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Study on growing degree days and population dynamics of thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae) on castor

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ABSTRACT

Investigations on population dynamics against thrips on castor was carried out during the year 2002-03 and 2003-04 at Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh. Peak activity was observed in 44th standard week (first week of November) and 42nd standard week (third week of October) by registering 196 and 193 thrips per flag leaf during 2002-03 and 2003-04, respectively. Maximum temperature, sunshine hours and evaporation exhibited significant positive correlation whereas, morning/afternoon humidity showed significant negative association. Path analysis showed that maximum / minimum temperature exhibited highly significant positive direct effect. Stepwise regression analysis further revealed that an increase in 1°C of maximum temperature increased the thrips population by 18.44 and 16.51 per flag leaf during 2002-03 and 2003-04, respectively, whereas a unit increase in minimum temperature and morning relative humidity reduced the thrips population to the tune of 7.19 and 2.22 per flag leaf during 2002-03 and 2003-04, respectively. The requirements of heat units for thrips build up and to attain the peaks were almost similar in both the years. Relatively higher heat units in the month of October with the end of rainy season indicated the build up of thrips population.

Key words: *Scirtothrips dorsalis*, castor, population dynamics, GDD, path analysis

Indian vegetable oil economy is the fourth largest in the world accounting for about 14 per cent of world's oilseed area and 8 per cent of world's production. Castor is one of the important cash and oilseed crops in the world and is cultivated on a commercial scale in about 30 different countries. India is the largest producer of castor seed and oil in the world accounting 57 per cent area and 64 per cent production. (Damodaram and Hegde, 2002). The area, production and productivity of castor in the country have increased consistently from 1965-66 to 2002-03 which were 5.00 lakh hectares, 5.41 lakh tones and 1080 kg ha^{-1} in 2002-03, respectively (Singhal, 2003).

Damage caused by several insect and non-insect pests is one of the major constraints for the low yield of this crop right from seedling to harvest stage. Among the different pests, thrips, *Scirtothrips dorsalis* Hood is the new emerging important pest causing damage by sucking sap of the leaves and flowers of castor crop. This pest is recorded for the first time on castor and considered as an important pest of castor in Gujarat (Anonymous, 1995). In natural environment, the population of *S. dorsalis* was showing violent fluctuations. The studies on population dynamics provide relative influence of biotic and abiotic factors on population fluctuation of the pest (Atwal and Bains, 1974). The knowledge of GDD can provide an estimate of forecasting of initiation of pest and its peaks during the crop life (Roy *et al.*, 2005). Hence, an attempt was made to study the impact of abiotic factors on fluctuation of thrips population.

MATERIALS AND METHODS

Castor variety GCH-4 was grown in an isolated plot with plot size of 20.0 m x 20.0 m with spacing of 90 cm x 60 cm during *kharif* 2002-03 and 2003-04. All the recommended agronomic practices were followed to raise the crop and were kept unsprayed throughout the crop seasons. Population counts of *S. dorsalis* were recorded at weekly interval from three randomly selected plants per each of 20 quadrates. From each selected plants three different flag leaves were selected and number of thrips were counted by jerking each flag leaf on thick transparent plastic sheet. Mean thrips population/ flag leaf was worked out. The data thus, collected were used to work out the impact of various weather factors on thrips population on castor using various statistical tools like simple correlation, path analysis and multiple regression analysis by adopting stepwise method. The accumulated growing degree days were determined as per Nuttonson (1955) using a base temperature of 5 °C.

RESULTS AND DISCUSSION

Fluctuation in thrips population in castor

Thrips, *S. dorasalis* was active from the third week of August (Table 1 & 2) to last week of January on castor crop during both the years under study. The peak activities of thrips were observed in 44th standard week (first week of November) and 42nd standard week (third week of October) by registering 196 and 193 thrips per flag leaf on castor during 2002-03 and 2003-04, respectively. The population, there after,

Table 1: Influence of accumulated growing degree days on castor thrips population, *S. dorsalis* during 2002-03

Month	Std. Week	Thrips / flag leaf	Average weekly Temp. (°C)			Accumulated GDD Days °C
			Max	min	Average	
Sept. '02	36	5	31.5	23.6	27.6	156
	37	9	33.3	22.4	27.8	347
	38	7	32.9	22.6	27.8	538
	39	28	34.5	23.6	29.1	707
Oct. '02	40	70	38.6	21.8	30.2	883
	41	96	39.8	22.7	31.2	1066
	42	121	39.3	22.9	31.1	1149
	43	181	38.0	19.9	29.0	1217
Nov. '02	44	196	37.9	19.7	28.8	1384
	45	120	36.8	20.4	28.6	1549
	46	100	34.5	17.6	26.1	1696
	47	95	35.9	16.4	26.2	1844
Dec. '02	48	70	33.7	14.2	23.9	1976
	49	95	33.9	13.9	23.9	2108
	50	80	34.7	15.0	24.9	2257
	51	55	33.9	16.4	25.2	2398
	52	31	30.3	14.9	22.5	2521

Table 2 : Influence of accumulated growing degree days on castor thrips population, *S. dorsalis* during 2003-04

Month	Std. Week	Thrips/ flag leaf	Average weekly Temp. (°C)			Accumulated GDD Day °C
			max	min	Average	
Sept. '03	36	10	31.7	24.1	27.9	159
	37	11	31.8	24.1	27.9	318
	38	13	32.2	24.5	28.3	481
	39	54	34.2	24.2	29.2	650
Oct. '03	40	91	36.8	21.5	29.2	819
	41	106	36.7	22.0	29.4	990
	42	193	37.6	19.2	28.4	1154
	43	169	36.7	17.3	27.0	1308
Nov. '03	44	143	36.7	19.0	27.9	1467
	45	124	36.4	19.9	28.2	1629
	46	110	34.6	18.5	26.5	1780
	47	96	32.7	17.0	24.8	1919
Dec. '03	48	89	34.2	15.2	24.7	2057
	49	85	34.2	13.8	24.0	2190
	50	30	31.3	15.9	23.6	2320
	51	26	28.5	10.9	19.7	2423
	52	18	28.4	10.2	19.2	2522

gradually declined and the lowest population was recorded during 5th standard week (last week of January) and then disappeared. More or less similar observations were recorded by Anonymous (2001) and Panickar and Patel (2001) in castor and chilli, respectively.

Correlation, path coefficient and regression analysis

The results of the correlation studies (Table 3) revealed that the maximum temperature (r=0.805 and r=0.867), sunshine hours (r=0.466 and r=0.605) and evaporation (r=0.394 and r=0.590) exhibited significant positive correlation with thrips population on castor indicating that an increase in either maximum temperature or sunshine hours or evaporation enhanced the thrips population whereas, morning relative humidity (r=-0.441 and r=–0.474) and afternoon relative humidity (r=-0.616 and r=–0.547) showed significant negative association with *S. dorsalis* population on castor during the year 2002-03 and 2003-04, respectively.

Table 3: Correlation coefficient, direct effect regression coefficient and overall contribution between thrips population and weather parameters during 2002-03 and 2003-04 on castor

Weather parameters	Correlation coefficient with thrips population		Dir
	2002-03	2003-04	20
Maximum temperature (°C) (X1)	0.805**	0.867**	3
Minimum temperature (° C) (X2)	0.072	0.041	2
Morning Relative humidity (%) (X3)	-0.441*	-0.474*	-
Afternoon Relative humidity (%) (X4)	-0.616**	-0.547**	-
Sunshine hours (X5)	0.466*	0.605**	-
Evaporation (mm) (X6)	0.394*	0.590**	0
Rainfall (mm) (X7)	-0.299	-0.301	-
Rainy days (X8)	-0.312	-0.438*	0

* Significant at 5 %, ** Significant at 1 %

While rainy days exhibited significant negative relationship (r=-0.438) during 2003-04 indicating that increase in either morning relative humidity or afternoon relative humidity or rainy days retarded the development of thrips on castor. Similar is the case with direct effect (Table 3). On the basis of the stepwise regression analyses following equations were fitted for both years of study:

For year 2002-03 the model is

$Y = - 382.55 + 18.44^{**} X1 - 7.19^{**} X_2 - 6.12 X_5 - 0.22 X_7 + 10.68 X_8$ with R^2 of 0.77**

and

for year 2003-04 the model is

$Y = -300.12 + 16.51^{**} X_1 - 2.22^{**} X_3 - 4.69 X_6 + 0.06 X_7 + 3.51 X_8$ with R^2 of 0.91**

Where,

X_1 = Maximum Temperature (°C),
X_2 = Minimum Temperature (°C),
X_3 = Morning relative humidity (%),
X_5 = Bright sunshine hour,
X_6 = Evaporation (mm),
X_7 = Rainfall (mm),
X_8 = Rainy days

The prediction equation indicated that an increase in 1°C of maximum temperature increased the thrips population by 18.44 and 16.51 per flag leaf during 2002-03 and 2003-04, respectively whereas, unit increase in minimum temperature and morning relative humidity reduced the thrips population to the tune of 7.19 and 2.22 thrips per flag leaf during 2002-03 and 2003-04, respectively. The values of coefficient of determination (R^2) revealed that the weather parameters under study contributed 77.05 and 91.00 per cent variation in thrips population during the year 2002-03 and 2003-04, respectively in castor crop.

Thus, increase in maximum temperature and evaporation with low rainfall and minimum rainy days in week enhanced the thrips intensity whereas, increase in minimum temperature and morning as well as afternoon relative humidity adversely affected the development of thrips on castor (Table 3).

The data for thrips population, weekly GDD and accumulated growing degree days were presented in Table 1 and 2. about 135.0 weekly GDD were required to initiate the thrips population in castor. Comparing data between accumulated GDD and thrips population revealed that after reaching a peak, warmer thermal environment (eg. 2003-2004) maintains thrips population relatively high, than under a relatively a cooler environment (2002-2003). GDD accumulation could possibly be used to monitor and predict

thrips population a week or two ahead in the season.

It could be concluded that the increase in heat units after completion of rainy season in Gujarat in month of October, the population of thrips also increased and attained the peaks. It means the hot and dry weather condition favours the development of thrips in castor crop.

Manjunatha *et al.* (2001) concluded that higher thrips populations were noticed in areas with higher temperature. Panickar and Patel (2001) observed a significant negative relationship between population of *S. dorsalis on* chilli and minimum temperature and mean relative humidity. Duraimurugan and Jagadish (2002) found that the incidence of *S. dorsalis* on rose was significantly positively correlated with the maximum temperature and sunshine hours but significantly negatively correlated with the mean relative humidity. Gahukar (2003) stated that maximum and minimum temperatures had a significantly negative effect on infestation of thrips, *S. dorsalis on* rose. Thus, the present findings are more or less in agreement with the findings of the earlier workers.

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