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Influence of abiotic factors on the population dynamics of Cashew pests in Konkan region of Maharashtra

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Abstract
The abiotic parameters are known to have direct influence on insect population dynamics through modulation of developmental rates, survival, fecundity and dispersal. Among the climatic factors; temperature, humidity and rainfall pattern are an important factors. The studies conducted at Regional Fruit Research station Vengurla, showed that the minimum temperature and evening relative humidity play an important role in multiplication of cashew tea mosquito bug, flower thrips and apple and nut borer. For tea mosquito bug and flower thrips, the minimum temperature ranging between 16±1^{0}C to 21±1^{0}C and afternoon humidity 53±1% to 63±1% found favorable. Incidence of pest of cashew also coincides with availability of succulent plant parts on tree. The pest population was negligible, when there was no availability of succulent plant parts.

Keywords: Cashew pest, tea mosquito bug, thrips and weather parameters

1. Introduction
Cashew is one of the most important commercial crops in India. The production and productivity of cashew is influenced by many factors; among them insect pests is one of the major constraints. As area and productivity of cashew increased, the problem of pests is also increased. In spite of adoption of package of practices, decline in production is mainly due to pest. Cashew is attacked by a number of insect pests during different stages of its growth and development. Around 180 species of insect and non-insect pests was in India resulting in substantial yield losses [1]. Out of these, the tea mosquito bug (*Helopeltis antonii*), stem and root borer (*Plocaederus ferrugineus*), inflorescence thrips (*Scirtothrips dorsalis*), apple and nut borer (*Nephopteryx* sp.) etc. are considered to be major pests of cashew in West coast of Maharashtra [2].

The tea mosquito bug (*Helopeltis antonii*) is the most divesting pest of cashew causes yield losses by damaging tender shoot, inflorescences and immature nuts at various stages of development [3]. The adults and immature stages of this pest suck the sap from tender shoots, leaves, floral branches, developing nuts and apples; the injury made by the suctorial mouth parts of the insect causes the tender shoots to exude the resinous gummy substances. The tissue round the point of entry of stylets become necrotized and brown or black scabs formed presumably due to the action of the phytotoxin present in saliva of the insect injected to the plant tissue at the time of feeding.

Other two species *viz., H. theivora* and *H. bradyi* also infest cashew trees. Incidence of tea mosquito bug was observed from the emergence of new flush and continued up to the nut development and maturation. It is [4] estimated the average damage of tea mosquito bug to tender shoots up to 25 per cent to inflorescences up to 30 per cent and on tender nuts up to 15 per cent. In case of severe, infestation it causes up to 40 per cent losses [3].

Similarly, cashew apple and nut borer (*Nephopteryx sp.*) is one of the important pests of cashew. It causes 10 per cent yield loss during years of severe infestation in certain cashew growing areas. The apple and nut borer responsible for heavy losses[5].

Among the sucking pests, flowering thrips (*Scirtothrips dorsalis*) pose a major problem. Adults and nymphs are seen in colonies on the lower surface of leaves and suck the sap from leaves, inflorescence and tender apples and nuts. As a result of their rasping and sucking activity the leaves become pale brown, scab on floral branches, apples and nuts forms corky layers on the affected parts.

In severe cases there will be shedding of leaves and stunting of growth of trees [6]. Due to sustained feeding by large number of thrips, the terminal leaves begin to curl downward from margin toward midrib. In due course the young leaves fall from the plant.

Adequate research efforts have been undertaken for management pest. In this process chemical pesticides emerged as the most reliable, cheap and popular solution. But management of pests by chemically have many disadvantages therefore, it is necessary to find out some alternatives to chemical management. The abiotic parameters are known to have direct impact on insect population dynamics through modulation of development of rates, survival, fecundity and dispersible. The climate change would result in change in population dynamic of insect. The investigation was carried out to study the population dynamic of insect pests of cashew and their correlation with weather parameters.

2. Materials and methods

2.1.Experimental area and layout:

A trial was conducted during 2014-15 and 2015-16 at Regional Fruit Research Station, Vengurla with an object to find out seasonal distribution of cashew pests in west coast of Maharashtra and their correlation with abiotic factors. The observations on incidence of pests of cashew were recorded throughout the year at weekly interval. For recording of observation, cashew plants were selected randomly. The selected plants kept unsprayed to observed the intensity of incidences of pests of cashew and the obtained data converted into percentage.

2.2 Recording of observation:

For recording of per cent incidence of tea mosquito bug infestation, 52 leader shoots of cashew tree in four directions ((E,W,N,S) were randomly selected and tagged during first fortnight of October. The extent of damage to the shoot and panicle was scored in 0-4 scale on the basis of the number and nature of necrotic lesion [7].

	No lesion /streak
1	Up to 3 necrotic lesions/streaks
2	4-6 coalescing or non- coalescing lesion/streak
3	Above 6 coalescing or non- coalescing lesions
4	Lesions/streak confluent – complete drying of affected shoot/panicle

Similarly, for recording of per cent damage infestation (crockery growth or presence of scabs) of thrips, 100 nuts as well as apples per tree were selected randomly and scored as below [8].

	No damage
1	1-25 per cent nut or apple surface damaged (up to 1/4 of the damaged surface area)
2	26-50 per cent nut or apple surface damaged (up to 1/2 of the damaged surface area)
3	51-75 per cent nut or apple surface damaged (up to 3/4 of the damaged surface area)
4	76-100 per cent nut or apple surface damaged (up to 3/4 of the damaged surface area)

The recoded data converted in to percentage on the basis of formula given below,

$$\text{Per cent incidence} = \frac{\text{Sum of all numerical rating}}{\text{No. of shoots observed x maximum rating}} \times 100$$

For recording the incidence of apple and nut borer, all the selected 52 leader shoots were examined and the infested nuts were observed and percentage damage was worked out.

The data on weather parameters namely, maximum temperature minimum temperature, humidity and rain fall were collected from meteorological station of Regional Fruit Research Station Vengurla and used for to find out correlation of pests of cashew with weather parameters.

2.3 Correlation coefficent

The simple correlation coefficient between pest population and various abiotic parameters as per the correlation coefficient procedure[9].

Table 1: Weather parameter and seasonal incidence of pests of Cashew mean for two year 2014-15 and 2015-16.

Month	Temperature (^{0}C)		Rainfall (mm)	Humidity (%)		Sun shine (hrs)	Per cent incidence of TMB*	Per cent Incidence of Thrips	Per cent incidence of ANB*
	Max	Min		am	pm				
Aprl.	33.49	23.45	0.00	82.60	63.33	9.61	1.01	1.10	0.00
May.	34.17	25.23	53.90	77.90	65.00	8.27	0.00	0.00	0.00
Jun.	32.21	25.23	529.10	84.80	74.30	4.44	0.00	0.00	0.00
Jul.	30.55	24.32	770.20	87.09	80.03	2.59	0.00	0.00	0.00
Aug.	30.71	24.05	478.90	89.96	78.24	3.09	0.00	0.00	0.00
Sept.	31.10	24.04	223.45	89.61	75.73	4.10	0.00	0.00	000
Oct.	33.25	23.50	129.00	88.54	71.01	6.43	0.00	0.00	0.00
Nov.	34.05	21.08	28.00	92.21	64.23	6.27	1.11	1.83	0.00
Dec.	33.29	18.95	0.60	89.08	55.43	7.68	2.44	2.30	0.32
Jan	32.59	16.79	0.00	88.87	56.91	7.87	6.62	3.85	0.44
Feb	32.76	18.50	0.00	91.37	61.60	8.52	7.87	4.05	1.47
Mar.	32.98	21.30	20.40	87.75	62.95	7.91	7.47	5.15	1.10

* TMB: Tea mosquito bug, ANB: Apple and nut borer

Table 2: Correlation of pest of cashew with weather parameters

Month	TMB*	Thrips	ABN*
Temp (Max.)	0.193	0.300	0.176
Temp (Min.)	-0.802*	-0.808*	-0.616*
Rain fall	-0.517	-0.584*	-0.462
R. Humidity (morning)	0.328	0.347	0.256
R. Humidity (evening)	-0.642*	-0.707*	-0.519
Sun shine(hrs)	0.542	0.579	0.548

*TMB: Tea mosquito bug, ANB: Apple and nut borer

*Significant at 5% level of significance. r = 0.576 at 5% level of significance

3. Results and Discussion:

3.1 Tea mosquito bug

The population dynamics of cashew tea mosquito bug from the average of the two years (2014-15 and 2015-16) of experimental data (Table1) indicated that, the incidence of tea mosquito bugs was started in the month of November (1.11%) after the onset of monsoon and when there were emergence of vegetative flush. The peak period for incidence of tea mosquito bug was observed in February (7.87%) when the tree was in full bloom. Similar finding was also reported by Raviprasad [10] that the incidence of tea mosquito bug was started in the month of October and maximum in the month of January, when the tree was in full bloom. However, there was no incidence of tea mosquito bug from April to October due to absence of succulent plant part on tree. Pillai [11]., reported that during monsoon period June to September, when succulent plant parts are not available on grown up tree, the pest population completely absent, however, tea mosquito bug damage younger cashew tree through out the year as it produce flushes almost contineously. Siswanto [12] reported that during rainy season October to March with relative humidity 79 to 91.5 percent temperature of 26.3-28.1^{0}C,rainfall of 0.69 to 21.77 mm per day reduces number of shoots and inflorences and the population of *H. antonii* become very low. The minimum temperature (Table 1) ranging between 15±1^{0}C to 21±1^{0}C found favorable for multiplication of cashew tea mosquito bug. Rao [13] reported that, the minimum temperature favorable for TMB incidence ranged in between 13^{0}C to 18^{0}C.

The correlation between tea mosquito bug and weather parameters is also worked out (Table 2) and the study revealed that, the incidence of tea mosquito bug showed significant negative correlation with minimum temperature (r = -0.802) and evening humidity (r = -0.642). There was no significant correlation between maximum temperature, rainfall and morning humidity and tea mosquito bug. Godse [2] reported that there is no correlation between maximum temperature, relative humidity, rainfall and TMB incidence. However; the minimum temperature showed significant negative correlation with TMB incidence.

3.2 Apple and Nut Borer

The cashew apple and nut borer was considered to be a pest of minor significance in the past. Hence the earlier research workers have paid not much attentation. Also, during the investigation period, the incidence of apple and nut borer was very low. From the average of the two year presented in Table 1 indicates that incidence of apple and nut borer started in the month of December (0.32%) when there was fruit setting. The incidence of apple and nut borer was maximum in the month of February (1.47%). Anon [14], reported that maximum infestation of apple and nut borer was observed during March to May. The incidence of apple and nut borer showed significantly negative correlation with minimum temperature (r = -616).

3.3 Cashew flower trips

From the data it isTable.1 noticed that; the per cent incidence of flower thrips observed on vegetative flushes in the month of November (1.83%) and was maximum (5.15%) in the month of March. Navik [15], reported that the peak incidence of thrips on panicle stage noticed during first fort night of February- March. Godse [2] reported that the incidence of thrips was more severe on developing nuts. The minimum temperature ranging between 16±1 ^{0}C to 21±1 ^{0}C was favorable for multiplication of cashew flower thrips. Jalgaonkar [16], reported that thrips population were maximum in between minimum temperature range 18± 1 ^{0}C to 21± 1 ^{0}C. The correlation study (Table 2) between thrips population and weather parameters indicated that the incidence of thrips showed negative but significant correlation with minimum temperature (r = -0.808), evening humidity (r = -0.707) and rainfall (-0.584). Navik [15], reported that thrips population showed significantly negative correlation with minimum temperature and evening humidity.

The abiotic parameters are known to have direct impact on insect population dynamics. The population dynamics of insect pests change with the change of environmental factors. The change in surrounding temperature regimes certainly involve alterations in development rates, survival of insects and subsequently act upon size, density and genetic composition of populations as well as on the extent of host plant exploitations Bale [17]. Therefore, climate changes would result in changes in the population dynamics of insect pests. Thus, temperature, humidity, rainfall etc. plays important role in pests development.

4. Conclusion

From the above study, it is concluded that, the incidence of pests of cashew were started in the month of November when there was emergence of new vegetative flush on the tree and was maximum incidence in the month of January-February, when tree was in full bloom. The pests of cashew showed significantly negative correlation with minimum temperature.

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