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INVESTIGATION OF THE EFFECTS OF DIVERSE DIET COMBINATIONS ON THE LIFE-CYCLE OF *CORCYRA CEPHALONICA*

Sumit Mehla*, Deepak Kumar, Deepika Kalkal, B.L. Sharma, Palvi Thakur, Preeti Sharma, Rakshit Mehla, Raj Kumar, Pooja Yadav and Ankit Saini

Department of Entomology, College of Agriculture, Chaudhary Charan Singh Haryana Agricultural University, Hisar-125004, Haryana, India

*Corresponding author E-mail: sumitmehlajadala@hau.ac.in

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ABSTRACT

A laboratory study was conducted at the Biocontrol Laboratory, CCSHAU, Hisar, Haryana, during March–April 2025 to assess the impact of four different diets T_1 (sorghum + bajra), T_2 (bajra), T_3 (gram + bajra) and T_4 (sorghum + gram) on the development of *Corcyra cephalonica*. The study aimed to identify optimal rearing media for enhancing mass production of *C. cephalonica* as a factitious host in biocontrol programs. Results demonstrated that larvae reared on T_3 (gram + bajra), T_2 (bajra) and T_1 (sorghum + bajra) attained greater weights, recording 53.10 mg, 51.50 mg, and 46.80 mg, respectively. Similar trends were observed at the pupal stage, with T_3, T_2, and T_1 yielding heavier pupae (31.6 mg, 30.8 mg, and 29.2 mg, respectively). The heaviest female moths emerged from T_3, T_2, and T_1 diets, weighing 39.3 mg, 37.9 mg, and 35.6 mg, respectively. Diet T_4 (sorghum + gram) resulted in relatively lower weights across all developmental stages. Importantly, altering the rearing media did not adversely affect the overall life-cycle of *C. cephalonica*. These findings suggest that gram + bajra, bajra and sorghum + bajra are promising diets for the efficient mass rearing of rice moth.

Keywords : Biocontrol, *Corcyra*, Diets, Treatments, Weight

Introduction

The rice meal moth, scientifically known as *Corcyra cephalonica*, is a significant pest primarily affecting stored grains, particularly rice, but also a variety of other food sources, including oil seeds, dried fruits and spices. This dietary adaptability contributes to its status as a significant agricultural pest, leading to substantial economic losses in grain storage and food industries worldwide. Understanding the biology and ecology of this moth is essential for developing effective pest management strategies (Shukla *et al*., 2014). The life-cycle of *C. cephalonica* includes multiple developmental stages influenced by various environmental factors and the composition of its diet, which plays a critical role in its growth, reproductive success, and overall health. After agricultural food is harvested, substantial losses may transpire before its eventual consumption. Depending on the crop variety, the area and particular handling or storage techniques, these losses might be economic, qualitative or quantitative. Due to the favourable weather circumstances, insects are a major source of harm to food that has been preserved in tropical locations. Because of its rapid reproduction and ease of rearing, this insect is also frequently used as a factitious host in labs to mass rear biological control agents like *Trichogramma* species. However, the nutritional value of the food fed to *C. cephalonica* is a major factor in its success during rearing. Important biological factors, including longevity, fertility, adult emergence, larval and pupal weights and larval length, can all be directly impacted by the diet's composition. Therefore, improving mass-rearing techniques requires an understanding of how various diets affect these factors (Malik, 2018). In order to determine the best and most economical way to raise *C. cephalonica*, this study aims to assess several food formulas, including combinations of different grains. The results will contribute to improving the quality and efficiency of insect production, which is critical for more sustainable pest management initiatives and large-scale parasitoid and predator rearing. In order to determine the best diet

for optimising yield and fitness, the study specifically examines the effects of several diet combinations on the growth and development of *C. cephalonica* in the lab.

Materials and Methods

The material method used for the rearing process of *Corcyra cephalonica* in Biocontrol lab, CCSHAU, Hisar (March-April 2025), using four replications and four treatments (bajra+sorghum, bajra, bajra+gram and sorghum+gram) under a Completely Randomized Design (CRD) can be described as follows:

Materials

- **Grains for treatments:** bajra (Pearl millet), sorghum, gram (chickpea) in specified combinations.
- **Rearing containers:** Transparent plastic containers or trays.
- **Petri plates:** Approximately 9 cm in diameter (standard size for insect observation).
- **Muslin cloth:** For covering containers to allow ventilation but prevent escapes.
- **Microscope:** Zeiss microscope for measuring larval, pupal and adult morphological features.
- **Weighing balance:** A sensitive machine for weighing insects (larvae, pupae, adults).
- **Other:** Forceps, camel hairbrush, rubber bands, scissors and sterilized diet materials. Plastic rearing trays or containers (38×29×36 cm).

Experimental Design

Design: Completely Randomized Design (CRD) with four treatments:

Treatment	Treatment combination	Proportion (grains)
T_1	Bajra + Sorghum	1;1
T_2	Bajra + Gram	3:1
T_3	Bajra only	-
T_4	Sorghum + Gram	3:1

Replications: Four replicates per treatment.

Preparation of diet: Sound grains of sorghum, bajra and gram were milled in a domestic grinding machine by making 2 to 3 pieces of each grain. The grains were subsequently heat sterilized in a hot air oven at 100ºC for 30-35 minutes to eliminate any possible secondary infestation. Prepare diets by mixing the grains according to the treatments. After that diet mixture and plates were sterilized in the oven at 95ºC. The material was treated in the same way with streptomycin sulphate at 0.2 g per kg to inhibit bacterial infection. Adding 0.1 per cent solution of formalin, 5g yeast powder and 5g sulphur powder to prevent the attack of mites and maintain the nutritional quality of the grinding mixture. Take plastic boxes or trays (approx. 38×29×36 cm) and add 0.5-1kg of diet according to treatment. Introduction of eggs in sterilized plates or boxes with freshly collected eggs of *C. cephalonica* and place them on sterilized brown paper strips or inside the container on the diet. Egg density can be around (0.25cc eggs) 5000 eggs per container. Maintain the containers under controlled laboratory conditions of temperature 25±1°C and relative humidity 55±10%. Keep the cultures away from direct sunlight. Larvae hatch in 2-3 days and start feeding on the diet. Larval duration lasts around 31-39 days, depending on diet. Mature larvae spin white cocoons for pupation in the diet substrate. This pupation occurs within a silk cocoon constructed inside the grain and the time from egg to adult emergence can vary between 35 to 40 days under optimal conditions. Adults emerge after 7-8 days of pupation. Place a thin wire mesh or muslin lid to prevent adults from escaping.

Observations and Measurements: Length measurement: Use a Zeiss sterni 508 microscope with a calibrated eyepiece micrometer to measure the length of larvae, pupae and adults. Place insects on a Petri plate (9 cm diameter) with a thin layer of water to immobilize them gently for measurement.

Weight measurement: Use a sensitive electronic weighing machine to measure the weight of larvae, pupae and adults individually or by pooling multiple individuals and then calculating the average weight.

Parameter recorded:

- Larval weight of 25-day-old larvae.
- Pupal weight of twenty pupae was randomly selected from each treatment tray and weighed on a balance.
- The adult weight of twenty adult females was randomly selected at moth emergence.
- Developmental durations of each stage.
- Survival rate and percent emergence of adults.

Observations should be recorded in a data sheet for each replication and treatment.

Summary of Conditions

- Temperature: 25±1 °C
- Relative Humidity: 55±10%

This rearing method ensures a systematic assessment of the effect of different diet treatments on growth parameters of *C. cephalonica*, which can be used for biocontrol agent production and laboratory experiments. Observations and analysis under Zeiss Stereomicroscope 508 with 1.0X and precise weight measurements lend scientific accuracy to developmental studies.

Results and Discussion

The effects of different diets on the developmental weights of the insect at larval, pupal and adult stages were evaluated. The results, presented in Table 2, indicate that diet composition significantly influenced growth and development across all life stages.

Table 2: Effect of diet on larval weight, pupal weight and adult weight of rice moth

Diet	Larval weight (mg ± SE)	Pupal weight (mg ± SE)	Female adult weight (mg ± SE)	Male adult weight (mg ± SE)
Bajra + Sorghum	46.8 ± 1.2	29.2 ± 0.9	35.6 ± 1.0	31.1 ± 1.0
Bajra	51.5 ± 1.5	30.8 ± 1.0	37.9 ± 1.3	32.6 ± 1.2
Bajra + Gram	53.1 ± 1.4	31.6 ± 1.1	39.3 ± 1.2	33.8 ± 1.1
Sorghum + Gram	44.3 ± 1.3	28.5 ± 0.8	34.1 ± 1.1	30.4 ± 0.9

Plates of the experiments

A. Rearing plastic plates

B. Grind powder of different grains

C. Larva of *Corcyra cephalonica*

D. Pupa of *Corcyra cephalonica*

E. Adult of *Corcyra cephalonica*

Larval weight

From the present study, it was observed that the larval weight of *C. cephalonica* was highest on the bajra + gram diet (53.1 ± 1.4 mg), followed by bajra alone (51.5 ± 1.5 mg), while the lowest larval weight was recorded on sorghum + gram (44.3 ± 1.3 mg). These findings underscore the positive influence of gram (a pulse rich in protein and micronutrients) when combined with energy-rich cereals like bajra on larval development. The high protein and carbohydrate content of gram likely enhanced nutrient assimilation and biomass accumulation. These results are in partial agreement with earlier work by Bushan *et al*. 2012;

Rao *et al*. (1980), who demonstrated that the addition of glucose (3.0–4.0%) or protein (50–60%) to sorghum flour significantly improved larval weight. In support of the current findings, Ingle *et al*. (2000) also reported enhanced larval growth when yeast and protein sources were incorporated into rearing media, further validating the role of supplementary nutrients in improving insect biomass. The inclusion of yeast, often rich in B-complex vitamins and amino acids, could synergize with gram to optimize larval development.

Pupal weight

A similar trend was observed at the pupal stage. The pupal weight in *C. cephalonica* was influenced significantly by diet composition. The highest pupal weight was observed in insects reared on a bajra + gram diet (31.6 ± 1.1 mg), while the lowest was recorded in the sorghum + gram diet (28.5 ± 0.8 mg). This confirms that bajra-based diets support superior pupal development compared to sorghum-based combinations, likely due to better nutrient availability and energy content. These findings are in general agreement with Ingle *et al*. (2000), who reported that bajra combined with oilseed meals (such as groundnut, mustard, and cotton) resulted in higher pupal weights, with maximum values of 47.1 mg (bajra + groundnut), compared to lower weights in sorghum-based (42.5–38.7 mg) and maize-based (37.3–34.1 mg) diets. The present findings are corroborated with the study conducted by Fand *et al*. 2013; Dangat *et al*. (2016) who found that maximum pupal weight 24.71 mg, adult emergence 64.04 per cent and minimum larval mortality 35.96 per cent was observed in 50 per cent sorghum + 50 per cent bajra diet. Mehendale *et al*. 2014; Nathan *et al*. 2006 also reported that heavier pupae (34.67 mg) were recorded in T_4 (sorghum + gram + powdered yeast).

Adult weights

Both female and male adult weights followed the same dietary trend. Female adults reached the maximum weight when reared on bajra + gram (39.3 ± 1.2 mg), followed by bajra alone (37.9 ± 1.3 mg). The lowest female weight was found in the sorghum + gram diet (34.1 ± 1.1 mg). For males, the highest weight (33.8 ± 1.1 mg) also occurred with the bajra + gram diet, while the lowest (30.4 ± 0.9 mg) was again noted in the sorghum + gram group. Here is a comparative analysis that identifies how the findings from Kumar & Kumar 2002; Tiwari & Khan 2003; Jacob *et al*. 1966; Uberoi 1961; Kumar 1991; Haritha *et al*. 2000 relate to our current results on adult weights, specifically for female and male moths of *C. cephalonica*.

Nutrient-Rich Diets Lead to Heavier Females: our study shows that female moths had the highest body weight (39.3 ± 1.2 mg) when reared on bajra + gram, a combination of cereal and pulse. This aligns with findings from Tiwari and Khan (2003) and Kumar *et al*. (2002), who observed the highest female emergence and fecundity in diets supplemented with pulses (groundnut, gram, cowpea) and yeast.

Conclusion

The conclusion that pulse proteins, in combination with energy sources, promote healthier and more fecund females, supports your observation that protein-rich media like bajra + gram produced heavier females. Tiwari and Khan (2003) directly associated heavier female moths with increased egg production, showing that protein supplementation (from pulses and yeast) resulted in better reproductive outcomes. Sorghum alone or with limited protein showed that sorghum + gram resulted in the lowest adult weights (34.1 ± 1.1 mg for females, 30.4 ± 0.9 mg for males), aligning with the reported lowest female emergence and fecundity in sorghum alone or sorghum + maize + yeast in the cited studies. The conclusion that sorghum alone is nutritionally inadequate (due to low protein) is consistently supported across both our study and earlier literature (e.g., Malik 2018; Jacob *et al*. 1966, Kumar 1991). The results align with Uberoi (1961) and others who have emphasized protein and B-vitamin sources (e.g., yeast) as crucial for healthy development and reproduction in *Corcyra.*

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