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Impact of trap crops on hadda beetle (*Henosepilachna* Sp.) population in brinjal ecosystem

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Abstract

Repeated and indiscriminate use of chemical pesticides over a long time leads to human health hazards, development of resistance in insect pests, toxicity to non-target organism & ecological disruption. A sustainable eco-friendly experiment was conducted on brinjal accompanying with different trap crops to observe their impact and efficacy on the management of hadda beetle (*Henosepilachna* Sp) population during the seasons of summer & winter, 2018-19 in Central Research farm, Gayeshpur, Nadia, West Bengal. The experiment consisted of 6 different treatments with brinjal as the main crop and sweet potato (T₁), marigold (T₂), cowpea (T₃), maize (T₄) & brinjal itself (T₅) {1.5 times of recommended fertilizer dose} as trap crop in the periphery of the plots. During the whole cropping season, the hadda beetle (grub & adult) population was significantly lesser in all the trap cropped treatments (T₁-T₅) than the sole crop control (T₆). The average mean number of hadda beetle population (grub & adult) during the two cropping season (15SW to 34SW of 2018 and 39 SW of 2018 to 6 SW of 2019) were lowest in brinjal+maize combination (T₅) respectively 1.77,0.51 and highest in the sole crop control (T₆) i.e 3.29,1.08.

Keywords: Trap crops, main crop, hadda beetle, brinjal

Introduction

Brinjal (*Solanum melongena* L.) an important crop of sub-tropics and tropics. It belongs to the Solanaceae family and referred by different names viz., eggplant, aubergine, garden egg, baingan, etc. This family contains more than 2450 plant species distributed in 95 genera [9]. Brinjal is the most consumed and most-sprayed vegetable in India. In India, it holds an area of 668.7 thousands ha with a production of 12399.9 thousands MT with a productivity of 18.5 MT/ha in India [1]. Brinjal is a common man's vegetable grown in almost all over India. After potato, it ranks as the second-highest consumed vegetable in the country along with tomato [10]. Brinjal is attacked by several insect pests from the nursery stage to the harvesting stage. Hadda beetle (*Henosepilachna* Sp) is one of the important pests in brinjal ecosystem. It causes serious damage and considerable economic losses to Solanaceous & Cucurbitaceous crops depending on the place and season due to variations of prevailing environmental conditions. Both grubs and adults are damaging stages. They consume on the epidermal layer of the leaves, decreasing the photosynthetic area and cause severe defoliation [7]. The most damaging and voracious stages are 3rd and 4th instar grubs and may cause damage up to 80% in favorable conditions however it varies depending on the environmental conditions [12]. The adults confine their damage to the upper side while grubs usually on the lower side of the leaves [11]. Most farmers prefer the use of chemical pesticides to control hadda beetle population which have bad effects on the environment leading to serious hazardous effects on human health. The indiscriminate use of chemical pesticides over a long period has not only been proved to be harmful to soil microflora, but also contributed to many side effects, like the development of resistance by the insects, resurgence and outbreak of new pests, & toxicity to the non-target organism [8]. Trap cropping is one such type of special companion planting strategy that's traditionally used for insect pest management through vegetative diversification. It is used to attract insect pests away from the main crops throughout the crucial period by providing them another preferred alternative. Trap crops not only attract the insects for feeding and oviposition but also act as a sink for any pathogen that may be a vector [13]

So, we should focus on sustainable and environmentally friendly approaches for the management of this pest. To manage the hadda beetle, a sustainable eco-friendly agro-ecosystem has to be considered. Hence in the present investigation was studied to know the impact of different trap crops at border rows against hadda beetle in the brinjal ecosystem.

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Materials & methods

The experiment was conducted at the Central Research Farm, Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Nadia, West Bengal during the crop growing period of 11th April 2018 to 22nd August 2018 and another is 27th September 2018 to 6th February 2019. (Geographical location- Latitude 23°N, Longitude 89°E, Altitude 9.75m MSL). Brinjal variety "Muktakeshi" was transplanted in the experimental site. The crop has been raised without applying any insecticide by adopting standard agronomic practices with different types of trap crops in border rows. The experiment had 6 treatments in a randomized block design, and each treatment was replicated 4 times with a plot size of 5 m × 4m per replicate. Each side 2 rows of trap crops like maize and cowpea were sown 15 days earlier at border rows before transplanting of the main crop. In case marigold, sweet-potato, and brinjal (trap) were transplanted at the time of transplanting of the main crop in the same way as previously. The treatments with trap crops in border rows of main crop (brinjal) respectively, were as follows: T₁- sweet potato, T₂- marigold, T₃-brinjal itself, T₄-cowpea, T₅-maize, and T₆- sole crop control (without any intercrop or border crop). In T₃, brinjal itself as trap crop at border rows; here we use 1.5 times more fertilizer for trap crop compared to the main crop. Otherwise, all trap crops' fertilizer dose is the same as the main crop.

Observation on hadda beetle started two weeks after transplanting and it continued till harvesting of the crop at each meteorological week. Observations of grubs and adults of this pest from tagged 5 plants were observed carefully. The mean population of the insects was expressed as the number of totals (grub+ adult)/plant. Population data of hadda beetle (*Henosepilachna Sp.*) thus obtained were subjected to statistical analysis to find out the SE(M) and CD value.

Results

Data recorded relating to the Hadda beetle, *Henosepilachna Sp.* (grub & adult) during the field trial during the crop growing season 11th April to 22nd August 2018, it could be accessible from Table 1, Table 3, and Figure 1. Data unveiled that the least hadda beetle population was recorded as 1.61 per plant in the trap crop combination T₅ during the 1st -4th SWAT. Other combinations like T₁, T₂, T₃, and T₄ hosted considerably moderate hadda beetle population per plant noted to be 1.91, 1.97, 2.70 & 2.21 per plant respectively under the temperature range of 20.04 ° C - 34.23 ° C, relative humidity 65.68% - 94.39% and rainfall 29 mm. The highest Hadda beetle population was scored as 3.69 per plant in the combination T₆ during the 17th-20th SWAT of the crop growing season whereas, the other combinations T₁, T₂, T₃, T₄, and T₅ recorded hadda beetle population to be 2.13, 2.25, 2.60, 3.28 & 1.91 respectively under the temperature range of 22.87 ° C- 32.18 ° C, the relative humidity of 79.29% - 97.25% and 52.58 mm rainfall. During the cropping season (11th April to 22nd August 2018), the hadda beetle population was significantly smaller in all border cropped treatments (T₁-T₅) than in the sole crop control (T₆). The cumulative mean value of hadda beetle population during the entire crop season was smallest in T₅ (1.77 insects per plant) and highest in T₆ (3.29 insects per plant). The reduction percentage over control was also best in brinjal+maize combination (T₅) which was 46.36% followed by brinjal+marigold (30.16%), brinjal+brinjal (26.31) and brinjal+sweet potato (24.98%) & brinjal+cowpea (21.69%) respectively.

A perusal of Table 2, Table 4 and Figure 2 revealed that during the crop growing season (27th September 2018 - 7th February 2019) the least hadda beetle population was

recorded as 0.36 per plant in the companion crop combination T₅ during the 1st-4th SWAT. Other combinations like T₁, T₂, T₃, and T₄ hosted considerably moderate hadda beetle population per plant noted to be 0.64, 0.41, 0.42 and 0.59 per plant respectively under the temperature range of 20.24 ° C - 33.16 ° C, relative humidity 65.57% - 97.07% and rainfall 21.50 mm. The highest Hadda beetle population was scored as 1.31 per plant in the combination T₆ during the 5th-8th SWAT of the crop growing season whereas, the other combinations T₁, T₂, T₃, T₄, and T₅ recorded hadda beetle population to be 0.97, 0.84, 0.91, 1.00 and 0.81 respectively under the temperature range of 15.81 ° C- 30.05 ° C, the relative humidity of 56.35% - 95.39% and 5.9 mm rainfall. During the cropping season (27th September 2018 - 7th February 2019), the hadda beetle population was significantly smaller in all border cropped treatments (T₁-T₅) than in the sole crop control (T₆). The cumulative mean value of hadda beetle population during the entire crop season was the smallest in T₅ (0.51 insects per plant). & highest in T₆ (1.08 insects per plant). The reduction percentage over control was also best in brinjal+ maize combination (T₅) which was 52.33% followed by brinjal+ marigold (46.51%), brinjal+ brinjal (29.94%), brinjal+ cowpea (24.42%) and brinjal+sweet potato (18.90%) respectively.

Discussion

Conservation biological control through vegetative diversification is an effective strategy for pest management [6]. The border crop modify the microclimate of the main crop, that successively hinders insect pest development and favors natural enemy proliferation by providing supplementary food and refugia [15]. Results from the present investigation shown that insect population was lesser in all the trap cropped treatments (T₁, T₂, T₃, T₄, T₅). Treatment having maize as the trap crop (T₅) was recorded lowest insect population followed by marigold (T₂). Maize likely acted as a barrier crop for the movement of hadda beetle, as maize plants are much taller than the main crop. Insect pests have difficulty in locating their host plants due to the presence of intercrops and border crops that emit volatiles that have either masking effects or repellency [4-5]. The trap crop marigold is odoriferous in nature. Moreover, 7 types of volatiles present in marigold [2]. When odoriferous plants are raised with host plants of insect pests, it can prevent the recognition, feeding, and reproduction of the pests on their host plants. [3,14] The present finding is in agreement with this. Insect movements in and out of the system are affected by the permeability of the vegetation.

Conclusion

Based on the present finding it can be concluded that hadda beetle (grub & adult) population was significantly lesser in all trap cropped treatments (T₁-T₅) than the sole crop control (T₆). When brinjal was grown with maize as the trap crop showed the lowest abundance of hadda beetle in comparison to other trap crops grown with brinjal. As this treatment (T₅) indicated that maize as border crop reduced effectively the beetle population in brinjal and it is the best treatment followed by T₂ (brinjal + marigold combination). Therefore the trap crops could be grown along with the main crop brinjal to maintain ecological balance without the use of synthetic chemical toxicants for pest control. This study revealed the pest diversion by an environmentally safe approach. Also, the growth of trap crops along with the main crop would lead to the earning of extra cash for the farmers and would be economically advantageous.

Table 1: Fluctuation of the population of hadda beetle in brinjal ecosystem under the influence of different trap crops during the crop season in summer 2018

Treatments	1 st - 4 th SWAT*	5 th -8 th SWAT	9 th -12 th SWAT	13 th -16 th SWAT	17 th -20 th SWAT	Mean	Reduction % over control
T ₁	1.91 ** (1.55)	3.19 (1.92)	3.09 (1.90)	2.04 (1.59)	2.13 (1.62)	2.47 (1.72)	24.98
T ₂	1.97 (1.57)	2.57 (1.75)	2.27 (1.66)	2.44 (1.71)	2.25 (1.66)	2.30 (1.67)	30.16
T ₃	2.70 (1.79)	2.93 (1.85)	2.31 (1.68)	1.59 (1.45)	2.60 (1.76)	2.43 (1.71)	26.31
T ₄	2.21 (1.65)	2.50 (1.73)	3.09 (1.90)	1.81 (1.52)	3.28 (1.94)	2.58 (1.75)	21.69
T ₅	1.61 (1.45)	1.39 (1.37)	2.34 (1.69)	1.58 (1.44)	1.91 (1.55)	1.77 (1.51)	46.36
T ₆	3.41 (1.98)	3.56 (2.02)	3.56 (2.02)	2.24 (1.66)	3.69 (2.05)	3.29 (1.95)	-
SE(M)	0.02	0.01	0.03	0.01	0.01	-	-
CD(p=0.05)	0.05	0.04	0.08	0.03	0.04	-	-

*Mean population of four standard weeks. SWAT- Standard Weeks After Transplanting

**Data in parentheses indicate $\sqrt{(x+0.5)}$ transformation.

Temperature range 20.04^oC-34.39^oC and R.H range 65.68% - 97.25% during crop season.

Main crop – Brinjal

Trap crops - sweet potato, marigold, brinjal (1.5x more fertilizer dose), cowpea, maize.

T₁=brinjal+sweetpotato,

T₂=Brinjal +marigold,

T₃=brinjal+ brinjal (1.5 times more fertilizer dose),

T₄=brinjal+ cowpea,

T₅=brinjal+ maize,

T₆=sole brinjal (control plot)

Table 2: Fluctuation of the population of hadda beetle in brinjal ecosystem under the influence of different trap crops during the crop season in winter 2018-19

Treatments	1 st - 4 th SWAT*	5 th -8 th SWAT	9 th -12 th SWAT	13 th -16 th SWAT	17 th -20 th SWAT	Mean	Reduction % over control
T ₁	0.64 (1.07)**	0.97 (1.21)	0.98 (1.22)	0.59 (1.05)	1.17 (1.29)	0.87 (1.17)	18.90
T ₂	0.41 (0.95)	0.84 (1.16)	0.66 (1.08)	0.50 (1.00)	0.47 (0.98)	0.58 (1.04)	46.51
T ₃	0.42 (0.96)	0.91 (1.19)	0.63 (1.06)	0.72 (1.10)	1.09 (1.26)	0.75 (1.12)	29.94
T ₄	0.59 (1.05)**	1.00 (1.22)	1.00 (1.22)	0.69 (1.09)	0.78 (1.13)	0.81 (1.15)	24.42
T ₅	0.36 (0.93)	0.81 (1.15)	0.58 (1.04)	0.44 (0.97)	0.38 (0.94)	0.51 (1.01)	52.33
T ₆	0.70 (1.10)	1.31 (1.35)	1.22 (1.31)	1.00(1.22)	1.14 (1.28)	1.08 (1.25)	-
SE(M)	0.02	0.02	0.02	0.05	0.02	-	-
CD(p=0.05)	0.05	0.06	0.06	0.14	0.05	-	-

*Mean population of four standard weeks. Swat- Standard Weeks After Transplanting

**Data in parentheses indicate $\sqrt{(x+0.5)}$ transformation.

Temperature range 7.74^o C to 33.16^o C and R.H range 47.75% to 97.92% during crop season.

Main crop – Brinjal

Trap crops - sweet potato, marigold, brinjal (1.5x more fertilizer dose), cowpea, maize.

T₁=brinjal+sweetpotato,

T₂=brinjal+marigold,

T₃=brinjal+brinjal(1.5 times more fertilizer dose),

T₄=brinjal+cowpea,

T₅=brinjal+maize,

T₆=sole brinjal (control plot)

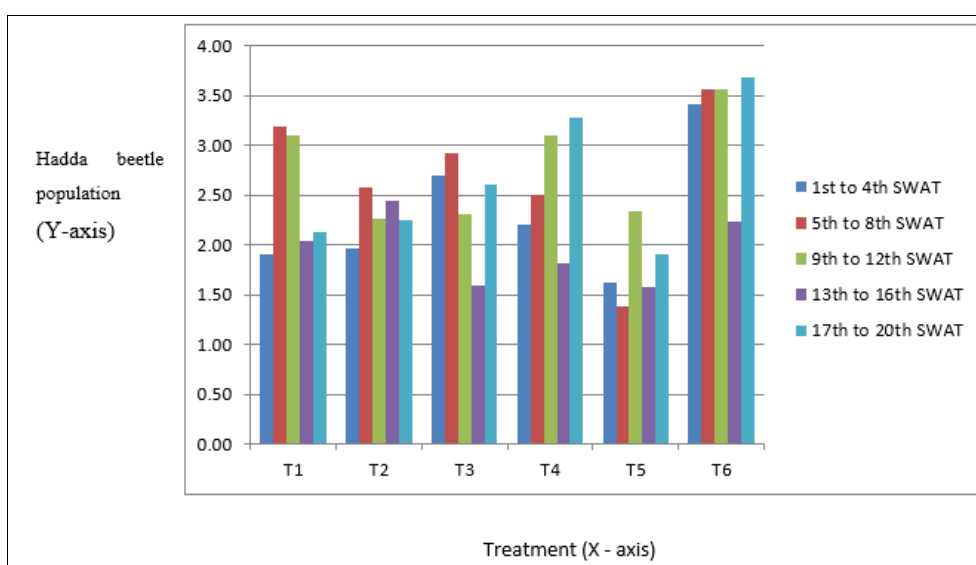


Fig 1: Fluctuation of the population of hadda beetle in brinjal ecosystem under the influence of different trap crops during the crop season in summer 2018

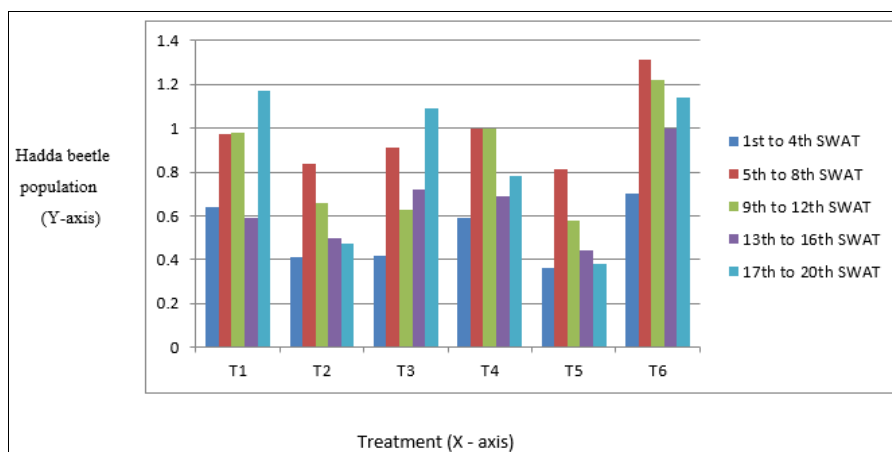


Fig 2: Fluctuation of the population of hadda beetle in brinjal ecosystem under the influence of different trap crops during the crop season in winter 2018-19

Table 3: Temperature, Relative humidity & Rainfall data during crop season 11th April to 22nd August 2018

Standard weeks after transplanting (SWAT)	Temperature (°C).		Relative humidity (%).		Total Rainfall (mm)
	Max.	Min.	Max.	Min.	
1 st -4 th SWAT	34.23	20.04	94.39	65.68	29.00
5 th – 8 th SWAT	34.39	21.84	94.57	72.07	22.80
9 th – 12 th SWAT	34.25	23.36	90.00	73.00	35.03
13 th -16 th SWAT	31.83	23.25	96.36	80.21	67.75
17 th -20 th SWAT	32.18	22.87	97.25	79.29	52.58

Table 4: Temperature, Relative humidity & Rainfall data during crop season 27th September 2018 to 6th February 2019

Standard weeks after transplanting (SWAT)	Temperature (°C).		Relative humidity (%).		Total Rainfall (mm)
	Max.	Min.	Max.	Min.	
1 st -4 th SWAT	33.16	20.24	97.07	65.57	21.50
5 th – 8 th SWAT	30.05	15.81	95.39	56.35	5.9
9 th – 12 th SWAT	27.95	11.19	96.03	47.75	0
13 th -16 th SWAT	24.14	7.74	97.92	52.17	13.8
17 th -20 th SWAT	26.11	8.82	94.28	45.46	0

Source-Department of Agro-meteorology, BCKV, Mohanpur, Nadia, W.B., 741252 N.B.: Max. = Maximum, Min. = Minimum and mm.=Millimeter, SW= standard weeks, SWAT=standard weeks after transplanting.

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