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INSECT PEST STATUS AND INSECTICIDE USE IN T. AMAN RICE CULTIVATION UNDER BARIND AREAS OF BANGLADESH

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ABSTRACT

The study was conducted in four districts viz., Rajshahi, Noagaon, Chapainawabganj and Natore under Barind areas of Bangladesh during July to November 2020 through pre-tested questionnaire survey among the target farmers, i.e. 30 farmers per district to gather information on existing socio-economic aspects of T. Aman rice farmers as well as their opinion on insect pests and insecticide application against insect pest. Most of the farmers were middle to old aged with illiterate to primary level of education having small to medium farm size, small to medium family size with high farming experiences and medium to high level of annual income. According to the farmers' opinion in selected areas, stem borer (*Scirpophaga incertulas*), leaf folder (*Cnaphalocrosis medinalis*) and brown plant hopper (BPH) (*Nilparvata lugens*) were detected as severe while ear cutting caterpillar (*Mythimna separata*) and rice gall midge (*Orseolia oryzae*) were the major insect pests of T. Aman rice. For combating those insect pests', farmers mainly use Thiamethoxam (20%) + Chlorantraniliprole (20%), Chlorpyrifos (20%), Chlorpyrifos (50%) + Cypermethrin (5%), Acephate (45%) + Imidacloprid (25%), Cartap (50%) and Carbofuran (3% or 5%). Number of insecticides use, number of sprays and number of insects pests manage by farmers were positively correlated with the education level, farm size, farming experience and annual income of the respondents.

Keywords: Survey, insecticide using pattern, rice stem borer, brown plant hoppers, leaf folder

Introduction

In Bangladesh, Rajshahi region especially the Barind Tract is different from other parts of the country due to its undulating topography having compact and low fertile soils. The High Barind Tract, lying in Rajshahi, Chapai Nawabganj and Naogaon districts, is one of the distinct areas of Barind, occupying 160.0 thousand ha, roughly 21.0% of the region. The region experienced high temperature with limited soil moisture storage along with low and erratic rainfall (Ali 2000).

Rice dominates the cropping pattern across Bangladesh, with nearly 90% of the population relying on it. Rice production especially in T. Aman rice cultivation is severely hampered by insect pests by chewing leaf and root tissues, boring and tunneling into stems, or sucking fluid sap from stems and grains. However, insect pest attacks frequently occur with varying intensities and frequencies possibly induced by the changes in climate and cropping systems in modern rice cultivation. In Bangladesh rice ecosystems, 267 insect pest species, 185 parasitoids and 192 predators have been identified. However, 20-33 insect species are considered significant pests capable of causing yield losses if they infest plants in sufficiently large numbers (Ali *et al*. 2021).

Crop protection products particularly the use of pesticides is one of the several factors that are contributing to the huge growth in agricultural production (Damalas and Eleftherohorinos 2011). In the process of checking and killing pests over the years, pesticide application in Bangladesh has increased manifold from 758 MT in 1960 and 3028 MT in 1980 to over 19000 MT in 2000 and in 2020, the amount of pesticide applied in fields across the country rose to 37422 MT. Insecticides, being the dominant item, account for 76% of the pesticides applied in year. More than half of the amount of those insecticides was applied against rice pests (BCPA 2020).

The role of insecticide use has become critically important with the modernization of agriculture in Bangladesh.

Mostly Bangladeshi farmers is use insecticides in their agricultural crop fields in the forms of granules, liquid and powder (Akhter *et al*. 2016). In a developing country like Bangladesh, more than 90% of farmers used pesticide without its actual requirements and they used pesticide unnecessarily, indiscriminately and excessively at high concentration and more frequent due to their ignorance and unconsciousness about the use (Akhter *et al*. 2016).

The socio-economic condition of farmers is directly influenced by cropping system, production technology and management strategy against pests (Mohiuddin *et al*. 2009). It is critical to understand the status of current use of pesticides among small-scale farmers in order to promote appropriate pesticide use. Therefore, background information on insect pests and insecticide application with considering socioeconomic condition of farmers is very necessary for taking adaptive measures to climate change for ensuring the food security of Bangladesh. The objective of the study was to gather knowledge on existing socio-economic aspects of T. Aman rice growers as well as their opinion on insect pests attack and insecticide application against them at farm level in the pest control processes.

Materials and Methods

The study was conducted in Rajshahi, Noagaon, Chapainawabganj and Natore district under Barind areas of Bangladesh through pre-tested questionnaire survey among the 120 target farmers (30 farmers per district) during July to November 2020 with the help of Department of Agricultural Extension (DAE). The questions were explained and clarified whenever any respondent feel difficulty in understanding them properly. The demographic data were included age, education, family size, farm size, monthly income and farming experience of the respondents.

According to the BBS (2013) the farm size of the respondents was classified into four categories: marginal farm size (Below 0.02 ha), small farm size (0.02-1.01 ha), medium farm size (above 1.01-3.01 ha) and large farm size (above 3.01 ha). There was made another classification of land area under T. Aman rice cultivation: small (cultivation area below 30 decimal), medium (cultivation area 30-60 decimal) and large (cultivation area above 60 decimal). The farming experience of the respondents was categorized as poor (up to 15 years), moderate (16-20 years) and high (above 20 years). The annual income of the respondents was categorized as low (up to BDT 50000.00), medium (BDT 50000.00-75000.00) and high (above BDT 75000.00).

The insect pests addressed by the farmers were listed and were considered as severe (if reported >80% farmers), major (if reported >40 to 79% farmers) and minor (if reported >1 to 40% farmers) as extent of damage in field according to farmer's response (Hossain *et al*. 2020).

The common name of insecticide was collected from List of Registered Agricultural Pesticides, Bio Pesticides and Public Health Pesticides in Bangladesh by Plant Protection Wing under Department of Agricultural Extension (DAE 2020). The dose and WHO class of the insecticides was collected from label information.

The collected data were coded, complied, tabulated and analyze for processing through tabular method using average, percentage, ratio etc. in accordance with the objectives of the study. The SPSS/PC+ computer program was used to perform the data analysis. Coefficients of correlation (r) was computed to test relationship between the independent and dependent variables.

Results and Discussion

The socio-economic and demographic profile of the respondents are presented in Table 1. The mean age of total respondents was 46.2 years where most of the farmers were older (52.5%), 41.7% farmers were of middle age, and only 5.8% were young farmers aged up to 35 years. A major portion of the farmers was illiterate (51.7%) compared with 23.3% farmers who obtained at least primary education. The percentage of the respondents went up to secondary school was only 5.0%, whereas 20.0% farmers completed their higher secondary level of education. The average family size (no. of family members) of the respondents was 5.3 dominated by medium (45.0%) and small (40.0%) families but the number of farmers with large family were comparatively less (15.0%). Most of the families in the survey area were maintained by male (93.3%), whereas only 6.7% families were under female leadership. The average annual income

Table 1. Demographic profile of farmers in the study area

Character	Measuring unit	Categories	No. of respondents	Percent	Mean
Age	Actual year	Young aged (up to 35)	7	5.8	46.2
		Middle aged (36-50)	50	41.7	
		Old (>50)	63	52.5	
Education	Year of schooling	Illiterate (0)	62	51.7	6.5
		Primary (1-5)	28	23.3	
		Secondary (6-10)	6	5.0	
		Higher (>10)	24	20.0	
Family size	Number	Small (up to 4)	48	40.0	5.3
		Medium (5 to 6)	54	45.0	
		Large (7 and above)	18	15	
Family leadership	Number	Male	112	93.3	-
		Female	8	6.7	
Annual income	Actual (taka)	Low (up to BDT 50000)	21	17.5	85,600.0
		Medium (BDT 50001 to 75000)	40	33.3	
		High (above BDT 75000)	59	49.2	

(BDT) of the respondents was 85,600.00 with more or less equally distributed groups of high income (49.2%), medium income (33.3%) and low income generating farmers (17.5%).

In a case-study on vegetable growers of Tangail district by Islam *et al*. (2022) it was found that most of the farmers were middle to old aged with illiterate to primary level of education having small to medium farm size, small to medium family size with moderate farming experiences and medium to low level of annual income.

The farm size and farming experience of T. Aman rice growers are presented in Table 2. The average farm size of the respondents was 0.256 hectare comprised of mainly small (68.3%) and medium farms (28.3%). Only 3.3% of the farmers had large farm and no farmer was found landless. The average farm size under T. Aman rice cultivation in survey period of the respondents was 75.3 decimal with dominating medium rice field (73.3%), followed by small rice field (25.0%) but only about 1.7% of the farmers had large rice field. The

Table 2. Farm size and farming experience of the farmers in the study area

Character	Measuring unit	Categories	No. of respondents	Percent	Mean
Farm size	Actual (ha)	Marginal (Below 0.02 ha)	0	0.0	0.256
		Small (0.02 ha- 1.01 ha)	82	68.3	
		Medium (above 1.01 ha- 3.01ha)	34	28.3	
		Large (above 3.01 ha)	4	3.3	
Land use for T. Aman rice cultivation	Actual (Decimal)	Small (<30)	30	25.0	75.3
		Medium (30 to 60)	88	73.3	
		Large (>60)	2	1.7	
Farming experience	No. of years	Poor (up to 15)	17	14.2	28.3
		Moderate (16 to 20)	25	20.8	
		High (above 20)	78	65.0	

average farming experience of the respondents was 28.3 years expressing high level (65.0%) to moderate level (20.8%) of farming experience compared to poor farming experience (14.2%).

In another similar study, Hossain *et al*. (2020) found that the most of farmers were middle to old aged (82.5%) with primary to secondary level of education (83.0%), small to medium farm size (97.0%), small to medium family size (mean 5.5) with good farming experiences (mean 15.88 years) and medium to high level of annual income (mean 81100.0 Tk.).

The farmers of the survey area detected a total of 10 insect pests, namely stem borer (*Scirpophaga incertulas)* and leaf folder (*Cnaphalocrosis medinalis*) of Pyralidae Family under Lepidoptera Order, ear cutting caterpillar (*Mythimna separata*) of Noctuidae Family under Lepidoptera Order, brown plant hopper (BPH) (*Nilparvata lugens*) and white backed plant hopper (*Sogatella furcifera*) of Delphacidae Family under Hemiptera Order, green leaf hopper (GLH) (*Nephotettix virescens*) of Cicadellidae Family under Hemiptera Order, rice hispa (*Dicladispa armigera*) of Chrysomelidae Family under Coleoptera Order, rice gall midge (*Orseolia oryzae*) of Cecidomyiidae Family under Diptera Order, rice bug (*Leptocorisa acuta*) of Alydidae Family under Hemiptera Order and grasshoppers (*Hieroglyphus banian, Oxya nitidula*) of Acrididae Family under Orthoptera Order.

Among them, stem borer (88.3%), leaf folder (85.0%) and BPH (93.3%) were marked as severe pests. Ear cutting caterpillar (62.5%) and rice gall midge (54.2%) were considered as major while GLH (37.5%), white backed plant hopper (11.7%), rice hispa (34.2%), rice bug (31.7%) and grasshoppers (15.0%) were considered as minor insect pests based on the extent of crop damage found during the survey (Table 3).

In Bangladesh, rice covers almost 80% of the total cultivable area. Insect pest is a major constraint to rice production. Both the mature and immature stages of insects can injure rice plants by chewing leaf and root tissues, boring and tunneling into stems, or sucking fluid sap from stems and grains. However, insect pest attacks frequently occur with varying intensities and frequencies possibly induced by the changes in climate and cropping systems in modern rice cultivation. Two hundred sixty-seven insect pest species, 185 parasitoids, and 192 predators are

Table 3. Insect pests of T. Aman rice and their status in study area (total 120 respondents)

Name of insect pests	Scientific name	Family and Order	No. of respondents reported	Extent of damage in field (%)	Status
Stem borers	*Scirpophaga incertulas*	Pyralidae Lepidoptera	106	88.3	Severe
Ear cutting caterpillar	*Mythimna separata*	Noctuidae Lepidoptera	75	62.5	Major
Leaf folder	*Cnaphalocrosis medinalis*	Pyralidae Lepidoptera	102	85.0	Severe
Brown plant hopper (BPH)	*Nilparvata lugens*	Delphacidae Hemiptera	112	93.3	Severe
Green leaf hopper (GLH)	*Nephotettix virescens*	Cicadellidae Hemiptera	45	37.5	Minor
White backed plant hopper	*Sogatella furcifera*	Delphacidae Hemiptera	14	11.7	Minor
Rice hispa	*Dicladispa armigera*	Chrysomelidae Coleoptera	41	34.2	Minor
Rice gall midge	*Orseolia oryzae*	Cecidomyiidae Diptera	65	54.2	Major
Rice bug	*Leptocorisa acuta*	Coreidae, Hemiptera	38	31.7	Minor
Grasshoppers	*Hieroglyphus banian Oxya nitidula*	Acrididae Orthoptera	18	15.0	Minor

known to occur in Bangladesh rice ecosystems (Islam and Catling 2012; Islam *et al*. 2003; Ali *et al*. 2017). However, 20-33 species are considered significant pests capable of causing yield losses if they infest plants in sufficiently large numbers. The insect attacking rice can be divided into major and minor pests. The major pest is those which frequently cause very distinct economic damage and minor pests are those insects which are often found but cause less serious damage (Van Halteren 1979). Among these pest species, several of them were considered as minor pests which have recently become major pests. Major insect pests cause about 13% yield losses to Boro, 24% to Aus and 28% to Aman crops. The estimated annual loss of rice in Bangladesh due to insect pest and diseases amounts to 1.5 to 2.0 million tons (Siddique 1992).

Insecticide application against the target pests by farmers in T. Aman rice cultivation has been presented in Table 4. A majority of the farmers (about 95%) were found to apply Thiamethoxam 20% + Chlorantraniliprole 20% in their field against stem borer, leaf folder and ear cutting caterpillar. Chlorpyrifos 20%, another major chemical group was found to be applied by 90.8% farmers to control leaf folder, BPH, stem borers, rice hispa, rice bug and GLH. A total of 73.3% farmers applied Chlorpyrifos 50% + Cypermethrin 5% against BPH and GLH. Acetaphate 45% + Imidacloprid 25% were applied by 66.6% farmers, followed by Thiamethoxam 25% by 29.2% farmers, Pymetrozine 50% by 23.3% farmers, Imidacloprid 20% by 15.0% farmers, Acephate 75% by 13.3% farmers and Acetamiprid 20% by 10.8% farmers to control BPH.

Table 4. Insecticides used against target insect pests of T. Aman rice in study area (total 120 respondents)

Common name of insecticide	Name of target insect pests	No. of respondent reported	Percentage of farmers' used
Thiamethoxam (20%) + Chlorantraniliprole (20%)	Stem borer, leaf folder, ear cutting caterpillar	114	95.0
Chlorpyrifos (20%)	Leaf folder, BPH, stem borer, rice hispa, rice bug, GLH	109	90.8
Chlorpyrifos (50%) + Cypermethrin (5%)	BPH, GLH	88	73.3
Acephate (45%) + Imidacloprid (25%)	BPH	80	66.6
Cartap (50%)	Stem borer, BPH, rice hispa	71	59.1
Carbofuran (3% or 5%)	Stem borer, BPH, gall midge, grasshopper	63	52.5
Acetamiprid (3%) + Cartap (92%)	Stem borer, leaf folder, ear cutting caterpillar	54	45.0
Profenofos (40%) + Cypermethrin (2.5%)	Stem borer, leaf folder	52	43.3
Carbaryl (85%)	GLH, stem borer, leaf folder, ear cutting caterpillar	48	40.0
Thiamethoxam (25%)	BPH	35	29.2
Carbosulfan (20%)	Stem borer, BPH, rice hispa	29	24.2
Pymetrozine (50%)	BPH	28	23.3
Diazinon (10%)	Stem borer, BPH, gall midge	25	20.8
Dimethoate (40%)	BPH, rice hispa, GLH	21	17.5
Fenitrothion (50%)	Stem borer, BPH	20	16.7
Imidacloprid (20%)	BPH	18	15.0
Acephate (75%)	BPH	16	13.3
Acetamiprid (20%)	BPH	13	10.8
Phenthoate (5%)	Stem borer, rice gall midge, BPH, Rice hispa	12	10.0
Others (Unknown)	-	7	5.3

(*Multiple-answer considered)

Table 5. Correlation coefficients (r values) between the socio-economic characteristics and the insecticides use by the farmers

Variables/ Parameter	Age	Education	Family size	Farm size	Farming experience	Annual income
Number of insecticides use	0.035^{NS}	0.425**	0.018^{NS}	0.408**	0.218*	0.283*
Number of sprays	0.024^{NS}	0.340**	0.083^{NS}	0.249*	0.262*	0.419**
Number of insects pests	0.067^{NS}	0.605**	0.009^{NS}	0.411**	0.229*	0.204*

Cartap 50%, Carbosulfan 20% and Dimethoate 40% were found to be applied against stem borer, BPH and rice hispa by 59.1%, 24.2% and 17.5% respondents, respectively. Some of the farmers applied Carbofuran 3% or 5%, Diazinon 10% and Phenthoate 5% (52.5%, 20.8% and 10.0% respondents, respectively) against stem borers, BPH and gall midge. To control stem borer, ear cutting caterpillar and leaf folder, Acetamiprid 3% + Caratp 92%, Profenofos 40% + Cypermethrin 2.5% and Carbaryl 85% were found to be applied by 45.0%, 43.3% and 40.0% farmers, respectively.

Karthikeyan and Christy (2014) observed significantly least stem borer damage in chlorantraniliprole 18.5 EC @150 ml/ha treated plot over untreated check. Seni and Naik (2017) observed that Thiamethoxam 25 WG @ 37.50g a.i/ha was recorded significantly superior (>60 % reduction over control) in efficacy against plant hoppers. Bhavani (2006) also observed the effectiveness of Thiamethoxam 25 WG for suppression of plant hoppers population in rice. Krishnaiah (2004) have found the effectiveness of application of Imidacloprid in suppressing the BPH population. Sulagitti *et al*. (2017) reported that the application of Acetamiprid and Imidacloprid were the most effective against BPH. Thiamethoxam is a neonicotinoid insecticide that selectively and quickly acts on nicotinic receptors, causing pest death in a short time (Maienfisch *et al*. 2001). The field trials conducted by Chen *et al*. 2012 revealed that 25% Pymetrozine + Thiamethoxam SC had a better and quicker action against rice planthoppers than commercial 25% Pymetrozine WP.

The correlation of different socio-economic characteristics of the farmers particularly age, education, family size, farm size, farming experience and annual income with the insecticides use by farmers. Overall, the correlation values indicated that the number of insecticides use, number of sprays and number of insects pests manage by farmers was positively correlated with the education level, farm size, farming experience and annual income of the respondents.

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