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Effect of Different Diet Formulations on Adult Emergence of *Corcyra cephalonica* (Stainton)

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Abstract: Experiment was conducted to evaluate the efficacy of various diet formulations on the adult emergence of *Corcyra cephalonica,* an important factitious host used in biological control programs. Ten different diets, including five solo grains (sorghum, maize, bajra, ragi, and broken rice) and five additive-enriched combinations (with groundnut powder and yeast), were tested under controlled conditions. Data on adult emergence were recorded weekly for five weeks. Among the diets, bajra and sorghum with additives resulted in the highest moth emergence (1294.3 adults), followed by bajra alone (1156.7) and maize + sorghum + additives (1007.0), whereas broken rice yielded the lowest moth emergence. These results confirm that dietary additives significantly enhance the reproductive performance of *C. cephalonica* and can be recommended for cost-effective mass rearing in biocontrol programs.

Keywords*:* Additives, Adult emergence, *Corcyra cephalonica*, Host diet, Mass rearing, Biocontrol

Biological control has been employed for over a century to manage various insect pests (Dhawan 2007, Sampaio 2010 and Dhaliwal et al., 2010). It is widely recognized as an eco-friendly and sustainable alternative to chemical control, especially in light of the environmental and health hazards associated with the indiscriminate use of pesticides. In recent years, the adoption of biological control has gained significant momentum, particularly with the increased emphasis on Integrated Pest Management (IPM) strategies (Dhawan 2007, Dhaliwal et al., 2010, Dhawan et al., 2013, Stenberg 2017). Among the multiple approaches to biological control, augmentative release preceded by laboratory mass rearing has been proven effective in several cropping systems, including protected cultivation (Van Lenteren 2012, Brodeur et al., 2018). Successful implementation of these programs requires efficient mass production and conservation of beneficial organisms (Padhy et al., 2020). In India, the rice meal moth, *C. cephalonica* (Stainton), is extensively used as a factitious host for mass rearing of egg parasitoids such as *Trichogramma spp*. (Bernardi et al., 2000, Gauraha and Deole 2016). Various cereal grains including rice, maize, wheat, sorghum, and pearl millet have been evaluated for their suitability in rearing *C. cephalonica,* with differing opinions reported in earlier studies (Pathak et al., 2010, Gauraha and Deole 2016, Nasrin et al.,2016, Jhala et al., 2019 , Jitendra Kumar et al., 2025). The nutritional composition of the larval diet plays a crucial role in determining the quality and quantity of host eggs produced, which directly influences the field performance of released parasitoids (Hunter 2003). Hence, diet optimization is critical for both host production and the performance of natural enemies. In this context, the present study was conducted undertaken under laboratory conditions to assess the impact of different diet formulations, comprising solo grains and grain mixtures with nutritional additives on the adult emergence of *C. cephalonica*.

MATERIAL AND METHODS

The experiment was conducted under laboratory conditions at the Centre for Biological Control (CBC), National Institute of Plant Health Management (NIPHM), Rajendranagar, Hyderabad duirng 2022. Ten dietary treatments were evaluated consisting of five solo cereal grains: sorghum, maize, bajra, ragi, and broken rice and five combinations with additives. Each combination included two grains mixed in a 1:1 ratio and each supplemented with 40 g groundnut kernel powder and 5 g dry yeast per kg of diet. The treatments were sorghum, maize, bajra, ragi, broken rice, bajra + sorghum + additives, maize + sorghum + additives, sorghum + broken rice + additives, ragi + bajra + additives and bajra + broken rice + additives. Each treatment was replicated three times. The grains were cleaned, coarsely ground to 2–3 fragments, and sterilized at 100°C for one hour to eliminate microbial contaminants. After cooling, 1 kg of each diet was placed in individual plastic tubs. Additive mixtures were incorporated into the relevant diet treatments before infestation.

Each tub was inoculated with *C. cephalonica* eggs at a rate of 800 eggs (0.05 cc) per kg of diet, obtained from the insect culture maintained at Prof. Jayasankar Telangana State Agricultural University (PJTSAU), Hyderabad. The tubs were covered with muslin cloth secured with rubber bands and arranged on iron racks under laboratory conditions (temperature: 25±1ºC; RH: 70±5%; photo period: 14:10 h L:D). Adult moth emergence was monitored daily beginning on the 34^{th} day after inoculation. Emerged moths were collected using specimen tubes, transferred to ovipositional cages and weekly cumulative emergence data were recorded for five consecutive weeks. Data were analyzed and treatment means were separated with Tukey's HSD using SPSS statistical software.

RESULTS AND DISCUSSION

The adult emergence of *C. cephalonica* was recorded weekly across all ten treatments for five consecutive weeks. The results showed significant differences in moth emergence among diets. During the first week, the highest adult emergence was observed in bajra + sorghum + additives with 86.00 moths, followed closely by bajra (83.3 adults) and maize + sorghum + additives (82.7 adults). The lowest adult emergence was observed in broken rice (13.0) and ragi (19.0).

In the second week, again bajra + sorghum + additives recorded the highest emergence (245.67), followed by maize + sorghum + additives and sorghum + broken rice + additives. Broken rice recorded lowest emergence (21.00). Similar trends continued in the subsequent weeks, with bajra + sorghum + additives consistently producing the maximum number of adults, peaking at 405.7 moths in the third week followed by bajra , maize + sorghum + additives, and sorghum + broken rice + additives . Broken rice and Ragi consistently yielded the fewest adults.

Adult emergence during the fourth week was highest in bajra (375.00) and bajra + sorghum + additives (364.33), followed by maize + sorghum + additives, sorghum + broken rice + additives, maize, and sorghum. In the fifth week, bajra + sorghum + additives recorded the maximum emergence (192.67 moths), followed by Bajra , maize + sorghum + additives, and sorghum + broken rice + additives (155.67). In contrast, broken rice consistently registered the lowest adult emergence across all five weeks. The daily emergence pattern over the 35-day period indicates the superior performance of bajra + sorghum + additives and bajra as reflected in their linear trend lines compared with the other diet treatments (Fig. 1).

The pooled analysis across five weeks further confirmed the superiority of additive-enriched diets. bajra + sorghum + additives with maximum cumulative emergence (1294.33 moths), followed by bajra, maize + sorghum + additives with 1007.00, and sorghum + broken rice + additives. Solo grain cereal diets such as sorghum and maize recorded moderate

Table 1. Weekly adult emergence of *C. cephalonica* on different diet formulations

Treatment	Adult emergence in different weeks (Numbers)					Total
	Week '1'	Week '2'	Week '3'	Week '4'	Week '5'	
T1 - Sorghum (S)	36.33^{c} (6.01)	173.33^{bc} (13.16)	230.67^{c} (15.11)	213.33^{b} (14.59)	147.33^{b} (12.12)	801.00^{d} (28.27)
T2- Maize (M)	54.33^{b} (7.33)	174.67^{bc} (13.19)	208.00^{c} (14.41)	241.33^{b} (15.53)	145.67^{bc} (12.07)	824.00^{d} (28.70)
T3- Bajra(B)	83.33^{a} (9.04)	183.00^{bc} (13.51)	344.00^{ab} (18.51)	375.00^{a} (19.36)	171.33^{ab} (13.08)	1156.67^{b} (34.01)
T4 – Ragi (R)	19.00^{d} (4.35)	32.33^{e} (5.68)	97.67^{d} (9.88)	102.00^{d} (10.10)	74.33^{e} (8.53)	325.3f (18.01)
T5 - Broken Rice (BR)	13.00^{d} (3.60)	21.00^{e} (4.53)	83.00^{d} (9.10)	75.67^{e} (8.69)	58.00^{e} (7.61)	250.67^{g} (15.83)
T6 - B+ S + Additives	86.00^{a} (9.27)	245.67^{a} (15.67)	405.67^{a} (20.13)	364.33^{a} (19.07)	192.67^{a} (13.84)	1294.33^{a} (35.97)
T7 - M+S+ Additives	82.67^{a} (9.09)	202.67^{b} (14.21)	334.33^{b} (18.28)	224.33^{b} (14.97)	163.00^{ab} (12.76)	1007.00^{c} (31.72)
T8 - S+BR+ Additives	42.67^{bc} (6.50)	195.67^{b} (13.99)	323.00^{b} (17.96)	216.33^{b} (14.71)	155.67^{ab} (12.47)	933.33^{c} (30.55)
T9 – R+B + Additives	31.67^{c} (5.62)	157.33^{cd} (12.53)	212.67^{c} (14.55)	166.00^{c} (12.87)	111.67^{d} (10.56)	679.33^{e} (26.06)
T10 - B+BR + Additives	41.00^{bc} (6.39)	141.00^{d} (11.87)	188.67^{c} (13.72)	141.33^{c} (11.88)	114.00^{cd} (10.68)	626.00^{e} (25.01)
'p-Value'	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
'Tukey HSD at 5%'	1.658	1.119	1.632	1.006	1.409	1.675

Figures in the parentheses are arc sin transformed values. Column values with same superscripts do not differ significantly

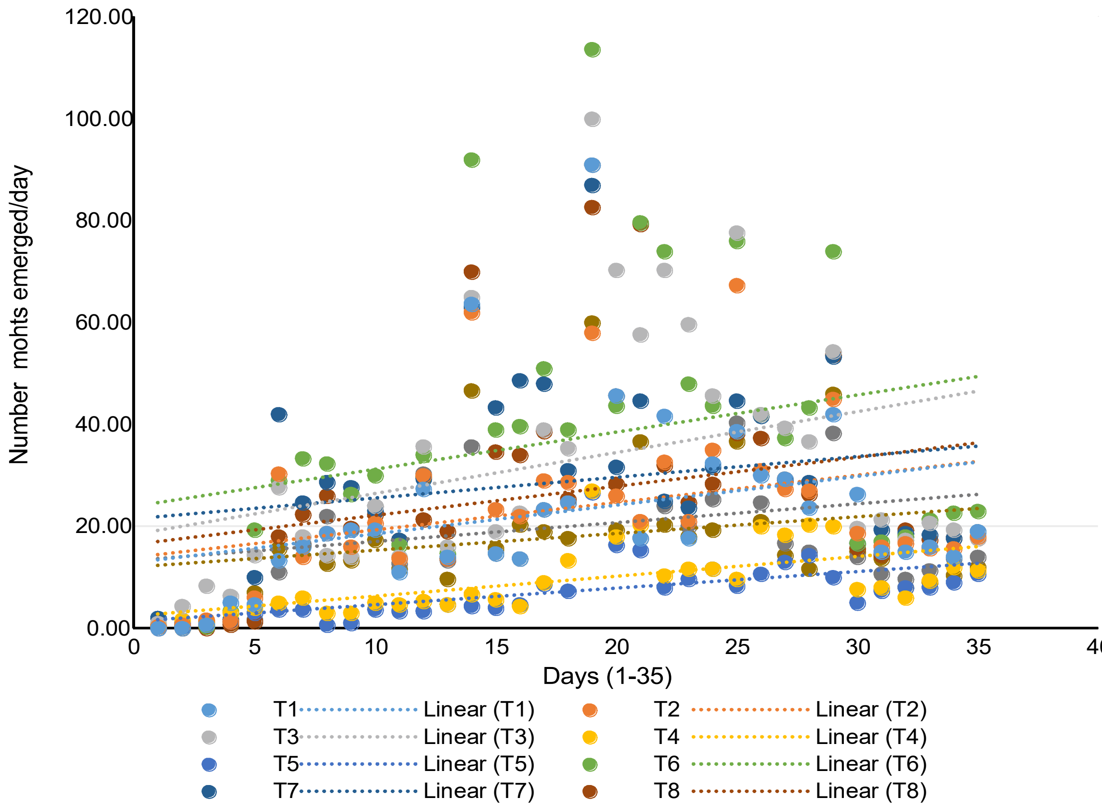

Fig. 1. Moth emergence in treatments during study period (day wise)

performance and were statistically at par. The lowest emergence was observed in broken rice with 250.67 moths and was significantly inferior.

The results suggest that diets containing additives significantly improved the emergence and development of *C. cephalonica*. Nutrient-enriched media likely improved moth performance by supplying essential proteins, vitamins, and micronutrients necessary for larval growth and successful pupation. Bait additives, groundnut powder and yeast provide essential amino acids, fatty acids, and B-complex vitamins needed for larval development. These additives enhance digestibility and assimilation of nutrients, improving feed conversion efficiency. The balanced nutrition reduces larval mortality, accelerates growth, and supports successful pupation. Lipids and sterols from groundnut and yeast also aid hormone synthesis required for metamorphosis, thereby ensuring better adult survival and emergence (Nasrin et al., 2016, Jhala et al., 2019, Kaur et al., 2024). The superior performance of Bajra + Sorghum + additives can be attributed to the synergistic nutritional effects of bajra, sorghum, groundnut powder and yeast. Conversely, the inferior performance of broken rice may be due to the low non-starch polysaccharide (NSP) content in broken rice, which affects nutrient utilization and digestibility.

The findings corroborate earlier reports that highlighted the positive influence of protein-rich and yeast-supplemented diets on the reproductive output of *C. cephalonica* (Sathpathy et al., 2003, Pathak et al., 2010, Kumar et al., 2019, Jitendra Kumar et al., 2025). Arun Kumar et al. (2018) and Mehendale et al. *(*2014) also recorded enhanced emergence and fitness in moths reared on sorghum and additive-based media.

CONCLUSION

Among the tested diets, bajra + sorghum supplemented with groundnut kernel powder and yeast proved to be the most effective formulations for supporting adult emergence of *C. cephalonica*. Diets enriched with nutritional supplements significantly outperformed solo cereals, indicating their potential use in large-scale and cost-effective mass rearing for biological control programs.

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