INFLUENCE OF WEEDS ON DISPERSION OF INSECT PESTS AND PREDATORS IN BRINJAL AND GROUNDNUT CROP ECOSYSTEM

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Abstract. A heterogenous agricultural habitat with brinjal, groundnut and a host of associated weeds was selected to study the influence of weeds on dispersion of insect pests and predators in Tiruvallur district of Tamil Nadu, India. In the field experiment, impact of weed on diversity on pests and predators in two weed management practices was quantified in weedy and control plots. Fourteen insect species were found to infest brinjal crop and seven species on groundnut crop and associated weed species. Population of *Henosepilachna vigintocto punctata* and *Caliothrips indicus* were observed throughout the year. Allowing weeds to grow in weedy plots, increased the population of predators and reduced pests in brinjal and groundnut crops. On both the crops, pests population declined as weed diversity increased. The weeds *Solanum xanthocarpum, Solanum nigrum* and *Physali sminima* served as alternate hosts for *H. vigintocto punctata* during the absence of main crop of brinjal. Population of *C. indicus* dispersed from *Achyranthes aspera* and *Justicia simplex* to brinjal during the early stage of the crop. Upon senescence of brinjal crop they dispersed to groundnut and *Tridax procumbens. Echinocloa colona* and *Euphorbia hirta* were the important reservoirs for *Aphis gossypii* during the harvesting stage of groundnut. *Hibiscus sabdariffa* gave regular support for *Bemisia tabacci* and *Amrasca devastans.* The dispersal of pest and the predator complex is discussed in relation to the abiotic factors of the environment and the relative density of the weeds. Hence, in addition to varying competitiveness, the pest management practices may depend on how the insects are influenced by adjacent plant and weed diversity. The results indicated that brinjal and groundnut crops might benefit from stronger natural pest control with minimum weed management practices.
Keywords: *insect pests, predators, weed management, Solanum melongena L., Arachis hypogaea L.*

Introduction

Integrated pest management program stresses the need to understand the natural complex of the ecosystem involving pests and their natural enemies along with the physiochemical components of the environment. The management strategy would vary from region to region and on the nature of the pest. Furthermore, the behavior of pests in a homogenous agricultural habitat would differ from that of a heterogeneous habitat and so also the management strategy to be employed. Weed competition with the crops play a major role in limiting profitability and also weed management is major challenge for the farmers (Brown et al., 2019) At the same time, researchers debate whether increasing plant diversity brings about an analogous reduction in population densities of phytophagous insects, improvement of soil physical properties, enhancement of crop pollinators and natural enemies (Horn, 2000; Altieri and Letourneau, 1982; Marshall et al., 2003; Barberi et al., 2010; Blaix et al., 2018; Blubaugh et al., 2020). The activity of insect pests varies in different agro-ecological situations and also in different growing

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seasons even in the same region. Weeds may inhibit the colonization of insect pests in main crop from the bottom-up or may strengthen top-down suppression of insect pests by increase in natural enemy complex (Horn, 1981; Blaix et al., 2018). Also the changes in the tillage practices for weed management can impact the population development of insect pests and predator complex in an ecosystem (Norris, 2005). With this understanding, a typical agricultural field containing the brinjal and groundnut crop was selected for an analysis of the occurrence and dispersal of the insect pest and predatory complex and to study the impact of intensity of weed management on insect pest population and crop yield. The selected area for study was kept barren from three months from Apr to June 2021. In Tiruvallur district of Tamil Nadu, India, Brinjal is cultivated in 380 hectares and groundnut is cultivated 4865 ha of area. It was found that the insect pests start attacking the brinjal crop from the first week of transplanted crop and continued till harvest. Major sucking pests attacking on the crop were leaf hoppers, aphids and white fly which also play a major role as vectors for little leaf of brinjal and leaf curl virus. Shoot and fruit borer was recorded as a major pest causing 25-30 percent yield reduction (Soren et al., 2020). This study will help the farmers to understand the diversity and dispersal of insect pests, effect of weed management on insect pests and to decide the timely plant protection measures.

Materials and methods

The study on the influence of weed diversity on the dispersal of insect pests and predatory complex was conducted for one year from July 2021 to March 2022 at a typical agricultural field at Kilambakkam village (13.1511°N, 79.9703°E) Tiruvallur, Tamil Nadu, India. In the experiment, insect pests and predator complex was studied in i) Treatment 1 (Weedy plot) with minimum weed management practices (Trimming of weeds followed once in a month) and ii) Treatment 2 (Control plot) with regular weed management practices (regular hand weeding followed once in a week where the weeds were removed completely). Brinjal crop was grown in one acre of area and groundnut in an adjacent area in once acre as a rabi crop. Data on insect pests and predator complex associated with various stages of the crop were observed and recorded in brinjal crop from 15 days after planting (DAP) (July 2021 to January 2022) and in groundnut crop from 15 DAP (December 2021 to March 2022) in both the treatments.

Insects survey

Sampling was carried out in five microplots (1 × 1 m) four of which are located at the corners of the plot and one at the center In both the treatments. An estimate of the predator complex was made by recording the total number of spiders, coccineilids, chrysopids and preying mantids in each microplot. Field counts of the sucking pests (nymphs and adults of aphids, thrips, jassids) were made from the terminal leaves of the crop, while whiteflies and mites, infested leaves were brought to the laboratory and the number of puparia of white flies and nymphs and adults of mites were counted under dissection microscope. To enumerate the shoot borer, the number of healthy and dead heart shoots was counted in each plot and the data expressed as percent dead heart. The incidence of fruit borers was assessed by recording healthy and affected fruits at each picking along with the yields and expressed as percent fruit damage. An estimate of predator complex was made by recording the total number of spiders, coccinellids, chysopids and preying mantids in each microplot.

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Weeds survey

Observations were also made on the weed species present in the crop field, bunds and neighboring fallow land and the weed density measured by 1 m^2 quadrat sampling in both the treatment plots. For every weed species, the relative weed density (RWD) was calculated (No. of individual weed species/Total number of all species × 100). Weed density was calculated only in weedy plots of brinjal and groundnut crop (T1) as minimal weed management practices followed in T1. To analyze the influence of weather parameters, linear regression was worked out between the incidence of insect pests and major weather parameters *viz.,* temperature, relative humidity and rainfall during the period. For this purpose, the population of the insect species on all the host plants in the habitat (both crop and weed) was pooled for each month and the pooled monthly data was analyzed for regression with the abiotic factors.

Results and discussion

(a) Insect population counts in brinjal and groundnut crops

Fourteen species of insect pests, *viz., Aphis gossypii* Glov. (Aphididae), *Henosepilachna vigintioctapunctata* (L.) (Coccinellidae), *Amrasca devastans* (Ishida) (Cicadellidae), *Leucinodes orbonalis* Guen. (Noctuidae), *Bemisia tabaci* (Genn.) (Aleurodidae), *Nezara viridula* (L.) (Pentatomidae), *Caliothrips indicus* (Bagn.) (Thripidae), *Oxycarenus hyalinipennis* Costa (Lygaeidae), *Cyrtopeltistenuis* (Reut.) (Miridae), *Rapidopalpa foveicollis* (Lucas) (Chrysomelidae), *Euzophera perticella* (Rag.) (Pyralidae), *Spilostethus hospes* (Fab) (Lygaeidae), *Ferritiavirgata* (Ckll.) (Pseudococcidae) and *Tetranychus cinnabarinus* (Boisd.) (Tetranychidae) were observed feeding at the various stages of the crop. *C. indicus, H. vigintioctapunctata, B. tabaci and L. orbonalis* were the major pests recorded in habiting the brinjal crop. Population of *H. vigintioctapunctata* and *C. indicus* were high at the early growth stage of the crop during August and September and then declined with the age of the crop in both weedy (T1) and control plots (T2). Similarly, *B. tabaci* and *A. devastans* increased with the age of the and reached a maximum of 86/microplot and 42/microplot respectively in weedy plot and 88.45/microplot and 55.02/microplot at 210-day-old crop and then declined with the age of the crop. *L. orbonlis* infested heavily during the fruiting stage of the crop (150-240 DAP) and *T. cinnabarimis,* the red spider mite, was found to infest from 90–210-day old crop with the maximum count during 180 days crop in both the treatments (*Tables 1* and *2*). While comparing the mean population of insect pest from 30-240 days crop, significant increase was recorded in control plot over weedy plot due to dispersion of insects on the weeds and reduction was observed in predator population counts (*Fig. 1*). Insect pests, *viz., Spodoptera litura, Caliothrips indicus, Bemiia tabaci, Amrasca devastens, Aphis gosypii, T. cinnabarinus* and *Frankliniella schultzei* were observed infesting groundnut crop. Maximum infestation was observed at 45 days old crop. *S. litura* (3.5/microplot) and *C. indicus* (20/microplot) populations reached the maximum on the 45-day old crop in T1, while *A. craccivora* (11.6/microplot in T1 and 7.4/microplot in T2) and *T. Cinnabarinus* (25.7/microplot in T1 and 18.6/microplot in T2) buildup was observed to be maximum on the 60 day old crop. While comparing the mean population of insect pest from 15-90 days crop, significant increase was recorded in control plot over weedy plot due to dispersion of insects on the weeds and reduction was observed in predator population counts in

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control plot (*Table 3*). This indicated that the diverse vegetation might work to camouflage the host plant from detection by specialist insect pests or interfere with their competitive abilities on the crop (Madden et al., 2023). Similarly, Letourneau et al. (2011) and Wan et al. (2020), highlighted the fact that the plant diversity promotes strong control of herbivores (*Fig. 2*).

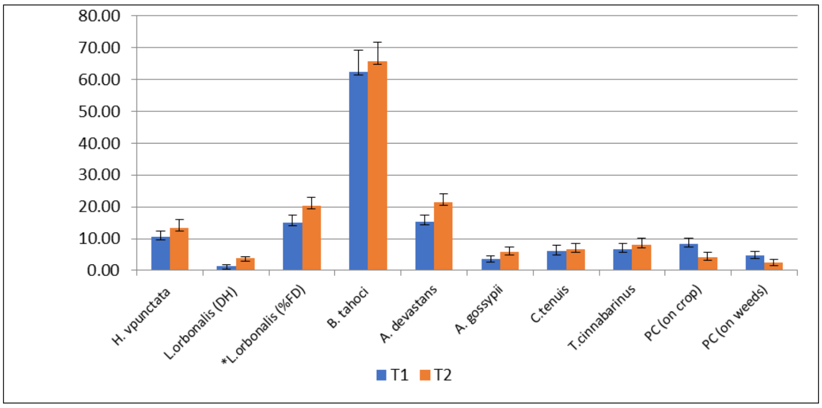

***Figure 1.** Comparison of mean population of insect pests in weedy and control plots. T1-weedy plot; T2-control plot in brinjal crop; PC-predator complex*

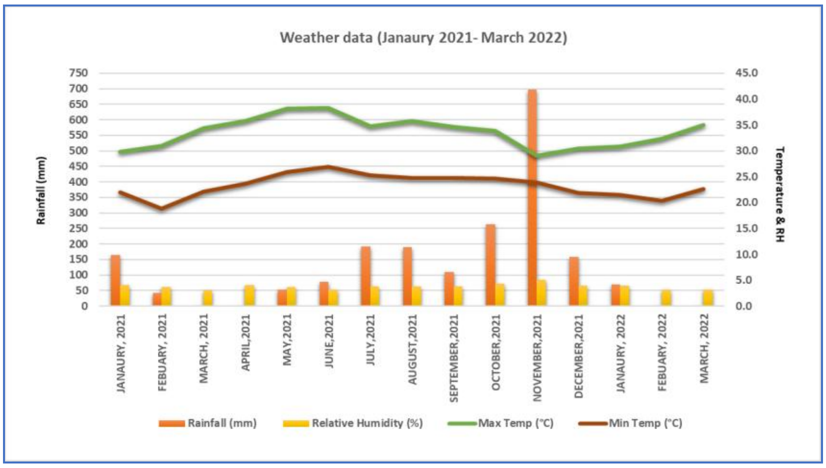

***Figure 2.** Weather data (January 2021 - March 2022)*

(b) Predator complex in the ecosystem

The predominant insect predators observed were Coccinella septumpunctata, Menochilus sexmaculatus, Scymnus sp. Canthoconidea furcellata and Chrysoperla cornea. Three species of spiders Oxypes javanus, Argiope pulchella and Araneus sp. were observed preying on the sucking pests. Increase in population of predator complex was observed with increase in the pest population. Generally, during the cropping season, high population was on the crop when compared to that of the associated weeds. A maximum insect predator count was observed during 90-day old brinjal crop (12.45/microplot) in weedy plots and 6.45/microplot in control plots (*Tables 1* and *2*). In groundnut crop, weedy plots exhibited maximum predator count in 60-day old crop (5.7/microplot) and 2.5/microplot in control plots during 75-day old crop (*Tables 3* and *4*).

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Table 1. *Population dynamics of insect pests on brinjal crop in weedy plot (treatment 1)*

	Insect pests	Population count (nos/microplot) – weedy plot (treatment 1)								
		30 DAP	**60 DAP**	**90 DAP**	**120 DAP**	**150 DAP**	**180 DAP**	**210 DAP**	**240 DAP**	**Mean**
1	*H.* v. *punctata*	19.50 ±2.40	16.80 ±2.60	12.00 ±1.80	9.60 ±2.70	5.60 ±1.40	11.50 ±1.60	6.20 ±0.80	4.00 ±1.22	10.65 ±1.82
2	*L. orbonalis (DH*)	0.00	1.00 ±0.44	2.20 ±0.71	2.40 ±0.84	2.00 ±0.71	1.00 ±0.05	1.00 ±0.71	1.50 ±1.24	1.39 ±0.51
3	*L. orbonalis* (fruit damage)*	0.00	0.00	7.00 ±2.65	22.50 ±4.33	22.00 ±2.65	26.50 ±3.65	26.20 ±4.10	17.00 ±2.50	15.15 ±2.33
4	*B. tahoci*	38.20 ±4.35	70.00 ±5.65	53.00 ±5.20	54.20 ±5.25	60.20 ±8.20	76.50 ±10.20	86.00 ±8.40	62.00 ±7.25	62.51 ±6.82
5	*A. devastans*	9.80 ±1.40	9.40 ±2.46	10.80 ±0.91	7.20 ±1.25	11.60 ±0.91	21.80 ±2.80	42.00 ±3.40	10.80 ±1.01	15.43 ±2.10
6	*A. gossypii*	3.40 ±1.10	5.00 ±1.22	5.60 ±1.13	7.40 ±1.88	2.10 ±1.13	2.10 ±1.20	0.60 ±0.71	1.80 ±0.52	3.50 ±1.16
7	*C. indicus*	9.00 ±1.30	2.00 ±1.50	6.00 ±2.68	10.00 ±3.18	11.50 ±2.68	5.00 ±1.66	2.00 ±1.40	2.50 ±1.20	6.00 ±1.80
8	*T. cinnabarinus*	0.00	0.00	17.00 ±2.50	7.20 ±2.36	8.80 ±2.50	10.50 ±2.30	8.60 ±1.52	2.00 ±0.89	6.76 ±1.72
9	Predator complex (on crop)	4.00 ±1.44	6.70 ±1.12	12.50 ±2.49	9.50 ±2.24	9.60 ±1.42	8.10 ±1.42	10.50 ±1.50	6.70 ±1.05	8.45 ±1.74
10	Predator complex (on weeds)	2.15 ±0.87	2.80 ±0.65	3.40 ±1.49	5.20 ±1.49	5.40 ±1.47	5.50 ±1.47	6.60 ±0.85	7.80 ±1.10	4.86 ±1.12

DAP – days after planting. *Percent fruit damage

Table 2. *Population dynamics of insect pests on brinjal crop in control plot (treatment 2)*

	Insect pests	Population count (nos/microplot) – control plot (treatment 2)								
		30 DAP	**60 DAP**	**90 DAP**	**120 DAP**	**150 DAP**	**180 DAP**	**210 DAP**	**240 DAP**	**Mean**
1	*H.* v. *punctata*	20.50± 3.10	18.40 ±3.20	15.45 ±2.05	15.40 ±3.40	9.75 ±3.10	15.20 ±3.02	7.15 ±1.20	5.20 ±2.05	13.38 ±2.64
2	*L. orbonalis (DH*)	0.00	1.22 ±0.25	5.50 ±0.22	5.10 ±0.75	4.10 ±0.25	4.60 ±1.02	5.20 ±0.75	5.05 ±1.20	3.85 ±0.56
3	*L. orbonalis* (fruit damage)*	0.00	0.00	5.75 ±1.15	24.15 ±2.22	30.80 ±2.00	32.05 ±5.60	35.25 ±4.75	34.00 ±5.75	20.25 ±2.81
4	*B. tahoci*	35.20 ±5.12	65.75 ±5.50	55.40 ±4.40	64.25 ±3.20	74.25 ±6.24	76.45 ±12.15	88.45 ±5.20	65.50 ±6.10	65.66 ±5.99
5	*A. devastans*	9.50 ±1.45	10.50 ±3.20	15.20 ±3.15	14.82 ±2.05	17.50 ±1.42	30.45 ±1.40	55.02 ±3.50	18.45 ±4.25	21.43 ±2.55
6	*A. gossypii*	3.50 ±1.15	8.60 ±1.20	10.45 ±2.24	12.15 ±2.15	4.60 ±1.05	4.20 ±3.10	0.75 ±0.20	1.75 ±1.05	5.75 ±1.63
7	*C. indicus*	8.25 ±1.50	1.52 ±1.75	7.60 ±1.50	10.24 ±3.10	14.15 ±3.00	7.15 ±1.75	1.50 ±0.72	2.15 ±1.25	6.57 ±2.00
8	*T. cinnabarinus*	0.00	0.00	17.50 ±3.75	10.40 ±2.00	11.05 ±3.15	15.42 ±2.20	8.75 ±2.60	2.50 ±1.42	8.20 ±2.02
9	Predator complex (on crop)	1.50 ±1.05	2.50 ±12.00	5.20 ±1.10	4.05 ±1.05	5.75 ±1.15	4.50 ±0.75	6.45 ±1.10	4.12 ±1.02	4.26 ±1.40
10	Predator complex (on weeds)	0.50 ±0.75	1.06 ±0.20	1.40 ±0.50	2.75 ±1.20	2.10 ±0.75	3.05 ±1.10	4.50 ±0.50	4.50 ±1.15	2.48 ±1.05

DAP – days after planting. *Percent fruit damage

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Table 3. *Insect pests on groundnut crop in weedy and control plots*

Insect pests	Population count (nos/microplot) –T1							Population count (nos/microplot) – T2						
	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	Mean	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	Mean
S. litura	0	3.2 ±1.1	3.5 ±1.6	2.6 ±0.9	1.10 ±0.4	1.7 ±0.6	2.00 ±1.1	0	0	0.6 ±0.3	0.55 ±0.2	0.05 ±0.02	0	0.20 ±0.1
A. devastens	2.4 ±1.1	3.3 ±1.6	8 ±3.7	11.6 ±4.2	4.00 ±1.1	3.5 ±0.8	5.47 ±2.2	0.75 ±0.4	2.0 ±0.4	3.3 ±1	4.15 ±1	2.75 ±0.4	1.05 ±0.3	2.34 ±0.58
C. indicus	10.5 ±3.8	15.7 ±5.8	20 ±3.1	16 ±4.8	10.0 ±4.1	10.7 ±5.2	13.8 ±4.5	4.2 ±1	6.25 ±1.3	10.1 ±2.5	7.4 ±2.2	4.2 ±0.8	4.75 ±1	6.15 ±1.48
T. cinnabarinus	0	0	0	25.7 ±10	21.2 ±8.4	17.5 ±8.5	10.7 ±4.9	0	0	1.25 ±0.3	18.6 ±4.5	12.5 ±3.4	9.5 ±2.2	6.98 ±1.75
Predator insects (on crop)	1.2 ±0.3	1.46 ±0.5	3.5 ±1	5.7 ±1.8	4.2 ±1.1	2.7 ±0.7	3.13 ±0.9	0.25 ±0.05	0.33 ±0.1	1.05 ±0.6	2.5 ±0.5	2.4 ±0.5	1.33 ±0.2	1.31 ±0.33
Predator insects (on weeds)	0.33 ±0.2	0.5 ±0.1	1.6 ±0.5	3.15 ±1.0	1.25 ±1	0.75 ±0.2	1.26 ±0.2	0	0	0.5 ±0.1	0.2 ±0.1	0.5 ±0.1	0.5 ±0.1	0.28 ±0.08

T1- treatment 1 (weedy plot); T2 –treatment (control plot); DAS = days after sowing

(c) Weeds in the ecosystem

In general, the density of monocot weeds in crop field was more when compared to the neighboring fallow and bunds and *vice versa* for dicot weeds. Considering the individual weed species density in the brinjal crop field, *C. dactylon* (17.5%) was the most dense followed by *C. rotundas* (13.8%), *J. simplex* (7.76%) *and E. hirta* (7.38%). In the groundnut field, *C. dactylon* density (14.41%) was more followed by *E. colona* (13.95%) and *T. portulacastrum* (11.16%) (*Table 5*). The weeds *J. simplex*, *T. procumbens* and *A. aspera* harbored population of *C. indicus,* while the weeds *P. minima* and *S. xanthocarpum* harbored population of epilachna beetle in the brinjal field.

Given the uniform abundance of the crop plant in the field, its ecology is seldom considered; it is there or not, as determined by the farmer following the regular cultivation practices. However, the situation with weeds is somewhat different. Although weeds may also be either widespread or localized within landscapes, once present at a location they lend to persist across years (Liebman et al., 2001). Hence mosaic of sites/fields in which they are present can be predictable over time than for crops. Within a field their distribution may be highly non-uniform (Rew et al., 1996) and their abundance may fluctuate markedly from year to year (Chancellor,1985). The abundance, spatial distribution, diversity and sizes of host plants are likely to affect the ability of the insect to reproduce and spread. While it is common that most insect pests reproduce best on the nutritious crop hosts, their population in a habitat is determined by their capacity to use mixed hosts in their diet. The presence of weeds in the habitat being more predictable than the crop, the weeds have a major role in harboring the insect pests. Spatial variation in weed density is considerable. It is common to see dense patches of particular weeds in some parts of fields, while they may be completely absent from other parts. Hence it would be pertinent to discuss the occurrence of the pests in a crop in relation to the weed composition and their relative density.

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***Table 4.** Relative weed density (RWD) in weedy plots (T1) brinjal and groundnut crop ecosystem*

Weed species	Relative weed density (%)			
	Brinjal		Groundnut	
	C	F + B	C	F + B
Monocot weeds				
Chloris barbata Sw	7.38	3.84	6.98	--
Cynodon dactylon Pers	17.5	5.63	14.41	8.77
Cyperus iria Linn	9.59	4.12	6.98	3.51
Cyperus rotundus Linn	13.8	2.74	13.48	6.32
Dactyloctenium aegyptium Beauv	5.16	1.64	--	--
Echinocloa colona Link.	--	1.92	13.95	5.61
Echinocloaindica Link.	6.82	2.33	--	--
Isachne dispar Trin.	--	3.15	--	1.75
Iselema laxum	--	--	--	3.86
RWD of monocot weeds (Total)	60.25	25.41	55.81	29.82
Dicot weeds				
Acalypa indica Linn.	--	3.70	--	6.67
Achyranthes aspera Linn.	--	5.08	--	8.77
Amaranthus viridis Linn.	6.08	--	9.67	--
Asistacia gangetica T. And.	--	1.78	--	--
Carchorus aestuans Linn.	--	--	--	1.75
Cleome viscosa Linn	4.24	2.19	4.65	4.21
Croton sparsiflorus Morong.	1.66	6.73	3.26	3.17
Euphorbia hirta Linn.	7.38	3.15	5.58	7.02
Evolvulus mimularis Linn.	--	3.43	--	--
Gomphrena decumbens Jacq.	--	3.63	--	--
Hibiscus sabdariffa	2.83	10.85	--	--
Justicia simplex D. Don.	7.76	10.85	--	14.74
Leucas aspera Spreng.	1.57	2.88	--	--
Mollugo nudicaulis Lamk.	3.50	2.33	--	3.16
Ocimum canum Linn.	--	--	--	
Phyllanthus niruri Linn.	2.21	5.21	--	3.16
Physalis minima Linn	--	2.19	--	--
Portulaca oliracea Linn.	5.35	--	9.76	--
Scoparsia dulcis Linn.	--	1.23	--	--
Solanum xanthocarpum Shrad and Wendl.	--	3.02	--	--
Trianthema portulacastrum Linn.	--	--	11.16	--
Tridax procumbens Linn.	--	9.61	--	10.18
Vernonia ceneria Nees.	--	4.25	--	--
Waltheria indica Linn.	--	1.79	--	--70.17
RWI of dicot weeds (Total)	39.75	74.59	44.19	100
Grand total	100	100	100	

(d) Influence on weeds on dispersal of insects

In general, the population of insect pests on the weeds was less when compared to that of the main crop in both the treatment plots (T1 and T2). In weedy plots, population of thrips, *C. indicus* on brinjal was maximum during August (25.2/plant) and then decreased with the age of the crop, whereas weeds like *J. simplex* and *A. aspera*, provided a steady support of thrips population throughout the cropping season. At the senescent stage of the crop (Feb-March) more number of thrips was recorded on *T. procumbens* (5-6/plant). There is a continuous spectrum between insect species that

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feed only on one plant species and others that feed on a very wide range of plants under a number of families. Weeds in particular harbor many insect pests during crop season as well as off–season (Sushil et al., 2021). Mohan Daniel et al. (1984) reported the weed, *A. aspera* to appear in the habitat by August and served as a reservoir for *C. indicus*. Results have shown that the number of individuals of *C. indicus* on *T. procumbens* was more in the later stage of the groundnut crop when compared to *A. aspera.* At the maturity stage of the crop, *C. indicus* population was more on the weed species (*Fig. 3*). Study on the development of the polyphagous pest *Caliothrips indicus* on groundnut and the weed *Achyranthes aspera* reported that the fecundity was generally higher on groundnut than on the weed and the life cycle was also longer on the crop. Populations on *A. aspera* exhibited marked spatial and seasonal fluctuations and both the weed density and numbers of the predators were important factors affecting population fluctuations of the thrips. Observation on Epilachna beetle, *H. vigintioctopundata incidence* was high on the weed, *P. minima* during October (5.1/plant), and on *S. xanthocarpum* during October and March (4.5-4.8/plant). However, the maximum population was on the brinjal during September (7.25/Plant) (*Fig. 4*). Epilachna beetle depend mainly on solanaceous plants as hosts and the major wild host as *Solanum torvum* in Java, Indonesia (Katakura et al., 2001). However, in several regions of Southeast Asia, including Java, *H. vigintioctopunctata* also occurs on the introduced fabaceous weed, *Centrosema molle* (Fujiyama et al., 2023).

Table 5. *Relationship between insect population and abiotic factors*

Insect species	Temperature			Relative humidity			Rainfall		
	R	**r^2**	***P*-value**	**R**	**r^2**	***P*-value**	**R**	**r^2**	***P*-value**
H. v punctata	0.780	-0.609	0.003**	0.892	0.806	0.001**	0.504	0.254	0.095
L. orbonalis	-0.251	-0.063	0.456	0.177	0.031	0.604	-0.032	-0.293	0.037
B. tabaci	0.453	0.205	0.140	-0.604	-0.361	0.03*	-0.057	-0.003	0.850
C. indicus	0.678	0.547	0.05*	-0.339	-0.115	0.280	-0.436	-0.409	0.625
A. devastens	-0.643	-0.609	0.02*	0.643	0.414	0.02*	0.023	-0.005	0.944
A. gossypii	-0.989	-0.967	0.01**	0.846	0.574	0.05*	0.413	-0.245	0.587
C. tenuis	-0.483	-0.233	0.132	0.361	0.130	0.276	-0.041	-0.001	0.904
S. litura	-0.639	0.408	0.05*	0.892	0.795	0.05*	0.245	0.060	0.842
Predator complex	-0.593	-0.263	0.05	0.521	0.272	0.100	0.249	0.061	0.461

R - correlation coefficient; r^2 regression coefficient. *Significant at 5% level of significance. **Significant at 1% level of significance

The polyphagous pest, white fly, *B. tabaci* was prevailing in the habitat throughout the year with population showing a bimodal peak during October and March on the brinjal crop. *H. sabdariffa* having an relative weed density of 2.83-3.63% facilitated as a reservoir host where heavy population of *B. tabaci* was recorded during September. Also, populations of whitefly were maintained on the weed species *C. viscosa* and *H. sabdariffa* throughout the year. The total population of the whitefly in the habitat was maximum during March (6l.6/3 host plant) (*Fig. 5*). Zhang et al. (2014) observed that *B. tabaci* in cotton ecosystem appeared on weeds, the common ragweed and piemarker in about 10 days earlier than on cotton, or the other cultivated plants. The peak population densities were observed over a span of 2 to 3 weeks on cotton, starting in mid-August

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and reported that the common ragweed growing adjacent to cotton field supported the highest *B. tabaci* densities which was 12-22 fold higher than on cotton itself. The population fluctuation of *A. devastans* was high on brinjal during March (11.6/plant) and they colonized on *S. xanthocarpum and H. sabdariffa* which was an alternative host in the habitat (*Fig. 6*).

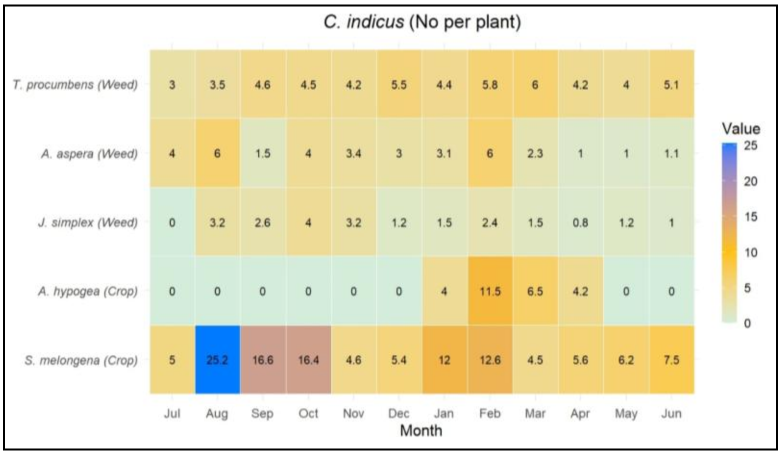

Figure 3. *Dispersion of Caliothrips indicus (thrips) in crop and weed species (July 2021 - June 2022)*

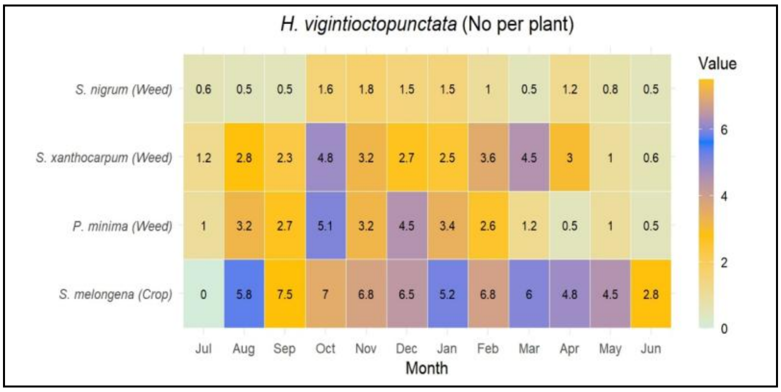

Figure 4. *Dispersion of H. vigitiocata punctata (Epilachna beetle) in crop and weed species (July 2021 - June 2022)*

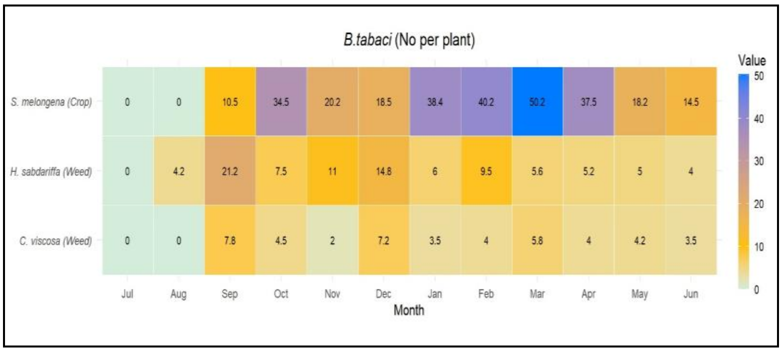

Figure 5. *Dispersion of Bemisia tabaci (white fly) in crop and weed species (July 2021 - June 2022)*

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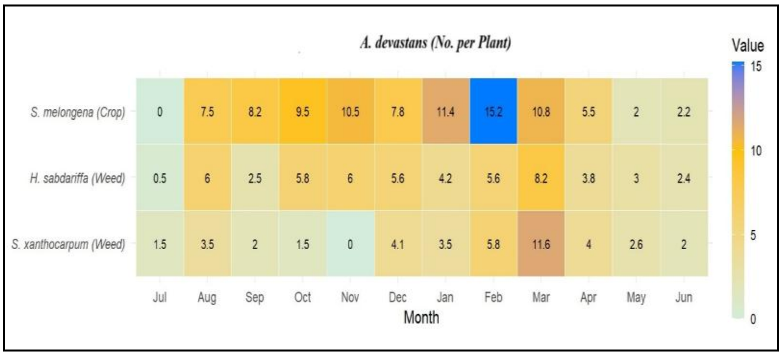

Figure 6. *Dispersion of A. devastans (Jassids) in crop and weed species (July 2021 - June 2022)*

(e) Influence of weather parameters on population dynamics of insect pests

Values of the correlation and regression coefficient (*Table 5*) revealed that the population of epilachna beetle significantly decreased with the increase in temperature (r = -0.609**) and increased with the increase in relative humidity (0.806**). Although pattern of incidence varied with region, epilachna population was reported to increase with increase in temperature, humidity and rainfall at terai region of West Bengal (Suresh et al., 1996). High fruit infestation of *L. orbonalis* coincided with the increase in relative humidity as reported by Singh and Brar (1990) and Kumar and Singh (2013). However, in the present study, no significant relationship was observed between the population of fruit borer and abiotic factors in this agroecosystem. It is obvious that infestation occurs based on the availability of host. *S. litura, A. gossypii* and *A. devastens* population showed significant positive and negative relationship with relative humidity and temperature respectively which is in conformity with the study by Prasanth et al., 2023. Population of the predator complex in the agroecosystem increased with reduction in temperature (r = -0.263*) while population of *C. indicus* (r = 0.547*) was positively correlated with temperature. No significant relationship was observed between pest population and rainfall in the present study.

The presence of diverse vegetation within or near the field may add essential resource for predators or parasitoids and so enable them to find all their requirements near the pest population. Such resources include food, cover or alternate prey. Conversely, weeds may also adversely affect the orientation of predator and parasitoids to their prey. The weeds may even directly contribute to pest multiplication by providing preferred surface for oviposition. When insects have a wide host range they sometime move from weeds to crop plants, causing crop damage. Weeds in particular harbor some insect pests during crop season as well as during off season. The relationship between insects and host plants varies largely from very specialized to generalized feeding behaviors (Capinera, 2005). Phytophagous insect species locate their host plants from mixed vegetation when they face the dangers of annihilation by various abiotic and biotic agents. Hence, the damage caused by insects is quite limited in weedy ecosystem. In contrast, natural regulating factors play only a limited role in agro-ecosystem, and insect pest outbreaks are quite frequent (Sharma et al., 2017). Insects often have a well–defined preferential hierarchy, feeding on alternative host only when preferred hosts are unavailable. The significance of alternative hosts is that they can serve as an over–seasoning bridge from one crop growing season to a

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susceptible crop in next season, providing a localized source of initial inoculum for the next susceptible crop (Clementine et al., 2005; Nutter, 2007; Sileshi et al., 2008). Hence effective weed management play a major role in insect pest management in crops

Conclusion

Present study indicated that minimum weed management practices would decrease the number of pests and increase the number of predators on both the brinjal and groundnut crops. Alternate hosts, weeds and abiotic factors directly affect the dispersal ability of insect pests in an ecosystem. The study on dispersal of insect pests and influence of weather parameters in population dynamics of insect pests in an agroecosystem facilitates an understanding for management to target pests during vital stages of insects. This avoids damage to the crop and potentially decreases insecticide applications. Hence the dispersal of insect pests defines their distribution and spatial abundance and consequently the severity of the damage they cause to the crops.

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Conflict of interests. We declare no known conflict of interests that could have appeared to influence the work reported in this paper.

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