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A SURVEY OF POTATO GROWERS IN BANGLADESH: PRODUCTION AND CHALLENGES

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ABSTRACT

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The study was conducted in the 20 upazila of 10 selected major potato growing districts of Bangladesh to find out the present potato cultivation status, challenges, diversity of pests and their risks management options among the farmers. The data were collected through interview of 500 potato farmers considering 25 potato farmers from each upazila. Infections of diseases were reported to be the major problems followed by lower market price of the produced potato. Other major problems faced during potato cultivation were insect pest attack and weed attack. The BARI Alu-7 (Diamant) was most susceptible potato variety to insect pests and diseases, whereas the Lal-pakhri was the least susceptible to pests. Most of the fields (98.50%) were infested by cutworm. Among these pests, cutworm and aphid were identified as major pests and caused high and moderate infestations respectively. Others were identified as minor pests of potato with low infestations. Potato tuber worm was found as the key pest in storage condition. Rat was reported as the most infesting vertebrate storage pests. Currently cutworm and aphid were more damaging insect pest of potato in field condition than previous infestation, and potato tuber worm was more damaging insect pest in storage. Insecticide spray is the most favorable pest control method among the potato growers. Only a little portion of farmers have knowledge about integrated pest management (IPM) practices. So, it is expected the proper awareness program and planning will be taken to handle such challenges.

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INTRODUCTION

The potato is the world's most important nongrain food crop worldwide under Solanaceae family (Sanwen Huang *et al.*, 2011). It is grown in more than 125 countries and consumed almost daily by more than a billion people. Hundreds of millions of people in developing countries depend on potatoes for their survival. Potato cultivation is expanding strongly in the developing world, where the potato's ease of cultivation and nutritive content has made it a valuable food security and cash crop for millions of farmers. Potato as well as potato products are nowadays being produced and exported by developing countries. The total world potato production is estimated at 364,808,768 tonnes in 2012 (FAOSTAT, 2012). Information from FAO in 2005 revealed that the production of potato in developing countries surpassed that production in developed countries.

Thinking about the pattern of population development and thusly the expanded interest for sustenance in the nation and diminishing cultivable land area, the potato is prone to assume a crucial part. Potato is a well-known also, essential vegetable in Bangladesh. For the entirety year, it is utilized as the primary vegetable. Potato generation in Bangladesh in the financial year (FY) 2012-2013, hit another record of 8.603 million tons outperforming the record of 8.38 million tons in FY'11 (Chowdhury and Chowdhury, 2015). Potato has become the third most important food terms of Bangladesh (FAOSTAT, 2012). The crop is widely own across the country in the northwestern region of the country namely Rangpur and Bogra.

The weather condition favors potato production but because of the tropical and humid climate the potato cultivation is severely affected by the pests such as insect, diseases and weeds etc. However, the current status of insect pests has not been properly investigated in Bangladesh. For managing insect pests farmers rarely imply integrated pest management (IPM) tactics. Rather, they often apply chemical pesticides to get rid of insect infestation (Alam *et al.*, 2016). Considering the above points view in mind, present study was undertaken to assess the present scenario of potato growers and identifying the major challenges of potato in Bangladesh as well as to find out the control options against insect pests of potato commonly used by the farmers in Bangladesh.

MATERIALS AND METHODS

Study Area

The survey was conducted in some selected 10 major potato growing districts of Bangladesh (Table 1).

Table 1. Respondents' distribution in the sampled upazila and districts

District	Upazila	No. of potato farmers	District	Upazila	No. of potato farmers
1. Dinajpur	1.Sadar	25	6. Joypurhat	11.Panchbibi	25
	2.Birgonj	25		12.Khetlal	25
2. Thakurgaon	3.Ranisankail	25	7. Munshigonj	13.Sadar	25
	4.Pirgonj	25		14.Tongibari	25
3. Rangpur	5.Pirgacha	25	8. Chandpur	15.Motlab North	25
	6.Badargonj	25		16.Hajigonj	25
4. Gaibandha	7.Polashbari	25	9. Sherpur	17.Sadar	25
	8.Gobindagonj	25		18.Nalitabari	25
5. Bogra	9.Sherpur	25	10. Kishoregonj	19.Sadar	25
	10.Shibgonj	25		20.Pakundia	25
Total				20	500

Study design

A total of 20 upazilas were selected under 10 sampled districts considering 2 upazila for each district and 25 potato growers were interviewed in each upazila through pre-tested questionnaire. There were some well-defined data indicators in the questionnaire namely name, age, sex, education, profession, farm size, variety of potato cultivated, occurrence and severity of insect pests of potato, potential risk and economic damage caused by these pests, status of insect pests of potato, effective measures practiced by the farmers in controlling the insect pests of potato, suggestions for improving management options for controlling insect pests of potato in Bangladesh. For survey, stratified sampling technique was followed to select districts and simple random sampling technique was used to select sample areas in districts.

Data collection

Data were obtained by face to face interview of 500 respondents of selected areas. Before interviewing, objectives of the study were explained to them. The survey was carried out during the major potato growing season of Bangladesh (December 2014 to February 2015). Out of 500, most (94.5%) of the potato farmers (473) were male, while only 5.5% potato farmers (28) participated in the study were female. The information of the farmers' knowledge on insect pests of potato and their risks has been discussed.

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 as well as the data were analyzed for tabulation of the primary data into data tables.

RESULTS AND DISCUSSION

The results obtained from the survey have been presented systematically and discussed below in various parameters and forms to represent the present scenario of potato cultivation, insect pest risk and their potential management strategies in Bangladesh.

Commonly used potato varieties

In response of the farmers participated (500) in the field study; the maximum (65.4%) farmers used Diamant variety of potato for cultivation in their field, whereas 29.6% reported that they (farmers) used Cardinal variety (Table 2). This was followed by Granula variety (25.8%); while 14.8% farmers used Lal-pakhri variety, 5.2% used Estarise (local) variety and only 4.8% farmers used newly imported potato variety to cultivate in their field.

Table 2. Commonly used potato varieties by farmers in Bangladesh

Potato Varieties	% Response of potato variety cultivation
Diamant	65.4
Cardinal	29.6
Granula	25.8
Lal-Pakhri	14.8
Estarise (local)	5.2
Newly imported potato	4.8

Source of potato seeds for cultivation

Potato farmers used seed potatoes from different sources for cultivation (Table 3). Among the potato farmers, most of the farmers used seed potatoes from their own seeds (66.60%). Other important sources were BADC seed, neighbor's seed, local seed producer and NGO.

Table 3. Sources of seed potatoes usually used for cultivation

Sources of potato seeds	Frequency	Response (%)
Farmers' own seed	333	66.60
Neighbors	92	18.40
BADC seed	256	51.10
Other company seed	54	10.9
Local seed producer	80	16.00
Directly from importer	73	14.60
NGO	53	10.70
Traders/dealers	104	20.90
Other sources	12	2.30

Major problems faced during potato cultivation

Major hurdle during potato cultivation in Bangladesh reported by the farmers has been represented in Table 4. Almost ninety percent (89.20 %) farmers asserted that lower price of produced potato is the main constraints they face. However, the most devastating problem they reported is disease infection (90.20%) which causes a serious damage to the crops as well as yield. Meanwhile, 70.80% reported insect pest attack a major problem during potato cultivation. Lack of High Yielding Variety (HYV) is another major drawback asserted by the farmers.

Table 4. Farmers' opinion on major problems faced during potato cultivation

Major Problems	Frequency	% Response
Insect pest attack	354	70.80
Weed infestation	325	65.00
Disease infection	451	90.20
Lack of HYV variety	329	65.80
Lack of irrigation facilities	105	21.00
Pest attack in storage	61	12.20
Lack of marketing facilities	21	4.20
Lack of farmers training facilities	11	2.20
High price of pesticides	4	0.80
Low price of produced potato	446	89.20

Susceptibility to insect pests

Out of 500 farmers, maximum farmers reported that the potato variety BARI Alu-7 (Diamant) was susceptible to insect pests (Table 5). This variety was followed by newly imported potatoes as reported by only 1.3% farmers, cardinal was susceptible to insect pests as reported only by 1.1% farmers. Whereas, only 1.0% farmers reported that the potato variety Lal-pakhri was susceptible to insect pests.

Susceptibility to diseases

Maximum farmers reported that the potato variety BARI Alu-7 (Diamant) was susceptible to diseases (Table 5). This variety was followed by BARI Alu-8 (Cardinal) as asserted by 18.40% farmers followed by BARI Alu-11 (Chomok) reported by 14.40% followed by newly imported potatoes were susceptible to diseases as reported by only 11.2% farmers. Whereas only 6.8% farmers reported that BARI Alu-13 (Granolla) was susceptible to diseases followed by Lal-pakhri as reported by only 5.4% farmers.

Susceptibility to weeds

There were no significant variations among different potato varieties those had been attacked with weed infestation (Table 5). Only 3.2 to 6.0% farmers reported that different potato varieties were attacked with weed infestation. Considering the susceptibility of potato varieties to insect pests, diseases and weeds, the Diamant variety was much susceptible to pests that other varieties followed by Cardinal, whereas the Lal-pakhri (local variety) was least susceptible to insect pests diseases and weeds.

Table 5. Farmers' response on susceptibility of potato varieties to pests

Sl. No.	Potato varieties	Response on susceptibility to pests (%)		
		Insect pests	Diseases	Weeds
1.	BARI Alu-7 (Diamant)	16.80	26.40	6.00
2.	BARI Alu-8 (Cardinal)	5.20	18.40	5.40
3.	BARI Alu-11 (Chomok)	3.40	14.40	3.40
4.	BARI Alu- 13 (Granolla)	1.80	6.80	4.80
5.	Lal-Pakhri	1.80	5.40	3.20
6.	Newly imported potato	3.00	11.20	5.20

Various insect pests of potato in field condition (Table 6)

Occurrence of insect pests of potato in field condition

Most of the farmers reported that the potato was infested in the field by cutworm, which was followed by aphid infestation. The potato was attacked by potato tuber worms, followed by leaf miner, mole cricket, field cricket, leaf hoppers and whitefly. 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).

Table 6. Farmers' response on occurrence of insect pests of potato Vulnerable, stages, parts of potato plants to insect pests, infestation status, severity in field condition

SL. No	Name of insect pest	Occurrence of insect Pest (N=500)		Response on pest status (%)		Response on vulnerable stages (%)			Response on vulnerable parts (%)				Response on infestation severity (%)		
		Frequency	% response	Major pest	Minor pest	Seedling	Vegetative	Tuberization	Leaf	Stem	Tuber	Root	Low	Moderate	High
1	Aphid	452	90.30	55.00	45.00	24.27	73.70	1.60	97.5	1.90	1.60	0.00	11.70	49.30	39.00
2	Cut worm	493	98.50	77.80	22.20	49.30	39.0	11.70	2.80	86.10	8.60	2.50	20.80	5.10	74.20
3	Tuber worm	365	73.00	16.00	84.00	0.60	4.50	95.00	1.50	1.90	96.10	0.60	51.70	24.00	24.20
4	Leaf hopper	207	41.30	5.70	94.30	14.30	80.70	5.00	94.10	4.30	1.40	0.20	79.70	14.10	6.20
5	Leaf miner	251	50.10	9.60	90.40	12.10	78.50	9.40	92.8	4.60	0.80	1.70	70.00	22.10	7.90
6	White Fly	136	27.15	--	--	15.40	76.18	8.42	98.20	1.80	--	--	88.30	5.45	6.25
7	Field cricket	229	45.80	11.70	88.30	29.70	31.70	38.70	18.30	24.00	28.70	29.00	74.70	10.90	14.4
8	Mole cricket	272	54.30	11.10	88.90	35.70	27.50	36.90	6.00	30.40	29.10	34.50	80.00	8.70	11.30

Infestation status of insect pests of potato in field condition

Out of 500 farmers, the major insect pest of potato in field condition was cutworm. This was followed by aphid. On the other hand, the minor insect pests of potato were potato tuber worm, leaf hoppers, leaf miner, field cricket and mole cricket. 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).

Vulnerable stages of potato plants to insect pests in field condition

Among the insect pests, cutworm and mole cricket attacked potatoes at all stages of the potato plants but mostly at seedling stages (Table 6). Whereas, aphid, leafhopper, leaf miner and whitefly mostly attacked potato plants at vegetative stages. On the other hand, potato tuber worm mostly attacked potato at its tuberization stage. The insect pests attack on tobacco, potato, tomato, bottle gourd, lady's finger, cabbage, sugar beat, turnips, grams and many ornamental plants, at different times of the year and at different localities was also recorded by Khan (1976).

Vulnerable parts of potato plants to insect pests in field condition

The leaves of potato plants were most vulnerable for aphids, leafhoppers, leaf miners. The stems of potato plants were most vulnerable for cutworm and mole. On the other hand, the tuber was vulnerable to potato tuber worm, whereas the root was vulnerable to field cricket and mole cricket.

Infestation severity of potato crops by insect pests in field condition

Most of the farmers expressed that cutworm caused damage potatoes in the field with high infestation intensity. Whereas, aphids caused damage potato plants with moderate to high infestation severity. On the other hand, potato tuber worm, leaf miner, field cricket leafhoppers, mole cricket and whitefly caused damage potato plants with low infestation severity.

Degree of relationship among insect pests, diseases and weed infestation in potato field

There was a positive and high degree of relationship among insect pest and disease incidence with weed infestation; as well as disease infection with the incidence of insect vector in the potato field (Table 7). This result indicated that the insect infestation and disease infection become high when weed infestation become high. Similarly, disease infection become high when insect vector populations become high. But in this case, maximum respondents did not reply about the degree of relationship between disease infection and vector population. Cutworms and Potato peach aphid are the two devastating insect pest in the spring crop (Sing 2002). Cutworm is a polyphagous pest. Larvae of cutworm can damage 30 cultivated and 20 wild species of plants but the greatest damage was observed on Tobacco, Potato, maize, beet and vegetable crop (NicoLova 1971).

Table 7. Farmers' response on the degree of relationship among insect pest, disease and weed infestation in potato field

Relationship	Response (%) on the degree of relationship				
	High	Medium	Low	Don't Know	Total
Insect infestation high when weed infestation	33.0	15.00	11.00	41.0	100.0
Disease infection high when weed infestation	46.0	25.00	18.00	11.00	100.0
Disease infection high when vector insect	21.0	12.00	10.00	57.00	100.0

Various insect pests during storage period in potato

Occurrence of insect and vertebrate pests of potato in storage

Most (73.50%) of the farmers stated their opinion that potato tuber worm attacked in storage condition, among them 56.20% stated as minor pest and 17.30% stated as major pest. In case of vertebrate pest, most (89.00%) of the farmers stated their opinion that rat attacked in storage, among them 32.40% stated as minor and 56.60% stated as major pest. Open storage does not provide adequate protection against insect pests or other animals such as birds and rodents (Appert, 1987; Gwinner et al., 1996).

Infestation status of insect and vertebrate pests of potato in storage

Out of 500 farmers, most (89%) of them stated their opinion that rat attacked the potato tubers in storage condition and caused damage, where as 74% farmers reported that potato tuber worm attacked potato at storage condition. On the other hand, 18% farmers reported other problems caused damage potatoes in storage but they did not specify the problem. 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 & Parveen, 1989; Santos et al., 1990).

Infestation severity of insect and vertebrate pests of potato in storage

The potato tuber worm caused damage potatoes in storage with low to high infestation intensity, where majority of the farmers reported low infestation intensity (Table 8). On the other hand, majority of farmers reported that the rat caused damage potato tubers in storage with high infestation intensity. The presence of insects also raises the product temperature, due to their feeding activity, resulting in "hot spots" (Mills, 1989).

Table 8. Infestation status of insect and vertebrate pests of potato in storage

Name of insects pest	Occurrence as pest (%)		Pest status (% response)		Severity of infestation (% response)		
	Yes	No	Major pest	Minor pest	Low	Moderate	High
Tuber worm	73.50	26.40	17.30	56.20	40.20	34.30	25.45
Rat	89.00	12.00	56.60	32.40	19.60	16.30	64.20
Others	17.50	82.40	7.40	10.10	-	-	-

Currently more damaging insect pests of potato than previous infestation

Out of 500, majority of the potato farmers 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. On the other hand, some potato farmers did not provide any response about this issue.

Table 9. Currently more damaging insect pests of potato than previous infestation

More damaging insect pests	Frequency	% Response
1.Aphid	95	19.00
2.Cut worm	279	55.80
3.Potato tuber worm	56	11.20
4. Don't know	130	26.00

Options for controlling insect pests of potato

Most (93.40%) of them reported that they applied insecticides in potato fields to control insect pests of potato. This control option was followed by application of flood irrigation particularly for controlling cutworm. Whereas 41% farmers used granular insecticides in furrows during planting of seed tubers followed by hand picking of insect pests especially cutworm as reported by 33% farmers. Other methods used by the farmers to control insect pests of potato were perching and IPM. It is crucial that the storage area is dark, well ventilated and for long-term storage maintained at temperatures near 4°C (39°F). For short-term storage before cooking, temperatures of about 7 to 10°C (45 to 50°F) are preferred (Kohli, 2009).

Table 10. Options for controlling insect pests of potato

Control options	Frequency	% response
Spraying of insecticides in potato field	467	93.40
Use of granular insecticides in during planting of seed tubers	205	41.00
Application of insecticides along with irrigation in the field	49	9.80
Flood irrigation particularly for cutworm	269	53.80
Hand picking of insect pests especially cutworm	167	33.40
Perching	27	5.40
IPM method	62	12.40

CONCLUSION

Present study was conducted to assess the current scenario and the major challenges of potato production along with the aim of finding the risk management tactics among the farmers in Bangladesh. Data showed that major growers of potato are male and the potato variety Diamant is the most popular variety among them. Though BADC is responsible to supply any kind of seeds in Bangladesh, majority of farmers use their own seed for potato cultivation. Government should emphasize in potato seed production to be sufficient in their own. However, facing variety of problems, growers reported that diseases are the most devastating and the lower fetching of potato prices is one of the top challenges in Bangladesh. Subsequently, their favourite varieties are frequently being attacked by various pests such as insects, diseases and weeds. Cutworm was found to be the major insect pests in the field. This pest along with mole cricket attack potato plants throughout the crop cycle. Among the non-vertebrate storage pests tuber worm and among the vertebrate storage pests, rat was ranked the apex position. Surprisingly, most of the farmers only apply pesticides to control the pests infesting field. It can be understood that people are still unaware of the risk hazard of chemical application. So, government should take proper steps to help out this problem.

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