



Studies on the effects of pesticides on natural enemies of the tea pests

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Abstract

The effect of pesticides on insect natural enemies of tea pest were carried out under field conditions. The insect population was studied before and after spraying of six different commonly using approved insecticides, two biopesticides and unsprayed control field in Tea. The study revealed that pesticide impact on natural enemies like predators and parasitoid populations varies depend up on the class and mode of action of the pesticides. The pesticides like synthetic pyrethroid class of chemicals causing the maximum damage on tea pest natural enemies followed by organophosphates. The study revealed that the minimum impact on natural enemies caused by the neonicotinoid group of chemicals.

Keywords: Tea, pests, natural enemies, D-Vac, pesticides

Introduction

Tea (*Camellia sinensis*) is a perennial monoculture crop infested by both the wet and dry weather pests. The natural enemies of these pests also available throughout the year in the tea field. The incidence of the tea pest's natural enemies was examined in this study both before and after spraying of the six recommended pesticides against the pests viz, Tea mosquito bug, Red spider mite, Shot hole borer, and Tea thrips. Tea is produced throughout as monocultures in south India, where a constant supply of food and a consistent microclimate facilitates the growth of pests. Pesticides is the main management options for control of insect pest of tea cultivation. In addition to the high pest incidence, unsuitability of the climate and geography for ecological farming, it is not always possible to choose this approach in northeastern India. Nevertheless, a garden can choose integrated management techniques that use fewer synthetic pesticides and promote natural enemy control of pests. (Prasad *et al.* 2019). Due to the climatic variations the existence of pest persist throughout the year so there is a necessity of application of pesticides also in the field conditions. Nevertheless, because pesticides harm non-targeted organisms like parasitoids and predators that coexist with pests in the same crop-ecosystem. Synthetic pesticides have been shown to be detrimental to beneficial insects, which serve as pests' natural predators. (Desneux *et al.* 2007) [8]. Secondary pest attacks resulted from pesticides eradicating natural enemies from the field (Dutcher 2007) [10]. Crop losses associated with pests have remained unchanged significantly over the last few decades, despite an increase in the use of pesticides. Broad-spectrum pesticides are capable of having an impact on non-target insect species, such as reducing the number and activity of natural enemies and increasing competition between pest species, in addition to their primary target pests. Pesticide residues have demonstrated that pesticide persistence may be a significant factor in their adverse impacts on natural enemies in the field. Tea ecosystem provides stable, favourable microclimate, food supply and sites for the reproduction and survival of the pests. It is estimated that 1000 species of arthropods associate with tea. Acarina, Hemiptera, Thysanoptera, Lepidoptera, Coleoptera and Isoptera are the most important orders of arthropods pest

infesting tea. Tea mosquito bug *Helopeltis theivora*, Red spider mite *Oligonychus coffeae*, Tea thrips *Scirtotrips bispinosus* and Shot hole borer *Euwallacea fornicatus* are considered as major pests causing severe damage especially in tea plantations in South India. This requires implementation of effective control strategies, and it is being achieved by the application of synthetic pesticides. The indiscriminate application of pesticides and the inadequate implementation of pest control strategies can result in unfavourable residue issues in tea, the development of pest resistance, and negative impacts on beneficial insect predators. For integrated pest management to be successful, pesticides must be used judiciously to control tea pests without affecting their natural enemies. Tea plantations are thought to be excellent options for a biological control programme because of their size, agronomic techniques, longevity of crop, and type of climate. (Subramanian Guru *et al.* 2008) [11]

In order to collect insects and other arthropods such as arachnids, Hemiptera, and coleoptera from the ground and low vegetation, Herzog *et al.* (2012) [13] used a motorised hoover (D-Vac). When utilised as one of the sampling techniques in lime orchards, the D-Vac sucking machine is said to have the least amount of spider population collected (Amalin *et al.* 2001) [1]. According to Prasad *et al.* 2019, he has utilised a D-Vac sampler (Model No. 122, D-Vac Suction sampler; Rincon-vitova D-VAC Company, Ventura, CA, USA; airstream 280 cu. ft. /min.). A spider sample was taken using a suction device. Tea plantations are considered highly suitable for biological control programme in view of the type of climate, duration of crop, scale of planting and agronomic practices. Hazarika *et al.* (2001) [12], Das *et al.* (2010) [5], Muraleedhran and Roy (2016), and Dhanapati and Varatharajan (2016) [9] are among the natural enemies that have been documented to feed on the tea pest. These consist of various spider species, mantis, lacewings, ladybird beetles, flies, and predatory mites. Among the natural enemies, spiders are the most widespread and varied group, according to Pekár (2012). In North East India, there are forty species of parasitoids and predators that prey on common tea pests (Das *et al.* 2006) [7]. According to Guru Subramanian *et al.* (2008) [11], the ecological balance between pests and their natural enemies would be disrupted

if pesticides were applied indiscriminately. Banerjee 1982 [2] states that chlorinated hydrocarbon pesticides and synthetic pyrethroids such as Permethrin and Deltamethrin effects the population of natural enemies in the tea gardens. The present study was carried out to observe the impact of post pesticidal application on population of natural enemies in tea plantations. The selected pesticides are the recommended pesticides against the major pests of Tea.

Materials and Methods

The study was conducted at the experimental farm of the UPASI Tea Research Institute in Valparai, in the Tamil Nadu district of Coimbatore. The location is the experimental form of the UPASI Tea Research Foundation (10°15'51.9"N 76°58'04.8"E). There were sufficient numbers of pests and predators in the study area. For the present study a tea field was selected without any exposure

of any pesticides for the last six months. This study was carried out using six different approved chemicals and two biopesticides were selected viz. Quinalphos, Dimethoate, Thiamethoxam, Thiacloprid, Deltamethrin, Emmamectin benzoate, Pungam soap and neem soap. These chemicals were sprayed in each plot at the recommended dosage with three replications. The natural enemy’s population were collected by using D Vac sucking machine from each plot. (D - Vac Suction sampler STHIL BG 86/C 70dB (A) measured at 50 ft per ANSI B 175.2-2012) (Fig. 1). The evaluation was done at predetermined days of intervals up until the 21st day following the application of the appropriate pesticide. Following the pesticide application, all of the insect population was collected using a D-vac and brought into the lab. The insects were sorted by family and order, and the number of beneficial insects was taken into account.



Fig 1: Collection of insects with D – Vac sucking machine

Results

The result showed that all the pesticide adversely affected the population of natural enemies of pests varies according to the class of pesticides. The contact pesticides like Deltamethrin, Quinalphos and Dimethoate showed immediate and maximum impact on the natural enemies when compared to systemic insecticides (Table 1& Fig 3). The study indicated that natural enemies of Tea mosquito bugs especially the spiders, praying mantis and parasitoid population were declined after spraying of pesticides.

Similarly, declining trend was noticed the insect population like lady bird beetles, leaf beetles, anthocorid bugs, Robber fly, praying mantis, white-footed ant, hoverfly, green lace wings, and dragon flies which are good predators for Tea mosquito bugs, red spider mite and thrips. Similarly, Ichneumon wasps and Trichogramma sp are good parasitoids for Tea mosquito bugs (Fig.2). So, the results clearly indicated that the synthetic pyrethroids deltamethrin followed by the contact insecticide like quinalphos and dimethoate affecting the beneficial insect population.

Table 1: Effect of pesticides on natural enemies in different days after spraying.

s Agrochemicals	% reduction of natural enemies’ population						
	1 DAT	3DAT	5DAT	7DAT	10DAT	14DAT	21DAT
Emmamectin benzoate	68.9	62.3	53	47.9	41.3	34.2	18.1
Deltamethrin	83.2	78.1	76.1	77.6	73.9	73.2	72.4
Dimethoate	48.9	42.7	40.6	40.6	39.2	37	37
Thiamethoxam	43.5	36.2	16.1	16.1	15.4	14.6	9.5
Quinalphos	74.5	70.1	60.1	60.1	58.6	56.7	51.6
Thiacloprid	70.7	60.5	48.6	40.9	37.2	26.8	17.3
Pongum oil	36.4	33.6	13.8	13.8	13.1	12.4	7.2
Neem oil	40.3	33.7	31.5	31.5	29.9	27.7	27.7
Absolute control	-7.2	-10.0	-13.6	-14.3	-15.0	-17.2	-23.6

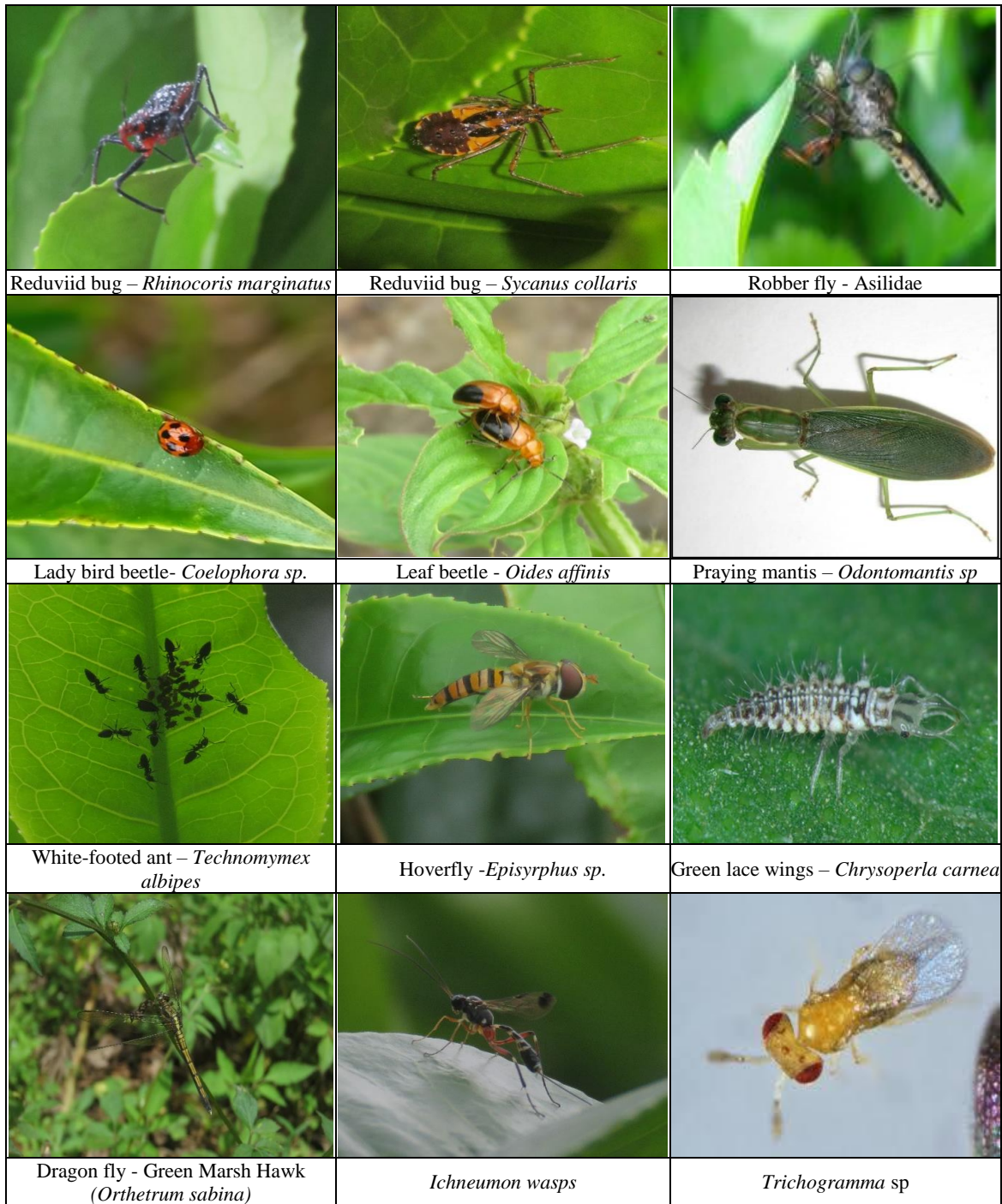


Fig 2: Identified natural enemies of tea pests

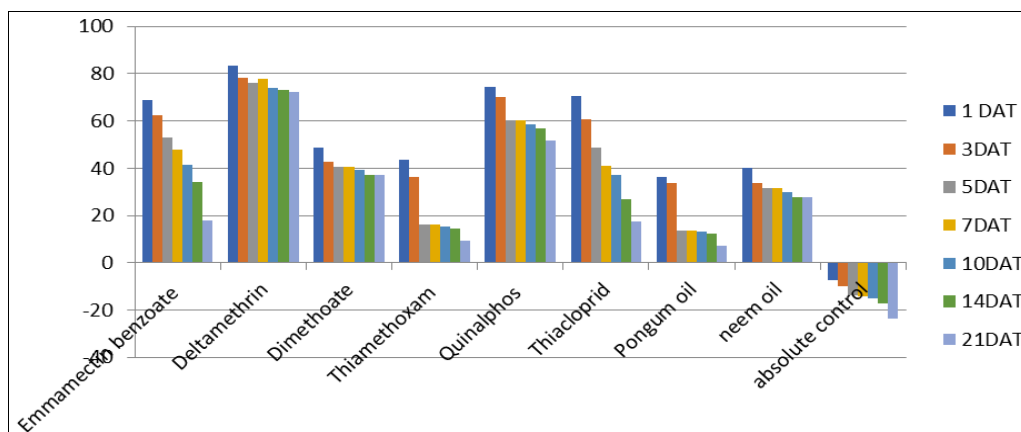


Fig 3: Effect of pesticides on natural enemies in different days after spraying.

The motorised hoover which used to collect the insects from the tea bushes shows that after 24 hours of spraying the agrochemicals there is a widespread reduction in the insect population of the experimental plot. The result shows that the highest reduction of insect population from the plot sprayed with deltamethrin 83 %, Quinalphos 75 % and around 70% in thiamethoxam and Emamectin benzoate. On the other hand, the agrochemicals such as Dimethoate, Thiamethoxam, Pongum oil and neem oil shows 40 % reduction. The experiment results concluded that after third week of the initiation of the experiment Deltamethrin shows 73 % reduction in the insect population followed by Quinalphos 52% and Dimethoate 37%. Emamectin benzoate and thiacloprid shows 18 % reduction and the least effective chemicals are Thiamethoxam, Pungam soap and Neem soap. The thiamethoxam shows highest reduction of the population in 24 hours and it were reduced to the least after 3rd week.

Discussion

The results of this study have shown that it is possible to integrate or combine natural enemies with certain types of pesticides, including contact and systemic insecticides. Indirect effects that vary based on concentration, natural enemy species, duration of pesticide exposure, evaluated developmental life stage(s), and the impact of repellence and residues. Prasad *et al.* 2019 draw the conclusion that there appears to be evidence linking the use of integrated pest management strategies and garden practices to natural enemy populations. Specifically, they find that switching from conventionally managed to ecologically managed plots will increase the number of natural enemies, which will then help to maintain a stable ecosystem and control pest populations. Research conducted by Sarmah *et al.* (2006) against *G. ochropterus*, *C. carnea*, *S. gilvifrons*, and *A. hystrix* using a variety of pesticides, plant extracts, bio pesticides, and Neem formulations revealed that the majority of them are extremely toxic and that some are moderately to very toxic. The population of spiders in the sprayed orchards may be impacted by the way pesticides affect arthropod pests, especially the possible prey for various spider species. *Theridion* sp. prefers mites and aphids, which may be the cause of the high population of this spider in the sprayed orchards. Our findings unequivocally show that the pesticides used in the orchards have nontarget effects (Amalin *et al.* 2001) ^[4]. The presence of natural enemies in the tea ecosystem suggests that they play an important role as biological indicators of the health of the tea agro-ecosystem and as bio control agents for maintaining ecological balance (Das *et al.* 2005) ^[6]. Therefore, it is important to emphasise the limited use of pesticides and integrated pest management in order to preserve the native predators, parasites, and pathogens that are part of the tea ecosystem for the purpose of sustainable crop protection (Borthakur *et al.* 2005b) ^[4]. This also suggests how to better use these organisms under the IPM programme in order to ensure that North East India's tea is free of pesticides and is healthier (Das *et al.* 2005) ^[6]. Therefore, it is important to emphasise the limited use of pesticides and integrated pest management in order to preserve the native predators, parasites, and pathogens that are part of the tea ecosystem for the purpose of sustainable

crop protection (Borthakur *et al.* 2005b) ^[4]. This also suggests how to better use these organisms under the IPM programme to ensure that North East According to Thatheyus and Selvam (2013) ^[19], synthetic pyrethroids, which are intended to control the larvae of mosquito, black, and tsetse fly, are highly toxic to aquatic organisms, include fish, at concentrations comparable to those used for pest control. In accordance with Prabhaker *et al.* (2011) ^[14], natural enemies are generally thought to be safe from systemically applied Neonicotinoids like Imidacloprid and Thiamethoxam unless they: consume plant tissue or excretions; or are exposed to the pesticide through food chain toxicity. Naturally, when predators consume prey that has consumed plants treated systemically, they may come into contact with systemic pesticides.

Conclusion

Integrated pest management relies on the selective application of plant products, insecticides, and bio pesticides to control tea pests without negatively influencing natural enemies. Consequently, it is necessary to develop pesticides or other products that are less toxic to beneficial organisms to implement a bio intensive pest management programme.

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