafhopper

Objective: To find out susceptible baseline of GLH to different group of selected insecticides

Materials and Methods: More than fifteen (15) generations mass rearing GLH population were used for the experiment in laboratory of Entomology Division, BRRI. International resistance action committee (IRAC) susceptible test method 005 was performed (IRAC, 2022) in lab condition with 25°C temperature and 70% humidity. Six insecticides group i.e., Carbamate (Mipsin 75WP), Organophosphate (Dursban 20 EC), Neonicotinoids (Confidor 70WG), Nereistoxin analogue (Suntap 50 SP), Insect growth regulator (Award 40 SC) and Organophosphate+Pyrethroids (Nitro 505 EC) were used this experiment. The bioassay test was conducted at six concentrations of each insecticide group solutions with three replications and the design was complete randomize design (CRD). The concentrations of Mipcin 75 WP were 3450 ppm, 1725 ppm (recommendation dose), 864 ppm, 432 ppm, 216 ppm, and control, Dursban 20 EC were 3200 ppm, 1600 ppm, 800 ppm, 400 ppm (recommended dose), 200 ppm, and control, Confidor 70WG were 98 ppm, 49 ppm (recommended dose), 24 ppm, 12 ppm, 6 ppm, and control, Suntap 50 SP were 2400 ppm, 1200 ppm (recommended dose), 600 ppm, 300 ppm, 150 ppm, and control, Award 40 SC were 400 ppm, 200 ppm (recommended dose), 100 ppm, 50 ppm, 25 ppm, and control and Nitro 55 EC were 500 ppm (recommended dose), 32 ppm, 16 ppm, 8 ppm, 4 ppm, and control.

Per small plastic pot contained with three rice seedlings of 12 to 14 days' old was dipped in insecticide solution for 10 seconds (IRAC 2022). After dipping in insecticide solution, rice seedlings were dried for 20 minutes. Fifteen number of 3rd or 4th instar nymphs of GLH were put in treated rice seedlings. Each of the pot along with treated rice seedlings was covered by a mylar

film cage and the open side of the mylar cages were closed with fine mesh nylon net. Mortality data recorded to Carbamate and Organophosphate group after 24 and 48 hours of treatment, Neonicotinoids and Neristoxin analogue group after 72 hours of treatment and Orghanophospate and Pyrethroid combinations after 24, 48, and 72 hours after treatment (IRAC, 2022).

The lethal dose (LD₅₀) was calculated using PoloPlus software, yielding LD₅₀ values for Mipsin 75 WP, Dursban 20 EC, Confidor 70 WG, Suntap 50 SP, Award 40 SC, and Nitro 505 EC insecticides were 48.44, 360.32, 8.19, 216.41, 24.78, and 0.91, respectively (Table 9).

Table 9. Toxicity of different insecticides to laboratory strain Green leafhopper population

Strains (GLH)	Insecticides	Slope ± SE	LD ₅₀
Lab ¹	Mipcin 75 WP	1.26 ± 0.45	48.44
	Suntap 50 SP	1.19 ± 0.33	216.41
	Award 40 SC	1.30 ± 0.34	24.78
	Dursban 20 EC	0.90 ± 0.31	360.32
	Confidor 70 WG	1.42 ± 0.33	8.19
	Nitro 55 EC	1.12 ± 0.35	0.91

¹ reared for more than 15 generations in controlled environment without any contact to insecticides

PI: Mir Md. Moniruzzaman Kabir, **CI:** Md. Nazmul Bari, **PL:** Sheikh Shamiul Haque



Photo 5. A view of GLH susceptibility test experiment

Results: In Mipsin 75WP, highest mortality (100%) was found at double of the recommended dose @ 3450 ppm, followed by 1725 ppm, 864 ppm, 432 ppm, 216 ppm and control. More than 80% or above mortality was found with recommended dose 1725 ppm at 24 hours after spray (HAS). Mortality >80% were also found @ 864 ppm and 432 ppm and 216 ppm. The percent mortality increase with higher concentration and over time up to 72 HAS (Fig. 22).

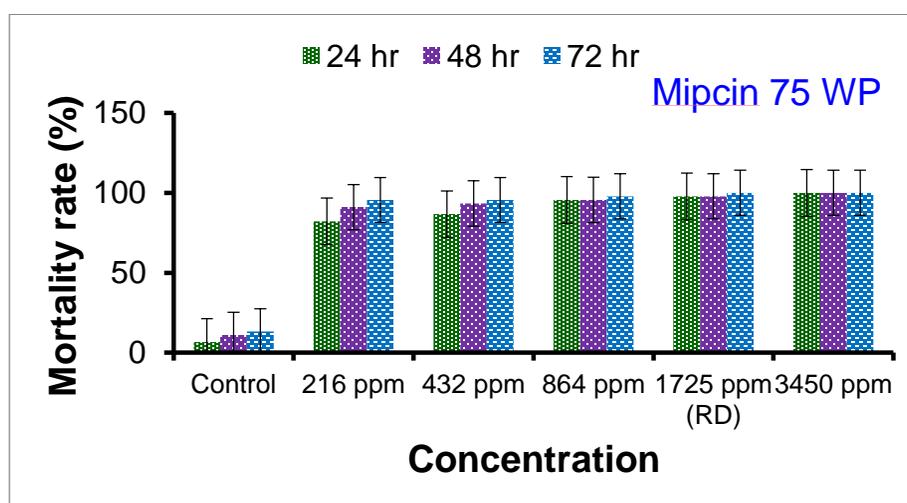


Fig. 22. Mortality of GLH (greenhouse population) after the application of Mipcin 75WP

In Dursban 20 EC, none of the concentrations, including recommended dose 400 ppm even 8 fold of the recommended dose 3200 ppm failed to show mortality 80% or above at 24 hours after spray (HAS). The highest mortality of green house GLH was found 86.66% @ 3200 ppm at 72 HAS (Fig. 23). The recommended dose showed 53, 62, and 64% mortality at 24, 48, and 72 hours after treatment respectively. This indicated that the insecticide Dursban 20EC was not work properly in the field to control the GLH. GLH might be resistant with Dursban 20EC.

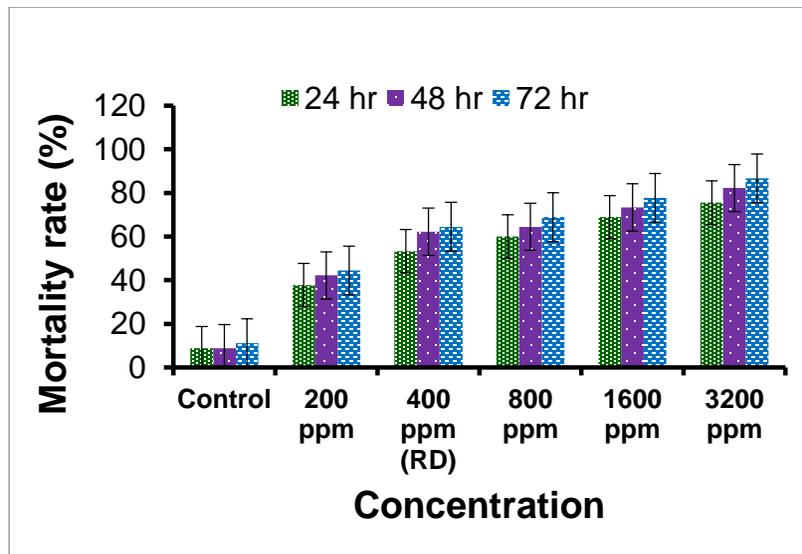


Fig. 23. Mortality of GLH (greenhouse population) after the application of Dursban 20EC

The insecticide Confidor 70 WG showed GLH mortality more than 80% at recommended dose 49 ppm and 98 ppm after 24 hrs after treatment (HAT). Nereistoxin analogue group insecticide Suntap 50SP recommended dose found more than 80% mortality at 48 HAT at the same time Award 40 SC recommended dose found more than eighty percent mortality at 72 hours after treatment (Figs. 24-26).

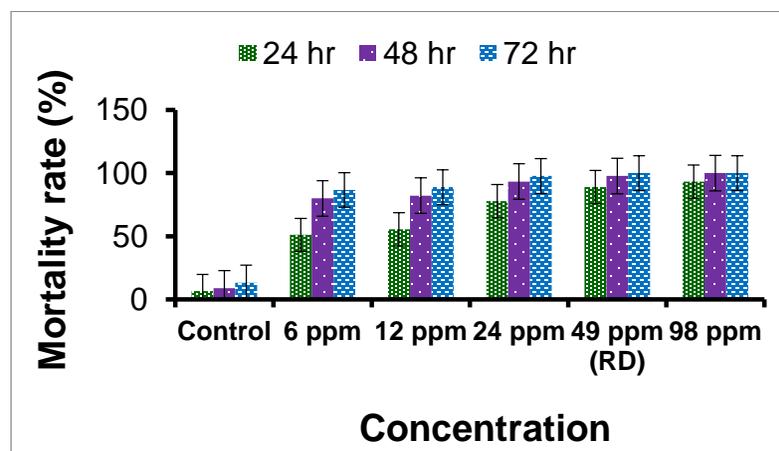


Fig. 24. Mortality of GLH (greenhouse population) after the application of Confidor 70WG

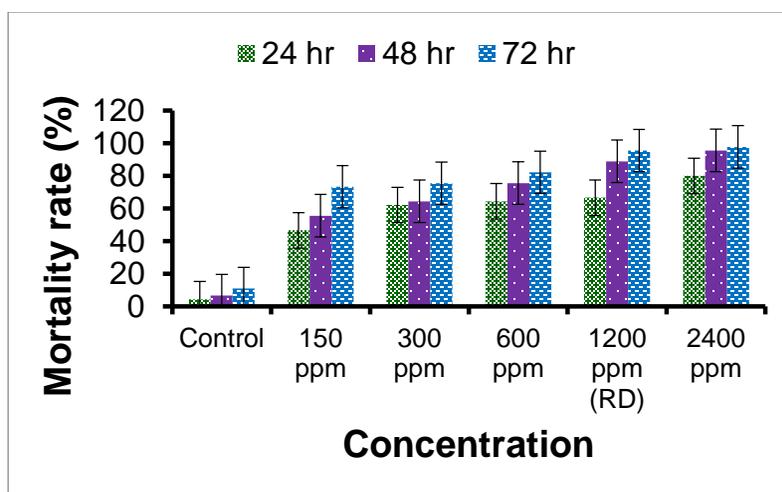


Fig. 25. Mortality of GLH (greenhouse population) after the application of Suntap 50SP

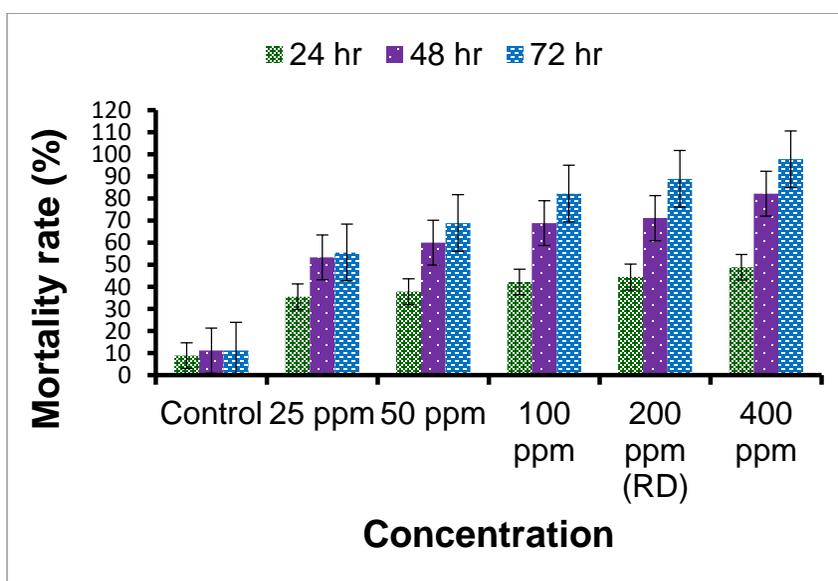


Fig. 26. Mortality of GLH (greenhouse population) after the application of Award 40SC

Nitro 505 EC is a combination formulation consist of Organophosphate and Synthetic Pyrethroids group insecticides. Synthetic Pyrethroids group insecticides not recommended to use in rice field. But it is widely used to control rice insect pests. In these circumstances, we have included Nitro 505 EC in the experiments for bioassay test. The recommended dose of Nitro 505 EC is 500 ppm for field crops except rice. It was found that more than 80% mortality occurred @ 8.0 ppm at 24 hours after treatment (Fig. 27). But it is widely use in the rice field @500 ppm (extreme dose). As a result, it kills all living organisms both in the terrestrial and aquatic rice ecosystems. Which disrupt the faunal biodiversity in the ecosystem as well as it creates negative impact on environment. It is urgently needed to banned such type of insecticide use in the rice field.

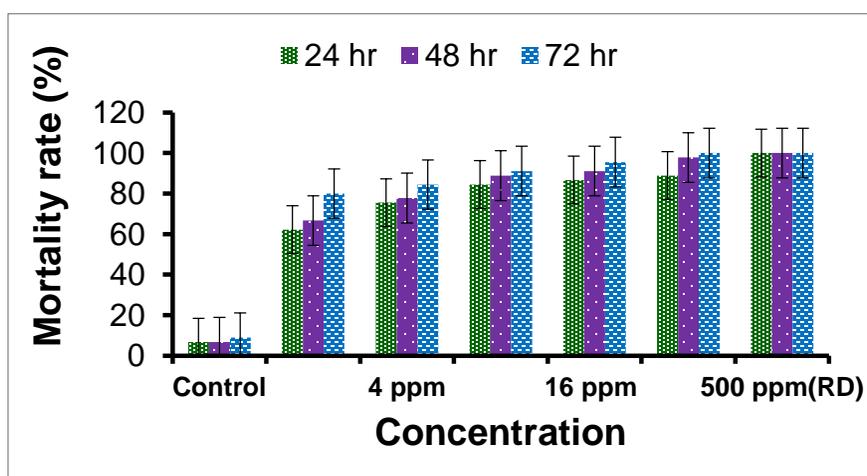


Fig. 27. Mortality of GLH (greenhouse population) after the application of Nitro 505 EC

Expt. 5. 6. Effect of different doses of insecticide for resurgence of green leafhopper (GLH)

Objective: To determine the resurgence of GLH caused by different insecticide doses

Materials and Methods: The laboratory experiment was carried out at the Entomology Division, BRRI, to determine the insecticide doses that cause resurgence of the green leafhopper (GLH). Rice seedlings with four tillers were grown in pots. The GLH population was developed in the net house of mass rearing cages. Subsequently, twenty-five (25) third instar nymphs were released in each treatment. Forth eight hours after insect release, Mipcin 75WP insecticide was applied at the following doses: T₁ = Double of recommended dose (3450 ppm), T₂ = recommended dose (1725 ppm), T₃ = Half of the recommended dose (864 ppm), and T₄ = Control (water). The experiment was laid out followed a Completely Randomized Design (CRD) with four replications. The number of dead and alive GLH was recorded 48 hours after treatment (HAT). The first-generation GLH population was also recorded 30 days after the initial data collection. The resurgence ratio was calculated as the population of one month after the first generation divided by the control population.



Photo 6. A view of different doses of insecticide for resurgence of green leafhopper GLH

Results: Two days after the application of Mipcin 75 WP insecticide, the average survival rates of the green leafhopper (GLH) in treatments T₁, T₂, T₃ and T₄ were found 0, 1.25, 1.50 and 19.75 respectively (Table 10). Statistically significant differences of mortality were observed among the four treatments at 48 hours after insecticide application and the development of first generation after one month. One month after the insecticide application, first-generation GLH (1st or 2nd instar) emerged from the surviving population. The number of first-generation nymphs was recorded as 0.00, 2.75, 44.25, and 129.5 in treatments T₁, T₂, T₃ and T₄, respectively (Fig. 27). The highest resurgence ratio of GLH was found 0.34 after Mipcin 75 WP @ half of the recommended dose (low dose) in treatment (T₃), followed by the recommended dose (0.02) and 0.00 with double of the recommended dose (Table 10).

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Table 10. Effect of different doses of Mipsin 75 WP on resurgence development

Treatment	Doses (ppm)	No. of GLH/pot at different time intervals			Resurgence ratio
		Pre-treatment	2 DAT	30 DAT	
T1	3450	23.5 a	0.00 c	0.00 b	0.00
T2	1725 (RD)	25.00 a	1.25 b	2.75 b	0.02
T3	864	24.50 a	1.5 b	44.25 a	0.34
T4	Control	23.75 a	19.75 a	129.5 a	-
P value		0.36	0.00	0.00	
SE		0.01	0.07	2.17	
CV		1.65	28.73	28.02	

The highest mortality (100%) was observed in treatment T₁, followed by 95% in T₂, 74% in T₃, and the lowest mortality (21%) in T₄ at 48 hours after insecticide application (Fig. 28).

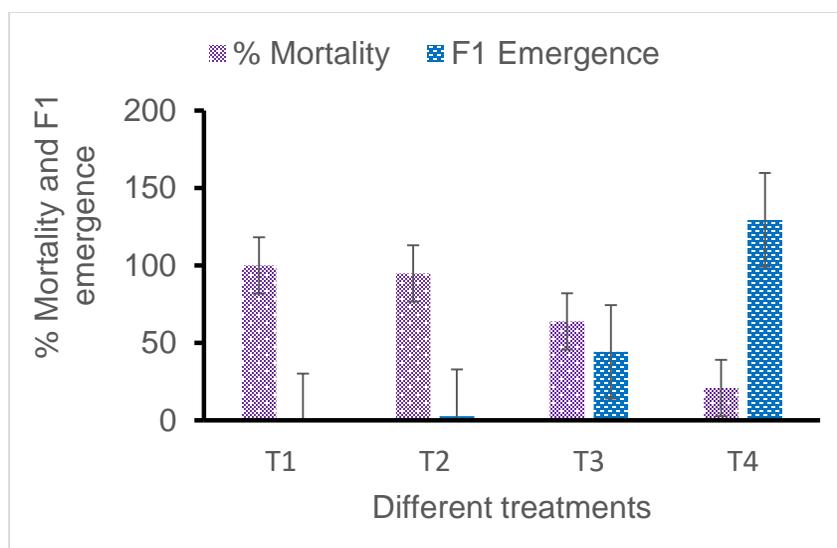


Fig. 28. Percent mortality at 48 HAS and first generation population of GLH after 30 DAT

Expt. 5.7. Effect of insecticides on natural enemies of rice insect pests

Objective: To identify relatively safer insecticides for using in IPM program

Materials and Methods: Eight commercially registered insecticides for rice of different chemical group were evaluated at BRRI, Gazipur in T. Aman 2023 and Boro 2023-24 with popular BRRI variety. The generic name of eight insecticides were *celastrus angulatus*, tetraniliprole+ fipronil(vayego superb), abamectin, cyantrianiliprole+ lufenuron (Minectoextra 40SC), clothianidin, isocycloserum, cartap and fipronil. These insecticides were sprayed in rice at vegetative stage with three replicated trial and control plot remain free of insecticides. Recommended dose was used for each insecticide. Insects and natural enemy population were collected after 48 hours after spraying (HAS) by twenty complete sweeps. The data of natural enemy populations were counted & recorded.

Results: Different natural enemies were found lower in all the insecticide treated plots than the control plot at 48 after spraying. Spider, damsel fly, dragon fly, green mirid bug, carabid beetle, chironomids, parasitoids and dipteran flies were the major natural enemies (NE) found in the counted sweep sample. Total natural number of NE and other non-pest, comparable with control were found in fipronil, cartap, tetraniliprole+ fipronil, Abamectin and *Celastrus angulatus* (Fig. 29). So these insecticides may be considered as safer for NE.

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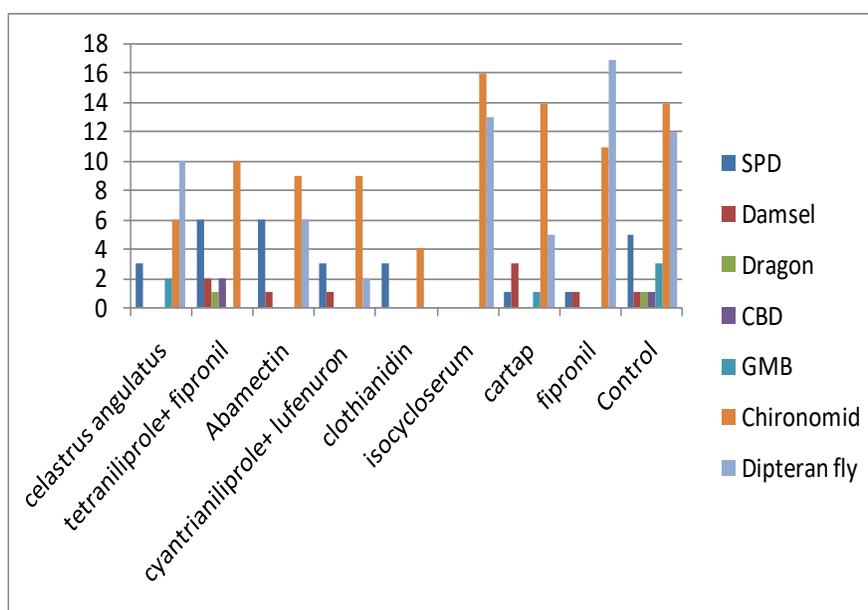


Fig. 29. Total natural enemies and non-pest rice insects caught in sweep net from different insecticides treated plots

PROJECT VI: INSECTICIDE TOXICOLOGY

Expt. 6.1. Residue analysis of different insecticide in rice by liquid chromatography tandem mass spectrometry (LCMS)

Objective(S):

- i. To detect insecticide residues from the polished rice grain.
- ii. To establish monitoring and guidance on safe use of insecticide in rice field.

Materials and methods: The field study was carried out at BIRRI Gazipur during Boro 2023-24 season in 3 adjacent field plots with complete randomized block design (CRD), each with an area of $5 \times 4 = 20 \text{ m}^2$ for a particular insecticide. The area was separated by irrigation and drainage channels. Most popular selected insecticide was applied at doses. Four treatments were used i.e., T₁= chlorantraniliprole (3 times) with standard dose, T₂= chlorantraniliprole (3 times) double of standard dose, T₃= imidacloprid (3 times) with standard dose, and T₄= imidacloprid (3 times) @ double dose and T₅= Control. Three plots were remained untreated (not sprayed) as a control. After harvest, a homogenous sample 1.0 kg was separated for each treatment. The collected samples were then stored in a freezer at -20°C during 30 day period until extraction for pesticide residues analysis.



Photo 7. Field view of insecticide residue analysis, Boro 2023-24

Sample preparation: Extraction were conducted using acetonitrile (ACN) following AOAC (Association of official agricultural chemist) method of analysis with primary secondary amine (PSA). Sample extraction was carried out by modified QuEChERS (Quick easy cheap effective rugged and safe) method.

Chromatographic conditions: A Shimadzu Acquity ultra pressure liquid chromatography (UPLC), LC2030 instrument (Kyoto, Japan) and liquid chromatography tandem mass spectrometry (LC MS 8050) with optimized chromatographic condition will be used in this study. Separation was carried out on an Acquity C18 column ($50 \text{ mm} \times 2.1 \text{ mm}$, $1.7 \mu\text{m}$) maintained at 30°C .

Detection conditions: Detection were carried out by a LC-MS2030 fitted with electrospray ionization (ESI) probe operated in the positive ion mode. Detection were carried out in multiple reaction monitoring (MRM) mode with an optimized detection conditions depending on different chemicals.

Results: Residues of chlorantraniliprole and imidacloprid were detected using a LC-MS2020 fitted with electrospray ionization (ESI) probe operated in the positive ion mode. The retention time of chlorantraniliprole was 2.05 minute and imidacloprid 7.95 minute. The concentrations of chlorantraniliprole (CTP), and imidacloprid (IMIDA) were analyzed separately by the developed method of LCMS. The insecticide residues in different treatments were below the detection level so, that was not detected (n.d.) by the LCMS except CTP in T₂ and IMIDA in T₄ where insecticide was used double of the recommended doses (Table 11). The detection concentration of

chlorantraniliprole was found 0.018 mg kg⁻¹ only in T₂ and imidacloprid was 0.029 mg kg⁻¹ in T₄ (Table 12), which were below the Maximum Residue Limit (MRL: 0.4 mg kg⁻¹ for chlorantraniliprole and 0.6 mg kg⁻¹ for thiamethoxam, EU)

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Table 11. Residue analysis of chlorantraniliprole (CTP) and imidacloprid (IMIDA) insecticides from rice grain

Treatments	Insecticide residue (PPM)		EU MRL *	EU MRL *
	chlorantraniliprole (CTP)	imidacloprid (IMIDA)	CTP	IMIDA
T ₁ = chlorantraniliprole (3 times) std. dose	n.d.*	n.d.*		
T ₂ = chlorantraniliprole (3 times) double dose	0.018	n.d.*	0.05	
T ₃ = imidacloprid (3 times) std. dose	n.d.*	n.d.*		0.21
T ₄ = imidacloprid (3 times) double dose	n.d.*	0.029		
T ₅ = Control	n.d.*	n.d.*		

n.d.* = not detected, LoD= 0.15 ppm, EU MRL*=European union Maximum Residual Limit

Expt. 6.2. Multiple residue analysis of different insecticide in rice ecosystem

Objective(s):

- i. To detect multiple insecticide residues from the polished rice grain.
- ii. To establish monitoring and guidance on safe use of insecticide in rice field.

Materials and methods: The field study was carried out at BRFI Gazipur during Boro 2023-24 season in 3 adjacent field plots with complete randomized block design (CRD), each with an area of 5 × 4 = 20 m² for a particular insecticide. The area was separated by irrigation and drainage channels. Most popular selected insecticide was applied at the recommended doses or with different combination in different growth stages of the rice plant. Three treatments were used in the experiments i.e., T₁= chlorantraniliprole (2 times), T₂= T₁ + imidacloprid (1 times) and T₃= T₁ + T₂ + thiamethoxam (1 times). Three plots were remained untreated (not sprayed) as a control (T₄). After harvest, a homogenous sample 1.0 kg was separated for each treatment. The collected samples were then stored in a freezer at -20°C during 30 day period until extraction for pesticide residues analysis.

Sample preparation: Extraction were conduct using acetonitrile (ACN) following AOAC (Association of official agricultural chemist) method of analysis with primary secondary amine (PSA). Sample extraction were carried out by modified QuEChERS (Quick easy cheap effective rugged and safe) method.



Photo 8. Field view of multiple residue analysis, Boro 2023-24

Chromatographic conditions: A Shimadzu Acquity ultra pressure liquid chromatography (UPLC), LC2030 instrument (Kyoto, Japan) and liquid chromatography tandem mass spectrometry (LC MS 8050) with optimized chromatographic condition will be used in this study. Separation was carried out on an Acquity C18 column (50 mm X 2.1 mm, 1.7 μ m) maintained at 30°C.

Detection conditions: Detection were carried out by a LC-MS2030 and LC MS 8050 fitted with electrospray ionization (ESI) probe operated in the positive ion mode. Detection will be carried out in multiple reaction monitoring (MRM) mode with a optimized detection conditions depending on different chemicals.

Results: Insecticide residues were detected using a LC-MS2020 fitted with electrospray ionization (ESI) probe operated in the positive ion mode. The retention time of chlorantraniliprole was 1.97 minute, imidacloprid 7.95 minute and thiamethoxam 2.05 minutes. The concentrations of chlorantraniliprole (CTP), imidacloprid (IMIDA) and thiamethoxam (THM) were analyzed separately by the developed method of LCMS. The concentration of the insecticide residues in different treatments were below the detection level. So, that was not detected (n.d.) by the LCMS except T₃ (Table 12). The concentration of the insecticide residues was below the detection level so, that was not detected (n.d.) by the LCMS (Table 12). The concentration of thiamethoxam were found 0.022 mg kg⁻¹ only in T₃ (Table 12), which were below the Maximum Residue Limit (MRL: 0.6 mg kg⁻¹ for thiamethoxam, EU).

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Table 12. Multiple residue analysis of chlorantraniliprole (CTP) and imidacloprid (IMIDA) and thiamethoxam (THM) from rice grain

Treatments	Insecticide residue (PPM)			EU MRL *	EU MRL *
	CTP	IMIDA	THM	CTP	IMIDA & THM
T ₁ = chlorantraniliprole (2 times)	n.d.*	n.d.	n.d.	0.012	0.6
T ₂ = T ₁ + imidacloprid (1 times)	n.d.	n.d.	n.d.		
T ₃ = T ₁ + T ₂ +thiamethoxam (1 times)	n.d.	n.d.	0.022		
T ₄ = Control	n.d.	n.d.	n.d.		

n.d.* = not detected, EU MRL* =European union Maximum residual limit

Expt. 6.3. Development and validation of analytical methods for multiple pesticide residue determination in rice grain using Liquid Chromatography with Tandem Mass Spectrometry (LC-MS/MS)

Objective: To develop and validate a multi-residue analytical method for the analysis of different pesticides in rice grain using QuEChERS extraction.

Materials and Methods: Method development for multiple pesticide residue determination in rice grain was carried out by using Liquid Chromatography with Tandem Mass Spectrometry (LCMS/MS8050, SHIMADZU) fitted with electrospray ionization (ESI) probe operated in the positive ion mode. The methods were developed for the determination of carbofuran, chlorantraniliprole, chlorpyrifos, isoprocarb, thiamethoxam, malathion, diazinon, dinotefuran, imidacloprid, pymetrozine, nitenpyram, carbaryl, carbosulfan, cypermethrin and fipronil. The pesticide residue database of the LCMS/MS system was used for the data analysis. QuEChERS

Method for Pesticide Residue Analysis (Method AOAC 2007.01) was applied for sample preparation.

Results: A total of 15 insecticides determination methods namely carbofuran (m/z 222.2500>123.1000 and RT 1.81 mins), chlorantraniliprole (m/z 482.0000>283.9500 and RT 1.41 mins), chlorpyrifos (m/z 350.0000>97.1000 and RT 2.73 mins), isoprocarb (m/z 194.1000>95.0000 and RT 1.51 mins) and thiamethoxam (m/z 292.0000>211.1000 and RT 1.96 mins), malathion (m/z 331.0000>97.0000 and RT 5.44 mins), diazinon (m/z 305.1000>169.1000 and RT 2.08 mins), dinotefuran (m/z 203.1000>114.2000, RT 9.62 mins), imidacloprid (m/z 256.15000>175.2000 and RT 1.36 mins), pymetrozine (m/z 218.1000>105.000 and RT 1.16 mins), nitenpyram (m/z 270.8000>225.0000), carbaryl (m/z 202.2000>127.1000 RT 3.50 mins), carbosulfan (m/z 381.2000>118.1000), cypermethrin (m/z 433.1000>191.1000), and fipronil (m/z 435.0000>330.000 and RT 4.21 mins) were standardized by Shimadzu LCMS/MS 8050. The ranged of LoD were 0.04 to 7.45 ppb and LoQ were 0.13 to 22.58 ppb. In the method file, ESI interface, Desolvation temperature, DL temperature, nebulizing gas flow, heating gas flow, and drying gas flow were set at 300°C, 526°C, 250°C, 2.00 L/min, 10.00 L/min and 10.00 L/min respectively. Detection was carried out in multiple reactions monitoring (MRM).

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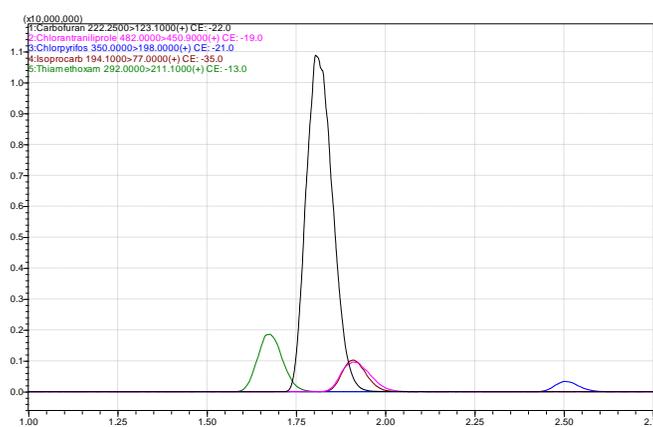


Fig. 30. Chromatogram of multiples pesticide residue determination in rice

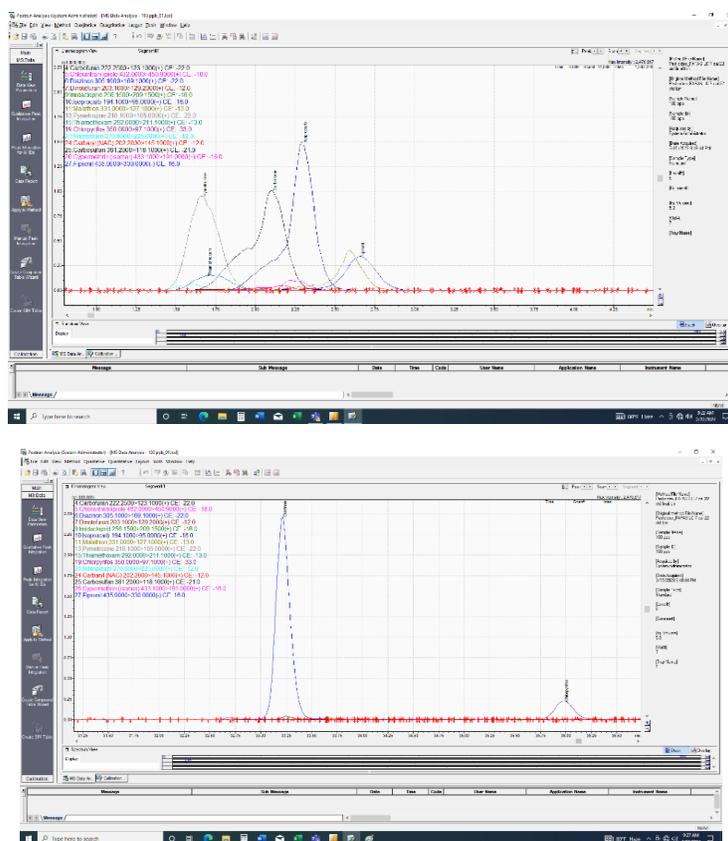


Fig. 31. Chromatogram of multiples pesticide residue determination in rice

ID# : 10 m/z : 194.1000>95.0000
 Name : Isoprocarb
 Quantitative Method : External Standard
 Function : $f(x)=180716*x-128954$
 $Rr1=0.9998569$ $Rr2=0.9997137$
 MeanRF: 1.512718e+005 RF SD: 4.565788e+004 RF %RSD: 30.182666
 FitType : Linear
 ZeroThrough : Not Through
 Weighted Regression : 1/C

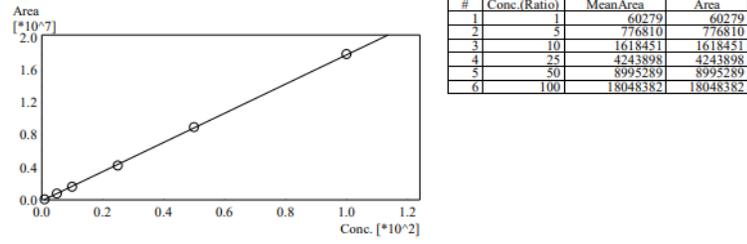


Fig. 32. Standard curve of isoprocarb insecticide

ID# : 11 m/z : 331.0000>99.0000
 Name : Malathion
 Quantitative Method : External Standard
 Function : $f(x)=65781.2*x-49821.7$
 $Rr1=0.9998868$ $Rr2=0.9997737$
 MeanRF: 5.440522e+004 RF SD: 1.707043e+004 RF %RSD: 31.376448
 FitType : Linear
 ZeroThrough : Not Through
 Weighted Regression : 1/C

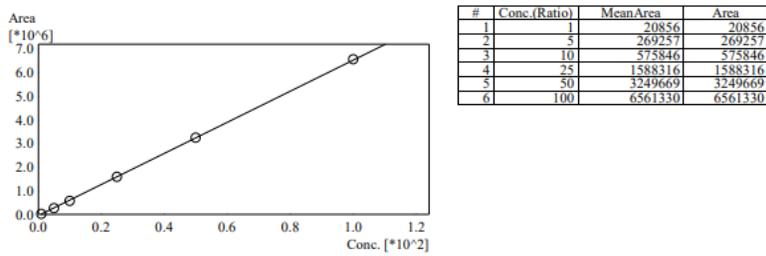


Fig. 33. Standard curve of malathion insecticide

ID# : 18 m/z : 350.0000>97.1000
 Name : Chlorpyrifos
 Quantitative Method : External Standard
 Function : $f(x)=30516.2*x-14245.5$
 $Rr1=0.9996355$ $Rr2=0.9992712$
 MeanRF: 2.726347e+004 RF SD: 7.055169e+003 RF %RSD: 25.877738
 FitType : Linear
 ZeroThrough : Not Through
 Weighted Regression : 1/C

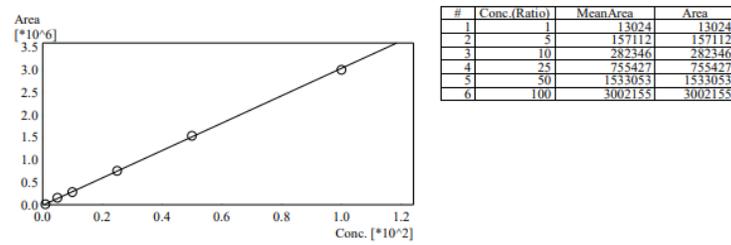


Fig. 34. Standard curve of chlorpyrifos insecticide

ID# : 22 m/z : 202.2000>127.1000
 Name : Carbaryl (NAC)
 Quantitative Method : External Standard
 Function : $f(x)=46752.6*x-51171.5$
 $Rr1=0.9980387$ $Rr2=0.9960812$
 MeanRF: 3.506847e+004 RF SD: 1.632179e+004 RF %RSD: 46.542650
 FitType : Linear
 ZeroThrough : Not Through
 Weighted Regression : 1/C

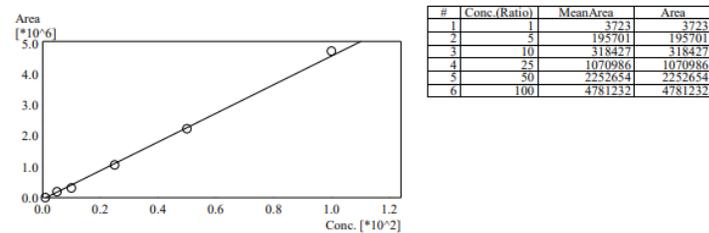


Fig. 35. Standard curve of carbaryl insecticide

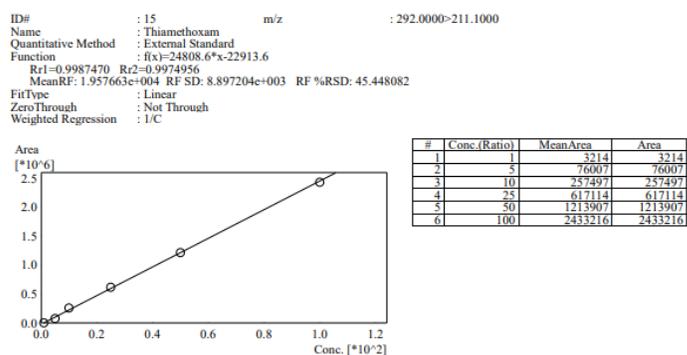


Fig. 36. Standard curve of thiamethoxam insecticide

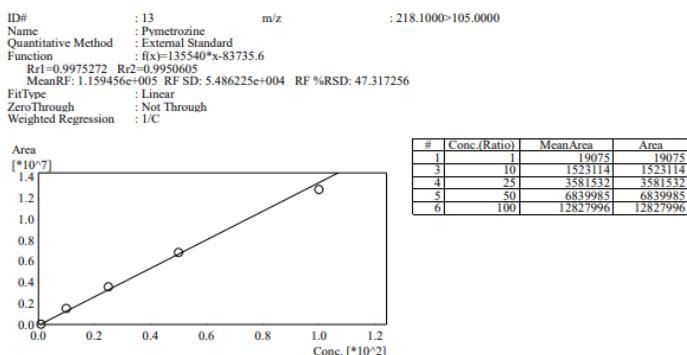


Fig. 37. Standard curve of pymetrozine insecticide

Expt. 6.4. Determination of insecticide residues in rice grain samples collected from different locations of Bangladesh

Objectives: To detect insecticide residues in rice grain collected from different locations of Bangladesh.

Materials and methods: Forty (40) rice sample were collected randomly from Dinajpur, Rangpur, Chattogram, Khulna and Cox'sbazar. A homogenous sample 0.5 kg amount of 8 to 12 different rice varieties from each of locations were collected. The collected samples were then stored in a freezer at -20°C during 30-day period until extraction for pesticide residues analysis. Different popular rice samples i.e., Shampa Katari, Siddho Katari, Dhekichata Shampa Katari, Nizershail, Chinigura, Summon Swarna, Ranjit Swarna, Anowara pajam, Radhuni jira, Rajbhog, Amin Minikit, Jirashail, Jahura Minikit, Kumragore, Ranisalute and Gobindobhog were collected from local popular market of Dinajpur, Rangpur and Khulna region (Table 13).

Sample preparation: Extraction were done using acetonitrile (ACN) following AOAC (Association of official agricultural chemist) method of analysis with primary secondary amine (PSA). Sample extraction were carried out by modified QuEChERS (Quick easy cheap effective rugged and safe) method.

Chromatographic conditions: A Shimadzu Acuity liquid chromatography tandem mass spectrometry (LC MS 8050, Kyoto, Japan) with optimized chromatographic condition was used in this study. Separation was carried out on an Acuity C18 column (50 mm × 2.1 mm, 1.7 μm) maintained at 30°C.

Detection conditions: Detection were carried out by a LC MS 8050 fitted with electrospray ionization (ESI) probe operated in the positive ion mode. Detection were be carried out in multiple reaction monitoring (MRM) mode with an optimized detection conditions depending on different chemicals.

Results: Among the collected 30 samples, 16 were analyzed to determine 10 different insecticides i.e., chlorantraniliprole (ctp), imidacloprid (imida), thiamethoxam (thm), carbofuran (carbo), diazinon (diazi), dinotefuran (dinote), fipronil (fipro), iso procarb (isop), malathion (mala) and carbaryl (cabryl). The concentrations of different insecticides were determined by the developed multiresidue analysis methods. Insecticides residues were not found in all the samples (not detected) except Chinigura. Among the tested 10 different insecticides three insecticide residues

were determined in Chinigura rice. The concentrations of chlorantraniliprole (ctp), imidacloprid (imida) and isoprocarb (isop) were found in the chinigura rice samples 0.012, 0.01 and 0.019 mgkg⁻¹ respectively (Table 13). The maximum residue limit of the insecticides is 0.05, 0.12 and 0.4 mgkg⁻¹ respectively. The retention time of the tested insecticides were 1.67 to 33.22 minutes. The highest (33.22 minutes) and lowest (1.67 minutes) retention time were observed in diazinon and dinotefuran respectively.

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Table 13. Determination of insecticide residues in rice grain samples collected from different locations of Bangladesh

Sample names	Locations	Insecticide residue (PPM)									
		ctp	imida	thm	carbo	diazi	dinote	fipro	isop	mala	cabryl
Shampa Katari	Dinajpur	n.d.*	n.d.*	n.d.*	n.d.*	n.d.*	n.d.*	n.d.*	n.d.*	n.d.*	n.d.*
Shiddo Katari	Dinajpur	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Dhekichata ShampaKatari	Dinajpur	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Nizershail	Dinajpur	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Chinigura	Dinajpur	0.012	0.01	n.d.	n.d.*	n.d.*	n.d.*	n.d.*	0.019	n.d.*	n.d.*
Sumon Swarna	Rangpur	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Ranjit Swarna	Rangpur	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Anowara Pajam	Rangpur	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Radhuni Jira	Rangpur	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Rajbhog	Rangpur	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Amin Minikit	Rangpur	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Jirashail	Rangpur	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Jahura Minikit	Rangpur	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Kumragore	Khulna	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Ranisalute	Khulna	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Gobindobhog	Khulna	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
RT (minute)		2.25	1.71	1.78	2.11	33.22	1.67	2.65	2.31	2.59	2.17
LoD (ppb)		0.71	0.8	0.68	0.71	0.04	7.45	0.29	0.26	2.91	0.52
LoQ (ppb)		2.16	2.42	2.07	2.16	0.13	22.58	0.89	2.91	8.81	1.58
MRL (mg kg ⁻¹)		0.05	0.05	0.4	0.10	0.02	0.3	0.01	0.3	0.05	1.0

n.d.* = not detected, LoD= Level of detection, LoQ= Level of quantification, MRL* = Maximum residual limit (EU)

PROJECT VII: HOST PLANT RESISTANCE

Expt. 7.1. Screening of advanced breeding lines against major insect pests of rice

Objective: To identify resistance sources from elite breeding lines against major insect pests of rice

Material & methods: A total of 40 entries during Aman 2023-24 and 932 entries during boro 2023-24, including breeding lines, advance breeding lines, genotypes and varieties received from

Plant breeding division, were screened against BPH, WBPH and GLH. Twenty RYT advanced breeding lines of rainfed lowland rice (RLR), eight drought tolerant rice (DTR), eight RYT materials of zinc enriched rice (ZER), and four ALART Antioxidant enriched rice materials were screened against different insects in T. Aman 2023 season. Three ALART(SD) favorable boro rice (FBR), two ALART(LD) FBR, six ALART (LB) FBR, four ALART cold tolerant rice (CTR), three PVT FBR, one hundred eighty eight FBR CTR , twelve ALART boro, fifteen disease resistant rice, nine RYT-1 of premium quality rice (PQR), eight RYT-2 PQR, thirteen RYT-3 PQR, nine RYT zinc enriched rice (ZER), seventy six FBR (BPH 17 and BPH 32), sixty two FBR lodging tolerance, twenty RYT_CS1 on cold tolerant rice, twenty one RYT_CS2 on cold tolerant rice, three hundred fifty two OYT insect resistant rice (IRR), eighty four PYT insect resistant rice (IRR) and forty five AYT insect resistant rice (IRR) were evaluated against brown plant hopper (BPH), white backed plant hopper (WBPH), green leaf hopper (GLH) in boro 2023-24 season. The screening was done by seedling bulk test method in the BRRI net house of Entomology division. Scores were made according to SES of IRRI.

Results:

Among the rainfed lowland Rice (RLR) and zinc enriched rice (ZER), no resistant lines were found in T. Aman 2023 (Table 14 and 16). One drought tolerant rice (DTR) IR127009-B-8-2-1-2 and one ALART antioxidant enriched rice BR12836-4R-312 showed moderately susceptible reaction (score 5) against BPH in T. Aman 2023 season (Table 15 and 17). Among ALART (SD) favorable boro rice, ALART (LD) FBR, ALART (LB) FBR, ALART cold tolerant rice, PVT FBR, ALART boro, disease resistant rice, RYT-1 premium quality rice, RYT-2 PQR, RYT-3 PQR, RYT zinc enriched rice (ZER), AYT insect resistant rice of Boro 2023-24, no entry was found resistant (Table 17-27). Among FBR Lodging tolerance trial, one entry IR17A2922 showed moderately resistant reaction (score 3) and three entries BR12676-4R-392, BR7528-2R-19-16-RIL-59 and IR12A173 showed moderately susceptible reaction (score 5) against BPH (Table 29). Among FBR (BPH 17 and BPH 32) BPH gene rice, two entry BR13418-5R-81 and BR13418-5R-93 showed moderately resistant reaction (score 3) and thirteen entries BR13418-5R-3, BR13418-5R-6, BR13418-5R-8, BR13418-5R-26, BR13418-5R-37, BR13418-5R-40, BR13418-5R-47, BR13418-5R-51, BR13418-5R-53, BR13418-5R-76, BR13418-5R-78, BR13418-5R-82 and BR13418-5R-100 showed moderately susceptible reaction (score 5) showed moderately susceptible reaction (score 5) against BPH (Table 28). Among RYT_CS1 cold tolerant Rice one entry IR17A2922 showed moderately resistant reaction (score 3).

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Table 14. Resistant reactions of Rainfed Lowland Rice (RLR), RYT, rice entries against BPH, WBPH and GLH, at BRRI greenhouse, T. Aman 2023-24

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
RYT-1				
1	BR12001-6R-205	7	7	7
2	BR10795-6R-133	7	9	7
3	BR12005-6R-14	9	7	7
4	BR10797-6R-140	9	7	7
5	BR10799-6R-104	7	7	9
6	BR12007-6R-61	9	9	9
7	BR11333-6R-4	7	7	9
8	BR11333-6R-84	9	9	7
9	BR10799-6R-31	9	7	7
10	BRRRI dhan71(CK)	7	7	7
11	BRRRI dhan75(CK)	9	7	7
RYT-2				
1	BR12011-6R-178	9	9	7
2	BR10797-6R-24	9	7	7
3	BR10799-6R-70	7	7	7
4	BR11343-6R-51	7	7	7

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
5	BR11227-6R-98	7	7	9
6	BR10802-6R-66	7	7	7
7	BR11336-6R-10	9	7	7
8	BRR1 dhan49 (Ck)	9	7	9
9	BRR1 dhan87 (Ck)	7	7	9
	BR3 (Sus. ck.)	9	9	9
	T27A/IR64/BR6 (Res. ck.)	3 (T27A)	5 (IR 64)	5 (BR6)

Susceptible Check: BR 3 (for all), Resistant ck: T27A, IR64 and BR6 BPH, WBPH and GLH respectively. Scores were made according to SES. BPH= brown planthopper, WBPH= white-backed planthopper, GLH= green leafhopper, R= resistant (score 0-1), MR= moderately resistant (3), MS= moderately susceptible (5), S=susceptible (>7).

Table 15. Resistant reactions of RYT drought tolerant rice (DTR) against BPH, WBPH and GLH, at BRR1 greenhouse, T. Aman 2023-24

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
1	BR12023-6R-111	NG	NG	9
2	BR12021-6R-117	NG	9	7
3	IR15L1720	7	9	7
4	IR127009-B-8-2-1-2	5	9	7
5	IR17L1314	7	7	9
6	IR100097-B-B-RGA-B-	7	7	9
7	IR17L1360	7	7	9
8	BRR1 dhan71 (Ck)	9	7	9
	BR3 (Sus. ck.)	9	9	9
	T27A/IR64/BR6 (Res. ck.)	3 (T27A)	5 (IR 64)	5 (BR6)

NG= No germination

Table 16. Seed sources of advanced breeding lines of Zinc enriched rice (ZER), RYT and their reaction against major rice insect pests in T. Aman 2023-24 at BRR1 greenhouse

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
1	BR10854-4-1-1-2-8	9	9	9
2	BR10855-3-2-5-2-5	9	7	9
3	BR10863-8-3-5-3-2	9	9	9
4	BR11176-16-7-4-4-2	7	9	9
5	BRR1 dhan49 (CK)	9	7	7
6	BRR1 dhan72 (CK)	7	7	7
7	BRR1 dhan87 (CK)	7	9	9
8	BRR1 dhan93 (CK)	7	9	9
	BR3 (Sus. ck.)	9	9	9
	T27A/IR64/BR6 (Res. ck.)	5 (T27A)	5 (IR 64)	5 (BR6)

Table 17. Seed sources of advanced breeding lines of ALART antioxidant enriched rice and their reaction against major rice insect pests in T. Aman 2023-24 at BRR1 greenhouse

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
1	BR12836-4R-63	NG	NG	NG
2	BR12836-4R-312	5	7	7
3	BRR1 dhan34 (CK)	NG	NG	NG
4	BRR1 dhan70 (CK)	NG	NG	NG
	BR3 (Sus. ck.)	9	9	9

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
	T27A/IR64/BR6 (Res. ck.)	5 (T27A)	5 (IR 64)	5 (BR6)

Table 18. Resistant reactions of ALART (SD) favorable boro rice (FBR) trial against BPH at BIRRI greenhouse, Boro 2023-24

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
1	BR11903-5R-56	7	-	-
2	IR18A2119	9	-	-
3	BIRRI dhan89 (Std. & Sus.	9	-	-
	BR3 (Sus. ck.)	9	-	-
	T27A/IR64/BR6 (Res. ck.)	3 (T27A)	5 (IR 64)	5 (BR6)

Table 19. Resistant reactions of ALART (LD) favorable boro rice (FBR) trial against BPH, at BIRRI greenhouse, Boro 2023-24

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
1	BR11318-5R-84	7	-	-
2	BIRRI dhan92	9	-	-
	BR3 (Sus. ck.)	9	-	-
	T27A/IR64/BR6 (Res. ck.)	3 (T27A)	5 (IR 64)	5 (BR6)

Table 20. Resistant reactions of ALART (LB) favorable boro rice (FBR) trial against BPH, WBPH and GLH, at BIRRI greenhouse, Boro 2023-24

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
1	BR11845-4R-62	7	-	-
2	BR12266-BC3-23-1	7	-	-
3	BIRRI dhan29-SC3-28-16-10-6-HR6 (Com)-HR1 (Gaz)-P11	NG	-	-
4	BIRRI dhan14	9		
5	BIRRI dhan28	9		
6	BIRRI dhan98	9		
	BR3 (Sus. ck.)	9	-	-
	T27A/IR64/BR6 (Res. ck.)	3 (T27A)	5 (IR 64)	5 (BR6)

Table 21. Resistant reactions of ALART cold tolerant rice (CTR) against BPH, WBPH and GLH, at BIRRI greenhouse, Boro 2023-24

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
1	BR11894-R-R-R-R-169	9	-	-
2	TP16199	9	-	-
3	BIRRI dhan28	9	-	-
4	BIRRI dhan67	7		
	BR3 (Sus. ck.)	9	-	-
	T27A/IR64/BR6 (Res. ck.)	3 (T27A)	5 (IR 64)	5 (BR6)

Table 22. Resistant reactions of PVT FBR against BPH, WBPH and GLH, at BIRRI greenhouse, Boro 2023-24

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
1	BR11318-5R-63	9	-	-

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
2	BR11337-5R-72	9	-	-
3	BRRI dhan88	7	-	-
	BR3 (Sus. ck.)	9	-	-
	T27A/IR64/BR6 (Res. ck.)	3 (T27A)	5 (IR 64)	5 (BR6)

Table 23. Resistant reactions of FBR cold tolerant rice (CTR) against BPH at BRRI greenhouse, Boro 2023-24

Sl. no.	Designation	BPH Score	Sl. no.	Designation	BPH Score
1	BR11318-5R-63	9	96	IR19A7429	NG
2	BR11337-5R-72	9	97	IR19A7529	7
3	BR11903-5R-56	7	98	IR19A8056	7
4	IR18A2119	9	99	IR19A8128	NG
5	BR11318-5R-84	7	100	IR19A8263	7
6	BR11845-4R-62	7	101	IR19A8517	7
7	BR12266-BC3-23-1	7	102	IR19A8589	NG
8	BRRI dhan29-SC3-28-16-10-6-HR6 (Com)-HR1 (Gaz)-P11 (Hbj)	NG	103	IR19A9140	NG
9	TP16199	7	104	BR13027-BC1-3R-109	7
10	BR11894-R-R-R-R-169	9	105	BR13027-BC1-3R-25	7
11	BR11894-R-R-R-R-72	9	106	BR11894-R-R-R-R-228	NG
12	BR13027-BC1-3R-14	7	107	BR13027-BC1-3R-127	NG
13	BR13026-BC1-3R-10	NG	108	IR17A1779	7
14	BR11894-R-R-R-R-152	9	109	BR13026-BC1-3R-6	7
15	IR19A1473	9	110	IR19A2553	7
16	IR19A5712	9	111	IR17A2946	7
17	IR19A4821	7	112	IR17A2917	5
18	IR18A1859	9	113	IR17A2945	NG
19	BR12574-5R-168	7	114	BR13026-BC1-3R-151	7
20	BR12574-5R-52	7	115	BR13027-BC1-3R-102	7
21	BR12667-4R-86	9	116	BR13026-BC1-3R-197	7
22	BR12671-4R-95	9	117	BR13027-BC1-3R-24	7
23	BR12676-4R-392	5	118	BR13027-BC1-3R-164	7
24	BR12682-4R-50	9	119	BR13026-BC1-3R-41	7
25	BR12208-4R-278	9	120	BR13027-BC1-3R-127	NG
26	BR12508-5R-5	9	121	BR13027-BC1-3R-107/8	7
27	BR12517-5R-57	7	122	BR13026-BC1-3R-58	7
28	BR12514-5R-97	7	123	BR13027-BC1-3R-212	7
29	BR12520-5R-11	7	124	BR13027-BC1-3R-1	7
30	BR12423-6R-38	7	125	BR13027-BC1-3R-51	7
31	IR18A1398	9	126	BR13026-BC1-3R-92	7
32	BR11318-5R-148	7	127	BR13027-BC1-3R-76	7
33	BR11894-5R-260	9	128	BR13027-BC1-3R-67	9
34	BR13027-BC1-3R-77	7	129	BR13027-BC1-3R-13	7
35	IR17A2875	7	130	BR13027-BC1-3R-180	7

Sl. no.	Designation	BPH Score	Sl. no.	Designation	BPH Score
36	BR11894-R-R-R-R-158	7	131	BR12421-4R-171	7
37	BR11894-R-R-R-R-148	7	132	BR12570-5R-150-3	9
38	BR11894-R-R-R-R-115	7	133	BR12421-4R-43	7
39	IR18A2427	7	134	BR12570-5R-146-1	9
40	IR17A2922	3	135	BR12552-3R-208	7
41	BR11894-R-R-R-R-105	7	136	BR12570-5R-66-3	9
42	BR11894-R-R-R-R-329	7	137	BR12570-5R-189-1	7
43	BR7528-2R-19-16-RIL-52	7	138	BR12570-5R-177-3	9
44	BR7528-2R-19-16-RIL-55	7	139	BR12570-5R-37-1	9
45	BR7528-2R-19-16-RIL-59	7	140	BR12552-3R-182	7
46	BR9945-5R-21	NG	141	BR12552-3R-179	7
47	BR13134-5R-27	7	142	BR12570-5R-110-2	9
48	BR13138-5R-141	5	143	BR12570-5R-189-2	7
49	BR13140-5R-113	7	144	BR12570-5R-204-1	7
50	BR13140-5R-157	7	145	BR12552-3R-149	7
51	BR13140-5R-21	7	146	BR12570-5R-202-1	7
52	BR13140-5R-61	7	147	BR12570-5R-189-3	7
53	BR13141-5R-103	9	148	BR12552-3R-229	7
54	BR13141-5R-149	9	149	BR12570-5R-44-3	NG
55	BR13141-5R-22	9	150	BR12570-5R-33-2	7
56	BR13141-5R-91	9	151	BR12570-5R-107-2	7
57	BR13142-5R-51	9	152	BR12570-5R-204-3	9
58	BR13142-5R-54	7	153	BR13027-BC1-3R-149	9
59	BR13142-5R-63	7	154	BR13027-BC1-3R-51	9
60	BR13142-5R-81	9	155	BR13027-BC1-3R-40	7
61	BR13144-5R-137	9	156	BR13026-BC1-3R-209	7
62	BR13149-5R-87	9	157	BR13027-BC1-3R-108	7
63	BR13153-5R-136	9	158	BR13026-BC1-3R-53	7
64	BR13153-5R-63	9	159	BR13027-BC1-3R-119	9
65	BR13153-5R-86	9	160	BR13026-BC1-3R-3	7
66	BR13153-5R-91	9	161	BR13027-BC1-3R-76	7
67	BR13154-5R-118	9	162	BR13026-BC1-3R-1	7
68	BR13154-5R-127	9	163	BR13027-BC1-3R-181	9
69	BR13155-5R-110	7	164	BR13027-BC1-3R-121	9
70	BR13155-5R-233	7	165	BR13027-BC1-3R-21	9
71	BR13409-5R-26	9	166	BR13027-BC1-3R-136	9
72	BR13409-5R-41	9	167	BR13027-BC1-3R-128	9
73	BR13414-5R-6	9	168	BR13027-BC1-3R-138	9
74	BR13417-5R-26	9	169	BR13026-BC1-3R-194	7
75	BR13418-5R-18	9	170	BR13027-BC1-3R-139	7
76	BR13418-5R-51	9	171	BR13026-BC1-3R-8	9
77	BR13431-5R-168	NG	172	BR13027-BC1-3R-149	7
78	BR13431-5R-194	9	173	SVIN109	7

Sl. no.	Designation	BPH Score	Sl. no.	Designation	BPH Score
79	IR19A7530	7	174	IR17A1723	7
80	IR19A7570	NG	175	IR12A173	5
81	IR19A7575	NG	176	IR17A1694	9
82	IR19A8062	7	177	BRR1 dhan28	7
83	IR19A8188	9	178	BRR1 dhan58	7
84	IR19A8237	NG	179	BRR1 dhan63	7
85	IR19A8309	7	180	BRR1 dhan67	7
86	IR19A8524	NG	181	BRR1 dhan88	7
87	IR19A8531	NG	182	BRR1 dhan89	9
88	IR19A8595	7	183	BRR1 dhan92	9
89	IR19A8780	NG	184	BRR1 dhan96	9
90	IR19A8986	7	185	BRR1 dhan98	9
91	IR19A9086	7	186	BRR1 dhan102	9
92	IR19A9128	7	187	BRR1 dhan104	7
93	IR19A9292	NG	188	BINA dhan14	9
94	IRRI 174	7		T27A (R. Ck)	3
95	IR19A7367	NG		BR3	9

Table 24. Resistant reactions of ALART boro rice against BPH, WBPH and GLH, at BRR1 greenhouse, Boro 2023-24

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
1	BR (Bio)13028-AC24-I-2	9	7	9
2	BR (Bio)13028-AC24-2-3	9	7	7
3	BR (Bio) 13028-AC24-2-4	7	9	9
4	BR (Bio) 13028-AC24-3-3	9	7	9
5	BR (Bio)j29-AC6-2-6	9	9	9
6	BR (Bio)13028-ACI-2-2	7	7	7
7	BR (Bio)1 3028-AC 1-2-3	7	7	7
8	BR (Bio)13028.AC I-2-4	7	7	9
9	IR (Bio) 13028-AC 1-2-7	9	7	7
10	BR (Bio)13030- AC 13-2-2	9	7	7
11	BRR1 dhan86	9	7	9
12	BRR1 dhan96	9	7	9
	BR3 (Sus. ck.)	9	9	9
	T27A/IR64/BR6 (Res. ck.)	3 (T27A)	5 (IR 64)	5 (BR6)

Table 25. Resistant reactions of disease resistant rice against BPH, WBPH and GLH, at BRR1 greenhouse, Boro 2023-24

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
1	BR (path)13800-BC3-8-1	7	9	9
2	BR (path)13800.BC3-8-9	9	9	9
3	BR (path)13800-BC3-224-28	7	9	9
4	BR (path)13800-BC3-134-8	9	7	9
5	BR (path)13800-BC3-134-25	9	7	9
6	BR (path)13800-BC3-224-44	9	7	9
7	BRR1 dhan29(Ck)	9	9	9
8	BR12452-BC3-42-22-11-4	7	9	9
9	BR12452-BC3-53-21-11	7	9	9

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
10	10 BR(Path) 1 3784-BC3-	7	7	9
11	BR1 2454-BC2-69-97-39-5-	9	9	9
12	FIR 1 2454(Path)-BC2-75-	9	9	9
13	BRRIdhan28 (Ck)	9	9	9
14	BRRIdhan29 (Ck)	9	9	9
15	BRRIdhan89 (Ck)	9	9	9
	BR3 (Sus. ck.)	9	9	9
	T27A/IR64/BR6 (Res. ck.)	3 (T27A)	5 (IR 64)	5 (BR6)

Table 26. Resistant reactions of RYT Premium Quality Rice (PQR), against BPH, WBPH and GLH, at BIRRI greenhouse, Boro 2023-24

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
	RYT 1			
1	BR11359-4R-24	7	9	7
2	BR11359-4R-341	7	9	7
3	BR11361-4R-149	9	9	7
4	BR11366-4R-133	9	9	7
5	BR11366-4R-179	7	9	9
6	BR11371-4R-522	7	7	9
7	BRRIdhan81(Ck)	7	9	7
8	BRRIdhan104(Ck)	7	7	7
9	BRRIdhan107(Ck)	7	7	5
	RYT 2			
1	BR11359-4R-11	7	9	7
2	BR11359-4R-169	9	9	7
3	BR11359-4R-250	9	9	9
4	BR11361-4R-154	9	9	9
5	BR11363-4R-20	9	9	7
6	BRRIdhan58(Ck)	9	9	7
7	BRRIdhan104(Ck)	7	9	7
8	BRRIdhan107(Ck)	7	7	5
	RYT 3			
1	BR11359-4R-181	7	7	7
2	BR11359-4R-211	9	9	7
3	BR11359-4R-260	7	7	7
4	BR11359-4R-263	9	9	7
5	BR11359-4R-275	7	7	7
6	BR11359-4R-279	7	7	7
7	BR11359-4R-288	7	7	7
8	BR11359-4R-304	9	9	7
9	BR11359-4R-351	9	9	7
10	BR11359-4R-373	9	9	7
11	BRRIdhan102(Ck)	7	7	7
12	BRRIdhan 104 (Ck)	7	7	7
13	BRRIdhan107(Ck)	7	7	7
	BR3 (Sus. ck.)	9	9	9
	T27A/IR64/BR6 (Res. ck.)	3 (T27A)	5 (IR 64)	5 (BR6)

Table 27. Seed sources of advanced breeding lines of Zinc enriched rice (ZER), RYT and their reaction against major rice insect pests in T. Aman 2022-23 at BIRRI greenhouse

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
1	BR10552-1-1-3-4	9	-	-
2	BR10552-1-1-4-6	9	-	-

Sl. no.	Designation	Score		
		BPH	WBPH	GLH
3	BR10570-29-7-3-2	9	-	-
4	BR10571-15-6-8-5	9	-	-
5	BR10572-2-7-1-4	9	-	-
6	BR9674-1-4-1-3-P1	9	-	-
7	BRR1 dhan74 (Ck)	9	-	-
8	BRR1 dhan89 (Ck)	9	-	-
9	Bangabandhu dhan100(Ck)	9	-	-
	BR3 (Sus. ck.)	9	9	9
	T27A/IR64/BR6 (Res. ck.)	5 (T27A)	5 (IR 64)	5 (BR6)

Table 28. Resistant reactions of FBR (BPH 17 and BPH 32), BPH gene rice against BPH at BRR1 greenhouse, Boro 2023-24

Sl. no.	Designation	BPH Score	Sl. no.	Designation	BPH Score
1	BR13136-5R-36	7	40	BR13418-5R-60	7
2	BR13136-5R-107	7	41	BR13418-5R-69	7
3	BR13136-5R-176	9	42	BR13418-5R-76	5
4	BR13139-5R-10	9	43	BR13418-5R-78	5
5	BR13139-5R-19	7	44	BR13418-5R-81	3
6	BR13139-5R-23	9	45	BR13418-5R-82	5
7	BR13139-5R-26	9	46	BR13418-5R-83	7
8	BR13139-5R-36	9	47	BR13418-5R-88	7
9	BR13139-5R-45	9	48	BR13418-5R-89	7
10	BR13139-5R-53	9	49	BR13418-5R-93	3
11	BR13139-5R-61	9	50	BR13418-5R-96	9
12	BR13139-5R-64	9	51	BR13418-5R-98	9
13	BR13139-5R-85	7	52	BR13418-5R-100	5
14	BR13139-5R-111	7	53	BR13418-5R-102	7
15	BR13149-5R-53	9	54	BR13418-5R-110	9
16	BR13418-5R-3	5	55	BR13418-5R-111	9
17	BR13418-5R-6	5	56	BR13418-5R-113	9
18	BR13418-5R-8	5	57	BR13418-5R-114	9
19	BR13418-5R-11	7	58	BR13418-5R-118	7
20	BR13418-5R-14	9	59	BR13418-5R-120	9
21	BR13418-5R-18	9	60	BR13420-5R-1	9
22	BR13418-5R-20	7	61	BR13420-5R-2	9
23	BR13418-5R-26	5	62	BR13420-5R-14	9
24	BR13418-5R-29	9	63	BR13420-5R-24	9
25	BR13418-5R-30	9	64	BR13420-5R-32	9
26	BR13418-5R-32	9	65	BR13420-5R-36	9
27	BR13418-5R-37	5	66	BR13420-5R-37	9
28	BR13418-5R-39	9	67	BR13420-5R-39	9
29	BR13418-5R-40	5	68	BR13420-5R-42	9
30	BR13418-5R-42	7	69	BR13420-5R-44	9
31	BR13418-5R-44	7	70	BR13420-5R-54	9
32	BR13418-5R-45	7	71	BR13420-5R-56	7
33	BR13418-5R-46	7	72	BR13420-5R-57	9

Sl. no.	Designation	BPH Score	Sl. no.	Designation	BPH Score
34	BR13418-5R-47	5	73	BR13420-5R-65	9
35	BR13418-5R-51	5	74	BR13420-5R-69	9
36	BR13418-5R-53	5	75	BR13420-5R-70	9
37	BR13418-5R-54	7	76	BR13420-5R-71	9
38	BR13418-5R-58	9	77	T27A (R. Ck)	3
39	BR13418-5R-59	7	78	BR3	9

Table 29. Resistant reactions of FBR Lodging tolerance trial against BPH at BRRRI greenhouse, Boro 2023-24

Sl. no.	Designation	BPH Score	Sl. no.	Designation	BPH Score
1	BR11318-5R-63	9	33	BR11894-5R-260	9
2	BR11337-5R-72	9	34	BR13027-BC1-3R-77	7
3	BR11903-5R-56	7	35	IR17A2875	7
4	IR18A2119	9	36	BR11894-R-R-R-R-158	7
5	BR11318-5R-84	7	37	BR11894-R-R-R-R-148	
6	BR11845-4R-62	7	38	BR11894-R-R-R-R-115	7
7	BR12266-BC3-23-1	7	39	IR18A2427	7
8	BRRRI dhan29-SC3-28-16-10-6-HR6 (Com)-HR1 (Gaz)-P11 (Hbj)	NG	40	IR17A2922	3
9	TP16199	7	41	BR11894-R-R-R-R-105	7
10	BR11894-R-R-R-R-169	9	42	BR11894-R-R-R-R-329	7
11	BR11894-R-R-R-R-72	9	43	BR7528-2R-19-16-RIL-52	7
12	BR13027-BC1-3R-14	7	44	BR7528-2R-19-16-RIL-55	7
13	BR13026-BC1-3R-10	NG	45	BR7528-2R-19-16-RIL-59	5
14	BR11894-R-R-R-R-152	9	46	BR9945-5R-21	NG
15	IR19A1473	9	47	SVIN109	7
16	IR19A5712	9	48	IR17A1723	7
17	IR19A4821	7	49	IR12A173	5
18	IR18A1859	9	50	IR17A1694	9
19	BR12574-5R-168	7	51	BRRRI dhan28	9
20	BR12574-5R-52	7	52	BRRRI dhan58	9
21	BR12667-4R-86	9	53	BRRRI dhan63	9
22	BR12671-4R-95	9	54	BRRRI dhan67	7
23	BR12676-4R-392	5	55	BRRRI dhan88	9
24	BR12682-4R-50	9	56	BRRRI dhan89	9
25	BR12208-4R-278	9	57	BRRRI dhan92	9
26	BR12508-5R-5	9	58	BRRRI dhan96	9
27	BR12517-5R-57	7	59	BRRRI dhan98	9
28	BR12514-5R-97	7	60	BRRRI dhan102	9
29	BR12520-5R-11	7	61	BRRRI dhan104	7
30	BR12423-6R-38	7	62	BINA dhan14	9
31	IR18A1398	9		T27A (R. Ck)	3
32	BR11318-5R-148	7		BR3	9

PROJECT VIII: INTEGRATED PEST MANAGEMENT

Expt. 8.1. Scale up trials on the develop IPM package for rice during Boro 2023-24 season in different locations of Bangladesh

Objective(s):

- i. To validate IPM packages for pest management in farmer's field.
- ii. To conserve natural enemies in rice eco system.
- iii. To reduce pesticide use in rice production.

Materials and Methods: Seven experiments were conducted in seven different locations i.e., i) BRRI HQ farm Gazipur ii) Farmers field at Kaliganj, Gazipur iii. Farmers field at Kaliganj, Jhenaidha iv). Farmers field at Jhikargacha, Jashore v) Farmers field at Tala, Satkhira vi) Farmers field at Batiaghata, Khulna and vii) Farmers field at Patuakhali Sadar during Boro 2023-24 season. Each of the fields were divided in to two blocks for two treatments. The treatments were T_1 = Integrated pest management (IPM) practice and T_2 = Farmers practice i.e. prophylactic insecticide use. In T_1 , flowering plants (Marigold, cosmos and sunflower) were grown on bunds surroundings of the rice crop (to serve as nectar and pollen sources and shelter for different parasitoids and predators). Three flowering plants were grown in a one meter distance i.e., plant to plant distance was 500 cm. Rice bunds distance was 6 to 10 m in different locations. So, the row-to-row distance of the flowering plants were 6-10 meter and the length of the rice bunds were depending on the length of the plot 25 to 75 meters. The fields were maintained an even level of water to minimize weed growth. Seedlings were remained free from weed seedlings at the time of transplanting. Balanced doses of basal fertilizer and split apply of nitrogenous fertilizer were applied to reduce planthopper, bacterial blight and stem rot diseases. The IPM practiced field (T_1) was also refrained from insecticide use for the first 40 days after transplanting (DAT) to enhance the natural enemies in rice ecosystem.

At first, granular insecticide was applied in T_2 with 1st top dressing of nitrogenous fertilizer (urea) followed by 15-20 days interval for 2nd and 3rd application (farmers practice). Twenty complete sweeps were taken from both the blocks of 3 days after insecticide applied in T_2 . Insect pests and natural enemies' number of all sweeps from both blocks were counted and recorded separately. Crops were taken at 80% maturity of the grain and moisture were adjusted at 14% during weighing of the grain.

Benefit cost ratio (BCR) was calculated both for IPM practiced plot (T_1) and farmers practiced plot (T_2) in all locations on the basis of full cost.

Results: Irrespective of locations and rice varieties the insect pests were remain below the economic threshold level (ETL) both in IPM practiced (T_1) and farmers practiced field (T_2) during Boro 2023-24 season. Among the insect pests short horned grasshopper (SHG) and green leafhopper (GLH) were found in all the locations except GLH in T_1 at Khulna. A little number of yellow stem borer (YSB) and brown planthopper (BPH) were found in the farmers field except Tala, Satkhira. Likewise, rice leafroller (RLR) were not found at BRRI Gazipur, Jhenaidha and Tala Satkhira and white backed planthopper (WBPH) were not found in Tala, Satkhira. Yellow stemborer population was found highest at Batiaghata, Khulna (3.50/20 sweep) followed by Sadar, Patuakhali (3.0/ 20 sweep) in T_2 . Brown planthopper (BPH) population was found highest in T_2 at Jhikargacha, Jashore (1.83/20 sweep) followed by Kaliganj, Gazipur and Sadar, Patuakhali (1.57/20 sweep) for each location. Rice leafroller population also dominating in T_2 at Sadar Patuakhali and Jhikargacha, Jashore (1.33/20 sweep) followed by Kaliganj, Gazipur (1.0/20 sweep) during Boro 2023-24 season. Green leafhopper population was found highest in T_2 at Patuakhali (1.33/20 sweep) followed by at BRRI, Gazipur (1.17/20 sweep). Green leafhopper and other insect pests were observed less than 1.0/20 sweep in all locations except short horned grasshopper. Though the prevalence of SHG occurred all the locations with higher number but it is a minor pest of rice and seldom cause economic damage. Moreover, yellow stem borer (YSB) and brown planthopper (BPH) are the major pests of rice in Bangladesh. But no significance differences were observed incase of SHG, YSB and BPH between IPM practiced plot (T_1) and farmers practiced plots (T_2) i.e., insecticide application plots (Table 30). Another two major pests,

white backed planthopper (WBPH) and rice leafroller (RLR) were found significantly higher in T₂, where insecticide was applied 3 times (Table 30).

Table 30. Irrespective of locations and varieties insect pests/20 sweep in different treatments

Treatments	Insect pests					
	GLH	SHG	YSB	BPH	WBPH	RLR
T ₁	0.74 a	1.69	0.92	0.50	0.64 b	0.26b
T ₂	0.49 b	1.54	1.14	0.81	0.99 a	0.67a
LS	*	ns	ns	ns	*	*
LSD (5%)	0.19	-	-	-	0.314	0.38
CV	24.03	11.40	31.39	61.66	29.31	61.27

T₁= Integrated pest management (IPM) practice T₂= Farmers practice i.e. prophylactic insecticide use

Natural enemies status: Four common natural enemies i.e., spider (SPD), damselfly (Dam. fly), lady bird beetle (LBB) and parasitic wasp (PW) were found in all locations. Among the natural enemies spider (SPD) population was found highest in all the locations. Highest SPD was found in T₁ at Jhikargacha, Jashore and Batiaghata, Khulna (8.50/20 sweep) followed by Kaliganj, Gazipur (8.0/20 sweep) and BRRI Gazipur (7.67/ 20 sweep). Damsel fly was found highest in T₁ at Jhikargacha, Jashore (3.0/20 sweep) followed by Batiaghata, Khulna (2.83/20 sweep) and at Sadar, Patuakhali (2.50/20 sweep). LBB found highest in T₁ at Jhikargacha, Jashore (2.83/20 sweep) followed by Batiaghata, Khulna (2.50/20 sweep), Kaliganj, Jhenaidha (2.17/20 sweep) and BRRI Gazipur (1.50/20sweep). Parasitic wasp (PW) found highest in T₁ at Batiaghata, Khulna (3.0/20 sweep) followed by Jhikargacha, Jashore (2.0/20 sweep), Kaliganj, Gazipur, BRRI, Gazipur and Tala, Satkhira (each of 1.83/20 sweep). Irrespective of locations, all natural enemies were found significantly highest in T₁ compared to T₂ except dragon flies (Table 31). No significance difference was found between T₁ and T₂ in case of dragon fly during Boro 2023-24 season (Table 31).

Table 31. Irrespective of locations and varieties natural enemies/20 sweep in different treatments

Treatments	Natural enemy				
	SPD	Dam. fly	Drag fly	LBB	PW
T ₁	6.04 a	2.24 a	0.36	1.79a	1.95 a
T ₂	2.71 b	0.86 b	0.28	0.67b	0.71 b
LS	*	***	ns	***	*
LSD (5%)	2.35	0.54	-	0.44	0.87
CV	40.96	26.57	46.54	27.59	49.98

The ranged of grain yield were 6.19 to 12.72 t/ha in T₁ and 5.97 to 12.77 t/ha in T₂ (Table 32). Neither insecticide nor herbicide or fungicide was used in T₁ in all locations. But herbicide one time, insecticide thrice and fungicides were used twice in T₂ (Farmers practice) which indicated that pesticides were applied 6 times in farmers practiced field (T₂) in a season. But no significance differences of yield were observed in T₁ and T₂ in three locations another three location highest yield obtained in T₁ and significantly highest yield obtained only one location in T₂ at Tala, Satkhira (Table 4). Moreover, on an average 0.16 t/ha i.e., 1.99% yield reduction was found in T₂ (Table 32).

Table 32. Grain yield and Benefit Cost Ratio (BCR) T₁ and T₂ at different locations of Bangladesh

Location	Grain yield (t/ha)		Benefit Cost Ratio (BCR)	
	T ₁	T ₂	T ₁	T ₂
BRRI, Gazipur	9.38	8.90	1.58	1.37
Kaliganj Gazipur	6.45	6.19	1.16	1.11
Kaliganj, Jhenaidha	7.60	7.58	1.11	1.11
Jikargacha, Jashore	7.60	7.58	1.33	1.26
Tala, Satkhira	12.72	12.77	2.21	2.18

Location	Grain yield (t/ha)		Benefit Cost Ratio (BCR)	
	T ₁	T ₂	T ₁	T ₂
Batiaghata, Khulna	6.19	6.15	1.11	1.09
Sadar, Potuakhali	6.34	5.97	1.20	1.12
Average	8.04	7.88	1.39	1.32

Irrespective of locations and variety BCR is always higher in T₁ compared to T₂ (Table 32). For T₁, highest BCR (2.21) was found at Tala, Satkhira followed by BRRI Gazipur (1.58), farmers field of Jhikargacha, Jashore (1.33) and lowest (1.11) both at Batiaghata, Khulna and Kaliganj, Jhenaidha (Table 32). More or less similar trend was also found in T₂ (farmers practiced field) highest BCR (2.18) was found at Tala, Satkhira followed by BRRI Gazipur (1.37), Jhikargacha, Jashore (1.26) and lowest (1.09) at Batiaghata, Khulna (Table 32). Due to higher yield and lower variable cost (specially labourer cost) BCR was found highest at the farmers field at Tala, Satkhira. The field of Tala, Satkhira was a fish gher (an aquatic place where fish are grown up for marketing for commercial culture in artificial or natural environment) which was more fertile and the variety was BRRI release newly developed hybrid rice (BRRI hybrid dhan8). Irrespective of location and variety on an average 8.04 t/ha yield obtained in IPM practiced field (T₁) and 7.88 t/ha in farmers practiced field (T₂) and the average BCR 1.39 and 1.32 were observed in T₁ and T₂ respectively (Table 32).

PROJECT IX: VERTEBRATE PEST MANAGEMENT

Expt. 9.1. Use of owl watching tower to manage rice rats

Objective: To reduce rice rat damage with the help of watch tower facilitating owl to hunt

Materials and Methods: The study on rat damage around the watch tower was conducted at BRRI, Gazipur experimental field. Ten owl watching tower were installed in the field. Watching tower are 3.5m long pole prepared by bamboo or iron with cross (X) shaped top for seating owl on it and perching and searching rat in crop field. Rat damage by rat was assessed around the watch tower areas. Rat damage assessment around the owl watching tower was done by two ways. One-number of active burrow count methods and another- crop damage assessment method. Active burrow count and crop damage was done three 0-25, 26-50 and 51-75 meters apart around the owl watching tower.

Results: Newly developed burrows became inactive (dead) surrounding the 50m dia of watching Tower. The collected and observed pellets of owl from watching tower confirmed the rat predation.

PI: Md. Mosaddeque Hossain, **CI:** Mofazzel Hossain **PL:** Sheikh Shamiul Haque



Photo 21. Owl watching tower set at BRRI field.

AGRICULTURAL AND RURAL TRANSFORMATION FOR NUTRITION EMPLOYMENT AND RESILIENCE (PARTNER PROGRAM)

Activity/Expt 41. Eco-friendly cost-effective, location and ecosystem specific pest management and production packages

Title of main activities/task: Development and validation of eco-friendly insect pests management technologies in rice production

Activities/sub-title 1. Insect pest management without or less use of insecticide in rice production

Specific objective:

- To develop eco-friendly insect pests' management technology in rice production.
- To reduce insecticide use in rice production and increase farmers income.
- To demonstrate sustainable insect pest management practices in farmer's field.

Materials and methods: Fifteen experiments were conducted in different farmer's fields during Boro 2023-24 season which covered PARTNER targeted nine upazilas of six districts and three divisions of Bangladesh. The locations were- Madhabpur, Bahubal and Baniachong upazilas of Habiganj districts, South surma of Sylhet district, Belkuchi of Sirajganj district, Saidpur of Nilphamari district, Badarganj, Taraganj and Pirganj of Rangpur district and Fulbari of Kurigram district. Location and fields for the component treatments were selected based on land type, variety cultivated and transplanting time. The field size for each farmer was 100 decimals. One portion of farmer's field was managed with BRRI recommended practices treated as T₁ (Research practice). Another portion was remained under the respective farmers' supervision without any intervention treated as T₂ (Farmers practice). BRRI released popular varieties including new varieties were grown in different locations of Bangladesh (Table 33). Same varieties was used both in T₁ and T₂. In T₁, rice field was refrained from insecticide use up to 40 days after transplanting (DAT) to increase natural enemies in rice field. Insect pests in the rice field was monitored fortnightly by sweeping and visual counting of randomly selected 20 hills. Perching @100/ha was also used in T₁ and insecticide used at ETL based or not. In T₂, farmers were manage the field in his own practice (insecticide application) to control the insect pests. A total of 15 experiments along with four field days were conducted during the season in collaboration with respective BRRI regional stations and DAE office of the locality. Crop cut was done separately both from researchers practiced (T₁) and farmers practiced (T₂) plot for yield comparison.

Results

Insect pests status: Irrespective of locations and rice varieties the insect pests were remain below the economic threshold level (ETL) both in Research practiced (T₁) and farmers practiced field (T₂) during Boro 2023-24 season. Among the insect pests short horned grasshopper (SHG), green leafhopper (GLH), yellow stem borer (YSB), rice leafroller (RLR) and brown planthopper (BPH), white backed planthopper (WBPH) and whorl maggot (WM) were found in all the locations (Figs. 36, 38 and 40). Among the major insect pests highest WBPH (3.38/20 sweep) were found in T₂ followed by BPH (2.75/20 sweep), SHG (2.25/20 sweep), and GLH (1.88/20 sweep). In T₁, SHG was found highest (4.13/20 sweep) followed by GLH (1.13/20 sweep), and WBPH (0.75/20 sweep). Rice leafroller and YSB were found 0.63 and 0.50/20 sweep respectively in T₁ at Sylhet region (Fig. 38).

Insect pests were remained below the economic threshold level (ETL) both in Research practiced (T₁) and farmers practiced field (T₂) in Rangpur region. Short horned grasshopper (SHG) was found highest (4.5/20 sweep) in T₁ compared to T₂ (3.25/20 sweep). Like SHG all other insect pests like GLH, YSB and RLR were also found highest in T₁ (0.50 to 0.75/20 sweep) compared to T₂ (0.38 to 0.50/20 sweep) except BPH (Fig. 39). Brown planthopper was found highest in T₂ (0.38/20 sweep) compared to T₁ (0.25/20 sweep) during Boro season (Fig. 40).

Highest WBPH was found in T₂ (22.38 /20 sweep) followed by BPH (21.8/ 20 sweep). Likewise, T₂ WBPH and BPH were also found highest in T₁ (12.25 and 11.50/20 sweep) respectively at Belkuchi, Sirajganj (Fig. 42). The ranged of other insect pests were found (0.50 to 1.50 /20 sweep)

in T₁ and (0.63 to 2.50/ 20sweep) in T₂ (Fig. 42). During data collection though we observed more predators of BPH and WBPH in the experimental field (Fig. 41), we did not use any insecticide. But farmers used insecticide two-times to control the BPH in T₂ at Belkuchi, Sirajganj. But no hopper burn and no yield reduction was observed both in T₁ compared to T₂.

Natural enemies status: Different common natural enemies i.e., spider (SPD), damselfly (Dam. fly), lady bird beetle (LBB), carabid beetle (CBB) and staphylinid beetle (STB) were found in all locations (Figs. 37, 39 and 41). Among the natural enemies SPD and Dam. fly population were found highest in all the locations (Figs. 37, 39 and 41). Though different natural enemies were found highest in different locations but irrespective of location and variety all natural enemies were found highest in T₁ compared to T₂ (Figs. 37, 39 and 41). Highest spider population (3.75/20 sweep) were found in T₁ followed by green mirid bug (3.25/20 sweep), damsel fly (2.25 /20 sweep) and parasitic wasp (PW) 1.25/20 sweep in Sylhet region (Fig. 39). The range of other natural enemies were found (0.50 to 1.88/ 20 sweep) in T₁ (0.25 to 0.63 /20 sweep) and in T₂ at Sylhet region (Fig. 39).

In Rangpur region, spider population found highest (4.88 /20 sweep) followed by damsel fly (2.13 /20 sweep) and LBB (1.25/20 sweep) during Boro 2023-24 season (Fig. 39). The range of other natural enemies were found (0.63 to 0.75 /20 sweep) and (0.25 to 0.63 /20 sweep) in T₁ and T₂ respectively at Rangpur region (Fig. 41).

In Belkuchi, Sirajganj, spider population found highest (4.75 /20 sweep) followed by damsel fly (4.0 /20 sweep) during Boro 2023-24 season (Fig. 43). The range of other natural enemies were found (0.63 to 0.75 /20 sweep) in T₁ and (0.25 to 0.63 /20 sweep) in T₂ (Fig. 43).

Grain yield: Irrespective of location and variety, the ranged of grain yield were 6.74 to 8.69 t/ha in T₁ and 6.75 to 8.60 t/ha in T₂ (Table 33). Highest yield was obtained in Belkuchi, Sirajganj and lowest was in Baniachong, Habiganj. Breeder seed of BRRI dhan89 was cultivated in Boro-Fallow-Mustard cropping pattern may be the cause of highest yield of BRRI dhan89. Due to blast diseases at Baniachong, Habiganj showed lowest yield in BRRI dhan89 (Table 33). Neither insecticide nor fungicide was used in T₁ in all locations. But herbicide one time, insecticide thrice and fungicides were used twice in T₂ (Farmers practice) which indicated that pesticides were applied 6 times in farmers practiced field (T₂) in a season. But no significance differences of yield were observed in T₁ and T₂ (Table 33).

Table 33. Location, variety and yield in different treatments in insecticide reduction experiment during Boro 2023-24

Sl no	Location	Variety	Area (acre)	Average yield (t/ha)		Remarks
				T ₁	T ₂	
01	Madhabpur, Habiganj	BRRI dhan89	01	8.14	8.09	*Lower yield obtained due to blast disease.
02	Bahubal, Habiganj	BRRI dhan89	01	8.03	8.05	
03	Baniachang, Habiganj	BRRI dhan89	01	6.74*	6.75*	
04	South Surma, Sylhet	BRRI dhan89	02	7.94	7.89	
05	Belkuchi, Sirajganj	BRRI dhan89	05	8.69	8.60	
06	Taraganj, Rangpur	BRRI dhan92	01	7.84	7.79	
07	Saidpur, Nilphamari	BRRI dhan102	01	7.07	7.30	
08	Badarganj, Rangpur	BRRI dhan102	01	7.04	7.06	
09	Pirganj, Rangpur	BRRI dhan102	01	7.73	7.53	
10	Fulbari, Dinajpur	BRRI dhan102	01	7.89	7.86	
Total/average			15	7.71	7.69	

T₁= Research practice T₂= Farmers practice i.e., insecticide application

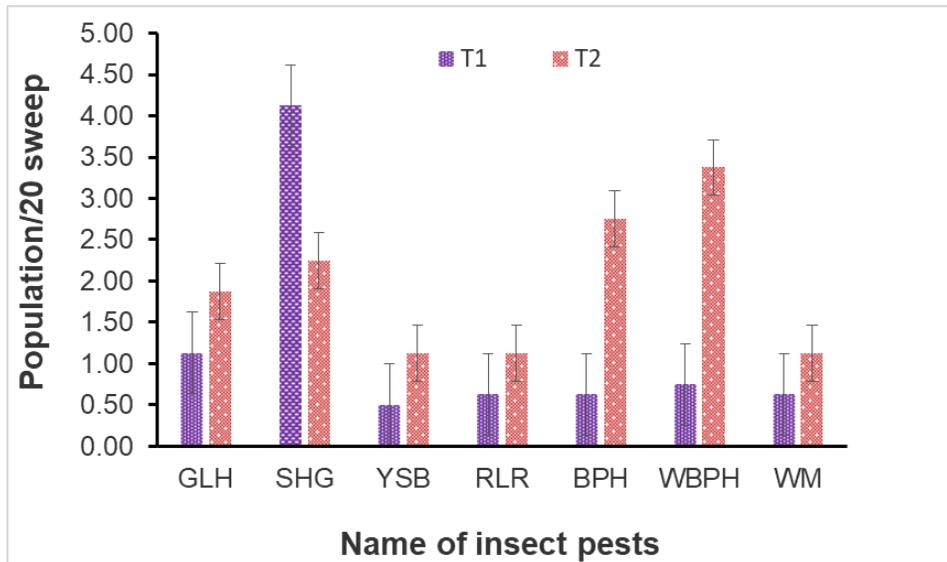


Fig. 38. Insect pests number per 20 complete sweep in different treatments during Boro 2023-24, Sylhet region (T₁=Research practice, T₂= Farmers Practice i.e., insecticide application)

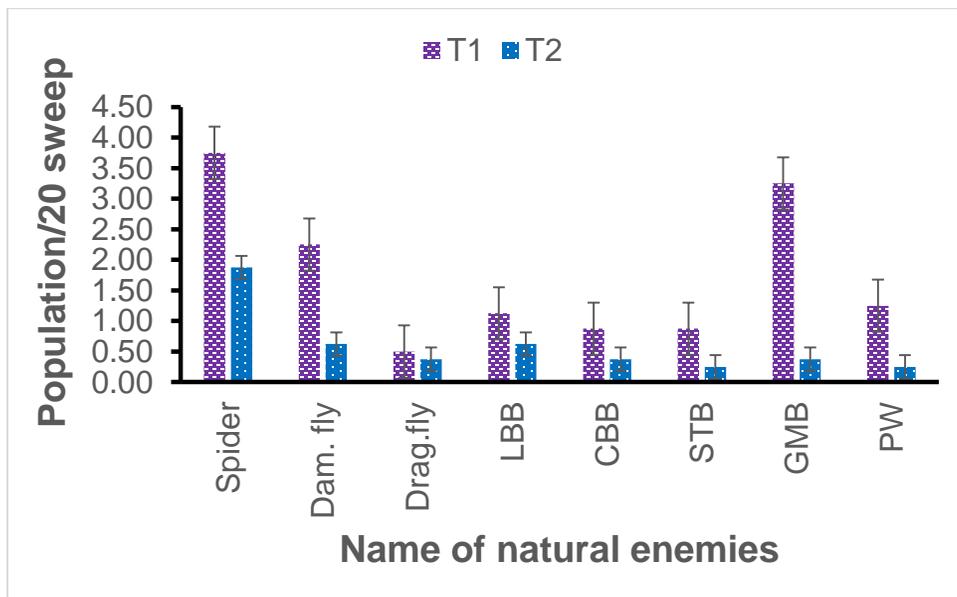


Fig. 39. Natural enemies number per 20 complete sweep in different treatments during Boro 2023-24, Sylhet region (T₁=Research practice, T₂= Farmers Practice i.e., insecticide application)

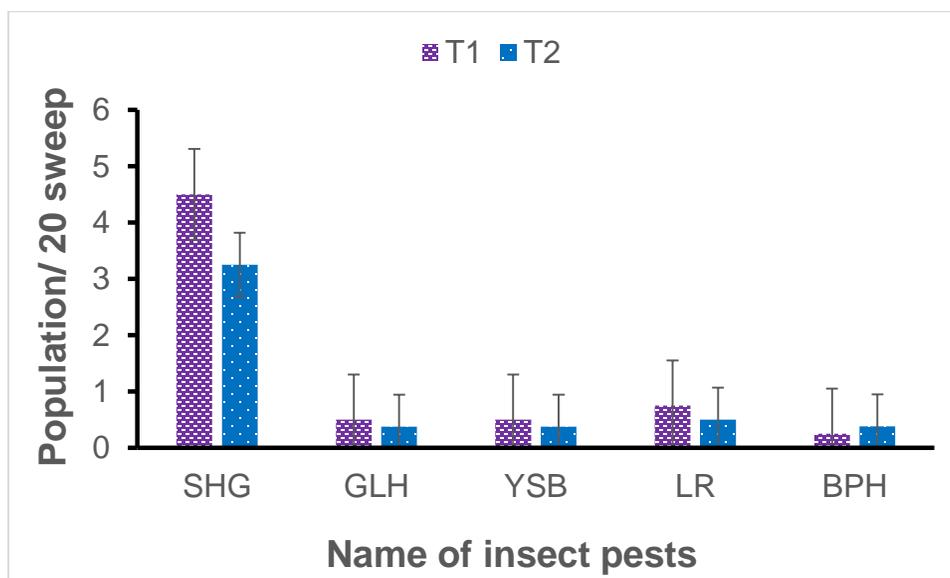


Fig. 40. Insect pests number per 20 complete sweep in different treatments during Boro 2023-24, Rangpur region (T₁= Research practice, T₂= Farmers Practice i.e., insecticide application)

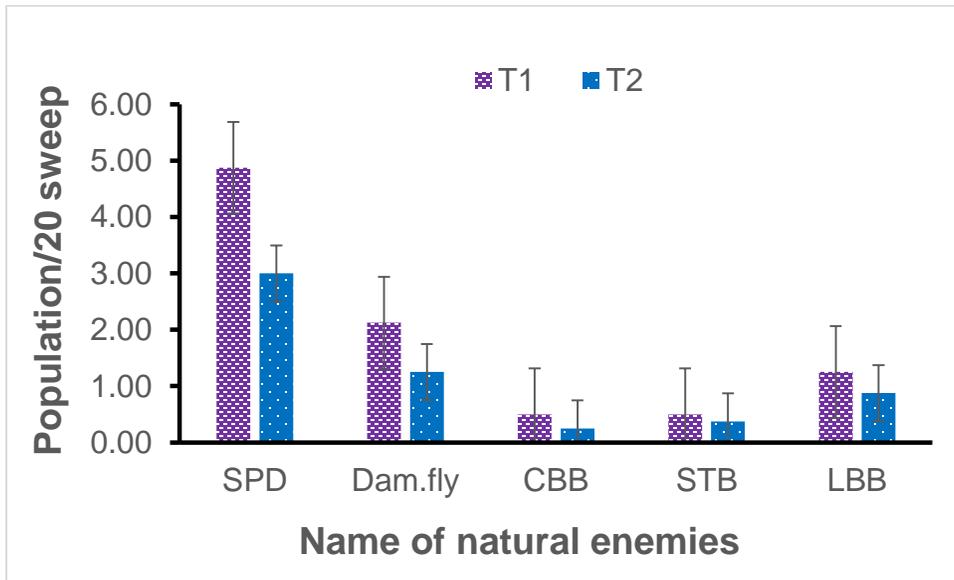


Fig. 41. Natural enemies number per 20 complete sweep in different treatments during Boro 2023-24, Rangpur region (T₁=Research practice, T₂= Farmers Practice i.e., insecticide application)

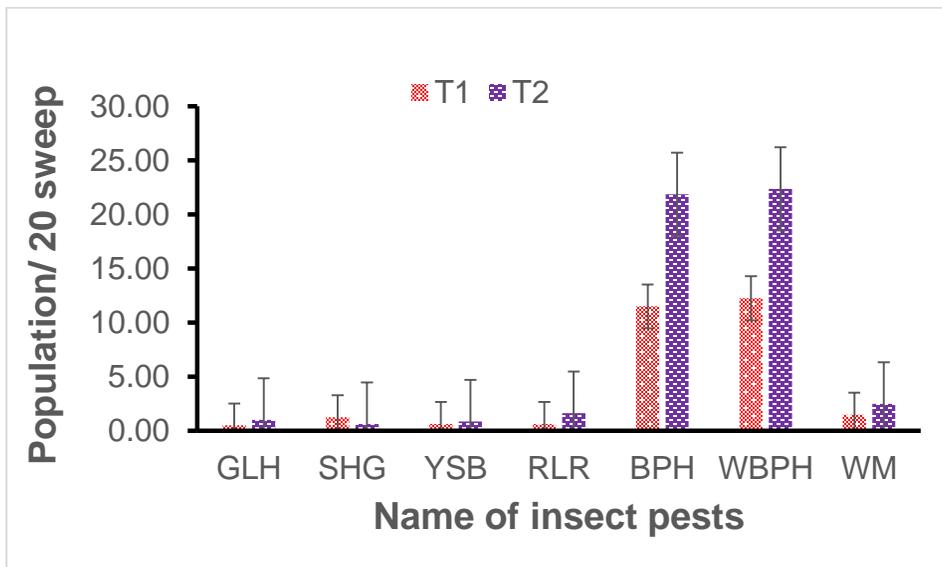


Fig. 42. Insect pests number per 20 complete sweep in different treatments during Boro 2023-24, Belkuchi, Sirajganj (T₁=Research practice, T₂= Farmers Practice i.e., insecticide application)

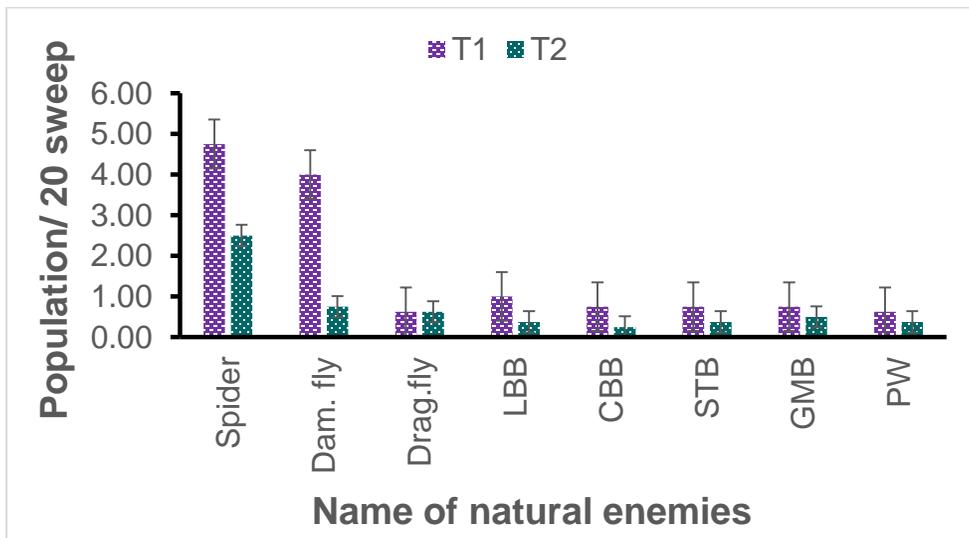


Fig. 43. Natural enemies number per 20 complete sweep in different treatments during Boro 2023-24, Belkuchi, Sirajganj (T₁=Research practice, T₂= Farmers Practice i.e., insecticide application)



Photo 9. Input distribution to farmers, Madhabpur, Habiganj, Boro 2023-24



Photo 10. Field view of the expt. rice production, without insecticide, Madhabpur, Habiganj Boro 2023-24



Photo 11. Field view of the expt. rice production, without insecticide, Bahubal, Habiganj, Boro 2023-24



Photo 12. Field view of the expt. rice production, without insecticide, Belkuchi, Sirajganj, Boro 2023-24



Photo 13. Field view of the expt. rice production, without insecticide, Pirganj, Rangpur, Boro 2023-24



Photo 14. Field view of the expt. rice production, without insecticide, Fulbari, Kurigram, Boro 2023-24

Activities/sub-title 2. Management of insect pests in rice field through eco-engineering

Specific objectives:

- To reduce pesticide dependency and yield loss in rice production.
- To develop eco-friendly insect pests' management technology in rice production.
- To conserve natural enemies (beneficial insects) in rice eco system.
- To reduce insecticide use in rice production and increase farmers income.

Materials and methods: The experiment was conducted in three farmer's fields of Madhabpur, Habiganj, Pirganj, Rangpur and Belkuchi of Sirajganj during Boro 2023-24 season. Location and fields for the component treatments was selected based on land type, variety cultivated and transplanting time. The field size for each farmer was 100 decimals. The field was divided into two blocks for two treatments. The treatments were T₁=Rice field with flowering plants (marigold, sunflower, sesame and cosmos) on bunds (to provide food and shelter for different parasitoids). Three flowering plants were grown in a one-meter distance i.e., plant to plant distance was 500 cm. Rice bunds distance was 5 to 8 m depending on size of the farmers field. So, the row-to-row distance of the flowering plants was 5-8 meter and the length of the rice bunds were in accordance with land size (15 to 30m). The fields of T₁ were maintained an even level of water to minimize weed growth. Seedlings remained free from weed seedlings at the time of transplanting. Balanced doses of basal fertilizer and split apply of nitrogenous fertilizer was applied to reduce planthopper, bacterial blight and stem rot diseases. In T₂=Farmers practiced field; prophylactic insecticide was used at 15 days interval after 1st top dressing of urea fertilizer. Irrespective of locations, twenty complete sweeps were taken from both the blocks. Insect pests and natural enemies number of all sweeps from both blocks were counted and recorded separately.

Results:

Insect pests status: Irrespective of locations and rice varieties the insect pests were remained below the economic threshold level (ETL) both in T₁ (Rice field with flowering plants on bunds) and T₂ (Farmers practice) during Boro 2023-24 season. Among the insect pests short horned grasshopper (SHG), green leafhopper (GLH), yellow stem borer (YSB), rice leafroller (RLR) brown planthopper (BPH), white backed planthopper (WBPH) and whorl maggot (WM) were found in all the locations (Figs. 44, 46 and 48). Short horned grasshopper found highest (5.50/ 20

sweep) in T₁ followed by WBPH (2.50/20 sweep), BPH (2.13/20 sweep) at Madhabpur, Habiganj. The range of other insect pests were found (0.63 to 1.88/ 20 sweep) in T₁ (Fig. 42). But highest WBPH were found (3.75 /20 sweep) in T₂ followed by BPH (3.25/20 sweep) and SHG (1.88/20 sweep). The range of other insect pests were (0.5 to 1.25/20 sweep) in T₂ at Madhabpur, Habiganj (Fig. 44).

In Rangpur region, insect pests were remaining below the economic threshold level (ETL) both in T₁ (Flowering plants grown on rice bunds) and T₂ (farmers practiced) during Boro 2023-24 season. The range of insect pests were (0.13 to 0.88/20 sweep) in T₁ and (0.25 to 1.75/20 sweep) in T₂ (Fig. 46).

In Belkuchi, Sirajganj highest BPH (16.0 /20 sweep) was found in T₂ followed by WBPH (13.88 /20 sweep) compared to T₁, BPH (9.38 /20 sweep) and WBPH (7.88 /20 sweep) during Boro 2023-24 (Fig. 48). The range of other insect pests were found (1.25 to 3.0 /20 sweep) in T₁ and (1.50 to 2.88 /20 sweep) in T₂ (Fig. 48).

Natural enemies status: Different common natural enemies i.e., spider (SPD), damselfly (Dam. fly), lady bird beetle (LBB), carabid beetle (CBB) and staphylinid beetle (STB), green mirid bug (GMB) and parasitic wasp (PW) were found in all locations (Figs. 45, 47 and 49). Among the natural enemies SPD and PW population were found highest in all the locations (Figs. 43, 45 and 47). Though different natural enemies were found highest in different locations but irrespective of location and variety all natural enemies were found highest in T₁ compared to T₂ (Figs. 45, 47 and 49). Highest spider population (7.38/20 sweep) were found in T₁ followed by dam.fly (3.75/20 sweep), LBB (3.50 /20 sweep) and PW (2.88/20 sweep) in Madhabpur, Habiganj (Fig. 45). The range of other natural enemies were found (0.63 to 1.0/ 20 sweep) in T₁. Highest spider population (2.25/ 20 sweep) was found in T₂ (Fig. 45). The ranged of other natural enemies were found (0.25 to 0.63 /20 sweep) in T₂ at Madhabpur Habiganj (Fig. 45).

Spider population found highest (3.50 /20 sweep) followed by PW (1.88 /20 sweep) and damsel fly (1.75 /20 sweep) during Boro 2023-24 season at Pirganj, Rangpur (Fig. 45). The range of other natural enemies were found (0.38 to 1.75 /20 sweep) in T₁ (Fig. 47). All natural enemies were remained below in T₂ compared to T₁. Among them, SPD population found highest (1.75 /20 sweep) and the range of other natural enemies were found very low (0 to 0.63 /20 sweep) in T₂ at Pirganj, Rangpur (Fig. 47).

In Belkuchi, Sirajganj, spider population found highest (9.25 /20 sweep) followed by PW (9.13 /20 sweep), LBB (4.13 /20 sweep) and GMB (3.38 /20 sweep) during Boro 2023-24 season (Fig. 49). The range of other natural enemies were found (0.63 to 2.63 /20 sweep) in T₁ (Fig. 49). Likewise. Pirganj, Rangpur all natural enemies were remained below in T₂ compared to T₁ in Belkuchi Sirajganj. Among them, SPD population found highest (5.75 /20 weep) and the range of other natural enemies were found very low (0.25 to 1.13 /20 sweep) in T₂ at Belkuchi, Sirajganj (Fig.49).

Grain yield: Irrespective of location and variety, the ranged of grain yield were 7.47 to 8.91 t/ha in T₁ (Rice field with flowering plants grown on bunds) and 7.49 to 8.85 t/ha in T₂ (Farmers practice) during Boro 2023-24 season (Table 34). Neither insecticide nor fungicide was used in T₁ in all locations. But herbicide one time, insecticide three times and fungicides were used two times in T₂ (Farmers practice) which indicated that pesticides were applied 6 times in farmers practiced field (T₂) in a season. But no significance differences on yield were observed in T₁ and T₂ (Table 34). On an average grain yield was found 8.18 t/ha in T₁ and 8.17 t/ha in T₂. Moreover, insecticides or fungicide were not use in T₁, which increased farmers income by save the production cost and save the environment from insecticidal pollution. Irrespective of location and variety natural enemies population were found highest in T₁ compared to T₂ which indicated that natural enemies conservation were increased in T₁ by not using insecticide. Thus, farmers can avoid hazardous pesticide by growing flowering plants on rice bunds to control insect pests of rice.

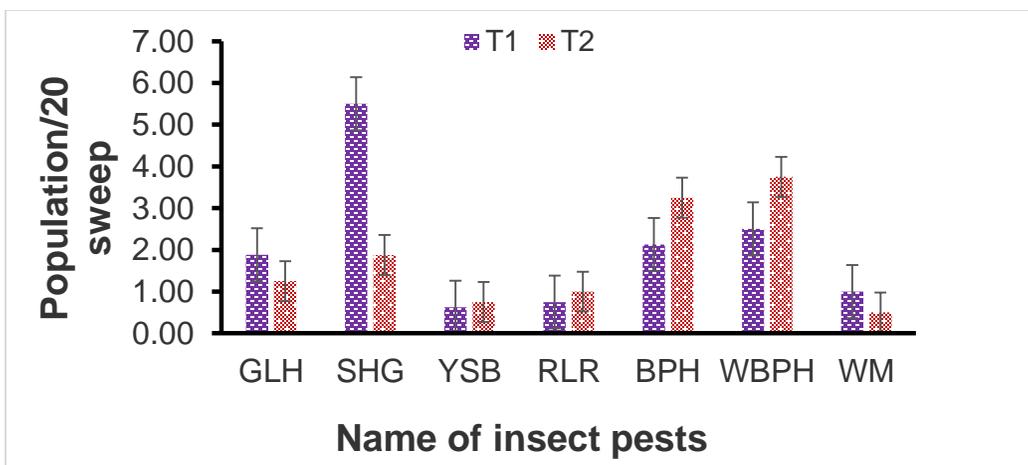


Fig. 44. Insect pests number per 20 complete sweep in different treatments during Boro 2023-24, Madhabpur, Habiganj (T₁=Rice field with flowering plant on bunds, T₂= Farmers Practice i.e., insecticide application)

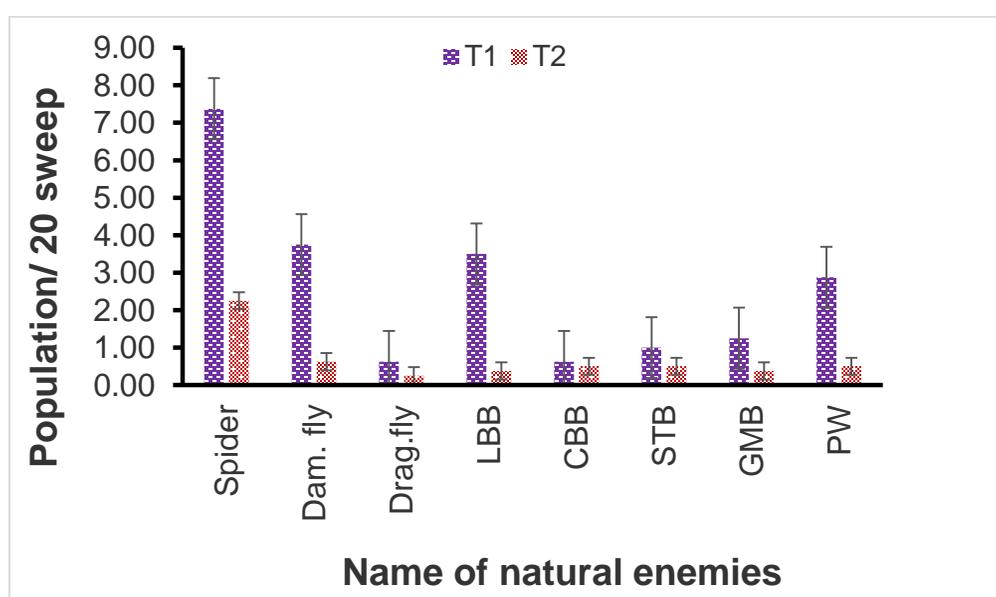


Fig. 45. Natural enemies number per 20 complete sweep in different treatments during Boro 2023-24, Madhabpur, Habiganj (T₁=Rice field with flowering plant on bunds, T₂= Farmers Practice i.e., insecticide application)

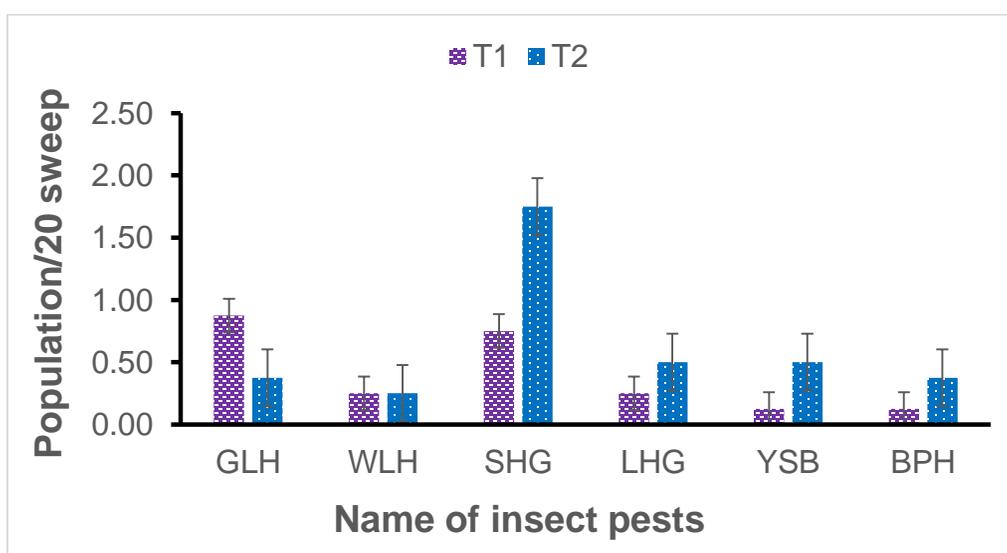


Fig. 46. Insect pests number per 20 complete sweep in different treatments during Boro 2023-24, Pirganj, Rangpur (T₁=Rice field with flowering plant on bunds, T₂= Farmers Practice i.e., insecticide application)

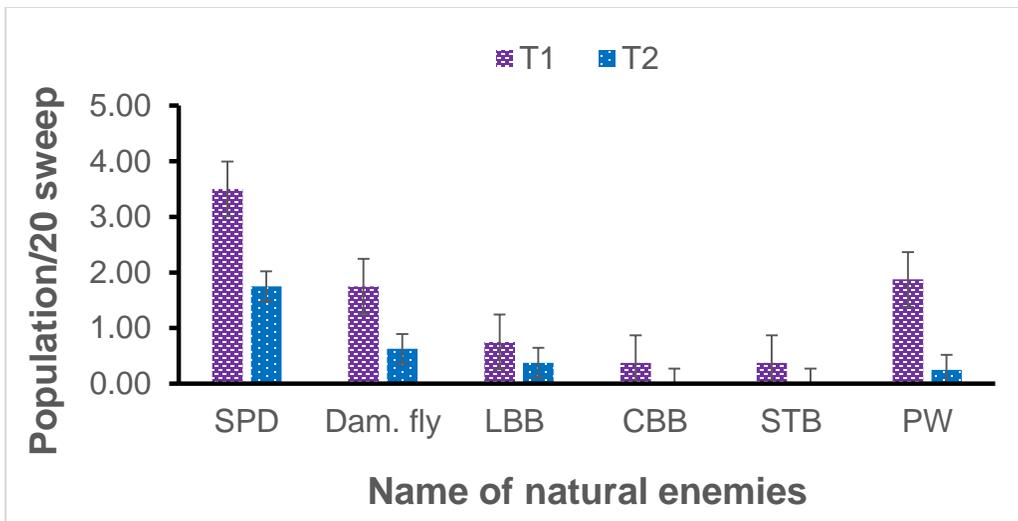


Fig. 47. Natural enemies number per 20 complete sweep in different treatments during Boro 2023-24, Pirganj, Rangpur
(T₁=Rice field with flowering plant on bunds, T₂= Farmers Practice i.e., insecticide application)

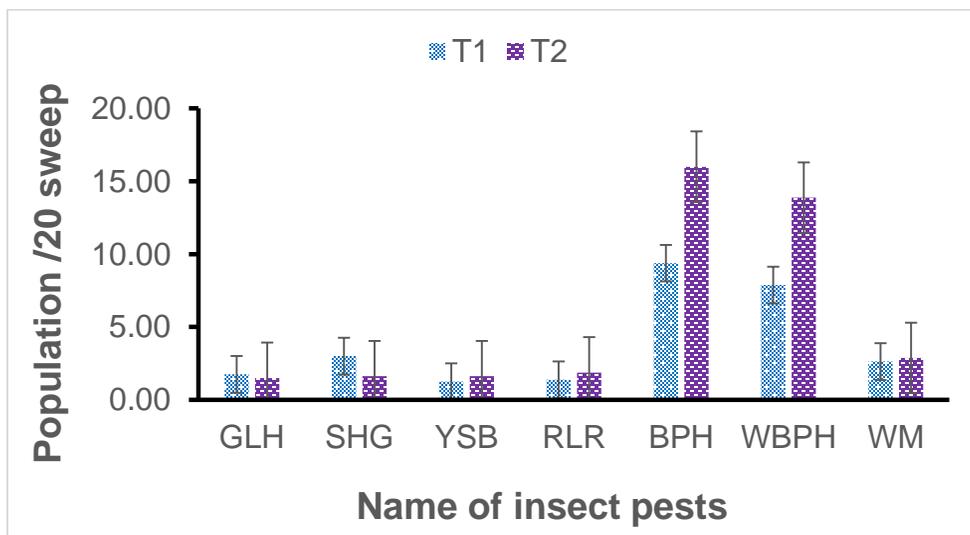


Fig. 48. Insect pests number per 20 complete sweep in different treatments during Boro 2023-24, Belkuchi, Sirajganj
(T₁=Rice field with flowering plant on bunds, T₂= Farmers Practice i.e., insecticide application)

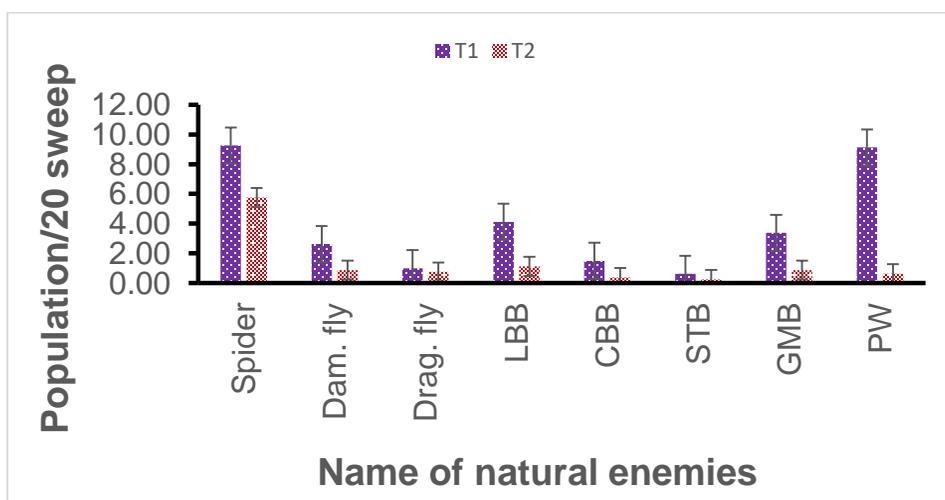


Fig. 49. Natural enemies number per 20 complete sweep in different treatments during Boro 2023-24, Belkuchi, Sirajganj
(T₁=Rice field with flowering plant on bunds, T₂= Farmers Practice i.e., insecticide application)

Table 34. Location, variety and yield in different treatments in ecological engineering experiment during Boro 2023-24

Sl no	Location	Variety	Area (acre)	Average yield (t/ha)	
				T ₁	T ₂
01	Madhabpur, Habiganj	BRR1 dhan89	01	8.17	8.16
02	Belkuchi, Sirajganj	BRR1 dhan89	01	8.91	8.85
03	Pirganj, Rangpur	BRR1 dhan102	01	7.47	7.49
Total/average			03	8.18	8.17

T₁= Rice field with flowering plants on bunds T₂= Farmers practice i.e., insecticide application



Photo 15. Field view of Eco-engineering experiment at vegetative stage, Madhabpur, Habiganj Boro 2023-24



Photo 16. Field view of Eco-engineering experiment at ripening stage, Madhabpur, Habiganj, Boro 2023-24

Activity/sub-title 3. Evaluation of bio, new and combination molecule insecticides against major insect pests of rice

Rationale: Insect pests are increasing day by day with the increasing trend of high yielding rice varieties. Pesticides are widely used and most common in Bangladesh to control the pests. Not only that the pesticide also used as a last resort in Integrated Pest management Programme (IPM). Most of the insect pests has the capabilities to resist the pesticide after a certain period of time when same pesticide was used for a long time to control the certain pests. To combat this problem new molecules of pesticide is required. Now a day's bio-pesticide is widely used due to its low residual effect and less toxicity to natural enemies and the environment. With this connection the

study was undertaken for evaluating bio, new and combination molecules of insecticides against major insect pests of rice.

Objectives:

- To evaluate the effectiveness of commercial formulations of different bio, new and combination molecules insecticides against BPH and YSB of rice.
- To identify less toxic and effective formulations of insecticide for insect management.

Materials and Methods:

Brown Planthopper (BPH): The field trials was conducted in a completely randomized design (CRD) with 4 replications. A large rice field was divided into unit plots. Each plot measuring 4m×5m (20 m²) and the variety was BRR1 dhan87 in T. Aman season and BRR1 dhan89 in Boro season. In each unit plot a test insecticide was applied with standard doses and four hills was selected randomly from each plot. Each hill was representing a replication. One hour after spraying of test insecticides, ten 3rd-4th instar BPH nymphs of greenhouse populations were confined by mylar film cages on each of four randomly selected rice hills. Another plot of same size was used as control without insecticide application. Four hills were select randomly from the control plots and same number of test insects was confined with the same procedure. The granular formulation insecticides were broadcasted one day before infestation and other formulation insecticides were sprayed one or two hours before insect release. Mortality of insects were counted both from treated and untreated plots at 24 and 48 hours after treatment (HAT) and the results were adjusted by Abbott's formula.

Yellow stem borer (YSB): The field trial was conducted in a completely randomized design (CRD) with 4 replications. A large rice field was divided into unit plots. Each plots measuring 4m×5m (20 m²) and the variety BR3 was used in this study. The adult female moths of the insects were captivated in a wire mesh net cage (1.8m × 0.6m) and allowed to lay eggs on potted BR3 plants. After 4-5 days, each egg mass containing rice leaves was cut into a piece and placed separately in a 5 mm glass vials with few drops of water in it. After 6 to 7 days when the egg masses started to hatch, each of the four randomly selected rice hills/plot was separately infest with the 1st instar larvae emerging from one egg mass. Test insecticides was applied one to two hours after infestation. The hills were again infested with new larvae at 48 hours after spraying (HAS) or broadcasting. Another plot of same size in each replication was used as control without applying of any insecticide. The dead hearts were counted at 7 and 14 days after insecticide application both from infested and control plots. Percent dead heart reduction over control was estimated by using the formula of Gomez (1994).

Results: A total of 39 and 25 bio, new and combination formulations insecticides were evaluated against brown planthopper (BPH) and yellow stem borer (YSB) respectively during T. Aman season. Among them 08 and 05 were found effective respectively (Fig. 50). During Boro season, 77 and 08 bio, new and combination formulations insecticides were evaluated against brown planthopper (BPH) and yellow stem borer (YSB) respectively. Among them 56 and 04 were found effective respectively (Fig. 50).

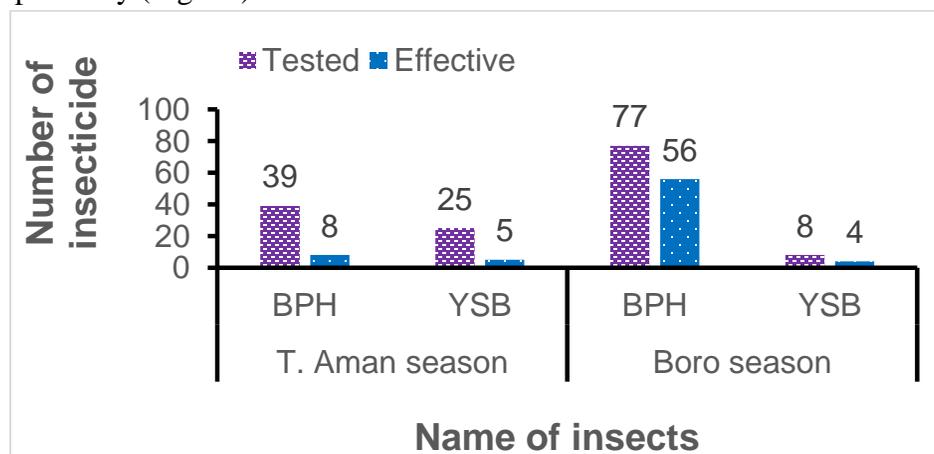


Fig. 50. Evaluation of bio, new and combination molecule insecticides against YSB and BPH



Photo 17. Field view of the expt. evaluation of bio, new and combination molecule insecticides against YSB and BPH, Boro 2023-24

Activity/sub-title 4. Field Day Programme

Four field day programme on ‘**Insect pest management without or less use of insecticide in rice production**’ were conducted at Bahubal, Habiganj, South Surma, Sylhet, Fulbari, Kurigram and Pirganj, Rangpur. Deputy Director, DAE, Rangpur and Kurigram were present as a Chief Guest in Pirganj, Rangpur and Fulbari, Dinajpur respectively. Dr. Md. Nazmul Bari, PSO, Entomology Division, BRRI, Gazipur, Dr. Md. Rokebul Hasan, PSO and Head, BRRI regional station, Rangpur were presented as a Special guest in Fulbari, Kurigram and Pirganj, Rangpur. Dr. Sheikh Shamiul Haque, CSO and Head, Entomology Division, BRRI, Gazipur was the Chairperson of both the Field Day Programme. Scientist from BRRI Gazipur, BRRI regional station Rangpur, Sub Assistant Agriculture Officer and 100 rice growing farmers from the locality were also attended in the field day programme. Mr. Md. Mosaddeque Hossain, PSO, Entomology Division, BRRI, Dr. Md. Mamunur Rashid, PSO and Head, BRRI Regional station, Habiganj, UAO, DAE, Bahubal, Habiganj and South Surma, Sylhet, Scientist from BRRI Regional station, Habiganj and BRRI Gazipur, respective SAAO’s and more than 100 farmers of the locality were present in both the Field Day programme at Bahubal, Habiganj and South Surma, Sylhet.



Photo 18. A view of Field Day programme at Pirganj, Rangpur & Bahubal, Habiganj, Boro 2023-24



Photo 19. A view of Field Day programme at Fulbari, Kurigram

Activity/sub-title 5. Farmers training on integrated pest management (IPM) in rice to ensure safe food production

Specific objectives:

- To disseminate eco-friendly insect pests’ management technologies to farmers.
- To reduce insecticide use in rice production.
- To disseminate the technology on safe and judicious use of insecticide.

Materials and methods: Twelve batch farmers training on ‘Integrated pest management (IPM) in rice’ were conducted in the farmers periphery in collaboration with BIRRI regional station along with respective DAE personnel. Training was conducted in respective experimental site of Entomology Division as well as need based insect pests’ vulnerable areas across the country. Thirty rice growing farmers were included in each batch for a day long training programme. The training was conducted in Belkuchi, Sirajganj; Madhabpur, Habiganj; Fulbari, Kurigram; Pirganj, Rangpur; Trishal, Mymensingh and Sherpur, Bogura. Three hundred sixty farmers were trained up in 12 batch during Boro 2023-24.



Photo 20. A view of farmers training programme at Fulbari, Kurigram