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Efficacy of Jasmonic Acid Application on Aphid (*Aphis gossypii* Glover) Population in Chilli (*Capsicum annuum* L.)

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***Abstract*:** Studies conducted during 2022–23 at the Insectary, AICRP on Biocontrol, AAU, Jorhat evaluated Jasmonic acid (JA)–induced resistance in chilli against aphids. Two experimental sets were maintained: Set A with a single JA spray at 20 DAT and Set B with two sprays at 20 and 60 DAT, comprising JA at 0.1, 0.5, 1.0 and 1.5 mM along with an untreated control. Results indicated that JA application significantly reduced aphid infestation, with the lowest aphid population consistently observed at 1.0 mM concentration. Two JA applications were more effective than a single spray in suppressing aphid population and enhancing plant recovery from aphid stress. Overall, JA @ 1.0 mM proved most effective in inducing resistance, highlighting jasmonic acid as a promising and sustainable elicitor for aphid management in chilli.

***Keywords*:** *Aphis gossypii*, Chilli, Exogenous application, Induced resistance, Insect herbivory and jasmonic acid

Chilli (*Capsicum annuum* L.) belongs to the Solanaceae family and originated in tropical America (Swamy 2023), cultivated mainly for its pungency due to the alkaloid capsaicin ($C_{17}H_{27}O_3N$) (Chakradhar et al., 2013). *C. annuum* was domesticated in the Tehuacan valley of Mexico around 5000 BC (Ettenberg 2019). Widely grown across tropical, subtropical and temperate regions of India. In 2020-21, global green chilli production reached 36 million tonnes, with India contributing 42% and ranking as the top producer, followed by Bangladesh, Thailand, China, Ethiopia and Indonesia (FAOSTAT 2021). Chilli cultivation is hindered by both biotic and abiotic stresses, with insect pests being a major threat. Several insect species are recognized as major pests of chilli crops. These include the fruit borer (*Helicoverpa armigera*), mites (*Polyphagotarsonemus latus*), whitefly (*Bemisia tabaci*), aphid (*Aphis gossypii*) and jassid (*Amrasca biguttula biguttula*) (Subhashree et al., 2020). These pests have the potential to cause significant damage to the chilli plants, affecting their overall health and productivity. Even with the application of pesticides in substantial quantities, crop damage, particularly from aphids, has been observed. Despite efforts to control pest populations through pesticide use, aphids have exhibited resilience and continued to cause harm to crops.

Jasmonic acid (JA) is a key phytohormone involved in plant defense against herbivores, activating both direct and indirect responses (Shivaji et al., 2010). Jasmonates, cyclopentanone compounds synthesized via the octadecanoid pathway from linolenic acid, regulate multiple defense mechanisms (Wasternack and Hause 2013). Increasing attention has been given to pest and disease management, particularly through host plant resistance (HPR), which is a cost-effective strategy (Walling 2000). Exogenous application of JA and its precursors activate defensive proteins and secondary metabolites in plants (Zhao et al., 2009; Pieterse et al., 2009). Therefore, the current study was conducted to explore the potential of jasmonic acid-induced resistance against aphids.

MATERIAL AND METHODS

The study was conducted at Assam Agricultural University (AAU), Jorhat, Assam, located at 26.72˚N latitude and 94.20˚E longitude. The field experiments were carried out under protected and laboratory conditions in a completely randomized design comprising five treatments with four replications during 2022-23. Based on the frequency of jasmonic acid application, two separate experimental sets Set A and Set B were established, each consisting of 20 pots.

Exogenous application of jasmonic acid: The study evaluated the effect of exogenous jasmonic acid (JA) on inducing resistance to *Aphis gossypii* in chilli (*Capsicum annuum* L., var. BSS918). Seedlings were raised in peat moss, transplanted into pots (soil: FYM, 3:1) and grown under controlled conditions (16 h photoperiod, 32/30°C) in December 2022. JA was applied at four concentrations (0.1, 0.5, 1.0, and 1.5 mM) following Farmer *et al.* (1992). Treatments were replicated four times. Set A received single spray at 40 DAS, while Set B received two sprays (40 and 80 DAS). Aphid counts on the top 10 cm shoot were recorded every five days interval before flowering. Feeding preference was assessed in two experimental sets following using 30 aphids per plant (Aslam et al., 2022).

Statistical analysis: Data were statistically analyzed using SPSS-21 software. Tukey's HSD test was used for post-hoc comparison of treatment means.

RESULTS AND DISCUSSION

The population of *A. gossypii* on leaves of chilli plants was determined in all the treatments after single spray. Different concentrations of jasmonic acid were applied exogenously to chilli leaves and a total of 30 aphids per 10 cm terminal shoot were released on the fifth day after treatment. The number of aphids was recorded at 1, 5, 10, 15, 20, 25 and 30 days after release of aphids in each treatment. Among all the treatments, at fifteen days after spray, JA @ 1.0 mM recorded the minimum aphid population (1.75 aphids), which was statistically at par with @1.5mM (3.50 aphids), while the control maintained a significantly higher population of 30.75 aphids. Complete suppression of aphid population was observed in 1.0mM by 20 days after spray, followed by 1.5mM and 0.5mM by 25 days after spray. In contrast, the control treatment sustained appreciable aphid population throughout the experimental period, recording 8.25 aphids even at 30 days after spray (Table 1). The study showed that exogenous jasmonic acid effectively induced resistance in chilli against *A. gossypii*, with 1.0 mM JA being the most effective treatment. JA-treated plants had significantly fewer aphids than controls. These results agree with earlier studies (Aslam et al., 2022, Bayram and Tonga 2018, El-Wakeil and Volkmar 2012, El-Wakeil et al., 2010).

Feeding preference of *A. gossypii* on chilli plants after two sprays of JA: The chilli plants were again sprayed with different concentrations of jasmonic acid and a total of 30 numbers of aphids per10 cm terminal shoot was released on the fifth day after the second spray of JA at 60 DAT to determine the feeding preference of *A. gossypii* on chilli leaves. Similar observations were taken where the number of aphids was recorded at 1, 5, 10, 15, 20, 25 and 30 days after release of aphids in each treatment. The gradual decrease in the number of aphids per 10 cm terminal shoot was observed from first day in four treatments (0.1, 0.5, 1.0, and 1.5 mM) (Table 2). At 0.1 mM, aphid counts decreased from 25.50 to 5.25 aphids by 20 days and reached zero by 25 days. At 0.5 mM, populations reduced from 24.25– 1.75 aphids by 20 days and became nil by 25 days. Higher concentrations (1.0 and 1.5 mM) showed faster suppression, with aphid numbers declining from 22.00– 3.75 and 23.25–4.50, respectively, to low levels by 10 days and complete absence from 15 days onwards. In contrast, the untreated control maintained comparatively higher aphid populations throughout the observation period, ranging from 32.50–35.50 aphids during the initial stages and persisting at 5.25 aphids. Jasmonic acid (JA) regulates key physiological processes that enhance plant defense. It alters glucose metabolism (Machado et al., 2017) modulates hormones and reduces ROS (Kang et al., 2005) and promotes secondary metabolite production that deters insect feeding (Bruinsma et al., 2007, Qiu et al., 2009). Overall, JA effectively activates defense responses in chilli, making it a promising tool for eco-friendly aphid management.

Table 1. Population of *A. gossypii* on leaves of chilli plants after single spray of jasmonic acid

Treatment	Number of aphids/10 cm terminal shoot after single spray*						
	1 d	5 d	10 d	15 d	20 d	25 d	30 d
JA @ 0.1 mM	28.75^{bc}	24.75^{c}	19.50^{c}	15.50^{c}	8.75^{b}	3.50^{a}	0.00^{a}
JA @ 0.5 mM	26.50^{ab}	21.25^{bc}	14.75^{b}	7.25^{b}	3.50^{a}	0.00^{a}	0.00^{a}
JA @ 1 mM	25.75^{a}	16.75^{ab}	4.75^{a}	1.75^{a}	0.00^{a}	0.00^{a}	0.00^{a}
JA @ 1.5 mM	24.751^{a}	15.50^{a}	5.25^{a}	3.50^{a}	1.50^{a}	0.00^{a}	0.00^{a}
Control	30.75^{c}	33.75^{d}	35.75^{d}	30.75^{d}	27.50^{c}	17.50^{b}	8.25^{b}
CD (p=0.05)	3.12	3.65	3.94	3.58	2.91	2.40	1.85

*Mean within column with same letter do not differ significantly (p≤0.05), Tukey's HSD Test

Table 2. Population of *A. gossypii* on leaves of chilli plants after second spray of jasmonic acid

Treatment	Number of aphids/10 cm terminal shoot after second spray*						
	1 d	5 d	10 d	15 d	20 d	25 d	30 d
JA @ 0.1 mM	25.50^{a}	21.25^{b}	16.75^{c}	10.75^{b}	5.25^{b}	0.00	0.00
JA @ 0.5 mM	24.25^{a}	19.50^{b}	11.25^{b}	6.75^{a}	1.75^{a}	0.00	0.00
JA @ 1 mM	22.00^{a}	13.25^{a}	3.75^{a}	0.00	0.00	0.00	0.00
JA @ 1.5 mM	23.25^{a}	14.00^{a}	4.50^{a}	0.00	0.00	0.00	0.00
Control	32.50^{b}	34.25^{c}	35.50^{d}	27.25^{c}	19.75^{c}	12.00^{b}	5.25^{b}
CD (p=0.05)	2.51	3.92	2.59	1.92	2.14	1.23	0.65

*Mean within column with same letter do not differ significantly (p≤0.05), Tukey's HSD Test

CONCLUSION

The study revealed that two sprays of jasmonic acid (1.0 mM) at 20 and 60 days after transplanting (DAT) significantly reduced aphid populations compared to a single spray at 20 DAT. The dual application enhanced early resistance and improved plant recovery from aphid stress. These results indicate that jasmonic acid is an effective, eco-friendly option for aphid management in chilli cultivation, supporting sustainable and productive agriculture.

AUTHOR'S CONTRIBUTION

SBK and BB conceptualized the research, MSK, SBK and KD conducted the experiment, collected data, MSK and SBK wrote the manuscript, MSK and DS done analysis of data and interpretation.

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