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INSECT MANAGEMENT PRACTICES AND PROFITABILITY ANALYSIS OF SUMMER VEGETABLE PRODUCTION IN SIRAJGANJ DISTRICT OF BANGLADESH

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ABSTRACT

The study investigated the insect pest management practices of summer vegetables and profitability of the practices in Sirajgonj district of Bangladesh through survey among the growers. In total fifteen groups of insect under 7 orders attacked 5 vegetable crops in the study area. Among the status groups, a total of 9 were found as major and 6 as minor groups. Chemical control, physical and hand picking, integrated pest management (IPM), field cleaning, botanical pesticide, biological control, twig or leaf cutting, crop rotation, mulching and intercropping methods were practiced to manage insect pests. Farmers apply tactics dealing with other farmers, agricultural dealers, agricultural extension officers or obtaining ideas from agricultural fair and demonstration also with their experience. The findings showed that the highest total return was obtained from the bitter gourd (532170 Taka/ha) and lowest in okra (374250 Taka/ha). Variable and total cost bases benefit cost ratios (BCR) were the highest in brinjal (2.7 and 2.4, respectively) and the lowest in okra (2.5 and 2.1, respectively). Among five vegetable crops, brinjal was more profitable in terms of gross margin, net return and benefit cost ratio compared to other summer vegetables.

Keywords: Summer vegetables, insect, management practices, cost return

Introduction

More than 60 different types of vegetables are grown in Bangladesh and most of them are cultivated in winter. The major summer vegetables are pumpkin, bitter gourd, teasle gourd, ribbed gourd, ash gourd, okra, yard long bean, and Indian spinach. Vegetable is quick growing and cash earning enterprise to the farmers. Its cultivation creates more productive employment opportunities than cereal crops and it requires modern technologies, and provides significant source of income to small scale farmers (Ojiewo *et al*. 2010). Thus vegetable farming has become an advantage for the farmers of Bangladesh. Vegetable production in Bangladesh increased by 35.3% over the last five years and the country reached to the third position across the global vegetable production (MOA 2018). However, the production of vegetable is still insufficient for the nation.

Insect infestation is one of the main reasons of the low production and quality of vegetables in Bangladesh. Different types of insect pests attack the vegetables during the growing summer season. Infestation of insects poses a considerable economic threat to the agro-ecosystem (Sharma and Rao 2012). The magnitude of vegetables production loss depends on insect pest severity and environmental calamities. However, it varied from place to place and time to time. Bangladeshi farmers mostly rely on the use of synthetic insecticides to control the insect pest. Inappropriate selection of insecticide, doses, improper and inadequate spray may cause of failure in controlling insect (Rashid *et al.* 2008). The production per unit area of Bangladesh is quite low since the insect pests cause 30-40% losses in general and even 100% losses in case of menace if no control measure is applied. However, the researcher and extension personnel are trying to motivate the farmers for adoption of integrated management tactics to overcome the insect pest problems in Bangladesh.

For introducing and adopting insect management technologies in a study area, it is necessary to study the scenario of the problems, status of the stakeholders and existing practices of that area. This insect management practice will be helpful for the policy makers to initiate appropriate policy to control manacle pest in less

expensive and environment friendly ways. So the present study was undertaken to analyze the abundance of insect pests of summer vegetables, their present management practices and profitability of a major vegetable producing area of Bangladesh.

Materials and Methods

A total of 180 summer vegetable farmers from Sirajgong district were selected for this study and the primary data were collected from April to July, 2019 with questionnaire. The information of questionnaire the socio-economic profile, existing insect management practices, sources of insect management practices information, costs of variable and fixed inputs; and returns of the summer vegetable production were included. Secondary data were gathered from different published scientific article, books, papers etc. Insects were collected by Sub Assistant Agricultural Officer (SAAO) from assigned vegetable fields. The collected insects were send to the Entomology Laboratory of Bangbandhu Sheikh Mujibur Rahman Agricultural University for identification.

The profitability of summer vegetable production was calculated using simple accounting procedures. To determine the cost of production both variable and fixed costs were considered. The following equations were used for calculating total cost, gross return, gross margin, net return and benefit cost ratio:

Total cost= Total fixed cost + Total variable cost

Gross return (GR)

$$GR= \sum_{i=1}^{n} Q_i P_i$$

Where, GR= Gross return from i^{th} product; Q_i = Quantity of the i^{th} product; P_i = Average price of the i^{th} product; and i = 1, 2, 3.....n.

Gross margin = Gross return -total variable cost

Net return = Gross return - Total cost; (Total cost = Total variable cost + Total fixed cost)

Benefit cost ratio (BCR) = Gross Return/Total cost

Results and Discussion

From the Table 1, it is evident that most of the summer vegetables producing farmers (39%) were middle- aged with the age ranged from 30 to 45 years, whereas 36% were in the age group of above 45 years. Comparing with the above two groups, a less number of young people (25%) were found in the study areas who were interested in vegetable production. This is clear from the study that agriculture production is the main occupation (84%), followed by business (11%) and others (5%). Education is one of the most important socioeconomic variables which influence the overall pattern of a better livelihood. The educational status of the summer vegetable producers allows them to easily understand and apply new practices, objects and techniques in the production processes. In general, a farmer with a higher level of education has more potentiality than a lower one especially in the situation where more technical knowledge is required. The formal education level of the vegetable producing farmers were pitiable that was 44% up to class eight, 40% from class eight to SSC and only 15% above SSC. Household size refers to the total number of individuals who live within and feed from the same pot. The vegetable producing farmers in the study area mostly had a household size of 4-6 persons (66%) followed by above 6 persons (29%) and only 5% family members up to four persons. The result of the study matched with the results of Hasan *et al*. (2014). The majority of the farmers (44%) had land size from 2-4 bigha (one bigha = 33 decimals). Forty percent of the farmers had land size of above four bigha and sixteen percent family had land size of up to two bigha. Majority farmers of the study area (82%) had vegetable production experience less than five years. Fourteen percent had experience of 5-10 years and only 4% farmers

Table 1. Socio economic profile of summer vegetable producers in Sirajganj district, 2019

Particulars	Categories	Participated (%)
Age (Years)	<30	25
	30-45	39
	> 45	36
Major occupation	Agriculture/farming	84
	Business	11
	Others	5
Education level (Class)	Up to 8	44
	8 -SSC	40
	Above SSC	16
Family size (Person)	Up to 4	5
	4-6	66
	Above 6	29
Average farm size (Bigha)	Up to 2	16
	2-4	44
	Above 4	40
Experience (Years)	Up to 5	82
	5-10	14
	Above 10	4

had experience of more than ten years. It is revealed that the summer vegetables production in the study areas is a new intervention.

From the Table 2, it was observed in the study areas that 15 insect pests (9 major and 6 minor) were found under 7 orders (Acarina, Coleoptera, Diptera, Homoptera, Thysanoptera, Lepidoptera and Orthoptera) belonging to 14 families in different host vegetables. Pumpkin beetle, epilachna beetle, fruit fly, shoot and fruit borer, jassid, field cricket, cutworm, aphid, mealy bug were major insect pests as well as thrips, leaf eating weevil, white fly, red mite, leaf folder and leaf miner were minor insects. Pumpkin beetle, epilachna beetle, fruit fly and mealy bug insect mainly damaged cucurbits like pumpkin, sponge gourd and bitter gourd etc. A lion share damaged of binjal were caused by shoot and fruit borer. Jassid, red mite, leaf eating weevil, leaf miner and cut worm damaged okra, eggplant. Aphid and mealy bug suck cell sap from younger leaves and stem as well as damage flowers and fruits of different vegetables. Thrips damage many other garden vegetables. Field cricket and cutworm damaged brinjal and okra. According to Hovorka (2005) and Bhat *et al.* (2011) vegetables production faced a serious threat by different insect pests and adverse effects on production. Pumpkin beetle and epilachna beetle feed voraciously on the leaves, flowers and fruits, hole on the plant tissues and causing death or deterioration. Fruit fly and borer pest feed pulp, fruits, restored and malformed fruits resulting premature dropping fruits. Aphid and mealy bug suck cell sap from younger leaves and stem, damage flowers and fruits. Field cricket in large numbers can damage by feeding on the growth centre of plants and caterpillars of cutworm cut the leaf or shoot or the plants just above the ground level and buried in the soil.

From the Table 3, it was found that in the study area farmers practiced chemical control, physical and hand picking, integrated pest management, field cleaning, botanical pesticides, biological control, twig or leaf cutting, crop rotation, mulching, inter cropping etc. methods in management of insect in summer vegetable production. Physical and hand picking (*viz*. swiping, destroy of egg mass and infested plant parts, and burning), chemical control, integrated pest management (IPM), field cleaning (weeding and destroy of crop debris), use of botanical pesticide, biological control, twig or leaf cutting, crop rotation, mulching (break down of earth crust after irrigation, used straw and water hyacinth) and intercropping (trap cropping e.g. wild okra, safflower, thorn brinjal) method were used by vegetables growers to manage insect pest during summer vegetables growing period. The majority of the farmers (94%) in the study area farmer used systemic and contact insecticides

Table 2. Detrimental insects in summer vegetables production and their infestation status in Sirajgani district, 2019

Local Name of insect	Scientific Name	Order	Family	Status	Infested vegetables
Pumpkin beetle	*Aulacaphara*spp.	Coleoptera	Chrysomelidae	Major	Cucurbits
Epilachna beetle	*Epilachna*spp.	Coleoptera	Coccinellidae	Major	Cucurbits
Fruit fly	*Batroceracucurbitae*	Diptera	Tephritidae	Major	Cucurbits, brinjal
Thrips	*Thripsflavidus*	Thysanoptera	Thripidae	Minor	Cucurbits, brinjal
Shoot & fruit borer	*Leucinodesorbonalis*	Lepidoptera	Pyralidae	Major	Brinjal, other Solanaceae crops
Jassid	*Empoasca*sp.	Homoptera	Cicadellidae	Major	Okra, brinjal
Field cricket	*Brachytrypesportentgosus*	Orthoptera	Gryllidae	Major	Cucurbits, brinjal, okra
Leaf eating weevil	*Hypolixustruncatulus*	Copeoptera	Curculionidae	Minor	Pumpkin
White fly	*Bemisiatabaci*	Homoptera	Aleyrodidae	Minor	Cucurbits,brinjal
Red mite	*Tetranychus*sp.	Acarina	Tetranychidae	Minor	Cucurbits, brinjal
Aphid	*Aphis* spp.	Homoptera	Aphididae	Major	Cucurbits, brinjal
Mealy bug	*Coccidohystrixinsolitus*	Homoptera	Pseudo- coccidae	Major	Cucurbits, brinjal, okra
Leaf folder	*Eublemmaolivacea*	Lepidoptera	Noctuidae	Minor	Brinjal
Leaf miner	*Cosmopterixmimetix*	Lepidoptera	Cosmopterxi-dae	Minor	Cucurbits, brinjal
Cut worm	*Agrotisipsilon*	Lepidoptera	Noctuidae	Major	Cucurbits,brinjal

Table 3. Efficacy of different insect management practices of summer vegetable producers in Sirajgani district, 2019

Methods	Participation (%)	Name of insect	Techniques of control	Frequency of use/ application
Chemical control	94	Shoot & fruit borer, pumpkin beetle, epilachna beetle, thrips, jassid, field cricket, leaf eating weevil, red mite, mealy bug	Systemic and contact poisoning	30-40 times
Physical & hand picking	87	Pumpkin beetle, epilachna beetle, cutworm	Hand picking and sweeping net	7 times
Integrated pest management (IPM)	76	Pumpkin beetle, epilachna beetle, fruit fly, white fly, aphid, shoot & fruit borer	Clean cultivation, biological, mechanical and chemical	Season based
Field cleaning (weeding)	71	Thrips, jassid, white fly, aphid	Weeding, remove infested plant parts	3 times
Botanical pesticides	60	Thrips, jassid, white fly, aphid	Spraying extract of neem leaves	2 times
Biological control	55	Thrips, jassid, white fly, aphid	Bird, tiger beetle, carabid beetle, wasp, spiders, frog	Season based
Twig or leaf cutting	49	Aphid, leaf folder, white fly, thrips, jassid, leaf miner	Cultural and mechanical	3 times
Crop rotation	42	Fruit fly, red pumpkin, epilachna beetle	Cultural	Season based
Mulching	38	Cutworm, field cricket	Break down of earth crust after irrigation, used straw and water hyacinth	2 times
Intercropping	35	Jassid, white fly, aphid	Trap cropping	Season based

30-40 times as chemical control method in vegetable production against shoot & fruit borer, pumpkin beetle, epilachna beetle, thrips, jassid, field cricket, leaf eating weevil, red mite, mealy bug insects. Hand picking and sweeping net were used by 87% farmers as physical & hand picking method to control pumpkin beetle, epilachna beetle, cutworm insects. This method was used 7 times during vegetable production period. Clean cultivation, biological, mechanical and chemical control methods were practiced during vegetable production season of integrated pest management (IPM) that was practiced by 76% of the vegetable growers to control pumpkin beetle, epilachna beetle, fruit fly, white fly, aphid, shoot and fruit borer insects. To control thrips, jassid, white fly, aphid insects 71% of the vegetable producer practiced weeding, removing infested plant parts as a part of field cleaning (weeding) method 3 (three) times during production period. Spraying extract of neem leaves was used 2 times by 60% of the farmers as a part of botanical pesticides method in controlling thrips, jassid, white fly, aphid insects. Season based bird, tiger beetle, carabid beetle, wasp, spiders, frog etc were natural controlled by 55% of biological control against thrips, jassid, white fly, aphid. In controlling aphid, leaf folder, white fly, thrips, jassid, leaf miner of 49% farmers practiced cultural and mechanical methods 3 times as a part of twig or leaf cutting. Season based cultural technique was used as part of crop rotation method used in controlling fruit fly, red pumpkin, epilachna beetle. Break down of earth crust after irrigation, used straw and water hyacinth mulch techniques were used 2 times during vegetable production period as a representation of mulching in controlling cutworm, field cricket of 38. The lowest (35%) of the respondents practiced trap cropping as a technique of intercropping method for controlling jassid, white fly, aphid insect to produce summer vegetables. Hovorka (2005) reported that many insect pest attacked vegetables due to unidentified insect and their control measure, lack of limited knowledge and skills on their management practices. Insect is important constraints to vegetable production; however, rainy season, humidity, warm climates and climate change are most reasons on vegetable pest severity (Abang *et al*. 2014).

From the Table 4, it was stated that the highest sources of information was collected by other farmers of 92%. Seventy-five percent of the farmers used insecticide from their own previous knowledge. About 69% farmers reported that they received advice on the selection of insecticides and their dosages from agricultural dealers. Even if they have the necessary expertise, they are obviously motivated by profits from their own business of pesticide sale. Sixty-one percent of the farmers got advice from Agricultural Extension Officers (AEO) which means that their (AEO) communication with farmers is not convincing enough. Agricultural fair/Demonstration

Table 4. Sources of insect pest management information of the farmers in Sirajgani district, 2019

Sources of information	Respondent (%)	Score
Other farmers	92	1
Own previous knowledge	75	2
Agricultural dealers	69	3
Agricultural Extension officers	61	4
Agricultural fair/Demonstration	52	5
Leaflets/Flipchart	37	6
Radio/TV/Magazine	31	7
Research Institutes	25	8
Non -government organization (NGO)	22	9

were information sources to the farmers in managing insects that was mentioned by 52% farmers. Thirty-seven percent farmers mentioned Leaflets/Flipchart was informational source in controlling insect for summer vegetable production. Radio/TV/Magazine, Research Institutes and Non-government organization (NGO) were the information sources as mentioned by 31%, 25% and 22% farmers, respectively. These results matched with the results of Missanga and Rubanza (2018). Chowdhuri *et al*. (2014) reported that appropriate training facility and sufficient extension services needed of the better management of insect pest of vegetable farmers. The results indicated that there is scope of increasing helping hand from DAE and research institutes to the vegetables producing farmers of the study area.

Table 5 presents the cost and revenues structure of engaging in different summer vegetable production. The total variable cost per hectare was estimated Tk. 172585.00, Tk. 151240.00, Tk. 198877.00, Tk. 194997.00 and Tk. 150707.00, respectively for cultivating pumpkin, sponge gourd, bitter gourd, brinjal and okra. Total fixed cost per hectare incurred by farmers Tk. 25997.00 for

Table 5. Average estimation of cost and return for summer vegetables production in Sirajganj district, 2019 (Tk. ha^{-1})

Particulars	Vegetables				
	Pumpkin	Sponge gourd	Bitter gourd	Brinjal	Okra
Seed	6736	5239	7485	12724	13473
Fertilizer	26197	17215	23203	28817	17365
Land preparation	11751	6736	18712	22455	18712
Irrigation	6362	5614	9244	8982	6362
Weeding	25149	14783	13473	27620	23652
Bamboo	44909	28068	33682	0	0
Pesticide	14970	11227	14970	22455	12537
Harvesting and marketing	33682	59879	74848	68748	56136
Interest on operating capital	2829	2479	3260	3196	2470
Total variable cost (TVC)	172585	151240	198877	194997	150707
Family labour	4790	3929	1497	6062	6287
Land rent cost for 4 months	21207	19960	24950	19960	18712
Total fixed cost (TFC)	25997	23889	26447	26022	24999
Total cost (TC)	198582	175129	225324	221019	175706
Total production (kg/ha)	22455	19461	11826	21257	14970
Sold unit price (Tk.kg^{-1})	20	20	45	25	25
Total return (Tk./ha^{-1}))	449100	389220	532170	531425	374250
GM (Tk./ha^{-1})	276515	237980	333293	336428	223543
NR(Tk./ha^{-1}))	250518	214091	306846	310406	198544
Cost of production (Tk.kg^{-1})	8.84	9.00	19.05	10.40	11.74
BCR (Variable cost basis)	2.60	2.57	2.68	2.73	2.48
BCR (Total cost basis)	2.26	2.22	2.36	2.40	2.13

pumpkin, Tk. 23889.00 for sponge gourd, Tk. 26447.00 for bitter gourd, Tk. 26022.00 for brinjal and Tk. 24999.00 for okra cultivation. The highest production cost was found in bitter gourd Tk. 225324.00 per hectare and lowest in sponge gourd cultivation was Tk. 175129.00. The results revealed that the revenue generated per hectare for cultivating summer vegetables were estimated Tk. 449100.00 from pumpkin, Tk. 389220.00 from sponge gourd, Tk.532170.00 from bitter gourd, Tk.531425.00 from brinjal and Tk.374250.00 from okra cultivation. The highest revenue per hectare was observed Tk. 532170.00 from bitter gourd cultivation and lowest from okra cultivation that was estimated Tk. 374250.00. The highest gross margin and net return was found from brinjal cultivation Tk. 336428.00 and Tk. 310406.00, respectively and lowest from okra Tk. 223543.00 and Tk. 198544.00, respectively. The benefit cost ratios of the study indicated that farmers earned substantial profits from summer vegetable cultivation. The highest benefit cost ratio in both variable and total cost basis were found from brinjal cultivation 2.73and 2.40, respectively and the lowest from okra cultivation 2.48 and 2.13, respectively. These results matched the result of Hasan *et al*. (2014). They reported that brinjal cultivation is more profitable compare to other summer vegetables.

Majority farmers of the study area received suggestions from other farmers to overcome the adverse situation created by insects where judicial use of pesticides was not maintained properly. Awareness should be developed among farmers about judicial use of pesticides or chemical-free vegetable production. Government along with other mastermind organizations should take necessary initiatives to train up the farmers about insect management practices that in turn will create great opportunity in getting higher production as well as higher profit from summer vegetable production. In the study area, brinjal production was more profitable in terms of gross margin, net return and benefit cost ratio compared to other summer vegetables. Therefore, it is concluded that summer brijal production in Sirajgonj district is a profitable practice.

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