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Epidemiology of sunflower necrosis disease

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ABSTRACT

The occurrence of disease in a given crop is mainly influenced by weather parameters and biological factors. Therefore, the data pertaining to the incidence of Sunflower Necrosis Disease (SND) and *Thrips palmi* (Karny), vector of Sunflower Necrosis Virus (SNV) in sunflower across different sowing dates was subjected to correlation and multiple linear regression analysis with different meteorological parameters. The disease incidence in the crop sown at different dates varied, ranging from 0.67 per cent in the crop sown in November to as high as 39.30 per cent in the crop sown in January. It clearly revealed that, the disease incidence was very low in the crop sown during September and November months and moderate in the crop sown during July, August and December months. Also it was observed that disease incidence and thrips count positively correlated with bright sunshine hours, maximum and minimum temperature and negatively correlated with total number of rainy days, rainfall and relative humidity.

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Key words : Sunflower Necrosis Virus, *Thrips palmi,* Weather parameters, Correlation and multiple linear regression

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an important oilseed crop of India. Apart from many fungal diseases a new viral disease caused by Sunflower Necrosis Virus (SNV) is becoming a threat for sunflower cultivation. The disease was noticed for the first time in the country during 1997 at Bagepalli of Kolar district of Karnataka. Later its occurrence was recorded in different states like Tamil Nadu, Andhra Pradesh and Maharastra (Nagaraju *et al.,* 1998). The disease is initiated as necrosis of part of the leaf lamina followed by various types of necrosis and mosaic mottling symptoms (Ajith Prasad and Nagaraju, 2005). Aravind (2002) reported that *Thrips palmi* was successful in transmitting the disease, thus acting as the vector of SNV. It was observed that the disease incidence being maximum in May-June sown crop but declined with the onset of rains during *Kharif* (Anonymous, 1997). With all these basic information experiments were laid out to study the exact influence of different sowing dates on SND and its vector and further correlation and regression analysis were done with the weather parameters.

MATERIALS AND METHODS

In this experiment, the sunflower hybrid KBSH-44 and open pollinated variety Morden (susceptible to necrosis virus disease) were sown in plots of 3m x 3m with a spacing of 60 x 30 cm laid as Randomized Complete Block Design and replicating thrice at ZARS, GKVK at monthly intervals starting from July to Jan 2006. The different dates of sowing were 21st July, 17th August, 10th September, 10th October, 24th November, 16th December 2005 and 28th January 2006. The recommended package of practice was followed during experimentation, except plant protection measures. The necrosis disease incidence was monitored from the germination of the crop till 50 per cent flowering stage in each of the sowing dates.

The per cent disease incidence and thrips per plant were recorded at 20, 40 and 60 days after sowing in all the replications and average was calculated. In each plot thrips population was recorded from randomly selected five plants (in each plant two leaves each at basal, middle and top level of canopy were selected). The number of nymphs and adults prevalent on these leaf surfaces was counted and expressed as total number of thrips per plant

Correlation between disease incidence and *Thrips palmi* with weather parameters:

The data pertaining to the disease incidence and thrips in sunflower across six different sowing dates was subjected to correlation and multiple linear regression analysis with meteorological parameters such as, maximum and minimum temperature, morning and evening relative humidity, bright sunshine hours, total rainfall and number of rainy days.

The weather parameters and the thrips count was correlated with the disease incidence by adopting the Karl

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Pearson's correlation co-efficient (r), as given below :

$$r = \frac{\Sigma(x - X)(y - Y)}{\sqrt{\Sigma(x - X)^2}\sqrt{\Sigma(y - Y)^2}}$$

where X and Y are the two variables
X – Mean of x
Y – Mean of y
r – Karl Pearson's correlation coefficient

RESULTS AND DISCUSSION

The results of the studies revealed that the mean per cent disease incidence ranged from 0.88 to 57.87 and the average number of thrips per plant ranged from 0.06 to 8.60 on KBSH-44 (Table 2). In case of Morden, mean per cent disease incidence ranged from 1.75 to 29.30 and average number of thrips per plant ranged from 0.00 to 7.86 (Table 3).

Influence of weather parameters on Sunflower necrosis disease and thrips population:

KBSH-44:

In case of KBSH–44, least mean per cent disease incidence was recorded on 4th Jan. (0.88), followed by 8th Sept. (1.39) and 30th Jan. (2.25). Highest mean per cent disease incidence was recorded on 8th April (57.87), followed by 21st Sept. (16.93) and 14th March 05 (11.62). However, the crop remained disease free at 10th Aug., 26th Sept., 12th Dec. and 6th Jan. 2006.

The data also revealed that least average number of thrips per plant was observed on 2nd Sept. and 8th Sept. (0.06 each), followed by 12th Dec. (0.07), 21st Oct. (0.13). Highest average number of thrips per plant was observed at 24th Feb. (8.6), followed by 21st Feb. and 8th April (6.07). However, the crop did not harbor any thrips when the observation was made at 10th Aug. and 11th Nov. 2005.

Morden:

Incase of Modern, the crop remained disease free at 10th Aug., 26th Sept., 12th Dec. and 6th Jan.. Least mean per cent disease incidence was recorded at 4th Jan. (0.45), followed by 8th Sept. (0.65), 21st Oct. (1.75), 30th Jan. (1.77). Highest mean per cent disease incidence was observed at 14th March (29.3), followed by 21st Sept. (27.9) and 8th April (20.73).

Least average number of thrips per plant was observed at 11th Nov. (0.06), followed by 6th Jan. (0.07), 8th Sept. (0.26), 26th Sept. and 4th Jan. (0.4 each). Highest mean per cent disease incidence was recorded at 24th Feb. (7.86), followed by 8th April (5.87), 14th March (5.13), 30th Jan. (5.00). Further, the crop remained free from thrips when the observation was recorded at 10th Aug. and 12th Dec.

Table 1: Influence of different sowing dates on the incidence of sunflower necrosis disease (SND) and thrips

Sowing date	Cultivar	No. of thrips/plant DAS			SND % DAS		
		20	40	60	20	40	60
I	KBSH-44	0.00	0.06	0.33	0.00	10.39	16.93
21/7/2005	Morden	0.00	0.88	1.00	0.00	11.30	27.90
	Mean	0.00	0.47	0.67	0.00	10.85	22.42
II	KBSH-44	0.06	0.33	0.40	1.39	5.97	10.75
17/8/2005	Morden	0.26	1.86	1.20	0.65	8.67	17.08
	Mean	0.16	1.10	0.80	1.02	7.32	13.92
III	KBSH-44	0.33	0.13	0.00	0.00	4.42	5.5
10/9/2005	Morden	0.40	0.27	0.06	0.00	1.75	4.50
	Mean	0.37	0.20	0.03	0.00	3.09	5.5
V	KBSH-44	0.07	0.60	3.00	0.00	0.88	2.25
24/11/2005	Morden	0.00	0.40	4.60	0.00	0.45	1.77
	Mean	0.04	0.50	3.80	0.00	0.67	2.01
VI	KBSH-44	0.93	4.86	8.60	0.00	2.67	7.79
16/12/2005	Morden	0.07	5.00	7.86	0.00	4.04	14.18
	Mean	0.50	4.93	8.23	0.00	3.36	10.99
VII	KBSH-44	6.07	5.27	6.07	6.06	11.62	57.87
28-1-2006	Morden	4.00	5.13	5.87	3.30	29.30	20.73
	Mean	5.04	5.20	5.97	4.68	20.46	39.30

Note : DAS = Days after sowing

Table 2: Relationship between incidence of SND and *Thrips palmi* in KBSH-44 with weather

Sowing date	Days after sowing	Observation date	Average no. of thrips per plant	SND (%)	No. of rainy days	Rainfall (mm)	Temperature (°C)		RH%	Sunshine hours
							Max	Min		
I	20	10/08/05	00.00	00.00	04	029.80	27.07	19.17	75.87	03.03
21/7/2005	40	2/09/05	00.06	10.39	07	246.40	27.83	19.09	70.90	04.93
	60	21/09/05	00.33	16.93	06	178.80	27.68	19.32	73.74	04.88
II	20	8/09//05	00.06	01.39	07	132.60	27.98	19.19	72.31	05.48
17/8/2005	40	26/09/05	00.33	05.97	02	028.40	27.28	19.03	72.39	05.23
	60	15/10/05	00.40	10.75	08	182.80	27.74	18.96	72.53	04.87
III	20	26/09/05	00.33	00.00	19	518.00	27.28	18.98	72.47	05.41
10/9/2005	40	21/10/05	00.13	04.42	11	307.40	27.72	18.89	73.02	05.30
	60	11/11/05	00.00	05.50	06	256.00	25.33	18.59	78.50	02.50
V	20	12/12/05	00.07	00.00	14	551.40	25.04	14.85	74.23	05.55
24/11/2005	40	4/01/06	00.60	00.88	00	000.00	25.58	13.79	68.78	08.44
	60	30/01/06	03.00	02.25	00	027.60	27.94	13.78	63.83	09.44
VI	20	6/01/06	00.93	00.00	00	000.00	25.81	13.60	68.26	09.34
16/12/2005	40	30/01/06	04.86	02.67	00	000.00	28.10	13.69	63.71	09.46
	60	24/02/06	08.60	07.79	00	000.00	29.60	11.98	60.08	10.57
VII	20	21/02/06	06.07	06.06	00	000.00	29.32	11.90	60.80	10.53
28-1-2006	40	14/03/06	05.27	11.62	03	091.80	30.58	17.96	63.13	09.07
	60	08/04/06	06.07	57.87	00	000.00	31.78	18.05	59.00	08.93

Table 3 : Relationship between incidence of SND and *Thrips palmi* in morden with weather parameters

Sowing date	Days after sowing	Observation date	Average no. of thrips per plant	SND (%)	No. of rainy days	Rainfall (mm)	Temperature (°C)		RH%	Sunshine hours
							Max	Min		
I	20	10/08/05	00.00	00.00	04	029.80	27.07	19.17	75.87	03.03
21/7/2005	40	02/09/05	00.88	11.30	07	246.40	27.83	19.09	70.90	04.93
	60	21/09/05	01.00	27.90	06	178.80	27.68	19.32	73.74	04.88
II	20	8/09//05	00.26	00.65	07	132.60	27.98	19.19	72.31	05.48
17/8/2005	40	26/09/05	01.86	08.67	02	028.40	27.28	19.03	72.39	05.23
	60	15/10/05	01.20	17.08	08	182.80	27.74	18.96	72.53	04.87
III	20	26/09/05	00.40	00.00	19	518.00	27.28	18.98	72.47	05.41
10/9/2005	40	21/10/05	00.27	01.75	11	307.40	27.72	18.89	73.02	05.30
	60	11/11/05	00.06	04.50	06	256.00	25.33	18.59	78.50	02.50
V	20	12/12/05	00.00	00.00	14	551.40	25.04	14.85	74.23	05.55
24/11/2005	40	04/01/06	00.40	00.45	00	000.00	25.58	13.79	68.78	08.44
	60	30/01/06	04.60	01.77	00	027.60	27.94	13.78	63.83	09.44
VI	20	06/01/06	00.07	00.00	00	000.00	25.81	13.60	68.26	09.34
16/12/2005	40	30/01/06	05.00	04.04	00	000.00	28.10	13.69	63.71	09.46
	60	24/02/06	07.86	14.18	00	000.00	29.60	11.98	60.08	10.57
VII	20	21/02/06	04.00	03.30	00	000.00	29.32	11.90	60.80	10.53
28-1-2006	40	14/03/06	05.13	29.30	03	091.80	30.58	17.96	63.13	09.07
	60	08/04/06	05.87	20.73	00	000.00	31.78	18.05	59.00	08.93

Correlation and multiple linear regressions between sunflower necrosis disease, thrips vector and weather parameters in:

Sunflower necrosis disease (SND):

In KBSH–44 SND incidence showed highly significant and positive association with the maximum temperature (r = 0.59), whereas, the influence of rainy days (r = -0.21), rainfall (r = -0.17), minimum temperature (r = 0.28), relative humidity (r = -0.33) and sunshine hours (r = 0.07) on SND were found to be non-significant (Table

Table 4 : Correlation between the SND and *Thrips palmi* in KBSH- 44 with weather parameters

Sunflower necrosis disease (SND) and thrips count	Rainy days (No.)	Rainfall (mm)	Maximum temperature (ºC)	Minimum temperature (ºC)	Relative humidity (%)	Sunshine hours
SND	- 0.21	- 0.17	0.59**	0.28	-0.33	0.07
Thrips palmi count	- 0.45*	- 0.42	0.59**	-0.57**	-0.75**	0.68*

* and ** indicate significance of value at P = 0.05 and 0.01, respectively

4).

The incidence of necrosis in Morden was also highly significant and showed a positive association with the maximum temperature (r = 0.62), whereas its relationship with the other parameters *i.e*., rainfall (r = -0.17), rainy days (r = - 0.18), minimum temperature (r = 0.28), relative humidity (r = -0.29) and sunshine hours (r = 0.10) was found to be non-significant (Table 6). The multiple linear regression equation threw light on the fact that, SND incidence in KBSH – 44 and Modern was influenced by 72 and 62 per cent, respectively by weather parameters (Table 5 and 7). Further the table also revealed a clear positive correlation between thrips population and disease incidence in both KBSH-44 and Modern indicating the involvement of this agent in spread of the disease.

Thrips:

The thrips population in KBSH-44 showed highly significant and positive relationship with maximum temperature (r = 0.59) and sunshine hours (r = 0.68). However, the thrips population showed a highly significant and negative association with relative humidity (r = -0.75) and minimum temperature (r = -0.57) and also negative and significant association with rainy days (r = -0.45). Rainfall showed non significant negative correlation (r = -0.42) with the incidence of thrips (Table 4).

Similar results were obtained in Morden where the thrips population showed a positive and a highly significant association with maximum temperature (r = 0.60) and sunshine hours (r = 0.63) and significant negative association with minimum temperature (r = -0.51), relative humidity (r = -0.73) and rainy days (r = -0.45). However, its association with the rainfall (r = -0.41) was found to be non-significant (Table 6).

The multiple linear regression analysis suggests that thrips incidence in KBSH-44 and Morden was influenced to an extent of 75 and 67 per cent, respectively by the abiotic parameters (Table 5 and 7).

From the above results it is clear that the disease incidence was low during November and very high during January and also that the thrips incidence was also lower in the July, August and September sown crops and it was higher in the December and January sown crops. These findings are similar to that of Anil Kumar (1999) and

Table 5 : Regression analysis for SND and *Thrips palmi* in KBSH- 44 with abiotic factors

Sunflower necrosis disease (SND) and thrips count	Regression equation	R^2 value
SND	$Y= 417.03 – 3.37 X_1+ 0.09 X_2 + 3.48 X_3 + 4.623X_4 – 5.01 X_5 – 5.91 X_6$	0.72
Thrips	$Y= -70.82 + 0.01 X_1+ 0.0002X_2 + 3.14 X_3 – 2.07 X_4 + 0.38 X_5 – 0.84 X_6$	0.75

Note: X_1 = Rainy days (No.) X_2 = Rain fall (Total) X_3 = Maximum temperature (Mean)
X_4 = Minimum temperature (Mean) X_5 = Relative humidity (Mean) X_6 = Sunshine hours (Mean)

Table 6: Correlation between SND and *Thrips palmi* in Morden with weather parameters

Sunflower necrosis disease (SND) and thrips count	Rainy days (No.)	Rainfall (mm)	Maximum temperature (ºC)	Minimum temperature (ºC)	Relative humidity (%)	Sunshine hours
SND	- 0.18	- 0.17	0.62**	0.28	- 0.29	0.10
Thrips	- 0.45*	- 0.41	0.60**	- 0.51*	- 0.73**	0.63**

* and ** indicate significance of values at P = 0.05 and 0.01, respectively

Table 7 : Regression analysis for SND and *Thrips palmi* in Morden with abiotic parameters

Sunflower necrosis disease (SND) and thrips count	Regression equation	R^2 value
SND	$Y = -552.78 – 3.54 X_1+ 0.10 X_2 + 8.626X_3 + 1.66 X_4 + 3.75 X_5 + 5.803X_6$	0.67
Thrips	$Y = -40.18 – 0.04 X_1+ 0.001 X_2 + 2.49 X_3 – 1.65 X_4 + 0.11 X_5 – 1.00 X_6$	0.67

Note: X_1 = Rainy days (No.) X_2 = Rain fall (Total) X_3 = Maximum temperature (Mean)
X_4 = Minimum temperature (Mean) X_5 = Relative humidity (Mean) X_6 = Sunshine hours (Mean)

Shivasharanayya (2000) who reported that the disease incidence was more in crops during summer months followed by *Rabi* and *Kharif* sown crops. Further, Nagaraju *et al*. (2003) reported that the incidence was very low in crops sown during rainy period and started increasing in the crops sown from December onwards (*Rabi* and summer months) while it was moderate in the crop sown during early monsoon months.

The correlation studies revealed that, the sunflower necrosis disease incidence had a significant positive correlation with maximum temperature and negative correlation with the relative humidity. The multiple regression analysis revealed that, the weather parameters together had 58 per cent impact on the incidence of necrosis disease. The correlation study further revealed that, the thrips population had a highly significant positive correlation with maximum temperature and sunshine hours, while it was negatively correlated with the relative humidity, whereas, it showed significant negative correlation with the rainy days. The multiple regression analysis also revealed that the weather parameters together had 71 per cent impact on the incidence of thrips, Similar findings were found by Shivasharanayya and Nagaraju (2003) and Lokesh (2006) who observed positive correlation of necrosis disease and thrips incidence with that of maximum and minimum temperature, bright sunshine hours in sunflower. Further, a non-significant positive correlation was obtained between thrips population and necrosis disease incidence in the present study, which is in agreement with the findings of Shivasharanayya (2000). Thus, these findings indicated the involvement of thrips vector in the initiation and spread of the virus disease and the profound influence of the weather parameters in the fluctuation of the thrips population and necrosis virus disease under field condition. Thus, by these experiments it is confirmed that the disease incidence and its vector population increase is high during summer, followed by *Rabi* and is low during rainy season.

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