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Present Status of Sunflower Pests and their Natural Enemies in North Karnataka

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ABSTRACT: Field studies conducted during 2020-21 rabi and 2021-22 kharif season to know population fluctuation of sunflower insect pests and their natural enemies revealed that thrips and lepidopteran pests (*Helicoverpa armigera, Spodoptera litura* and *Spilarctina oblique*) were the major pests during kharif and Sucking pests (leafhopper and whiteflies) were major insect pests during rabi season. Lady bird beetles, *Chrysoperla* and spiders were recorded as major predators throughout season. Weather parameters played an important role on the incidence of pests as revealed by Correlation and regression studies.

Keywords: Insect pests, Natural enemies, Population dynamics, Sunflower, correlation and regression.

INTRODUCTION

Sunflower is a day neutral crop is suitable to various agro-climatic situations due to its wider adaptability and response to best management practices. Sunflower is associated with different species of beneficial and harmful insects. Leaf hoppers, cutworm, (*Agrotis* spp.) capitulum borer (*Helicoverpa armigera* Hubner), tobacco caterpillar (*Spodoptera litura* Fabricius), Bihar hairy caterpillar (*Spilarctina obliqua* Walker), green semilooper (*Thvsanoplusia orichalcea* Fabricius) and cabbage semilooper (*Trichoplusia ni* Hubner) are of major economic importance. In recent years, thrips (*Frankliniella schulzi* Trybom), *Scirtothrips dorsalis* Hood and *Megalurothrips usitatus* (Bagnall) are gain importance as they are associated with sunflower necrosis disease. Various pests can cause different level of damage to sunflower across major sunflower growing areas in Karnataka (Basappa and Santhalakshmiprasad 2005). In the present study, objectives were planned to work out the period of maximum pest population and their relation with biotic and abiotic factors. Yield losses of sunflower to the tune of 46 per cent were reported due to this pest alone in Maharashtra. Because of distinguished biological features it is very difficult to manage Leafhoppers by chemical pesticides alone. Determination of suitable control method and exact time of action requires knowledge on pest incidence with reference to weather factors (Fand *et al*., 2018).

MATERIALS AND METHODS

Field experiments were conducted at Main Agricultural Research Station, Raichur (16.21’ N and 77.3’E) Karnataka during *rabi* 2020-21 to kharif 2021-22 in randomized complete block design (RCBD) with three replications. Sunflower hybrid KBSH-44 was used and sown at 0.6 m × 0.3 m rows for the study. Fertilizers application and agronomic practices were followed as per the University recommended production practice for the region. After fifteen days of sowing, data on sucking pests (Thrips, leafhoppers and whiteflies) were recorded from 6 leaves (2 each from top, middle and lower portion) at weekly interval up to maturity. Fifty plants were observed for recording pest population. Head borer was recorded as number of larvae per capitulam and for defoliators number of larvae per plant was considered. Whereas, Observations on whole plant basis was recorded for natural enemies. Pesticides were not applied throughout crop period.

The meteorological data was collected from the university weather station located at 500 m distance from the experimental block. Weekly weather data *viz*. minimum and maximum temperature, the morning and evening relative humidity, the rainfall, and the bright sunshine hours were recorded during the study period. Pests and natural enemies data were averaged and subjected to correlation and regression analysis with weather parameters following standard procedure. The significance level was set at $P < 0.05$. For computing the regression equation, pest population (Y) and weather parameters were taken as dependent and independent variables respectively.

RESULTS AND DISCUSSION

Population of sucking pests, head borer, defoliators and predators were recorded at weekly intervals from 31st to 40th Standard Meteorological Weeks (SMW) in kharif (kharif 2021)and 48th to 4th Standard Meteorological Weeks (SMW) in rabi season (2020-21).

***Rabi*, 2020-21.** Observations on various pest population and their natural enemies were recorded on sunflower Hybrid KBSH-44 under untreated condition starting from 48th Standard week. Thrips population ranged from 0.00 to 0.64 per 6 leaves/plant and was considered to be negligible. Incidence of leafhopper was moderate (2.70 to 18.00 per 6 leaves/plant) and maximum population found from 50th to 2nd standard week. Population of whiteflies ranged from 2.50 to 26.50 whiteflies per 6 leaves/plant which was on increasing trend up to 52nd standard week and decreased thereafter. Incidence of head borer and defoliator pests was not noticed during the season. Population of Coccinellids, *Chrysoperla* and Spiders ranged between 0.12-2.04, 0.00-0.12 and 0.10-0.48 respectively (Table 1).

Correlation coefficient values between Sunflower insect pests and their natural enemies and weather factors during Rabi season. Thrips population was positively correlated with evening relative humidity and negatively correlated with rest of the weather parameters with significant relation with morning relative humidity. Negative and non-significant correlation was found between leafhopper population and all the abiotic factors. Whitefly population found to have negative significant relation with minimum temperature and positive non-significant relation with rainfall and evening relative humidity. Relation was negative and non-significant with maximum temperature. Coccinellid population was found to have significant negative relation with Minimum temperature and non-significant negative relation with rest of the parameters. Chrysoperla population was found to have non-significant positive relation with minimum temperature and significant positive relation with rainfall and evening relative humidity. Significant negative relation was observed between chrysoperla and maximum temperature. Spider population was found to have significant negative relation with maximum temperature. The relation was positive and non-significant with Rainfall, Morning and evening relative humidity (Table 3).

***Kharif* 2021.** Pest incidence was observed from 30th July 2020 to 7th October, 2021 on sunflower hybrid KBSH-44 under unprotected condition. The population of thrips was maximum (4.62/6 leaves/plant) during 33rd standard week and decreased thereafter. Leafhopper population was low and was in the range of 0.56 t0 3.30/6 leaves/plant with highest population recorded during 37th standard week. Incidence of whiteflies was noticed from 36th Standard week with population range of 0.00 to 3.70/6 leaves/plant (Table 2).

Table 1: Population dynamics of major insect pests and natural enemies of sunflower and correlation with weather factors during Rabi 2020-21.

SMW	Sucking pests/ 6 leaves/plant			Predators/plant		
	Thrips	Leaf hopper	White flies	Coccinellid	*Chrysoperla*	Spiders
48	0.40	2.70	12.50	0.30	0.04	0.28
49	0.30	9.50	15.90	0.36	0.12	0.38
50	0.50	17.00	13.90	0.32	0.08	0.24
51	0.30	13.04	18.50	1.48	0.00	0.36
52	0.64	18.00	26.50	2.04	0.10	0.32
1	0.28	17.82	20.50	1.30	0.00	0.48
2	0.16	15.96	11.24	0.50	0.10	0.28
3	0.12	11.36	5.30	0.12	0.04	0.16
4	0.00	6.30	2.50	0.14	0.00	0.10

Table 2: Population dynamics of major insect pests and natural enemies of sunflower and correlation with weather factors during Kharif 2021-22.

SMW	Population/6 leaves/plant			Larvae/plant		Population of natural enemies/plant		
	Thrips	Leaf hoppers	White flies	Head borer	Spodo ptera	Coccine llids	*Chryso perla*	Spiders
31	0.44	0.56	0.00	0.00	0.00	0.16	0.04	0.10
32	3.00	1.14	0.00	0.00	0.00	0.80	0.00	0.24
33	4.62	0.76	0.00	0.00	0.04	1.30	0.10	0.64
34	3.04	1.58	0.00	0.00	0.24	1.10	0.10	0.18
35	2.10	1.22	0.00	0.00	0.66	0.84	0.16	0.32
36	1.50	1.50	0.92	0.24	1.02	0.50	0.12	0.10
37	3.30	3.30	3.70	0.68	2.70	2.20	0.00	0.24
38	3.50	2.20	3.60	1.58	1.30	0.70	0.32	0.08
39	1.56	1.70	1.90	0.84	0.84	0.46	0.04	0.16
40	0.84	0.96	1.96	0.30	0.24	0.10	0.00	0.00

Table 3: Correlation coefficients between major insect pests and natural enemies of sunflower and weather factors.

Insect pests/ natural enemies	Weather parameters#				
	Max Temp (°C)	M in Temp (°C)	RF (mm)	RH I (%)	RH II (%)
***Rabi* 2020-21**					
Thrips	-0.01	-0.30	-0.03	-0.55	0.02
Leaf hopper	-0.37	-0.37	-0.18	-0.32	-0.05
White flies	-0.32	-0.59	0.08	-0.31	0.03
Coccinellid	-0.11	-0.85	-0.21	-0.32	-0.33
Chrysoperla	-0.60	0.49	0.56	-0.04	0.77
Spiders	-0.51	-0.35	0.30	0.03	0.25
***Kharif* 2021**					
Head borer	-0.42	-0.61	0.33	0.58	0.51
Spodoptera	-0.63	-0.44	0.63	0.68	0.67
Cocinellids	-0.01	0.28	0.09	-0.05	0.16
Chrysoperla	0.01	-0.07	0.37	0.23	0.16
Spiders	0.74	0.79	-0.23	-0.68	-0.61

* Significant at 5% level, # - 'r' values

Defoliator, *Spodoptera litura* larval population ranged from 0.00-2.70 larvae per plant with defoliation up to 30 per cent. Population head borer ranged between 0.00-1.58 larvae per plant. Coccinellids, *Chrysoperla* and Spiders ranged between 0.10-2.20, 0.00-0.32 and 0.00-0.64 respectively.

Correlation coefficient values between Sunflower insect pests and their natural enemies and weather factors during kharif season. The seasonality of sunflower insect pests and their natural enemies and their relationship with weather factors was observed between July to October 2021 at MARS, UAS, Raichur (Table 3). Head borer population was found to have positive significant relation with morning and evening relative humidity and positive non-significant relation with rainfall. Relationship with maximum temperature was negative and non-significant and negative and significant with minimum temperature. *Spodoptera* population was found to have positive significant relation with morning and evening relative humidity and rainfall and negative significant relation with maximum temperature. Relation with minimum temperature was negative and non-significant.

The relation of coccinellids with minimum temperature, rainfall and evening relative humidity was found to be positive and non-significant. The relation with maximum temperature and morning relative humidity was negative and non-significant. Chrysopa population was found to have non-significant positive relation with maximum temperature, morning and evening relative humidity and rainfall and negative relation with minimum temperature. The correlation between population of spiders and maximum and minimum temperature was positive and significant. Whereas, morning and evening relative humidity were found to have negative and significant relationship with spider population.

Multiple linear regression equation of Sunflower insect pests with weather factors. The multiple linear regression equation for Thrips is Y = -37.312 + (1.195 *Max T) - (0.0612 * Min T) + (0.00670 * Rainfall) - (0.0179 * RH1) + (0.0992 *RH2) indicated one unit increase in minimum temperature and morning relative humidity caused increase in thrips population by 0.612 and 0.0179 units. A unit increase in rainfall, evening relative humidity and maximum temperature led to decrease in thrips population by 0.0067, 0.0992 and 1.195, units. Thrips population was collectively influenced by the weather factors to the extent of 30.00 per cent (Table 4).

The multiple linear regression equation for Leafhopper is Y = 76.644 - 1.904 * Max T + 0.326 * Min T + 0.00439 * Rainfall - 0.0302 * RH1 - 0.313 *RH2 revealing that an unit increase in morning and evening relative humidity and maximum temperature will increase in leafhopper population by 0.0302, 0.313 and 1.904, units. Whereas, population was reduced by 0.326 and 0.0043 units due to unit increase in minimum temperature and rainfall. Collective influence of weather factors on population of leafhopper was to the tune of 41.60 per cent (Table 4).

The multiple linear regression equation for Whitefly is Y = 114.928 - 2.548 * Max T - 0.157 * Min T - 0.00445 * Rainfall - 0.165 * RH1- 0.238 * RH2 indicated one unit increase in maximum temperature, minimum temperature, rainfall, morning relative humidity and evening relative humidity led to increase in whitefly population by 2.548,0.157,0.0045,0.165 and 0.238 units. Collective influence of weather factors was to the tune of 59.10 per cent (Table 4).

The multiple linear regression equation for Head borer is Y = 1.284 - 0.0926*Max T + 0.0713 *Min T + 0.000473 * Rainfall + 0.0110 * RH1 - 0.0104 * RH2 indicated one unit increase in maximum temperature and evening relative humidity caused increase in head borer population by 0.0926 and 0.0104 units. Whereas, a unit increase in minimum temperature, rainfall and morning relative humidity caused decrease in their population by 0.0713, 0.0004 and 0.0110 units. Collective influence of weather factors was to the tune of 9.43 per cent (Table 4).

The multiple linear regression equation for *Spodoptera* is Y = -1.498 - 0.0932 * Max T + 0.146 *Min T - 0.00360 * Rainfall + 0.0291 * RH1 - 0.0146 *RH2 indicated one unit increase in maximum temperature, rainfall and evening relative humidity caused increase in spodoptera population by 0.0932, 0.00360 and 0.0146 units. Population was reduced by 0.146 and 0.0291 units due to unit increase in minimum temperature and morning relative humidity. Collective influence of weather factors was to the tune of 12.90 per cent (Table 4).

Table 4: Regression equation for sunflower insect pest population and weather parameters.

Pest	Regression Equation	R2 value (%)
Thrips	Y = -37.312 + (1.195 *Max T) - (0.0612 * Min T) + (0.00670 * Rainfall) - (0.0179 * RH1) + (0.0992 *RH2) (P=<0.001)	30.00
Leafhopper	Y = 76.644 - 1.904 * Max T + 0.326 * Min T + 0.00439 * Rainfall - 0.0302 * RH1 - 0.313 *RH1 (P=<0.001)	41.60
Whitefly	Y = 114.928 - 2.548 * Max T - 0.157 * Min T - 0.00445 * Rainfall - 0.165 * RH1- 0.238 * RH2 (P=<0.001)	59.10
Head Borer	Y = 1.284 - 0.0926*Max T + 0.0713 *Min T + 0.000473 * Rainfall +0.0110 * RH1 - 0.0104 * RH2 (P=0.846)	9.43
Spodoptera	Y = -1.498 - 0.0932 * Max T + 0.146 *Min T - 0.00360 * Rainfall + 0.0291 * RH1 - 0.0146 *RH2(P=0.448)	12.90

Leafhopper density was at its peak level during 37th MSW at Akola and at Raichur maximum population found from November to December in (Anon., 2002). Positive relation between leafhopper and maximum temperature and negative relation with relative humidity was reported at Bangalore by Meenakshi (2006). Hanumantappa and Katti (2010) reported that leafhopper activity started during August last week (6.66/6 leaves) and reached maximum level of 23.16 leafhoppers/6 leaves by November second week. Shera *et al*. (2013) from Punjab reported 'r^2' values of 0.67 to 0.80 for leafhopper that supports the present findings. Multiple linear regression relationship developed by Rajasekhar *et al*. (2015) revealed 57.20 per cent variation of leafhopper population in Guntur region of Andhra Pradesh. Similarly, 59.1 per cent and 80.6 per cent of variation leafhopper population due to weather factors were reported by Soujanya *et al*. (2010) and Arun Janu *et al*. (2018) respectively. Many of the earlier reports support the current findings with little deviations which could be due to local adaptations of the leafhoppers in the area.

Mean incidence ranging from 0.25 to 1.65/6 leaves per plant in sunflower was reported during 43rd and 45th SMW by Geetha and Hegde (2018) in Dharwad. Whiteflies found to have non-significant correlation with weather factors. Higher whitefly populations were noticed on first date of sowing compared to intermediate and late sown crop (Solanki and Jha 2018). All abiotic factors found to have non-significant relation with population of whitefly (Piyali Bhowmik *et al*., 2018). The present results are supported by the findings of Meena and Bairwa (2014) who reported negative and non-significant relationship between whitefly and parameters like evening relative humidity and rainfall. Geetha and Hegde (2018) reported collective influence of weather factors in 2015 and 2016 to the tune of 72.6 and 91.2 per cent respectively. Regression equation of pooled data Y= -2.199-0.025X1 + 0.487X2 - 0.057X3 -0.030X4 + 0.002X5 + 0.014X6 revealed increase *B. tabaci* population by 0.025, 0.057 and 0.030 units with every unit increase in maximum temperature, morning relative humidity, evening relative humidity indicating profound influence of weather factors on pest build up and hence the importance of weather parameters in forecasting of pest incidence.

Head borer incidence was reported to occur from 3rd week of October to 3rd week of November with highest incidence during first week of November (Ranjith and Prabhuraj 2013). Positive and non-significant relation was found between larval incidence on all crops except chickpea and weather parameters, maximum and minimum temperature. Rainfall and morning relative humidity found to have negative and non-significant relation. Multiple regression models for Capitulum borer as $y = 0.167 + 0.959(PD)$, $y = 2.829 - 0.259(TMIN) + 0.049(RH - 2) - 0.014(PD)$ and $y = -0.489 + 3.029(PD)$ respectively for first, second and third years with R^2 values of 0.465, 0.406 and 0.437.

Incidence of *S. litura* and *S. obliqua* on sunflower appeared in September at Bengaluru and in November at Hyderabad (Bilapate and Chakravarthy 1999). Kakakhel *et al.* (2000) reported highest incidence of hairy caterpillar (*D. obliqua*) on sunflower during October 2nd week. Significant positive correlation was recorded between larval density of *S. obliqua* and maximum temperature and non-significant relation was found with rest of the parameters (Patel, 2015). On soybean, significant positive correlation with wind velocity and non-significant relation with mean temperature, wind velocity, relative humidity and rainfall was reported by Lodaya (2016). Regression equation for defoliators was reported by Geetha and Hegde (2018) as Y= 340.650 - 15.549X1 + 10.563X2 + 2.543X3 -3.622 X4 - 0.033X5 -1.682X6 indicating increased *S. obliqua* larval population by 15.549, 3.622, 0.033 and 1.682 units with every unit increase in maximum temperature, evening relative humidity, rainfall and wind velocity.

Predators and abiotic factors have significant effect on the defoliator and head borer infestation affecting their growth and development. Different predatory insects viz., predatory bugs, *Chrysoperla*, spiders and insectivorous birds play an important role in the pest suppression Basappa (2011). Coccinellids and spiders population was found to be highest on 73 days old sunflower crop (Syed Muzammil and Biradar 2017). Results of present investigation on predatory species diversity in sunflower ecosystem was in line with earlier findings. The present study results showed numerical response of natural enemies with pest population.

Weather variables act as a limiting factor for the insect pest development. Pest population build up was significantly influenced by weather variables in Sunflower. Though empirical models are very useful in better understanding of pest and its dynamics, local weather conditions influence population dynamics of pest greatly and hence behave in a location-specific manner and thus they are influenced by different weather factors at different locations. Pest weather regression models would be useful in forecasting the likely pest build up, thereby helping in forewarning and timely management. Such information may be used for recommending required zone-wise management strategies.

CONCLUSION

Weather variables act as a limiting factor for the insect pest development. Pest population build up was significantly influenced by weather variables in Sunflower. Though empirical models are very useful in better understanding of pest and its dynamics, local weather conditions influence population dynamics of pest greatly and hence behave in a location-specific manner and thus they are influenced by different weather factors at different locations. Pest weather regression models would be useful in forecasting the likely pest build up, thereby helping in forewarning and timely management. Such information may be used for recommending required zone-wise management strategies.

FUTURE SCOPE

These studies may provide information to develop pest forecasting modules for area-wide pest management. Pest specific integrated module for cost effectives management should be developed.

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Conflict of Interest. None.

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