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Biological attributes of *Trichogramma chilonis* (Ishii) on coloured cards

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Abstract
The present investigations were undertaken, during the year 2014 and 2015 in the bio-control laboratory, Department of Entomology, CSA University of Agriculture and Technology, Kanpur. Studies conducted to investigate the impact of differently coloured cards, used for fixing the host *Corcyra* eggs, on the biological attributes of *Trichogramma chilonis* indicated that under multiple choice conditions, the per cent parasitism differed significantly on egg cards of different colours. The per cent parasitisation was recorded on five coloured cards *viz.* yellow, mint green, pink, blue and white. The observations were recorded after 4th, 6th and 8th days on 100 eggs of *Corcyra*, glued on coloured cards. To observe effect of different coloured tricho-cards on egg laying responses of females, *Trichogramma chilonis* showed maximum parasitism on yellow coloured cards to the tune of 86.00 and 85.50 per cent after 8th day during 2014 and 2015, respectively. Minimum parasitization was recorded on white coloured card with 75.25 and 77.40 per cent parasitization is both the years, respectively. However, maximum emergence on pink coloured egg card to the extent of 87.57 and 86.85 per cent was noticed in the year 2014 and 2015, respectively. Minimum emergence per cent was observed on white coloured egg cards to the extent of 76.35 and 77.40 adults on 12th days in both the years, respectively.

Keywords: *T. chilonis*, *C. cephalonica*, five coloured cards *viz.* yellow, mint green, pink, blue and white

Introduction
The first description of a *Trichogramma* species was in North America in 1871 by Charles V. Riley. He described the tiny wasps that emerged from eggs of the viceroy butterfly as *T. minutum*. In India, about 26 species of *Trichogramma* have been reported of which *T. chilonis*, *T. japonicum*, *T. achaeae* are of significant importance in biological control. Species of *Trichogramma* (Hym.: Trichogrammatidae) egg parasitoids are Important natural enemies of a large number of insect pests and are successfully used in biological control programs worldwide (Smith, 1996) [5]. *Trichogramma* spp. is perhaps the most thoroughly studied natural enemy genus, yet little has been published on how they locate their host habitat. Response to odors of some host plants has been reported but volatiles were found to arrest rather than attract the searching parasitoids. Orientation using visual cues such as plant color could also be involved in the host-habitat location process of *Trichogramma* spp. several hymenopteran parasitoids belonging to various families: Braconidae, Trichogrammatidae, Aphelinidae, Eulophidae, Epiricanidae, Cynipidae and Ichneumonidae**.** *Trichogramma* are released to control some 28 different caterpillar pests attacking corn, rice, sugarcane, cotton, vegetables, sugar beets, fruit trees and spruce trees. It has been estimated that around 30 per cent of agriculture produce is lost in our country by various pests amounting to roughly Rs.1.40 lakh crore annually (Businessline, 2007) [3]. In India, mass releases of *Trichogramma chilonis* have been used successfully in the control of sugarcane borers. The present studies were undertaken to investigate the egg laying responses of female Trichogrammatid to different coloured cards with an objective that suitable colour of the egg card may stimulate the parasitization to deposit more eggs on the egg cards containing its host and thus increasing the extent of parasitization. Colour of trichocards plays an important role in parasitizing efficiency of *Trichogramma chilonis* (Singh *et al*., 2001) [4].

Materials and Methods
Investigation of the parasitization response of *Trichogramma chilonis* to different coloured egg cards were under taken by multi choice test condition. For this five coloured cards *viz.*, yellow, mint green, pink, blue and white coloured cards were used. The temperature and relative humidity were maintained in the laboratory at 27±2 °C and 65±5%, respectively. The life cycle of *Trichogramma* ranges from 8-10 days in summer and 9-12 days in winter. A female parasitizes from 1 to 10 eggs per day or 10-190 during its life. Males emerge first and mated females produce male & female offspring.

Whereas unmated females produce only males (Smith, 1996) [5].

The coloured egg card were prepared by gluing 100 number of freshly laid UV irradiated *C. cephalonica* eggs on respective coloured cards with the help of 10% acacia gum. These cards will be kept equi-distantly on the bottom of a Petri dish. At the centre of the Petri dish, a small already parasitoid egg card containing 20 numbers of parasitoids eggs (likely to emerge) were placed and a very fine streak of 50% honey was kept on the card as adult diet. Then the Petri dish was covered and sealed with Para film in order to prevent the possible escape of adult parasitoids. The wasps were allowed to parasitize the eggs for 24 hr. Then, the parasitized eggs card were removed and kept in BOD at 27±2^{0}C and 65±5% R.H. for further development of wasp. After 4 days of incubation, parasitized egg turn black and fluffy. The per cent parasitisation was recorded on 4th, 6th and 8th days by observing the egg hole and adult emergence was recorded on 8th, 10th and 12th days after parasitization. The experiment was repeated four times by changing the position of eggs and card strips in Petri dish.

Results and Discussion

In the present study, the per cent parasitisation was recorded on five coloured cards *viz.* yellow, mint green, pink, blue and white. The observations were recorded after 4th, 6th and 8th days on 100 eggs of *Corcyra*, glued on coloured cards. *T. chilonis* showed higher parasitization percentage on yellow egg card after 4th, 6th and 8th days and their values were 26.50, 56.00 and 86.00 per cent, respectively in the year 2014. During 2015, however 25.75, 55.00 and 85.50 per cent parasitization was recorded after 4th, 6th and 8th days, respectively. The lowest parasitization was recorded on white colour egg card after 4, 6 and 8 days and it was 22.75, 50.25 and 74.00 per cent in the year 2014 and 19.50, 50.00 and 75.25 per cent during the year 2015 (Table-1, 3 and Fig. 1, 3).

After parasitization, the same cards were observed for emergence. The maximum emergence count of *T. chilonis* was found on pink colour tricho-card to the extent of 24.00, 67.50 and 70.25 after 8th, 10th and 12th days, respectively. Their subsequent percentages were 29.09, 81.81 and 87.57 per cent, respectively. The lowest emergence count was found on white colour egg card to the extent of 18.50, 55.25 and 56.50 adults on 8th, 10th and 12th days and the subsequent emergence percentage was 25.00, 74.66 and 76.35 per cent after 8th, 10th and 12th days of observation, respectively in first year.

During 2015, the lowest emergence count was found on white colour egg card to the extent of 16.00, 51.50 and 58.25 adults on 8th, 10th and 12th days and the subsequent emergence percentage was 21.26, 68.43 and 77.40 per cent after 8th, 10th and 12th days of observation, respectively. The maximum emergence count of *T. chilonis* was found on pink colour tricho-card to the extent of 23.50, 65.50 and 71.00 after 8th, 10th and 12th days and the subsequent percentages were 28.74, 80.12 and 86.85 per cent, respectively shown in table-2, 4 and fig. 2, 4.

Table 1: Effect of coloured cards on per cent parasitization by *Trichogramma chilonis* at different days during the year 2014.

S.N.	Card Colour	Mean per cent Parasitization of *Trichogramma chilonis*		
		4 Days	6 Days	8 Days
1	Yellow	26.50	56.00	86.00
2	Mint Green	25.75	53.50	80.25
3	Pink	26.25	55.25	82.50
4	Blue	24.25	51.25	77.50
5	White	22.75	50.25	74.00
	SE(m)±	0.876	1.149	1.116
	CD at 5%	2.639	3.464	3.364

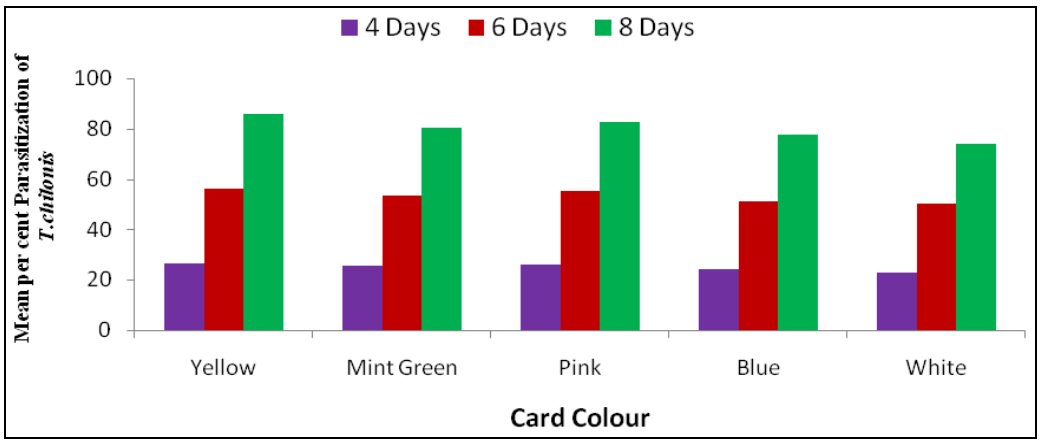

Fig 1: Effect of coloured cards on per cent parasitization by *T. chilonis* at different days during the year 2014.

These findings of coloured choice test of *T. chilonis* revealed that yellow paper had a preference for parasitization overall coloured papers but overall, pink card resulted in maximum emergence per cent followed by yellow cards. A thought scan of literature endorsed the present investigations as has been reported by various workers. Vishla *et al.* (2008) [6] observed that *T. chilonis* showed maximum parasitization on yellow coloured cards (81.37%). Bhattacharya *et al.* (2003) [2] reported the maximum parasitism on mint green coloured egg cards (64.7%) and lowest parasitization on chassis grey colour (11.50%). Singh and Singh (2001) [4] recorded after 6 days more parasitization pink tricho-card to the extent of 80.50 eggs per female. %). Baitha and Sinha (2002) [1] found that green coloured card supported the highest longevity (8 days) and highest emergence of females (76.46%) and adults (76.49%).

Table 2: Effect of coloured cards on Emergence of *Trichogramma chilonis* at different days during the year 2014.

S.N	Card Colour	Mean per cent Emergence of *Trichogramma chilonis*					
		Mean emergence	8 days Emergence (%)	Mean emergence	10 days Emergence (%)	Mean emergence	12 days Emergence (%)
1	Yellow	23.75	27.61	67.25	78.19	70.00	81.39
2	Mint Green	21.25	26.47	62.25	77.57	65.25	81.30
3	Pink	24.00	29.09	67.50	81.81	70.25	87.57
4	Blue	19.75	25.48	59.25	76.45	60.75	78.38
5	White	18.50	25.00	55.25	74.66	56.50	76.35
	SE(m)± CD at 5%	0.849 2.559		1.932 5.824		1.433 4.320	

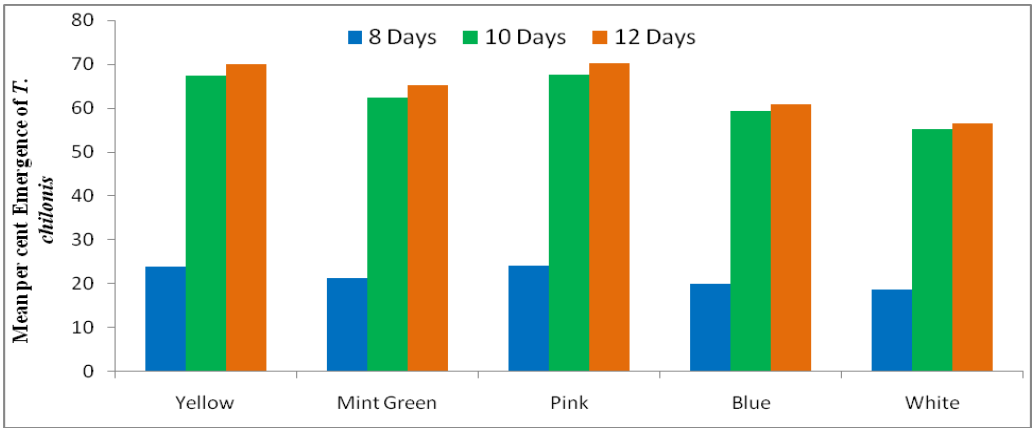

Fig 2: Effect of coloured cards on Emergence of *Trichogramma chilonis* at different days during the year 2014.

Table 3: Effect of coloured cards on per cent parasitization by *Trichogramma chilonis* at different days during the year 2015.

S.N.	Card Colour	Mean Per cent Parasitization of *Trichogramma chilonis*		
		4 Days	6 Days	8 Days
1	Yellow	25.75	55.00	85.50
2	Mint Green	23.50	52.25	79.75
3	Pink	25.00	54.25	81.75
4	Blue	21.50	52.00	78.25
5	White	19.50	50.00	75.25
	SE(m)± CD at 5%	0.911 2.745	1.423 NS	1.211 3.651

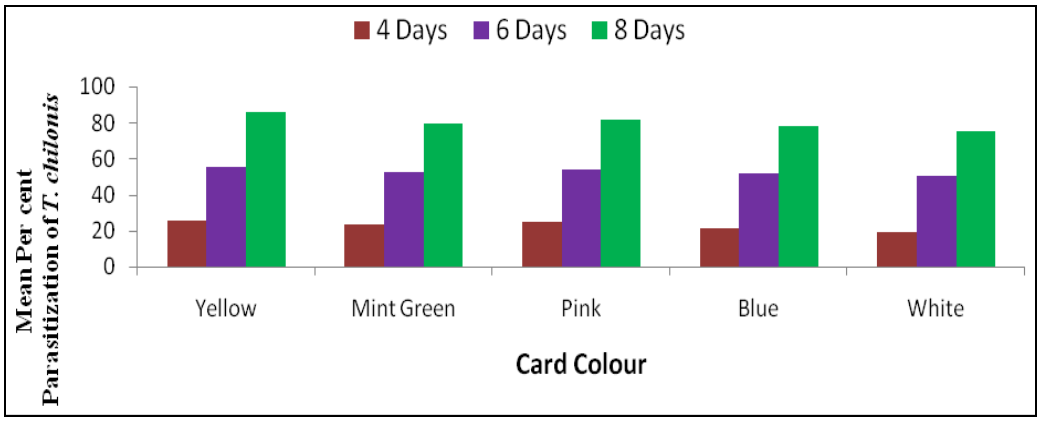

Fig 3: Effect of coloured cards on per cent parasitization by *Trichogramma chilonis* at different days during the year 2015.

Table 4: Effect of coloured cards on Emergence of *Trichogramma chilonis* at different days during the year 2015.

S.N.	Card Colour	Mean per cent Emergence of *Trichogramma chilonis*					
		Mean emergence	8 days Emergence (%)	Mean emergence	10 days Emergence (%)	Mean emergence	12 days Emergence (%)
1	Yellow	21.50	25.14	64.25	75.14	70.75	82.74
2	Mint Green	19.00	23.82	59.00	73.98	65.50	82.13
3	Pink	23.50	28.74	65.50	80.12	71.00	86.85
4	Blue	18.25	23.32	56.50	72.20	64.00	81.78
5	White	16.00	21.26	51.50	68.43	58.25	77.40
	SE(m)± CD at 5%	1.116 3.364		1.834 5.527		1.705 5.141	

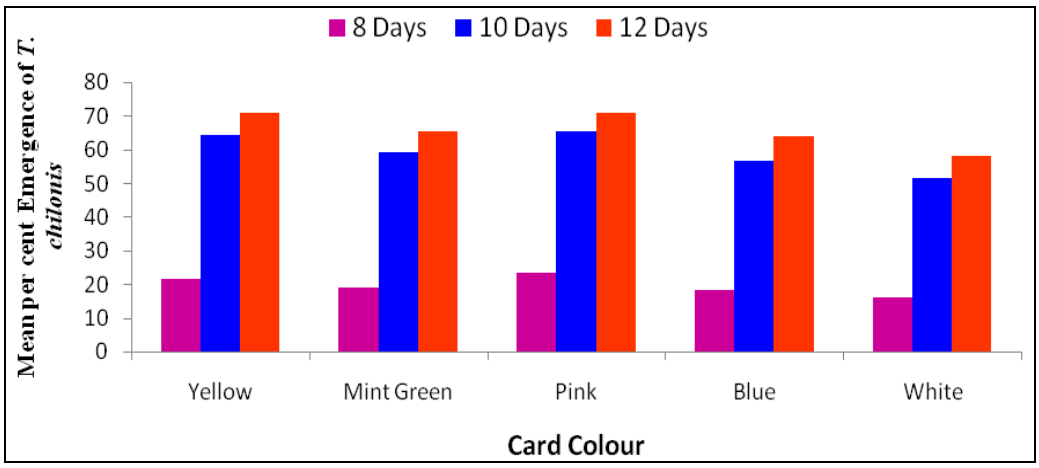

Fig 4: Effect of coloured cards on Emergence of *Trichogramma chilonis* at different days during the year 2015.

Conclusion

The findings also emphasized the use of yellow tricho- cards suitable for mass production of *Trichogramma chilonis* in the laboratory. Probably this colour egg card may incite the parasitoid female for more number of egg laying.

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