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Quality attributes of sugarcane adapted internode borer strain of *Trichogramma chilonis* Ishii (Trichogrammatidae: Hymenoptera) in successive generations

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ABSTRACT: Quality attributes of *Trichogramma chilonis* Ishii (Trichogrammatidae: Hymenoptera) (internode borer strain) was studied for F_1 to F_{10}generations. The low fecundity rate (38.1-42.5) in the F_1 to F_5 generations and a better performance in advanced generations can be related to the establishment process and maintenance of colonies of *Trichogramma chilonis* in the laboratory. The adult emergence was significantly higher in F_3-F_4, F_6-F_9 (100.8-115.2%) than F_1-F_2 and F_5 (73.1-89.0%). In generations F_3, F_6, F_7, F_8, F_9 *Corcyra* eggs were super parasitised because more than 100 percentages of adults emerged and these eggs yielded less female ratio. The female ratios of *T. chilonis* were higher than 50 per cent in all generations except F_8 generation, which demonstrates that the reproductive potential of *T. chilonis* was not affected by number of generations in the laboratory. It also shows that *T.chilonis* present good adaptable to laboratory host, *Corcyra cephalonica* eggs in the laboratory. It is concluded that INB-reared strain of *T.chilonis* seems to be a more promising candidate for biological control of sugarcane borers due to its high fecundity rate and female biased sex ratios.

Key words: *Trichogramma chilonis*, internode borer, generation, egg parasitoid, strain, sugarcane.

Introduction

Trichogramma chilonis Ishii (Trichogrammatidae: Hymenoptera) is gregarious endoparasitoid most widely produced and released against many lepidopterous pests including borers of sugarcane

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(Hassan *et al.,* 1988 Greenberg *et al.,* 1988; Baitha and Varma, 2003 and Sithanantham *et al.,* 2013).It is now known that efficiency of *Trichogramma* in bio-control system depends on the quality of the original strain from which mass multiplication was initiated. The quality control in *Trichogramma* mass rearing is one of the measures used to avoid failure in biological control (Bigler, 1994). Greenberg (1991) evaluated quality attributes of *T. evanescens* in the laboratory, such as searching ability, emergence rate, sex ratio and fecundity and related them to the effectiveness in the field.

The superiority of *T. chilonis* (sugarcane strain) has been reflected in different field trials conducted against sugarcane borers in subtropical India (Tanwar and Varma, 1996; Tiwari *et al.,* 1996). Lack or loss of ecological adaptability due to rearing at constant temperature and humidity, and the deleterious effects of prolonged inbreeding may be regarded as main factors responsible for the ineffectiveness of various *Trichogramma spp.* in the field (Rao, 1969; Nagarkatti and Nagaraja, 1978 and Baitha, 2012). The present study was undertaken to assess some quality attributesof internode borer strain of *Trichogramma chilonis* from sugarcane agro- ecosystem.

Materials & Methods

Wild strain of *T.chilonis* Ishii reared from eggs of sugarcane internode borer, *Chilo sacchariphagus indicus* (Kapur) from ICAR-IISR, Farm, and Lucknow (U.P.).Newly emerged mated female was used directly in the experiment to prevent any aging factor influencing the results. A female wasp (mated within 24 h after emergence) was kept singly in glass vial (70 x 30 mm). The female were fed on streaks of honey-water solution (1:1v/v).The laboratory host, *Corcyra cephalonica* eggs (uv treated) were glued 75 eggs on a piece of Tricho card (40 x 10 mm). Each female was offered these eggs on the first day for 24h and 50 eggs on subsequent days till death. Before introducing a fresh card of *Corcyra* eggs, the previous one was taken out. Quality attributes of *Trichogramma chilonis* (internode borer strain) was studied for F_1 to F_{10} generations. The observation on development period, the number of eggs laid by each female, adult and female emergence in each generation was recorded. The experiment was conducted in the laboratory $28 \pm 2^{\circ}$ C and 65 ± 5 % relative humidity with ten replications. The data were statistically analysed.

Results Discussion

The development period varied from 8.0 to 9.0 days with more time required to complete development in generation F_{10}.The development period of different species of *Trichogramma* was recorded as 9-10 days (Hasan, 1994 and Baitha, 2005) .The fecundity of *T. chilonis* ranged from 38.1 to 64.9 and was significantly lower in F_1-F_6 generations (Table 1). The advanced generations (F_7 to F_{10}) showed higher fecundity (53.2-64.9) than earlier generations. The low fecundity rate (38.1- 42.5) in the F_1 to F_5 generations and a better performance in advanced generations can be related to the establishment process and maintenance of colonies of *Trichogramma chilonis* in the laboratory. Field strain of *Trichogramma,* when taken to the laboratory, loose genetic variability due to limited selection and inbreeding (crossing among siblings) gaining through an adaption period with larger variations in their reproductive potential (Nagarkatti and Nagaraja, 1978). However, in the laboratory after a certain

number of generations, there is a recovery of this variability due to reduction and recombination, which results in higher variations in the biological indices of *Trichogramma* spp (Hasan, 1994).

The adult emergence was significantly higher in F_3-F_4, F_6 –F_9 (100.8-115.2%) than F_1-F_2 and F_5 (73.1-89.0%). In generations F_3, F_6, F_7, F_8, F_9 *Corcyra* eggs were superparasitised because more than 100 percentages of adults emerged and these eggs yielded less female ratio. The natural population of *Trichogramma chilonis* was found to superparasitised on internode borer egg mass from sugarcane agro ecosystem (Baitha *etal*., 2018).

Table.1 Quality attributes of sugarcane adapted internode borer strain of *Trichogramma chilonis*

Generation	Development period (days)	Fecundity	Emergence (%)		Sex ratio (F:M)
			Adult emergence (%)	Female (%)	
F_1	8.0 [a]	38.1 [a]	73.1 [a]	71.2 [c]	2.6:1
F_2	8.1 [a]	38.8 [a]	89.0 [b]	61.8 [b]	1.7:1
F_3	8.0 [a]	38.8 [a]	102.3 [c]	77.9 [d]	3.6:1
F_4	8.9 [b]	39.5 [a]	100.8 [c]	79.9 [d]	4.3:1
F_5	8.0 [a]	42.5 [a]	87.1 [b]	65.6 [b]	1.9:1
F_6	8.1 [a]	44.5 [a]	104.2 [c]	75.8 [d]	3.3:1
F_7	8.0 [a]	53.2 [b]	115.2 [d]	70.1 [c]	2.4:1
F_8	8.0 [a]	64.9 [c]	107.3 [c]	47.0 [a]	0.9:1
F_9	8.0 [a]	57.3 [b]	102.4 [c]	51.8 [a]	1.1:1
F_{10}	9.0 [b]	57.9 [b]	100.0 [c]	78.4 [d]	4.9:1

Means followed by different letters in the same column are significantly different (P<0.05)

The female emergence in F_3, F_4, F_6, F_{10} (75.8-79.9%) was significantly higher than F_1, F_2, F_5 F_7, F_8, F_9 (47-70.1%).The female biased sex ratio varied from 0.91:1 to 4.9:1 (F: M) in F_1-F_{10} generations with maximum female biased sex ratio (4.9:1) was found in F_{10} generation. The female ratios of *T. chilonis* were higher than 50 per cent in all generations except F_8 generation, which demonstrates that the reproductive potential of *T. chilonis* was not affected by number of generations in the laboratory. It also shows that *T.chilonis* present good adaptable tolaboratory host, *Corcyra cephalonica* eggs in the laboratory.

Adaptation to captivity (laboratory condition) generally increases productivity but a cost of lower quality. Generally captive populations rapidly adapt to the new environment- the rearing facility and

reach a relatively stable state of a laboratory stock within 10-20 generations (Nunney, 2007). Thus, in laboratory rearing, due to inbreeding both quantity and quality of strains are affected. By changing the mass-production system and colony maintenance, it was possible to improve the quality attributes of *T. brassicae* and achieve the efficiency in the field (Bigler, 1994).The quality attributes of *T.chilonis* may be improved through mass multiplication in semi-natural condition and through maintenance of proper balance in competition and rejuvenation of laboratory strain periodically with the wild strain. (Baitha and Varma, 2012).

Inbreeding is a major constraint in the maintenance of variability of *Trichogramma* in the laboratory, as it causes reduction in fecundity and vigor. A wild strain when reared in the laboratory for several generation, it becomes a laboratory strain. Any genetic change thus will be limited to this closed inbred population (Bartlett, 1984). Strain variability in parasitoid ability and host searching ability has been documented, and among different strains collected from cotton, tobacco, tomato, cotton and sugarcane, the *T. chilonis* from sugarcane proved to be the most efficient (Jalali and Singh, 1993). Subha Rao (1969) found that a strain of *T. chilonis* was the most effective in Madras (Tamil Nadu), giving over 70% control of INB. The Taiwan strain of *T. chilonis* parasitized 60.6% of the eggs of STB and the parasitoids releases reduced the number of infested canes significantly (Tuhan and Pawar, 1983).

The potential for relatively high rates of oviposition soon after release of *Trichogramma chilonis* may be a significant feature underlying the biological control potential of this parasitoid. It is concluded that from our present studies that INB-reared strain of *T.chilonis* seems to be a more promising candidate for biological control of sugarcaneborers due to its high fecundity rate and female biased sex ratios. It is also suggested that the strain should be also mass-multiplied under fluctuating temperatures so to ensure their adaptation to the harsh field conditions and *T.chilonis* (internode borer strain) may find a place in IPM strategy against sugarcane borers in subtropical India.

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References

Baitha, A. 2005. Growth rate differences of wild vs. laboratory-reared sugarcane adapted strains of *Trichogramma chilonis* Ishii (Hymenoptera: Trichogrammatidae). *Sugar Tech.* 7(2 &3): 53-56.

Baitha, A.,and Varma, A.2012. Assessment of quality attributes of tropical and subtropical laboratory reared strains of *Trichogramma chilonis* Ishii). *Indian Journal of Sugarcane Technology,* 27 (2): 98-99.

Baitha, Arun, and Varma Ashok.2003.Growth rate of sugarcane adapted strain of *Trichogramma chilonis* Ishii (Hymenoptera: Trichogrammatidae).*Journal of Biological Control*, 17(2):175-178.

Baitha, Arun,Sushil, S.N., Kumar, A., Kumar, Anuj and Maurya, B.L.2018. Superparasitism in natural population of *Trichogramma chilonis* Ishii (Trichogrammatidae: Hymenoptera) on eggs of

sugarcane internode borer. *Hexapoda (Insecta indica)* 25(1&2):25-11.

Baitha, Arun.2012. Biological observations on field collected strain of *Trichogramma chilonis* at fluctuating and constant temperatures. *Insect Environment*, 18(3):51-53.

Bartlett AC (1984) Genetic changes during insect domestication. In: King EG, Leppla NC (eds.), Advances and challenges in insect rearing, USDA, ARS, New Orleans, LA., pp. 2–8

Bartlett AC (1984) Genetic changes during insect domestication. In: King EG, Leppla NC (eds.), Advances and challenges in insect rearing, USDA, ARS, New Orleans, LA., pp. 2–8

Bigler F. 1994. Quality control in *Trichogramma* production. In: *Biological Control with Egg Parasitoids* (Eds: Wajnberg E and Hassan S A) pp.93-111, CABI International, Wallingford, Oxon.

Greenberg, S.M., Nordlund, D.A., and King, E.G. 1998. Mass production of *Trichogramma spp*.: Experience in the former Soviet Union, China, the United States and Western Europe. *Biocontrol News and Information* 17(3):51N-60N.

Greenberg,S.M.. 1991. Evaluation techniques for *Trichogramma* Quality. In: *Quality Control of Mass Reared Arthropods. Proceedings 5 th Workshop IOBC Global Working Group* (Ed: Bigler F) pp.138-45, Wageningen, Netherlands.

Hasan, S.A.1994.Strategies to select *Trichogramma* species for use in biological control. In: Biological control with egg parasitoids, *Eds*.E.Wajnberg and S.A.Hasan (eds.) Wallingford, UK: CAB International, 55-71pp.

Hassan, S.A., Kohler, E., and Rost, W. M.1988.Mass production and utilization of *Trichogramma*: 10. Control of the codling moth *Cydia pomonella* and the summer fruit tortrixmoth. *Adoxophyesorana* (Lep.:Tortricidae). *Entomophaga* 33: 413-20.

Jalali S.K., and Singh, S.P. 1993. Superior strain selection of the egg parasitoid *Trichogramma chilonis* Ishii – biological parameters. *Journal of Biological Control*, 7: 57-60.

Nagarkatti, S., andNagaraja, H. 1978. Experimental comparison of laboratory reared vs. wild-type *Trichogramma confusum* (=*chilonis*)(Hymenoptera: Trichogrammatidae) I. Fertility, fecundity and longevity. *Entomophaga*, 23(2): 129-136.

Nunney, L. 2007. Captive rearing for field release: a population genetic perspective. In: *Encyclopedia of Pest Management* (Ed: Pimental D) pp.175-78.

Sithanantham, S., Geetha N., Baitha, Arun and Jalali, S.K.2013.Utility of *Trichogramma* for bio control of sugarcane borers. In: *Biological control of Insect pests using egg parasitoid.* S.Sithanantham *et al*. (eds.), 271-300pp.

Subba Rao, B.R., and Sharma, A.K. 1969. The utilization of *Trichogramma* spp. in the biological control of sugarcane borers: a review and some suggestions for future lines of work., Poceedings of the Thirteenth Congress of the International Society of Sugarcane Technologists, Taiwan, Liu,K.C.(ed.),1342-1347.

Tanwar, R..K., and Varma, A. 1996. Intra-plant distribution of *Chilo sacchariphagus indicus* (Kapur) egg masses parasitised by *Trichogramma chilonis* Ishii in Uttar Pradesh. *Journal of Insect Science*, 9 (1): 67-68.

Tiwari, N.K., Tanwar, R.K., and Varma, Ashok. 1996. Effectiveness of *Trichogramma chilonis* against sugarcane borers (*Chilo auricilius* Dudgeon and *Chilo sachariphagus indicus* Kapur) in Uttar Pradesh. *Indian Journal of Sugarcane Technology*, 11(1):42-44.

Tuhan, N.C., and Pawar, A.D.1983. Life history, host suitability and effectiveness of *Trichogramma chilonis* Ishii for controlling sugarcane borers in the Punjab. *Journal of Advanced Zoology*, 4:71-76.