



Effect of Net House on Tomato Leaf Miner (*Tuta absoluta*) (Meyrick) (Lepidoptera: Gelechiidae) Population in Tomato Cultivated in Chitwan, Nepal

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ABSTRACT

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This experiment was conducted in tomato field at Agriculture and Forestry University (AFU, Chitwan, Nepal) between October 2016 and May 2017 to evaluate effect of net house on invasive insect species of tomato moth, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). The trial was setup with two treatments inside net house and under open conditions and was designed with four replications. The adults of *T. absoluta* were observed significantly lower numbers inside the net house (1.41 adult/trap) compared to the open condition (24.84 adult/trap). The *T. absoluta* population increased with rainfall. The marketable yield was significantly higher inside the net house (100.91 ton/hect) due to reduction of damage to tomato fruit (4 ton/hect) by *T. absoluta*. The initial level of investment was found to be higher inside the net house when compared to open cultivation. In terms of economic analysis in long term aspect only, the net house is a suitable means of pest management against *T. absoluta*.

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Introduction

Tomato (*Lycopersicon esculentum* Miller) is considered as one of the most widely grown vegetables all over the world and is the second most important vegetable crop after potato (Panthee and Chen, 2010). Tomato is the third most important vegetable after cauliflower and cabbage in terms of area and production in Nepal. It is cultivated in about 20,000 hectares (hec) with 0.3 million-ton production value annually (MoAD, 2014). Insect pests play a major role for declining tomato yield. The crop loss due to pest is estimated to be 35-40% of the total production (PPD FAO, 2004). Tomato moth, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) is considered a typical invasive species because of its capacity to develop very quickly during tomato cultivation and to spread rapidly to new areas causing economically relevant damage (Desneux et al., 2010). In Nepal, invasion of *T. absoluta* was declared on 16th of May, 2016 (Bajracharya et al., 2016).

The sex pheromone of *T. absoluta* is used for insect monitoring and mating disruption. Virgin female tomato leaf miner releases a sex pheromone that strongly attracts

males. This pheromone was identified by Attygalle et al. (1996) as (3E, 8Z, 11Z)-3, 8, 11- e-tradecatrien-1-yl acetate. Captures in traps baited with synthetic pheromone lures accurately show whether a specific insect species is present, and when its seasonal flight period starts (Witzgall et al., 2010).

In Nepal, the average pesticides use is 396 gm a.i/ha (PPD, 2015) and more than 85 percent of imported pesticides are applying only in vegetable crops in Nepal (Sharma, 2015). Massive use of chemical pesticides in vegetable growing areas raised possible health risks issue in Nepal (Atreya, 2007).

Pesticides used in tomato production to reduce the yield loss leads to occurrence of resistance in pest and diseases (Hossain et al., 2013). In this condition, the major challenge is to control insect pests by minimizing use of the chemical pesticides. Therefore, this study was aimed to evaluate the effectiveness of net house in management of *T. absoluta* and compare the yield of tomato in net house with other treatments.

Materials and Methods

The experiment was conducted at horticultural research field of AFU, Chitwan. According to the geographical classification of country, it falls in the terai region of Central Development Region. Geographically it is located at 27°37'N latitude and at an altitude of 256 meter above sea level (Thapa and Dangol, 1990). Monthly average data on different weather parameters such as maximum and minimum temperatures, total rainfall and relative humidity was obtained from National Maize Research Program (NMRP, Rampur, Chitwan) during the tomato growing season. The experiment was laid out two treatments with four replications. The treatments were tomato cultivation inside net house and open condition. The net house size features were 5×22 m² area, 4m height and 40 mess silver color net. Srijana tomato variety (NARC) was cultivated. Each plot size was 4.5 m×2.4 m (10.8 m²) and consisted 24 tomato plants planted at a distance of 75 cm row to row and 60 cm plant to plant. Inner six plants were chosen randomly as a sample plant from each plot and tagged for data collection of insects and yield attributing characters.

Pheromone (TLM lure) was used for monitoring of *T. absoluta*. Pheromones were placed in ottaT-trap. Lures were replaced up in monthly intervals. In weekly basis the number of insects was counted in the trap. Data were collected for different parameters such as plant height, diameter, days of flowering and fruiting, marketable yield, unmarketable yield damaged by the *T. absoluta*, economic analysis as cost of cultivation, gross return, net profit and benefit cost ratio.

The collected data were compiled using the MS-Excel program. Analysis of variance for all parameters was carried out as per the procedures given in R-STATC statistical computer package for the paired two T- test.

Results and Discussion

Monitoring of *Tuta Absoluta* Using Pheromone TLM lure

The adult of *T. absoluta* was observed first in pheromone trap outside the net house on 13th February 2017. Significantly large number of insects was trapped onward till 3rd April 2017. The average temperature recorded during the first emergence of *T. absoluta* in field was 18.7°C with maximum and minimum temperature of 27°C and 10.4°C. The peak population was recorded at the 1st week of April when the average temperature was 26.1°C with (33.2°C maximum temperature and 19°C minimum temperature) (Figure 1). The positive linear relationship between *T. absoluta* population and rainfall, where R square value was 0.70 and equation $y = 2.2888x - 3.993$ shows that *T. absoluta* population incidence increased with the rainfall.

Tuta absoluta population inside the net house and open condition

T. absoluta adult population was observed to be significantly lower inside the net house (1.41) than open cultivation tomato (24.84) shown in Figure 2. There was significant difference among the treatments in terms of number of *T. absoluta*. The p-value was found to be 0.036 (P<0.05).

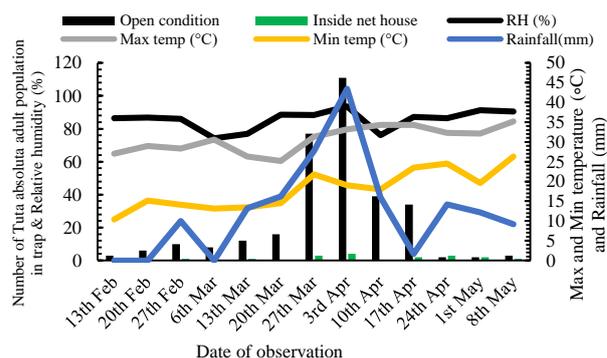


Figure 1. Graphical diagram showing number of *Tuta absoluta* adult population capture in trap in different dates of monitoring

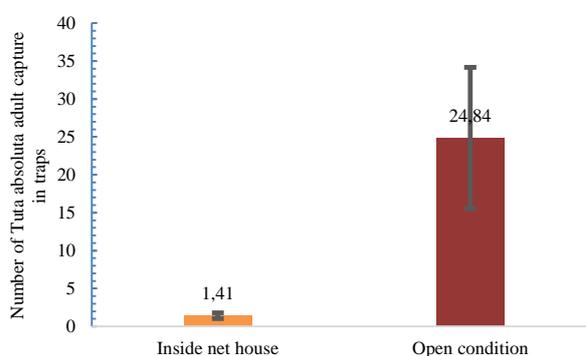


Figure 2. Number of *Tuta absoluta* population capture in traps in different treatments

Yield Attributing Characters of Tomato Crops

There was no significant difference in vegetative and flowering characteristics between the treatments, although variation was recorded in plant height, diameter of plant, days of 50% flowering, days of 50% fruiting (Table 1).

Yield

The result shows that there was significant difference between two treatments indicating that the yield was high in net house compared to open condition with p-value less than 0.05. The reduction of insect pest infestation was the major reason behind the increase in yield. As shown in Figure 3, yield infested by *T. absoluta* was recorded maximum in the open condition with 13.79 ton/hect and was minimum inside net house 4 ton/hect. As shown in Figure 4, the average yield of tomato in the net house is 100.91 ton/ha and 68.3 ton/ha in open condition. 47.73% of higher marketable yield was recorded inside the net house than open condition.

Economic analysis

While total cost of cultivation inside net house was 8963.34 \$/hect, value for in open condition was 6059.70 \$/hect. The total average fruit yield was found in net house and open condition to be 100.81 ton/hect and 68.31 ton/hect, respectively. Similarly, while average market price of tomato at the time of harvest was 250 \$/ton inside net house and it was 200 \$/ton in open condition.

Table 1. Effect of different treatments on yield attributing characters of tomato crops

Treatment	Plant height (cm)	Diameter of plant (cm)	First flowering (days)	50% flowering (days)	First fruiting (days)	50% fruiting (days)
Inside net house	211.375±11.44	16.61±0.55	36±0.81	42.75±0.25	50.75±0.25	57±0.4
Open condition	187.375±6.62	15.2±1.1	34.5±1.04	42±0.57	50.25±1.37	56.75±0.47
P- value	0.1315	0.316	0.3024	0.2978	0.7432	0.7052

Table 2. Economic analysis of tomato cultivation among different treatment

Treatments	Total cost of cultivation (\$/hec)	Total fruit yield (ton/hec)	Market price (\$/ton)	Gross income (\$/hec)	Net profit (\$/hec)	Benefit cost ratio
Net house	8963.34	100.91	250	25229.67	16266.32	2.81:1
Open condition	6059.70	68.31	200	13662.47	7602.77	2.25:1

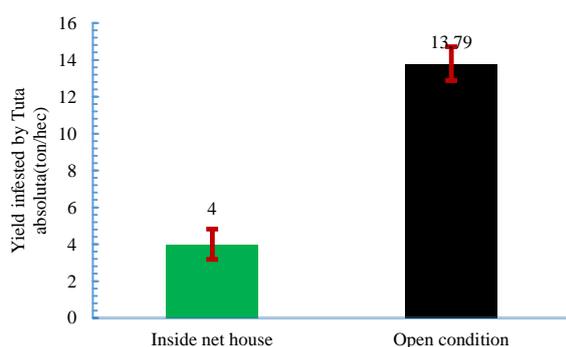
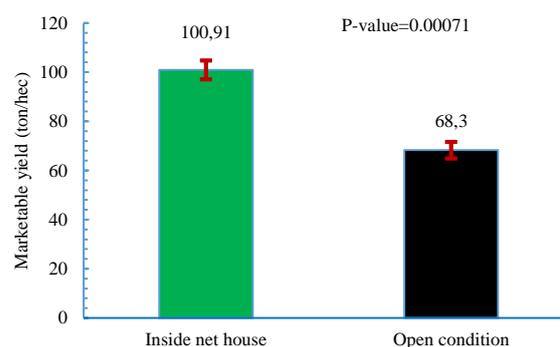
Figure 3. Yield infested by *Tuta absoluta* in different treatments

Figure 4. Marketable tomato yield in different treatments

The net profit was exerted maximum inside the net house with black polythene mulch (16266.32\$) and lower in open condition (7602.77\$) as shown in Table 2. Assuming the life of net house for 10 years and 2 seasons of cropping inside net house, the economic analysis has been done.

Discussion

Development time decreased with increasing temperature ranging from 78.17 days to 21.39 days within the range of 15-29°C. This range well encompasses the estimate of the optimum developmental threshold reported to be around the value of 25°C (Abolmaaty et al., 2011). The average development times are 76.3, 39.8 and 23.8 days at 14°C, 19.7°C and 27.1°C, respectively (EPPO, 2005).

According to our results, net house is very much effective in controlling insect pest like *T. absoluta*. Net house restricts the adult *T. absoluta* to enter in field. Similar result was observed by Cherif et al. (2013) and use of insect-proof screens significantly prevented *T. absoluta* infestations on host plants.

As the duration of harvesting was found maximum and insect pest activity was minimum inside the net house was reason for the maximum yield inside net house. These finding seems to be compatible with Palada and Ali (2007). The net shade greatly reduced insect population by 80% and marketable yield was 1.5 to 2 times greater under than in the open field.

Conclusion

T. absoluta is major invasive pest of tomato. In the spring season, tomato cultivation inside the net house plays the vital role for the *T. absoluta* management and exclusion comparative to open condition. The *T. absoluta* population was increased with rainfall. Marketable yield of tomato inside net house was higher than open condition with lower damaged fruit. Initial investment inside net house cultivation was higher than open cultivation. However, the net profit inside the net house was found to be higher than open condition. Therefore, net house in long run is the suitable means of protective cultivation to minimize the losses and enhancement of yield.

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