Status Report

HOW EFFECTIVE ARE PREDATORS OF TEA PESTS? - A PERSPECTIVE

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ABSTRACT

Natural enemies of tea pests have co-evolved with their preys. Most have a fairly low level of satiation and, therefore, may not control the pests in the conventional sense. They do, however, regulate the pest population to prevent large scale outbreaks. In the absence of natural enemies the pests may become endemic.

***Keywords**: India; predators; pest regulation; pest management; feeding satiation*

INTRODUCTION

Tea attracts a large number of insects and mites of different taxa, though they all may not damage the crop (Banerjee 1996). Some cause serious economic damage to tea by attacking the harvest or different parts of the plant. Depending upon the form and relative magnitude of their population levels, tea pests create a series of communities that range from being random assemblages of species to highly deterministic systems in which predators and parasites play crucial regulatory roles (Banerjee 1986,1996).

Predators and parasites of insect and mite pests of tea have been reported (Sengupta 1967; Das 1979, Sarma 1979; Muraleedharan *et al* 2001) but rarely their functional efficacies have been evaluated from the perspective of practical pest management. Though the objective of this study is not a crucial assessment of predatory systems in tea pest complex, a SWOT analysis is presented for a critical appreciation of the predator-prey relationship between a few species of tea pests and their specific predators.

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APPROACH

This paper is based on differential experiments conducted within a uniform spatial limit but at different points of time. The empirical data generated by Banerjee (1988), Sarma (1979) as well as those provided in the Annual Reports of Tocklai Experimental Station TRA (1967) form the basis of the thematic aspect of this paper. The principal attributes covered are:

1. Feeding rate and satiation levels of predators
2. Time sequenced population growth of tea pests and their predators
3. Post pesticidal application growth of pests and their predators

Observations made here are generalized to an extent as quantitative data on predation of all pest species by their predators at individual rather than species levels are not always available. As illustration, I have concentrated on one mite and one defoliator pest as was done in developing models on predator-prey interactions (Banerjee 1986).

A SWOT ANALYSIS

Strength

Multiple assemblage of predator species in tea ecosystem places pest management in tea in an advantageous position because some predators in varying densities are always available in the tea fields. Their presence, however, does not ensure effective predation from the perspective of the functional feeding relationship between the pests and their predators (Banerjee 1986).

In general, feeding capacities of individual predators, including those of the common predators like *Stethorus gilvifrons*, are low at individual level and the satiation level is reached rather quickly (Table 1). Interestingly though both insect and mite predators cannibalize the red spiders *Oligonychus coffeae* in their characteristic manners, they satiate rather quickly leaving a large segment of mites to damage the crop.

Table 1. Feeding rates of a single *Stethorus gilvifrons* and white mite *Tyrophagues putrescentae* under simulated conditions; figures in columns indicate numbers cannibalized out of 150 mites offered (Average of 10 experiments)

Hrs	Stethorus	Tyrophagus
1	4	3
2	6	5
3	8	7
4	9	8
5	11	9
6	25	11
7	28	13
8	32	13
9	35	13
10	35	13
11	35	13
12	35	13

P<0.05: ANOVA

Weakness

The satiated predators generally avoid further predation of red spider mite despite an abundance of food until the food ingested earlier is completely metabolized (Banerjee 2000). In such a scenario crop losses by pests would continue despite the presence of a surfeit of predators. Moreover, a majority of the predators is not specific to any particular species of tea pests and would feed indiscriminately sometimes even on non-pests leaving the major pests (Banerjee 1996).

Opportunity

The problem mentioned above could have been solved to an extent, were the natural enemies to remain at their function level, i.e. their population would be so structured as to predate a major part of the pest population on a continuous scale. But in reality the predators mostly remain at significantly lower levels (Table 2) than the tea pests (Banerjee 1986).

Table 2. Typical predator and prey populations in tea fields.

Bushes x 10	No of predators	No of preys
1	10	175
2	35	235
3	24	143
4	43	164
5	11	193
6	42	235
7	21	211
8	25	273
9	30	183
10	18	211
11	22	183
12	19	175

P<0.05: Friedman two-way analysis of variance.

Predator: Stethorus gilviforns

Prey: Red Spider (Oligonychus coffea)

Even with the parasites the degree of infection is not always high enough (Table 3) to affect a significant section of the pest population at any point of time (Banerjee 1982). Opportunities exist for augmenting predator population at a level where it would predate continuously by being in synchronization with the pest population.

Table 3. Relationship among bush population, bunch caterpillar density and their parasites

No of bushes sampled	Number of caterpillers	Number of parasites
10	300	35
50	411	43
100	570	48
150	631	51
200	721	82
250	831	54
300	840	39
350	846	45
400	868	48
450	850	37
500	848	39

P<0.05: ANOVA

Threat

This concerns mainly the effect of pesticides on predator prey matrix. The differential response to pesticides is worth noting (Table 4). The pest population declines linearly, but predator sharply, almost instantaneously in some cases. Moreover, unlike the pest population, predators fail to reach the original level quickly. Predators often took nearly 10 weeks to resurge though pest numbers generally peaked much earlier.

Table 4. Pest and predator levels following insecticidal applications.

Days after treatment	Pest (red spider mite)	Prey (Stethorus)
0	40	23
1	37	11
3	32	8
5	45	7
7	93	3
9	165	4
11	280	5
13	475	7
15	586	3
17	679	4

P<0.05: Friedman two way analysis of variance

The effect is total lack of synchronization between the pest and predator populations. And being free from regulatory effects of the predators, the pests may even reach the endemic levels. The importance of natural enemies is exactly here in that they help in preventing large scale outbreaks of pests.

DISCUSSION

Natural enemies are integral biological components in any ecological matrix and every species of pest has at least one species of associated predator or parasite. This relationship has stabilised in course of evolution and in most cases predators and their preys together provide classical examples of co-evolution. This relationship is neither symbiotic where both are benefited, nor it is synergistic. The association is a part of the ecological food chain by which the predators tend to keep their prey populations within a biologically sustainable limit (Banerjee 1986, 2000)

This biological limit, however, is not the same as the economic threshold level of pests causing maximum damage to crop. While the main objective of pest management is to bring the pest population below this damage inflicting level, current research suggests natural enemies cannot by themselves fully effect this unless they are made fully functional (Banerjee 2000). Restrictive distribution of predators, their limited searching abilities for prey and relatively low level of satiation put a premium on their effectiveness in suppressing the pest population well below the damage threshold. This attribute in natural enemies has evolved in course of selection, so much so that like parasites the natural enemies of pests will neither eliminate nor bring down pest populations at a level that would affect their own survival to avoid their extinction.

A theory doing round is that prior to pesticide era the natural enemies were more abundant than what they are today: hence their low activity and number relative to pests population. But the fact is that during the pre-pesticide era, despite suspected abundance of predators in tea fields, tea crop losses were much more than what they are today (Banerjee and Cranham 1984). This in no way negates the crucial role of natural enemies in preventing pest outbreaks, particularly of looper and bunch caterpillars, but total reliance in their effectiveness as means for preventing immediate crop losses may be misplaced. Preservation of natural enemies on this score is essential but serious damage to crop cannot be totally prevented by them, specially where pest generations overlap and population quickly builds up as in tea.

However, advantage can be taken of the level of abundance of different species of predators and their seasonality in adjusting pesticide application at lower levels, and more importantly in reducing the number of pesticide applications. The proportion of reduction would have to be worked taking into cognizance the abundance or rareness of predatory species and their predatory capacity. It is, therefore, more a question of skillful utilization rather than general preservation of the predators that always function in synchronization with the biological cycle of the insect and mite pests of tea (Banerjee 1979). In doing so it must be noted that predator populations are generally rare relative to the abundance of number of pest species. Hence major biological forces, like natural predation of pest populations, work vertically through the food chain on species to species basis and not horizontally with multiple pest species at the same trophic level.

REFERENCES

Annual Scientific Report, Tocklai Experimental Station Entomology Department (1967), pp 68-76.

Banerjee, B. (1979). Considerations in integrated control for mite pests of tea. Proc. 27th Tocklai Conf. Pp 10-115.

Banerjee, B. (1982). A strategy for the control of Andraca bipunctata Walker on tea (Bombycid: Lepid). Crop Protection 1: 115-119.

Banerjee, B. (1986). Mathematical Models And Theories On Oscillations in Populations. The Early Phase Publication.

Banerjee, B. (1988). An Introduction to Agricultural Acarology. Associated Publishers.

Banerjee, B. (1996). Insects on tea : who eats what, why and to what extent. Two and A Bud 52: 6-10.

Banerjee B. (2000). Insect – Plant Interface . ATPA Publishing Co.

Banerjee, B. and Cranhan, J.E. (1985). Tea. *In* "Spider Mites: Their Biology, Natural Enemies And Control", Vol. 2B (eds: W.Helle and M.W.Sabellis), Elsevier, Amsterdam, pp 371-394.

Das, S.C. (1979). Parasites and predators of tea pests. Two and A Bud 26: 72-73.

Muraleedharan, N.; Selvasundaram, R. and Radhakrishnan, B. (2001). Parasitoids and predators of tea pests in India. Journal of Plantation Crops 29: 1-10.

Sarma, P.V. (1979). Possibilities of integrated control of major pests of tea in India. PANS 25: 237-245.

Sengupta, N.S. (1967). Natural enemies of flushworm *Laspeyresia leucostoma* (Megr). Two and A Bud 14: 170-172.