Research article **Bangladesh Journal of Entomology**
ISSN (Print): 1021-1004, ISSN (Online): 3007-3332, Website: www.bangladeshes.org
Bangladesh J. Entomol. (2026) 34(1): 45-62

FARMERS' KNOWLEDGE OF INSECT PESTS IN BOTTLE GOURD (*LAGENARIA SICERARIA*) AND THEIR MANAGEMENT PRACTICES IN MAJOR BOTTLE GOURD PRODUCING DISTRICTS OF BANGLADESH

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Received: 5 February 2026; Accepted: 1 April 2026

ABSTRACT

Bottle gourd (*Lagenaria siceraria*) is a popular vegetable crop in Bangladesh including some other countries in Asia. The production of bottle gourd is hampered due to multiple insect pest infestation in recent years. For developing eco-friendly management, a survey among 150 farmers across three major districts of Bangladesh was performed to assess farmers' knowledge and perceptions on insect pest infestation of bottle gourd and management. Results showed that farmers identified a total of 7 insects in bottle gourd. Among them, all the farmers observed fruit fly and red pumpkin beetle as the major insect pest. Approximately 66.67% of farmers reported significant yield loss due to fruit fly infestation, while 22.0% experienced yield loss due to sap beetle infestation. Farmers employed chemical pesticides, pheromone trap, ash, soapy water and bio-pesticides for pest management in bottle gourd. Almost all the respondents (99.3%) applied pesticides more than 5 times in a single growing season. Most of the growers (62.7%) applied pesticides at 15-days interval. Majority farmers (68.67%) didn't receive any training on sustainable management of the insect complex of bottle gourd plant. Authors findings provide insight into the importance of developing sustainable pest management approaches for bottle gourd production in Bangladesh.

Keywords: Survey, insect complex of bottle gourd, eco-friendly & sustainable management

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INTRODUCTION

Bottle gourd is a monoecious annual vine plant that belongs to cucurbitaceae family, is a popular vegetable in Bangladesh (Barot *et al.* 2015, Christenhusz *et al.* 2016). This vegetable derived from African origins and now found in subtropics and the tropics throughout the world (Chimonyo and Modi 2013). It is a popular diet for preparing sweet curries, soups, jams, beverages, cakes, ice creams and tea (Barot *et al.* 2015). This vegetable contains vitamin C and niacin with essential minerals potassium, calcium and phosphorus which makes it nutritiously beneficial for human health (Sawate *et al.* 2009). High fiber content in bottle gourd helps protect the stomach from disorders like constipation and piles. Additionally, bottle gourd consumption helps to prevent diabetes and coronary heart diseases, mental stress, nervous dysfunction, insanity and epilepsy (Hassan *et al.* 2008, Mohale *et al.* 2008).

In Bangladesh, bottle gourd is widely consumed vegetable and locally known as "Lau" (Mohammad *et al.* 2015). Climatic condition of Bangladesh is favorable for growing bottle gourd. According to the Bangladesh Bureau of Statistics, the country produced approximately 0.314 million metric tons of bottle gourd from 0.02 million ha with an average yield of 15.45 million metric tons /ha (BBS 2025). But profitable production sometime hampered due to insect pest infestation (Parkash *et al.* 2023). The production of bottle gourd faces major damage from multiple insect pests including fruit fly (*Bactrocera cucurbitae*), Epilachna beetle (*Epilachna viginctiocpunctata*), white fly (*Bemisia tabaci*), sap beetle (*Epuraea* sp.), squash bug (*Anasa tristis*), leaf cutting caterpillar (*Spodoptera litura*), red pumpkin beetle (*Aulacophora foveicollis*), ash weevil (*Myllocerus subfasciatus*) and aphid (*Aphis gossypii*) (Haldhar *et al.* 2014, Bhowmik and Saha 2017, Parkash *et al.* 2023). In addition, sap beetle (*Epuraea* sp.) and mirid bugs (*Nesidiocoris cruentatus* and *Metacanthus pulchellus*) have emerged as new threat in bottle gourd production in Bangladesh and India, respectively (Mondal *et al.* 2022, Halder *et al.* 2021). Among these insects, fruit flies, red pumpkin beetles, and sap beetles can cause yield losses of over 50% in bottle gourd, while fruits affected by mirid bugs experience a significant reduction in market value (Sohrab and Prasad 2018, Abrol *et al.* 2019, Bhowmik and Saha 2017, Mondal *et al.* 2022, Halder *et al.* 2021).

Sustainable bottle gourd production demands urgent development of efficient management systems for controlling pest pressure. But before implementing any intervention, it is necessary to understand the current field data on insects in bottle gourd, and the effectiveness of existing management practices. Farmers traditional knowledge, perceptions and pest management strategies are necessary to develop successful pest management approaches (Olaniran *et al.* 2014). Besides, participatory farmer survey will help to design proper field monitoring tools, field guide and exploring potential approaches for pest protection (Litsinger *et al.* 2009, Midega *et al.* 2012). Still now, no studies investigate farmer viewpoints regarding insects of bottle gourd while the threat from these insect-pest continues to expand throughout Bangladesh. Therefore, this study aims to explore the farmers' knowledge and perceptions regarding insect pest infestation and their management strategies in bottle gourd field in some areas of Bangladesh.

MATERIALS AND METHODS

Survey: To assess the incidence and damage severity of different insect pests of bottle gourd and their managements, a comprehensive cross-sectional survey was conducted across the country. Before the survey, a pre-survey was conducted for the clarity of questions and identifying any potential biases or problems that might arise during the entire survey. Survey was performed in three most significant bottle gourd producing districts, namely Jashore, Sylhet and Chuadanga - between December, 2020 to February, 2021. Among these districts, three upazilas (sub-districts) such as Sylhet Sadar upazila (24.8917˚N 91.8833˚E) of Sylhet, Jashore Sadar upazila (23.1681˚N 89.2042˚E) of Jashore, Chuadanga Sadar upazila (23.6417˚N 88.8583˚E) of Chuadanga district were selected to complete the survey (Fig. 1).

Following Amon-Armah *et al.* (2023), a standardized, semi-structured questionnaire was developed, including both open-ended and closed-ended questions of different titles for effective survey (Table 1). The questionnaire contained 22 questions. The questions were written in English at first and then translated into Bengali for the farmers' convenience. Most of the data were collected when the farmers were in their field so that it would be easy to make them understand the question and answer. The questionnaires were divided into 4 parts. Socio-demographic characteristics and bottle gourd farming practices were

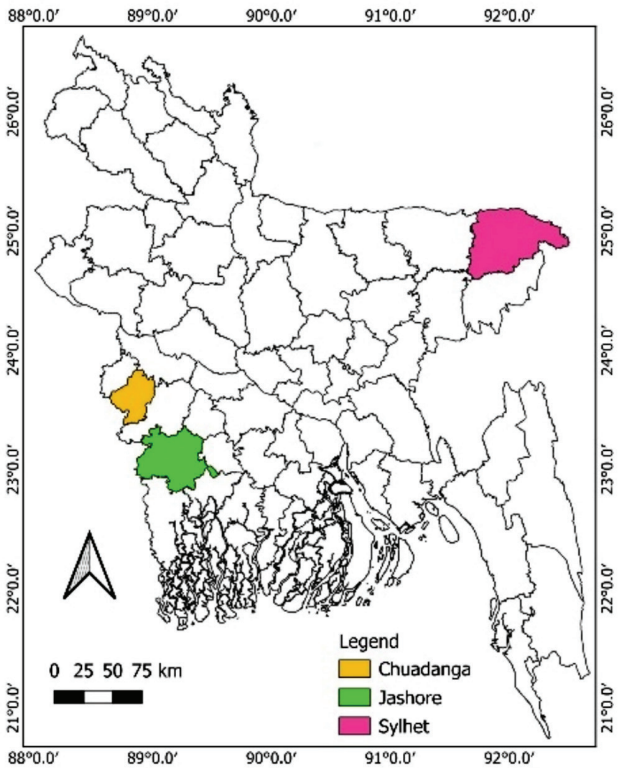

Fig. 1. Map showing the survey areas of bottle gourd insect pest in Bangladesh during 2020-2021

the main subject in the first section of the questionnaire. In the second part of the questionnaire, farmers' knowledge and perceptions on insect infestation in bottle gourd field was highlighted. The third section of the questionnaire aimed to gather information on farmers' insect-pest management strategies for bottle gourd, as well as the training status of the farmers about pest management of bottle gourd (Table 1). For the identification of bottle gourd insects, a laminated photograph was composed containing different key insects and their damage. The images of the insects were selected based on pre-survey and review and literature (Bhowmik and Saha 2017, Chanda *et al.* 2022).

Data collection: A face-to-face interview of 150 farmers was conducted with 50 farmers included from each upazila of each district. Farmers were randomly selected through consultation with the Agriculture Extension Officers (AEO) from

Table 1. Overview of survey questionnaire on insect pest infestation and its damage in bottle gourd across three surveyed districts of Bangladesh

Question group	Description
Farmers' socio-demographic characteristics and bottle gourd farming practices	1. Farmers' age 2. Farmers' gender 3. Farmers' educational level 4. Land type 5. Experience of bottle gourd cultivation 6. Varity of cultivated bottle gourd
Farmers' knowledge of insect infestation in bottle gourd	1. Major insect pest of bottle gourd 2. Insect pests at vegetative stage 3. Insect pests at reproductive stage 4. Yield loss caused by insect infestation 5. Effect of fruit fly infestation on shape and size of bottle gourd
Farmers' management practices of insect-pest and training status	1. Which type of methods do you apply? 2. How many times you apply pesticide? 3. In which stage you start to apply pesticide? 4. Pre-harvest interval of insecticide application 5. Did you get any training about bottle gourd pest management strategies?

the respective upazilas of the surveyed districts. The following equation was used to determine the total number of respondents (n = 150) for selecting farmers from the three districts. using following formulas:

$$n = \frac{N}{1+N\,\varepsilon^2}$$

Where, n is the sample size, N is the total number of farmers in each area and is the desired number of errors (Tuan *et al.* 2014).

Statistical Analysis: All the collected data were summarized and descriptive statistics (frequencies and percentages) were calculated using SPSS (version 27). The percentages of farmers' responses were calculated for each category of related response. The data were visualized through python (version 3.11.5) using pandas, matplotlib, seaborn libraries. Bar charts and pie charts were created to visualize the farmers' responses clearly.

RESULTS

Farmers' socio-demographic characteristics: The socio demographic results showed that among the surveyed bottle gourd farmers, majority of them (88.7%) were male and about 25.7% were in middle aged (31-45), whereas 19.3% were between 46-60 years. About 30.7% farmers got only primary level education. According to the results, about 70% of farmers have their own land for cultivation whereas 52.7% farmers cultivated bottle gourd taking land for lease. In the surveyed areas, 36% farmers have 1-5 years of bottle gourd cultivation experience whereas 28.7% farmers have more than 20 years of experiences (Table 2).

Table 2. Socio-demographic conditions of the bottle gourd farmers in three surveyed districts of Bangladesh (n=150)

Factor	Category	Frequency	% of total farmers
Age (years)	15-30	9	3.0
	31-45	77	25.7
	46-60	58	19.3
	>60	6	2.0
Gender	Male	133	88.7
	Female	17	11.3
Education level	Illiterate	2	1.3
	Only Signature	33	22.0
	Class 1-5	46	30.7
	Class 6-9	31	20.7
	SSC (Secondary School Certificate)	29	19.3
	HSC (Higher Secondary Certificate)	7	4.7
	Graduate	2	1.3
Land type	Own	105	70
	Lease	79	52.7
	Borga (Tenant)	21	14.0
Experience in bottle gourd cultivation (years)	1-5	54	36.0
	6-10	16	10.7
	11-15	20	13.3
	16-20	17	11.3
	>20	43	28.7

Farmers' knowledge and perception of insect pests of bottle gourd in Bangladesh: In Bangladesh, several varieties of bottle gourd are cultivated. Among them, the high-yielding hybrid varieties such as Moina, Daina, Marshal, and White Gold are particularly popular and widely recognized by the farming communities in the Sylhet, Jashore, and Chuadanga districts. (Table 3). All the framers (100%) in surveyed areas reported aphid, fruit fly and red pumpkin beetle as the major pests in their bottle gourd field. On average more than 50% farmers observed tobacco cutworm in bottle gourd plant. A large percentage of farmers (more than 70%) identified squash bug and sap beetle as major threat in bottle gourd (Table 4). The results revealed that all the farmers (100%) reported the presence of aphids and red pumpkin beetles during the vegetative stage of bottle gourd (Table 5).

According to the farmers, fruit fly (99.3%) and sap beetle (86.7%) were the most observed insects in bottle gourd plant at reproductive stage (Table 6). Most of the farmers (66.67%) identified fruit fly as the key insect that causes significant yield loss of bottle gourd. In addition, 22% of farmers reported sap beetle as a responsible pest to the yield loss of bottle gourd. A smaller number of farmers (7.3% -14%) identified aphids, thrips, and squash bugs as the causes of yield loss in bottle gourd (Table 7). Almost all the farmers (99.33%) reported that shape and size of bottle gourd distorted when fruit fly attacks the bottle gourd fruit (Fig. 2).

Table 3. Cultivated varieties of bottle gourd in three surveyed districts of Bangladesh (n=150)

Sylhet	Jashore	Chuadanga
Moina	Marshal	Moina
Diana	BARI Sita lau 1	Diana
Marshal	Diana	White Gold
White Gold	Moina	
Bari lau 2		

Table 4. Farmers' knowledge (%) on major insect pest of bottle gourd in three surveyed districts of Bangladesh (n=150)

Insects Name	Scientific Name	Family	Order	% respondent in different study areas		
				Sylhet	Jashore	Chuadanga
Aphid	*Aphis* spp.	Aphidoidea	Hemiptera	100	100	100
Fruit Fly	*Bactrocera cucurbitae*	Tephritidae	Diptera	100	100	100
Red pumpkin beetle	*Aulacophora faveicollis*	Chrysomelidae	Coleoptera	100	100	100
Thrips	*Magalurothrips* sp.	Thripidae	Thysanoptera	28	37	58
Tobacco Cutworm	*Spodoptera litura*	Noctuidae	Lepidoptera	66	49	76
Squash Bug	*Anasa tristis*	Coreidae	Hemiptera	87	70	92
Sap beetle	*Epuraea* sp.	Nitidulidae	Coleoptera	79	63	86

Table 5. Farmers' knowledge (%) on insect pest observed in vegetative stage of bottle gourd in three surveyed districts of Bangladesh (n=150)

Insects Name	Scientific Name	Family	Order	Frequency	% Respondents
Aphid	*Aphis* spp.	Aphidoidea	Hemiptera	150	100
Tobacco Cutworm	*Spodoptera litura*	Noctuidae	Lepidoptera	23	15.5
Squash Bug	*Anasa tristis*	Coreidae	Hemiptera	8	5.3
Red pumpkin beetle	*Aulacophora faveicollis*	Chrysomelidae	Coleoptera	150	100

Table 6. Farmers' knowledge (%) on insect pest observed in reproductive stage of bottle gourd in three surveyed districts of Bangladesh (n=150)

Insects Name	Scientific Name	Family	Order	Frequency	% respondents
Fruit fly	*Bactrocera cucurbitae*	Tephritidae	Diptera	149	99.3
Sap beetle	*Epuraea* sp.	Nitidulidae	Coleoptera	130	86.7
Thrips	*Magalurothrips* sp.	Thripidae	Thysanoptera	74	49.3

Table 7. Farmers' knowledge (%) on yield loss of bottle gourd due to the insect pest infestation in three surveyed districts of Bangladesh (n=150)

Insects Name	Scientific Name	Family	Order	Frequency	% Respondents
Fruit fly	Bactrocera cucurbitae	Tephritidae	Diptera	100	66.67
Aphid	*Aphis* spp.	Aphidoidea	Hemiptera	11	7.3
Red pumpkin beetle	*Aulacophora faveicollis*	Chrysomelidae	Coleoptera	4	2.7
Thrips	*Magalurothrips* sp.	Thripidae	Thysanoptera	21	14.0
Squash Bug	*Anasa tristis*	Coreidae	Hemiptera	11	7.3
Tobacco Cutworm	*Spodoptera litura*	Noctuidae	Lepidoptera	5	3.3
Sap beetle	*Epuraea* sp.	Nitidulidae	Coleoptera	33	22.0

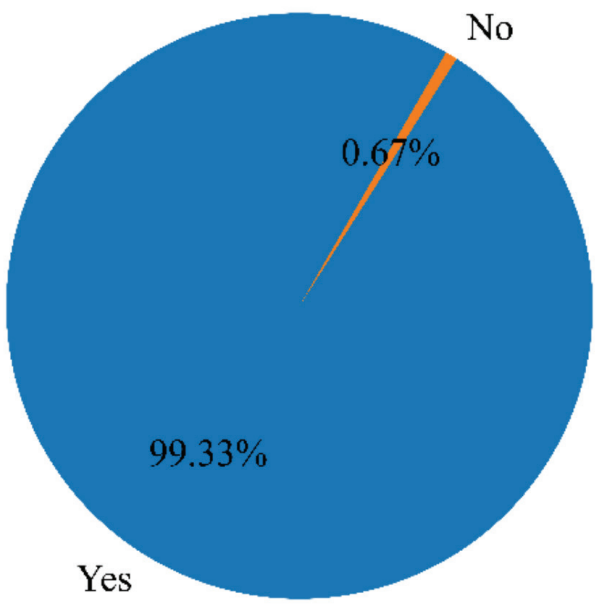

Fig. 2. Farmers' responses (%) of the impact of fruit fly infestation on the shape and size of bottle gourd in three surveyed districts of Bangladesh (N= 150)

Management practices implemented by farmers against insect pest of bottle gourd: The results revealed that, almost 100% of the farmers applied chemical pesticides to control bottle gourd insects and pests. Around 70% of the farmers used pheromone traps for fruit fly control, whereas 37.3%, 44% and 21% farmers applied soapy water, bio pesticides, and ash respectively (Fig. 3). Almost all farmers (99.3%) applied pesticides more than five times in a single bottle gourd cropping season, and majority of them (71.3%) started applying insecticides at seedling stage of bottle gourd (Figs. 4a-b). About 62.7% farmers maintained 15 days interval for insecticide application whereas 37.3% applied insecticide at 7 days interval. Most of the farmers (34%) stop insecticide application 4-5 days before harvesting of bottle gourd, while 30.7% and 18.7% farmers stop 6-7 days and 2-3 days before harvesting, respectively (Figs. 5a-b). Among the total respondents, majority of the farmers (68.67%) did not take any kind of training on pest management of bottle gourd (Fig. 6).

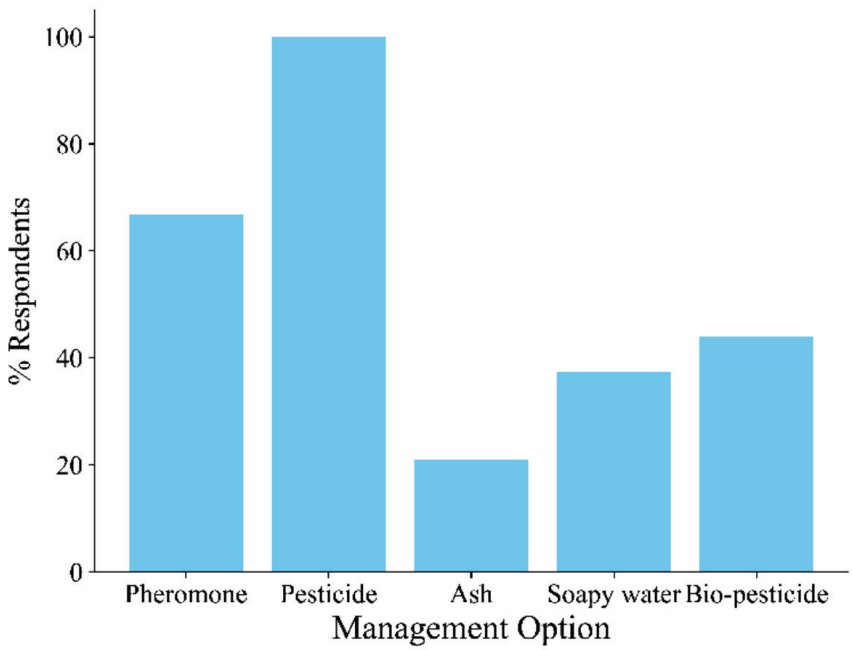

Fig. 3. Farmers' responses (%) on the use of management practices against the infestation of insect pests of bottle gourd in three surveyed districts of Bangladesh (N= 150)

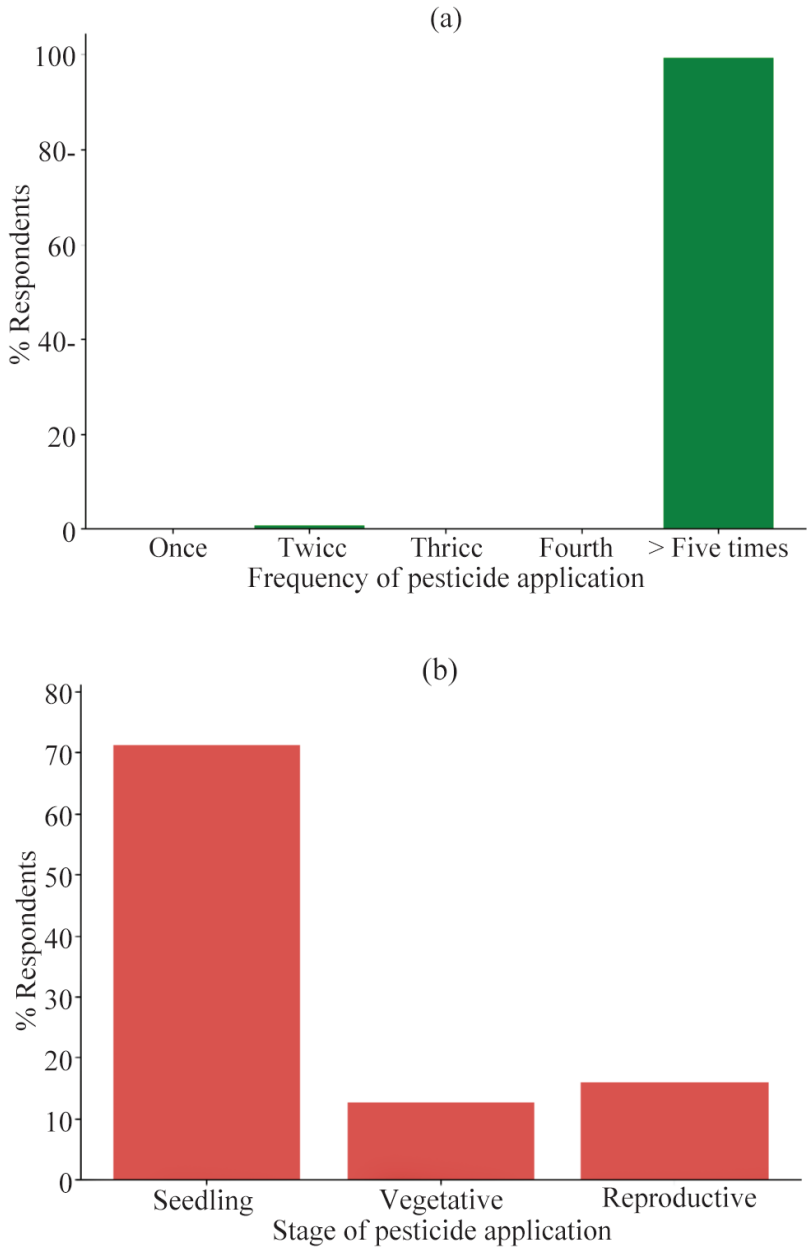

Fig. 4. Farmers' responses (%) on (a) the frequency of pesticides application, (b) the growth stages of pesticide application in a single bottle gourd growing season in three surveyed districts of Bangladesh (N= 150)

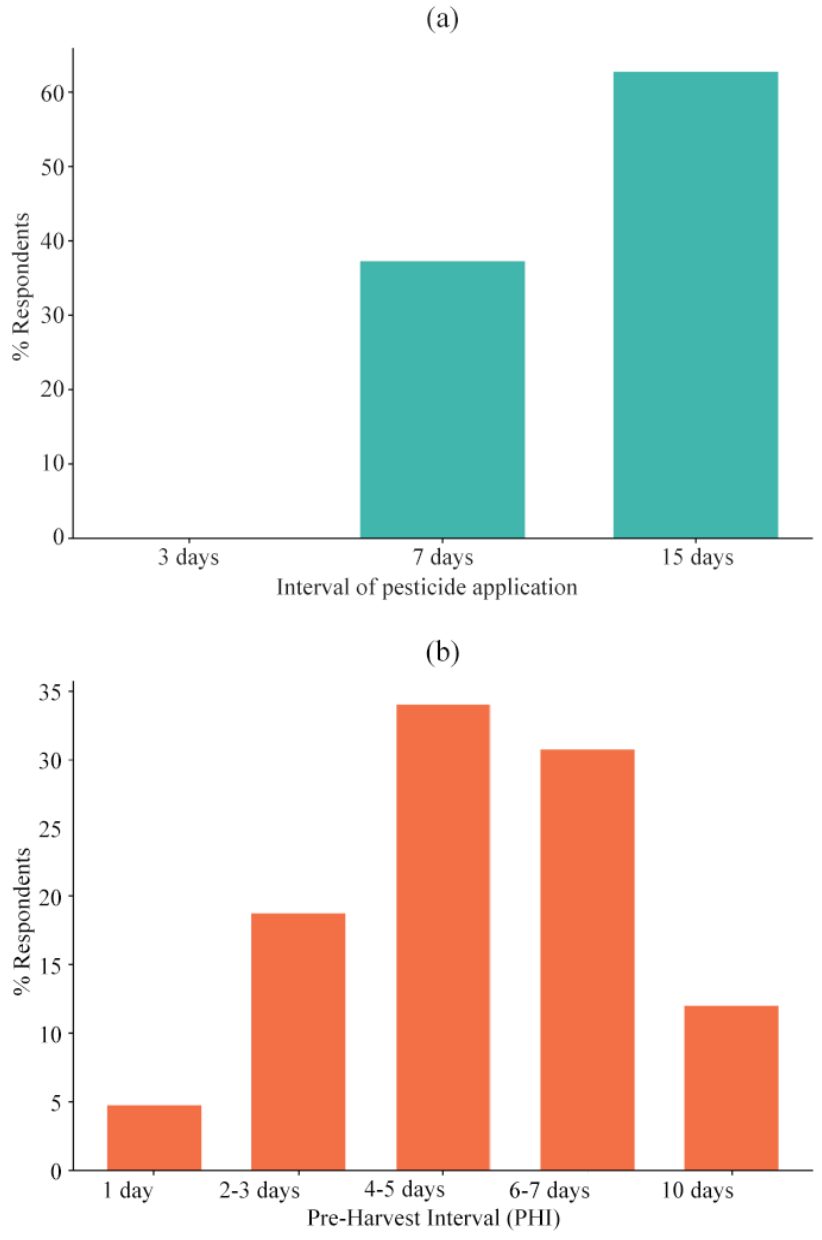

Fig. 5. Farmers' responses (%) on (a) interval of pesticides application; (b) Pre Harvest Interval (PHI) and in the bottle gourd field against the insect pests in three surveyed districts of Bangladesh (N= 150)

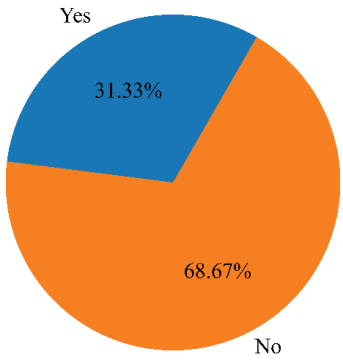

Fig 6: Farmers' responses (%) about training program on bottle gourd insect pest in three surveyed districts of Bangladesh (N= 150)

DISCUSSION

Results showed that most of the bottle gourd farmers were male, middle-aged and primarily educated in the surveyed districts. Several researches reported that most of the farmers are male, mid-aged, and primarily educated in Bangladesh (Islam *et al.* 2020, Rahman *et al.* 2022). The majority of the bottle gourd farmers in the survey areas cultivated hybrid varieties like Moina, Daina, Marshal and White gold. These results may be because of the higher yield of these varieties. Developed varieties provide higher yields, and that's why they are very common and cultivated by the growers in the most growing areas in Bangladesh (Miah *et al.* 2015, Sohrawardy and Sultana 2019).

All the bottle gourd growers identified aphid, fruit fly, red pumpkin beetle, are the main insect pests of bottle gourd. Several researches reported significant damage of fruit fly, red pumpkin beetle, in bottle gourd production (Sarker and Akter 2017, Abrol 2019, Rashid *et al.* 2014, Dhillon *et al.* 2005). Majority farmers reported that aphid attacked in bottle gourd at seedling stage and cause curling and yellowing of tender leaf. Islam (2020) also reported that aphid attack at seedling stage of bottle gourd, hamper the growth of tender leaf and disseminate the viral disease. The current results revealed that all bottle gourd farmers have been faced red pumpkin beetle infestation at vegetative stage in bottle gourd plant. Red pumpkin beetle attacked predominantly on leaves, flower buds and flowers of bottle gourd

plant (Rashid *et al.* 2014, Gahlot *et al*. 2024). The percentage of damages due to red pumpkin beetle reached up to 35-75% at seedling stage that might cause 30-100% yield losses in the bottle gourd (Dilon *et al.* 2005, Rahman and Uddin 2016). Results showed that majority of the farmers faces severe fruit fly infestation in their bottle gourd field. In addition, all the farmers agreed that shape and size of bottle gourd was distorted due to fruit fly attack. Several researches reported fruit fly as one of the major pests in cucurbit crops, and it can cause up to 100% yield loss in bottle gourd and other cucurbits at reproductive stage by damaging the fruits (Abrol 2019, Sarker and Akter 2017, Bhoumik *et al.* 2017). Our findings revealed that a significant number of farmers reported sap beetle infestation during the flowering stage of bottle gourd. Additionally, farmers also identified that this insect caused considerable yield loss in bottle gourd. Mondal *et al.* (2022) showed that sap beetle can reduced 29.6% to 52.6% yield by reducing flower setting of bottle gourd plant in North-eastern region of Bangladesh.

All the farmers in the surveyed areas mainly applied pesticide for pest management. Additionally, significant number of farmers used pheromone, bio-pesticide, soapy water and ash as their pest management strategies. Islam *et al.* (2023) confirm that farmers predominantly rely on chemical pesticides for pest control, whereas notable number of farmers adopting mechanical (pheromones, soapy water) and biological (biopesticides) methods for pest management strategies. Farmers applied pesticide more than five times in a single bottle gourd growing season. Most farmers applied pesticides at intervals of 7-15 days, while the majority maintained a pre-harvest interval of 4-7 days. Bentley and Jeffery (2009) reported that the farmers of Norsingdi district applied insecticides at least 6-7 times in a week for controlling cucurbit fruit fly in vegetable crops. In another study, Chanda *et al.* (2022) reported that majority of farmers employed insecticides 30-40 times as chemical control approach in vegetable production to combat pumpkin beetle, epilachna beetle, thrips, jassid, field cricket, leaf eating weevil, and mealy bug insects. Most of the farmers in our surveyed districts got no training on pest management of bottle gourd. Lack of field-based training among farmers is the main reason for farmers' misconceptions about proper pest management strategies. Feder *et al.* (2004) stated that field level training helps the farmers to adopt more sustainable methods of pest management.

CONCLUSION

Bottle gourd is one of the popular vegetables in Bangladesh. A large number of farmers face a great problem for insect pest infestation in bottle gourd production. The aim of this research was to assess the status of insect pest infestation in the field and explore the management practices employed by farmers. The survey results revealed that fruit fly, aphid, red pumpkin beetle, epilachna beetle and sap beetle were the major pest in bottle gourd field. Significant numbers of farmers are facing yield loss of due to fruit fly and sap beetle in bottle gourd. Farmers apply chemical pesticides, pheromone and bio pesticide to control the insect pests. Almost all the farmers applied pesticide severely in a single growing season. Farmers applied pesticides indiscriminately, without following the recommended application intervals. Most of the farmers didn't get any training about pest management of bottle gourd. Our baseline survey will help the policymaker to understand the seriousness of insect pest infestation in bottle gourd, as well as will help to develop sustainable insect management approaches.

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