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Research Note

Role of habitat manipulation for pest management in tomato

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ABSTRACT: The experimental field trials were undertaken during the *Rabi* season of 2021 and 2022 to assess the influence of habitat manipulation on the incidence of fruit borers of tomatoes and their natural enemies at Pasighat, Arunachal Pradesh. The pooled data of two years depicted that tomatoes intercropped with cowpea and bordered with marigold plants recorded the lowest fruit borer incidence (1.23 larvae per plant), the highest natural enemy population of 5.58 per plant, lowest fruit borer damage per cent (15.21%) and yield of about 15.99 tonnes per ha. It was followed by a crop combination of tomato + chickpea bordered with mustard with a fruit borer incidence of 1.59 larvae per plant, the natural enemy population of 5.32 per plant, 15.90 per cent incidence of fruit borers and 15.42 tonnes yield per ha. This study indicates the possibility of using these crop combinations as an integral part of bio-intensive pest management against fruit borers in tomatoes.

KEYWORDS: Fruit borers, habitat manipulation, tomato

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Tomato (*Lycopersicon esculentum* Mill.), is botanically a fruit belonging to the family Solanaceae and is believed to have originated in western South America, Mexico and Central America. Tomatoes are cultivated and produced by small and medium-scale farmers for consumption and as a source of income (Bawin *et al*., 2014; Retta and Berhe, 2015). It is commonly consumed as a vegetable. Tomato for consumption is produced in open fields and under protected conditions. It can either be eaten fresh or processed into different products. The crop is of large importance worldwide (Abdussamee *et al*., 2014; Mehraj *et al*., 2014; Kaur and Rishi, 2014). It is an important source of nutrients (Vitamins A, B, C and E), and contributes largely to household diet and national economy (Bhowmik *et al*., 2012). Production of the crop is threatened by multiple insect pests. Among the pests, tomato bugs, stink bugs, cutworms, fruit borers, hornworms, whiteflies, aphids, red spider mites, etc. are some common pests of tomato crops of which, fruit borers are the most economically important pest.

Habitat manipulation is the manipulation of agricultural areas and the surrounding environment to conserve or augment the population of natural enemies. Habitat manipulation is also referred to as Ecological engineering which is a new technology used in biological control programs that promotes biodiversity, results in a stable and sustainable agroecosystem, and works well with other biological control strategies (Kumar *et al*., 2013). It emphasizes lowering natural enemy mortality, providing more resources, and altering host plant traits for natural bio-agents (Hussain *et al*., 2021). In view of the above-mentioned points, present study has been taken up to assess the role of habitat manipulation in the management of fruit borer in tomato crop.

The experiment was laid out in a randomised block design with seven treatments each replicated thrice. Row-to-row and plant-to-plant distance was 60 × 45 cm. The experiment was conducted in the *Rabi* season of 2021 and 2022 at AICRP - Biocontrol farm, CAU, Pasighat. Tomato variety, Syngenta TO-1458 was used for the study. The main crop, intercrop and border crop were raised and transplanted as per recommended agronomic practices. Larval population per plant of fruit borers *viz*. *Helicoverpa armigera* and *Tuta absoluta*, natural enemies *viz*., coccinellids, syrphid flies and spiders were recorded at weekly intervals by selecting five random plants from each plot. Yield (kg/plot) was also recorded. The data was statistically analyzed using suitable transformation. The treatment details are as follows.

Treatments

- T_1 Tomato intercropped with Cowpea and Marigold as border crop
- T_2 Tomato intercropped with Field bean and Coriander as border crop
- T_3 Tomato intercropped with Chickpea and Mustard as border crop
- T_4 Tomato intercropped with French bean and Fennel as border crop
- T_5 Tomato intercropped with Pea and Buckwheat as border crop
- T_6 Tomato intercropped with Lentil and Linseed as border crop
- T_7 Tomato as sole crop

The pooled data of two years (2021 and 2022) on the influence of habitat manipulation on fruit borers' incidence is presented in Table 1. The data reveals that the intercropping of tomato crops with cowpea, chickpea and field bean has a significant influence on the incidence of tomato fruit borers. The observations revealed that the treatment T_1 – Tomato intercropped with cowpea and bordered with marigold recorded the lowest fruit borers incidence (1.23 larvae/plant) which was followed by the treatment T_3 – Tomato intercropped with chickpea and mustard as a border crop (1.59 larvae/plant) and T_2 – Tomato intercropped with field bean and coriander as border crop (1.76 larvae/plant). The treatment T_1 recorded highest natural enemy population of 5.58 per plant which was followed by the treatment T_3 (5.32/plant) and T_2 (5.29/plant) (Table 2). This improved activity of predators indicates the bio-diversity of insects in the region. The highest population of fruit borers was documented in the treatment T_7-tomato as a sole crop (3.33/plant) and the same treatment recorded the lowest number of coccinellids per plant (2.49). With regard to the data on tomato fruit borer damage, the treatment T_1 recorded the lowest fruit damage (15.21%) which was statistically at par with the treatment T_3 (15.90 %) followed by T_2 (16.68 %). However, the sole tomato treatment T_7 recorded the highest fruit borers' damage of 28.82 per cent.

The influence of intercrops and border crops in reducing pest incidence was reflected in the yield of the crop. The highest yield of 15.99t per ha was recorded in treatment $T_{1,}$ followed by treatment T_3 (15.42 t/ha) and T_2 (15.05 t/ha); these treatments were found statistically at par with each other. The lowest yield of tomato fruits was recorded in the treatment T_7 sole crop (10.26 t/ha), and this can be correlated to a higher incidence of pests and lesser activity of natural enemies in the sole crop.

Similar experiments were carried out in fields with sown annual flower strips (consisting of 11 plant species) to promote natural enemies of aphids and recorded an increase in the number of eggs deposited by hoverflies and lacewings by 127 per cent and 48 per cent and a reduction in number of aphids by 75 per cent in adjacent potato crops (Tschumi *et al*., 2016). Black gram + Cowpea border cropping system significantly influenced the maximum coccinellids on the black gram (3.72/plant), and the minimum *Aphis gossypii* population (3.63/terminal shoot) (Lokesh *et al.,* 2017). Marigold plants (*Tagetes erecta*) as border crop in rice attracted a significant population of natural enemies complex (5.17) which resulted in a significant drop in pest complex abundance (3.00) (Iamba *et al*., 2021). The maximum mean per cent reduction of *Phyllotreta striolata* and *Altica himensis* was 63.46 per cent in the main crop and the maximum mean per cent increase of natural enemies with 250.52 per cent was recorded in the main crop over the control plot when brinjal was integrated with insectary plants, trap crops along with other non-host crops to optimize the control of flea beetles (Maqsood *et al*., 2022). Field experiments in Pigeonpea with seven different border crops for *Maurica vitrata* management revealed that the crop bordered with Sorghum recorded lowest *M. vitrata* larval webbing per plant and highest per cent, decrease in larval webbing per plant (2.05 and 60.95 respectively), highest per cent increase in natural enemies i.e. 755.60 for *Coccinella septempunctata*, 844.40 for *Chellomenes sexmaculata* and 660 for spiders and highest pigeonpea yield of 730.72 kg per ha (Sujayanand *et al*., 2021).

Table 1. Influence of crop combinations on incidence of fruit borers in tomato

Treatments	2020-21						2021-22						Pooled data (2020-21 and 2021-22)
	No. of fruit borers larva/plant (After week)						No. of fruit borers larva/plant (After week)						
	1	2	3	4	5	Pooled	1	2	3	4	5	Pooled	
T_1	1.08 (0.66)*	1.39 (1.37)	1.46 (1.39)	1.31 (1.32)	1.18 (1.32)	1.28 (1.32)	1.09 (3.79)*	1.18 (3.85)	1.30 (4.00)	1.33 (4.04)	1.02 (3.68)	1.18 (3.88)	**1.23**
T_2	1.26 (1.09)	1.71 (1.48)	1.88 (1.53)	1.89 (1.52)	1.83 (1.52)	1.71 (1.47)	1.06 (3.75)	1.91 (4.64)	2.06 (4.79)	2.19 (4.90)	1.84 (4.56)	1.81 (4.53)	**1.76**
T_3	1.11 (0.73)	1.58 (1.43)	1.81 (1.50)	1.57 (1.42)	1.26 (1.42)	1.47 (1.39)	1.17 (3.88)	1.79 (4.52)	1.93 (4.67)	2.04 (4.77)	1.76 (4.48)	1.71 (4.42)	**1.59**
T_4	1.32 (1.25)	1.54 (1.54)	1.97 (1.55)	2.08 (1.59)	2.21 (1.59)	1.82 (1.50)	1.21 (3.93)	1.98 (4.69)	2.44 (5.10)	2.57 (5.23)	2.17 (4.85)	2.07 (4.75)	**1.94**
T_5	1.30 (1.19)	1.92 (1.53)	2.02 (1.56)	2.45 (1.60)	2.86 (1.70)	2.11 (1.60)	1.18 (3.97)	1.68 (4.39)	2.51 (5.18)	2.70 (5.31)	2.13 (4.85)	2.09 (4.81)	**2.10**
T_6	1.25 (1.06)	1.99 (1.56)	2.20 (1.62)	2.91 (1.67)	3.09 (1.83)	2.29 (1.65)	1.26 (3.97)	2.04 (4.76)	2.81 (5.43)	3.43 (5.94)	3.06 (5.63)	2.44 (5.14)	**2.36**
T_7	1.48 (1.69)	2.93 (1.84)	3.44 (1.98)	4.02 (2.08)	4.38 (2.12)	3.25 (2.92)	1.38 (4.11)	2.66 (5.29)	3.45 (5.94)	5.33 (6.45)	4.29 (6.55)	3.42 (5.93)	**3.33**
S. Em±	0.07	0.16	0.17	0.18	0.19	0.18	0.01	0.13	0.12	0.12	0.13	0.12	
C.D. at5%	0.21	0.48	0.53	0.55	0.57	0.55	NS	NS	0.36	0.38	0.41	0.37	

* Figures in the parenthesis are $\sqrt{x} + 0.5$ transformed values

Table 2. Influence of habitat manipulation on fuit borers damage, coccinellids and yield in tomato

Treatments	Per cent Fruit damage/plant (Pooled)			No. of Coccinellids/plant (Pooled)			Yield (t/ha) (Pooled)		
	2020-21	2021-22	Mean	2020-21	2021-22	Mean	2020-21	2021-22	Mean
T_1	16.60 (24.03)**	13.83 (65.31)	15.21	7.13 (2.76)*	4.03 (6.33)	5.58	16.15	15.83	15.99
T_2	17.47 (24.69)	15.89 (70.36)	16.68	6.79 (2.70)	3.80 (6.20)	5.29	16.10	14.01	15.05
T_3	17.15 (24.46)	14.65 (67.28)	15.90	7.15 (2.75)	3.49 (5.96)	5.32	16.12	14.72	15.42
T_4	17.94 (25.05)	16.13 (70.81)	17.03	5.81 (2.50)	3.33 (5.80)	4.57	15.07	13.05	14.06
T_5	18.63 (26.51)	18.38 (76.38)	18.50	5.53 (2.45)	3.19 (5.71)	4.36	14.30	12.53	13.41
T_6	19.95 (25.55)	21.26 (82.31)	20.60	5.30 (2.40)	2.78 (5.36)	4.04	14.16	10.70	12.43
T_7	29.72 (33.00)	27.93 (95.67)	28.82	3.53 (2.00)	1.46 (4.17)	2.49	10.94	9.58	10.26
S. Em±	0.91	1.11		0.14	0.18		0.13	0.21	
C.D. at5%	2.79	3.43		0.42	0.56		0.41	0.66	

* Figures in the parenthesis are √x + 0.5 transformed values,
**Figures in the parentheses are arcsine transformed values,
NS: Non-significant, DAS: Days After Spray

CONCLUSION

The present study on the role of habitat manipulation for pest management in tomatoes conducted at Pasighat, Arunachal Pradesh during two *Rabi* seasons 2021-22 revealed that the crop combination of tomato intercropped with cowpea and border crop of marigold has recorded lower fruit borer incidence and higher number of natural enemies. Further studies are required to formulate the main crop, intercrop and border crop row ratios for ecofriendly pest management and economic crop production by using these crop combination as a component in BIPM in Tomato crop.

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