Ecofriendly Management of Aphids, *Macrosiphoniella pseudoartemisiae* on Dawana, *Artemisia pallens*

Abstract

Artemisia pallens is an aromatic herb or shrubs, Xerophytic in nature. The flowers are racemose panicles it belongs to the Asteraceae family. It is commercially cultivated for its fragrant leaves and flowers. It grows from seeds and cuttings and reaches maturity in four months. The plant is woody in the lower part of the stem. Dawana crops are mostly grown in Andhra Pradesh, Karnataka, Maharashtra, and Tamil Nadu states in India. The aphids *Macrosiphoniella pseudoartemisiae* is the major pest of dawana in Maharashtra.

The pooled results indicated that among the treatments tested the treatment *Lecanicillium lecanii* @ 8 g/lit was significantly superior over all other treatments and found to be most effective by recording minimum survival of aphid population i.e. 13.13 aphids per tiller per plant after the first spray and 4.05 aphids per tiller per plant after second spray with 70.04% pest control and found at par with the treatment *Metarhizium anisopliae* @ 8 g/lit. *Lecanicillium lecanii* @ 8 g/lit. recorded maximum fresh herbage yield i.e. 104.54 q/ha.

Introduction

Artemissia pallens, is an aromatic herb or shrubs, xerophytic in nature. The flowers are racemose panicles, and bear numerous small yellow flower heads or capitula, but the silvery white silky covering of down gives the foliage a grey or white appearance. Dawana has alternate pinnatisect leaves or palmatisect leaves belonging to the family Asteraceae.

It is commercially cultivated for its fragrant leaves and flowers. It has two distinct morphological types one in which the plants are short in stature and flowering sets in early and the other in which plants are tall and flowers sets in later. It grows from seeds and cuttings and reaches maturity in four months. The plant is woody in the lower part of the stem, but with yearly branches seen mostly grown in Andhra Pradesh, Karnataka, Maharashtra, and Tamil Nadu states in India.

Davanone, divan ether, davana furan, and linalool are the major constituents of dawana oil.

The leaves and flowers yield as an essential oil known as the oil of Davana. Davana blossoms are offered to Shiva the God of transformation. Davana has been

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widely used in Indian folk medicine for the treatment of diabetes mellitus. This plant is accredited with antihelmintic, antipyretic, and tonic properties and is also considered as good fodder. The oil possesses antispasmodic, antibacterial, antifungal, and stimulant properties. Among the pests, the aphids *Macrosiphoniella pseudoartemisiae* (Khan et al. 2020) is the major pest of *Artemisia pallens* in Maharashtra, hence the efforts are made to study the management of aphids on Dawana.

Material and Methods

The field experiment was conducted for four years during 2015-16, 2016-17, 2017-18 and 2018-19 at AICRP on Medicinal, Aromatic Plants and Betelvine Project Research Farm, Central Campus, MPKV, Rahuri (M.S.) with nine treatments *viz.*, *Lecanicillium lecanii* @ 4 g/lit, *Lecanicillium lecanii* @ 8 g/lit, *Beauveria bassiana* @ 4 g /lit, *Beauveria bassiana* @ 8 g /lit, *Metarhizium anisopliae* @ 4 g/lit, *Metarhizium anisopliae* @ 8 g/lit, Azadirachtin 10000 ppm @ 3 ml/lit, NSE @ 5% and the control treatments also maintained for comparison with RBD design. The pre-pre-treatment count survival of the pest population was recorded before taking spraying at 3, 7, and 14 days after sprays. Two sprayings were given when conducting of the experiment during the maximum aphid population level was in the field.

The sowing of seeds on raised beds was done and after one to one and half months, the seedlings were transplanted in the experimental field as per treatments at 3 x 4 m plot size and 45 x 10 cm spacing were maintained.

Result and Discussion

The pooled results of four years of data i.e. 2015-16, 2016-17, 2017-18, and 2018-19 were presented in the table Table 1. Observations on pre-pre-treatment counts were recorded and the pooled mean ranged from 42.89 aphids per tiller per plant to 46.13 aphids per tiller 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 *Lecanicillium lecanii* @ 8 g/lit was significantly superior over all other treatments and found to be most effective by recording minimum survival of aphids population i.e. 13.13 aphids per tiller per plant after the first spray and 4.05 aphids per tiller per plant after second spray with 69.98% pest control and found at par with the treatment *Metarhizium anisopliae* @ 8 g/lit recordings the aphid population i.e. 15.30 aphids

per tiller per plant after first spray and 5.28 aphids per tiller per plant after second spray with 65.41% pest control.

As regards the fresh herbage yield of Dawana, statistically significant differences were recorded among the treatments. The treatment *Lecanicillium lecanii* @ 8 g/lit recorded significantly maximum fresh herbage yield i.e. 104.54 q/ha. However, the treatment *Metarhizium anisopliae* @ 8 g/ha was found at par recorded fresh herbage yield i.e. 95.51 q/ha. The treatment *Lecanicillium lecanii* @ 8 g/lit recorded the highest B: C ratio i.e. 2.80 and ICBR 17.25 among the treatments tested. It was found that two sprayings of the treatment *Lecanicillium lecanii* @ 8 g/lit ~~was~~ were most effective and found at par with the treatment *Metarhizium anisopliae* @ 8 g/lit.

Results of entomopathogenic fungi and ~~neem~~ neem-based insecticides ~~that~~ proved to be moderately effective up to 7 days after spray treatment during present investigation. These results are more or less in agreement with Gour and Parekh (2003), ~~they~~ who reported that NSE was at least effective against mustard aphids on mustard. Salunke (2003) reported a moderate effect of econeem and neem seed extract on cowpea aphids on cowpea. Verma and Chaman Lal (2006) reported that *Azadirachtin indica* was effective but provided only a moderate level of control of mustard aphids. Shivakumara *et al*. (2022) revealed that the commercial bioinsecticide Azadirachtin 10000 ppm ———@ 5 ml/L was the most effective in protecting plants from aphid feeding and was comparable to synthetic insecticide in the Bedki crop. Tambe (2009) reported that Azadirachtin 1% and NSE 5% were observed moderately effective against lucern aphids up to 5 days after spraying.

Among entomopathogenic fungi, *Lecanicillium lecanii* 1.15% @ 5 g/L proved excellent control on aphids. Shivkumara *et al.* (2022) reported neem oil spray of 10000 ppm @ 0.75% could effectively manage the aphid population in field conditions. Yeo *et al*. (2003) reported that *Lecanicillium lecanii* is the most effective and pathogenic to aphids. Karthikeyan and Selvanarayanan (2011) conducted studies on the bioefficacy of *Lecanicillium lecanii* against *Aphis gossypii* and recorded the highest mortality of *Aphis gossypii* (100 per-cent) at 0.025 concentration.

Gangawane (2017) reported that among all entomopathogenic fungi *Lecanicillium lecanii* 1.15% @ 7.5 g/L provides excellent control ~~on~~ of oat aphids on forage oat. Sosamma and Philp (2017) revealed that high concentration (10^8 spores/ml) gives the best result with *Lecanicillium lecanii* followed by *Beauveria*

bassiana as cowpea aphid mortality declined with decreasing concentration. Mishra *et al.* (2015) evaluated that in the okra crop *Lecanicillium lecanii* which recorded 82.16 and 82.92 per-cent reduction ~~of~~ in aphid population. Janghel *et al*. (2015) evaluated different biopesticides and bioagents against sucking pests of okra, results showed that for control of aphids, the most effective biopesticide ~~being~~ was *Lecanicillium lecanii* (Choudhury et al. 2021). Rana and Singh (2002) studied field trials of *Lecanicillium lecanii* against mustard aphid *Lipaphis erysimi* at the concentration of 10^6 spores/ml at ETL 13-15 aphids per plant and reported ~~the~~ a significant reduction was found ~~at~~ 10 days after spraying. Narwade- *et al*. (2023) evaluated six sequential strategies against the sucking pest complex of okra (Tanni et al. 2019). The result showed that treatment with spraying *Lecanicillium lecanii* @ 5 g/L followed by Thiamethoxam 25 SG @ 0.25 g/L followed by Pongamia oil 1% @ 10 ml/L was found to be most effective and recorded the least average survived population of aphids, leaf hoppers, whitefly, and mites.

Table 1. Efficacy of different biopesticides against aphids on Dawana *Artemisia pallens* (Summary table 2015-16 to 2018-19)

Treatments	~~Pre~~ Pre-treatment count (Pooled mean) aphids/tiller/ plant	I[st] spray (Pooled mean) survival aphid population aphids/tiller/ plant			% reduction in pest population
		3 DAT	7 DAT	14 DAT	
Lecanicillium lecanii @ 4 g/lit.	45.22 (6.68)	44.91 (6.66)	34.39 (5.86)	17.89 (4.17)	60.43
Lecanicillium lecanii @ 8 g/lit.	45.17 (6.67)	44.54 (6.63)	30.77 (5.56)	13.13 (3.59)	70.82
Beauveria bassiana @ 4 g/lit.	44.47 (6.61)	44.32 (6.60)	42.45 (6.46)	39.91 (6.26)	10.25
Beauveria bassiana @ 8 g/lit.	46.13 (6.74)	45.78 (6.72)	41.49 (6.41)	35.73 (5.96)	22.53
Metarhizium anisopliae @ 4 g/lit.	45.25 (6.67)	44.83 (6.64)	34.23 (5.84)	19.99 (4.44)	55.82
Metarhizium anisopliae @ 8 g/lit.	44.22 (6.60)	43.90 (6.58)	30.88 (5.56)	15.30 (3.90)	65.38
Azadirachtin 10,000 ppm @ 3 ml/lit.	42.89 (6.48)	33.87 (5.78)	21.17 (4.58)	23.72 (4.85)	44.67
NSE 5%	45.89 (6.72)	39.97 (6.29)	27.53 (5.22)	31.97 (5.63)	30.32
Control	45.72 (6.72)	47.05 (6.81)	48.38 (6.9)	47.86 (6.83)	--
S.E. ±	0.01	0.01	0.11	0.12	

C.D. @ 5%	N.S.	0.05	0.34	0.35

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

Table 1 contd…

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Treatments	II[nd] spray (Pooled mean) survival aphid population aphids/tiller/ plant			% reduction in pest population	Mean % pest control of two sprays	Fresh herbage yield (q/ha)
	3 DAT	7 DAT	14 DAT			
Lecanicillium lecanii @ 4 g/lit.	17.31 (4.11)	13.25 (3.65)	7.22 (2.66)	59.60	60.01	91.53
Lecanicillium lecanii @ 8 g/lit.	12.73 (3.54)	8.86 (3.02)	4.05 (2.05)	69.14	69.98	104.54
Beauveria bassiana @ 4 g/lit.	39.30 (6.22)	37.88 (6.11)	35.75 (5.93)	10.40	10.32	61.36
Beauveria bassiana @ 8 g/lit.	35.07 (5.91)	32.02 (5.66)	27.54 (5.26)	22.92	22.72	65.57
Metarhizium anisopliae @ 4 g/lit.	19.56 (4.39)	15.12 (3.90)	8.95 (3.01)	55.19	55.50	86.90
Metarhizium anisopliae @ 8 g/lit.	14.99 (3.86)	10.62 (3.30)	5.28 (2.35)	65.45	65.41	95.51
Azadirachtin 10,000 ppm @ 3 ml/lit.	18.97 (4.49)	12.11 (3.48)	13.53 (3.69)	41.91	43.29	78.39
NSE 5%	27.68 (5.25)	19.64 (4.41)	20.56 (4.72)	35.69	33.005	68.35
Control	46.60 (6.75)	42.58 (6.42)	32.85 (5.75)	--		60.71
S.E. ±	0.13	0.17	0.12			2.18
C.D. @ 5%	0.39	0.50	0.37			6.37

Table 2. Incremental cost-benefit ratio and B: C ratio of different treatments against aphids on Dawana

Treatments	Estimated oil yield (lit/ha)	Additional yield over control (lit./ha)	Additional income (Rs.)	Additional cost (Rs.)	Net profitable income (Rs.)	ICBR	B: C ratio
Lecanicillium lecanii @ 4 g/lit.	9.15	3.08	46200	2800	43400	15.50	2.55
Lecanicillium lecanii @ 8 g/lit.	10.45	4.38	65700	3600	62100	17.25	2.80
Beauveria bassiana @ 4 g/lit.	6.13	0.06	900	2800	0	0.00	1.81
Beauveria bassiana @ 8 g/lit.	6.55	0.48	7200	3600	3600	1.28	1.89
Metarhizium anisopliae @ 4 g/lit.	8.69	2.61	39150	2800	36350	12.98	2.44
Metarhizium anisopliae @ 8 g/lit.	9.55	3.48	52200	3600	48600	13.50	2.60
Azadirachtin 10,000 ppm @ 3 ml/lit.	7.83	1.76	26400	5600	20800	3.71	2.12
NSE 5%	6.83	0.76	11400	2300	9100	3.95	
Control	6.07	--	--	--	--	--	

Conclusion

From the four years of pooled data, it was concluded that among the treatments tested, the treatment *Lecanicillium lecanii* @ 8 g/lit was found most effective for the management of aphids on Dawana, *Artemisia pallens* with minimum survival of aphid population and maximum percentage of pest control and found at par with the treatment *Metarhizium anisopliae* @ 8 g/lit.

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