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Short Communication

Potential Use of Egg Parasitoids, *Trichogramma pretiosum* Riley and *Trichogramma chilonis* Ishii Against Brinjal Shoot and Fruit Borer, *Leucinodes orbonalis* Guenée

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ABSTRACT: The parasitizing efficiency and emergence rate of the egg parasitoids, *Trichogramma pretiosum* and *Trichogramma chilonis* on one-day, two-day and three-day old eggs of *Leucinodes orbonalis* was studied under laboratory condition during three different seasons at Bio-control Laboratory of Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore, India. The parasitizing ability of *T. pretiosum* reproduced through parthenogenesis reproduction in three different seasons was also investigated in a similar manner. No parasitism of *L. orbonalis* was observed by *T. chilonis* whereas, *T. pretiosum* expressed maximum parasitism. The findings clearly described the vulnerability of *T. pretiosum* to weather conditions that exist in the summer season. It was noted that the parasitoid, *T. pretiosum* preferred one-day-old eggs of *L. orbonalis* for parasitism during all seasons. *T. pretiosum* also expressed parthenogenesis reproduction to parasitize the eggs of *L. orbonalis*. The results indicated the usefulness of *T. pretiosum* in parasitizing eggs of *L. orbonalis*.

Keywords: Emergence rate, *Leucinodes orbonalis*, parasitism, parthenogenesis, *Trichogramma pretiosum*

INTRODUCTION

Brinjal (*Solanum melongena* Linnaeus) is an economically important crop in tropical and subtropical countries, and being cultivated since remote antiquity in Southeast Asia (Choudhary, 1967). The yield of brinjal crop is badly affected by infestation of shoot and fruit borer, *Leucinodes orbonalis* Guenée (Pyralidae: Lepidoptera) with the yield loss up to 60-80% (Krishnaiah and Vijay, 1975; Kaur *et al*., 2010). Currently, farmers depend exclusively on the application of insecticides to control *L. orbonalis* (Talekar, 2002). Frequent usage of pesticides threatens the health of farmers, and makes the brinjal fruits more costly to consumers. In addition, this triggers some negative effects such as development of resistance in pest populations, contamination of fresh fruits with insecticide

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residues: thereby the health of consumer, occurrence of pest resurgence and reduction of natural enemies of pest species, especially when non-selective insecticides are used. In India, pesticide residue levels of brinjal fruits exceed Maximum Residue Limit (MRL) some occasions (Chandrasekaran, 2005). Implementation of bio-control programmes provide one of the best alternative to overcome these adverse effects. The present study was conducted to investigate parasitism efficiency of *Trichogramma pretiosum* Riley and *Trichogramma chilonis* Ishii against the eggs of *L. orbonalis*. The outcome would be helpful to enhance Bio-Intensive Pest Management (BIPM) of *L. orbonalis* in brinjal.

METHODOLOGY

Parasitism efficiency of *T. pretiosum* and *T. chilonis* against *L. orbonalis*

The experiments on the parasitism efficiency of egg parasitoids *viz*., *T. pretiosum* and *T. chilonis* against the eggs of *L. orbonalis* were conducted during three seasons *Kharif*, 2013 (August–September, 2013, 30.6±1.3 °C) *Rabi*, 2013 (November - December 2013, 29.7±0.8 °C) and summer, 2014 (March – April 2014, 36.2±1.3 °C) at the Bio-control laboratory of the Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore, India. To perform this experiment, the egg parasitoids were obtained from National Bureau of Agricultural Insect Resources (NBAIR), Bangalore, India and they were mass cultured in the laboratory on the eggs of *Corcyra cephalonica*.

The eggs of *L. orbonalis* used in the experiments were taken from the laboratory cultures. White colour cotton cloth was used for egg laying of *L. orbonalis.* After egg laying the cloth with eggs was cut into three pieces, each containing thirty numbers of one-day old eggs. Each piece of cotton cloth with 30 eggs was individually kept in three test tubes. The adults of *T. pretiosum* or *T. chilonis* were introduced at host:parasitoid ratio of 6:1. The adults of parasitoids were transferred using an aspirator. The test tubes were covered with a piece of cloth tightly soon after introducing adult paracitoids to avoid their escape. A test tube with 30 eggs of *L. orbonalis* without introduction of parasitoids was kept as untreated control. Two sets of tubes were prepared separately for *T. chilonis* and *T. Pretiosum*. The same experimental procedure repeated with two-day and three-day old eggs of *L. orbonalis* to evaluate the effect of aging of host’s eggs on the efficiency of parasitisum. Each treatment was replicated thrice and arranged in Completely Randomized Design (CRD).

Observations on the colour change of the eggs were made daily on each treatment using hand magnifier (15x) until the creamy yellow colour eggs of *L. orbonalis* changed into black colour. When parasitized the yellow creamy colour of the eggs of *L. orbonalis* change into black colour. The data on the percentage of parasitisation was analysed using three-factor ANOVA with replications.

Emergence rate of *T. pretiosum*

Thirty numbers of one-day, two-day and three-day old eggs of *L. orbonalis* which were parasitized by *T. pretiosum* and turned to black colour were separately kept in cleaned test tubes. Thirty numbers of non-parasitized one-day old eggs of *L. orbonalis* were kept in a cleaned test tube as the control. Five replicates for each of the treatments were arranged in CRD in the Bio-control laboratory during the three seasons. The number of parasitoids emerged from each of the treatments was counted to work out the emergence rate. The data were analysed using two-way ANOVA.

Parasitism ability of *T. pretiosum* by parthenogenesis reproduction

One-day, two-day and three-day old eggs of *L. orbonalis* on pieces of cotton cloth were separately exposed to *T. pretiosum* for parasitizing. Small pieces of cloth, each containing a single parasitized egg were cautiously cut from the cotton cloth having eggs belongs to the different age groups were individually introduced to clean glass tubes. Then they were covered by pieces of cotton cloth and tied rigidly. After emergence of the parasititoid, a piece of cloth consisting 35, one day old eggs of *L. orbonalis* was introduced in to each test tube and covered eggs. The eggs produced by these parasititoids considered as parthenogenetically produced eggs. The percentage adult emergence from 35 one-day old eggs of *L. orbonalis* kept in a clean glass tube without introducing *T. pretiosum* was used as the untreated control. Each treatment was replicated five and arranged in CRD at the Bio-control laboratory during the three seasons. The data were analysed by two-way ANOVA.

RESULTS AND DISCUSSION

Parasitism efficiency of *T. pretiosum* and *T. chilonis* against *L. orbonalis*

The results revealed that the parasitism efficiency of *T. pretiosum* was superior over *T. chilonis* and untreated control where zero parasitism of *L. orbonalis* was recorded (Table 1). This was observed in three tested seasons and all these treated age groups of eggs of *L. orbonalis*). The results confirm that *T. chilonis* is not suitable parasitoid for managing *L. orbonalis*.

Further, the results revealed that *T. pretiosum* preferred freshly laid eggs of *L. orbonalis* than older eggs for parasitism. There was a great variation of the parasitizing efficiency of *T. pretiosum* on one-day old eggs of *L. orbonalis* in different seasons. It was 91.1 in Khaif, 92.2 in Rabi and 41.1 in summer 2014. The parasitism efficiency of *T. pretiosum* on three-day old eggs of *L. orbonalis* in three different seasons was 25.36, 33.33 and 13.33percent respectively. The results revealed that the weather conditions prevailing in the seasons of Kharif and Rabi promote the parasitism efficiency of *L. orbonalis* whereas it was decline during the summer season in Coimbatore, Tamil Nadu, India.

Earlier studies revealed that the egg parasitoid, *T. pretiosum* performed well against the eggs of lepidopteran pests, *Anticarsia gemmatalis, Pseudoplusia includen*in and *Trichoplusia ni* in the temperature ranges between 18–33 °C (Regiane *et al.*, 2012). Therefore, *L. orbonalis* effectively be used in bio-control programs where this temperature range prevailed.

In contrast to the present study findings on *T. chilonis,* it was found that the periodical release of *T. chilonis* effectively control *L. orbonalis* in brinjal damage in brinjal cultivation with substantial increase of yield (Satpathy *et al.*, 2005; Yadav and Sharma, 2005).

Table 1. Mean per cent parasitisation of *Trichogramma pretiosum* and *Trichogramma chilonis* against *L. Orbonalis*

Seasons	Age of eggs of *Leucinodes orbonalis*	Treatments	Per cent parasitisation*
Kharif, 2013 (August – September, 2013, 30.6±1.3°C)	One-day old	*Trichogramma pretiosum*	91.11 (72.65)[a]
		Trichogramma chilonis	0.00 (1.28)[g]
		Untreated control	0.00 (1.28)[g]
	Two-day old	*T. pretiosum*	77.78 (61.87)[b]
		T. chilonis	0.00 (1.28)[g]
		Untreated control	0.00 (1.28)[g]
	Three-day old	*T. pretiosum*	35.56 (36.60)[cd]
		T. chilonis	0.00 (1.28)[g]
		Untreated control	0.00 (1.28)[g]
Rabi, 2013 (November – December, 2013, 29.7±0.8°C)	One-day old	*T. pretiosum*	92.22 (75.04)[a]
		T. chilonis	0.00 (1.28)[g]
		Untreated control	0.00 (1.28)[g]
	Two-day old	*T. pretiosum*	76.67 (61.16)[b]
		T. chilonis	0.00 (1.28)[g]
		Untreated control	0.00 (1.28)[g]
	Three-day old	*T. pretiosum*	33.33 (35.00)[d]
		T. chilonis	0.00 (1.28)[g]
		Untreated control	0.00 (1.28)[g]
Summer, 2014 (March – April 2014, 36.2±1.3°C)	One-day old	*T. pretiosum*	41.11 (39.87)[c]
		T. chilonis	0.00 (1.28)[g]
		Untreated control	0.00 (1.28)[g]
	Two-day old	*T. pretiosum*	24.44 (29.55)[e]
		T. chilonis	0.00 (1.28)[g]
		Untreated control	0.00 (1.28)[g]
	Three-day old	*T. pretiosum*	13.33 (21.32)[f]
		T. chilonis	0.00 (1.28)[g]
		Untreated control	0.00 (1.28)[g]
CV (%)			14.18
C.D (0.05)			
Seasons			1.30
Age of eggs of *L. orbonalis*			1.30
Egg parasitoids			1.30
Seasons x Age of eggs of *L. orbonalis*			2.26
Age of eggs of *L. orbonalis* x Egg parasitoids			2.26
Seasons x Egg parasitoids			2.26
Seasons x Age of eggs of *L. orbonalis* x Egg parasitoids			3.91

*Values are mean of three replications.
Values in parentheses are arcsine transformation.
In each column, means with similar alphabets do not vary significantly at P=0.05 by DMRT

Emergence rate of *T. pretiosum*

The emergence rates of *T. pretiosum* for parasitized eggs of *L. orbonalis* in Coimbatore, Tamil Nadu, India was highly influenced by the season. The season Kharif, 2013 (August – September, 2013, 30.6±1.3 °C) and Rabi, 2013 (November – December, 2013, 29.7±0.8 °C) promoted the emergence rate of *T. pretiosum* with the rate of 88.90, 84.70 and 81.08 during Kharif and 88.20, 84.80 and 79.78 per cent in Rabi irrespectively from one-day, two-day and three-day old eggs of *L. orbonalis.* In contrast during the summer season it was drastically reduced may be due to extreme temperature. On the other hand, no difference was recorded in the emergence rate of *T. pretiosum* from parasitized eggs different age of *L. orbonalis.* The findings clearly indicated that *T. pretiosum* was highly susceptible to the weather factors. Therefore, the periodical release of *T. pretiosum* to brinjal cultivations is essential to achieve satisfactory control of the pest.

Table 2. Mean emergence rate of *Trichogramma pretiosum* from parasitized eggs of different age group eggs of *L. Orbonalis*

Seasons	Age of eggs of *L. orbonalis*	Emergence rate of *T. pretiosum**
Kharif, 2013 (August – September, 2013, 30.6±1.3°C)	One-day old	88.93 (70.79)[a]
	Two-day old	84.70 (67.16)[a]
	Three-day old	81.08 (64.72)[a]
	Untreated control (One-day old)	0.00 (1.28)[c]
Rabi, 2013 (November – December, 2013, 29.7±0.8°C)	One-day old	88.20 (70.43)[a]
	Two-day old	84.80 (67.11)[a]
	Three-day old	79.78 (63.34)[a]
	Untreated control (One-day old)	0.00 (1.28)[c]
Summer, 2014 (March – April 2014, 36.2±1.3°C)	One-day old	36.36 (37.04)[b]
	Two-day old	32.90 (34.87)[b]
	Three-day old	29.67 (30.15)[b]
	Untreated control (One-day old)	0.00 (1.28)[c]
CV (%)		15.00
C.D (0.05)		
Seasons		3.79
Age of eggs of *L. orbonalis*		4.38
Seasons x Age of eggs of *L. orbonalis*		7.59

*Values are mean of five replications.
Values in parentheses are arcsine transformation.
In each column, means with similar alphabets do not vary significantly at P=0.05 by DMRT

Parasitism ability of *T. pretiosum* by parthenogenesis reproduction

Number of *L. orbonalis* eggs parasitized by parthenogenatically produced adults of *T. pretiosum* in the seasons of Kharif, 2013 and Rabi, 2013 were significant greater (p=0.05) than their parasitism in summer, 2014 (Table 3). However, there was no significant difference (p=0.05) of the parasitism rates of *L. orbonalis* eggs belongs to three age groups exposed to the parthenogenatically produced parasitoid. The low parasitism in summer further conforming its vulnerability to adverse weather conditions prevailing in Coimbatore, Tamil Nadu, India. Further, the study reveals that the parasitoids *T. pretiosum* can parasitized *L. orbonalis* eggs even in the absence or in the lack of males by parthenogenesis reproduction. However, in contrast, the results of this study indicated that 100% adult emergence of the eggs of *L. orbonalis* could be obtained even under extreme weather conditions prevailing in summer under laboratory conditions.

Table 3. Mean number of eggs of *L. orbonalis* parasitized by parthenogenesis reproduction of *T. pretiosum* which emerged from different seasons and age of eggs of *L. orbonalis*

Seasons	Age of eggs of *L. orbonalis*	Number of eggs of *L. orbonalis* parasitized by parthenogenesis reproduction of *T. pretiosum**
Kharif, 2013 (August – September, 2013, 30.6±1.3°C)	One-day old	10.4 (3.30)[a]
	Two-day old	10.8 (3.36)[a]
	Three-day old	10.6 (3.33)[a]
	Untreated control (One-day old)	0.00 (0.71)[c]
Rabi, 2013 (November – December, 2013, 29.7±0.8°C)	One-day old	10.60 (3.33)[a]
	Two-day old	10.60 (3.33)[a]
	Three-day old	10.40 (3.30)[a]
	Untreated control (One-day old)	0.00 (0.71)[c]
Summer, 2014 (March – April 2014, 36.2±1.3°C)	One-day old	4.20 (2.17)[b]
	Two-day old	4.00 (2.12)[b]
	Three-day old	3.80 (2.07)[b]
	Untreated control (One-day old)	0.00 (0.71)[c]
CV (%)		6.18
C.D (0.05)		
Seasons		0.16
Age of eggs of *L. orbonalis*		0.23
Seasons x Age of eggs of *L. orbonalis*		0.32

*Values are mean of five replications.
Values in parentheses are $\sqrt{(x+0.5)}$ transformation.
In each column, means with similar alphabets do not vary significantly at P=0.05 by DMRT

CONCLUSIONS

Trichogramma pretiosum was an efficient egg parasitoid against the eggs of *Leucinodes orbonalis.* However, this parasitoid was highly vulnerable to the temperature existed in the summer season. *T. pretiosum* has the potential to parasitize the eggs of *L. orbonalis* even in the absence of male insects by parthenogenesis.

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