Ecofriendly Management of Mustard Sawfly *Athalia lugens* proxima (Klug) on Asalio, *Lepidium sativum*

Comment [DS21]: Needs to be modified

Abstract

The present research was under taken on the management of mustard sawfly, Atthalia lugens proxima (Klug) on Asalio, Lepidium sativum. Athalia lugens proxima (Klug) (Hymenoptera, Tenthredinidae) commonly known as mustard sawfly is a major pest of mustard. Seeds are used for recovery of chronic brochial asthma and enhancing milk yield in both animals and human beings. The field experiment was conducted with eight treatments and three replications with plot size of 3 m x 4 m with design RBD. The experiment was conducted during three years 2020-21 to 2022-23 during peak pest infestation on the crop Asalio, Lepidium sativum (Rabi season) at Central Campus, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar, Maharashtra. The pooled results of three years data i.e. 2020-21, 2021-22 and 2022-23 presented in the table 1. Observations on pre count was recorded and the pooled mean was ranged from 7.55 larvae per plant to 7.68 larvae per plant. Subsequently the observations were recorded at 3, 7 and 14 days after sprayings. From the three years pooled data, it was concluded that among all treatment tested the treatment Beauveria bassiana @ 5 g/lit was found statistically significant with minimum survival of larval pest population i.e. 2.66 larvae/plant after first spray and 0.91 larvae/plant after second spray with maximum seed yield 16.10 q/ha and maximum ICBR i.e. 1:12.17 and B:C ratio 2.13.

Comment [DS22]: 1- The researcher did not mention in the conclusion how many times the insect was sprayed with fungicide and other pesticides during the study period, in addition to whether the spraying was equal for all insects ((the duration of exposure and the quantity because when spraying there will be some places where the spray quantity is higher than others and here the dose given to all treated insects must be equal))

Keywords: Lepidium sativum, chronic brochial asthma, medicinal plant, folk medicine

Introduction

Senna, *Lepidium sativum* is an annual edible herb belonging to family Brassicaceae, it is also known as pepper cress, water cress or garden cress. It is native to West Asia and Europe (Gokavi *et al*., 2004). It is an important medicinal plant from India. In India, its cultivation spread across the states of Maharashtra, Gujarat, Uttar

Pradesh, Madhya Pradesh and Rajasthan in an area about 5000 hectares (Choudhary *et al*., 2010). In India, entire area under garden cress is 8450 ha (Anon, 2014).

Plants are 45 to 60 cm tall, seeds have laxative and diuretic properties. The seeds mucilage is used to treat intestinal irritations. Leaves are useful for treatment of liver diseases and anaemia, propagation is done through seeds (Anon., 2019 DMAPR, Anand). It is reported to improve brain power. It folk medicine, it is used as a therapy for inflammatory diseases including diabetes, arthritis and hepatitis (Bigoniya and Shukla, 2014; Sakran *et al*., 2014). It is used in preparation of medicines for asthma, cough, leprosy, skin disease, dysentery, diarrhoea, dyspepsia, lumbago, leucorrhoea, scurvy and seminal weakness (Kirtikar and Basu, 1933). Seeds are used for recovery of chronic brochial asthma and enhancing milk yield in both animals and human beings.

Athalia lugens proxima (Klug) (Hymenoptera, Tenthredinidae) commonly known as mustard sawfly is a major pest of mustard (Sharma *et al*., 1992). It is also reported on garden cress (*Lepidium sativum*) (Anon., 2012-2013 DMAPR, Anand). Pest generally active during October to March. The pest attack causes severe defoliation resulting in huge loss in seed yield due to death of plants during early stages and sometimes resowing becomes necessary (Jagtap and Kadam, 1978).

Excess use of pesticides causes residue problems as well as soil pollution. Keeping this in view, research was under taken on the management of mustard sawfly, *Atthalia lugens proxima* (Klug) on Asalio, *Lepidium sativum.*

Material and Methods

The field experiment was conducted with eight treatments and three replications with plot size of 3 m x 4 m with design RBD. The experiment was conducted during three years 2020-21 to 2022-23 during peak pest infestation on the crop Asalio, *Lepidium sativum* (*Rabi* season) at Central Campus, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar, Maharashtra.

Result and discussion

The pre count of survival pest population was recorded one day before spraying and survival larval pest population were recorded at 3, 7 and 14 days after spraying. Two sprayings were given during conducting the experiment.

Comment [DS23]: 2- In the work methods, the researcher did not mention the method of raising the insect, the generations it goes through, how to ensure the death of the larval stage of the insect, the statistical analysis used, or the name of the statistical version.

Comment [DS24]: The researcher did not mention the treatments used in the research, which should be mentioned in the work methods. (For example: the first treatment: with Beauveria sanja extract at a concentration of 5 mg/ml ..... and so on?)

Comment [DS25]: The researcher did not mention where the seeds, plants, and fungi used in the control were diagnosed, as well as the insects that were controlled.

Comment [DS26]: The researcher did not address any explanation during the presentation of the results and discussion. It is supposed to explain the reason for the superiority of the Bouveria Basania extract over the rest of the other extracts and making the plants grow better due to its overcoming of pests.

The pooled results of three years data i.e. 2020-21, 2021-22 and 2022-23 presented in the table 1. Observations on pre count was recorded and the pooled mean was ranged from 7.55 larvae per plant to 7.68 larvae per plant. Subsequently the observations were recorded at 3, 7 and 14 days after sprayings.

The pooled results indicated that among the treatments tested,the treatment *Beauveria bassiana* @ 5 g/lit. was found significantly superior over all other treatments tested and found to be most effective by recording minimum survival of larval pest population i.e. 2.66 larvae per plant after 14 days of first spray followed by the treatment *Metarhizium anisopliae* @ 5 g/lit. after first spray and recorded minimum survival of larval pest population i.e. 0.91 larvae per plant after 14 days of second spray and found significantly superior over all other treatment tested and followed by the treatment *Metarhizium anisopliae* @ 5 g/lit. after second spray. The percent pest reduction was recorded maximum i.e. 65.13% after first spray and 65.78% after second spray and average percent pest reduction after two sprays was also recorded maximum in the treatment *Beauveria bassiana* @ 5 g/lit. followed by the treatment *Metarhizium anisopliae* @ 5 g/lit.

As regards the seed yield of Asalio, statistically significant differences were recorded among the treatment. The maximum seed yield was recorded in the treatment Azadirachtin 10000 ppm @ 2 ml/lit. i.e. 16.42 q/ha and found at par with the treatment *Beauveria bassiana* @ 5 g/lit i.e. 16.09 q/ha and Azadirachtin 10000 ppm @ 2 ml/lit. followed by *Beauveria bassiana* @ 5 g/lit. The treatment *Beauveria bassiana* recorded maximum ICBR ratio i.e. 1:12.17 followed by the treatment *Metarhizium anisopliae* @ 5 g/lit i.e. 1:8.68 and treatment Azadirachtin 10000 ppm @ 2 ml/lit followed by *Beauveria bassiana* @ 5 g/lit i.e. 1:5.44.

It was found that two spraying of *Beauveria bassiana* @ 5 g/lit. was most effective and found significantly superior over all other treatments tested with minimum survival pest population after 14 days after first and second spray and seed yield was 16.10 q/ha with maximum ICBR (1:12.17) and B:C ratio 2.13.

Table 1. Management of Mustard sawfly, *Athalia lugens* proxima (Klug) on Asalio, *Lepidium sativum* by using bio-pesticides and plant products (Pooled mean 2020-21 to 2022-23)

Sr. No.	Treatments	Pre count (larve/plant)	Surviving larval population after I spray				Per cent pest
			3 DAS	7 DAS	14	Mean	

Comment [DS27]: Beauveria fungus is considered one of the fungi that kill harmful and beneficial insects because it grows and takes root on the cuticle layer of insects, and thus it will grow and extend hyphae into the body of the living organism, thus killing it from the inside. Therefore, it is used in biological control to get rid of all forms of insect parasitism on plant seeds, leaves, fruits and flowers.

Comment [DS28]: The researcher did not include one or more pictures to prove the type of work, as pictures of fungi, insects, and seeds have an effect in confirming the work.

					DAS		control
1.	*Metarhizium anisopliae* 1.15 WP (CFU 1 x 10^9) @ 5 g/lit.	7.66 (2.85)	7.55 (2.83)	4.46 (2.22)	3.06 (1.88)	5.02	60.05
2.	*Beauveria bassiana* 1.15 WP (CFU 1 x 10^9) @ 5 g/lit.	7.63 (2.85)	7.51 (2.83)	3.98 (2.11)	2.66 (1.77)	4.71	65.13
3.	NSE 5%	7.55 (2.83)	6.45 (2.63)	5.76 (2.49)	5.50 (2.44)	5.90	27.15
4.	Neem oil 2%	7.65 (2.85)	6.25 (2.59)	5.24 (2.39)	4.57 (2.25)	5.35	40.36
5.	Azadirachtin 10000 ppm @ 2 ml/lit.	7.55 (2.83)	4.90 (2.32)	3.63 (2.03)	3.39 (1.97)	3.97	55.09
6.	Azadirachtin 10000 ppm @ 2 ml/lit. followed by *Metarhizium anisopliae* (CFU 1 x 10^9) @ 5 g/lit.	7.67 (2.85)	4.99 (2.34)	3.70 (2.04)	3.44 (1.98)	4.04	55.14
7.	Azadirachtin 10000 ppm @ 2 ml/lit. followed by *Beauveria bassiana* 1.15 WP (CFU 1 x 10^9) @ 5 g/lit.	7.66 (2.85)	5.00 (2.34)	3.68 (2.04)	3.43 (1.98)	4.03	55.22
8.	Untreated control	7.68 (2.86)	7.87 (2.89)	7.85 (2.88)	7.80 (2.87)	7.84	--
	S.E. ±	**0.006**	**0.009**	**0.03**	**0.009**		
	C.D. @ 5%	**N.S.**	**0.03**	**0.10**	**0.03**		

Figures in parenthesis are $\sqrt{X + 0.5}$ transformed values

Table 2. Management of Mustard sawfly, *Athalia lugens* proxima (Klug) on Asalio, *Lepidium sativum* by using bio-pesticides and plant products (Pooled mean 2020-21 to 2022-23)

Sr. No.	Treatments	Surviving larval population after II spray				Per cent pest control
		3 DAS	7 DAS	14 DAS	Mean	
1.	*Metarhizium anisopliae* 1.15 WP (CFU 1 x 10^9) @5 g/lit.	3.01 (1.87)	1.77 (1.50)	1.18 (1.31)	1.98	61.43
2.	*Beauveria bassiana* 1.15 WP (CFU 1 x 10^9) @5 g/lit.	2.61 (1.76)	1.38 (1.36)	0.91 (1.18)	1.63	65.78
3.	NSE 5%	4.67 (2.27)	4.15 (2.15)	3.99 (2.11)	4.27	27.45
4.	Neem oil 2%	3.74 (2.05)	3.05 (1.88)	2.73 (1.79)	3.17	40.16
5.	Azadirachtin 10000 ppm @ 2 ml/lit.	2.22 (1.65)	1.62 (1.45)	1.54 (1.42)	1.79	54.57
6.	Azadirachtin 10000 ppm @ 2 ml/lit. followed by *Metarhizium anisopliae* (CFU 1 x 10^9) @ 5 g/lit.	3.04 (1.87)	1.92 (1.55)	1.41 (1.38)	2.12	59.01
7.	Azadirachtin 10000 ppm @ 2 ml/lit. followed by *Beauveria bassiana* 1.15 WP (CFU 1 x 10^9) @5 g/lit.	2.98 (1.85)	1.79 (1.51)	1.26 (1.32)	2.01	63.26
8.	Untreated control	7.67 (2.85)	7.63 (2.83)	7.54 (2.82)	7.61	--
	S.E. ±	0.04	0.03	0.03		
	C.D. @ 5%	0.14	0.09	0.10		

Figures in parenthesis are $\sqrt{X + 0.5}$ transformed values

Table 3. **Effect of bio-pesticides and plant products against Mustard sawfly, *Athalia lugens* proxima (Klug) on seed yield of Asalio, *Lepidium sativum***

Sr. No.	Treatments	Seed yield (q/ha)	Per cent increase in seed yield over control
1.	*Metarhizium anisopliae* 1.15 WP (CFU 1 x 10^9) @ 5 g/lit.	14.78	32.44
2.	*Beauveria bassiana* 1.15 WP (CFU 1 x 10^9) @ 5 g/lit.	16.09	44.18
3.	NSE 5%	12.15	8.87
4.	Neem oil 2%	12.74	14.16
5.	Azadirachtin 10000 ppm @ 2 ml/lit.	16.42	47.13
6.	Azadirachtin 10000 ppm @ 2 ml/lit. followed by *Metarhizium anisopliae* (CFU 1 x 10^9) @ 5 g/lit.	15.04	34.77
7.	Azadirachtin 10000 ppm @ 2 ml/lit. followed by *Beauveria bassiana* 1.15 WP (CFU 1 x 10^9) @5 g/lit.	15.74	41.04
8.	Untreated control	11.16	--
	S.E. ±	**0.45**	
	C.D. @ 5%	**1.36**	

Table 4. Incremental cost benefit ratio of different treatments against Mustard sawfly

Sr. No.	Treatments	Yield (q/ha)	Additional yield over control (q/ha)	Additional income (Rs.)	Cost of plant protection (Rs.)	Net returns (Rs.)	Cost of cultivation (Rs.)	Gross monetary returns (Rs./ha)	Net monetary returns (Rs./ha)	B.C. ratio	ICBR
1.	*Metarhizium anisopliae* 1.15 WP (CFU 1 x 10^9) @ 5 g/lit.	14.79	3.63	29040	3000	26040	60485	118240	57755	1.95	1:8.68
2.	*Beauveria bassiana* 1.15 WP (CFU 1 x 10^9) @ 5 g/lit.	16.10	4.94	39520	3000	36520	60485	128720	68235	2.13	1:12.17
3.	NSE 5%	12.15	0.99	7920	2910	5010	60395	97200	36805	1.61	1:1.72
4.	Neem oil 2%	12.74	1.58	12640	8000	4640	64485	101920	37435	1.58	1:0.58
5.	Azadirachtin 10000 ppm @ 2 ml/lit.	16.42	5.26	42080	8400	33680	65885	131360	65475	1.99	1:4.00
6.	Azadirachtin 10000 ppm @ 2 ml/lit. followed by *Metarhizium anisopliae* (CFU 1 x 10^9) @ 5 g/lit.	15.05	3.89	31120	5700	25420	63185	120320	57135	1.90	1:4.45
7.	Azadirachtin 10000 ppm @ 2 ml/lit. followed by *Beauveria bassiana* 1.15 WP (CFU 1 x 10^9) @5 g/lit.	15.75	4.59	36720	5700	31020	63185	125920	62735	1.99	1:5.44
8.	Untreated control	11.16	-	-	-	-	57485	89280	31795	1.55	

Labour charges @ Rs. 1000/ha, *Metarhizium anisopliae* and *Beauveria bassiana* @ Rs. 200/kg, Neem oil @ 300/lit, Neem powder @ Rs. 18.2/kg, Azadirachtin @ 3200/lit., Selling rate of Asalio @ Rs. 80/kg

Conclusion

From the three years pooled data, it was concluded that among all treatment tested the treatment *Beauveria bassiana* @ 5 g/lit was found statistically significant with minimum survival of larval pest population i.e. 2.66 larvae/plant after first spray and 0.91 larvae/plant after second spray with maximum seed yield 16.10 q/ha and maximum ICBR i.e. 1:12.17 and B:C ratio 2.13.

Reference

Comment [DS29]: It is preferable to update the references, as most of them are considered old.

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