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Study on insect pest diversity and their risk management options in potato among extension personnels of Bangladesh

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ABSTRACT

The study was conducted in 20 upazila of 10 selected major potato growing districts of Bangladesh to find out the present status and diversity of insect pests of potato, their risks and management options. The data were collected through interview of 60 extension personnels of Department of Agricultural Extension (DAE). BARI Alu-7 (Diamant) variety and BARI Alu-8 (Cardinal) variety of potato were the most popular potato varieties used by the farmers for cultivation. Among the problems for potato cultivation, lower market price ranked the first position. Other major problems faced during potato cultivation were diseases, insect pest attack and weed infestation. The BARI Alu-7 (Diamant) and BARI Alu-8 were the most susceptible potato varieties in terms of insect pests and diseases, whereas the Lal-pakhri was the least susceptible to pest attack. Mostly (98.50%) the potato was infested in the field by cutworm, aphid, potato tuber worm, leaf miner, mole cricket, field cricket and leaf hoppers. Among these insect pests, cutworm and aphid were identified as the major pests and caused damage with high and moderate infestation intensity, respectively. Rat was found as the major pest in storage. The potato tuber worm attacked potato tubers in storage mostly (73.50%) and designated as a major insect pest of potato in storage and damaged potato with high infestation intensity. Spraying of insecticides on the standing potato field is the main control option among farmers to check the pest attack in potato field. Other important control options were application of flood irrigation and hand picking particularly for controlling cutworm, use of granular insecticides in furrows during planting of seed tubers. Most (95%) of the farmers received assistance and advices for controlling insect pests of potato from pesticide dealers. Other sources of services were DAE officials, neighboring farmers and NGO officials. So, emphasis should be given on finding higher value market price for potato as well as safe cultivation through proper control measure upon consultancy with respective personnel.

Keywords: Extension personnels, insect pest, potato, risk management, awareness

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1 Introduction

The potato is the world's most important tuber crop worldwide under solanaceae family. It is grown in more than 125 countries and consumed almost daily by more than a billion people. Hundreds of million of people in developing countries depend on potatoes for their survival. Potato is third most important crop in Bangladesh (FAO, 2016). In the last fiscal year 2016, Bangladesh's potato production hit an all-time-high of 9.47 million tonnes. (FAOSTAT, 2017). FAO data show that in 2016, the developing world's potato production exceeded that of the developed world. China is now the biggest potato producer, and almost a third of all potatoes is harvested in China and India.

Bangladesh has a primarily agrarian economy. Agriculture is the single largest producing sector of the economy since it comprises about 16.58% of the country's GDP and employs around 45% of the total labor force (BBS, 2013). The crop is very widely grown across Bangladesh, with the greatest concentration of area (through generally not the highest yields) occurring in the northwestern region of the country, especially the districts of Rangpur and Bogra. The climate of Bangladesh is characterized by a tropical moon soon with three main seasons having relatively little variation from month to month. Therefore, favorable agronomical characteristics are prevailing here to cultivate more potato crops in Bangladesh.

But the production of potato is attacked by pests like insect, diseases and weeds etc. As Bangladesh being the tropical and humid country, the infestation of insect pests is very common here. But a little information was present regarding the diversity and risk assessment of insect pests of potato in Bangladesh. Therefore, it was felt to undertake the study to find out the present status of insect pests of potato, their diversity, risk and management options for controlling in Bangladesh.The main objectives of present study were to identify the major and minor insect pests of potatotheir risk assessment during cultivation and storage period and find out the control options against insect pests of potato are commonly recommended by the upazila level officers in Bangladesh.

2 Materials and Methods

2.1 Study area and design

The survey was conducted in some selected 10 major potato growing districts of Bangladesh namely Dinajpur, Thakurgaon, Rangpur, Gaibanda, Bogra, Joypurhat, Munshigonj, Chandpur, Sherpur, Kishoregonj.A total of 20 upazilas were selected under 10 sampled districts considering 2 upazila for each district were interviewed through pre-tested questionnaire. A total of 60 extension personnels (FO) of DAE were also interviewed through pre-designed questionnaire considering one UAO, one AEO and one SAAO from each upazila under 10 sampled districts.

2.2 Respondents survey

The respondents' survey was conducted in the 20 selected upazila under 10 selected most potato growing districts of Bangladesh. The face to face interview was conducted among 60 FLOs and they filled up a set of pre-designed questionnaire. The variables in the questionnaire were FLO's knowledge on major insect pest that cause potential damage in the survey area, key pest in their area that cause damage in every year, newer insect pests in the survey area as well as farmers pest risk management options. The sampled 60 extension personnels of DAE were selected from 20 upazila under 10 major potato growing districts of Bangladesh. The distribution of sampled respondents has been presented in the following Table 1.

2.3 Data collection

Direct personal interview approach was adopted for collection of primary data. The researcher personally contacted with the potato growers in the respective upazila under 10 sampled potato growing districts. When found the target respondents and the researcher started interview by explaining the objectives of the study to the respondents. After getting respondents, the researcher filled up each question of the questionnaire one by one and obtained desired information. The data collection was conducted for a period from December 2014 to February 2015.

2.4 Data analysis

After the completion of data collection, all filled up questionnaires were preserved according to the category of respondents for processing and data analysis. Data on different parameters were analyzed through computer software SPSS version 20. As soon as collected from the field, the filled up questionnaires were coded and data entry were completed using SPSS and MS Access computer packages.

3 Results

3.1 Knowledge on insect pests of potato, their risks and management

3.1.1 Gender of the extension personnels

The field survey was revealed that conducted among 60 extension personnels. Most (95%) of the extension personnels were male (57), while only 5% officers (3) participated in the study were female.

Table 1. Respondents distribution in the sampled upazila and districts

District	Upazila	No. of FO	District	Upazila	No. of FO
Dinajpur	1. Sadar	3	Joypurhat	11. Panchbibi	3
	2. Birgonj	3		12. Khetlal	3
Thakurgaon	3. Ranisankail	3	Munshigonj	13. Sadar	3
	4. Pirgonj	3		14. Tongibari	3
Rangpur	5. Pirgacha	3	Chandpur	15. Motlab North	3
	6. Badargonj	3		16. Hajigonj	3
Gaibandha	7. Polashbari	3	Sherpur	17. Sadar	3
	8. Gobindagonj	3		18. Nalitabari	3
Bogra	9. Sherpur	3	Kishoregonj	19. Sadar	3
	10. Shibgonj	3		20. Pakundia	3

Table 2. Commonly used potato varieties cultivated by the farmers

Potato variety	Frequency	% Response
Diamant	46	76.67
Cardinal	28	46.67
Granula	12	20
Lal-Pakhri	8	13.33
Estarise (local)	3	5
Newly imported potato	6	10

Table 3. Response on the sources of purchasing seed potatoes usually used for cultivation

Sources	Frequency	% Response
Farmers' own seed	40	66.67
Neighbors	11	18.33
BADC seed	31	51.67
Other company seed	7	11.67
Local seed producer	10	16.67
Directly from importer	9	15
Research Organization	2	3.33
NGO	7	11.67
Seed traders/dealers	13	21.67

Table 4. Opinion of the extension personnels on the major problems of potato cultivation

Major problems	Freq.	% Response
Insect pest attack	40	66.67
Weed infestation	46	76.67
Disease infection	56	93.33
Lack of HYV variety	38	63.33
Lack of irrigation facilities	26	43.33
Pest attack in storage	10	16.67
Lack of marketing facilities	17	28.33
Lack of farmers training facil.	22	36.67
High price of pesticides	12	20
Low price of produced potato	58	96.67

3.1.2 Categories of extension personnels

Among 60 extension personnels participated in the field study, 33.33% of them (20) were Upazilla Agriculture officer (UAO), whereas 33.33% of them (20) were Agriculture Extension Officers (AEO) and 33.33% of them (20) were Sub-Assistant Agriculture Officers (SAAO).

3.1.3 Commonly used potato varieties

In response of the extension personnels (FO) participated (60) in the field study; the maximum (76.67%) FO (46) reported that farmers used diamant variety of potato for cultivation in their field, whereas 46.67% FO (28) reported that they (farmers) used cardinal variety (Table 2). This was followed by granula variety (20.0%); while 13.33% f FO reported that farmers used lal-pakhri variety, 5.0% used estarise (local) variety and only 10.0% farmers used newly imported potato variety to cultivate in their field. Both private and public sector together supply only 5% quality seed of the total requirement (Karim, 2009). Remaining 95% is the low quality seed potato which is produced by the farmers themselves.

3.1.4 Source of potato seeds

Potato farmers used seed potatoes from different sources for cultivation (Table 3). Field officers reported that, among the potato farmers, most of the farmers used seed potatoes from their own seeds. Other important sources were BADC seed, neighbor's seed, local seed producer and NGO.

3.1.5 Major problems faced during potato cultivation

In the opinion of 60 extension personnels participated in the field survey, most of them asserted their opinion that lower market price of the produced potato, disease, insect pest attack lack of HYV variety, lack of irrigation facilities, lack of farmers training on potato

Table 5. Responses of extension personnels on the occurrence, status, vulnerable stages, infestation severity of the insect pests of potato in field condition

Insect pests	Occurrence of insect pests [N=60]		Response on pest status (%)		Response on vulnerable stage (%)†			Response on infestation severity (%)		
	Freq.	% Response	Major	Minor	S	V	T	High	Moderate	Low
Aphid	60	100	85	15	21.7	75.7	2.6	89	5.3	5.7
Cutworm	60	100	87.8	12.2	54.3	31	14.7	84.2	5.1	10.7
Tuber worm	42	70	26	74	0.8	6.7	92.5	21.2	27	51.8
Leaf hopper	7	11.67	5.7	94.3	17.7	78.7	3.6	6.2	34.1	59.7
Leaf miner	9	15	9.6	90.4	14.1	72.5	13.4	7.9	32.1	60
Whitefly	6	10	0	0	13.3	79.1	7.6	0	0	0
Field cricket	6	10	11.7	88.3	33.1	35.7	31.2	12.4	40.9	46.7
Mole cricket	7	11.67	11.2	89.9	39.8	27.1	33.1	11.3	28.7	60

† S, V, T desigate seedling, vegetative, and tuberization stages, respectively.

Table 6. Response of extension personnels on the degree of relation among insect pest, disease and weed infestation in the potato field

Relationship	Response (%) on the degree of relationship			
	High	Medium	Low	Don't know
Insect infestation high when weed infestation	47.5	23	11.2	18.3
Disease infection high when weed infestation	63.25	17.75	4.5	14.5
Disease infection high when vector insect	75.25	14.5	7.5	2.75

Table 7. Infestation status, severity of insect and vertebrate pests of potato in storage

Insect pests	Occurrence as pest (% response)		Pest status (% response)		Severity of infestation (% response)		
	Yes	No	Major pest	Minor pest	High	Moderate	Low
Tuber worm	75	25	47.3	52.7	24.45	44.3	31.25
Rat	90	10	76.6	23.4	59.2	19.3	21.5
Others	18.33	81.67	11.4	88.6	–	–	–

cultivation, lack of marketing facilities, high price of pesticides and pest attack in storage (Table 4).

3.2 Insect pests in the field

3.2.1 Occurrence of the insect pests

Most of the extension personnels reported that the potato was infested in the field by aphid, cutworm, potato tuber worm, leaf miner, leaf hopper and mole cricket, field cricket and whitefly (Table 5). The potato farmers faced high incidence of disease (late and early blight of potato, fusarium and brown rot, leaf roll virus, common scab, black heart, root knot etc.) and insect/pests (cut worm, aphids, tuber moth, cricket, leaf hopper etc.) still remain a drawback to attain maximum yield of potato (Siddique et al., 2015). Three species of potato tuber worms is now present in all potato growing regions with the exception of colder north temperate areas; in many regions this is the insect responsible for the largest potato losses (Rondon, 2010).

Table 8. Current and recent emerging major insects pests

	Freq.	% Response
More damaging insect pests		
Aphid	42	70
Cut worm	47	78.33
Potato tuber worm	30	50
Leaf hopper	13	21.67
Don't know	12	20
Newly seen insect pests		
Mite	1	25
White fly	2	50
Mealy bug	3	75

Table 9. Options for controlling insect pests of potato

Control options	Freq. [N=60]	% Response
Spraying of insecticides on the standing potato field	48	80
Broadcasting of granular insecticides in the furrow during planting of seed tubers	18	30
Broadcasting of granular insecticides before irrigation in the field	9	15
Application of insecticides along with irrigation in the field	6	10
Potato tuber treatment through insecticides before planting	15	25
Irrigation	12	20
Hand picking of insect pests especially cutworm	27	45
Perching	12	20
IPM method	10	16.67
Application of balanced fertilizer to prevent insect pest infestation	8	13.33

3.2.2 Vulnerable stages to insect pests

Among the insect pests, cutworm and mole cricket attacked potatoes at all stages of the potato plants but mostly at seedling stages. Aphid, leafhopper, leaf miner and whitefly mostly attacked potato plants at vegetative stages (Table 5). On the other hand, potato tuber worm mostly attacked potato at it tuberization stage.

3.2.3 Infestation severity

Aphid and cutworm caused damage potatoes in the field with high infestation intensity (Table 5). On the other hand, potato tuber worm, leaf hopper, leaf miner, field cricket and mole cricket caused damage potato plants with low infestation severity.

3.3 Relationship among insect pest, disease and weed infestation

According to 60 field officials of DAE participate in the survey study, most (76.25%) of the them expressed their positive opinion about relationship of insect pest infestation with disease and weed infestation in the maize field, whereas only 23.75% respondents expressed their negative opinion (Table 6).

3.4 Insect pests in the storage

3.4.1 Infestation status of insect and vertebrate pests

Most of the extension personnels stated their opinion that potato tuber worm attacked in storage condition, among them 52.7% stated as minor pest and 47.3% stated as major pest (Table 7). In case of vertebrate pest most of the officers stated their opinion that rat attacked in storage as major pest. Insect pests inflict their damage on stored products mainly by direct feeding. Some species feed on the endosperm causing loss of weight and quality, while other species feed on the germ, resulting in poor seed germination and less viability (Malek and Parveen, 1989; Santos et al., 1990).

3.4.2 Infestation severity

The extension personnels stated that the potato tuber worm caused damage to potatoes in storage with low to high infestation intensity, where majority of the officers reported moderate infestation intensity (Table 7). The presence of insects also raises the product temperature, due to their feeding activity, resulting in "hot spots" (Mills, 1989).

3.5 Emergence of new major pests

According to opinion of extension personnels, out of 60, majority of the them reported that cutworm was more damaging insect pest of potato in field condition than previous infestation, which was followed by aphid infestation and potato tuber worm (Table 8). On the other hand, 20% officers did not provide any response about this issue. Considering the opinion expressed by the extension personnels, 93.33% responded have no idea about the new insect pest that are currently seen in the field of potato and only 6.67% expressed the positive answer. According to the opinion expressed by the extension personnels, who expressed positive answer about newly seen insect pest of potato, those were not seen earlier. The newly seen insect pests were mite (25%), white fly (50%) and mealy bug (75%) respectively (Table 8).

3.6 Options for controlling insect pests of potato

Out of 60 extension personnels participated in the field survey, most of them reported that farmers applied insecticides in potato fields to control insect pests of potato (Table 9). This control option was followed by hand picking of insect pests especially cutworm and 30% farmers used granular insecticides in furrows during planting of seed tubers. Other methods used by the farmers to control insect pests

of potato were perching and intergrated pest management (IPM).

4 Conclusions

In spite of immense importance, potato cultivation has been hindered by many obstacles. Among them lower market price of potato ranked the apex position. Though diamant variety is the most popular among farmers, but still some other varieties are available in farmers field. As the main source of seed potato is farmers own seed, BADC should give proper attention to cope up this problem. High incidence of insect pest infestation has been reported and aphid as well as cutworm are said to be the most infesting pests in farmers potato field. Rat is also a major concern for potato as a storage pest. Pest resurgence has been also reported by extension personnels as mealy bug is described as newer pest which was unavailable earlier. However, to control the infestation of insect pests in growers field many control options have been taken by farmers. Among the all control options the most common is spraying insecticide in field. So, it can be understood that farmers are still unware of safe cultivation. New programs should be taken to make them aware of food safety as well as to get them acquainted with integrated pest management packages.

Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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