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Adaptation of environment friendly technology by reducing pesticide use for cucumber cultivation at Farmers' level

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Abstract

A field experiment was conducted in the farmer's field at Salaipur, Mithapukur, On Farm Research Division, Rangpur during 2015-2016to control cucurbit fruit fly effectively through the use of sex pheromone trap. The trial was conducted among six farmers. Three treatments viz., T_1 (Sex pheromone + Poison bait + Sanitation (9 spot)), T_2 (Sex pheromone + Poison bait + Sanitation (16 spot)) and T_3 (Farmers practice) were compared. The total land area was 7200m^2. The higher fruit yield (63.99t/ha) was obtained from T_2 (Sex pheromone + Poison bait + Sanitation (16 spot). The lower fruit yield (27.99 t/ha) was obtained from T_3. The gross margin (Tk. 294706/ha) and gross return was also higher with the use of T_2 (Sex pheromone + Poison bait + Sanitation (16 spot).The highest gross margin and gross return was found in T_2 (Sex pheromone + Poison bait + Sanitation (16 spot) treatment. Use of insect lures can improve safe vegetable production as well as yield. Innovative agricultural technologies have the potential to increase yield and income of smallholder vegetable farmers in the northern region of Bangladesh.

Key words: Fruit fly, sex pheromone, profitability

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Introduction

Bangladesh is located where the river Padma enters the Bay of Bengal and consists of a river delta (Husain and Tinker, 2013). Bangladesh is one of the most densely populated countries in the world and around a third of the Bangladeshi people live in poverty. The population growth is causing a great pressure on the natural resources of the country, especially on the cultivatable land (IFAD, 2013; Rahman *et al.,* 2011; Sarker *et al*., 2010). In Bangladesh around 84% of the population is, in some meaning, dependent on agriculture for their livelihood (Dasgupta *et al*., 2004). Despite this, most Bangladeshis struggle to keep the agricultural production at a significant level. Pesticide use in Bangladesh has increased rapidly over the past four decades (Islam et al., 2015a). The farmers use pesticides to increase the crop production and to prevent crop losses due to pest attack (Rahman, 2012; Islam *et al.*, 2015a; Ferdous *et al.*, 2018). The concerns regarding high pesticide usage are the possibility of pesticide resistance and their harmful effect of human health and environment (Rahman, 2002; Islam *et al.*, 2015b; Islam *et al.*, 2015c). Pesticides include compounds that are known to cause cancer, genetic damage and allergic responses. Many of the harmful

effects are believed to be a direct result from overuse and misuse of pesticides. The lack of information to the farmers leads to a higher use of toxic chemicals than recommended. Pesticide poisoning and environmental damages are now common in Bangladesh due to overuse. To prevent the hazardous effects of pesticides, farmers need to be educated about the risks of overuse and the importance of using safety gear (Dasgupta *et al.,* 2004). Despite this, little effort has been made in Bangladesh to develop other methods than pesticides for pest management (Rahman *et al.,* 1994). Vegetable based cropping system on currently under-utilized lands could substantially benefit smallholder farmers (Anwar *et al.*, 2012, 2017; Ferdous *et al.*, 2017a) and make considerable contributions to regional food security objectives; though there is uncertainty about what management options are most appropriate in these environments.

The vegetable production in Bangladesh is very low in summer. In this season, the major vegetables grown are cucurbits. Therefore, during the lag period, cucurbitaceous vegetables play an important role to supplement this shortage (Rashid, 1993). Cucurbits occupy 66 percent of the land under vegetable production in Bangladesh and contribute 11 percent of total vegetable production in the country (IPM CRSP, 2004). Cucurbits include crops, such as cucumber *(Cucumis sativus*), squash (*Cucurbita pepo*), sweet gourd (*Cucurbita maxima*), bitter gourd (*Momordica charantia*) and snake gourd (*Trichosanthes anguina*). Fruit fly, *Bactrocera cucurbitae* Coquillet, is a major pest causing yield loss in cucurbits, and infests all 15 kinds of cucurbit vegetables grown in Bangladesh. A major constraint improved cucurbit production is high rate of fruit fly infestation (Ferdous *et al.*, 2017b, 2017c). Fruit flies reduce yield as well as the quality fruit (IPM CRSP, 2004). One of the primary cucurbit crops attacked by fruit fly is cucumber. Usually such type of pests controlled by sex pheromone trap which is environmentally safe (Islam and Ando, 2012). Though the knowledge and perception of our farmers about the use of sex pheromone is still limited (Islam, 2012).

Cucurbits are a major group of vegetable crops grown in Bangladesh. It is available throughout the year in all parts of the country. Cucumber is one of the most common popular cucurbits grown in Bangladesh. It is a good source of carotene and calcium. It contains 93 % water, 0.7 % mineral, 0.7 % fibre, 1.4 % protein, 0.5 %fat and 4.5 % carbohydrate per 100 g of edible portion. But cucurbit fruit fly is a major problem in its production. The crop is attacked by a large number of insect pests of which fruit fly (*Bactrocera cucurbitae*) is the most destructive pest. Female fly laid their eggs through long ovipositor by injuring young and tender fruits. After hatching the larvae feed on internal soft tissue and finally fruits are rotten. The insect damages all cucurbits like bitter gourd, cucumber, cucumber, ash gourd, watermelon, squash and teasel gourd. Farmers use huge amount of insecticides to control this pest which is very harmful for human heath as well as environment. So, this experimental trial was under taken in cucurbit growing area to popularize the technology among the farmers.

Materials and Methods

The experiment was conducted at the farmer's field, Salaipur, Mithapukur, OFRD, Rangpur during kharif-1 season 2011-2012. The land was medium high and the soil was sandy loam in texture which belongs to Agro Ecological Zone-3. The area mostly falls under high and medium high land areas of the Tista Meander Floodplain covering 946,803 ha (Anowar *et al.,* 2015; Khatun *et al*., 2014 & Mahamood *et al.*, 2016). Water holding capacity of the soil is good. The area receives an average annual rainfall of around 2,160 mm with an average temperature of about 25°C (Ferdous *et al*., 2016).

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ecological Zone-3. The trial was conducted among six farmers field. Three treatments viz., T_1 (Sex pheromone + Poison bait + Sanitation (9 spot)), T_2 (Sex pheromone+ Poison bait + Sanitation (16 spot)) and T_3 (Farmers practice) were compared. Weed free field, clean cultivation and removal of old senescence or infested leaf or shoot were the IPM techniques used in the experiment. The control plot was about 1000 meter away from the pheromone treated plot. The total land area was 7200m^2. Local variety of sweet gourd was used as a test crop. The crop was fertilized at the rate of recommended dose. Intercultural operation and irrigation were done as and when necessary .The sex pheromone trap and bait distance between placed by 10m × 10m and 7.5m × 7.5m spacing just after flowering.

***Data collection and statistical analysis*:** After physiological maturity, 10 randomly selected plants from each plot were harvested and plant height, yield and yield attributes of brinjal and cucumber and were measured. Yield $plant^{-1}$ for each crop was determined plot-wise and converted into yield on an area basis (kg ha^{-1}). Data on number of fresh fruits $plant^{-1}$, number of infested fruits $plant^{-1}$, weight of fresh fruits $plant^{-1}$, and weight of infested fruits $plant^{-1}$, yield and yield attributes were statistically analyzed using MSTAT-C software package (Ahmed *et al*., 2017 & Ferdous *et al*., 2014).

Production costs of cucumber included the cost of field preparation, seed, planting, irrigation, organic manure and fertilizer, plant protection chemicals, and harvesting. Gross return under a treatment was calculated by multiplying the gross amount of crop produced by the farm-gate price. The gross margin was calculated by subtracting cost of production from the gross return (Ferdous *et al*., 2017b, 2017c, 2018).

Results and Discussion

The yield and yield contributing characters of cucumber are presented in Table 1. Significantly the highest number fresh fruit per plant (22.46/plant) was obtained from treated with T_2 (Sex pheromone + Poison bait + Sanitation (16 spot). The lowest number of fresh fruit per plant (11.3) was recorded from farmers practice. The freshest fruit per plant was from plants with the pheromone lure; the least of fresh fruit per plant was from plants without the pheromone lure (Table 1).

Table 1. Yield of cucumber as influenced by sex pheromone trap at Mithapukur, Rangpur during 2015-2016.

Treatments	No of fresh fruit/plant	No of infested fruit /plant	Wt. of fresh fruit/Plant (kg)	Wt. of infested fruit/ Plant (kg)	Fruit yield (t/ha)
Sex pheromone + Poison bait + Sanitation	21.85a	0.80b	5.30a	0.19b	36.66a
Sex pheromone + Poison bait + Sanitation	22.46a	0.74b	5.36a	0.17b	36.99a
Farmers Practice	11.30b	9.0a	2.31b	1.87a	27.99b
CV (%)	4.76	6.87	6.35	3.21	5.33

The heaviest fresh fruit per plant was from plants with the pheromone lure and the lightest fresh fruit per plant was from plants without the pheromone lure.The number of infested fruit was only 0.74 per plant in T_2 (Sex pheromone + Poison bait + Sanitation (16 spot) treated plot while it was 1.87 per plant in farmers practice. Numbers of infested fruit per plant were greater and weight of infested fruit per plant was and heavier from plants without the pheromone lure compared to plants with the pheromone lure (Table 1).

The weight of individual fruit (5.36kg) was also higher with T_2 (Sex pheromone + Poison bait + Sanitation (16 spot) treated plot and the lowest weight of fresh fruit per plant was found in farmers practice. Weight of infested fruits plant^{-1} was found in lowest with T_2 (Sex pheromone + Poison bait + Sanitation (16 spot) treated plot and the highest weight of infested fruits plant^{-1} with farmers practice (Table 2). The higher fruit yield (36.99 t/ha) was obtained from T_2 (Sex pheromone + Poison bait + Sanitation (16 spot) treatment and the lowest (27.99t/ha) from farmers practice.

Economic analysis: The economic benefits were much higher from plots with pheromone lure than without pheromone lure, despite the higher initial cost of pheromone lure with materials (Table 2)

The cost of production is estimated based on the production elements in Table 2. From cost and return analysis at salaipur, Mithapukur, Rangpur, it was found that the highest gross return 369900 BDT. from T_2 (Sex pheromone + Poison bait + Sanitation (16 spot) treatment and gross margin 296248 BDT. also found from T_2 (Sex pheromone + Poison bait + Sanitation (16 spot) treatment though the highest cost of production was involved in T_2 (Sex pheromone + Poison bait + Sanitation (16 spot) treatment (Table 2).

Table 2. Cost and return analysis of cucumber at Mithapukur, Rangpur during 2015-2016.

Treatments	Fruit yield (t/ha)	Gross return (Tk/ha)	Total variable cost(Tk/ha)	Gross margin (Tk/ha)	BCR
Sex pheromone + Poison bait + Sanitation	36.66	366600	71894	294706	5.09
Sex pheromone + Poison bait + Sanitation	36.99	369900	73652	296248	5.02
Farmers Practice	27.99	231940	68520	163420	3.38

Price (Tk./kg): Urea = 11.80 , TSP = 22, MP = 25, Gypsum = 7, Zinc sulphate = 140, Boric acid = 180, Cucumber = 10.

The lowest yield (27.99 t/ha) was recorded from farmers practice and lowest gross return 231940 BDT. from farmers practice and gross margin 163420 BDT. also found from farmers practice though the lowest cost of production was involved in farmers practice (Table 2).

Fruit flies (Diptera: Tephritidae) are among the most important pests worldwide. Fruit fly causes severe damage to fruits and vegetables in Asia. The cucumber fly, *Dacus ciliates* Loew., is a major pest of cucurbits in some countries (Azab *et al*., 1970; Nagappan *et al*., 1971). Sex pheromone trapping techniques have become widespread alternative methodologies for managing pests, especially Lepidoptera and Diptera (fruit flies) pests (El-Sayed *et al*., 2006, 2009). Throughout the last two decades, devices, feeding stations, traps, and other technologies have been developed, tested and marketed (Armsworth *et al*., 2008; Piñero *et al.,* 2009). All these techniques are based on the principle of attracting efficiently the pest insects to the phenomena, where they are removed from the rest of the population, either by retaining them in the device (e.g., mass-trapping) (Cunningham, 1989; Economopoulos, 1989). The general idea behind these methods is that a large proportion of the pest population will be removed from the agro ecosystem, thus effectively reducing crop damage.

This pheromone trap can be used in organic farming and in agro ecological crop protection systems (Deguine *et al*., 2008). The trapped insects proved very representative of the adult in field populations (Deguine *et al*., 2013) and were particularly appreciated by the farmers: it is simple, easy to make,

low cost, uses no insecticides, and provides a positive psychological effect to the farmers communities.

Conclusion

This is a very effective method for controlling fruit fly insect for cucurbit vegetable cultivation. But it is needed low price of sex pheromone trap and availability of the same in the local market. It is better than poison bait and insecticide.

Therefore, there is great advantage of using integrated nutrient management (INM), integrated pest management (INM) or in other words integrated crop management (ICM) as a whole must be followed well. That is why, these days "Evergreen Revolution" and not "Green Revolution" is the most advocated slogan.

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