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 2015-2016 to control cucurbit fruit fly effectively through the use of sex pheromone trap. The trial was conducted among six farmers. Three treatments viz., T₁ (Sex pheromone + Poison bait + Sanitation (9 spot)), T₂ (Sex pheromone + Poison bait + Sanitation (16 spot)) and T₃ (Farmers practice) were compared. The total land area was 7200m². The higher fruit yield (63.99t/ha) was obtained from T₂ (Sex pheromone + Poison bait + Sanitation (16 spot)). The lower fruit yield (27.99 t/ha) was obtained from T₃. The gross margin (Tk. 294706/ha) and gross return was also higher with the use of T₂ (Sex pheromone + Poison bait + Sanitation (16 spot)). The highest gross margin and gross return was found in T₂ (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

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 Coqillet, 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 cucumber 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., T₁ (Sex pheromone + Poison bait + Sanitation (9 spot)), T₂ (Sex pheromone + Poison bait + Sanitation (16 spot)) and T₃ (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 7200m². 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 T₂ (Sex pheromone + Poison bait + Sanitation (16 spot). The lowest number of fresh fruit per plant (11.3) was recorded from farmers practice. The fresh 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.

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

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 T₂ (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 T2 (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 T2 (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 T2 (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 T2 (Sex pheromone + Poison bait + Sanitation (16 spot) treatment and gross margin 296248 BDT. also found from T2 (Sex pheromone + Poison bait + Sanitation (16 spot) treatment though the highest cost of production was involved in T2 (Sex pheromone + Poison bait + Sanitation (16 spot) treatment (Table 2).

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

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

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.

**References**


