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FOREWARNING MODEL AND CORRELATION BETWEEN WEATHER PARAMETERS AND THRIPS OF SUNFLOWER ON DIFFERENT VARIETIES

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Abstract: *The experiment was conducted in a split-split plot design with three replications having eighteen treatment combinations formed considering different protection, varieties and sowing windows. The significantly highest yield and minimum infestation was observed in variety PhuleRaviraj than variety Bhanu and MSFH-17, sowing window 30th MW (S_2: 23rdJuly – 29th July) was higher then S_3 and S_1 and under protected condition (P_1) as compared to unprotected condition (P_2). It would be, therefore, advisable to sow PhuleRaviraj variety of kharif sunflower during 30th MW (S_2: 23rdJuly – 29th July) to get maximum returns with minimum infestation of thrips on sunflower. The incidence of thrips on sunflower can be predicted to an extent of 66 % accuracy with help of forewarning model.*

Key words: *Forewarning model, Correlation, weather parameters, thrips, Sunflower.*

Introduction

Sunflower (*Helianthus annuus L.*) belongs to the family Compositae. It is a seasonal, erect and herbacious plant with leaves simple, alternate with stout petioles and lanceolate in shape. A single head produces 350 to 2000 seeds. Seeds are pointed at base and round at end.

In early 1970s, only about 0.1 million hectares were under sunflower cultivation, however, by 2012-13, it gone up to 5.5 million hectares. In India, it was used mainly as ornamental crop but in recent past it became an important source of edible and nutritious oil. Sunflower is a major source of vegetable oil in the world. It is used for a variety of cooking purposes. Sunflower seed contains about 48 – 53 % edible oil. The sunflower oil is considered premium compared to other vegetable oils as it is light yellow in color, high level of linoleic acid and absence of linolenic acid, possesses good flavor and high smoke point. Sunflower oil is a rich source (64 %) of linoleic acid which is good for heart patients. Linoleic acid helps in washing out cholesterol deposition in the coronary arteries of the heart. The oil is also used for manufacturing hydrogenated oil. Recent study confirms that varieties differ extensively in the physiological process determining the yield. It has been also shown that the total yield per plant and per unit area is determined by the number of head and seed weight per plant. These physiological factors also determined by environmental factors.

Sunflower is photo and thermo-insensitive and day neutral plant. The sunflower oil has greater stability and quality under various climatic conditions. Incidence of pest is majorly influenced by date of sowing of crop. So it is necessary to identify suitable date of sowing for sunflower crop to minimize the damage due to thrips. Study of correlation of pest incidence with weather parameters very useful in Integrated Pest Management (IPM). Forewarning models were very important tool to predict insect pest infestation in advance .it is very useful for farmers to be ready for insect attack if formula containing values of weather are observed in particular period for sunflower.

Now days, attentions also paid on global warming and due to global warming climatic change are oftenly observed in India. Growth, yield, oil percent is greatly affected. To overcome this problem, there is necessity to study the response of different varieties of sunflower to different sowing times and incident of insect pest on it. With this view, to identify suitable variety and influencing sowing date and incidence of thrips on sunflower, present investigation has been undertaken.

Material and Methods

The field experiment was conducted during *kharif*, 2015 at Mulegaon Agricultural Farm, Zonal Agricultural Research Station, Solapur, Maharashtra State (India). Geographically the campus of Mulegaon Agricultural Farm is situated on 17º41' N latitude and 75º 56'E longitude. The altitude is about 483.6 M above mean sea level.

The data revealed that during the crop growth period, the annual maximum and minimum temperature ranged between 25.0 to 43.2^{0}C and 7.3 to 27.1^{0}C, respectively. During the *kharif* season, the maximum temperature ranged between 29.0 to 40.8^{0}C with an average of 34.7^{0}C, whereas, the minimum temperature ranged between 18.0 to 26.2^{0}C. The pan evaporation ranged between 1.8 to 12.8 mm with an average of 7.4 mm. The wind speed ranged between 2.1 to 18.3 Kmph with an average of 9.7 Kmph. In case of BSS which was ranged between 0.0 to 12.1 hrs with an average of 5.2 hrs. The morning RH ranged between 60 to 90 per cent with an average of 75 per cent and the afternoon RH ranged between 24 to 90 per cent during the crop growth period. Experiment details and treatment details was given below.

Experiment details

a) Name of crop	: Sunflower
b) Cultivars	: 1. Bhanu : 2. MSFH-17 :3. PhuleRaviraj
c) Season	: *Kharif*, 2015
d) Design	: Split-split plot
e) No. of replications	: 3
f) Treatments	: 3 sowing windows
g) Spacing	: 45 × 20 cm^2
h) Seed rate	: 8-10 kg/ha (all Varieties)
i) Fertilizer application	: 50 kg N + 25 kg P_2O_5 ha^{-1}
j) Irrigation	: NIL
k) Pest/diseases observed, if any	: Hairycaterpillar, thrips
l) Plant protection measures taken, if any	: Quinolphos
m) Weed control	: 2 hand weeding's
n) Plot size	: Gross: 6.0 x 4.5 m^2 : Net : 4.2 x 3.6 m^2
o) Place of research work	:Mulegaon Agricultural Farm, Zonal Agricultural Research Station, Solapur
p) Commencement of Research work	: *Kharif*,2015

Treatment Details:

Treatment	Combinations
T_1 - S_1V_1	S_1 - 26MW (26 June-01 July), V_1 - Bhanu
T_2 - S_1V_2	S_1 - 26MW (26 June-01 July), V_2- MSFH-17
T_3 - S_1V_3	S_1 - 26MW (26 June-01 July), V_3 - PhuleRaviraj
T_4 - S_2V_1	S_2 - 30MW (23 July-29 July), V_1–Bhanu
T_5 - S_2V_2	S_2 - 30MW (23 July-29 July), V_2 - MSFH-17
T_6 - S_2V_3	S_2 - 30MW(23 July-29 July), V_3 - PhuleRaviraj
T_7 - S_3V_1	S_3 - 34MW(20 Aug.-26 Aug.), V_1 –Bhanu
T_8 - S_3V_2	S_3 - 34MW(20 Aug.-26 Aug.), V_2 - MSFH-17
T_9 - S_3V_3	S_3 - 34MW(20 Aug.-26 Aug.),V_3 - PhuleRaviraj

Then all treatments take (2 split plots) under treated and untreated plot by Quinolphos.

Entomological observations

Pest incidence observations recorded from selected five plants from each plots of experimental field. Observation, were recorded from selected five plants and then number of thrips per 5 cm length of twigs of plant were counted. Two treatments that treated and untreated are differentiating by spraying of Quinolphose 1.5 ml/1 lit. water on treated treatments. No any control measure was applied on untreated treatment.

Correlation Studies

The weather elements play an important role in success or failure of the crop. The weather requirement varies differently in the different phenophase and hence the study of individual weather element prevailed during different phenopheses was conducted by studying the degree of association between seed yield and total biomass versus weather elements.

The weather elements considered are maximum temperature ($T_{max.}$), minimum temperature ($T_{min.}$), morning time relative humidity (RH-I), noon time relative humidity (RH-II), bright sunshine hours (BSSH) and canopy temperature, wind speed, pan evaporation etc. were included in this study. The correlation

Table: Correlation between weather parameters and thrips on sunflower **in treated condition**

Sr. no.	Particulars	Bhanu (V_1)			MSFH-17(V_2)			Phule Raviraj(V_3)		
	Climatic factor	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
1.	Rainfall	0.684	0.082	0.420	-0.740	0.132	0.391	-0.690	-0.089	0.372
2.	Tmax	-0.369	-0.262	-0.454	0.383	-0.307	-0.467	0.396	-0.110	-0.387
3.	Tmin	0.610	0.703	0.684	0.615	0.670	0.691	0.617	0.662	0.673
4.	BSS	-0.309	-0.445	-0.329	-0.289	-0.408	-0.334	-0.269	-0.632	-0.264
5.	RH-I	-0.769	0.224	0.766	-0.795	0.333	0.761	-0.788	-0.008	0.741
6.	RH-II	-0.636	0.323	0.639	-0.671	0.414	0.633	-0.649	0.038	0.585

Table: Correlation between weather parameters and thrips of sunflower untreated condition

Sr. no.	Particulars	Bhanu (V_1)			MSFH-17(V_2)			Phule Raviraj(V_3)		
	Climatic factor	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
1.	Rainfall	-0.714	0.082	0.420	-0.995**	0.132	0.391	0.750	0.092	0.372
2.	Tmax	0.392	-0.262	-0.454	0.386	-0.307	-0.467	0.439	-0.177	-0.387
3.	Tmin	0.618	0.703	0.684	0.616	0.670	0.691	0.633	0.649	0.673
4.	BSS	-0.287	-0.445	-0.329	-0.285	-0.408	-0.334	-0.228	-0.337	-0.264
5.	RH-I	-0.787	0.224	0.766	-0.930**	0.333	0.761	0.825*	0.216	0.741
6.	RH-II	-0.660	0.323	0.639	-0.900**	0.414	0.633	-0.696	0.310	0.585

*significant at 5% level ** significant at 1% level

coefficients for each treatment were estimated through pearsmans correlation techniques.

1: Correlation between weather parameters and incidence of thrips under treated condition

On variety Bhanu

Correlation analysis of incidence of thrips with weather parameters revealed non-significant negative correlation with BSS and rainfall and non-significant positive correlation with temperature in 26thMW. The similar result found by Akashe *et al.* (2010)

On variety MSFH-17

Correlation analysis of incidence of thrips with weather parameters revealed non-significant negative correlation with BSS and non-significant positive correlation with minimum temperature in all sowing window. Similar results were reported by Banerjee and Bandopadhyaya *et al* (2005).

On variety Phule Raviraj

Correlation analysis of incidence of thrips with weather parameters revealednon-significant negative correlation with BSS, maximum temperature and non-significant positive correlation with minimum temperature and rainfall in all sowing windows. The similar result found by Akashe *et al.* (2010).

2: Correlation between weather parameters and incidence of thrips under untreated condition

On variety Bhanu

Correlation analysis of Incidence of thrips with weather parameters revealed non-significant negative correlation with BSS and maximum temperature and non-significant positive correlation with minimum temperature, RH-I, rainfall in 30th MW. The similar results were found by Akashe *et al.* (2010).

On variety MSFH-17

Correlation analysis of incidence of thrips with weather parameters revealed highly significant negative correlation with rainfall, (0.995**) RH-I (0.930**) and RH-II (0.900**) non-significant negative correlation with Tmin and BSS in 26th MW.

When sunflower sown in 34th MW produced non-significant negative correlation with rainfall and 32th MW non-significant positive correlation with BSS, minimum temperature, humidity. The similar results were found by Akashe *et al.* (2010).

On variety Phule Raviraj

Correlation analysis of incidence of thrips with weather parameters revealed significant positive correlation with RH-I (0.825*) and non-significant positive correlation with minimum temperature in 26th MW and non-significant negative correlation with maximum temperature and BSS when sown in 30 MW and 34th MW and non-significant positive correlation with RH, minimum temperature when sown in 34th MW . The similar results were found by Akashe *et al.* (2010).

3: Pest forewarning model

Weather has a highly domineering impact on incidence of insect pests or diseases on all crops. Almost all insect pests are 'Meteotropic' *i. e.* influenced by weather conditions. Weather based pest forecast models (FORECASTERS) are used in the crop protection parlance. Forecasters, as a tool in the IPM, can be beneficially used for efficiently planning control measures well in time. For development of these models, both meteorological and biological data are required as input. The output is the 'anticipated outbreak' of insect pests or diseases. Predictive models can be used for insurance whereas Quantitative models are useful for good management of insect pests or diseases.

Forewarning model for thrips (*Scirtothripsdorsalis)* on sunflower (*Helianthus annus* L.).

After calculation of available data sets on weather parameters and thrip population on sunflower during *Kharif* seasons of last 1 year (2015-16), the linear regression model is developed for the prediction of thrip incidence on sunflower during crop growth period. The standard procedure for regression analysis was used. Correlation of thrips with weather parameters for past years has been calculated with reference to maximum temperature (°C), relative humidity morning (%), relative humidity evening (%) and rainfall (mm) and summarized in Table-29 with corresponding significance for given years and central tendency of common weather parameters. Other parameters were non-significant. The further no data for validation purpose. The data on weather parameters and thrip population was subjected to the statistical analysis and correlation coefficient (r), linear regression coefficient, squared multiple correlation (R^2) and regression equation were worked out for predicting the thrip incidence on sunflower in the scarcity zone of Maharashtra, India.

By employing step down linear regression model, the incidence of thrips on sunflower can be predicted to an extent of 66 % accuracy. Observed and predicted values of thrips on sunflower will validation for next year. These results are confirmatory with Hanumantharaya *et al.* (2008).

Table: Effect of weather on thrips population of sunflower during year, 2015

MW	THIRPS	T-Max	T-Min	RH-1	RH-II	WS	RF	BSS
30	7.90	34.5	22.5	77	41	8.6	0	4.7
31	10.63	34.4	22.4	78	42	7.7	0	5.3
32	10.50	33.4	22.6	83	52	8.8	34.5	2.4
33	10.67	33.4	22.3	79	45	9.6	0.5	4.2
34	8.22	35.3	21.7	82	43	7.6	23.4	7.5
35	8.92	33.8	21.6	82	45	6.0	14.6	5.5
36	7.50	34.2	22.3	85	53	6.6	27.6	6.6
37	6.25	32.2	21.4	93	64	6.2	116	4
38	5.01	32.5	21.3	88	51	5.0	3.7	5.8
39	3.08	35.5	21.3	73	36	5.0	0.8	9.6

Table: Regression coefficient and R^2 for thrips population of sunflower in 2015

Parameter	Regression coefficient (with significant parameters)
	Linear Model
Constant (Y)	-20.374
T_{mim}	1.168
W.S	0.536
B.S.S	-0.013
R^2	**0.66**

Table (i): ANOVA table

Source of variation	d. f.	SS	MS	'F'	Prob.
Regression	3	37.42	12.47	3.73	0.080
Residual	6	20.06	3.344		
Total	9	57.45			

Y = -20.374 +1.168 x Tmin + 0.536 x W.S -0.013 x BSS.

Y = Thrip population (in equation), T_{min} = Min.Temp. (°C),
WS = Wind speed (km/hrs), BSS = Bright sunshine hours (hrs)
R^2 = Squared multiple correlation.

Conclusions:

1. incidence of thrips on sunflower can be forecasted by Forewarning model at 66 % accuracy
2. The significantly highest yield and minimum infestation was observed in variety PhuleRaviraj than variety Bhanu and MSFH-17, sowing window 30th MW (S_2: 23rdJuly – 29th July) was higher than S_3 and S_1 and under protected condition (P_1) as compared to unprotected condition (P_2).
3. It would be, therefore, advisable to sow PhuleRaviraj variety of *kharif* sunflower during 30th MW (S_2: 23rdJuly – 29th July) to get maximum returns with less thrips infestation.

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