



Journal of Applied and Natural Science 9 (3): 1302 - 1304 (2017)



## An improved foolproof device for eggs' sterilization of *Corcyra cephalonica* (Stainton)

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Received: August 8, 2016; Revised received: February 19, 2017; Accepted: June 28, 2017

**Abstract:** Mass rearing of numerous biological control agents depends on large amounts of eggs of factitious hosts like rice meal moth, *Corcyra cephalonica* (Stainton) (Lepidoptera : Pyralidae). *Corcyra* eggs sterilization is required before they are used for parasitisation by *Trichogrammatids*. To meet the requirement of eggs sterilization of this insect, a new innovative device was invented, fabricated and studied. It consisted of an enclosed structure having semi-circular shaped drawer. An ultra violet (UV) tube of 30 W is fixed on the centre of its ceiling to maintain a uniform distance of 35 cm from the eggs to be sterilized. An exposure of 10 minutes to eggs of *C. cephalonica* was required to get optimum sterilization. As whole body of the device was an enclosed structure, hence, there was no exposure of UV rays to the laboratory workers. The different sized-models (150,100, 50 of "egg cards" required for *Trichogrammatids*) can be fabricated to meet the diverse requirements. Irradiated eggs were found having no any adverse effects on the abilities of *Trichogrammatids* parasitisation and its emergence. It can also used for UV sterilization of laboratory materials like glassware, plastic ware, clothes, cotton etc. The period of exposure to the UV light was set using timer. This innovative UV chamber had numerous advantages *i.e.*, the UV rays used had damaged the host embryo. The damaged embryo could not develop into next stage, at the same time damaged embryo found suitable for parasitization of *Trichogrammatids*. The whole body of the device was made-up of an enclosed structure; hence, there was no exposure of UV rays to the laboratory workers. The different sized-models (150,100, 50 of "egg cards" required for *Trichogrammatids*) can be fabricated to meet the diverse requirements of clients. As the UV chamber was made up of metal and ply boards, hence, it was durable. The longitudinal flanges provided in the drawer of the device prevented the host egg bearing cards to glide one over other from curved surface. The device was found safe and effective for sterilization of *Corcyra* eggs and easy to operate.

**Keywords:** *Corcyra cephalonica*, Egg sterilization, Mass rearing of *Trichogrammatids*, UV sterilization chamber

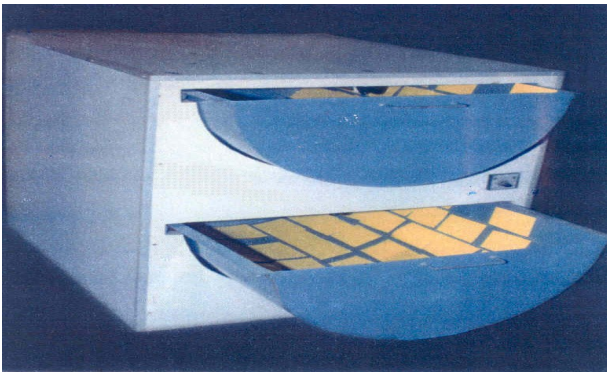
### INTRODUCTION

Biological control approach of crop pests offers a viable, sustainable, ecological and economical solution to the pest problems. Rice meal moth, *Corcyra cephalonica* (Stainton) (Lepidoptera :Pyralidae) a stored grain insect pest is industrialized for mass production of many predators and parasitoids in the laboratory. Among biological control agents, *Trichogrammatid* parasitoids were used worldwide (Senthil-Nathan *et al.*, 2006), as they were found attacking the eggs of over 200 insect species (Mansfield and Mills, 2004). Mass rearing of *Trichogramma* spp. is an economically feasible methodology for control of many Lepidopteran pests (Wang *et al.*, 2012). *Trichogrammatid* parasitize eggs of Lepidoptera by laying one or more eggs inside the eggs of the host insects. Tuncbilek *et al.* (2012) studied the potential improvements in the suitability of host eggs for mass-rearing of *Trichogrammatid* through pre-exposure of *C. Cephalonica* eggs to radiation. Irradiation plays significant role in the production of natural enemies. It has been reported that

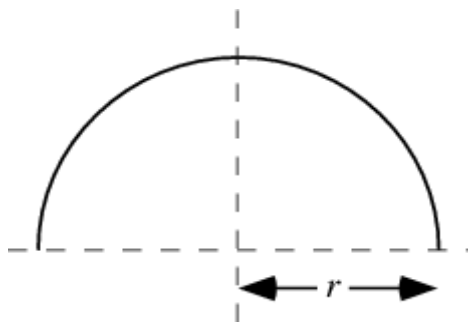
the parasitisation increased in the irradiated hosts (Hamed *et al.*, 2009 and Tuncbilek *et al.*, 2009) as irradiated eggs were found more suitable as compared to normal for parasitoid development. Hendrichs *et al.* (2009) reported that irradiated eggs can be used as supplemental host individuals without fearing that the released host insects themselves be converted into pests. The sterilization of *C. Cephalonica* eggs is required to avoid emergence of its larvae as these eggs are used for mass-multiplication of *Trichogrammatid* egg parasitoids. As there was no proper device for *C. Cephalonica* eggs sterilization, therefore, the present study was done and an innovative device was invented, up-scaled and standardized.

### MATERIALS AND METHODS

For mass production of *Trichogrammatid*, *Corcyra* eggs need to be sterilized before use and for quick and uniform sterilization of the eggs, a new type of sterilization chamber was conceptualized, designed, fabricated, up-scaled and standardized (Fig.1). It was made-up of metal and ply boards. The chamber comprised a



**Fig. 1.** An improved fool-proof device (105-cm long, 88-cm broad and 105-cm high) for eggs' sterilization of *Corcyra cephalonica* (Stainton).



**Fig. 2.** Semicircle drawer having uniform radius in the newly conceptualized UV device.

cuboid box, 105-cm long, 88-cm broad and 105-cm high. It was closed on all sides except from the front and was divided into two equal parts by a horizontal partition. Each partition was provided with a drawer which had semi-circular base of 35 cm radius. The cross section of this drawer was semi-circular. The length of the drawer was 100 cm. Inside the semi-circular chamber, the drawer was provided with longitudinal flanges of 2-mm thickness and 9-cm apart. These flanges were provided to prevent egg bearing cards to glide one over other from curved surface. Postcard size cards (75 in total) bearing eggs (approx. 1 cubic cm eggs/card) can be kept in one drawer. In the outer surface-side, the drawer was provided with channels and wheels. With these provisions, the drawers can be pulled out and pushed back in place easily. The ceiling of each drawer was provided with a 30W UV tube-light. Each tube was connected with a timer.

For the sterilization of *Corcyra cephalonica* eggs, the freshly laid eggs were glued on the post-card size cards (approx. 13.5cm length x 9 cm width). Such cards are called as "egg card" or "Trichocards" as it being to be used for parasitisation by *Trichogrammatid* egg parasitoids. Precautions were taken to ensure that glue film remain thin enough and dry enough so that the eggs were not immersed in it but just remain stick by a small contact with the card. The eggs were uniformly sprinkled on the egg cards on its upper surface and

then these were arranged in the longitudinal flanges of the semi-circular drawer. The drawer was closed and the timer was set for a required period of time. The UV light source was switched on. The "egg cards" were exposed to ultra violet rays (30 W UV-tube) for 10 minutes in the enclosed chamber having a uniform distance of 35 cm from the UV tube.

To further test the performance of the device, a total of two treatments (treatment-1 UV exposure to egg cards and Treatment-2/control - no UV exposure to egg cards) were done. In treatment-1, a total of 18 egg cards were put randomly inside the drawer of the device and these were exposed to UV rays (30 W UV-tube) for a period of 10 minutes. After treatment, a set of two egg cards (total 3 repeats) were taken out and then these were kept in the polythene bags separately and the mouth of these bags were tightened with the help of elastic bands and these were kept for a period of ten days in the laboratory to observe the emergence of *C. Cephalonica* larvae, if any. Another set of two egg cards (total 3 repeats) were offered for parasitisation to *Trichogramma japonicum* Ashmead and *T. chilonis* Ishii each to find out the parasitisation and adult emergence. Such emerged *Trichogrammatid* from treated egg cards were further offered UV treated egg cards to find out the parasitism and adult emergence subsequently. Simultaneously, a total of six untreated egg cards were kept separately as control and emergence of larvae of *C. Cephalonica* were observed from these egg cards.

## RESULTS AND DISCUSSION

An innovative prototype of the newly conceptualized UV device was fabricated and standardized. When the egg-cards were exposed to the UV radiation in the device, it was found that there was 100 % mortality of the embryos of the eggs of *C. cephalonica* as there was no emergence of larvae from these UV treated egg-cards. On the other hand, the emergences of larvae of *C. Cephalonica* from untreated egg-cards were found. Due to the central position of UV light source in the ceiling of the device, it maintains equidistance (35 cm) from the bottom of the drawer and thus uniform radiation was put on the egg-cards and thus all the embryos of the eggs of *C. Cephalonica* were found dead in the treated egg-cards. It is well-established principle that a circle contains uniform radius ( $r$ ) and all points on the arc of a circle always remain equidistance from the centre of the circle (Fig. 2). Utilizing this fundamental basic principle of the circle, the drawer of the UV device was designed and fabricated in semi-circular shape and the effect of UV radiation was found uniform as there was 100 % mortality of the embryos of the eggs. Similar effect of UV radiation on mortality of *C. cephalonica* eggs was found by Singh *et al.*, 1994. It was found that the irradiated "egg cards" did not have any adverse effects on the abilities of *T. japoni-*

*cum* and *T. chilonis* parasitisation. Successful parasitisation and subsequently normal adults' emergence was found from these irradiated eggs. They had normal body shape, structure and normal ability to further parasitize the egg-cards as offered subsequently. UV rays used had damaged the host embryo due to smaller size and thin outer layer of the eggs; the damaged embryo could not develop into next stage. At the same time, damaged embryo had helped the *Trichogrammatid* for successful parasitization. Faruki *et al.* (2007) also observed decrease in egg hatching and adult emergence in UV radiated eggs of *Tribolium castaneum*, *T. confusum* and the almond moth, *Cadra cautella*. Herlin *et al.* (2015) had also observed effect of UV radiation on the life cycle of rice moth *Corcyra cephalonica* (Stainton) (Lepidoptera: Pyralidae) and disruption in hatchability.

As the egg cards were exposed to UV radiations in a closed semi-circular chamber, hence undesired exposure to UV radiations was ruled out. This drawer can be easily pulled out of or pushed into this chamber as it is being provided with the channels and the wheels. There was no sliding of "egg cards" over one-another as the drawer was being provided with longitudinal flanges of 2-mm thickness. To meet the requirements of different laboratories, the up-scaled foolproof device for eggs sterilization of *C. Cephalonica* can be made of various capacities *viz.*, for the sterilization of 150, 100, 50 Trichocards or any other similar capacities by changing the dimensions of the drawer, channels, Trichocards etc. It can be easily made multi-storied chambered. It can also be used for the UV sterilization of laboratory materials like glassware, plastic ware, clothes, cotton etc. Since there are two drawers, the time required to arrange the egg cards in one drawer was sufficient to sterilize the cards in other drawer. Thus one can sterilize 75 cards per 10 minutes using these drawers alternately. As the device was made-up of metal and ply boards, hence, it was durable. The accessories like installations of handles and wheels for to and fro movements of the device in the laboratories etc. can be installed in it as per the requirements.

## Conclusion

An innovative prototype of UV device for eggs' sterilization of *C. cephalonica* was fabricated and standardized. The drawer of the UV device was designed and fabricated in semi-circular shape (having uniform radius) for uniform UV radiation on egg cards. Due to uniform radiation on egg-cards, there was 100% mortality of the embryos of the eggs. The UV rays used had damaged the host embryo. The damaged embryo could not develop into next stage. At the same time, damaged embryo had helped the *Trichogrammatid* for successful parasitisation and emergence. These emerged *Trichogrammatid* had normal body shape and structure and had ability to further parasitize and emergence in subsequent generation. Advantages of this method

were numerous *i.e.*, the radiation helped the parasitoids to parasitize eggs without any difficulty and if the eggs escaped from the parasitoid, the radiation had already damaged the host eggs, therefore, there was no hatching of *C. cephalonica* eggs. As the egg cards were exposed to UV radiations in a closed semi-circular chamber, the undesired exposure to UV radiations was ruled out. The drawer was provided with channels and wheels and with these provisions, the drawers can be pulled out and pushed back in place easily.

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