

Potential insecticidal effects of *Valeriana jatamansi* and *Isodon rugosus* against *Acanthoscelides obtectus* (Say) (Coleoptera, Chrysomelidae), a pest of *Phaseolus vulgaris* L.

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ABSTRACT: The insecticidal efficacy of *Valeriana jatamansi* and *Isodon rugosus* was evaluated against the bean weevil *Acanthoscelides obtectus* (Say), a pest of *Phaseolus vulgaris* L. The rhizome and leaves extracts from *V. jatamansi* and *I. rugosus* were prepared by using both acetone and methanol solvents and five concentrations of each extract were evaluated for its effectiveness in inducing adult mortality of the adult weevils. Acetone and methanol extracts of *V. jatamansi* rhizome and *I. rugosus* leaves at 12 per cent concentration exhibited 100 per cent mortality of adult bean weevils on the 7th and 8th day, respectively. As the concentration of the extracts escalated from 4 to 12 percent, the death rate also correspondingly increased. © 2026 Association for Advancement of Entomology

KEYWORDS: Bean weevil, adult mortality, biopesticide, dose-dependent mortality, post-harvest storage

INTRODUCTION

The global population is to reach 9.8 billion by 2050, with global food demand anticipated to rise by a minimum of 50 per cent, but the requirement for protein-rich products may escalate at an even faster rate (Mesterházy *et al.*, 2020). Pulses provide essential protein, especially for India's large vegetarian population (Hans *et al.*, 2024) encompasses various crops, including peas, many bean varieties, fava beans, chickpeas, lentils, lupins, and others. Beans (*Phaseolus* spp.) are essential for poor communities, providing protein, carbohydrates, vitamins, and minerals (Celmeli *et al.*, 2018). *Acanthoscelides obtectus* Say

(Coleoptera, Chrysomelidae), infest stored common beans, *Phaseolus vulgaris* L. (Thakur, 2012). Infestation typically initiates in the field and progresses during post-harvest storage. Oviposition occurs superficially amid the seeds, and the first instar larvae pierce the seed coat and infect the cotyledons. The endophytic larval stages demonstrate vigorous feeding behavior, finishing their development within the endosperm (Thakur and Renuka, 2014). Post-harvest food loss (PHL) denotes the food that is lost during the supply chain from the moment of harvest to eating or other ultimate applications (Aulakh *et al.*, 2013). Postharvest loss includes both direct physical losses and quality deterioration that degrades the economic

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value of crops or renders them unsuitable for human consumption. In extreme cases, these losses may reach to 80 per cent of total production (Fox and Fimeche, 2013). The management and supervision of this pest (*A. obtectus*) in large storage facilities predominantly depend on the application of phosphine, pyrethroids, organophosphates, and various other synthetic pesticides (Daglish *et al.*, 1993). Considering the detrimental impacts of chemical pesticides on agricultural soils, water resources, human health, and the environment, there is an urgent need for enhanced pest management strategies. Utilizing biopesticides is a primary strategy for controlling these pests in an environmentally sustainable way (Khurshed *et al.*, 2022). The various elements of medicinal plants, such as stems, flowers, leaves, and roots, are ecologically sustainable and provide an alternative for pest management. These may eradicate pests and inhibit their growth and reproduction (Mohammad *et al.*, 2024). The current study aims to examine the biopesticidal effects of *Isodon rugosus* (Wall. ex Benth. Codd) (Lamiaceae family) and *Valeriana jatamansi* Jones ex Roxb. on the bean weevil, *A. obtectus*. *Valeriana jatamansi*, (Valerianaceae family), Indian valerian is a wild herb located in the subtropical and temperate areas of the Himalayas (Raina and Negi, 2015). It is beneficial due to its insect repellent and antihelminthic properties. Similarly, traditional pharmaceutical systems, particularly in Asia, exhibit sedative, neurotoxic, cytotoxic, antidepressant, antioxidant, and antibacterial activities (Jugran *et al.*, 2019). The toxicity of *V. jatamansi* has been demonstrated on cowpea aphid (*Aphis craccivora*) and cigarette beetle *Lasioderma serricornis* (Feng *et al.*, 2020; Tewary *et al.*, 2005). *Isodon rugosus* is an important medicinal plant is primarily found in the country's eastern and peninsular regions. (Khanal *et al.*, 2025). This herb is well-known in ethnomedicine and has been used to treat analgesia and pain (Zeb *et al.*, 2016). According to Zeb *et al.* (2017) *I. rugosus* has potent antibacterial, insecticidal, and anthelmintic properties. It also has antinociceptive, antioxidant, and anti-cholinesterase properties (Sadiq *et al.*, 2018). Therefore, research was done on the insecticidal efficacy of extracts of rhizome and leaves from *V. jatamansi* and *I.*

rugosus against the bean weevil *A. obtectus*, a serious pest.

MATERIALS AND METHODS

Sample collection and maintenance of the insect culture: Infested seeds of *P. vulgaris* were procured from Kotkhair, Shimla district, Himachal Pradesh, India. The culture has been sustained under controlled conditions of temperature (28.00 ± 1 °C) and relative humidity (65.00 ± 2) in a BOD incubator. Culture of bean weevils was maintained on the identical host grain (*P. vulgaris*) to provide uniformity in feeding substrate and developmental circumstances. The culture was sustained in the laboratory for 11–14 generations before the start of experiment. Periodic sub-culturing was carried out by transferring newly emerging adults to fresh beans. The leaves and rhizomes of *I. rugosus* and *V. jatamansi* respectively were collected from Prospectus Hills and Ghanahatti of Shimla District of Himachal Pradesh, India. They were washed and dried in the shade at ambient temperature in the lab. The dried leaves and rhizomes were crushed into a fine powder. For extraction, 20g of powdered material was subjected solvent extraction (1:5 w/v) using acetone and methanol (Talukdar and Howse, 1993). After 48 hours, the soaked powdered material (leaves and rhizome) was filtered using Whatman No. 1 filter paper and re-extracted to make sure that as much as possible was recovered. About one gram more or less crude extract was obtained after the evaporation of solvents at their respective boiling points in water bath. Subsequent to processing, the extracts were preserved at 4°C for future investigations.

Fumigant toxicity test: The toxicity of the fumigant was evaluated using the filter paper impregnation method. Crude extracts were serially diluted in acetone and methanol to achieve concentrations of 4, 6, 8, 10, and 12 per cent (w/v). An aliquot (1.0 mL) of each concentration was uniformly dropped onto Whatman No. 1 filter paper discs (9 cm diameter) and air-dried for 20–30 minutes ensuring full solvent evaporation. The treated discs were positioned in Petri dishes, into which ten newly emerging adults were put in each Petri dish separately. Each treatment was

replicated thrice under controlled conditions. Filter papers treated with acetone and methanol in Petri dishes served as controls. All Petri dishes were inspected and mortality was recorded every 24 hours until the insects were completely eradicated. The corrected percentage mortality was recorded after the application of extracts through the Abbott's formula (Abbott, 1925).

RESULTS AND DISCUSSION

Effect of rhizome extracts of *V. jatamansi* on the adult mortality of *A. obtectus*: With the increase in concentration of the extracts from 4 to 12 per cent, the adult mortality rate also increased. Methanol extract of *V. jatamansi* rhizome showed 100 per cent mortality at 4, 6 per cent concentration on 11th day of exposure, while 8 per cent concentration showed on 9th day, 10 per cent concentration showed on 8th day and 12 per cent concentration showed on 7th day. In the case of acetone extract the adult mortality was cent per cent at 4, 6, 8 and 10 per cent concentration, on 10th, 9th, 8th and 7th day respectively. Both acetone and methanol extracts of *V. jatamansi* rhizome demonstrated total elimination of the bean weevil

by the seventh day of treatment. Whereas, mortality in control on the respective days (11th and 10th) was 33.1 and 29.9 per cent in methanol and acetone treatments respectively (Figs. 1a, b).

These findings align with those of Mohammad *et al.* (2024), who assessed the methanolic extracts of five medicinal plants viz. *Lantana camara* (leaves), *Carica papaya* (seeds), *Ricinus communis* (leaves), *Calotropis gigantea* (flowers), and *Gliricidia sepium* (leaves) for their insecticidal efficacy against the rice weevil through mortality assays conducted in laboratory settings. The leaves of *G. sepium* exhibited the 100 percent insecticidal activity after a duration of seven days.

Effect of leaves extracts of *I. rugosus* on the adult mortality rate of *A. obtectus*:

As the concentration of the extracts increased from 4 to 12 percent the mortality rate was also increased. Methanol leaves extract at 4, 6, 8, 10 and 12 per cent concentration showed 100 per cent mortality on 10th each, 9th and 8th each day of exposure respectively and in case of acetone extract the mortality at respective concentrations was on 12th,

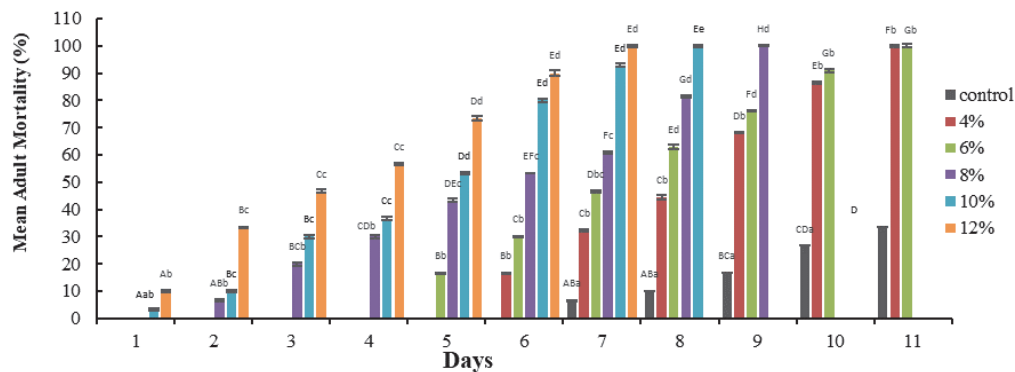


Fig 1a. Mean adult mortality of *A. obtectus* by rhizome extract of *V. jatamansi* in methanol

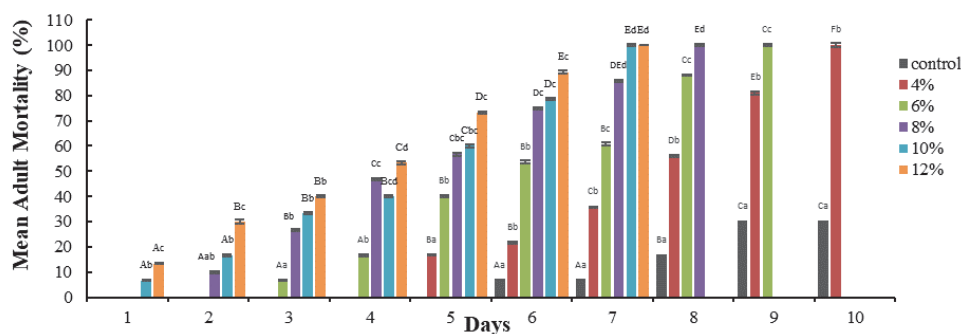


Fig 1b Mean adult mortality of *A. obtectus* by rhizome extract of *V. jatamansi* in acetone

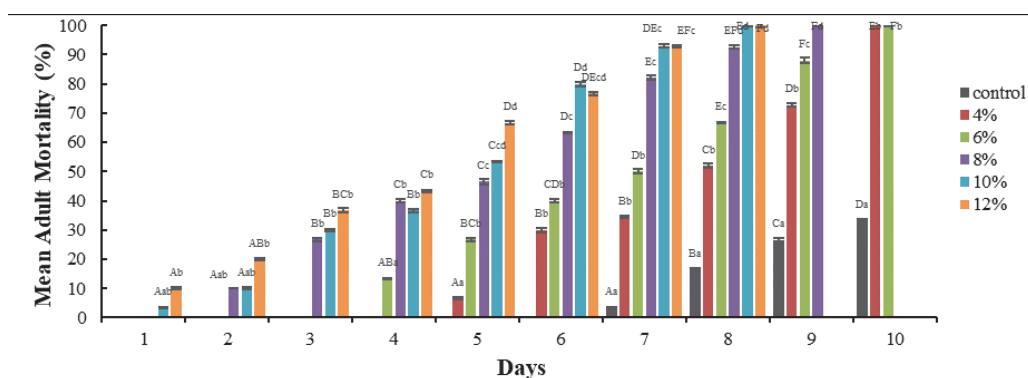


Fig.2a Mean adult mortality of *A. obtectus* by leaves extract of *I. rugosus*- in methanol

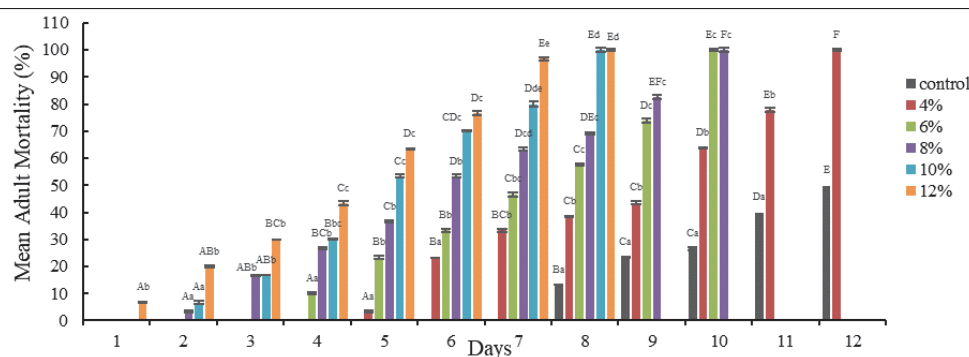


Fig.2b Mean adult mortality of *A. obtectus* by leaves extract of *I. rugosus* in acetone

10th each and 8th each day respectively. Whereas, mortality in control on the respective days (10th and 12th) was 31.1 and 49.9 percent in methanol and acetone treatments respectively (Figs. 2a, b).

Khan *et al.* (2017) discovered corresponding findings, indicating that among the seven plant extracts evaluated, the crude extract from *I. rugosus* exhibited the highest mortality rate in pea aphids. Rosmarinic acid has been identified as the bioactive compound in *I. rugosus* and is considered the principal substance exhibiting insecticidal properties (Khan *et al.*, 2019). The methanol extract of *I. rugosus* exhibited marginally greater efficacy than the acetone extract. This result aligned with the findings of Songwe *et al.* (2021), which indicated that the methanol extract of *Moringa oleifera* L. seeds exhibited a greater death rate against *A. obtectus* as compared to the ethanol and acetone seed extracts.

The insecticidal efficacy enhanced when the concentration of extracts increased from 4 to 12 per cent for both *I. rugosus* and *V. jatamansi*

extracts. The average adult mortality of *A. obtectus* on the 7th day was 35.76 and 100 per cent at 4 and 12 per cent concentrations of *V. jatamansi* rhizome acetone extract, respectively. Aslan *et al.* (2006) also observed that the insecticidal efficacy of *Sideritis trojana* acetone extract against *A. obtectus* increased with the dosage administered.

The current investigation revealed that the rhizome extracts of *V. jatamansi* and leaves extracts of *I. rugosus* in both solvents (acetone and methanol) were effective in causing adult bruchid mortality. However, acetone rhizome extract of *V. jatamansi* and methanol leaves extract of *I. rugosus* were more effective against *A. obtectus*. The mortality of the bean weevil observed on 7th and 8th day of exposure in acetone rhizome extract of *V. jatamansi* and methanol leaves extract of *I. rugosus* respectively was 100 per cent. The current findings indicate that a 4 per cent concentration of all investigated extracts caused *A. obtectus* mortality on the 10th, 11th, and 12th days post-treatment. Rodríguez-González *et al.* (2019) noted that *Ocimum basilicum* and *Cymbopogon*

winterianus had comparable insecticidal efficacy against *A. obtectus*. The essential oils from these two plants at a dosage of 120µL resulted in 100 percent mortality of *A. obtectus* by the 11th day of exposure. These results are closely related to the current study. The extracts of both plants were evaluated at varying concentrations of 4, 6, 8, 10, and 12 per cent in the selected solvents. The insecticidal efficacy enhanced when the concentration of extracts increased from 4 to 12 per cent for both *I. rugosus* and *V. jatamansi* extracts. Clove and cinnamon essential oils exhibited comparable toxicity towards *A. obtectus*, resulting in a dose-dependent reduction in the growth rate of this pest (Jumbo *et al.*, 2014). Ethanolic extracts from the leaves of *Ocimum gratissimum*, *Sida acuta*, *Telfaria occidentalis*, and *Vernonia amygdalina* were assessed for their secondary metabolite composition and insecticidal efficacy against the bean weevil (*A. obtectus*), demonstrating that the effectiveness of each extract increased with both concentration and exposure time (Adeniyi *et al.*, 2010). Previous research predominantly focuses on the therapeutic characteristics of *V. jatamansi* and *I. rugosus*, whereas their insecticidal potential remains underexplored. *A. obtectus* is a significant pest of *P. vulgaris*. The insecticidal efficacy of *V. jatamansi* and *I. rugosus* against this pest has not yet been investigated. The findings of the current investigation indicate that both *I. rugosus* and *V. jatamansi*, particularly their leaves and rhizomes, have insecticidal efficiency. The acetone extract of *V. jatamansi* rhizome and the methanol extract of *I. rugosus* were more effective in accelerating the adult mortality of *A. obtectus*. The insecticidal efficacy increased as the concentration of extracts rose from 4 to 12 percent for both plants. The research advocates for the utilization of *I. rugosus* and *V. jatamansi* for the management of stored grain pests.

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