



## Study of pesticide use on bitter gourd production at Jashore district

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Received 29 August 2020, Revised 17 December 2020, Accepted 24 December 2020, Published online 31 December 2020

### ABSTRACT

The study was designed to assess the extent of pesticide use and profitability of bitter gourd production at farm level in selected areas of Jashore district during January-May, 2019. Average farm size was 0.79 ha and average bitter gourd cultivated area per farmer was 0.07 ha. Most of the farmer cultivated local variety, which is called Gajkorola and some farmer cultivated hybrid korola such as Gonggajoli, Tia and BARI Korola-1 variety. About ninety-nine percent farmers sprayed insecticides and fungicides in their fields to protect crops from different insect pests and diseases. Thirty-nine percent farmers used pheromone trap for crop protection. A farmer averagely used 11.19 times spray in their fields and its range was 5-18 times in a season. The average yield of bitter gourd was 16.74 t ha<sup>-1</sup> for non-IPM farmer and 16.16 t ha<sup>-1</sup> for IPM farmer. The average total cost of production of bitter gourd was Tk. 203984 ha<sup>-1</sup> for non-IPM farmer and Tk. 191246 ha<sup>-1</sup> for IPM farmer. Gross return was Tk. 389705 ha<sup>-1</sup> and net return was Tk. 185721 ha<sup>-1</sup> for non-IPM farmer. While, gross return of IPM farmer was Tk. 360828 ha<sup>-1</sup> and net return was Tk. 169582 ha<sup>-1</sup>. Benefit cost ratio was 1.91 and 1.89 for non-IPM and IPM farmer, respectively that means bitter gourd production was profitable. Cent percent farmer reported that IPM technology was time-consuming method and it was not only the measures to protect pests.

**Keywords:** Pesticide, IPM technology, Bitter gourd, Cost and return.

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Cite this article as: Hajong, P., Rahman, M.S., Islam, M.A. and Biswas, G.C.2020. Study of pesticide use on bitter gourd production at Jashore district. *Int. J. Agril. Res. Innov. Tech.* 10(2): 110-115. <https://doi.org/10.3329/ijarit.v10i2.51584>

## Introduction

Bangladesh is primarily an agrarian economy. Agriculture is the single largest producing sector of economy. Farmers of Bangladesh are producing a lot of vegetable and the minimum recommended dietary allowance of vegetables per capita per day is 300 g but its present availability is 166.1 g (NFPCSP, 2013). Vegetables are the cheapest source of vitamins, minerals, salts and proteins, which are essential elements for human health. Therefore, it plays an important role in balanced diet for human being as well as it acts as an income-generating source of the farmers. Bitter gourd (*Momordica charantia* L.) is one of the most popular cucurbitaceous vegetable in Bangladesh for its nutritive and medicinal value (Islam *et al.*, 2013). In Bangladesh summer vegetable cultivated 1.27% of total cultivated area (BBS, 2019) and among them bitter gourd was important vegetable produced in this season. It is grown extensively throughout Bangladesh; the fruit is wormicidal and good for rheumatism. Previously it was considered as homestead vegetable but now it is grown as field crop. The cucurbit fruit fly is a highly damaging pest of

almost all the cucurbit vegetables. It is grown extensively throughout the country round the year. The nutritive value of bitter gourd in 100 g of edible portion are carbohydrate 4.2 g, calcium 20 mg, phosphorus 55 mg, protein 2.1 g and iron 1.8 g. It is also rich in Vitamin A 210 IU and Vitamin C 88 mg, which plays a vital role in human nutrition (Singh and Kirtiraj, 2012). Presently a large number of farmers in different regions of Bangladesh are producing huge amount of vegetables by using eco-friendly pheromone trap instead of harmful pesticides and are being financially benefited by using the trap at lesser cost compared to that of using pesticides (Anonymous, 2015). Although pesticides may provide temporary relief, it is now widely accepted that indiscriminate and excessive use of pesticides and the long-term dependency on them threaten the sustainability of agricultural production. Indiscriminate use of pesticides by farmers to control the pest has endangered the safety of the environment and increased the chances of accumulation of poisonous residues in the produce. It was

homestead vegetable in the past years but now it is grown as field crop. It has great appeal to the diabetes patient. They favor it for controlling diabetes. Bitter gourd is relatively rich in food value compared to other summer vegetable. The

non-judicious use of insecticides is a concern due to various potentially harmful health and environmental effects.

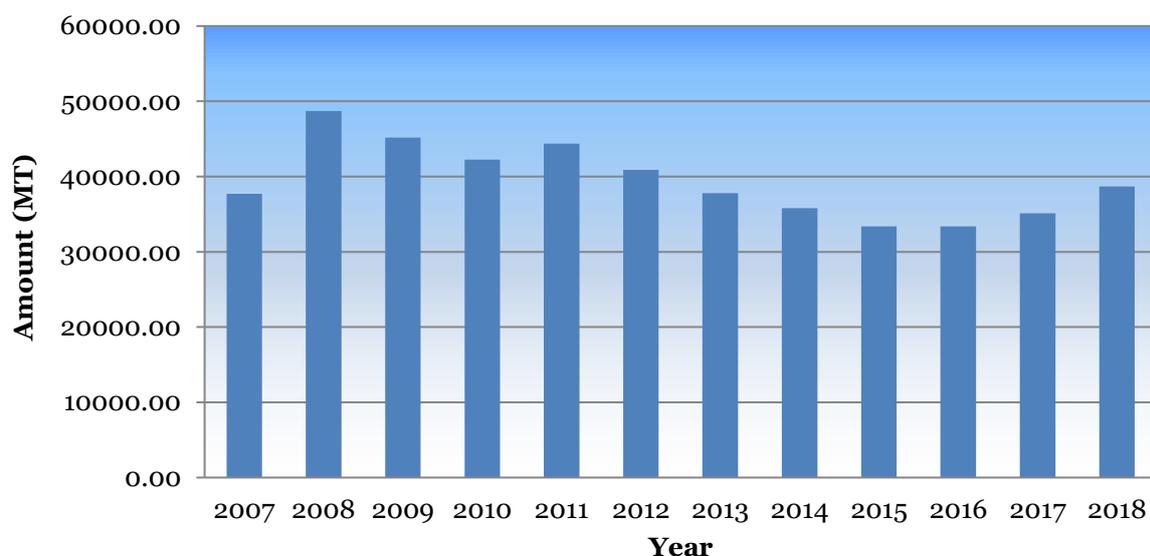


Fig. 1. Annual consumption of pesticides in Bangladesh during 2007 to 2018.

Source: BBS, 2012 and BBS, 2019

In Bangladesh huge amount of pesticide used every year and it was 38691.86 MT during 2018 (BBS, 2019). Annual pesticide consumption was more or less same in every year (Fig. 1) and for this reason huge amount of foreign currency was spends for import of pesticide from different countries. Pesticides include different insecticides (granular, liquid and powder), miticide, fungicide (general, sulphur), herbicide and rodenticide, which broadly used in Bangladesh.

However, very few economic studies (Islam *et al.*, 2013; Islam *et al.*, 2017) were conducted on IPM technology on bitter gourd production. Some studies conducted on profitability of bitter gourd production (Mila *et al.*, 2015). Therefore, much work is required to enhance the level of pesticide use and draw backs of IPM technology in the study areas. Jashore is the vegetable growing area and grown all types of vegetable such as summer and winter vegetable were grown all over the year. Among them bitter gourd is the important vegetable crops grown in the summer season at Jashore. In Jashore during 2018-19, the bitter gourd area was 368.42 ha and production was 2868 MT (BBS, 2019). The present study attempts to analyze the pesticide use on bitter gourd production in Jashore District of Bangladesh. The specific objectives of the study were as follows: i) to assess the level of pesticide use on bitter gourd production; ii) to estimate cost and return of bitter gourd production; iii) to estimate the draw backs of use of IPM technology for bitter gourd production.

### Sample size and sample selection

For present study 90 bitter gourd farmers from three upazila of Jashore district namely Jashore sadar, Bagharpara and Jhikargacha upazila were purposively selected for data collection. Thirty samples from each upazila were selected for the present study. Although there were not sole IPM farmer, but two IPM farmer considered for data collection from each upazila. IPM farmer also use pesticide in their fields. Data were collected from each farmer by the prepared questionnaire and descriptive and statistical method of analysis was followed.

### Analytical techniques

Data were collected from each farmer by the prepared questionnaire. Collected data were edited, summarized, tabulated and analyzed to fulfill the objectives of the study. Descriptive statistics using different statistical tools like averages, percentages and ratios were used in presenting the results of the study. The profitability of crop production was examined based on gross return, gross margin and benefit cost ratio analysis. Land use cost was calculated based on per year value of land.

### Equations for profitability analysis

$$\text{Gross return, GR}_{ij} = Y_{ij}P_{ij}$$

Where,

$$\text{GR}_{ij} = \text{Gross return (Tk. ha}^{-1}\text{)}$$

$$Y_{ij} = \text{Quantity produced (Kg ha}^{-1}\text{)}$$

$$P_{ij} = \text{Price of } j^{\text{th}} \text{ crops received by } i^{\text{th}} \text{ farmer (Tk. ha}^{-1}\text{)}$$

$$\text{Net return} = \text{gross return} - \text{total cost}$$

$$\text{Gross margin} = \text{gross return} - \text{variable cost}$$

$$\text{Benefit cost ratio, BCR} = \text{Gross return/Total cost}$$

## Results and Discussion

Socio-economic status, economic profitability and use of pesticide on bitter gourd production were discussed below:

### ***Socio-economic profile of the respondent farmers***

Socio-economic profile of the respondent farmers is required to have an idea about the present farm activities, possible development opportunities and potentials for more efficient farming. Therefore, information regarding respondents age, education, occupation, family size, farm size, land use pattern and experience in cultivation were recorded for the study. Major farmers of the study areas were experienced farmer and they works in their farm by inheritance. Most of the farmers were young that means their age range were 31 to 50 years and it was about sixty-nine

percent. Again there also aged farmer involved in the farming (age < 50 years). About seventeen percent farmer was old aged farmer (Table 1). Average family size was 5.00, which was equal to national average. Majority farmers (81%) were literate and rest of the farmer (19%) can sign their name that means they were not illiterate farmer. Most of the farmers' main occupation was agriculture and some has business and service. Those farmer's whose business and service was main occupation, agriculture was their subsidiary occupation. The average farming experience was 21.10 years and average experience on bitter gourd cultivation was 6.88 years. About thirty-six percent farmers got training on agricultural crop production and other related training. Among the farmers, twenty-one percent farmers got training from DAE and eighteen percent from research institute (BARI).

Table 1. Socio-economic profile of the respondent farmers in the study areas.

Farmer attributes	Categories	Percentage of farmer
Age group (Year)	>30 years	14.44
	31-40	37.78
	41-50	31.11
	<50 years	16.67
Family member	Male	39.71
	Female	32.60
	Children	27.70
Level of education	Can sign	18.89
	Primary	44.44
	SSC	24.44
	HSC and above	12.23

Source: Field data, 2019.

### ***Land use pattern***

Most of the farmers more or less have their own land and some other farmer cultivate land by share from other or mortgage from other farmer. The average farm size was 0.79 ha (Table 2). Average bitter gourd cultivated area per farmer was 0.07 ha, which was only about nine percent of the total cultivated land of this area. Most of the farmer cultivated local variety, which is called Gaj corolla and some farmer cultivated hybrid corolla such as Gonggajoli and Tia variety. Among the sampled farmers, only one farmer found to be cultivated BARI released bitter gourd variety (BARI Korola-1).

Table 2. Land use pattern of the farmers (ha).

Land use pattern	Average area (ha)
Average farm size	0.79
Own cultivated land	0.53
Share cultivated land	0.33
Mortgage in cultivated land	0.28
Bitter gourd area	0.07

### ***Extent of level of pesticide use***

Farmer used excessive insecticides and fungicides in bitter gourd fields to get better crops and good yields. Farmer used pesticides which adoption was high in Jashore district (Hajong *et al.*, 2018). Jashore farmer spends more pesticide (17.12%) on bitter gourd (Table 5) than summer tomato (6.24%) and panikachu production (3.63%) (Hajong *et al.*, 2015). For pest control farmer used different types of pesticide in bitter gourd fields such as Shobicron 425 EC, Proclaim 5 SG, Voliam Flexi 300 SC, Marshal 20 EC, Tafgor 40 EC, Vertimec 1.8 EC, Actara 25 WG, Confidor 70 WG, Antracol 70 WP, Corolux 25 EC and Dursban 20 EC. Some pesticide used more than one times. Majority farmer (95.56%) used Shobicron 425 EC and it was 14.50% of total pesticide spray for controlling fruit fly in bitter gourd fields (Table 3). Farmer also used bio pesticide Spinosad such as Success 2.5 SC and Tracer 45 SC in bitter gourd cultivation.

Table 3. Percent distribution of pesticide used in bitter gourd cultivation.

Name of pesticide	Frequency of pesticide application	Percentage of pesticide used	Percentage of farmer involved
Shobicron 425 EC	146	14.50	95.56
Proclaim 5 SG	129	12.81	81.11
Voliam Flexi 300 SC	123	12.21	92.22
Marshal 20 EC	111	11.02	90.00
Tafgor 40 EC	81	8.04	87.78
Vertimec 1.8 EC	64	6.36	71.11
Actara 25 WG	62	6.16	68.89
Confidor 70 WG	61	6.06	67.78
Antracol 70 WP	56	5.56	62.22
Corolux 25 EC	50	4.97	55.56
Dursban 20 EC	48	4.77	53.33
Tracer 45 SC	42	4.17	46.67
Success 2.5 SC	34	3.38	37.78
Average spray	11.19		

Source: Field survey, 2019.

Cent percent farmer sprayed insecticide in their fields to protect crops from different insect and disease (Table 4). About sixty-two percent farmers used bio pesticide such as Spinosad, Bio-neem etc. in their fields. Although there was better IPM technology on bitter gourd production a good number of farmers (46.67%) used pheromone trap for crop protection. Again, farmer collected insect larva from their fields with hand for protecting crops and it was 37.78 percent. Although the farmer used pheromone trap and they sprayed insecticide in their fields.

They did not fully believe that pheromone trap controlled insect in their fields. A farmer averagely used 11.19 times spray in their fields and its range was 5-18 times in a season. About ninety-three percent farmers argued that crop production was not possible without insecticide and insecticides protected crops from insect pests (Table 4). About sixty-one percent farmer did not get training on IPM technology. They did not get any training on IPM technology and 28% farmer did not any knowledge on crop production without pesticide use.

Table 4. Percent distribution on crop protection technology and causes of insecticide use of bitter gourd.

Pest management method	% of farmer	Cause of insecticide use	% of farmer
Insecticide spray	100.00	Protect crops from insect pest	93.33
Bio-pesticide	62.22	Not training on IPM method	61.11
Pheromone trap	46.67	Not know any other method	27.78
Hand picking	37.78		

### Cost of bitter gourd production

On an average, the total cost of production of bitter gourd was Tk. 203984 ha<sup>-1</sup> for non-IPM farmer and Tk. 191246 ha<sup>-1</sup> for IPM farmer. Total variable cost was Tk. 189024 ha<sup>-1</sup> for non-IPM farmer and Tk. 176286 ha<sup>-1</sup> for IPM farmer (Table 5). Non-IPM farmer spent more cost than IPM farmer did, because non-IPM farmer used excess insecticide Tk. 34929 ha<sup>-1</sup> (17.12%) than IPM farmer Tk. 20570 ha<sup>-1</sup> (10.76%). Among the cost items, cost of labor was the highest Tk. 62850 ha<sup>-1</sup> (30.81%) for IPM farmer and Tk. 63791 ha<sup>-1</sup> (33.36%) for non-IPM farmer that means excess labor need to cultivate, nurturing, spraying and

harvesting of bitter gourd. Bitter gourd needed mancha where it was rearing and keeping the fruits safely. It incurred about twelve percent cost of production for mancha preparation. IPM farmer used pheromone along with pesticide, which cost Tk. 20570.00 ha<sup>-1</sup>. On the other hand, non-IPM farmer spent about ten percent cost (Tk.33075 ha<sup>-1</sup>) on the pesticide spray in their fields. For crop protection, non-IPM farmer spent higher than the IPM farmer dose, because they spent three times money for pesticide on their fields. If farmer spray less pesticide on their fields then it lessen its cost of production.

Table 5. Per hectare production cost of bitter gourd production.

Cost item	Non-IPM farmer		IPM farmer	
	Cost (Tk. ha <sup>-1</sup> )	% of cost	Cost (Tk. ha <sup>-1</sup> )	% of cost
<b>A. Variable costs</b>				
Cost of land preparation	8749	4.29	8540	4.47
Cost of labor	62850	30.81	63791	33.36
Cost of seed	19843	9.73	19647	10.27
Organic fertilizer	8314	4.08	8910	4.66
Chemical fertilizer	23476	11.51	22977	12.01
Cost of irrigation	5175	2.54	5298	2.77
Cost of pesticide/pheromone	34929	17.12	20570	10.76
Cost of mancha preparation	21679	10.63	22814	11.93
Interest on operating capital @ 6.5%	4009	1.97	3739	1.95
<b>Total variable cost</b>	<b>189024</b>	<b>92.67</b>	<b>176286</b>	<b>92.18</b>
<b>B. Fixed cost</b>				
Land use cost	14960	7.33	14960	7.82
<b>Total fixed cost</b>	<b>14960</b>	<b>7.33</b>	<b>14960</b>	<b>7.82</b>
<b>C. Total cost (A+B)</b>	<b>203984</b>	<b>100.00</b>	<b>191246</b>	<b>100.00</b>

Source: Authors' estimation

### Returns from bitter gourd cultivation

The average yield was 16.74 t ha<sup>-1</sup> for non-IPM farmer and 16.16 t ha<sup>-1</sup> for IPM farmer and average price was Tk. 23.27 kg<sup>-1</sup> for non-IPM farmer and Tk. 22.33kg<sup>-1</sup> for IPM farmer. Market price was varied from month to month and season to season. Price became high at early time and it decreases with increase the time. Seasonal price fluctuation can be maintained by storage of the product (Hajong *et al.*, 2014). However, as for

perishable vegetable bitter gourd cannot store for long time. It needs to consume after harvest as early as possible. Gross return was Tk. 389705 ha<sup>-1</sup> and net return was Tk. 185721 ha<sup>-1</sup> for non-IPM farmer. Gross return of IPM farmer was Tk. 360828 ha<sup>-1</sup> and net return was Tk. 169582 ha<sup>-1</sup> (Table 6). Benefit cost ratios were 1.91 and 1.89 for non-IPM and IPM farmer, respectively that means bitter gourd production was profitable.

Table 6. Per hectare profitability of bitter gourd cultivation.

Particulars	Non-IPM farmer	IPM farmer
Yield (ton ha <sup>-1</sup> )	16.74	16.16
Price (Tk. kg <sup>-1</sup> )	23.27	22.33
Gross return (Tk. ha <sup>-1</sup> )	389705	360828
Total cost (Tk. ha <sup>-1</sup> )	203984	191246
Net return (Tk. ha <sup>-1</sup> )	185721	169582
BCR (total cost basis)	1.91	1.89

### Draw backs on IPM technology use

Pheromone trap was the most effective method used in bitter gourd fields. However, farmer did not use it properly. Cent percent farmer reported that IPM technology was time-consuming method (Table 7). Even IPM farmer used excessive pesticides and its rank was 1<sup>st</sup> compared to other environment friendly practices (Kamal *et*

*al.*, 2018). Some other said it was laborious to make trap and pheromone and someone argued it was laborious technology. Fifty percent farmer said that lack of sufficient trap was the main cause for not used pheromone in the farmer fields. Some other farmer but not larger were argued that it was less useful method and it need to spray pesticide if pheromone was also use.

Table 7. Drawbacks on IPM technology.

Draw backs	Percentage of farmer	Ranks
Time consuming method	100.00	I
Very laborious technology	83.33	II
Lack of sufficient pheromone trap	50.00	III
Less useful method	16.67	IV

## Conclusion and Recommendation

This study assesses the extent of pesticide used and the profitability of bitter gourd production at farm level. Most of the farmers' cultivated local variety called Gajkorola. Most of production cost involved in the labor cost. Insecticide spray in bitter gourd fields is important cost item and it varied the cost of production between IPM farmer and non-IPM farmer. For crop protection non-IPM farmer spent higher than the IPM farmer dose, because they spent three times money for pesticide on their fields. Farmers sprayed higher times, which were not necessary and unnecessary insecticide, which was

harmful for human health as well as their health. When they sprayed, they did not use any protection measures. Although there was pheromone trap for crop protection in bitter gourd fields, they did not use it properly and spray insecticide with pheromone trap.

Based on the above findings of the study, the following recommendations are given below:

- Farmer used huge amount of pesticide on bitter gourd production, which affect on economy, environment and farmers health, so it should take step to reduce the pesticide use on bitter gourd production.
- Though there was scope of IPM technology on bitter gourd production, it should promote IPM technology everywhere properly for safe and pesticide free bitter gourd as well as other vegetable production.
- Regular training should be arranged for the farmers to use IPM technology and bio pesticide to bitter gourd fields.
- Agricultural extension and research organization should work together to reduce pesticide use and awareness of farmer about hazardous use of pesticide.

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