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Management of Sesame Phyllody: A Destructive Disease of East- Central Rajasthan, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Sesame (*Sesamum indicum L.*) is one of the important annual oldest oil seed crop grown in tropical to temperate zones in India. It belongs to family Pedaliaceae is native of India and plays an important role in the oilseed economy throughout the world. The sesame crop suffers from phyllody disease caused by phytoplasma. The effect of different treatments on "percent" disease incidence. The results obtained revealed that all the treatments reduced the disease significantly compared to unsprayed control. Seed treatment with imidachlorprid 70 % WG + spraying of imidachlorprid 17.8% SL+ spraying of tetracycline hydrochloride recorded the least disease incidence (7.27 %), minimum leaf hopper population and maximum "percent" disease control (65.59 %) and while seed treatment with imidachlorprid 70 % WG was least effective in which disease incidence of 15.46 "percent" and maximum leaf hopper population was recorded. The disease incidence in untreated check was 21.13 "percent" was recorded. Out of 22 germplasms/varieties screened against sesame phyllody 1 genotype was susceptible, 10 were moderately susceptible, 7 were moderately resistant and 4 genotypes were found resistant against phyllody of sesame.

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1. INTRODUCTION

"Sesame (*Sesamum indicum* L.) is an important edible kharif oilseed crop grown in hotter and drier areas. Sesame seed is unique in its composition having appreciable amounts of protein (20%) and edible oil (50%) and contains high amount of saturated fatty acids (47% oleic acid and 39% linolenic acid)" (Moazzami et al., [1] Uzun et al., [2] "Sesame oil contains natural antioxidants sesamoline, sesamin and sesamol which cause an excellent stability" Shyu and Hwang, [3] "In recent years, regular occurrence of Phyllody has been recorded from districts of Rajasthan State. Now it is becoming a serious phytoplasmal disease of sesame. The disease is transmitted in nature by the leaf hopper vector, *Orosius albicintus* Distant" Vasudeva and Sahambi, [4] Prasad and Sahambi, [5] Choudhary and Prasad, [6]. "Yield losses up to 34 per cent or even 100 per cent, in case of serious incidence" Sarwar and Haq, [7] "It has been observed that, 1 per cent increase in disease incidence decrease yield by 8.36 kg/ha" Maiti *et al.* [8]. Therefore, looking the economic importance of the disease, the present plant pathological study was conducted to produce the information on management of sesame phyllody by insecticides, biopesticides, antibiotics.

2. MATERIALS AND METHODS

2.1 To Evaluate *In-vivo* Efficacy of Insecticides, Bio-Pesticides and Antibiotics

A field trial was conducted during kharif 2019 to evaluate the efficacy of insecticides as seed treatment as well as foliar application in a combination of insecticides, biopesticides and antibiotics as a foliar spray for the management of vector-leaf hopper (*Orosius albicinctus*) and phyllody disease of sesame. The experiment was conducted at Agronomy farm of the Department of Plant Pathology, S.K.N. College of Agriculture, Jobner, Jaipur, Rajasthan in a randomized block design with three replications using local variety in 2.1m x 2.0 m plot size with row to row spacing at 30 cm and plant to plant spacing of 10 cm. Recommended doses of fertilizers were applied with light irrigation for better seedling germination. Intercultural operations are also performed as and when required. Three sprays of insecticide, biopesticides and antibiotics were given. First spraying was done after first appearance of disease and subsequently two at 15 day intervals. The trial consisted of following eight treatments viz. T_1= Seed Treatment Imidacloprid 70% WG @6gm/kg, T_2= T_1+ Spraying of Imidacloprid 17.8 % SL @0.25ml/lits, T_3 = T_1 + Spraying of Azadirachtin @0.03%, T_4= T_1 + Spraying of Tetracycline HCL@500ppm, T_5= T_2+ Spraying of Azadirachtin @0.03%, T_6= T_2 + Spraying of Tetracycline HCL@500ppm, T_7= T_3 + Spraying of Tetracycline HCL @500ppm, T_8 = Control (water spray only). Leaf hoppers were recorded early in the morning on randomly selected plants' top, middle, and bottom leaves. The observations on disease incidence were recorded at capsule formation stage and up the crop's maturity by counting total number plants and number of plant showing phyllody disease symptoms using the formula given below.

Per cent disease incidence (PDI) = Number of plants infected / Number of plants observed * 100

2.2 To Screen Sesame Germplasms/ Varieties against Sesame Phyllody

Twenty-two germplasm entries and varieties were screened against phyllody disease under field /natural conditions. The seeds of each variety were sown in two rows with three replications. Observations on disease incidence recorded near crop maturity as described above using the following rating scale given by Vanishree et al. [9].

List 1. Disease rating scale used for scoring sesame phyllody was as under

Scale	Percent Disease Incidence	Reaction
0	0	Immune
1	1-10	Resistant
2	10.1-25	Moderately Resistant
3	25.1-50	Moderately Susceptible
4	More than 50	Susceptible

3. RESULTS AND DISCUSSION

To study the effect of spraying insecticides, bio-pesticides and antibiotics on disease incidence as well as on leaf hopper population were recorded. The data was statistically analyzed and

presented in Table 1 and graphically in Fig. 1. In all eight treatments were used for management of phyllody disease including untreated check (T_8) namely seed treatment (ST) with ST Imidacloprid 70% WG (T_1), T_1 + Spraying of imidacloprid 17.8% SL (T_2), T_1+ Spraying of azadirachtin (T_3), T_1 + Spraying of tetracycline HCL (T_4), T_2 + Spraying of azadirachtin (T_5), T_2 + Spraying of tetracycline HCL (T_6), T_3+ Spraying of tetracycline HCL (T_7) and control (T_8) , respectively. Data on disease incidence were recorded the third spray. The results revealed that all the treatments were significantly superior over untreated check in controlling the disease and reducing the leaf hopper population. Among the treatments, T_6 *i.e.* T_2 + Spraying of tetracycline HCL was found the best with 0.70 leaf hopper population per leaf and 7.27% disease incidence over untreated check (disease incidence 21.13 "percent" and leaf hopper 1.15 per leaf). Next best was T_7 *i.e.* T_3+ Spraying of tetracycline HCL with followed by T_5 *i.e.* T_2 + Spraying of azadirachtin and T_4 *i.e.* T_1 + Spraying of tetracycline HCL, with 8.07, 9.20 and 8.67 "percent" disease incidence. From the results obtained (Table 2 and Fig. 1) on the sesame phyllody incidence and vector population, it can be concluded that seed treatment of imidacloprid (6 gm/kg) with three sprays of imidacloprid (0.25 ml/lits) + three sprays of tetracycline hydrochloride (500 ppm) at the intervals of 15 day found effective to minimize the disease incidence (7.27 "percent") as compared to control (21.13 "percent") and phyllody disease control up to 65.59 "percent".

To study the effect of spraying Insecticides, biopesticides and antibiotics on leaf hopper population were recorded. It was observed that, among all treatments of insecticides significantly decreases leaf hopper population in most of counts than other treatments. All treatment reduced leaf hopper population as compared with control. Minimum leaf hopper population (0.70 "percent") was observed in seed treatment followed by spray (ST imidacloprid+ spray of imidacloprid + spray of tetracycline HCL) as compared with other treatments. Similarly the effect of spraying insecticides, biopesticides and antibiotics on incidence of phyllody disease in sesame. The result revealed that, spraying insecticides, bio-pesticides and antibiotics viz., (ST of imidacloprid + Spraying of tetracycline HCL), (ST imidacloprid + spray of imidacloprid + Spraying of azadirachtin), (ST of imidacloprid + Spraying of imidacloprid 17.8% SL), (ST of imidacloprid + Spraying of azadirachtin), and (ST imidacloprid 70% WG), significantly reduced disease incidence.

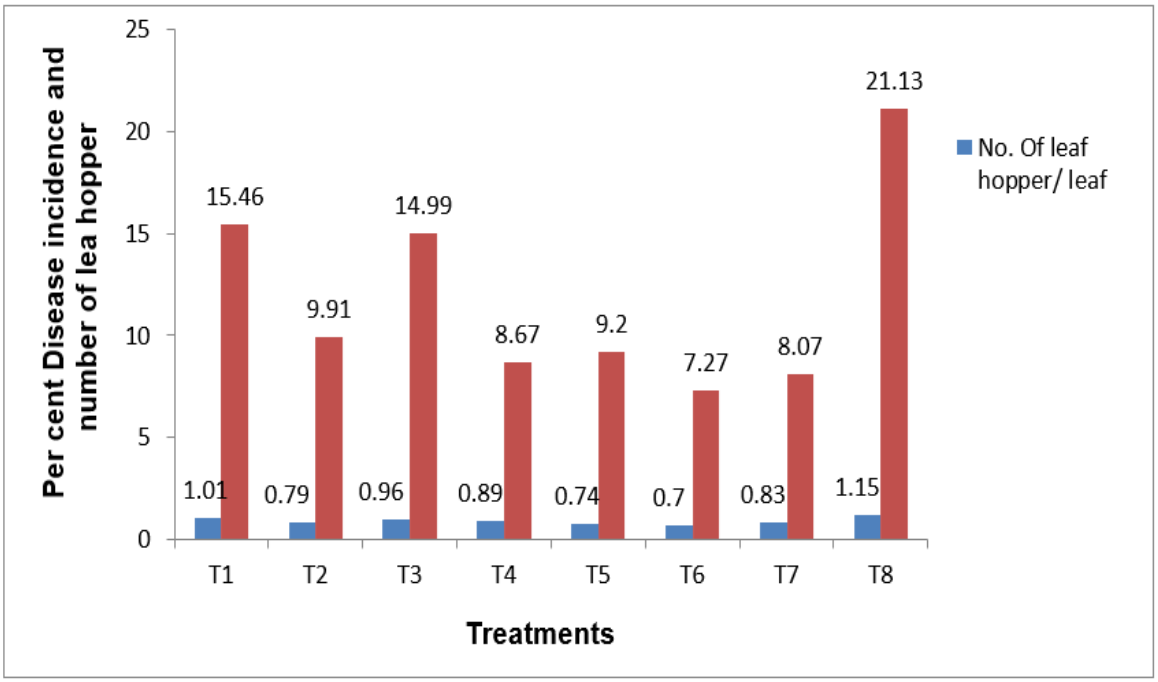

Fig. 1. Effect of spray of insecticides, bio-pesticides and antibiotics on leaf hopper population and disease incidence of phyllody in sesame

Table 1. Effect of spraying insecticides, pesticides and antibiotics on leaf hopper population and disease incidence of phyllody in sesame

Tr. No.	Treatments	Dose	Number of leaf hopper/ leaf*	Disease incidence (%)	"percent" disease control
T_1	ST Imidacloprid 70% WG	ST @6 gm/kg	1.01	15.46 (23.15)	26.83
T_2	T_1 + Spraying of Imidacloprid 17.8% SL	FS @0.25 ml/lits	0.79	9.91 (18.35)	53.09
T_3	T_1 + Spraying of Azadirachtin	FS @0.03%	0.96	14.99 (22.78)	29.05
T_4	T_1 + Spraying of Tetracycline HCL	FS @500 ppm	0.89	8.67 (17.12)	58.96
T_5	T_2 + Spraying of Azadirachtin	FS @0.03%	0.74	9.20 (17.66)	56.46
T_6	T_2 + Spraying of Tetracycline HCL	FS @500 ppm	0.70	7.27 (15.64)	65.59
T_7	T_3 + Spraying of Tetracycline HCL	FS @500 ppm	0.83	8.07 (16.50)	61.80
T_8	Control (water spray only)	--	1.15	21.13 (27.37)	
	SEm±		0.03	0.44	
	CD (p= 0.05)		0.10	1.33	

** = Mean values of three replications; ST= Seed Treatment; FS= Foliar Spray (Angular transformed values given in parenthesis)*

Table 2. Screening of sesame genotypes/varieties/cultivars evaluated against leaf hopper population & disease incidence

Sr. No.	Name of Cultivar	No. of Leaf hopper /leaf*	"percent" Disease Incidence*	Reaction
1	GT-10	1.03	13.67	MR
2	RT-125	1.14	18.23	MR
3	TKG-22	1.75	54.02	S
4	RMT-447	1.29	39.94	MS
5	RT-127	0.62	07.43	R
6	TC-25	1.09	16.54	MR
7	RMT-376	1.40	46.75	MS
8	RT-46	1.02	9.80	R
9	RT-54	1.05	13.24	MR
10	RT-351	1.17	23.32	MR
11	RT-346	1.42	47.12	MS
12	RMT-385	1.28	30.43	MS
13	RMT-479	1.39	41.56	MS
14	RT-375	1.02	12.89	MR
15	RT-372	1.21	28.92	MS
16	RT-450	1.32	29.08	MS
17	RMT-486	1.27	34.76	MS
18	Pragati	0.81	08.53	R
19	RMT-505	1.44	45.87	MS
20	RMT-378	1.23	26.34	MS
21	RT-103	0.89	9.07	R
22	GT-1	1.09	18.98	MR

** : Average of five plants*

All the treatments were found more effective in reducing disease incidence over control. The disease incidence recorded after third treatment ranged from 7.27 to 15.46 “percent” as against 21.13 “percent” in untreated control. However all the treatments (ST imidacloprid + spray of imidacloprid + Spraying of tetracycline HCL recorded least mean disease incidence (7.27%). From the result obtained on the sesame phyllody incidence and vector population, it can be concluded that seed treatment of imidacloprid (6 gm/kg) with three spray of Imidacloprid0.25ml/lits + three spray of tetracycline hydrochloride (500ppm) at the intervals of 15 day found effective to minimize the disease incidence (7.27 percent) as compared to control (21.13 “percent”) and phyllody disease control up to 65.59 “percent”.

Similar type of results also found by Panday et al., [10] as they noted that seed treatment with Imidacloprid 70 WS (7.5 g kg-1 seed) + foliar spray of Imidacloprid 17.8 SL (0.25 mL L-1) gave minimum incidence of leaf hopper, mirid bug, white fly and sesame phyllody. Markad et al*,* [11]. recorded as effective for management of sesame phyllody followed by insecticides and oils. The effect of integrated management on sesame phyllody disease can be controlled by seed treatment with insecticide *i.e.* Imidacloprid and spraying of antibiotic tetracycline. Seed treatment with insecticide Imidacloprid and spraying Thiomethoxam effectively control the vector leaf hopper and thereby reduce the incidence of phyllody disease. In antibiotic, seed treatment Imidacloprid and spraying tetracycline were found effective followed by seed treatment Imidacloprid and spraying Thiomethoxam. The highest disease incidence was recorded in spraying of Monocrotophos. Shinde et al., [12] studied the effect of insecticides, oils and antibiotics on brinjal little leaf disease and found that treatment with Dimethoate, neem oil 1000 ppm and Tetracycline @ 500 ppm. Effective against brinjal little leaf disease. Jaiman et al., [13] found that seedling root dip in Imidacloprid 0.04%, one spray of 0.005% imidacloprid after one month of transplanting followed by seedling grown in 40 mesh nylon cloth net was highly effective against phyllody disease of fennel. Revathi *et al,.* [14] revealed that two sprays of Pymetrozine, Dimethoate and Thiamethoxam was highly effective in reducing the leafhopper and phyllody. Prajapat *et al.*, [15] reported that Imidacloprid (0.005%) and Thiamethoxam (0.025%) were highly effective in reduction of jassid population and sesame phyllody infection.

3.1 To Screen Sesame Genotypes and Varieties against Sesame Phyllody

Twenty two prominent lines /varieties /hybrids /cultivars of sesame were screened under natural epiphytotic for their reaction to leaf hopper and phyllody disease incidence to trace out source of resistance and result obtained were presented in Table 2. Result revealed that, leaf hopper population varies from 0.62 to 1.75 leaf hopper per leaf. Lowest leaf hopper population was reported in RT-127, 0.62 leaf hopper/leaf followed by Pragati, RT-103 and RT-375 reported leaf hopper population 0.81, 0.89 and 1.02 leaf hopper/leaf, respectively. Highest leaf hopper population 1.75, leaf hopper/leaf was reported in TKG-22, respectively, In all the sesame lines the maximum disease incidence was recorded in TKG-22 and RT-346 with the other hand minimum disease incidence was recorded in RT-127, Pragati, RT-103 and RT-46 which showed 7.43%, 8.53%, 9.07%, and 9.80% disease incidence, respectively.

Further the sesame entries were characterized on the basis of their reactions to sesame phyllody and presented in Table 3. Among all the lines RT-103, RT-127, RT-46 and Pragati were found resistance to sesame phyllody. GT-10, RT-125, TC-25, RT-54, RT-351, RT-375, G-1 were moderately resistance to sesame phyllody and TKG-22 was found most susceptible to sesame phyllody disease.

Table 3. Reaction of sesame genotypes/ varieties/ hybrids/ cultivars to sesame phyllody disease under field condition

Scale	Reaction	Genotypes/ Varieties/Cultivars
0	Immune	----
1	Resistant	RT-103, RT-127, RT-46, Pragati
2	Moderately Resistant	GT-10, RT-125, TC-25, RT-54, RT-351, RT-375, GT-1
3	Moderately Susceptible	RT-346, RMT-385, RMT-479, RT-372, RMT-486, RMT-505,RMT-378, RMT-447, RMT-376, RT- 450
4	Susceptible	TKG-22

Similar type of results also found by Shobha et al, [16] Field screening of sesame hybrid for phyllody resistance, 130 sesame hybrid and 3 check were evaluated in field under natural condition, out of which Swethatil x KMR-14, Hima x KMR-14,Rajeshwari x KMR-14 were highly resistance, 7 other Swetha x AT-178,China, Shelna, Rajeshwari x RT-201, Bardur local, LT-8, SI-3160, HT-9713, NIC-8984, VS-01-023 were resistant, maximum phyllody percent were observed in hybrid Rajeshwari x CST-2001-1. Mahadevaprasad *et al*., (2017) Among the sesame lines screened against phyllody disease under field conditions, three genotypes *viz.,* KAU-05-2- 12, PC-14-2 and Kanakapura local showed resistant reaction, 27 lines *viz*., DS-28, RT-363, CUHY-57, AT-255, DS-23, DS10, NIC-16236, AKT 101, RT-54, Amrit, AKT-64, RT-125, TMV-3, TKG 306, ST-9-2, ES-48, Chandana, ES- 8779-4, IS 294, E-8, DS-1, GT-1, DS-9, K-15284, RT-11, EC-303419 and Gulbarga showed moderately resistant reaction, 13 lines *viz.,* JCS-2464, AT-249, PC-14-1, TKG-22, AT-282, GT-10, DS-19, CUMS-17, JLS-301-24, AT-231, DS-5, Local variety (black) and DSS-9 showed susceptible reaction. Vamshi *et al*., [17]reported that the Phyllody is a serious disease of sesame caused by phytoplasma. Among twenty genotypes two genotypes 11 Genotypes showed only phyllody symptoms, 2 genotypes produced witches broom symptom, while 2 genotypes showed phyllody as well as twisting of stem. Cracking of capsule was observed in genotype 24) JLT-408, while vivipary and phyllody symptom was observed in genotype 17) RT-351. Among 20 genotypes 17) ES-62 and 5) 12-JUN ranked as highly resistant and 4 genotypes ranked as moderately resistant [18,19].

4. CONCLUSION

In this study, variable reactivity of sesame phyllody pathogen against insecticides, biopesticides and antibiotics as seed treatment and foliar spray has been proved. Seed treatment with Imidacloprid 70% WG @ @6 g/kg seed + spray of Imidacloprid 17.8% SL @ 0.25 ml/lits + Spraying of tetracycline HCL @500 ppm were found most effective by recording minimum per cent disease incidence and maximum per cent disease control and recommended to farmer community for the management of sesame phyllody. Out of twenty two varieties/germplasms were screened against sesame phyllody, none of the varieties found to be immune and only some varieties are resistant to phyllody, therefore, it need to give more importance on resistance breeding program for find out resistance source to sesame phyllody.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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