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Marigold as a Trap Crop Against Tomato Fruit Borer (Lepidoptera:Noctuidae)

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Abstract: The use of marigold as a trap crop for the management of tomato fruit borer in tomato was evaluated. The proportion of larvae counted on trap row increased with increasing rate and on main crop decreased with decreasing rate at 65 and 80 days after transplanting. All the treatment combinations recorded lowest fruit damage, larval population on tomato but trapped higher larvae on marigold. Moreover, 3:1 combination observed (81.0-88.89%) larval reduction than sole crop and was significantly better than other treatments.

Key words: Tomato fruit borer, marigold, trap crop

Introduction

Tomato is one of the major vegetable crop grown throughout the world. Its ripe fruit is consumed as fresh vegetable and also in the form of various processed products. *Helicoverpa armigera* is one of the destructive pest, causes huge yield losses by boring in tomato fruits and the yield losses ranged from 5 to 80 per cent in India (Kakar *et al*., 1980; Lal and Lal, 1996). It is one of the most dominant insect pest in agriculture, accounting for the consumption of over 55% of the total insecticide used in the country (Puri, 1995). The most commonly method for the control of this pest is to have a film of a persistent effective insecticide over the foliage and fruiting bodies. As tomatoes are picked at short intervals maintenance of insecticidal film is both uneconomical and hazardous. Besides the indiscriminate use of insecticide has eroded sustainability and resulted in build up of pesticide residues, resistance to pesticides, resurgence, secondary outbreak of this pest and is becoming great problem for entomologists (Fitt, 1989; Mehrotra, 1991). So the use of insecticides for the control of this pest is highly criticized for various reasons and therefore switching from insecticides to trap cropping. Trap crop provides protection by preventing the pest from reaching the main crop and the pests are diverted away from the main crop or concentrated in certain pockets of the field where they are easily arrested or controlled. Trap crops have an important attribute that it is distinctly more attractive to the pest than the main crop and have additional function for natural enemies (Pats *et al*., 1997). Therefore, The main emphasize of the study is use of marigold as a trap crop against tomato fruit borer on tomato was evaluated in different cropping combinations.

Materials and Methods

A field experiment was conducted at Division of Entomology, SKUAST-K, farm during kharif 2003 and 2004 to evaluate different planting combinations of tomato hybrid (Arka Vishali) with marigold in a Randomized Block Design with three replications. Twenty days old tomato hybrid and forty day old marigold seedlings were simultaneously transplanted in the field. For tomato hybrid the

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row-to-row distance was 75 cm and plant-to-plant distance was maintained 50 cm. Whereas, marigold seedlings were planted 25 cm apart. No insecticidal spray was used during the period of experiment and the recommended cultural practices of SKUAST-K were adopted for raising good crops of both tomato and marigold.

During the present studies the six treatments were used as detailed below:

- Three rows of tomato with one row of marigold
- Six row of tomato with one row of marigold
- Nine rows of tomato with one row of marigold
- Twelve rows of tomato with one row of marigold
- Fifteen rows of tomato with one row of marigold
- Sole tomato (Ten rows of tomato, which act as a control was located at a minimum distance of 20 m away from the trap crop block

Observation on population of tomato fruit borer plant^{-1} was recorded from the selected plants of both tomato and marigold at 35, 65 and 80 Days After Transplanting (DAT)

The percentage of fruit damage was also calculated at 35, 65 and 80 days after transplanting. The fruit damage percentage was calculated by the percentage formula:

$$\text{Percent fruit damaged} = \frac{\text{No. of fruits damaged}}{\text{Total No.of fruits}} \times 100$$

Results

The data on the effect of marigold which act as a trap crop along with various combinations of tomato showed differential response to fruit borer and the resulted fruit damage by this pest was also found variable at 35, 65 and 80 days after transplanting during 2003 and 2004 at $p = 0.05$. At 50 days after transplanting there was a significant difference in percent fruit damage in treatments when compared with sole crop (control) at $p = 0.05$ during both years. However, fruit damage decreased significantly with the passage of time at 65 and 80 days after transplanting in all combinations except in case of sole tomato where it increased at different dates after transplanting.

It is quite evident from the data that average fruit damage ranged from 5.59 to 18.76% and 4.95 to 17.83% during 2003 and 2004, respectively. The lowest fruit damage was observed in 3:1 combination which recorded 5.59 and 4.95% during first year and second year as depicted in Table 1 and sole crop recorded highest fruit damage of 18.76 and 17.83 during first and second year. Observations recorded at different dates after transplanting revealed that average fruit damage in various combinations were in order of sole tomato >15:1>12:1>9:1>6:1>3:1 during both the years.

Population of larvae plant^{-1} on tomato plants revealed that there was a marked difference between sole crop and intercropped tomato with trap crop at different dates of transplanting at $p = 0.05$ (Table 2). 3:1 combination significantly recorded lowest population than other treatment combinations but sole crop recorded the highest population which act as a control. All the treatment combinations reduced the population on tomato plants which ranged from 81.0 to 61.0 and 88.89 to 54.70% during 2003 and 2004. Treatment combination, 3:1 gave maximum reduction (81.0 and 88.89%) followed by 6:1, 9:1, 12:1 and 15:1 combination (Table 2).

Population count of larvae plant^{-1} on marigold plants ranged from 0.30 to 0.86 in different treatments as compared to sole crop which trapped 1.00 larvae plant^{-1} (Table 3). Trapping of larvae plant^{-1} was highest in 3:1 (0.86) among the intercropped tomato during 2003 on marigold. During 2004, population of larvae plant^{-1} ranged from 0.28 to 0.91 in different treatment combinations. Trapping of larvae plant^{-1} was highest in 3:1 (0.91) among the intercropped tomato

Table 1: Effect of marigold on the infestation of tomato fruit borer on tomato during 2003 and 2004

Treatments (Tomato: Marigold)	Percent fruit damage (DAT*) 2003 50	65	80	Av.	2004 50	65	80	Av.
3:1	8.15	5.09	3.52	5.59	7.89	4.11	2.85	4.95
6:1	9.33	6.44	3.65	6.47	9.20	5.15	3.31	5.89
9:1	11.47	6.75	5.46	7.87	11.10	5.93	4.0	7.01
12:1	13.35	8.22	5.96	9.18	12.21	6.90	4.66	7.92
15:1	14.20	10.67	8.15	11.00	13.32	8.49	6.07	9.29
Sole tomato	17.13	18.98	20.17	18.76	16.87	17.54	19.08	17.83
p = 0.05%	1.77	1.24	0.83	-	1.67	1.89	1.05	-

* DAT = Days after transplanting

Table 2: Impact of marigold on incidence of *Helicoverpa armigera* on tomato during 2003 and 2004

Treatments (Tomato: Marigold)	*Population of tomato fruit borer/plant (DAT**) 2003 50	65	80	Av.	2004 50	65	80	Av.
3:1	0.30	0.13	0.13	0.19 (81.0)	0.20	0.10	0.10	0.13 (88.89)
6:1	0.40	0.20	0.13	0.24 (76.0)	0.33	0.13	0.13	0.20 (82.90)
9:1	0.40	0.23	0.20	0.28 (72.0)	0.43	0.20	0.16	0.26 (77.78)
12:1	0.60	0.30	0.20	0.37 (63.0)	0.60	0.30	0.23	0.38 (67.52)
15:1	0.60	0.33	0.23	0.39 (61.0)	0.70	0.47	0.43	0.53 (54.70)
Sole tomato	0.90	1.00	1.10	1.00	1.00	1.20	1.30	1.50
p = 0.05%	0.14	0.10	0.11	-	0.10	0.10	0.09	-

* Larval population, ** Days after transplanting, Figures in parenthesis are percent reduction

Table 3: Trapping of *Helicoverpa armigera* on marigold as a trap crop

Treatments (Tomato: Marigold)	*Population of tomato fruit borer/plant (DAT**) 2003 50	65	80	Av.	2004 50	65	80	Av.
3:1	0.50	0.97	1.10	0.86	0.50	1.13	1.10	0.91
6:1	0.40	0.77	1.00	0.72	0.23	1.03	1.07	0.78
9:1	0.30	0.70	0.90	0.63	0.20	0.57	1.00	0.59
12:1	0.20	0.60	0.70	0.50	0.20	0.37	0.47	0.35
15:1	0.20	0.40	0.43	0.30	0.10	0.30	0.43	0.28
Sole tomato	0.90	1.00	1.10	1.00	1.00	1.20	1.30	1.17
p = 0.05%	0.11	0.14	0.13	-	0.04	0.12	0.09	-

* Larval population, ** Days after transplanting

which was significant to sole crop and other treatments at p = 0.05. So the trapping of larvae plant^{-1} was in order of 3:1>6:1>9:1>12:1>15:1 combinations during both the years in different treatment combinations when marigold plants were used as a trap row.

Discussion

Successful use of marigold as a trap crop for management of tomato fruit borer on tomato is on record (Srinivasan *et al*., 1994). Continuous presence of marigold, which produces abundant flowers was maintained in order to facilitate feeding for tomato fruit borer throughout tomato cropping season in different row combination because the larvae readily feed on flowers and have no tendency to migrate to tomato crop/row. In the present investigation it was observed that fruit damage was less in all combinations where tomato was intercropped with marigold and in different combination treatments where the marigold plants were too away, the level of infestation on the main crop was higher. Further, fruit damage decreased in both years as tomato plant becomes more hardly at advanced growth stages

and therefore the infestation was low at 65 and 85 days after transplanting. These findings draw their support from the works of Srinivasan and Moorthy (1991), Srinivasan *et al*. (1994) and Virk *et al*. (2004).

Population of tomato fruit borer (larvae) was also significantly reduced in various treatment combinations on both tomato and marigold plants. Larval population on tomato plants decreased at latter stages because the larvae were trapped on marigold plants and have no tendency to migrate on tomato plant rows. However, the larval population on marigold plants increased at latter stages because of the quick appearance of marigold flowers. These observations draw their support from the findings of Sridhar *et al*. (2001), Srinivasan *et al*. (1994) and Torres-Villa *et al*. (2003). Moreover, larval population in early crop stages was surely higher on both marigold and tomato plants because larvae had a convenient environment in terms of abundance of flowers, fresh leaves and green fruits which promoted better larval performance (Shelton and Perez-Badenes, 2005).

In recent years, interest in trap cropping has increased considerably and become a vital component for pest management. Inherent characteristics of a trap crop may include not only differential attractiveness for feeding but also other attributes that enable the trap crop plants to serve as a sink for insects. Marigold used as a trap against tomato fruit borer gave maximum reduction in fruit damage as well as larvae on tomato plants because it does flower synchronously with the tomato with marigold in a 3:1 combination could be adopted for the management of tomato fruit borer.

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