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INSECTICIDE USE PATTERN ON SUMMER TOMATO PRODUCTION IN JASHORE AND SATKHIRA DISTRICTS OF BANGLADESH

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Abstract

The study was conducted at summer tomato growing areas in Jashore and Satkhira districts of Bangladesh to describe the insecticide use pattern on summer tomato production. Ninety farmers were selected randomly and an interview schedule was developed according to the objective of the study. Farmers of the study area used 16 different types of pesticides and most of them were toxic. In the study area 77.77% of the farmers sprayed insecticides on summer tomato one or more than one times in a week, 82.2% of the farmers harvested their crop at 0-5 days after spraying, 31.1% of the farmers depended on pesticide dealer for insecticide related knowledge, maximum farmers (84.4%) mixed different types of insecticides during spraying, most of the farmers (65.6%) measured insecticides approximately, 73.3% of the farmers started 1st spray without observing any insect in the field and 51.1% of the farmers didn't use any safety measures during spraying insecticides. Farmer's education, farm size annual income, training experience had negative relationship with the schedule of insecticide spray and positive relationship with the harvesting time after insecticide spray, use of tools for measuring pesticide, use of safety method where most of the relationships were significant.

Keywords**:** Summer tomato, Insecticides, Spraying frequency, Pre harvest interval, Safety method, Correlation.

Introduction

Agricultural production in Bangladesh is diversifying with high-value crops rather than solely focusing on rice to provide food security (FAO, 2011). Tomato (*Solanum Lycopersicum*) is the world's fourth most valuable food crop in terms of production, yield, commercial use, and consumption (Schreinemachers *et al.*, 2018). After eggplant and potatoes, tomatoes are the most significant vegetable in Bangladesh (Schreinemachers *et al.*, 2016). But tomato plant is highly susceptible to many insect pests and plant pathogens which cause large amount of economic losses and lead to the excessive use of pesticides. In the world, over 385 million people per year suffer from acute pesticide poisonings (Boedeker *et al*., 2020).

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Although tomato plants may thrive in a variety of climates, they are particularly vulnerable to the hot, humid conditions that characterize Bangladesh's summer and rainy seasons (Karim *et al.,* 2009). The optimum time to plant tomatoes in Bangladesh is in the early part of November when the climate remains favorable for their growth during the cold winter months (Hossain *et al.,* 1999). Tomatoes require a nighttime temperature of 15 to 20 ^{0}C for fruit setting, according to Charles and Harris (1972), but this temperature is not present in any location in Bangladesh from May to September. Seasonality and a variety of insect and disease issues are the two key factors that limit the ability of Bangladesh to produce tomato throughout the year. Due to tomatoes' superior nutritional and processing features, demand for them has greatly expanded in both domestic and international markets (Hossain *et al.,* 1999). Bangladesh Agricultural Research Institute (BARI) has taken the initiative to develop off-season summer and rainy season tomatoes due to the rising demand and significance of the tomato. Three hybrid tomato varieties that can be cultivated during the summer and rainy season have been introduced by BARI so far e.g., BARI Hybrid Tomato-3, BARI Hybrid Tomato-4, and BARI Hybrid Tomato-8 (Haque *et al.,* 2017). The farmers of Bagharpara upazila under Jashore district started to adopt this technology as pioneer farmer since 2005 (Karim *et al.,* 2009). Summer tomato is profitable in Jashore and Satkhira districts but insect attack is one of the major constraint there (Pradip *et al*, 2018). In tomato 100 to 200 insect pest attack occurs from seedling to harvesting stage (Lange and Bronson, 1981). In Jashore, average tomato yield losses from insect pests and diseases is 3.1tha^{-1} and tomato farmers are mostly depends on chemical pesticides to control the pest (Depenbusch *et al*., 2023). There is a possibility of indiscriminate use of pesticides on summer tomato as it is off season and high valued crop. The effect of off-season vegetable cultivation on income and pesticide use in developing countries has not been the subject of many researches (Kang *et al*., 2013, Nair and Barche, 2014). For this reason the present study was designed to find out the type of insecticides used on summer tomato and to investigate the insecticide use pattern on summer tomato production followed by summer tomato growers.

Materials and method

The study was a descriptive survey and for that reason an interview schedule was developed considering the objective of the study. Summer tomato growing areas were selected for data collection. Three upazila namely Bagherpara from Jashore, Kalaroa and Tala from Satkhira were selected as the study area on the basis of availability of the farmer involved in summer tomato cultivation. Thirty farmers involved in summer tomato cultivation were selected randomly from each of the selected Upazila and a total of ninety farmers were considered as the sample of the study.

The interview schedule was divided into two parts viz., (1) Personal and professional characteristics of the farmers and (2) their viewpoint (Name of insecticides used by the farmer, schedule of insecticide spray, harvesting time after insecticide spray, pesticide chosen by decision maker, mixing pesticide, decision for spraying and safety measures followed during pesticide spray) . Data were collected from the selected farmers by face to face interview method.

Age of a farmer was measured by counting the years from the time of his/her birth to the time of the interview. The level of education was measured by the number of years of schooling. Farm size refers to the area of land under the respondent's possession including share cropping and leased which was measured in terms of hectare. Annual income of a farmer was determined on the basis of his total earnings from agriculture, service, business, and other sources. Training experience was measured by respondent's training experience on summer tomato cultivation in his entire life from different organizations. The assigned score for having training experience was 1 and for not having training experience was 0.

Schedule of insecticide spray, harvesting time after insecticide spray, pesticide chosen by decision maker, mixing pesticide, decision for spraying and safety measures followed during pesticide spray data were collected by asking the farmer's opinion towards a prepared questionnaire. Information regarding used pesticides by the farmer was written on the data collection sheet.

Statistical Package for Social Science (SPSS) version 21 and descriptive statistical tools such as mean, percentage and frequency were used for analyzing the data of this study.

Results and discussion

Total 16 insecticides belong to 12 group were used by the farmer at study area. The highest number of farmers used nitro (50%), movento (46.66%), belt expert (42.22%), imitaf (34.4%) and voliam flexi (31.11) (Table 1). Among the insecticides only tracer and success were considered as bio-pesticides and the rests of them were toxic chemical. Different bio-pesticides viz., azadirachtin, D-limonene, sodium lauryl ether sulphate, matrine, abamectin, SNPV (Spodoptera nuclear polyhedrosis virus), HNPV (Helicoverpa nuclear polyhedrosis virus) etc. were found effective against tomato and other vegetable insects (Rahman *et al*., 2016; Mohammad *et al.,* 2018 and Rashid *et al.,* 2022), but farmers of the study area did not familiar with these. Depenbusch *et al*., 2023 also observed the similar situation where they found bio-pesticide made up less than 1% of the quantity of pesticides applied in Jashore area. So, there is a scope to disseminate bio-pesticide based management strategies among the summer tomato growers considering environmental and health issues.

Table 1. Type of pesticide used for summer tomato production by farmers in the study area

Group name	Name of insecticide	% Farmer used
Cypermethrin	Relothrin 10EC	22.2
	Ripcord 10EC	16.6
Imidacloprid	Imitaf 20SL	38.8
	Confidor 70 WG	27.7
Chlorpyrifos+ Cypermethrin	Nitro	50
Chlorantraniliprole+Thiamethoxam	Voliam Flexi	31.11
Acetamiprid	Tundra 20 SP	22.22
Spirotetramat	Movento240SC	46.66
Abamectin + Emamectin benzoate	Sienna 6WG	16.66
Emamectin benzoate	Proclaim	24.44
	Dana double plus 10WG	8.88
Spinosad	Tracer 45SC	15.55
	Success 2.5 SC	8.88
Carbosulfan	Marshal 20EC	23.33
Flubendiamide+Thiacloprid	Belt expert	42.22
Spiromesifen	Oberon 240SC	28.88

Source: Surveyed data collected by the author's in this study.

*Multiple insecticides used by a farmer was considered for determining percent of farmer.

Result indicated that 41.1% farmers of the study area sprayed insecticide one times in a week, 34.4% farmers sprayed more than 1 times in a week, 1.1% farmers sprayed one time in a day, 1.1% farmers sprayed more than one time in a day where only 22.2% farmers sprayed less than 1 time in a week (Table 2). Tomato insects are possible to control by 3-4 times spraying at 7-15 days interval during the cropping period (Carson *et al*., 2012; Rahman *et al*., 2016 and Rashid *et al.,* 2022). Therefore, most of the farmer of study area sprayed insecticide unnecessarily in summer tomato.

It was observed that the highest 36.7% farmers of the study area harvested summer tomato after 1-2 days of insecticide spraying, 34.4% farmers harvested after 3-5 days of insecticide spraying and 11.1% farmers harvested same day after insecticide spraying through 12.2% farmers harvested tomato after 6-8 days of insecticide spraying and 5.56% farmers harvested tomato more than 8 days after spraying (Table 2). Prodhan *et al*., 2018 and Kabir *et al*., 2008 determined 3-12 days pre harvest interval (PHI) for different insecticides in different vegetables including tomato. Considering this, a large number of farmers didn't follow the safe PHI during summer tomato harvesting.

Result revealed that, for insecticide related knowledge, the highest 31.1% farmers of the study area were depend on pesticide dealer, followed by 25.6% farmers were depend on neighbor, 22.2 % farmers were depend on Government officials, 17.8%

farmers were depend on NGO officials and 3.3 % farmers were depend on own knowledge (Table 2). Involvement of more government and NGO officials are needed to reduce pesticide dealer dependency of the farmer.

Present study was also indicated that 84.4% farmers of the study area mixed different type of insecticides during spray, 65.6% farmers measured insecticide approximately, 73.3% farmers sprayed in their field without observing any insect in the field and 51.1% farmers didn't use any kind of safety measure during insecticides spraying (Table 2). That means majority of the farmers had lack of knowledge on insecticide application, use and handling. So, training on judicial insecticide applications, its uses and handling should provide among the summer tomato growers.

Table 2. Insecticide use pattern on summer tomato production of the farmers in Jashore and Satkhira districts

Schedule of insecticide spray (n=90)	Frequencies	Percent of farmers
More than one times in a day	1	1.1
one times in a day	1	1.1
More than one times in a week	31	34.4
one times in a week	37	41.1
More than one times in a month	15	16.7
one time in a month	4	4.4
less than one time in a month	1	1.1
Harvesting time after insecticide spray(n=90)		
Same day after spray	10	11.1
1-2 days after spray	33	36.7
3-5 days after spray day	31	34.4
6-8 days after spray day	11	12.2
more than 8 days after spray	5	5.6
How farmer made decision about insect pest management like pesticide chosen, application dose fixation etc. (n=90)		
Own knowledge	3	3.3
Consulting with neighbor	23	25.6
Pesticide dealer	28	31.1
NGO workers	16	17.8
Government worker	20	22.2
Do farmer mix different pesticide(n=90)		
Yes	76	84.4
No	14	15.6

Schedule of insecticide spray (n=90)	Frequencies	Percent of farmers
How farmer measure pesticide(n=90)		
Using measuring tools	31	34.4
Approximately	59	65.6
When farmer take decision for spraying(n=90)		
Without observing any insect	66	73.3
After initial symptoms	24	26.7
Above ETL	0	0
Safety method followed by the farmer(n=90)		
No use of safety method	46	51.1
Use of partial safety method	40	44.4
Use of full safety method	4	4.4

Source: Surveyed data collected by the author's in this study.

Table 3. Demographic characteristics profile of the farmers (n= 90)

Variable	Categories	Frequencies	%
Farmer's age (Mean = 45.83, SD±9.26)	30 years and less	7	7.8
	31 to 40	22	24.4
	41 to 50	36	40
	51 to 60	22	24.4
	More than 60 years	3	3.3
Farmer's education(Mean = 4.97, SD±3.87)	No education/illitarate	26	28.9
	Primary education	32	35.6
	Secondary (SSC level)	26	28.9
	Upper SSC level	6	6.7
Farmer's annual income [Mean = 188090 BDT (1791.33 USD)]	Less than 150000 BDT	20	22.22
	150000-250000 BDT	55	61.11
	More than 250000 BDT	15	16.67
Farm size (Mean = 0.914, SD±0.723)	Less than 1.01 ha	61	67.8
	1.01 to 3.03 ha	27	30.0
	More than 0.03 ha	2	2.2
Training participation on Summer tomato cultivation	No training	50	55.6
	Training	40	44.4

Source: Surveyed data collected by the author's in this study

Socio-demographic information of the farmers like age, educational qualification, annual income, farm size and training experience are presented in Table 3. The

Table provided categories, frequencies, and percentage for all these demographic variables and indicated that the highest 40% farmers were within 41 to 50 years of age, most of the farmers (71.1%) of the study area were educated either in primary, secondary or tertiary level but 28.9% of them had no education. The average income of the farmers of the study area was Tk.188090.00 which was near to the national average of Tk.187397.7 (1784.74 USD) (Trading Economics, 2022). In the study area, 44.4% farmers had training exposure related to summer tomato cultivation and this percentage was comparatively higher than other technology adopted by farmers (Hasan *et al*., 2017 and Mohammad *et al.*, 2020). The reasons of higher training received by farmers of the study area may be due to farmer's early adoption behavior, high price of summer tomato and reputation of the study area for summer tomato cultivation (Karim *et al.,* 2009).

Pearsons Correlation Co-efficient "r" was used to determine the relationships between the selected demographic characteristics of the farmer and their behavior of insecticide use. Farmer's education, farm size, annual income and training experience had negative relationship with schedule of insecticide spray and positive relationship with harvesting time after insecticide spray, use of tools for measuring pesticide, safety method followed by the farmer where most of the relationships were significant (Table 4).

Table 4. Relationship between demographic characteristics of the farmer and their behavior of insecticide use

Personal and professional characteristics of the farmers	Coefficient correlation value of 'r'			
	Schedule of insecticide spray	Harvesting time after insecticide spray	Use of tools for measuring pesticide	Safety method followed by the farmers
Age	0.088	-0.074	-0.143	0.060
Education	-0.195	0.299**	0.225*	0.177
Farm size	-0.229*	0.353**	0.10	0.275*
Annual income	-0.298**	0.260*	0.259*	0.368**
Training experience	-0.476**	0.490**	0.507**	0.256*

** Correlation is significant at 1% level. * Correlation is significant at 5% level.

Conclusions

The study was conducted in two summer tomato growing regions of Bangladesh. Results indicated that most of the summer tomato growers depended on chemical insecticides and followed frequent spraying. Very minimum numbers of the farmers (17.7%) maintained 6 or more days of pre-harvest interval period. Majority of the farmers (65.6%) did not use any kind of measuring tools for pesticide measurement, 73.3% of farmers sprayed insecticide without observing any insect in the field, 51.1 % of farmers did not use any kind of safety measure during pesticide spraying and only 22.2 % of the farmers were depended on government

officials for insecticide related knowledge. Education, farm size annual income, training experience of the farmers had significant relationship with their insecticide use pattern.

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