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Management of Sesame Phyllody: A Destructive Disease of South-western Rajasthan

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Abstract: Various factors cause yield loss of sesame (*Sesamum indicum* L.) and among them sesame phyllody is a major one. Present field study showed the variable reactivity by sesame phyllody pathogen to insecticides, combination of phytoextract with insecticide and combination of antibiotic with insecticide as seed treatment and foliar spray. Seed treatment with Imidacloprid 17.8% SL @ 3 mL kg^{-1} seed followed by its two foliar sprays of @ 150 mL ha^{-1} were most effective. The per cent disease incidence came down from 33.33 in control to 5.55% after first spray and from 42.22 in control to 7.78% after second spray. Area under disease progress curve (AUDPC) was minimum (133.30) and per cent disease control (81.58%) was maximum. As a result yield of sesame obtained (543 kg ha^{-1}) was maximum. This effect of the above treatment was at par with that of Thiomethoxam 25% WG @ 100 g ha^{-1}. Thiomethoxam application reduced disease incidence to 7.78% and 12.22% after first and second spray respectively, with AUDPC being 200.00. It showed 71.05% disease control and resulted in the sesame yield of 520.67 kg ha^{-1}.

Key words: Sesame, phyllody, insecticide, phytoextract and antibiotic.

Sesame (*Sesamum indicum* L.) is an important and prehistoric oleaginous crop which belongs to the family Pedaliaceae. The sesame is cultivated in the tropical and subtropical regions of Asia, Africa, and South America. It is cultivated in over five million acres in the World. Out of 22 major producing countries six belong to the Asia, 13 to Africa and three in Latin America. India, Sudan, Myanmar and China are the major sesame producing countries while Mali, Bangladesh, Paraguay and Benin are the smallest producers. According to FAO statistics, 92.6% of the world sesame productions are accounted by these major sesame-producing countries (Dossa *et al*., 2023). 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*., 2006; Uzun *et al*., 2008). Sesame oil contains natural antioxidants sesamoline, sesamin and sesamol which cause an excellent stability (Shyu and Hwang, 2002).

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According to Directorate of Oilseeds Development estimates 2019-20, area under sesame cultivation in India is 1.62 mha with production of 0.66 mt and productivity of 405 kg ha^{-1}. In Rajasthan, sesame is grown during kharif season and is a good source of income to the farmers. Rajasthan produces 0.09 mt sesame seeds annually with an average productivity of 328 kg ha^{-1} (Anonymous, 2019-20).

Although it is widely used for different purposes, the crop has low productivity (405 kg ha^{-1}) due to its cultivation in submarginal lands often with conventional agronomic practices and non-availability of high yielding varieties lacking inbuilt resistance to biotic and abiotic stresses (Asri, 1998). Among various biotic stresses, phyllody is a highly destructive disease of sesame. It is caused by phytoplasma and is transmitted by leafhopper (Tan, 2010).

Phyllody disease is not restricted to the cultivated species of *Sesamum,* but it has been also observed in *S. alatyun, S. indicatum* (Ramanujam, 1944), *S. occidentale* and *S. radiatum* (Mazzani and Malaguti, 1952). The affected plants become stunted and the floral parts are transformed into green leaf-like structures followed by abundant vegetative growth resulting in a yield loss up to 34% oreven 100% in the cases of severe incidence (Abraham *et al*., 1977; Sarwar and Haq, 2006). It has been observed that one per cent increase in disease intensity reduces the yield by 8.36 kg ha^{-1} (Maiti *et al*., 1988). 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, phytoextract and antibiotics.

Materials and Methods

A field trial was conducted during kharif 2019 to evaluate efficacy of insecticides as seed treatment as well as foliar application in combination of phytoextract 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 Agricultural Research Sub-Station Farm (Agriculture University, Jodhpur), Sumerpur, Pali, Rajasthan in randomized block design with three replications using susceptible variety RT-351 in 3 x 4.2 m plot size with row to row spacing at 30 cm and plant to plant spacing of 10 cm. The spray of insecticides, phytoextract + insecticides and antibiotics + insecticides were applied at 35 and 55 days after sowing (DAS), respectively as per treatment. All the recommended agronomical practices were adopted for raising the crop (POP zone IIb of Rajasthan). The trial consisted of following eight treatments viz., T_1 - Seed treatment with Imidacloprid 17.8% SL @ 3 mL kg^{-1} seed + spray of Imidacloprid 17.8% SL @ 2 mL 10 L^{-1}, T_2 - seed treatment with Imidacloprid 17.8% SL @ 3 mL kg^{-1} seed + spray of Tetracycline @ 500 ppm at 35 and 55 DAS, T_3 - spray of Tetracycline @ 500 ppm at 35 and 55 DAS, T_4 - spray of Thiomethoxam 25% WG @ 2g 10 L^{-1} at 35 and 55 DAS, T_5 - seed treatment with Thiomethoxam 70% WS @ 5 g kg^{-1} seed + spray of Tetracycline 500 ppm at 35 and 55 DAS, T_6 - seed treatment with Thiomethoxam 70% WS @ 5 g kg^{-1} seed + spray of Azadirachtin @ 3 mL L^{-1} at 35 and 55 DAS, T_7 Spray of Diafenthiuron 50% WP @ 0.03% at 35 and 55 DAS and T_8 - control. The observations on disease incidence were recorded at 15 days after first spray and 15 days after second spray. Per cent disease incidence, area under the disease progress curve (AUDPC) and Per cent disease control were calculated by using the following formula:

$$\text{Per cent disease incidence (PDI)} = \frac{\text{Number of infected plants}}{\text{Total number of plants observed}} \times 100$$

$$\text{Per cent disease control (PDC)} = \frac{\text{PDI of control plot- PDI of treatment plot}}{\text{PDI of control plot}} \times 100$$

$$\text{Area under the disease progress curve (AUDPC)} = \sum_{i=1}^{n-1} \frac{y_i + y_{i+1}}{2} \times (t_{i+1} - t_i)$$

where y_i is an assessment of a disease (percentage, proportion, ordinal score, etc.) at the i^{th} observation, t_i is time (in days, hours, etc.) at the $_i^{th}$ observation, and n is the total number of observations (Shaner and Finney, 1977).

Results and Discussion

The results revealed that all the tested treatments are significantly superior in reducing the phyllody disease and increasing grain yield of sesame as compared to control during kharif 2019 (Table 1). Among all the

Table 1 Management of sesame phyllody

Tr. No.	Treatments	Percent disease incidence (PDI)		Per cent disease control	AUDPC
		15 days after 1st spray	15 days after 2nd spray		
T_1	Seed treatment with Imidacloprid 17.8% SL @ 3 mL kg^{-1} seed + spray of Imidacloprid 17.8% SL @ 2 mL 10 L^{-1}	5.55 (13.47*)	7.78 (16.11*)	81.58	133.30
T_2	Seed treatment with Imidacloprid 17.8% SL @ 3 mL kg^{-1} seed + spray of Tetracycline @ 150 ppm	16.66 (24.01)	20.00 (26.50)	52.63	366.60
T_3	Spray of Tetracycline @ 150 ppm	25.55 (30.27)	28.88 (32.43)	31.58	544.30
T_4	Spray of Thiomethoxam 25% WG @ 2 g 10 L^{-1}	7.78 (16.11)	12.22 (20.41)	71.05	200.00
T_5	Seed treatment with Thiomethoxam 70% WS @ 5 g kg^{-1} seed + spray of Tetracycline 150 ppm	20.00 (26.50)	23.33 (28.83)	44.73	433.30
T_6	Seed treatment with Thiomethoxam 70% WS @ 5 g kg^{-1} seed + spray of Azadirachtin @ 3 mL L^{-1}	12.22 (20.15)	16.66 (24.01)	60.52	288.80
T_7	Spray of Diafenthiuron 50% WP @ 0.03%	12.22 (20.41)	20.00 (26.50)	52.63	322.20
T_8	Control	33.33 (35.23)	42.22 (40.49)		755.50
	SEm +	1.62	1.37		
	CD (P=0.05)	4.98	4.19		
	CV (%)	11.10	8.82		

* Figures in parenthesis are angular transformed values.

treatments, seed treatment with Imidacloprid 17.8% SL @ 3 mL kg^{-1} seed, followed by foliar spray of Imidacloprid 17.8% SL @ 2 mL 10 L^{-1} recorded minimum per cent disease incidence (5.55% and 7.78%) of sesame phyllody, which was at par with Thiomethoxam 25% WG @ 2g 10 L^{-1} (7.78 and 12.22%). Whereas, rest of the treatments were found less effective against sesame phyllody. The data (Table 1) in terms of per cent disease control revealed that seed treatment with Imidacloprid 17.8% SL @ 3 mL kg^{-1} seed + spray of Imidacloprid 17.8% SL @ 2 mL 10 L^{-1} resulted in maximum per cent disease control (81.58%) followed by Thiomethoxam 25% WG @ 2 g 10 L^{-1} (71.05 %).

Moreover, data of area under disease progress curve (AUDPC) depicted in Table 1 revealed that seed treatment with Imidacloprid 17.8% SL @ 3 mL kg^{-1} seed followed by foliar spray of Imidacloprid 17.8% SL @ 2 mL 10 L^{-1} recorded minimum AUDPC (133.60) of sesame phyllody from 50 to 70 DAS, which followed by foliar spray of Thiomethoxam 25% WG @ 2 g 10 L^{-1} (200.00) and Diafenthiuron 50% WP @ 0.03% (322.20). The untreated plot showed 755.50 area under disease progress curve (AUDPC).

The influence of the treatments on seed yield revealed that Imidacloprid 17.8% SL @ 3 mL kg^{-1} seed followed by foliar spray of Imidacloprid 17.8% SL @ 2 mL 10 L^{-1} recorded maximum yield (543 kg ha^{-1}) which was followed by foliar spray of Thiomethoxam 25% WG @ 2 g m 10 L^{-1} (521 kg ha^{-1}). The result of cost benefit ratio showed that Imidacloprid 17.8% SL @ 3 mL kg^{-1} seed followed by foliar spray of Imidacloprid 17.8% SL @ 2 mL 10 L^{-1} (1.97) and foliar spray of Thiomethoxam 25% WG @ 2 g 10 L^{-1} (1.84) recorded highest cost benefit ratio (Table 2).

The results were in agreement with several workers, Singh *et al*. (2022) reported that seed treatment with Imidacloprid 17.8 SL @ 5 mL kg^{-1} + spray of Acetamiprid 20% SP @ 0.3 g L^{-1} was recorded least disease incidence and highest seed yield of sesame. Kumhar and Meena (2016) found that seed treatment with Imidacloprid 70WS @ 5 g kg^{-1} seed followed by two sprays of Thiomethoxam 25WG @ 0.25 g L^{-1} effectively manage sesame phyllody. Similarly, Thangjam and Vastrad (2015) revealed that Imidacloprid 600FS seed treatment + Imidacloprid 17.8 SL spraying was highly effective against sesame phyllody.

Table 2 Economics of different insecticides, phytoextract + insecticides and antibiotics+ insecticides treatments

Tr. No.	Treatments	Yield (kg ha^{-1})	Total cost of cultivation (Rs ha^{-1})	MSP (kg^{-1})	Total return (Rs.)	Cost benefit ratio
T_1	Seed treatment with Imidacloprid 17.8% SL @ 3 mL kg^{-1} seed + spray of Imidacloprid 17.8% SL @ 2 mL 10 L^{-1}	543	17865	64.85	35214	1.97
T_2	Seed treatment with Imidacloprid 17.8% SL @ 3 mL kg^{-1} seed + spray of Tetracycline @ 150 ppm	465	23925	64.85	30134	1.26
T_3	Spray of Tetracycline @ 150 ppm	399	23900	64.85	25854	1.08
T_4	Spray of Thiomethoxam 25% WG @ 2g 10 L^{-1}	521	18400	64.85	33765	1.84
T_5	Seed treatment with Thiomethoxam 70% WS @ 5g kg^{-1} seed + spray of Tetracycline 150 ppm	416	23970	64.85	26999	1.13
T_6	Seed treatment with Thiomethoxam 70% WS @ 5g kg^{-1} seed + spray of Azadirachtin @ 3 mL L^{-1}	489	23070	64.85	31690	1.37
T_7	Spray of Diafenthiuron 50% WP @ 0.03%	455	20400	64.85	29507	1.45
T_8	Control	334	17000	64.85	21638	1.27
	SEm +	4.62				
	CD (P=0.05)	13.45				
	CV (%)	6.21				

Similar type of results also found by Panday *et al*. (2018) 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. Shinde *et al*. (2019) 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*. (2013) 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*. (2021) revealed that two sprays of Pymetrozine, Dimethoate and Thiamethoxam was highly effective in reducing the leafhopper and phyllody. Prajapat *et al*. (2020) reported that Imidacloprid (0.005%) and Thiamethoxam (0.025%) were highly effective in reduction of jassid population and sesame phyllody infection. Pathak *et al*. (2013) noted that application of methyle-o-demeton @ 0.025% was superior insecticide against sesame phyllody management.

Conclusion

In this study, variable reactivity of sesame phyllody pathogen against insecticides, combination of phytoextract + insecticides and combination of antibiotic + insecticides as seed treatment and foliar spray has been proved. Seed treatment with Imidacloprid 17.8% SL @ 3 mL kg^{-1} seed + spray of Imidacloprid 17.8% SL @ 2 mL 10 L^{-1} and Thiomethoxam 25% WG @ 2g 10 L^{-1} were found most effective by recording minimum per cent disease incidence and maximum yield of sesame and recommended to farmer community for the management of sesame phyllody.

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