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MARIGOLD AS A TRAP CROP FOR THE MANAGEMENT OF TOMATO FRUIT BORER, *HELICOVERPA ARMIGERA* IN TARAI REGION OF UTTAR PRADESH

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ABSTRACT

The use of marigold as a trap crop for the management of *Helicoverpa armigera* (tomato fruit borer) in tomato was evaluated. The proportion of larvae counted on trap row increased with increasing rate and main crop decreased with decreasing rate 60 and 80 days after transplanting. All the treatment combinations recorded lowest fruit damage, larval population on tomato but trapped higher larvae on marigold. Moreover, planting of 25 days old tomato seedling with 40 days old marigold seedling in 5:1 row combinations observed (77-87%) larval reduction than sole crop was significantly better than other treatments. Low calorific value of marigold increases the larval mortality rate.

KEY WORDS: marigold, trap crop, *Helicoverpa armigera.*

INTRODUCTION

Helicoverpa armigera (Hubner) is most destructive pests of field crops world wide. Its wide dissemination high mobility, survival rate under adverse conditions ,capacity to complete several generations in a year, ability to develop resistance against insecticides, its polyphagy its ability to undergo facultative diapauses and migration, its management is very difficult. The out break of this pest has been attributed to the development of insecticide resistance and the use of broad spectrum insecticides, which are known to have detrimental effect on populations of its natural enemies and bioclimatic factors in host plants (Fitt *et al.,* 1995; Naseri *et al.,* 2009). The light trap is also used as an efficient tool in monitoring the population and developing forecasting method of *Helicoverpa armigera* (Kumar *et al.,* 2012). The successive generations of *Helicoverpa armigera* move from one economic crop to another there by exposed to many application of pesticides, this species has become highly pesticide resistant. *Helicoverpa armigera* accounts for the consumption of over 55% of the total insecticide used in the country (Puri, 1995). Insecticide for the control of this pest is highly criticized for various reasons and therefore switching from insecticide to trap crop. A trap crop is a plant that attracts agricultural pests usually insects away from main crop. Trap cropping - the use of plants within a cropping area to attract oviposition away from the main crop. Trap crop save the main crop from decimation by pest. Trap crops can be planted around the circumference of the field to be protected, or interspersed among them for example being planted every ninth row.

Mustard and alfalfa planted near strawberries to attract lygus bugs, *Pelargonium geranium* among rose bushes because Japanese beetles are drawn to the geranium, which are toxic to them. Trap crop provides protection by preventing the pest from reaching the main crop and pest are diverted away from the main crop or concentrated in certain products of the field where they are easily arrested or controlled. Trap crops have an important attributes that is distinctly more attractive to the pest and have additional function for natural enemies (Pats *et al.,* 1997). There fore the main emphasize of the study is used 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 in three different village of Balrampur district during January 2011 to June 2012 to evaluate different planting combinations of tomato with marigold. Kumar *et al.* (2012) reported that moth catches were lowest in number during January and it increases gradually from 6th standard week (February) to 13th standard week (March). Further, the number of moth catches increased and attended the peak with higher number of moth in 14th standard week (April) and number of moth catches declined from 16th standard week. The above information was used to know the pattern of its population build up and to use trap crop (marigold) against tomato fruit borer on tomato effectively so that flowering of marigold synchronized with the population build of *Helicoverpa armigera*. Hence 25 days of old tomato and 40 day old marigold seedlings were simultaneously transplanted in the field. For tomato row to row distance was 75 cm and plant to plant distance was maintained

50 cm. where as, marigold seedlings were planted 25 cm apart. No insecticides spray was used during the period of experiment and the modern cultural practices were adopted for raising good crops of both tomato and marigold.

During the present studies following four experiments with three replications were used as detailed below:

- Five rows of tomato with one row of marigold 5:1
- Ten rows of tomato with one of marigold 10:1
- Fifteen rows of tomato with one row of marigold 15:1
- Sole tomato (fifteen row of tomato) which acts as a control was located at a minimum distance of 50 m away from the trap crop experiment block.

Observation on population of tomato fruit borer plant^{-1} was recorded from the selected plants on both tomato and marigold at 40, 60 and 85 days after transplanting. The percentage of fruit damage was also calculated at 40, 60 and 85 days after transplanting.

The fruit damage percentage was calculated by the following formula :

$$\text{Percentfruit damage} = \frac{\text{No. of Fruit damage}}{\text{No. of fruit damage}} \times 100$$

RESULTS

The effect of marigold which act as a trap crop along with various combinations of tomato (5:1, 10:1 and 15:1) at 40, 60 and 85 days after transplantation of 25 days old tomato and 40 days old marigold seedlings during January 2011 to June 2012 at P = 0.05 were presented in the table 1-3. At 40 days after transplanting there was a significant difference in present 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 60 and 80 days after transplanting in all combinations except in case of sole tomato where it increased with the increases in days of after transplantation.

It is quite evident from the data that average fruit damage ranged from 5.86 to 19.61% and 5.35 to 17.73% during 2011 and 2012, respectively. The lowest fruit damage was observed in 5:1 combination which is record 5.86% and 5.35% during first year and second year as depicted in table 1 and sole crop recorded highest fruit damage of 19.61% and 17.73% during first gear and second year. Observations recorded at different days after transplanting revealed that average fruit damage in various combinations were in order of sole tomato > 15:1 > 10:1 > 5:1 during both the years.

Population of larvae per plant on tomato plants revealed that there was a marked difference between sole crop and inter crop tomato with crop (marigold) at different days of transplanting at P = 0.05 (table 2). 5:1 combination significantly recorded lowest population than other 10:1 and 15:1 combinations but sole crop recorded the highest population which act as a control.

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

Year	2011				2012			
Tomato: Marigold	Days after transplantation				Days after transplantation			
	40	60	85	Av.	40	60	85	Av.
5:1	8.33	5.29	3.98	5.86	8.32	4.75	2.99	5.35
10:1	11.92	7.03	5.85	8.26	11.50	5.45	4.52	7.15
15:1	13.38	10.25	8.22	10.61	13.04	8.12	6.01	9.05
Sole tomato	18.20	20.12	20.52	19.61	17.21	17.85	18.14	17.73
P = 0.05%	1.63	1.10	0.69		1.71	1.67	1.05	

Table 2: Impact of marigold on incidence of *Helicoverpa armigera* on tomato during January 2011-June 2012 (Larval population of tomato fruit borer / plant):

Year	2011				2012			
Tomato:	Days after transplantation			Average	Days after transplantation			Average
Marigold	40	60	85	(%Reduction)	40	60	85	(%Reduction)
5:1	0.35	0.17	0.18	0.23(77%)	0.30	0.12	0.11	0.17 (87%)
10:1	0.50	0.25	0.27	0.34(66%)	0.48	0.22	0.18	0.26 (74%)
15:1	0.55	0.31	0.21	0.35(65%)	0.60	0.45	0.42	0.49 (51%)
Sole tomato	0.95	1.05	1.10	1.00	0.95	1.05	1.10	1.00
P = 0.05%	0.13	0.11	0.10		0.10	0.10	0.09	

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

Year	2011				2012			
Tomato: Marigold	Days after transplantation				Days after transplantation			
	40	60	85	Av.	40	60	85	Av.
5:1	0.40	0.87	1.05	0.79	0.40	0.90	1.00	0.76
10:1	0.32	0.75	0.85	0.64	0.33	0.77	0.88	0.66
15:1	0.20	0.40	0.45	0.35	0.20	0.42	0.48	0.36
Sole tomato	0.85	1.00	1.10	0.98	0.87	1.05	1.10	1.00
P = 0.05%	0.11	0.14	0.13		0.12	0.13	0.11	

All the combinations (5:1, 10:1 and 15:1) reduced the population on tomato plants which ranged from 65-77% and 51-87% during 2011 and 2012, respectively. Treatment combination 5:1 gave maximum reduction (77% and 87%) followed by 10:1 and 15:1 combination (table 2).

Population count of larvae per plant on marigold plants ranged from 0.79 to 0.98 in different treatments as compared to sole crop which trapped larvae per plant (table 3). Trapping of larvae per plant was highest in 5:1 among the intercropped tomato during 2011 on marigold, during 2012, population of larvae per plant ranged from 0.36 to 1.00 in different treatment combination. Trapping of larvae per plant was highest in 5:1 (0.76) among the intercropped tomato during 2011 on marigold. During 2012, population of larvae per plant ranged from 0.36-0.76 in different treatment condition. Trapping of larvae per plant was highest in 5:1 (0.76) among the intercropped tomato which was significant to sole crop and other treatments at P = 0.05, So the trapping of larvae per plant was in order of 5:1 > 10:1 > 15:1 combinations during both the years in different treatment combinations when marigold plants were used as a trop row.

DISCUSSION

Marigold is a successful trap crop for management of tomato fruit borer on tomato (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 seasons in different row combination because the larva 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 60 and 80 days after transplanting.

Population of tomato fruit borer (larvae) was also significantly reduced in various treatment combinations on both tomato and 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 (Srinivasan *et al.,* 1994). Moreover, larval population in early crop stages was surely higher on both marigold and tomato plants because had a convenient environment in terms of abundance of flowers, fresh leaves and green fruits which promoted better larval performance (Hussain and Bilal, 2007). Low calorific value diets like rose and marigold resulted in higher mortality (25-35%) of *Helicoverpa armigera* (Sarate *et al.,* 2012). Raising of marigold nursery should be 15 days prior to tomato nursery, so that, 25 and 40 days old tomato and marigold seedlings are planted. Maximum egg laying is observed on marigold flowers and the movement of larvae from marigold to tomato is not significant. Eggs and larvae are removed from field along with flowers. This trap cropping system also helps in reducing the rootknot nematode infestation. Thus it can be concluded that marigold in a combination of 5:1 used as a trap crop against tomato fruit borer could be adapted for the management of this pest.

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