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Seasonal incidence of red banded thrips *(Selenothrips rubrocinctus* Giard.) and correlation with meteorological parameters in Bhubaneswar conditions of Odisha

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Abstract
Studies on foliage thrips of Cashew with special reference to Red Banded Thrips (*Selonothrips rubrocinctus* Giard.) was conducted at the Cashew Research Station (CRS), All India Coordinated Research Project (AICRP) on Cashew, Orissa University of Agriculture and Technology (OUAT), Bhubaneswar during 2016-17 and 2017-18. Periodical observation on the Red Banded Thrips infestation were recorded from unsprayed cashew plants in the germplasm block of 15-16 years old and the thrips incidence was correlated with corresponding weather parameters during the period of sampling. During 2016-17 the incidence of thrips was observed from February to May with highest 25.4 thrips per leaf on 2nd fortnight of March. During 2017-18 the incidence continued for a longer period from November to May. The highest being observed on 2nd fortnight of March.

Keywords: red banded thrips, cashew, germplasm, correlation

Introduction
Cashew (*Anacardium occidentale* L.) belongs to native of South America (Brazil) and is now found in many tropical areas. The English name cashew is derived from the Portuguese name "caju". The cashew tree was first described by Thivet (1558). In the 16th century cashew was introduced to India (Goa) by the Portuguese and it spread all along the laterite hill slopes in the Western area from Mumbai to Cape Comorian and to the sandy soil on the Eastern coast as well as over inland areas in the Southern states. The major cashew producing states in India are Kerala, Karnataka, Tamil nadu, Andhra Pradesh, Odisha, Maharashtra, Goa and West Bengal and interior tracts of Chhattisgarh, Andaman and Nicobar Islands, Gujarat, Jharkhand and North Eastern regions. The crop is also reported to be attacked by a number of insect pests as well as microbial pathogens causing diseases. About 400 species of arthropods are known to infest cashew, while 70 species of insect pests have been reported to infest cashew in different stages of crop growth in India (Pillai et al. 1979). Among these several insect pests cashew stem and root borer is the most important pest of this region followed by the incidence of Tea Mosquito Bug. Besides this Shoot Tip Caterpillar, Leaf Miner, Leaf and Blossom Webber, Apple and Nut Borer and Thrips also cause yield reduction in unmanaged plantations. Since last two years (2015-16) foliage thrips *(Selenothrips rubrocinctus*) had been recorded from Bhubaneswar seriously affecting the growth and yield of the cashew plants. Some cashew varieties in the germplasm block were observed to be highly susceptible to the pest. The affected trees showed leaf sheddings and drying of the branches and panicles. Red Banded Thrips was first reported in Cacao (Cocoa) plant in the country West Indies by Broadway (1898). The pest was found in the leaf with high population of 70-80 nymphs and adults per leaf and in high infestation, all the leaves are affected. Both nymphs and adults scrap and suck the cell content. Under severe conditions the leaves turn silvery white and shed off. 3 Red Banded Thrips was also found attacking grape, mango, avocado, guava along with cashew and cocoa. However available literatures on seasonal incidence, biology and management of the pest in cashew are very scanty. Therefore it was decided to conduct a thorough investigation of this pest in cashew at Cashew Research Station, Bhubaneswar.

Materials and methods
"Studies on foliage thrips of cashew *(Anacardium occidentale L.*) With special reference to Red Banded Thrips (*Selenothrips rubrocinctus*) under Bhubaneswar conditions" were conducted during the cropping season 2016-17 and 2017-18 under field conditions at Cashew Research Station (CRS), Orissa University of Agriculture and Technology (OUAT), Ranasinghpur, Bhubaneswar (BBSR). Seasonal incidence of Red Banded Thrips was recorded from 20 numbers of unsprayed cashew plants. Two branches were tagged in each labelled tree and all the leaves in a leader shoot were counted and thrips population in the leaves were also counted and thrips population in the leaves were also recorded by minutely observing the infested leaves through a hand lens 10X. Observations were taken twice at fortnightly intervals i:e at 1st and 15 days of every month. Pest population so recorded were averaged out for interpretation of the data. The sampling of Red Banded Thrips (*Selenothrips rubrocinctus*) was done from the unsprayed germplasm block during the growth period 2016-17 and 2017-18. Observations of the thrips incidence were recorded from 20 germplasms twice in a month starting from 1st fortnight of July to end of June of the next year. 8 laterals (2 per each direction) were selected and the total leaves and the affected leaves were recorded and converted into percentage affected leaves. Observations were taken from the affected trees only. 2 trees per germplasm were selected for recording the pest incidence in the germplasm.

Result and Discussion

The meteorological data collected during 2016-17 revealed that the rainy season commenced from 1st fortnight of July and continued upto 1st fortnight of November. There was well distribution of rainfall during July –September and post monsoon rainfall was observed during October and 1st fortnight of November, 2016.

The total of 980.33mm rainfall was received during the period of observation. The highest rainfall was received during 1st fortnight August. However, occurrence of rain was also observed during 1st fortnight of March (45.40 mm) and 2nd fortnight of April (29.20 mm) and also in 1st fortnight of May (25.65 mm) and in 2nd fortnight of May (18.78 mm).The maximum temperature ranged between 27.11^{0}C and 42.43^{0}C with highest temperature of 42.43^{0}C occurred during 2nd fortnight of April. Similarly the minimum temperature ranged between 13.65 and 25.96 ^{0}C with lowest temperature of 13.65 ^{0}C observed during 2nd fortnight of December. The morning Relative Humidity (RH) varied from 78.13 to 95.6 % while evening RH varied from 35.18 to 85.2. The sunshine hour varied from 2.42 to 9.89 hrs. Highest sunshine hour was observed during 2nd fortnight of May while lowest was observed during 1st fortnight of August. On an average the sunshine hour remained more than 5.0 from October 2016 to May 2017. The meteorological data during the year 2017-18 revealed that there was well distribution of rainfall from 1st fortnight of June and continued upto 1st fortnight of November. Light showers of rainfall were also observed in March 1st fortnight and in 1st fortnight of May. The total of 1565.3 mm of rainfall was observed during the period of observation. The highest rainfall was received during 1st fortnight of August. The morning Relative Humidity (RH) varied from 77.45 to 96.1 percent and evening RH varied from 34.28 to 85.3percent. The sunshine hours, varied from 4.34 to 8.93. Highest sunshine hour was observed during the 2nd fortnight of May while the lowest was observed during first fortnight of July.

Selenothrips rubrocinctus incidence was initiated coinciding with new flushing and flowering in cashew during 2nd Fortnight of February and remained upto1st fortnight of May during the crop growth period of 2016-17. The population of thrips at the beginning was 16.4 per leaf (2nd fortnight of February) and there was gradual increase of population of foliage thrips, observed during the subsequent periods. The incidence was confined to older leaves on the underside of the leaf lamina. The thrips population varied between 6.23 (1st fortnight of May)-25.4 per leaf (2nd fortnight of March). The severity of incidence was manifested in some cashew accessions with total scorching of leaves and drying of shoots. The incidence of Red Banded thrips was initiated during the 1st fortnight of November and continued upto 2nd Fortnight of May. Initially the population was 23.45 per leaf (2nd fortnight of November) and then there was gradual increase in the population in the subsequent periods. The highest population of the foliage thrips was recorded during 2nd fortnight of March (77.56 per leaf). The thrips population varied between 5.32(2nd fortnight of January) to 77.56 per leaf (2nd fortnight of March). Though the population had initiated in the 1st fortnight of November but it decreased during the months of December and January and again the population was observed in February and continued till May. It was observed the population had attained peaks during March2018 and continued in April and then gradually decreased during May and a very minimal population was observed during the 2nd fortnight of May 2018. The correlation analysis of thrips incidence and the weather data indicated that the minimum temperature (r=-0.089), evening RH (r=-0.623), and the rainfall (r=-0.027) showed a significant negative correlation with the pest incidence in the year 2016-17. The maximum temperature (r=0.853), morning RH (r=0.637) and the sunshine hours (r=0.617) showed a positive correlation with the pest population in the same year. All the above weather parameters contributed 91.07% for the incidence of the Red Banded Thrips (R^2=91.07%) During the year 2017-18 the minimum temperature (r=-0.665), evening RH (r=-0.004), and the rainfall (r=-0.043) showed a significant negative correlation with the pest incidence while the maximum temperature (r=0.216), morning RH (r=0.184) and the sunshine hours (r=0.031) were positively correlated with the thrips incidence during the same year. All the above weather factors contributed 91.54% for the incidence of the Red Banded Thrips (R^2=91.54%). The present findings were also in conformity with the findings of Jalgaokar *et al*, (2006), Jalgaokar *et al.* (2015), Navik *et al.* (2015) with respect to seasonal incidence of the pest. The correlation study during 2016-17 and 2017-18 on thrips incidence revealed that the maximum temperature, RH (morn.), and the sunshine hours showed a positive correlation with the Red Banded thrips. The minimum temperature, RH (even.) and the rainfall showed a significant but negative correlation with the pest incidence. Jalgaokar *et al.* (2015) reported that thrips population was negligible below 18±1^{0}C to 21±1^{0}C and it declined afterwards. Regarding afternoon humidity. Thrips population was found to be negligible below 53±1^0%. Maximum population was observed in between 53±1% to 64±1%.

Table 1: Meteorological data during the period of study (July, 2016 to May, 2017)

Period	Temperature (^{0}C)		RH (%)		Rainfall (mm)		BSH (Hrs)
	Max.	Min.	Morn	Even	Total	Avg	
JULY-I	31.57	25.98	91.33	81.00	127.40	8.49	4.46
JULY-II	32.86	25.63	92.25	76.50	94.80	5.92	5.68
AUG-I	30.73	25.09	95.06	85.20	165.30	11.20	2.42
AUG-II	32.77	25.82	91.62	74.25	82.50	5.16	5.84
SEPT-I	30.94	25.18	93.40	80.20	115.00	7.67	2.50
SEPT-II	32.11	25.60	92.67	79.87	123.20	8.21	4.70
0CT-I	31.92	24.08	92.13	70.66	116.00	7.73	5.32
0CT-II	32.42	21.24	86.62	64.93	16.80	1.05	6.53
NOV-I	30.78	19.04	92.33	53.06	20.30	1.35	6.11
NOV-II	31.27	15.78	90.80	38.40	0.00	0.00	8.10
DEC-I	30.49	16.60	78.13	38.73	0.00	0.00	7.92

DEC-II	29.70	13.65	92.18	37.68	0.00	0.00	6.53
JAN-I	27.11	15.11	88.20	39.13	0.00	0.00	5.47
JAN-II	30.27	14.01	90.94	35.18	0.00	0.00	6.89
FEB-I	32.90	17.52	94.06	35.92	0.00	0.00	7.78
FEB-II	34.76	20.64	93.46	40.07	0.00	0.00	7.95
MAR-I	33.94	21.94	92.60	44.93	45.40	3.03	6.24
MAR-II	33.25	23.56	88.87	39.68	0.00	0.00	7.92
APRIL-I	34.18	25.96	87.40	45.00	0.00	0.00	6.58
APRIL-II	37.17	24.78	88.00	53.20	29.20	1.95	8.09
MAY-I	40.45	21.56	85.34	47.87	25.65	1.54	9.68
MAY-II	42.43	23.45	84.78	43.76	18.78	2.23	9.89

Table 2: Meteorological data during the period of study (June, 2017 to May, 2018)

Period	**Temperature (^{0}C)**	**RH (%)**	**Rainfall (mm)**	**BSH (Hrs)**	**Period**	**Temperature (^{0}C)**	**RH (%)**
	Max.	**Min.**	**Morn.**	**Even.**		**Max.**	**Min.**
JUNE-I	32.45	23.31	91.23	78.57	JUNE-I	32.45	23.31
JUNE-II	33.11	24.12	92.10	79.94	JUNE-II	33.11	24.12
JULY-I	33.51	24.78	92.25	80.00	JULY-I	33.51	24.78
JULY-II	35.57	25.85	92.45	75.21	JULY-II	35.57	25.85
AUG-I	32.83	24.12	96.1	85.3	AUG-I	32.83	24.12
AUG-II	34.65	25.05	92.24	73.15	AUG-II	34.65	25.05
SEPT-I	29.84	24.24	93.5	81.15	SEPT-I	29.84	24.24
SEPT-II	32.24	25.15	93.76	78.57	SEPT-II	32.24	25.15
OCT-I	32.94	23.95	92.24	71.21	OCT-I	32.94	23.95
OCT-II	33.52	21.35	85.54	63.35	OCT-II	33.52	21.35
NOV-I	31.54	18.42	93.23	52.15	NOV-I	31.54	18.42
NOV-II	32.34	15.65	91.12	37.5	NOV-II	32.34	15.65
DEC-I	29.45	16.42	77.45	38.42	DEC-I	29.45	16.42
DEC-II	28.50	12.45	91.18	37.15	DEC-II	28.50	12.45
JAN-I	26.24	15.25	85.50	38.45	JAN-I	26.24	15.25
JAN-II	30.45	13.23	91.21	39.24	JAN-II	30.45	13.23
FEB-I	32.50	18.25	95.51	34.28	FEB-I	32.50	18.25
FEB-II	35.64	21.53	93.35	35.85	FEB-II	35.64	21.53
MAR-I	34.85	21.49	87.78	44.15	MAR-I	34.85	21.49
MAR-II	33.35	24.65	88.25	40.07	MAR-II	33.35	24.65
APRIL-I	35.25	24.95	88.11	45.24	APRIL-I	35.25	24.95
APRIL-II	38.18	23.68	88.00	55.50	APRIL-II	38.18	23.68
MAY-I	41.57	22.76	84.78	45.76	21.00	1.43	8.87
MAY-II	42.21	22.23	85.65	51.65	19.87	1.23	8.93

Table 3: Pest distribution of Red banded thrips (*Selenothrips rubrocinctus)*

Period	**2016-17 Foliage thrips (No./leaf)**	**2017-18 Foliage thrips (No./leaf)**
July-I	0.00	0.00
July-II	0.00	0.00
Aug-I	0.00	0.00
Aug-II	0.00	0.00
Sept-I	0.00	0.00
Sept-II	0.00	0.00
Oct-I	0.00	0.00
Oct-II	0.00	0.00
Nov-I	0.00	23.45
Nov-II	0.00	21.62
Dec-I	0.00	10.23
Dec-II	0.00	8.45
Jan-I	0.00	5.51
Jan-II	0.00	5.32
Feb-I	0.00	23.62
Feb-II	16.40	55.63
Mar-I	24.60	67.54
Mar-II	25.40	77.56
April-I	13.40	45.43
April-II	11.30	30.23
May-I	6.23	17.25
May-II	0.00	8.65

The correlation of the insect pest incidence in plantations of cashew with weather parameters for the year 2016-17and 2017-18 was worked out and presented in the following table.

Table 4: Correlation of Red Banded Thrips population incidence with weather parameters 2016-17 and 2017-18**.**

Factors	Red Banded thrips (2016-17)	Red Banded thrips (2017-18)
Temp (max.)	0.853	0.216
Temp (min.)	-0.089*	-0.665**
RH (morn.)	0.637	0.184
RH (even.)	-0.623*	-0.004*
Rainfall	-0.027*	-0.043*
BSH	0.617	0.031
R2	91.07%	91.54%

(*-Significant at t for P=0.05, **-Significant at t for P=0.01).

Conclusion

Studies on foliage thrips of cashew with special reference to Red Banded thrips (*Selenothrips rubrocinctus* Giard.) were conducted under Bhubaneswar conditions during 2016-17 and 2017-18. Incidence of Red Banded thrips (*Selenothrips rubrocinctus*) in 2016-17 was observed during 2nd fortnight of February and continued upto 1st fortnight of May. The incidence was observed from 1st fortnight of November to 2nd fortnight of May coinciding with the flushing, flowering and fruiting period of cashew during 2017-18.The population of the Red Banded Thrips nymphs +adults ranged between 6.23-25.4 in the year 2016-17 and between 5.32-77.56 in the year 2017-18. The peak population of the Red Banded thrips was recorded 25.4 nymphs+adult per leaf during 2nd fortnight of March in 2016-17 and 77.56 nymphs+ adults per leaf during 2nd fortnight of march again in the year 2017-18. The incidence of the pest was recorded only from established plantations from the infested matured leaves. The correlation of the meteorological data with thrips incidence revealed that the Temp (min.) (r=-0.089), RH (even.) (r=-0.623) and rainfall (r=-0.027) showed negative significant correlation while the Temp (max.) (r=0.853), RH (morn.) (r=0.637) and BSH (r=0.617) had positive influence on the thrips population in the year 2016-17 and the correlation of the weather parameters with the thrips incidence revealed that the Temp (min.) (r=-0.665), RH (even.) (r=-0.004) and rainfall (r=-0.043) showed negative significant correlation while the Temp (max.) (r=0.216), RH (morn.) (r=0.637) and BSH (r=0.617) had positive influence on the thrips population in the year 2017-18.

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