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Earthworm Meal as Cost Effective Artificial Diet for Mass Rearing of Cryptolaemus Montrouzieri (Mulsant), a Biocontrol Agent

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Abstract:
First time Earthworm meal powder was used as an artificial diet for mass rearing of Cryptolaemus montrouzieri (Mulsant) an excellent Biocontrol agent against mealybugs. Cent percent mortality was noticed with 1st and 2nd instars when grubs treated individually and as pairs per box. There was 61.33% pupation in 3rd instar and 78.00% in 4th instar grubs when left singly in containers. When allowed in pairs per box, there was increase in percent pupation of 3rd (68.33%) and 4th (82.33%) instar grubs. adult emergence was observed to be 80-90% in both the treatments. To overcome the mortality in early instars, it is essential to look for supplementing the earthworm meal with micronutrients, aminoacids and fatty acids.

Keywords: *Earthworm meal, Cryptolaemus montrouzieri, Grubs, Biocontrol*

1. Introduction

Disadvantages of unilateral approach of controlling crop pests with synthetic chemicals have voiced the need for developing cost effective, eco-friendly and safe pest control strategies. That is biological control. Biological control was defined as 'action of predators, parasites or pathogens in curtailing the population density of the organism whose presence would be deleterious to host plant in their absence' (Debach, 1964a). Among the different groups of predators, coccinellids play a major role in the suppression of several crop pests throughout the world. *Cryptolaemus montrouzieri* Mulsantis popularly known as mealybug destroyer, mealybug predator, Australian ladybird beetle, Crypts andmealybug ladybird. *C. montrouzieri* is native of Australia and was observed as imported species in more than 40 countries including India.

C. montrouzieri is well known to control the mealybugs effectively and its use will go a long way in management of mealybugs.Adults and grubs feed extensively on all stages of mealybugs. This technology is both farmers and consumer friendly. It will have beneficial role in environmental safety. Although Indian farmers are aware of effectiveness of biocontrol agent against mealybugs, they rarely adopt the principle, primarily due to unavailability of the predators in the market. Problems that have limited the expansion of use of biocontrol agents include technical and economic difficulties for *in vitro* commercial production. Available refined multiplication of *C. mountrozeire* is laborious, cost prohibitive and unapproachable to farmers. Keeping the above information in view the present investigation on development of an easy and cost- effective mass rearing methods for predator *C. mountrozeire* on artificial diet was initiated. Many attempts have been made to rear *Cryptolaemus montrouzieri* grubs on different types of artificial media and one of that comprised water, agar, honey, casein, brewer's yeast, beef liver, egg yolk, sucrose, multivitamin, vitamin E, cotton oil, groundnut oil and other micro nutrients.

In the present study an attempt was made for developing cost effective earthworm meal (powdered earthworm powder) as artificial feed for mass multiplication of *C. montrouzieri* grubs.

2. Materials and Methods

2.1. Preparation of Earthworm Meal

Adult earthworms (*Eudrilus eugeniae*) were cultured on garden waste materials. They were picked from culture bins and released on wet blotting paper in a plastic box and covered with lid to prevent the escape of worms. Pin holes were made on lids for aeration. Within48hrs. the gut was cleared of organic debris. Later they were collected and added into container having 2 % Sodium chloride

(NaCl) solution for 10 minutes to narcotise them. The inactive worms were sun dried for 2 days. The dried worms were ground to get the fine powder and stored in airtight container for further use.

2.2. Feed Trials on Different Instars

Different concentration of Earthworm meal powder (0.25-2gm) was provided for first, second, third and fourth instars of*C. montrouzieri* grubs and monitored for diet acceptance and feeding by grubs until pupation and adult emergence.

3. Results and Discussion

Cent percent mortality was noticed with 1st and 2ndinstars when single grub was introduced into plastic box (3.5cm length X 6.5 cm breath X 1.0 cm Height).There was 61.33% pupation in 3rd and 78.00% in 4th instars grubs under similar condition (Table 1). As the grubs are gregarious in nature in second set of experiment they were released in pairs in to the plastic box (3.5cm length X 6.5 cm breath X 1.0 cm Height).This did not improve the acceptance or survival of first two instars and again it resulted in Cent per cent mortality. But in case of 3rd instar there was slight increase pupation (68.33%) and in 4ththere marked increase in pupation (82.33%) (Table 2).The adult emergence was 80-90% in both the treatments. The larvae were reared on a more complicated diet but suffered from high mortality (Chumakova, 1962). Another artificial diet for the rearing of *C. montrouzieri* was also described by Sogoyan (1969) with similar results. Development of C. *montrouzieri* was studied on a freeze-dried artificial diet devoid of insect components and mean adult emergence of the predators reared on artificial diet and mealybug reared were 58.0 and 90.0% respectively (Venkatesan *et al*., 2001).To overcome mortality rate in early instars more additives like micronutrients, vitamins may be essential and this needs to be tested further to achieve total success in culturing of this beetle. Once the total success is achieved the same method may be adopted for mass propagation of other predatory insects that serve as bio-control agents.

Instars	Total No treated*	Mortality (%)	Pupation (%)
Third	150	38.66	61.33
Fourth	150	22.00	78.00

Table 1: Mean percent pupation of different instars of C. montrouzieri released individually per box on earthworm meal.
**Total No is from three replications, 50 grubs were included per replication*

Instars	Total No treated*	Mortality (%)	Pupation (%)
Third	300	31.66	68.33
Fourth	300	17.66	82.33

Table 2: Percent pupation of different instars of C. montrouzieri released in pairs per bottle on earthworm meal
**Total No is from three replications, 100 grubs were included per replication*

Chemical Composition	As such basis in %	100% Dry matter basis in %
Moisture	7.70	-
Crude Protein	56.27	60.95
Total Ash	10.49	11.36
Crude fibre	0.56	0.60
Calcium	1.01	1.09
Phosphorus	1.25	1.36
Fat (Ether extract)	6.05	6.55
Silica	3.76	4.07

Table 3: Chemical Composition of earthworm meal (Kale, R.D. 1986)

Amino acids in earthworm meal g/100g protein (O. Graff, 1981)	
Aspartic acid	10.3
Threonine	4.8
Serine	4.8
Glutamic acid	13.8
Alanine	5.2
Cystine	1.6
Valine	5.0
Methionine	2.0
Isoleucine	4.5
Leucine	7.9
Tyrosine	3.4
Phenylalanine	4.1
Lysine	7.1
Histidine	2.6
Arginine	6.1

Table 4

Figure 1: Mass rearing of Earthworm

Figure 2: a. Adult Earthworm b. Earthworm meal powder c. Grubs feeding on Earthworm meal

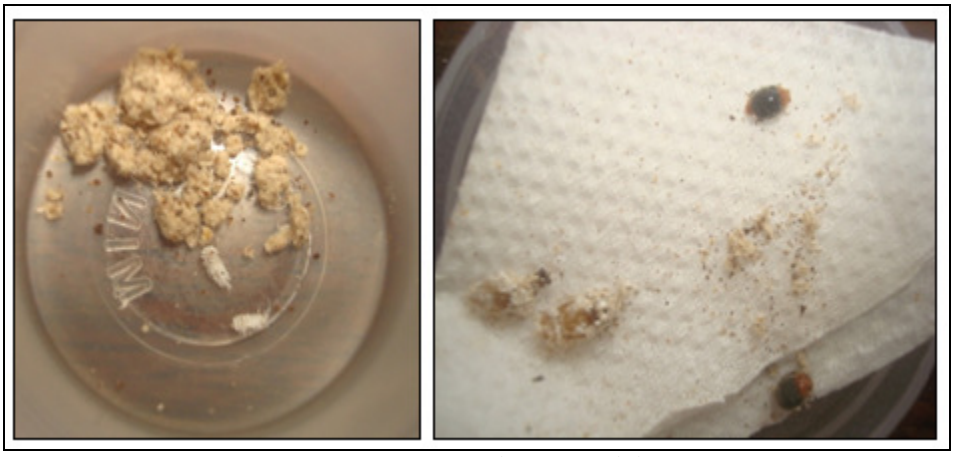

Figure 3: Emerged Crypto Adults

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