Mass Rearing Technique of a Larval Parasitoid; *Bracon hebetor* and its Integration with Insecticides for the Management of Lepidopterous Insects

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Crop production in the present era is dependent upon integrated plant protection measures to combat natural pests and diseases. These measures also include the integration of chemical insecticides with natural biocontrol agents (entomophagous insects) for the suppression of insect pest populations. Mostly, the chemical insecticides are not produced in developing countries and are imported for formulations, though accompanied by safety data sheet but still needs recertification of certain toxicities in local environments besides being efficacious against pests and diseases. The natural enemies of insect pests, also known as biological control agents, include predators, parasitoids, and pathogens. *Bracon hebetor*, primarily recognized as an ectoparasitoid of the larvae of many Pyralid pest-species attacking stored grain; is considered to have a potential for the biological control of many other Lepidopteran pests of various crops, because it is highly aggressive. It occurs naturally, throughout the world. There is a growing evidence that *B. hebetor* can also be an important bio-control agent of *Helicoverpa armigera*. It is used in Turkmenistan, on cotton, and to a lesser extent in Uzbekistan, where they rely more on *Trichogramma pintoi*.

In order to obtain the efficient control of the pests by integrating the chemical and biological control, we have developed the methodology for the mass rearing of *Bracon hebetor* in the laboratory. Its release in the field gave encouraging results for the management of *Spodoptera litura*.

Parasitoid Rearing

Rearing of the laboratory host (greater wax moth, *g. Mellonella* (l.))

The larvae of *G. mellonella,* are reared on a semi-natural diet comprising; crushed wheat grains, bee-wax, yeast, plain/commercial glycerin and date syrup. The larvae, pupae and adults of the *G. mellonella,* can be collected from the infested bee hives. The adults are released in plastic jars (dia, 5 cm and depth 30 cm) for mating and eggs collection and provided with the artificial diet/folded card sheets, for feeding as well as for egg-laying. These jars, were incubated in the growth chamber, at optimum condition of 31 1 °C, 75 5 % R.H. The larvae, thus, reared are used as host insects for the mass-rearing of the parasitoid *B. hebetor*.

Rearing of *B. hebetor*(say.) (larval parasitoid)

The field collected adults of the parasitoid are reared on a large scale, by using the larvae of the greater wax moth, *Galleria mellonella* (L.) as host, at 29 ± 1 °C, 65 ± 5% R.H and 16:8 L.D. A number of 2 to 3 larvae of the 3rd or 4th instars of *G. mellonella,* are placed in the glass vial, with a fertilized female of the parasitoid, *B. hebetor* (Say.). The female was provided with a cotton swab, soaked in 20 % honey solution, for feeding the parasitoid. After 24 hours, the females are shifted to the other vials, with new larvae of the host, *G. mellonella* and honey-soaked cotton swab. This process can be continued upto the end of the life of the female parasitoid. The parasitized larvae of the host, *G. mellonella,* are incubated, under the optimum conditions of 29 ± 1 °C temperature and 65 ± 10 % of the relative humidity.

Integration of insecticides and parasitoid

The different chemical insecticides commercially used for the management of lepidopterous insects like *Spodoptera* sp. can be selected for integration with the parasitoid *Braconhebetor*. The insecticide treatments can be applied on the pest infested plants. Afterwards the cards containing the pupae of parasitoids (near adult emergence) are placed in the plastic capsules which are then hanged in the plant canopy. The female adult parasitoids, will hatch out of pupae and search for their hosts in the field.

Salient Results of previous research

The new chemistry insecticides, like, abamectin, emamectin benzoate, spinosad, indoxacarb and lufenuron, performed better to control the pest insect, at their recommended dose rates and when integrated with *B. hebetor*, under semi-field and field conditions. In experiments maximum mortality of the pest was observed, in the plots treated with these insecticides, along with the bio-control agent. Therefore, these insecticides are recommended for their integration with the bio-control agent. However, it is strongly recommended that the parasitoid should be released, at least 48 hours after the application of these insecticides.

Significance/Impact in the field

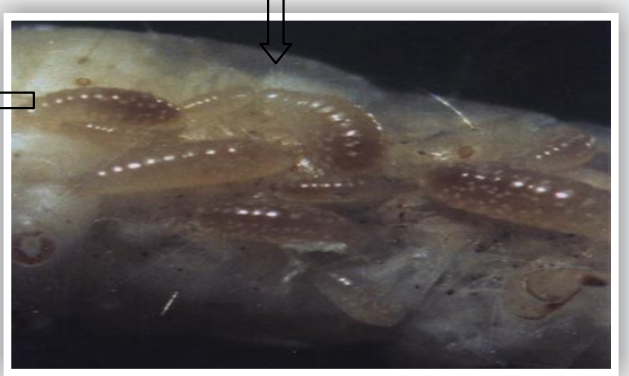
The biological control of insect pests plays an important role in plant protection. When integrated with other pest management tactics, the efficacy of pest management can be enhanced. The extreme environmental conditions are the potential risk for the effective application of the bio-control agents. The parasitoid, *Bracon hebetor* can be used as an efficient tool for integration with chemical insecticides to perform effective pest control.

Various Life Stages of the parasitoid, *Braconhebetor* (Say.)

Adults of *Bracon hebetor* (Say)

Eggs of *Bracon hebetor* (Say)

Pupae of *Bracon hebetor* (Say)



Larvae of *Bracon hebetor* (Say)

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