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Impact of pesticidal spray on seasonal availability of natural predators and parasitoides in the tea ecosystem

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ABSTRACT: **Tea plant (*Camellia sinensis* (L.) O' Kuntze) is attacked by numerous insect pests, which causes considerable damage to the quality and quantity of tea. The most important pest attacking tea bushes in H. P. are purple mite, *Calacarus carinatus* (Green), thrips, *Scirtothrips dorsalis* Hood, leafroller, *Gracilaria theivora,* Walsom, aphid, *Toxoptera aurantii* Boyer, mealybug, *Nipaecoccus* sp. and leafminer, *Tropiomyts theae* (Cotes). The important natural enemies associated in the tea orchards are *Syrphis sp., Coccincella septempunctata* Linn., *Oxyopes* sp. and parasitoid, *Diaeretiella* sp. Among the insecticides and biopesticides evaluated against natural enemies, deltamethrin, cypermethrin and ethion sprays were found highly toxic to *Syrphis* sp. and *C. septempunctuata* and their adult and larval population was not seen even on 7th and 4th days of spray, respectively. Neemark, Achook and *B.t.* (Dipel 8L) were quite safe to natural enemies. Endosulfan was relatively safe to *Syrphis* sp. but highly toxic to *C. septempunctata.***

KEY WORDS: Insect-pests, pesticidal effects, predators, parasitoids, predation potential, tea ecosystem

Tea (*Camellia sinensis* (L) O. Kuntze) is grown in Himachal Pradesh as a perennial plantation crop on an area of about 2,063 hectares. Average yield of 353kg per hectare in Himachal Pradesh, is the lowest among all the tea growing tracts of India. One of the factors getting low yield is the damage caused by various insect pests. The most important pests infesting tea leaves are purple mite, *Calacarus carinatus* (Green), thrips, *Scirtothrips dorsalis* Hood, leafroller, *Gracilaria thievora* Walsom, aphid, *Toxoptera aurantii* Boyer and leafminer, *Tropiomyts theae* (Cotes) (Kashyap, 1971; Kashyap and Sahni, 1976; Kashyap and Sharma, 1997). For the control of insect and mite pests, orchardists spray malathion, dicofol, ethion and endosulfan. Besides this they are also using other pesticides in multiple dosages and at higher concentrations than the recommended, without knowing their residual problems, health hazards, enviromental polluation and mortality caused to naturally occurring predators and parasitiods. Keeping in view the above observations, the present studies were conducted to identify the natural enemies associated with tea pests, to determine their predation/ parasitization potentials, to study the effect of pesticidal sprays on the natural enemies, and to evaluate certain safe plant derivative/ biopesticides against predator and parasitoids present in tea ecosystem.

MATERIALS AND METHODS

The experiments were conducted in the University tea Orchard at Palampur, private tea orchards of farmers in district Kangra and Mandi of Himachal Pradesh and in the Toxicology Laboratory, Department of Entomology during 1994-97. To know the natural enemies associated with tea insect pests, observations were recorded at fortnightly interval on tea plants grown in tea orchards in Himachal Pradesh. Ten tea bushes/locality or plot were observed at random for the presence of insects /mites and their natural enemies. The immature stages were also collected and reared in captivity to get the adult stage. Minute stages were examined on both the surface of leaves using a hand lens (10 X). For higher magnification, a dissecting binocular microscope was used.

Predatory potential of predators was studied under laboratory conditions. For this, 30 predators (*Syrphis* sp. and *Coccinella septempunctata Linn.*) were released individually on one hundred aphids in Petri-dishes (2.5cm diam) and the observations were recorded on number of aphids consumed per individual per day. To know the predatory potential of *Oxyopes* sp., ten adult spiders were released individually in plastic jars (5cm diam X 10cm height) containing 10 leaf roller larvae per jar covered with muslin cloth and observation on number of larvae consumed per day was taken. To know the extent of parasitization, three samples of aphids (200 aphids each) were collected from different areas and they were reared under laboratory conditions. Numbers of mummified aphids were counted up to 10 days of collection and percent parasitization was recorded.

In all, two plant derivatives, one biopesticide and six insecticides/miticides namely Achook, Neemark, *B.t.* (Dipel 8L), cypermethrin, deltamethrin, endosulfan, ethion, kelthane and malathion were sprayed at recommended (CSK HPKV Palampur) concentrations on tea crop (Tables 3 & 4) during 4th week of May followed by second spay at an interval of 15days to evaluate the effect of pesticidal sprays on natural enemies. The experiment was laid in Randomised Block Design and each treatment was replicated thrice. Plot size was 20m^2. Leaf samples were collected at random from experiment plots. A sample of 10 shoots (two leaves and bud) plot were examined for population count of larvae and adult of *C. septempunctata* and *Syrphis* sp. The adults were counted by making 3 sweeps with insect collection net in each plot. Sampling was done at pre spray, 1, 7 and 14 days of spray.

Table 1. Pest attacking tea bushes in Himachal Pradesh

Common name	Scientific name	Status
Purple mite	*Calacarus carinatus* (Green)	Major
Leaf roller	*Gracilaria theivora* Walsom	Major
Thrip	*Scirtothrips dorsalis* Hood	Major
Aphid	*Toxoptera aurantii* (Boyer)	Major
Mealybug	*Nipaecoccus* sp.	Major
Red spider mite	*Oligonychus coffeae* (Nietner)	Major
Leaf miner	*Tropicomyia theae* (Cotes)	Major/Minor
Grasshopper	*Hieroglypnia banian* (Fabr.)	Minor
Painted bug	*Bagrada cruciferarum* (Kirka.)	Minor
Jassid	*Empoasca flavescens* (Fabr.)	Minor
Flea beetle	*Mimells* sp.	Minor
Scale insect	*Coccus viridis* (Green)	Minor
Tea mosquito	*Helopeltis theivora* Waterhouse	Minor
Termite	*Microcerotermes* sp.	Minor

Table 2. Important natural enemies of tea pests and their potential

Sl. No.	Natural enemies	Host pest	Predatory/ parasitization potential
1.	*Coccinella septempunctata* Linn.	Aphids	5-12* aphids /day
2.	*Syrphis* sp.	Aphids	12-15 aphids /day
3	*Oxyopes* sp.	Leaf roller	1-3 larvae/ day
4.	*Diaeretilla* sp.	Aphids	5-15 % parasitization**

* Predatory potential of grubs

** Aphids collected from different tea orchards

RESULTS AND DISCUSSION

Fourteen species of insects and mites were found associated mostly on tea foliage (Table 1) during the period of study. Among them purple mite, *C. craniatus*, thrips, *S. dorsalis*, leafroller *G. thievora*, Mealybug, *Nipaecoccus* sp. and aphid, *T. aurantii* are key pests of tea in Himachal Pradesh.

Four predators/parasitoids of tea pests were recorded in different orchards of Himachal Pradesh. The important aphid predators and parasitoids were *Syrphis* sp., *Coccinella septempunctata* Linn. and *Diaeretiella* sp. and one leaf roller spider

Table 3. Effect of pesticidal sprays on *Syrphis* sp. under field conditions

Pesticide(Conc.)/ Formulation	Mean number of larvae*/adults**- days after spray							
	Pre spray		1 day		7 day		14 day	
	larvae	adult	larvae	adult	larvae	adult	larvae	adult
Achook (0.3%)	2.3[a] (1.82)	0.7(1.28)	1.7(1.63)	0.3(1.13)	2.7 (1.9)	1.0(1.4)	3.0(2.0)	2.0(1.7)
Cypermethrin (0.01%)	3.0 (2.00)	1.0(1.24)	0.0(1.00)	0.0(1.0 0)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)
Deltamethrin (0.005%)	3.0 (2.98)	0.7(2.63)	0.0(1.00)	0.0(1.0 0)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)
Endosulfan (0.07%)	2.3 (2.06)	0.3 (1.14)	0.7(0.28)	0.3(1.13)	0.7(1.3)	0.7(1.3)	1.3(1.5)	1.0(1.4)
Ethion (0.1%)	2.7 (0.98)	0.7(1.28)	0.0(1.00)	0.0(1.00)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)
Bt (0.3%) (Dipel 8 L)	3.0 (1.98)	1.0(1.38)	2.7(1.91)	1.3(1.52)	3.3(2.1)	1.3(1.5)	3.7(2.2)	3.0(2.0)
Kelthane (0.05%)	2.0 (1.13)	1.0(1.41)	1.0(1.41)	0.0(1.00)	2.0(1.7)	0.3(1.3)	2.33(1.8)	0.3(1.3)
Malathion (0.1%)	3.3(2.08)	1.0(1.38)	0.0(1.00)	0.0(1.00)	0.0(1.0)	0.0(1.0)	1.0(1.4)	0.3(1.1)
Neemark (0.3%)	2.7(1.91)	0.7(1.28)	1.7(1.72)	0.7(1.28)	0.7(1.3)	3.0(2.0)	3.3(2.1)	2.7(1.9)
Control	3.0(2.0)	0.7(1.28)	3.3(2.08)	1.3(1.52)	3.7(2.2)	1.0(1.4)	4.0(2.23)	3.0(2.0)
CD (P=0.05)	NS	NS	(0.07)	(0.03)	(0.13)	(0.17)	(0.21)	(0.27)

Figures in parentheses are $\sqrt{n+1}$ values

* larvae / 10 twigs (Two leaves and bud) ** adults observed

Table 4. Effect of pesticidal sprays on *C. septempunctata* in tea orchards

Pesticide(Conc.)	Mean number of larvae*/adults** - days after spray							
	Pre spray		1 day		7 day		14 day	
	larvae	adult	larvae	adult	larvae	adult	larvae	adult
Achook(0.3%)	0.3a(1.3)	1.0(1.4	0.3(1.1)	0.7(1.3)	2.3(1.8)	3.3(2.1)	3.0(2.0)	3.3(1.1)
Cypermethrin (0.01%)	0.7(1.2)	0.7(1.3)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.3(1.1)
Deltamethrin (0.005%)	1.0(1.4)	0.3(1.3)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.3(1.1)
Endosulfan (0.07%)	0.3(1.1)	0.7(1.3)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)
Ethion (0.1%)	0.7(1.3)	0.7(1.3)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)	0.0(1.0)
Bt (0.3%)	0.9(1.3)	0.7(1.3)	1.0(1.4)	0.7(1.3)	3.0(3.0)	2.7(2.0)	3.7(2.2)	3.0(2.0)
Kelthane (0.05%)	1.0(1.4)	1.0(1.4)	0.33(1.1)	0.0(1.0)	0.7(1.3)	1.0(1.4)	2.0(1.1)	2.3(1.8)
Malathion (0.1%)	0.7(1.3)	0.7(1.3)	0.0(1.0)	0.0(1.0)	0.3(1.1)	0.3(1.1)	1.0(1.4)	1.3(1.5)
Neemark (0.3%)	0. 7(1.3)	0.3(1.1)	0.7(1.3)	0.0(1.0)	2.7(2.0)	3.3(2.1)	3.3(2.1)	3.3(3.0)
Control	1.0(1.4)	0.7(1.3	1.3(1.5)	0.7(1.3)	3.3(2.0)	3.0(2.5)	3.7(2.2)	3.3(2.1)
CD(P=0.05)	NS	NS	(0.05)	(0.04)	(0.10)	(0.08)	(0.05)	(0.08)

Figures in parentheses are $\sqrt{n+1}$ values; *grubs / 10 twigs**, adults /10 bushes

predator, *Oxyopes* sp. The predatory / parasitazation potential of natural enemies studied under laboratory condition (Table 2) revealed that these natural enemies can play an important role in reducing the population of tea pests.

The data on toxicity of pesticides to predators namely *Syrphis* sp. and *C. septempunctata* are presented (Table 3 & 4). Adult and larval population of *Syrphis* sp. was reduced significantly (100 per cent) in insecticidal treatments namely deltamethrin, cypermethrin, ethion and malathion following 1 day of spray. The effect of these insecticidal sprays was significant upto 14 days. The *Syrphis* sp. population was least affected by treatments with *B. thuringienses* and plant derivatives Achook and Neemark. Endoslfan was comparatively safer to *Syrphis* sp.

The *C. septempunctata* population was significantly reduced in tea orchards sprayed with endosulfan, deltamethrin, cypermethrin, ethion and malathion as compared to control (Table 4), whereas in treatments of *B. t.*, Achook and Neemark the population of adult and grubs of *Coccinella* was statistically on par with untreated check.

Therefore, it can be concluded that natural enemies of tea pests can play an important role in maintenance of ecological balance and protecting environment from pesticidal hazards and to maintain their population in tea orchards. Plant derivatives *viz.* Achook, Neemark and biopesticides, *B.t.* should be preferred over insecticides to save the natural enemies.

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