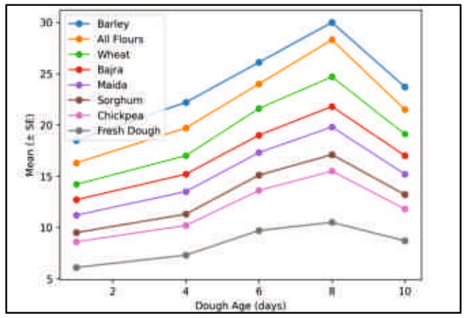


Figure1 Effect of dough aging on the attractiveness of different fermented dough formulations to snails and slugs under laboratory conditions. Treatments include barley, all flours (composite), wheat, bajra, maida, sorghum, chickpea, and fresh dough (non-fermented control). Mean (± SE) response values were recorded at 1, 4, 6, 8, and 10 days of fermentation. Barley and composite flour treatments showed the highest attraction, peaking at 8 days, while fresh dough consistently exhibited the lowest response, indicating the importance of fermentation duration in enhancing attractant efficiency.

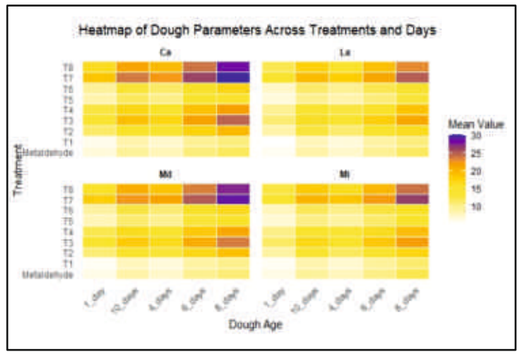


Figure2 Heat map showing the species-specific response of four gastropods C. aspersum (Ca), L. alte (La), M. dussumieri (Md), and M. indica (Mi)to different fermented dough treatments (T1–T8) and metaldehyde control across various dough aging periods (1, 4, 6, 8, and 10 days). Color intensity represents mean response values, with light yellow indicating lower attraction and orange to dark purple indicating higher attraction. The figure highlights the influence of dough formulation and fermentation duration on gastropod behavioral response.

Published by

Dr. Ashutush Kumar Tirpathi

Director

ICFRE-Arid Forest Research Institute

Post-Krishi Upaj Mandi, New Pali Road, Jodhpur

Web: http://afri.icfre.org email:dir_afri@icfre.org

Phone : +91-0291-2722549

Prepared by

Dr. Tanmaya Kumar Bhoi, Scientist C

Forest Protection Division

Funded by : CAMPA Extension 2025-26

Designed by : Kusum Lata Parihar, ACTO Ext. Div.

Eco-Friendly Attractant for Effective Snail and Slug Management in Forest Nurseries

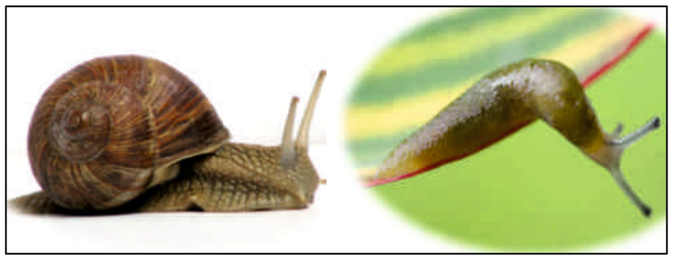
ICFRE-ARID FOREST RESEARCH INSTITUTE (AFRI) JODHPUR

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION DEHRADUN

(AN AUTONOMOUS BODY OF MOEF & CC, GOVT. OF INDIA)

Background

In arid regions, forest nurseries are maintained under controlled irrigation and shade-net conditions to support seedling growth, creating localized humid microclimates that favor the activity of snails and slugs. Although the surrounding environment remains dry, frequent watering, organic-rich potting mixtures, and dense seedling arrangements provide ideal conditions for molluscan infestation. These pests feed on tender leaves, cotyledons, and young stems, often causing severe damage and seedling mortality, particularly during monsoon or high-humidity periods. In such ecologically fragile arid ecosystems, the excessive use of chemical molluscicides is not advisable due to the risk of soil contamination, harm to beneficial organisms, and disruption of the nursery environment. Therefore, the use of fermented dough as an eco-friendly attractant becomes highly relevant. Fermented dough prepared from wheat flour, jaggery or sugar, and baker's yeast releases carbon dioxide, ethanol, and other volatile compounds during fermentation, which strongly attract snails and slugs by mimicking natural decomposition odors. When strategically placed around nursery beds, polybags, or irrigation lines, the bait concentrates molluscs at specific points for easy trapping or manual removal. This approach is cost-effective, environmentally safe, and well-suited for sustainable snail and slug management in forest nurseries of arid regions.



ICFRE – Arid Forest Research Institute (AFRI), Jodhpur Intervention

During 2023–2024, the ICFRE–Arid Forest Research Institute (AFRI), Jodhpur, initiated a research project entitled "Eco-Friendly Attractant for Effective Snail and Slug Management in Forest Nurseries Using Fermented Dough", funded by ICFRE, with the objective of developing a sustainable and environmentally safe alternative to chemical molluscicides. The project was conceptualized in response to increasing concerns regarding the excessive use of metaldehyde-based baits in nursery systems, which may pose risks to non-target organisms, soil health, and overall ecosystem stability. The research focused on utilizing fermented dough as a biodegradable and locally available attractant, based on the principle that fermentation releases volatile compounds capable of attracting gastropods.Under this study, different dough formulations were prepared using active dry yeast combined with various flour substrates such as wheat, barley, bajra, chickpea, sorghum, and all-purpose flour, along with a composite mixture. Standardized proportions of flour, deionized water, and yeast were maintained to ensure uniform fermentation. The fermentation process was allowed to proceed for different durations to assess the effect of dough aging on attractant efficiency. The hypothesis was that fermentation would produce alcohols, organic acids, and other volatile metabolites that enhance olfactory attraction in snails and slugs.The fermented dough formulations were tested against four major gastropod species commonly associated with nursery damage: Brown garden snail (Cornu aspersum), Horntail snail (Macrochlamys indica), Brown slug (Mariaella dussumieri), and Asian tramp slug (Laevicaulisalte). These species were selected due to their frequent occurrence in forest nurseries and their high feeding potential on young seedlings. Laboratory bioassays and multiple-choice Petri plate experiments were conducted to evaluate the attractiveness and behavioral response of these snails and slugs toward different fermented dough treatments in comparison with a standard metaldehyde-based bait.

Findings

The results clearly demonstrate that the attractiveness of fermented dough varied significantly among treatments and increased with dough aging up to 8 days, after which a slight decline was observed at 10 days. Among all treatments, barley-based dough consistently recorded the highest mean values across all observation days, reaching a peak at 8 days, indicating maximum attraction at this stage of fermentation. The combined flour treatment (all flours) also showed strong performance, ranking second and following a similar increasing trend up to 8 days. Wheat and bajra formulations exhibited moderate attractiveness, with steady increases from day 1 to day 8 and a decline thereafter. Maida and sorghum showed comparatively lower but consistent attraction responses, while chickpea recorded slightly lower values than sorghum across all days. Fresh dough (non-fermented control) showed the lowest mean values throughout the experiment, confirming that fermentation significantly enhances attractant efficiency. Overall, the findings indicate that fermentation duration plays a crucial role in improving attractant performance, with 8-day-old barley and composite dough formulations showing the highest efficacy against snails and slugs under laboratory conditions.

Furthermore, the heat map clearly demonstrates species-specific variation in response to different fermented dough treatments across aging periods. The four panels represent the responses of C. aspersum (Ca), L. alte (La), M. dussumieri (Md), and M. indica (Mi). In all species, darker color intensitiesindicating higher mean response valuesare predominantly observed in treatments T7 (barley flour) and T8 (combination of flours), especially at 6 and 8 days of fermentation. This pattern suggests that these formulations produced stronger attraction and activity compared to other treatments.A consistent trend across panels shows increasing color intensity from 1 day to 8 days of dough aging, indicating that fermentation duration significantly enhances attractiveness, likely due to progressive biochemical changes and volatile compound production. At 10 days, a slight reduction in intensity is visible in several treatments, suggesting a decline in peak attractiveness beyond optimal fermentation time. Treatments T1 (yeast alone) and the metaldehyde control generally display lighter shades throughout the panels, reflecting comparatively lower responses. Overall, the heat map highlights that both formulation type and fermentation age strongly influence gastropod behavior, with 8-day-old barley and composite dough showing the most pronounced and consistent effectiveness across all tested species.

Recommendations

- Based on laboratory bioassays and behavioral studies, fermented dough particularly barley-based and composite flour formulations aged for about 6–8 dayshas shown strong attractiveness to major snail and slug species. Therefore, fermented dough can be recommended as an eco-friendly attractant for integrated gastropod management in forest nurseries.
- For practical application, nursery managers should prepare dough using 500 g flour (preferably barley or a composite of flours), 500 mL water, and 5 g active dry yeast, and allow it to ferment for 6–8 days under shaded conditions. Small portions of the fermented dough can be placed in shallow trays, earthen pots, or bait stations around nursery beds, especially near moist and shaded areas where snails and slugs are active. Placement should preferably be done in the evening, as these pests are nocturnal feeders. The attracted snails and slugs can then be manually collected and destroyed early in the morning.
- For better results, the fermented dough method should be integrated with other cultural practices such as maintaining proper drainage, avoiding excessive irrigation, removing weeds and debris, and reducing hiding places around nursery beds. Regular monitoring should be conducted during humid and rainy seasons when gastropod activity is high. The fermented dough bait should be replaced every 8–10 days to maintain effectiveness.
- This approach offers a biodegradable, low-cost, and environmentally safe alternative to chemical molluscicides like metaldehyde. Adoption of fermented dough attractant in forest nurseries can reduce chemical dependency, protect beneficial organisms, and promote sustainable nursery management practices.