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Evaluation of Avoidable Yield Losses Inflicted by Cucumber moth (*Diaphania indica*) in Bitter gourd

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ABSTRACT: The cucumber moth, *Diaphania indica*, a recognized and significant pest in Africa and Asia, has demonstrated an increasingly detrimental impact on bitter gourd cultivation in recent years. Crop loss assessment is critical in developing comprehensive pest management programs, allowing for optimal resource allocation depending on the pest's relative impact. In this regard, a recent study was conducted to estimate the avoidable yield losses caused by *D. indica* infestation in the 'Pusa Do Mausami' bitter gourd variety. The investigation was conducted at Experimental Area, Department of Entomology, Chaudhary Charan Singh Haryana Agricultural University, Hisar during *Kharif* 2019. The results demonstrated substantial differences in the yields of treated (Malathion 50% EC @ 1ml/l) and untreated plots. The average yield of bitter gourd in untreated plots was 1.41 times lower, measuring 54.93 q/ha, in comparison to the treated plots, which yielded 77.36 q/ha. As a result, the computed avoidable yield loss attributed to *D. indica* infestation in bitter gourd was determined to be 29.04 per cent.

Keywords: *Diaphania indica*, avoidable yield losses, bitter gourd, malathion.

INTRODUCTION

In agro-ecosystems, sustainable agriculture plays a pivotal role in satisfying the ever-growing demands for food and fiber while upholding social acceptability, economic viability, and environmental conservation. The ultimate objective is to establish farming systems that not only exhibit high productivity and profitability but also committed to conservation of natural resources, protection of the environment, and the long-term well-being of agricultural ecosystems. Integrated Pest Management (IPM) emerges as a crucial strategy for achieving optimal crop yields across various agro-ecological zones. For the successful implementation of IPM, one critical prerequisite is the availability of precise information concerning crop losses. This information, in turn, determines the relative significance of various pests.

Among the cucurbitaceous vegetables, bitter gourd (*Momordica charantia* L.) is one of the most important and well-known vegetable crops cultivated all around the globe. It is a cross-pollinated annual, tropical and subtropical vine with inexplicable medical advantages, about the treatment of diabetes (Grover *et al.*, 2002), dysentery, gout and rheumatism (Subratty *et al*., 2005) and prevention of breast cancer (Ray *et al*., 2010). It is laxative and consumption imparts heating and wormicidal power to the human body. In India, it is cultivated over an area of 109,500 ha with the production of 13.75 lakh MT and productivity of 12.60 MT/ha (Anonymous, 2021-22).

Despite its global significance, bitter gourd faces a multifaceted array of insect pests, which have been documented to cause varying degrees of damage. These pests include, red pumpkin beetle (*Aulacophora foveicollis* Lucas), hadda beetle (*Henosepilachna vigintioctopunctata* Fabricius), cucumber moth (*D. indica* Saunders), melon fruit fly, (*Bactrocera cucurbitae* Coquillett), aphid (*Aphis gossypii* Glover) and gall fly (*Lasioptera falcate*) (Vallarasu *et al.*, 2022; Sunil *et al*., 2017).

Among these pests, *D. indica* (Saunders), commonly known as the cucumber moth, stands out as a polyphagous insect, posing a significant threat to bitter gourd cultivation (George *et al*., 2002). This species exhibits a wide distribution, with documented presence in regions spanning India, Pakistan, Japan, Pacific Islands, Australia, Africa, and South America (Peter & David, 1991). In particular, Lefroy and Howlett's pioneering work in 1909 marked the first report of this species infesting cucurbits in India. Over time, this pest has been recognised with various taxonomic names, including *Margaronia indica* (Saunders), *Palpita indica* (Saunders), and *Glyphodes indica* (Saunders) (Namvar & Alipanah, 2002). It is also recognized by common names such as the cotton caterpillar and pumpkin caterpillar (Yaligar *et al.*, 2022; Clavijo *et al*., 1995). *D. indica* is also a serious pest of cucumber, melon, gherkin, bottle gourd, snake gourd, luffa, little cucumber and cotton (Debnath *et al*., 2020).

The larvae of these caterpillars are known to inflict damage on various parts of the bitter gourd plants, including leaves, flowers, fruits, and stems (Namvar & Alipanah 2002), resulting in significant damage. Literature indicates that the larvae typically cause 3 to 14% of damage to bitter gourds, whereas the damage is limited to around 25 to 30% in the leaves of pointed

gourds (Nagaraju *et al.*, 2018). However, the extent of damage becomes most severe when these caterpillars target the reproductive components of the plants, namely the flowers and young fruits. Their feeding habits leave characteristic holes on the fruits, and they consume the interior, rendering the affected fruits unfit for consumption and causing a loss in marketability (Rai *et al.*, 2014). In fact, Jhala *et al.* (2005) underscore the severity by attributing 60 and 90% of fruit damage in bitter gourd and little gourd, respectively due to cucumber moth. This highlights the importance of evaluating the avoidable yield losses.

Such assessments can provide essential insights for the development of safe, cost-effective, and sustainable pest management methods, thereby contributing to future food security. Therefore, the present study was undertaken to generate location-specific data regarding the extent of damage inflicted on bitter gourd by *D. indica*, with the aim of identifying suitable management strategies to mitigate these losses.

MATERIAL AND METHODS

The field experiment for the estimation of avoidable losses was carried out at Experimental Area, Department of Entomology, Chaudhary Charan Singh Haryana Agricultural University, Hisar during *Kharif* 2019 using the variety 'Pusa Do Mausami' of bitter gourd. The experimental setup comprised twenty-six plots, each measuring 3 × 3 m^2, with a spacing of 150 x 45 cm^2 where two treatments *i.e.* treated and untreated were replicated thirteen times. The treated plots were subjected to a spray of Malathion 50% EC @ 1 ml per litre of water to mitigate losses attributed to *D. indica* infestation. Healthy and infested fruits were sorted out at each picking.

The collected yield data was analysed statistically employing the 'paired t' test, which was utilized to assess the significance of differences between treated and untreated plots. To quantify the effectiveness of the Malathion treatment in preventing yield losses, the avoidable yield loss was calculated as per Kate *et al.* (2009) using the following formula:

$$\text{Avoidable yield loss } (\%) = \frac{T - C}{T} \times 100$$

Where,

T = yield of treated plots (q/ha)

C = yield of untreated/control plots (q/ha)

RESULTS AND DISCUSSION

The investigation of avoidable losses attributed to the cucumber moth (*D. indica*) was conducted using a 'paired t' test, and the results are summarized in Table 1. The analysis clearly revealed a significant difference between the treated and untreated plots. The average yield from the treated plots was recorded as 77.36 quintals per hectare, while the untreated plots yielded an average of 54.93 quintals per hectare (Fig. 1). This significant mean difference of 22.43 quintals per hectare highlights that the untreated plots suffered considerably lower yields. Evidently, these findings underscore the substantial impact of *D. indica* larvae on bitter gourd crop yields under the local agro-climatic conditions prevailing in Hisar. Consequently, the calculated avoidable yield loss, based on the difference in yield between treated and untreated plots, was estimated at 29.04 per cent.

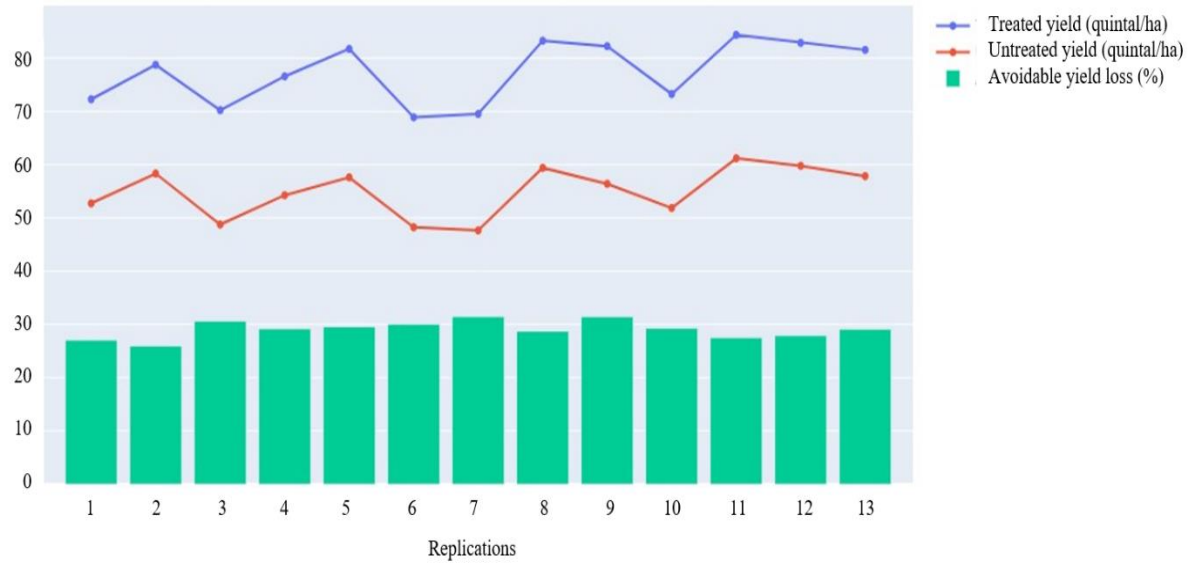

Fig. 1. Avoidable yield loss in bitter gourd inflicted by *Diaphania indica.*

These results align with previous research, as reported by Lenin (2011) and Singh and Naik (2006), who documented high fruit infestation in bitter gourd. According to Lenin (2011), *D. indica* inflicted significantly higher damage in bitter gourd, cucumber, and snake gourd, with infestation indices of 64.75, 63.47, and 61.27 per cent, respectively. Conversely, little gourd exhibited a significantly lower infestation index of 28 percent. She also stated that the damage was particularly pronounced during the fruiting stage, ranging from 67.50 to 100.00 percent, and the flowering stage, with infestation rates between 56.66 and 90.00 per cent in bitter gourd. Sivakumar and Jiji (2002) reported that infestation by *D. indica* on snake gourd tends to increase as the plant matures. Additionally, previous research by Jhala *et al.* (2005) indicated that *D. indica* was

responsible for substantial fruit damage, accounting for 90 per cent in little gourd and 60 percent in bitter gourd, while the damage was limited to 25 to 30 per cent in the case of pointed gourd, primarily affecting the leaves. Furthermore, Schreiner (1991) observed an approximate 10 percent yield loss in cucumbers when *D. indica* populations reached one per leaf.

Table 1: Avoidable yield loss caused by *Diaphania indica* on bitter gourd during *Kharif* 2019.

Replications	Yield (quintal/ha)		Difference	Deviation from mean (d)	Square of deviation (d^2)	Value of 't' at 5% level of significance		Avoidable yield loss (%)
	Treated	Untreated				Calculated	Tabulated	
1	72.28	52.73	19.55	2.88	8.30	45.96*	1.78	**29.04**
2	78.76	58.34	20.42	2.01	4.04			
3	70.24	48.76	21.48	0.95	0.90			
4	76.59	54.26	22.33	0.10	0.01			
5	81.74	57.62	24.12	-1.69	2.85			
6	68.9	48.24	20.66	1.77	3.14			
7	69.52	47.65	21.87	0.56	0.31			
8	83.28	59.4	23.88	-1.45	2.1			
9	82.26	56.4	25.86	-3.43	11.76			
10	73.27	51.86	21.41	1.02	1.04			
11	84.39	61.2	23.19	-0.76	0.58			
12	82.89	59.78	23.11	-0.68	0.46			
13	81.56	57.84	23.72	-1.29	1.66			
	77.36	**54.93**	**22.43**		**37.16**			

CONCLUSIONS

The present study revealed a significant yield difference between treated (Malathion application) and untreated plots. The untreated plots yielded 1.41 times less bitter gourd, with an average of 54.93 quintals per hectare, compared to 77.36 quintals per hectare in the treated plots, showing a significant difference of 22.43 quintals per hectare. The avoidable yield loss due to *D. indica* was calculated at 29.04 per cent, highlighting the economic impact of this pest on bitter gourd crops.

FUTURE SCOPE

The future scope of the study lies in conducting assessments of avoidable yield losses, offering crucial insights for the development of safe, cost-effective, and sustainable pest management methods. This, in turn, will contribute to enhancing future food security.

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Conflict of Interest. The authors declare that they have no conflict of interest.

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