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INSECT PEST STATUS AND INSECTICIDE USE IN SUMMER VEGETABLES: A CASE STUDY IN TANGAIL DISTRICT OF BANGLADESH

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ABSTRACT

The study was conducted in Dhanbari and Madhupur upazila under Tangail district through pre-tested questionnaire survey among the target farmers (60 farmers per upazilla) during July to October 2020 to gather knowledge on existing socio-economic aspects of summer vegetables growers as well as their opinion on insect pests and insecticide application against those pests at farm level. 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. According to the farmers opinion, brinjal shoot and fruit borer, okra shoot and fruit borer, fruit fly, whitefly, hairy caterpillar, armyworm and jassid were the major insect pests of brinjal, okra, cucurbits, red amaranth, Indian spinach and taro in the selected areas. For combating those insect pests, farmers mainly used Thiamethoxam (20%) + Chloranlraniliprole (20%), Carbosulfan (20%), Emamectin Benzoate (5%) against shoot and fruit borer, Profenofos (40%) + Cypermathrin (2.5%) as well as Cypermathrin (10%) against fruit fly, Chlorpyrifos (50%) + Cypermathrin (5%) as well as Imidacloprid (20%) against whitefly and Cypermathrin (10%) against hairy caterpillar.

Keywords: Survey, pattern of pesticide use, vegetable pests, pesticide hotspots, pest management

Introduction

Modernization of agriculture implies the increased use of modern inputs such as chemical fertilizers, irrigation, quality seeds etc. However, those practices provide a favorable climate for rapid growth of pests (Krebs *et al*. 1999). Pests, including insects, mites, pathogens (disease causing organisms), weeds, nematodes, rodents and others significantly responsible to high farm production costs and reduce quality and yields (Henneberry *et al.* 1991). The yield loss by different agricultural pests varies in different environment conditions but can exceed 65% in Bangladesh (BARI 1999).

For vegetables in general, Sabur and Mollah (2000) observed an increase in use of pesticides by farmers in combating pests throughout Bangladesh. Under farmers' field conditions, in certain years and places, yield losses range from 35% to 80% – up to 100% loss has been recorded due to a single insect or disease. Therefore, the use of pesticides in Bangladesh has increased over the last 4 decades (Rahman *et al.* 2012).

Insecticides are those which are applied to the field to manage insect pests for increasing the productivity. 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 socioeconomic condition of farmers directly influences the production technology and management strategy against insect pests (Mohiuddin *et al*. 2009). 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. This study was conducted to know the insect pest status and insecticide use in summer vegetables in Tangail district.

Materials and Methods

Pre-designed and pre tested interview schedule was used for data collection. The study was conducted in Dhanbari and Madhupur upazilas under Tangail district through pre-tested questionnaire survey among the 120 target farmers (60 farmers per upazila) during July to October 2020 with the help of Department of Agricultural Extension (DAE) to gather knowledge on existing socio-economic aspects of vegetables growers as well as their opinion on insect pests attack and insecticide application against them at farm level in the pest control processes. The selected study areas is now a famous vegetables growing regions of Bangladesh. 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 ha-1.01 ha), medium farm size (above 1.01 ha- 3.01ha) and large farm size (above 3.01 ha). There was made another classification of land area under vegetables cultivation: small (vegetables cultivation area 0-10 decimal), medium (vegetables cultivation area 11-20 decimal) and large (vegetables cultivation area above 20 decimal). The farming experience of the respondents was categorized as poor (up to 15 years), moderate (16-20 years) and high (above 15 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 common name of insecticide was collected from List of Registered Agricultural Pesticides, Bio Pesticides and Public Health Pesticides in Bangladesh by Plant Protection

Table 1. Socio-economic and demographic profile of the respondents in the study area

Character	Measuring unit	Categories	No. of respondents	Percent	Mean
Age	Actual year	Young aged (up to 35)	26	21.7	44.4
		Middle aged (36-50)	52	43.3	
		Old (>50)	42	35.0	
Education	Year of schooling	Illiterate (0)	42	35.0	6.2
		Primary (1-5)	48	40.0	
		Secondary (6-10)	20	16.7	
		Higher (>10)	10	8.3	
Family size	Number	Small (up to 4)	54	45.0	5.2
		Medium (5 to 6)	44	36.7	
		Large (7 and above)	22	18.3	
Family leadership	Number	Male	112	93.3	-
		Female	8	6.7	
Annual income	Actual (taka)	Low (up to BDT 50000)	38	31.7	78,600.0
		Medium (BDT 50001 to 75000)	46	38.3	
		High (above BDT 75000)	36	30.0	

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.

Results and Discussion

Socioeconomic and demographic profile of the farmer: The socioeconomic and demographic profile of the respondents is presented in Table 1. The mean age of total respondents was 44.4 years where the most of the farmers were middle aged (43.3%) followed by old aged (35.0%), whereas 21.7% farmer was found under young aged. The education level of most of the respondents was limited to primary school (40.0%) followed by illiterate farmers (35.0%) and 16.7% respondents went up to secondary school, but the number of farmer completed their higher secondary level of education were competitively less (8.3%). The average family size (No. of family member) of the respondents was 5.2 with dominating small (45.0%) and medium (36.7%) family size but the number of farmer whereas large family size were comparatively less (18.3%). Most of the families in the survey area were maintained by male (93.3%) but only 8.3% family was under the leadership of female. The average annual income (BDT) of the respondents was 78,600.00 with more or less equally distributed group as medium income (38.3%), low income (31.7%) and high income generating farmer (30.0%).

In a survey in using patterns of pesticides by Akhter *et al*. (2016) in Jhenidah district, nearly 36% farmers were within 31-40 years old, 31% farmer were 41-50 years old, 19% farmer were 20-30 years old, 11% farmer were 51-60 and only 3% farmer were over 60 years old. The education status of the farmers shown that was 42% had attained primary level, 26% secondary level, and 16% higher secondary, 10% illiterate and only 6% farmers were graduate. The study revealed that the literacy percentage (about 65.0%) of the farmers in the study area were quite higher than that of national average (51.6%) (Krishi Diary 2009). The average size of the household was 5.2, which was more or less similar to the national average (5.0) (BBS 2016).

Farm size and farming experience of the vegetables growers: The farm size and farming experience of the vegetables growers is presented in Table 2. The average farm size (decimal land area) of the respondents was 0.25 ha with dominating small farm (52.5%) and medium farm size (37.5%) but only about 5.0% farmer was found as

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

Character	Measuring unit	Categories	No. of respondents	Percent	Mean
Farm size	Actual (Decimal)	Marginal (<0.02 ha)	6	05.0	0.25
		Small (0.02-1.01 ha)	63	52.5	
		Medium (1.01-3.01 ha)	45	37.5	
		Large (>3.01 ha)	10	08.3	
Land use for vegetables cultivation	Actual (Decimal)	Small (<10)	70	58.3	24.0
		Medium (11 to 20)	32	26.7	
		Large (>20)	18	15.0	
Farming experience	No. of years	Poor (up to 15)	23	19.2	18.4
		Moderate (16 to 20)	64	53.3	
		High (above 20)	33	27.5	

Table 3. Summer vegetables with target insect pests and applied insecticides by the farmers in the selected study area during July to October 2020

Vegetables	Target pest	Name of insecticide(s) used	WHO class	Dose
Brinjal	Jassid	Chlorpyrifos 50% + Cypermathrin 5%	II	1 ml/L of water
		Chlorpyrifos 48%, 20%	II	1 ml/L of water
	Brinjal shoot and fruit borer	Thiamethoxam 20% + Chloranlraniliprole 20%	No class	0.5 ml/L of water
		Carbosulfan 20%	II	1 ml/L of water
		Emamectin Benzoate 5%	II	1 g/L of water
		Cartap 50%	II	2.5 g/L of water
Okra	Jassid	Chlorpyrifos 50% + Cypermathrin 5%	II	1 ml/L of water
		Chlorpyrifos 48%, 20%	II	1 ml/L of water
	Okra shoot and fruit borer	Thiamethoxam 20% + Chloranlraniliprole 20%	No class	0.5 ml/L of water
		Emamectin Benzoate 5%	II	1 g/L of water
Cucurbits	Fruit fly	Profenofos 40% + Cypermathrin 2.5%	III	2 ml/L of water
		Cypermathrin 10%	III	1 ml/L of water
	Whitefly	Imidacloprid 20%	III	0.5 ml/L of water
		Chlorpyrifos 50% + Cypermathrin 5%	II	1 ml/L of water
Red Amaranth	Hairy caterpillar	Cypermathrin 10%	III	1 ml/L of water
		Dimethoate 40%	II	2 ml/L of water
	Whitefly	Imidacloprid 20%	III	0.5 ml/L of water
Indian spinach	Hairy caterpillar	Cypermathrin 10%	II	1 ml/L of water
		Dimethoate 40%	II	2 ml/L of water
	Whitefly	Imidacloprid 20%	III	0.5 ml/L of water
Taro	Prodenia caterpillar	Thiamethoxam 20% + Chloranlraniliprole 20%	No class	0.5 ml/L of water
		Chlorpyrifos 50% + Cypermathrin 5%	II	1 ml/L of water

landless and 8.3% of the farmers were with large farm size. The average farm size under vegetables cultivation in survey period (decimal land area) of the respondents was 24.0 decimal with dominating small vegetable farms (58.3%) followed by medium vegetable farms (26.7%) but only about 15.0% of the farmers was with large vegetable farms size. The average farming experience (No. of year of farming) of the respondents was 18.4 years with dominating moderate (53.3%) to high level (27.5%) of farming experience compared to poor farming experience (19.2%). In a survey on maize farmers in Barind areas of Bangladesh, 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.).

Vegetables cultivation with target insect pests and applied insecticides by the farmers: Vegetables cultivation, insecticide application with target insect pests by the farmers has presented in Table 3. The vegetables crops namely brinjal, okra, cucurbits, red amaranth, Indian spinach and taro were mostly grown in the study area. In case of brinjal, jassid and brinjal shoot and fruit borer were found as major insect pests. To control these insect pests, Chlorpyrifos 50%+ Cypermathrin 5% and Chlorpyrifos 48%, 20% under the toxicity class II according to WHO (World Health Organization) were found to be applied in their field at 1ml/L of water against Jassid. Thiamethoxam 20% + Chloranlraniliprole 20% (no class of toxicity) at 0.5ml/L of water, Carbosulfan 20% (WHO toxicity class II) at 1 ml/L of water, Emamectin Benzoate 5% (WHO toxicity class II) at 1 g/L of water and Cartap 50% (WHO toxicity class II) at 2.5 g/L of water were found to be applied against brinjal shoot and fruit borer. Similar to brinjal in case of okra, jassid and okra shoot and fruit borer were controlled using the above discussed insecticides except Cartap 50% was not found to be used against okra shoot and fruit borer. Fruit fly and whitefly were found as the major insect pests of cucurbits. Fruit fly of cucurbits were found to be controlled by using Profenofos 40% + Cypermathrin 2.5%, Cypermathrin 10% which were under the class III at 2 ml/L of water and 1 ml/L of water, respectively. Imidacloprid 20% of the toxic class III was applied at 0.5 ml/L of water and Chlorpyrifos 50% + Cypermathrin 5% under the toxic class II was applied at 1 ml/L of water to control whitefly of cucurbits. In case of red amaranth and Indian spinach, the insect pests were the same (hairy caterpillar and whitefly) and their control measures were also found the same. Cypermathrin 10% under the toxicity class III at 1 ml/L of water and Dimethoate 40% under the toxicity class II at 2 ml/L of water were applied against hairy caterpillar. Imidacloprid 20% was found to be applied at 0.5 ml/L of water to control whitefly of red amaranth and Indian spinach. Prodenia caterpillar of taro was found to be controlled by using Thiamethoxam 20% + Chloranlraniliprole 20% at 0.5 ml/L of water and Chlorpyrifos 50% + Cypermathrin 5% at 1 ml/L of water.

Synthethic prethroid insecticides are now increasingly used on many crops because of some of their interesting properties, such as greater photo-stability, effectiveness at low concentrations, low environmental persistence, and easy breakdown as compared to organochlorine and organophosphorus insecticides. They constitute approximately 25% of worldwide insecticide market for plant protection and have been in use for more than 40 years (Shafer *et al*. 2005).

In a survey by Mohiuddin *et al*. (2009) on insecticide use on vegetables cultivation at farm level in Chittagong region found that about 23% of total land was used for brinjal, country bean and yard long bean cultivation. The farmers were growing brinjal, country bean and yard long bean in their 10%, 6%, and 7% of the total cultivated land, respectively. Shoot and fruit borer as the main insect pest in brinjal while 91% of them mentioned pod borer as the damaging insect in yard long bean. The bean borer and whitefly were reported to both major insects in country bean by 77% and 70% of the farmers, respectively.

Cypermethrin 10 EC or Cyfluthrin (Bethroid) 50 EC @ 1.0 ml per liter of water or Fanvalerate 20 EC @ 0.5 ml per liter of water was found to be effective in controlling the vegetables pest in Bangladesh when 3 to 4 sprays of any of the above insecticides were applied on plants at an interval of 15 days, starting from the first flowering (Karim 1994).

Hossain *et al*. (2020) studied that for combating insect pests of maize, farmers mainly use Chlorpyrifos (50%) + Cypermethrin (5%) against cutworm and fall armyworm as well as Thiamethoxam (20%) + Chlorantraniliprole (20%) against stem borer, pink stem borer and cob borer.

Status of the product name of the chemical group of insecticides used in the study area: Status of the product name of the chemical group of insecticides used in the study area is presented in Table 4. Considering the opinion given by the farmers, Chlorpyrifos 50% + Cypermathrin 5% was used as the brand names Nitro 505 EC, AC Mix 55 EC and Nurelle D 505. According to the findings, Nitro 505 EC was used by 50.8% respondents (61 respondents out of 120), whereas 36.7% farmers was used AC Mix 55 EC (44 respondents) and 7.5% farmers was used

Table 4. Status of the product name of the chemical group of insecticides used in the selected study area

Common name	Product name with formulation	No. of respondents (120)	Percent
Chlorpyrifos 50% + Cypermathrin 5%	Nitro 505 EC	61	50.8
	AC Mix 55 EC	44	36.7
	Nurelle D 505	9	7.5
Chlorpyrifos 48%, 20%	Dursban 20 EC	48	40.0
	Pyrifos 20 EC	36	30.0
	Classic 20 EC	24	20.0
	Neptune 48 EC	8	6.7
Thiamethoxam 20% + Chloranlraniliprole 20%	Gola 48 EC	58	48.3
	Virtako 40 WG	86	71.7
	Voliam Flexi 300 SC	24	20.0
Carbosulfan 20%	Marshal 20 EC	39	32.5
	Crown 20 SC	9	7.5
Emamectin Benzoate 5%	Proclaim 5 SG	112	93.3
	Protect 5SG	76	63.3
	Bicolaim 5SG	23	19.2
Cartap 50%	Care 50 SP	34	28.3
	Tenup 4G	14	11.7
	Suntap 50 SP	56	46.7
Profenofos 40% + Cypermathrin 2.5%	Shobicron 425 EC	22	18.3
Cypermathrin 10%	Ralothrin 10 EC	12	10.0
	Caught 10 EC	67	55.8
	Ripcord 10 EC	35	29.2
	Messi 10 EC	21	17.5
	Others	3	2.5
Imidacloprid 20%	Admire 20 SL	36	30.0
	Tez 20 SL	52	43.3
	Imitaf 20 S	45	37.5
	Others	2	1.7
Dimethoate 40%	Rogor 40 L	4	3.3
	Tafgor 40 EC	7	5.8

(*Multiple-answer considered).

Nurelle D 505 (9 respondents). Chlorpyrifos 48%, 20% were popularly used as Gola 48 EC to 48.3% of total respondents (58 respondents), followed by 40.0% of total respondents (48 respondents) as Dursban 20 EC, 30.0% of total respondents (36 respondents) as Pyrifos 20 EC, 20.0% of total respondents (24 respondents) as Classic 20 EC and 6.7% of total respondents (8 respondents) as Neptune 48 EC. Thiamethoxam 20% + Chloranlraniliprole 20% were found very popular insecticide in the study area. A total of 71.7% of total respondents (86 respondents out of 120) were used this insecticide as Virtako 40 WG and 20.0% of total respondents (24 respondents) was found to be used as Voliam Flexi 300 SC against their target pests. Carbosulfan 20% was popularly used as Marshal 20 EC by 32.5% of total respondents (39 respondents) and 7.5% of total respondents (9 respondents) as Crown 20 SC. Emamectin Benzoate 5% was also found very popular insecticide in the study area. About 93.3% of total respondents (112 respondents out of 120) were found to be applied as Proclaim 5 SG and 63.3% of total respondents (76 respondents) and 19.2% of total respondents (23 respondents) were found to be used as Protect 5 SG and Bicolaim 5 SG, respectively. For Cartap 50%, a total of 46.7% of total respondents (56 respondents) were used Suntap 50 SP followed by 28.3% of total respondents (34 respondents) and 11.7% of total respondents (14 respondents) as Care 50 SP and Tenup 4G, respectively. Profenofos 40% + Cypermathrin 2.5% were used as Shobicron 425 EC by 18.3% of total respondents (22 respondents). In case of used Cypermathrin 10% against different target insect pests, 55.8% of total respondents (67 respondents) was found to be used as Caught 10 EC followed by 29.2% of total respondents (35 respondents) used Ripcord 10 EC, 17.5% of total respondents (21 respondents) used Messi 10 EC, 10.0% of total respondents (12 respondents) was found to be used Ralothrin 10 EC and only 2.5% respondents used others brand name of Cypermathrin 10%. Imidacloprid 20% was popularly used by the farmers of the study area and Tez 20 SL was found to applied by 43.3% of total respondents (52 respondents out of 120) followed by Imitaf 20 SL by 37.5% of total respondents (45 respondents), Admire 20 SL by 30.0% of total respondents (36 respondents) and others brand name was only used by 1.7% of total respondents (2 respondents). Dimethoate 40% was a minor group of insecticides used as Tafgor 40 EC by 5.7% of total respondents (only 7 respondents out of 120) followed by Rogor 40 L by 3.3% of total respondents (4 respondents).

In a survey on insecticide use on vegetables cultivation at farm level in Chittagong region by Mohiuddin *et al*. (2009) revealed that Chittagong farmers used a variety of pesticides belonging to different chemical groups with different formulations, such as emulsifiable concentrate (EC), soluble powder (SP), granular (G), and water-soluble concentrate (WSC). Carbosulfan (Marshall) 20 EC and carbofuran (Furadan) 5 G were the most popular chemicals, being used by 36%, and 25%, of the vegetables growers, respectively. Other insecticides as: Malathion (Fyfanon) 57 EC, Cypermethrin (Ostad) 10 EC, Dimethoate (Perfecthion) 40 EC, Cartap (Cartuf) etc. were used in lesser quantities.

Mohiuddin *et al*. (2009) also studied that most of the farmers relied only on insecticide for control of insect pests and maximum of them (80%) used it from the initial attack and thereafter on a routine basis. Only 16% of the farmers of both Hathazari and Satkania and 4% farmers of Patiya sprayed insecticides in their fields without observing the attack of insect pests. The proportion of farmers spraying insecticides after detection of insect pest in their crops was 28% in Satkania, 24% in Hathazari and 16% in Patiya.

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