

SYSTEM ANALYSIS APPROACH IN TEA PEST MANAGEMENT IN BANGLADESH

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Tea being a monoculture crop and cultivated contiguously over large areas, provides unlimited opportunities for multiplication and spread of a wide divergence of pest composition throughout the growing period. Since it is estimated that about 15% crop loss is accounted by way of multiple pest complex, its control by adopting various cultural and chemical methods are unavoidable. Recently in developed countries work is being carried out in the field of system analysis approach and their proper implementation against pest problems. A similar study was undertaken in tea in Bangladesh taking into account the key components of the system which influence the outbreak of the pests as well as to evaluate the impact of decision analysis in production of tea.

INTRODUCTION

Tea is one of the most important agro-based and export oriented industries in Bangladesh and produces about 52 million kg. After meeting domestic consumption substantial foreign exchange is earned by exporting 60% of the production. However one disconcerting factor is that the crop yield is hindered to the tune of approximately 15% due to infestation of a wide array of pests.

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Because of the availability of host plants around the year a succession of pests is distinctly observed when favourable microclimatic conditions prevail. Since production cost is increasing daily as a result of the costs of various inputs including pesticides and sprayers, labour wages, etc., it is important that these are used effectively, economically and judiciously.

The garden managements are mainly dependent upon application of various pesticides to fight the pests. But its success depends on several pre-determining factors such as architecture of tea plantations, variability of plant types and systematic interaction of various agro-techniques (e.g., sequential pruning, cycle permanance or semi-permanance of shade trees, ancillary crops, etc.). Topography imposes a significant impact on colonization and distribution of pests. Pest populations are a dynamic phenomenon subjected to change in time and space under the influence of various factors (e.g., temperature, humidity, rainfall, weeding, mulching, irrigation, fertilization, drainage, etc). Few of them are conducive to rapid multiplication of the pest and on the contrary some reduce the problem to a great extent.

The aforesaid factors were evaluated for tea pests by the more modern approach of system analysis. The dissemination of this knowledge of system analysis amongst the planting community will undoubtedly be helpful in managing pest problems effectively and efficiently (Holt, 1986).

The work was carried out at Silwood Park under the Imperial College of Science, Technology and Medicine, U.K.

Today there is greater awareness of health hazards due to toxic residues in the finished product (made tea). This problem can be minimised to a great extent if the pre-requisite factors of the decision analysis is followed rigidly.

It has been observed that succession of tea pests are mostly aggravated by the use of chemicals through:

- a. Non judicious application
- b. Faulty application
- c. Below normal or over dose
- d. Identification problem of the pest
- e. Rapid growth potential of the pest
- f. Pest resurgence from residual population of pest complex
- g. Deforestation
- h. Irrigation and fertilizer application
- i. Improper shade, etc.

Detailed analysis of tea pests

Seasonal profile of the crop

The seasonal profile of the crop indicates how some major factors and some practices are associated with the tea crop (Fig. 1). Tea flush and its growth depend on the rainfall (Zaman, 1980). Under Bangladesh conditions, plucking, weeding, mulching and pruning seasons are directly related to the climatological variations. Biotic potential and rapid multiplication of *Helopeltis*, Red spider mite, Aphid, etc., are directly related to these factors and practices.

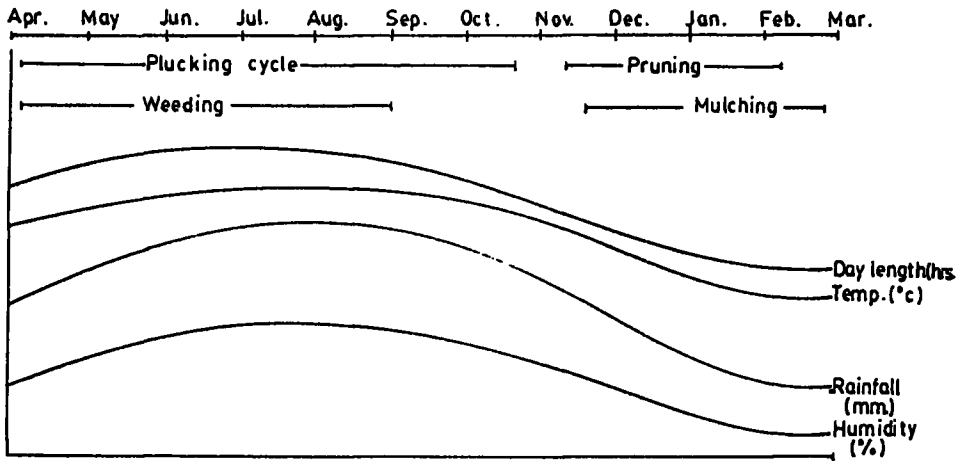


Fig. 1— Seasonal profile of the tea crop.

Tea pest interaction matrix

An interaction matrix is a part of the system analysis approaches of tea pest management (Fig. 2). This is an useful tool to help indicate those components which affect pest complex. The matrix is constructed as follows:

- The system components are listed
- The components are sorted into different categories e.g., tea crop, micro-environment, management.
- Interactions between components are identified.

		Micro-environment								Management					Tea crop			Pests							
		Temperature	Humidity	Light (sol. radiation)	Wind	Season/photoperiod	Soil moisture	Soil nutrients	Pruning cycle type	Pruning cycle stage	Shade	Mulching	Fertilizer	Irrigation	Insecticide	Fungicide	Vigour/growth rate	Yield	Quality	Age	Helopeltis	Red spider mite	Termite	Disease (Foliar)	
Micro-environment	Temperature		●	●	●		●			●															
	Humidity	●		●	●		●			●			●												
	Light(sol.rad.)									●															
	Wind									●															
	Soil moisture	●	●							●5	●		●			●								●	
	Soil Nutrients									●5	●	●				●								●	
Tea crops	Vigour/gr. rate	●		●		●	●	●	●							●					●	●	●	●	
	Yield															●					●	●	●	●	
	Quality	●		●	●	●	●	●	●							●					●	●	●	●	
	Age																								
Pests	Helopeltis	●	●	●2	●1			●3	●					●		●					●				
	Red spider mite	●	●					●3	●					●		●					●				
	Termite	●	●				●	●	●4							●					●				
	Diseases (foliar)	●	●					●	●							●	●							●	

1 – Immigration, 2 – feeding position, 3 – less in 3 yrs., cycle, 4 – by bush sanitation, 5 – via competition

Fig. 2 – Tea pest interaction matrix

Major interactions (●) are those causing direct changes on the factors affecting and for which there is reasonable experimental evidence to validate the significance of the interaction. Effects are uni-directional with column components affecting row components (Ahmed, 1991).

Alternate hosts of tea pests in Bangladesh

Tea pests have a number of alternate hosts (Fig. 3). Though the pests of tea are seemingly divergent, their global distribution and succession follow a definite habitat preference. Some pests are cosmopolitan and widely distributed over a wide range of ecological diversity while others are restricted to ecological zonation (Sana, 1983). For their management (cultural, mechanical, etc.), there is a need to identify and focus upon those hosts which are important and to reduce the population in them to some extent. This identification ultimately will have an effect on pest invasion.

Fig. 3 – Alternate hosts of tea pests in Bangladesh

Common name	Alternate hosts																	
	Coffee	Cocoa	Cotton	Jute	Rubber	Mango	Guava	Beans	Mikania creeper	Weeds	Acacia	Albizia	Tephrosia	Derris	Indigo	Bamboo	Forest plant	Bogamedeloa
<i>Helopeltis</i>		*	*			*	*		*									
Termite	*				*	*	*			*	*	*	*	*	*	*	*	*
Flushworm ¹																		
Tea aphid	*		*			*	*	*										
Tea jassid ²																		
Looper caterpillar				*				*										
Tea thrips ¹																		
Bag/Faggot worm	*									*	*	*	*	*			*	
Red borer	*	*								*	*							
Field cricket					*					*	*							
Tea seed bug ¹																		
Leaf roller ¹																		
Scale insect ¹																		
Red spider mite	*	*	*	*				*										
Scarlet mite	*									*	*							
Pink/Purple mite																		

1 Unknown

2 Diff. cultivated crops

* Reported alternate hosts

Damage matrix for some tea pests in Bangladesh

Different pests are located in different parts of the tea bush. Many pests are hidden under the leaves or stems or within the dense canopy.

Damage matrices (Fig. 4) focus the locations and the status of the pests. This will help identify the pests, habitat and their status for decision making as well as ensuring that the spray liquid is correctly placed on the plant or in close contact with the specific pests.

Common name of pests	Plant part damaged					
	Shoots/ buds	Young leaves	Mature leaves	Stems	Roots	Flower/ seeds
<i>Helopeltis</i> (Tea mosquito bugs)	***	***				
Termites				***	***	
Flush worm	**	**				
Tea aphid	*	**2				
Tea jassid	**	**2				
Looper caterpillar	*	*	*			
Tea thrips	*					
Bag worm/Faggot worm	*		*			
Red borer				*		
Tea seed bug						*
Leaf roller		*				
Field cricket				*	*	
Red spider mite			***1			
Scarlet mite			**2			
Pink mite		*3	*3			
Purple mite		*3	*3			

Fig. 4 – Damage for some tea pests in Bangladesh

- * Damage caused but no economic loss
- ** Moderate economic damage
- *** Major economic damage
- 1 Upper surface of the leaves
- 2 Lower surface of the leaves
- 3 Both surfaces of the leaves

Effects of cultural practices on tea plants

Cultural practices have some effect on pest incidence and these should be considered for the decision analysis techniques. The available practices can be described as being used to greater (+) or lesser (-) extent. From the planter's point of view the effect of these practices could be regarded as most beneficial (+++), moderately beneficial (++), slightly beneficial (+), most detrimental (- - -), moderately detrimental (- -) and slightly detrimental (-). These effects may be either direct or indirect (Fig. 5).

Available cultural practices	Effects on pests										
	<i>Helopeltis</i>	Termites	Flush worm	Aphid/Jassid/ Thrips	Looper caterpillar	Bag worm/ Faggot worm	Tea seed bug	Cricket	Red spider mite	Scarlet mite	Pink mite/ Purple mite
Soil rehabilitation	+ -	+++ +						+++ +			
Bush sanitation	+ -	++ +	+++ -		++ -		++ +		+++ +	++ +	++ +
Pruning											
3yrs. cycle	+	+++	+++	+++	++	++			+++	++	++
4 yrs cycle	-	++	++	+	+	+			++	+	+
Plucking											
Freq. pluck 7-9 days	+	+++		+++							++
Infreq. pluck above 10 days	-	+		+							+
Mulching	+		+			+		+	+	+	+
Weeding	+ -	+ -	+ -		+				+	+	+
Shade reduction	+ -	++ -	+ ---						+	+	+
Green crop management	+ -				++ ---					++ -	
Nursery management	+ -	+++ -		+++ -	+ -			+++ -	+++ -	++ -	++ -

Fig. 5 – Effects of cultural practices on tea plants

- | | | |
|-------------------|---------------------------------|-----------------------------------|
| + More practice | +++ Most beneficial effect | - - - Most detrimental effect |
| - Less practice | ++ Moderately beneficial effect | - - Moderately detrimental effect |
| * Indirect effect | + Slightly beneficial effect | - Slightly detrimental effect |

CONCLUSION

To reduce the cost of production of agricultural crops, the decision analysis approach is considered as one of the suitable components which help in increasing bio-control agents as well as minimise toxic residues of pesticides. An attempt has thus been made to apply a decision analysis method for tea in Bangladesh. The co-related factors associated with the pest complex were critically reviewed and utilized in developing one such model. A number of analysis techniques were used to examine control strategies and to reorient the approach to future pest control methods in Bangladesh.

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