Reprint **ISSN 1923-7766 (Web Version)**

International Journal of Experimental Agriculture

(Int. J. Expt. Agric.)

Volume: 13 **Issue: 2** **July 2023**

Int. J. Expt. Agric. 13(2): 30-34 (July 2023)

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An International Scientific Research Publisher

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ISSN-1923-7766 (Online)
Int. J. Expt. Agric. 13(2):30-34(July 2023)

DEVELOPMENT OF INTEGRATED PEST MANAGEMENT PACKAGE AGAINST THE MAJOR INSECT PESTS OF SESAME (*SESAMUM INDICUM* L.)

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Accepted for publication on 30 June 2023

ABSTRACT

Islam MA, Akter S, Roy P, Islam R (2023) Development of Integrated Pest Management package against the major insect pests of sesame (*Sesamum indicum* L.). *Int. J. Expt. Agric*. 13(2), 30-34.

The experiments were conducted during the Kharif seasons of 2022 and 2023 at the Oilseed Research Centre (ORC), Bangladesh Agricultural Research Institute (BARI), Gazipur, to develop an effective management approach against major insect pests of sesame. The treatments used were as follows: hand picking of larvae + perching + spraying of spinosad (success 2.5 SC) @ 1.2 ml/L of water, hand picking of larvae + ching + spraying of delegate (Spinetoram 11.7% SC) @ 1 ml/L of water, hand picking of larvae + ching + spraying of Biochamak (*Celastras angulatas* 1% EW) @ 2.5 ml/litre of water, and farmer practice (spraying of nitro 505 EC (Cypermethrin + Chlorpyriphos) @ 1.0 ml/L of water). The greatest numbers of whiteflies, hoppers, leaf beetles, green stink bugs and hairy caterpillars were found in the untreated control group in 2022 and 2023, and the lowest number was found in the Nitro 505 EC group, followed by the larva + perching + Biochamak group. The yield marginal benefit cost ratio (MBCR) was also greater for those treatments.

Key words: *sesame, IPM, stink bug, hairy caterpillar, yield*

INTRODUCTION

Sesame (*Sesamum indicum* L.; Family: Pedaliaceae) is a flowering plant in the genus Sesamum. Numerous wild relatives occur in Africa, and a smaller number occur in Bangladesh. It is an annual, self-pollinated, indeterminate minor oil crop grown in the *Kharif* season (Akhtar *et al.* 2015). The sesame seed is one of the oldest known oil seed crops and was domesticated well more than 3000 years ago. It is drought-tolerant and is able to grow where other crops fail. It is important because of the quality of its edible oil, protein, calcium and phosphorus. Due to the presence of tocopherol and lignin, sesame also has a remarkable antioxidant function. It is a versatile crop with diverse uses and contains 42-45% oil, 20% protein and 14-20% carbohydrate (BARI 2004). Due to the excellent nutritional, medicinal, skin care and cooking qualities of sesame oil, it is known as the "queen of oils".

Sesame is grown throughout the year and is a short-duration crop that is suitable for various cropping systems. The world's largest exporter of sesame seeds was India, and Japan was the largest importer. It occupies 92671 acres of land and produces 33999 tons of sesame (BBS 2018).

Many reports have shown that the productivity of sesame can be substantially increased if the losses due to the pest are suitably reduced (Rohilla *et al.* 2003). The insect pests of sesame in Bangladesh have been recorded by several scientists (Begum 1995). Among white fly pests, the leaf beetle, hairy caterpillar, sting bug, and leaf hopper are the most important pests throughout Bangladesh. Fifteen to twenty percent of the total sesame production is lost directly or indirectly by the attack of insect and mite pests every year (Biswas *et al.* 2000). These pests attack all parts of sesame plants except roots, and they feed on tender foliage leaves and bores into the shoot, flower and capsule. Singh (1983) reported 10 to 71% plant infestation and 10 to 43.5% capsule infestation, resulting in 8.9 to 71.5% yield loss and 66.31% seed loss per capsule (Kumar and Goel, 1994). The sesame leafhopper is well known for its role as a vector for spreading phyllody disease in sesame. Vasudeva and Sahambi (1955) reported that the vector of sesame phyllody was *Deltocephalus* sp., and Ghauri (1966) identified the same vector as *O. albicinctus*. Prasad and Sahambi (1982) confirmed the nature of the transmission of sesame phytoplasma by the leafhopper *O. albicinctus*. Past and recent research has provided techniques for managing these pests individually, primarily focusing on the use of synthetic pesticides (Tripathi *et al.* 2007). Farmers mostly spray toxic chemicals to combat these pests. However, the indiscriminate use of pesticides has not only complicated their management but also led to several adverse effects, such as pest resistance, secondary pest outbreaks, health hazards and environmental pollution. Therefore, the pesticide load in the environment should be reduced by developing integrated management package(s) for major insect pests of sesame.

MATERIALS AND METHODS

The experiments were conducted in Kharif seasons 2022 and 2023 in the ORC research field, BARI, and Gazipur to develop effective management approaches against major insect pests of sesame.

The treatments were as follows: T_1 (IPM Package 1) = Hand Picking of Larvae + Perching + Spinosad (Success 2.5 SC) @ 1.2 ml/L of water, T_2 (IPM Package 2) = Hand Picking of Larvae + Perching + Spraying Delegate (Spinetoram 11.7% SC) @ 1ml/L of water, T_3(IPM Package 3)= Hand Picking of Larvae + Perching + Spraying

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Biochamak (*Celastras Angulatas* 1% EW) @ 2.5 ml/litre of water, T_4 = Farmers Practice (Spraying of Nitro 505 EC (Cypermethrin + Chlorpyriphos) @ 1.0 ml/L of water), and T_5 = Untreated Control for both 2022 and 2023. The experiment was laid out in a randomized complete block design with three dispersed replications. Sesame seeds (BARI Till-4) were sown on 08 March 2022 and on 15 March 2023 at Gazipur. The unit plot size was 3.0 m × 2.0 m with 30 cm row to row and 1 m plot to plot distance in both years. Normal intercultural procedures were performed as necessary.

The whole plant was thoroughly covered by spray emulsion. The numbers of whiteflies, hoppers, and leaf beetles were recorded at 7-day intervals from five randomly selected plants from the middle rows and five leaves from each plant. The numbers of green stink bugs and hairy caterpillars were also recorded from five randomly selected branches per plot at seven-day intervals. The yield data were recorded simultaneously.

RESULTS AND DISCUSSION

Effects of different treatment packages on the whitefly, hopper and leaf beetle of sesame

In 2022, the number of whiteflies per leaf ranged from 0.92 to 3.39 and differed significantly among the treatments. However, the greatest number of whiteflies per leaf (3.39) was detected in the untreated control plots, while the lowest number (0.92) was detected in the T_4-treated plots, followed by the T_3-treated plots. The number of hoppers per leaf ranged from 0.69 to 2.87 and differed significantly among the treatments. However, the greatest number of hopper leaves (2.87) was detected in the untreated control plots, while the lowest number (0.69) was detected in the T_4-treated plots, followed by the T_3 -treated plots. The number of leaf beetles per five leaves ranged from 0.88 to 2.25 and differed significantly among the treatments. The highest number of leaf beetles per five leaves (2.25) was recorded in the untreated control plot, and the lowest was found in the T_4-treated plot (0.88), followed by the T_3-treated plot (Table 1).

Table 1. Effect of different treatments for controlling sucking pests and leaf beetles on sesame plants during 2022

Treatments	No. of whitefly/leaf	No. of hopper/leaf	No. of leaf beetle/5 leaf
T_1	1.74	1.49	1.34
T_2	2.89	1.93	1.88
T_3	1.12	1.08	1.15
T_4	0.92	0.69	0.88
T_5	3.39	2.87	2.76
LSD(0.05)	1.26	1.25	0.77
CV (%)	33.40	41.30	25.80

T_1 (IPM Package 1) = Hand picking of larvae + perching + spraying spinosad (success 2.5 SC) @ 1.2 ml/L of water, T_2 (IPM Package 2) = Hand picking of larvae + perching + spraying delegate (Spinetoram 11.7% SC) @ 1 ml/L of water, T_3 (IPM Package 3) = Hand picking of larvae + Perching + spraying Biochamak (*Celastras angulatas* 1% EW) @ 2.5 ml/litre of water, T_4 = Farmers practice (Spraying of Nitro 505 EC (Cypermethrin + Chlorpyriphos) @ 1.0 ml/L of water), T_5 = Untreated control for both 2022 and 2023.

However, in the following year, the number of whiteflies per leaf ranged from 0.72±0.09 to 2.97±0.22 and differed significantly among the treatments. However, the greatest number of whiteflies per leaf (2.97±0.22) was detected in the untreated control plots, while the lowest number (0.72±0.09) was detected in the T_4-treated plots, followed by the T_3-treated plots. The number of hoppers per leaf ranged from 0.59±0.09 to 2.74±0.24 and differed significantly among the treatments. However, the greatest number of hopper leaves (2.74±0.24) was detected in the untreated control plots, while the lowest number (0.59±0.09) was detected in the T_4-treated plots, followed by the T_3-treated plots. The number of leaf beetles per five leaves ranged from 0.82±0.08 to 2.64±0.41 and differed significantly among the treatments. The highest number of leaf beetles per five leaves (2.64±0.41) was recorded in the untreated control plot, and the lowest was found in the T4-treated plots (0.82±0.08), followed by the T_3-treated plots (Table 2).

Table 2. Effect of different treatments for controlling sucking pests and leaf beetles on sesame plants during 2023

Treatments	No. of whitefly/leaf	No. of hopper/leaf	No. of leaf beetle/5 leaf
T_1	1.48±0.16b	1.72±0.20b	1.32±0.28b
T_2	1.30±0.13b	1.45±0.18b	1.19±0.14b
T_3	1.06±0.08bc	0.92±0.11c	1.02±0.11b
T_4	0.72±0.09c	0.59±0.09c	0.82±0.08b
T_5	2.97±0.22a	2.74±0.24a	2.64±0.41a
CV(%)	18.02	18.09	25.72

T_1 (IPM Package 1) = Hand picking of larvae + perching + spraying spinosad (success 2.5 SC) @ 1.2 ml/L of water, T_2 (IPM Package 2) = Hand picking of larvae + perching + spraying delegate (Spinetoram 11.7% SC) @ 1 ml/L of water, T_3 (IPM Package 3) = Hand picking of larvae + Perching + spraying Biochamak (*Celastras angulatas* 1% EW) @ 2.5 ml/litre of

water, T_4 = Farmers practice (Spraying of Nitro 505 EC (Cypermethrin + Chlorpyriphos) @ 1.0 ml/L of water), T_5 = Untreated control for both 2022 and 2023.

Effect of different treatment packages against green stink bugs and hairy caterpillars of sesame

In 2022, the number of green stink bugs per branch ranged from 0.88 to 2.53 and differed significantly among the treatments. The greatest number of green stink bugs per branch (2.53) was recorded in the untreated control plots, and the lowest was found in the T_4-treated plots (0.88), followed by the T_3-treated plots. The number of hairy caterpillars per branch ranged from 0.88 to 2.53 and differed significantly among the treatments. The highest number of hairy caterpillars per branch (2.53) was recorded in the untreated control plot, and the lowest was found in the T_4-treated plot (0.88), followed by the T_3-treated plot. The highest yield was obtained from the T_4 -treated plot (1.50 t/ha), followed by the T_3-treated plot (1.41 t/ha) and the lowest in the (T_5) control plot (0.98) t/ha (Table 3).

Table 3. Effects of different treatments for controlling hairy caterpillars and green stink bugs on sesame plants during 2022

Treatments	No. of green stink bug/branch	No. of hairy caterpillar/branch	Yield (tha^{-1})
T_1	1.57	2.16	1.26
T_2	1.82	2.38	1.12
T_3	1.23	1.07	1.41
T_4	0.88	0.64	1.50
T_5	2.53	3.87	0.98
LSD(0.05)	0.77	1.60	0.17
CV(%)	25.80	42.20	7.60

T_1 (IPM Package 1) = Hand picking of larvae + perching + spraying spinosad (success 2.5 SC) @ 1.2 ml/L of water, T_2 (IPM Package 2) = Hand picking of larvae + perching + spraying delegate (Spinetoram 11.7% SC) @ 1 ml/L of water, T_3 (IPM Package 3) = Hand picking of larvae + Perching + spraying Biochamak (*Celastras angulatas* 1% EW) @ 2.5 ml/litre of water, T_4 = Farmers practice (Spraying of Nitro 505 EC (Cypermethrin + Chlorpyriphos) @ 1.0 ml/L of water), T_5 = Untreated control for both 2022 and 2023.

Table 4 shows that the number of green stink bugs per branch ranged from 0.78±0.08 to 3.58±0.38 and differed significantly among the treatments. The greatest number of green stink bugs per branch (3.58±0.38) was recorded in the untreated control plots, and the lowest was found in the T_4-treated plots (0.78±0.08), followed by the T_3-treated plots. The number of hairy caterpillars per branch ranged from 1.06±0.1 to 4.15±0.71 and differed significantly among the treatments. The highest number of hairy caterpillars per branch (4.15±0.71) was recorded in the untreated control plot, and the lowest was found in the T_4-treated plots (1.06±0.1), followed by the T_3-treated plots. The highest yield was obtained from the T_4-treated plot (1.47±0.02 t/ha), followed by the T_3-treated plot (1.38±0.03 t/ha), and the lowest yield was obtained from the T_5 control plot (0.92±0.04 t/ha).

Table 4. Effects of different treatments for controlling hairy caterpillars and green stink bugs on sesame plants during 2023

Treatments	No. of green stink bug/branch	No. of hairy caterpillar/branch	Yield (tha^{-1})
T_1	1.74±0.27b	2.33±0.21b	1.28±0.05b
T_2	1.51±0.10b	2. 11±0.13b	1.12±0.13b
T_3	1.38±0.15bc	1.25±0.11b	1.38±0.03ab
T_4	0.78±0.08c	1.06±0.10b	1.47±0.02a
T_5	3.58±0.38a	4.15±0.71a	0.92±0.04c
CV(%)	18.08	33.83	4.33

T_1 (IPM Package 1) = Hand picking of larvae + perching + spraying spinosad (success 2.5 SC) @ 1.2 ml/L of water, T_2 (IPM Package 2) = Hand picking of larvae + perching + spraying delegate (Spinetoram 11.7% SC) @ 1 ml/L of water, T_3 (IPM Package 3) = Hand picking of larvae + Perching + spraying Biochamak (*Celastras angulatas* 1% EW) @ 2.5 ml/litre of water, T_4 = Farmers practice (Spraying of Nitro 505 EC (Cypermethrin + Chlorpyriphos) @ 1.0 ml/L of water), T_5 = Untreated control for both 2022 and 2023.

Benefit cost analysis

The marginal cost–benefit ratios (MBCRs) of different treatments applied against major insect pests of sesame were determined based on the expenses incurred, and the values of the crops are presented in Table 5. It should be noted here that the expenses incurred referred to those only for pest control. The results revealed that the highest MBCR was observed in the treatment plot (Nitro 505 EC @1.0 ml/L of water) (5.82). The highest yield (1.50) and gross return (Tk90000) were obtained from treatment T_4, followed by treatment T_3.

Table 5. Economic analysis of different management options for major insect pests of sesame during 2022

Treatments	Yield of sesame (t/ha)	Gross return (Tk/ha)	Cost of treatments (Tk/ha)	Net return (Tk/ha)	Adjusted net return (Tk/ha)	MBCR
T_1	1.26	75600	5840	69760	10960	1.88
T_2	1.12	67200	6100	61100	2300	0.38
T_3	1.41	84600	5900	78700	19900	3.37
T_4	1.50	90000	4570	85430	26630	5.82
T_5	0.98	58800	-	-	-	-

T_1 (IPM Package 1) = Hand Picking of Larvae + Perching + spinosad (Success 2.5 SC) @ 1.2 ml/L of water, T_2 (IPM Package 2) = Hand Picking of Larvae + Perching + Spraying delegate (Spinetoram 11.7% SC) @ 1 ml/L of water, T_3 (IPM Package 3) = Hand Picking of Larvae + Perching + Spraying Biochamak (*Celastras angulatas* 1% EW) @ 2.5 ml/litre of water, T_4 = Farmers Practice (Spraying of nitro 505 EC (Cypermethrin + Chlorpyriphos) @ 1.0 ml/L of water), T_5 = Untreated Control for both 2022 and 2023.

Cost of relevant materials/activities: Farmgate price of sesame@TK. 60.00 per kg,
[Cost of Success 2.5SC: @ Tk 3200/L; Cost of Biochamak: @ Tk 3900/L; Cost of Delegate @ Tk 4000/L, Cost of Nitro: @ Tk 1850/L; Cost of Hand Picking: Five Labor/ha @ Tk 300/Labour/day; Cost of Perching: Tk 1000/ha; Cost of Spray: Two Labor/Spray/ha @ Tk 300.00/Labour/day; Spray volume needed: 500 L/ha].

However, in 2023, the highest MBCR was detected in the treatment plot (6.22), which had the highest yield (1.47 t/ha) and gross return (Tk88200), followed by those in the T_3 and T_2 plots (nitro 505 EC @1.0 ml/L of water (Table 6).

Table 6. Economic analysis of different management options for major insect pests of sesame during 2023

Treatments	Yield of sesame (t/ha)	Gross return (Tk/ha)	Cost of treatments (Tk/ha)	Net return (Tk/ha)	Adjusted net return (Tk/ha)	MBCR
T_1	1.28	76800	5840	70960	15760	2.70
T_2	1.33	81320	6100	75220	20020	3.28
T_3	1.38	82800	5900	76900	21700	3.67
T_4	1.47	88200	4570	83630	28430	6.22
T_5	0.92	55200	-	-	-	-

T_1 (IPM Package 1) = Hand picking of larvae + perching + spraying spinosad (success 2.5 SC) @ 1.2 ml/L of water, T_2 (IPM Package 2) = Hand picking of larvae + perching + spraying delegate (Spinetoram 11.7% SC) @ 1 ml/L of water, T_3 (IPM Package 3) = Hand picking of larvae + Perching + spraying Biochamak (*Celastras angulatas* 1% EW) @ 2.5 ml/litre of water, T_4 = Farmers practice (Spraying of Nitro 505 EC (Cypermethrin + Chlorpyriphos) @ 1.0 ml/L of water), T_5 = Untreated control for both 2022 and 2023

Cost of relevant materials/activities: Farmgate price of sesame@TK. 60.00 per kg,
[Cost of Success 2.5SC: @ Tk 3200/L; Cost of Biochamak: @ Tk 3900/L; Cost of Delegate @ Tk 4000/L, Cost of Nitro: @ Tk 1850/L; Cost of Hand Picking: Five Labor/ha @ Tk 300/Labour/day; Cost of Perching: Tk 1000/ha; Cost of Spray: Two Labor/Spray/ha @ Tk 300.00/Labour/day; Spray volume needed: 500 L/ha].

CONCLUSION

Based on the findings of the present study, it can be concluded that the plots treated with Nitro 505 EC and 1.0 ml/L water had greater yields and less infestation by whiteflies, hoppers, leaf beetles, green stink bugs and hairy caterpillars. The treatment was more effective against major insect pests of sesame, with a higher yield and marginal benefit cost ratio. However, in the case of IPM, hand picking of larvae + perching + Biochamak significantly increased the yield of the pest.

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