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Integrated Management of Sunflower Necrosis Disease

MANJUNATH S. HURAKADLI AND K. T. RANGASWAMY
Department of Plant Pathology, College of Agriculture, UAS, GKVK, Bengaluru-560 065
E-mail : mshurakadli@gmail.com

ABSTRACT

A field study was conducted during 2016-17 to find out the effectiveness of integrated disease management (IDM) method aimed at preventing sunflower necrosis disease infection process through cultural and vector management practices. The IDM technology using maize (variety African tall) as border crop and spraying insecticides like fipronil 5 per cent S.C and defense inducing molecules (oligocarranegen) was found effective in both vector and disease management. The bordering of maize crop recorded lowest mean necrosis incidence of 11.69, 12.80 and 15.26 per cent at 30, 60 and 90 DAS, respectively, with maximum yield of 12.22 q ha^{-1} over non border treatment. Amongst the sub-treatments, seed treatment with imidacloprid 600 F.S. at 5 ml / kg + spray of defense inducing molecules (oligocarranegen) along with foliar application of fipronil 5 per cent S.C at 15, 30 and 45 DAS recorded lowest necrosis disease incidence of 5.57, 7.16 and 7.90 per cent at 30, 60, and 90 DAS, respectively. The treatment recorded the least mean number of thrips of 1.05, 1.72, and 2.01 per plant at 15, 30, and 45 DAS, respectively, with maximum yield of 16.05 q ha^{-1}. Whereas,untreated control recorded the highest necrosis disease incidence of 22.88, 26.15 and 31.80 per cent,respectively, at 30, 60, and 90 DAS with highest mean number of thrips of 7.61, 11.50, and 9.57 per plant at 15, 30, and 45 DAS respectively with minimum yield of 6.90 q ha^{-1}.

Keywords : Sunflower necrosis disease, thrips, seed treatment, spray, border crop

SUNFLOWER (*Helianthus annuus* L.) is an important oilseed crop belonging to family *Asteraceae*. It is the third most important edible oilseed crop next to soybean and groundnut in the world. This crop was introduced into India during 1969, and accounts for nearly 5 per cent of the current oilseed production. The crop is cultivated in anarea of 1.48 million hectares with production of 0.9 million tonnes in India Anon., 2010). The crop is known to be infected byseveral fungal and viral diseases. Among the viral diseases, sunflower necrosis disease has gained importance because of its devastating nature in most of the sunflower growing states of India.

Sunflower necrosis disease was observed for the first time during 1997 in seed production area of Bagepalli village in Kolar district of Karnataka State (Singh *et al*., 1997). The disease is caused by Tobacco streak virus (Prasada Rao *et al*., 2000 and Bhat *et al*., 2002) and it is transmitted by *Thrips palmi* (Harvir Singh, 2005). The disease can cause crop losses to an extent of 100 per cent depending on the cultivar / variety and stage of infectionand has become a major limiting factor in sunflower production.

It is difficult to combat the virus disease through single approach. Most of the sunflower hybrids currently under cultivation in India have shown various degree of susceptibility to sunflower necrosis disease. So an integrated approach has been found very promising in sustainable management of vector borne diseases. Therefore, a field study was conducted during *kharif* season 2016-17 to evaluate effect of border crop, use of different insecticides and defense inducing molecules on the management of sunflower necrosis disease.

MATERIAL AND METHODS

Details of the experiment : A field experiment was conducted during *kharif* season of 2016-17 at ZARS, AICRP (Sunflower), UAS, GKVK, Bengaluru. Split plot design was used with two main treatments and eight sub-treatments replicated three times. Sunflower hybrid KBSH-44 was used for the experiment. The net plot size of 3.2 × 4.0 m was maintained for each treatment with 60 cm distance between rows and 30 cm between plants. All standard

agronomic practices were followed. Five rows of maize (var. African tall) were sown 15 day prior to sunflower sowing as a border crop around the main treatment (M_1). For sub-treatments, seed treatment and spray schedule were followed as described under treatment details. Necrosis disease incidence was recorded at 30, 60 and 90 DAS in each treatment by actually counting the diseased plants and the per cent disease incidence was calculated. Yield data were recorded separately for each treatment after the crop harvest. Treatment wisemean per cent necrosis disease incidence and yield.

Treatment details are as follows

I Main treatments;

M_1 With border crop (African tall maize)

M_2 Without border crop

II Sub treatments

T_1 Control

T_2 Soil application of carbofuran 3G @ 8-10kg/acre at 30DAS (days after sowing).

T_3 Seed treatment with imidacloprid 600 F.S. at 5 ml/kg of seeds

T_4 Seed treatment with imidacloprid 600 F.S. at 5 ml/kg of seeds + two sprays of fipronil 5%S.C. @ 1.5 ml/L at 15 and 30 DAS.

T_5 Seed treatment with imidacloprid 600 F.S. at 5 ml/kg of seeds + two sprays of fipronil 5% S.C @ 1.5 ml/Lat 15 and 45 DAS.

T_6 Seed treatment with imidacloprid 600 F.S. at 5 ml/kg + three sprays of fipronil 5% S.C @ 1.5 ml/L at 15, 30 and 45 DAS.

T_7 Seed treatment with imidacloprid 600 F.S. at 5 ml/kg + 3 sprays with defense inducing molecules (oligocarranegen) at 15, 30 and 45 DAS.

T_8 Seed treatment with imidacloprid 600 F.S. at 5 ml/kg + Spray of defense inducing molecules (oligocarranegen) along with foliar application of fipronil 5% S.C @ 1.5 ml/L at 15, 30 and 45 DAS.

Per cent disease reduction over control

The per cent disease reduction over control was calculated by using the formula given by Vincent (1947).

$$\text{Per cent disease reduction} = \frac{(C-T)}{C} \times 100$$

Where,

C = Per cent disease in control

T = Per cent disease in treatment

The thrips population was recorded at 15, 30 and 45 DAS immediately 5 days after respective spray from randomly selected three plants in each treatment. Observations were subjected to statistical analysis to assess the impact of different treatments on thrips vector incidence and data are presented in Table II.

Results and Discussion

Effect of different treatments on sunflower necrosis disease (SND) incidence

Border row plot recorded significantly less SND incidence when compared to non-border plot (Table I). The bordering of maize crop (M_1) recorded lowest mean necrosis disease incidence of 11.69, 12.80 and 15.26 per cent at 30, 60 and 90 DAS, respectively, over non border treatment (M_2). The former treatment (M_1) was found significantly superior over the latter treatment (M_2) on per cent necrosis incidence of sunflower necrosis virus (14.94, 17.57 and 19.31 per cent at 30, 60, and 90DAS, respectively). This indicated the effectiveness of border crop in minimizing necrosis incidence. The maize border acted as barrier for vector movement from outside sources.

Significant differences were observed among the different treatments with respect to SND incidence at 30, 60 and 90 DAS (Table I). Seed treatment with imidacloprid 600 F.S. at 5 ml / kg + spray of defense inducing molecules (oligocarranegen) along with foliar application of fipronil 5 per cent S.C at 15, 30 and 45 DAS (T_8) recorded lowest necrosis disease incidence of 5.57, 7.16 and 7.90 per cent at 30, 60, and 90 DAS, respectively, with 75.15 per cent disease reduction over the control. This treatment was on par with the seed treatment with imidacloprid 600 F.S. at 5 ml / kg +

TABLE I

Effect of different treatments on necrosis disease incidence and yield in sunflower

Treatments	Disease incidence (per cent)*						Per cent reduction over control (90 DAS)	Yield (q ha^{-1})
	30 DAS		60 DAS		90 DAS			
Main Plot								
M_1	11.69	(18.82)	12.81	(19.81)	15.26	(21.80)	-	12.22
M_2	14.94	(21.65)	17.57	(23.60)	19.31	(24.70)	-	10.73
SEm±	0.32		0.76		0.59		-	0.14
CD at 5%	1.05		2.39		1.83		-	0.51
C.V (%)	11.68		24.64		16.79			6.12
Subplot								
T_1	22.88	(27.45)	26.15	(29.37)	31.80	(32.52)	0.00	6.90
T_2	18.64	(24.76)	20.80	(25.80)	23.24	(27.71)	26.91	8.06
T_3	20.72	(25.96)	21.77	(26.74)	23.98	(28.14)	24.59	8.20
T_4	8.96	(17.01)	11.00	(18.85)	11.93	(19.71)	62.48	13.83
T_5	9.86	(17.88)	11.26	(19.14)	14.20	(21.59)	55.34	12.85
T_6	6.54	(14.56)	8.01	(16.09)	9.61	(17.61)	69.77	15.02
T_7	13.33	(20.94)	15.39	(22.50)	15.62	(22.68)	50.88	10.89
T_8	5.57	(13.32)	7.16	(15.17)	7.90	(16.03)	75.15	16.05
SEm±	1.05		0.59		0.67		-	0.40
CD at 5%	3.04		1.72		1.95		-	1.17
C. V (%)	19.29		9.59		9.55		-	8.65
Interaction								
Main within sub								
S.Em+	1.48		0.84		0.95		-	0.57
C.D.(P=0.05)	NS		NS		NS		-	NS
Sub within main								
S.Em+	0.93		1.41		1.06		-	0.41
C.D.(P=0.05)	NS		NS		NS		-	NS

*Figures in parenthesis are angular transformed values, DAS = Days after sowing, NS = Non significant

three sprays of fipronil 5 per cent S.C at 15, 30 and 45 DAS (T_6)which recorded disease incidence of 6.54, 8.01 and 9.61 per cent at 30, 60 and 90 DAS, respectively, with 69.77 per cent disease reduction over control.

Seed treatment with imidacloprid 600 F.S. at 5 ml / kg + 3 sprays with defense inducing molecules (oligocarranegen) at 15, 30 and 45 DAS (T_7) recorded disease incidence of 13.33, 15.39, and 15.62 per cent at 30, 60, and 90 DAS, respectively. It did not show

any significant reduction in thrips population but must have a role on inducing defense mechanisms in plants as it resulted in reduced disease incidence with increased yield, besides recorded 50.88 per cent disease reduction over control.

The highest necrosis disease incidence of 22.88, 26.15 and 31.80 per cent at 30, 60, and 90 DAS, respectively, was recorded in untreated control (T_1). Soil application of carbofuran 3G @ 8-10 kg / acre at 30 DAS (T_2) and seed treatment with imidacloprid 600 F.S. at 5 ml / kg of seeds (T_3) were found on par with the control. T_2 and T_3 recorded 26.91 and 24.59 per cent disease reduction, respectively, over control. However, the interaction effects werefound to benon-significant.

Effect of different treatments on yield

Significant difference was recorded for yield between border row and non-border row plots (Table I). The border row plot recorded significantly higher yield (12.22 q ha^{-1}) over non border plot (10.73 q ha^{-1}). The results signifies the role of border crop in minimizing necrosis disease incidence and increasing the crop yield.

Significant differences were observed among the different sub treatments with respect to yield (Table 1). The sub treatment comprising seed treatment (imidacloprid 600 F.S. at 5 ml / kg) and three foliar sprays of insecticide (fipronil 5 per cent S.C @ 1.5 ml / L) along with defense inducing molecules (oligocarranegen) at 15, 30 and 45 DAS (T_8) recorded the significantly maximum yield (16.05 q ha^{-1}) followed by sub treatment comprising seed treatment (imidacloprid 600 F.S. at 5 ml / kg) and three foliar sprays of insecticide (fipronil 5%. S.C@ 1.5ml / L) alone (T_6) at 15, 30 and 45 DAS (15.02 q ha^{-1}). The least yield was recorded with untreated control (6.90 q ha^{-1}).

Similar reports of Shirshikar (2008) supported the present findings, border crop with 6 rows of sorghum and seed treatment along withthree sprayings of imidacloprid recorded low mean necrosis incidence of 10.2 per cent and maximum yield of 1222 kg ha^{-1}. Seed treatment with thiamethoxam (4 g / kg seed) along with 2 sprays of thiomethoxam (0.05%) at 30 and 45 DAS recorded 4.89 per cent disease and yield of 1489 kg ha^{-1}.

Effect of different treatments on thrips population

Significant differences in between border row and non-border row plots pertaining to thrips population at 15, 30 and 45 DAS (Tables II). The main treatment, *i.e.,* bordering of maize crop (M_1) recorded least mean number of thrips of 2.99, 4.89 and 4.93 per plantat 15, 30 and 45 DAS, respectively, over non border treatment (M_2). The non-border main treatment (M_2) recorded the higher thrips population of 4.45, 6.36 and 6.32per plant at 15, 30 and 45 DAS, respectively.

The border crop with maize would have helped to minimize the frequency of vector movement from outside sources, thereby helps in minimizing necrosis incidence and increasing crop yield. Migratory thrips when alighted on the barrier cropmust have lost their viruliferous nature because of testprobing on the crop. Critical observation of the data reveals that significantreduction in SND and thrips population was found intreatments having a combination of barrier crop comparedto other treatments. The reduction in viral diseases by growing barrier crops around the field was also reported by Bhat *et al*. (2012).

The significant differences were observed within the sub-treatments in reducing the thrips population (Table II). Seed treatment with imidacloprid 600 F.S. at 5 ml / kg + spray of defense inducing molecules (oligocarranegen) along with foliar application of fipronil 5 per cent S.C at 15, 30 and 45 DAS (T_8) recorded the least mean number of thrips of 1.05, 1.72, and 2.01 per plant at 15, 30, and 45 DAS, respectively, and 78.99 per cent reduction in thrips population over the untreated control. The next best treatment in recording lower thrips population was seed treatment with imidacloprid 600 F.S. at 5 ml / kg + three sprays of fipronil 5 per cent S.C at 15, 30 and 45 DAS (T_6) which recorded the mean number of thrips of 1.22, 2.00, and 2.18 per plant at 15, 30, and 45 DAS, respectively, and found 77.22 per cent reduction in thrips population over the control. The highest mean number of thrips of 7.61, 11.50 and 9.57 per plant at 15, 30, and 45 DAS, respectively, was recorded in untreated control (T_1).

TABLE II

Effect of different treatments on thrips population in sunflower

Treatments	Thrips population (Mean of three plants)						Per cent reduction in trips over control (45 DAS)
	15 DAS		30 DAS		45 DAS		
Main Plot							
M_1	2.99	(1.77)	4.89	(2.19)	4.93	(2.25)	-
M_2	4.45	(2.10)	6.36	(2.51)	6.32	(2.51)	-
SEm±	0.03		0.20		0.18		-
CD at 5%	0.10		0.66		0.57		-
C. V (%)	12.70		17.76		15.63		-
Subplot							
T_1	7.61	(2.84)	11.50	(3.46)	9.57	(3.15)	0.00
T_2	6.67	(2.66)	4.17	(2.15)	9.07	(3.08)	5.22
T_3	5.89	(2.52)	9.66	(3.19)	8.74	(3.04)	8.67
T_4	1.33	(1.33)	2.05	(1.58)	5.24	(2.39)	45.24
T_5	1.39	(1.37)	7.28	(2.72)	2.31	(1.68)	75.86
T_6	1.22	(1.30)	2.00	(1.58)	2.18	(1.62)	77.22
T_7	4.60	(2.24)	6.61	(2.65)	6.18	(2.58)	35.42
T_8	1.05	(1.24)	1.72	(1.48)	2.01	(1.58)	78.99
SEm±	0.28		0.47		0.29		-
CD at 5%	0.81		1.36		0.86		-
C. V (%)	18.59		20.40		12.96		-
Interaction							
Main within sub							
S.Em+	0.39		0.66		0.42		-
C.D.(P=0.05)	NS		NS		NS		-
Sub within main							
S.Em+	0.37		0.76		0.61		-
C.D.(P=0.05)	NS		NS		NS		-

*Figures in parenthesis are angular transformed values, DAS = Days after sowing, NS = Non significant

The results are in agreement with the finding of Pandey *et al*. (2013) who have reported that lowest thrips population and highest bulb yield by applying fipronil. Similarly fipronil and imidacloprid reduced the thrips damage severity and increased the onion bulb yield (Ullah *et al.,* 2010; Gachu *et al*., 2012).

Growing a border crop around the main field and seed treatment with imidacloprid 600 F.S. at 5 ml / kg and Spray of defense inducing molecules (oligocarranegen) along with foliar application of fipronil 5 per cent S.C at 15, 30 and 45 DAS (T_8) was found effective over other treatments. Bhat *et al*.

(2012) also found that seed treatment with thiomethoxam and three sprays of thiomethoxam at 15, 30 and 45 days after sowing along with 3 rows of border crop of sorghum followed by seed treatment with imidacloprid and three sprays of imidacloprid along with 3 rows of border crop sorghum were found best in reducing the sunflower necrosis disease incidence (3.80 and 4.65 per cent respectively, compared to 21.16 per cent in control) and the thrips population (0.56 and 0.70 thrips / plant compared to 4.06 thrips / plant in control). The treatments not only reduced SND infection and thrips population but also increased yield and yield parameters in sunflower cv. Morden.

It can be concluded that management of necrosis disease through integrated approach comprising of growing a border crop around field and seed treatment with imidacloprid 600 F.S. at 5 ml / kg and Spray of defense inducing molecules (oligocarranegen) along with foliar application of fipronil 5 per cent S.C at 15, 30 and 45 DAS can be used for sustainable management of sunflower necrosis virus disease.

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