Fecundity variation assessment among iso-female lines in three strains of *Trichogramma chilonis* and *Trichogramma pretiosum* for parental stock improvement

R.Pandiyan[1*], M. Prabakaran[2] and S.Jeyarajan Nelson[1]

[1]Department of Agricultural Entomology, Tamil Nadu Agricultural University, coimbatore-641 003.
[2]SUN Agro Biotech Research Center, 3/1978, main road, Madanandapuram, Mugalivakkam, Chennai- 600 125.
*Corresponding author's E-mail: pandirymiz@gmail.com

Received: March 12, 2017 Accepted: March 25, 2017 Published: March 28, 2017

ABSTRACT

Intra-population variation in reproductive potential offers scope for enhancing the parental stock in mass-reared insect bio control agents. Laboratory cultures of two cold adapted strains of *Trichogramma chilonis,* along with a local strain and *T. pretiosum* were studied for such variation in fecundity by evaluating randomly chosen iso-female lines. The indicative fecundity (in first 3 days of adult life) was compared among 10 iso-female lines each among the strains/species. The results showed considerable variation in fecundity among the iso-female lines in Nilgiris, Kodaikanal and local strain of *T. chilonis,* besides *T. pretiosum,* from such selective pooling as parental stock, there was enhancement in overall progeny production capacity by 37.3, 19.7, 28.0 and 21.0, (for five pairs of adults) in Nilgiris, Kodaikanal and local strains of *T. chilonis* and *T. pretiosum,* respectively. The progeny from the top 3 lines for fecundity were selected for pooling as parental stock leading to enhancing the progeny production capacity by 26 and 15 per cent in the two cold adapted strains, besides 17 per cent for the local strain while for *T. pretiosum* such enhancement was 19 per cent. The utility of selecting among iso-female line within *Trichogramma* species/strains for parental stock improvement in commercial mass production is indicated. This initiative enabled the culturing of strains/ species with more robust genetic base for pursuing future studies on diapause induction in these strains/species.

Key words: *Trichogramma* strains, fecundity enhancement, iso-female lines, parental stock**.**

Parasitoid wasps of the genus *Trichogramma* (Hymenoptera: Trichogrammatidae) include several species that are frequently used as biological control agents worldwide (Consoli *et al.,* 2010). Currently, inundative releases of this bio agent for control of lepidopteran pests are being investigated in more than 30 countries and are reported to be used commercially on more than 32 million ha every year (Li, 1994). *Trichogramma*spp. lay their eggs inside the eggs of host insect pest and there by prevent the hatching and subsequent crop damage by the target insect pests. Trichogramatids continue to be the source of fascination to many biological control practitioners, not only for their very small size but also for their biodiversity and adaptation potential. Lepidoptera are a major group of insect pests infesting several economically important crops in India. The management of lepidopteran pests has relied heavily on the extensive use of chemical pesticides. Since, indiscriminate and prolonged use of insecticides has caused development of pesticide resistance in most of the lepidopteran insect pests, there is increasing interest to shift to more eco-friendly control methods. It is in this context that Trichogramatids have become more potential pest management alternatives. They are more useful for suppression of the borers in sugarcane, maize, rice, cotton and vegetables like *Chilo* spp. *Scirpophga excerptalis* Walker, *Scirophaga incertulas* (Walker) and *Helicoverpa armigera*(Hubner*).* Mass rearing and inundative release of Trichogrammatid egg parasitoids has been recommended for biological control of several important lepidopteran pests in India (Singh *et al.,* 1994a). The Trichogrammatid parasitoids are found useful for managing key pests in India including both native and exotic species. Singh *et al*. (2001) have pointed out the wide-scale utilization of potential native species like *T.chilonis* (Ishii) and exotic

species like *T.japonicum* Ashmead for bio control of several caterpillarpests of national importance. The present studies Climatic adaptation of *Trichogramma* species/strains is an important factor in impact potential of inundative releases of mass reared bio control agents like *Trichogramma* (Smith, 1996). In India, Abraham (1970) first pointed out the potential for developing temperature tolerant strains, and more recently Jalali *et al.* (2009) have reported on the potential for combining temperature tolerance with insecticide tolerance among *T. chilonis* strains. Baya *et al.* (2007) showed the scope for genetic enhancement of the parasitisation potential of native strains of *Trichogrammatoidea*. sp. nr. *lutea*. Intra-population variations in genetic attributes among Trichogrammatids was pointed out by Wajnberg (1994), while the potential benefits to improve population's performance using inbred lines was pointed out by Larralde (2014). The parental stock fitness is a key criterion for quality upkeep in mass reared insect biocontrol agents like Trichogramma (Ballal *et al.,* 2001). The present study was part of an initiative to improve the parental stock fitness among two high altitude strains of *T. chilonis* compared to a local strain of *T. chilonis* by comparing the variation in fecundity among iso-female lines, as part of a DBT project targeting Trichogrammatid strains which occur in high-altitude locations and hence locally adapted to survival in colder climates.

MATERIALS AND METHODS

From laboratory mass culture population of three strains in *T. chilonis* and one strain *T. pretiosum*, from each strain, ten randomly chosen iso-female lines were compared for indicative fecundity (progeny production per female) in the laboratory as per the method described by Judy *et al.*(2013). Five pairs of adults from each iso-female lines were chosen and offered about 250 host (C. *cephalonica*) eggs daily for three successive days to record the number of progeny that they could lay in the offered host eggs. The indicative fecundity (number of off spring produced within the first three days of adult's life) was studied for each iso-female progeny.

RESULTS AND DISCUSSION

The results showed considerable variation in fecundity among the ten iso-female lines in Nilgiris, Kodaikanal and local strains of *T. chilonis* and also in *T. pretiosum* (Table. 1). From each strain we could select the top 3 lines for pooling as parental stock leading to enhanced progeny production capacity by 37.3, 19.7, 28.0 and 21.0, respectively (for five pairs of adults) in the Nilgiris, Kodaikanal and local strains of *T. chilonis* and *T. pretiosum*, respectively. The top three iso-female lines in each strain/species were pooled and kept as more fecund parental stock for the further evaluations in diapause induction. The utility of re taining iso-female lines both for progeny homogeneity and for assessing the within population variation of *Trichogramma* strains has been well documented by Baya *et al.* (2007). The scope for utilizing the intra- population genetic variation among individuals by quantifying their reproductive potential has also been suggested earlier by Roitberg (1990). The present results from iso-female lines comparisons have shown that adequate variability exists for longevity and fecundity within the population of the cold-adapted *T. chilonis* strain collections from Nilgiris and Kodaikanal and also local strain and *T. pretiosum.* The scope for such intra- population variation in reproductive potential was earlier indicated in *T. cacoeciae* (Babi, 1990) besides in *T. bourarachae* and *T. voegelei* (Mimouni,1991). The relatively higher fecundity observed in the Nilgiris population compared to the Kodaikanal strain may be worth further studies with additional collections in the two locations. These studies are valuable tools for upgrading the parental stock with further individuals drawn from the same source population and recognized among future research thrusts by Sithanantham *et al.* (2013). The potential for intra-strain diversity in fecundity to be utilized by selecting more-fecund iso-female lines for parental stock has been well emphasized (Sithanantham *et al.,* 2014). The present results are also comparable in strategy to those adopted by Jalali and Singh (1992) who pursued such selection and parental stock upkeep among superior strains of *T. chilonis* collections made from different agro-climatic zones of India. The present studies have shown the scope for fecundity enhancement of the parental culture in the *T.chilonis* strains, by selecting the progeny from the top 3 lines for fecundity and pooling them as parental stock leading to the enhanced progeny production capacity by 26 and 15 per cent in the two cold adapted strains, besides 17 percent in the local strain of *T. chilonis*, while for *T. pretiosum* such enhancement was 19 per cent.

Table 1. Progeny production by iso-female lines of three *T. chilonis* strains and *T. pretiosum*

***Trichogramma* species /strains**	Total fecundity per five pairs of adults (for first 3 days)				Mean progeny production improvement made
	Ten iso-female lines		Top 3 lines chosen for parental stock		
	Range	Mean	Range	Mean	
T.c - Nilgiris strain	79-162	108.0 ± 8.76	133-162	145.3±8.64	37.3
T.c – Kodaikanal strain	74-140	113.6 ± 6.6	129-140	133.3±3.38	19.7
T.c - Local strain	107-179	138.3 ± 7.39	152-179	166.3±7.83	28.0
T. pretiosum	53-110	87.3 ± 5.97	106-110	108.3±1.20	21.0

T.c= *Trochogramma chilonis*

This simple strategy could be a reliable tool for rejuvenation in such mass reared bio control agents as *Trichogramma* species/strains.

CONCLUSION

In conclusion intra-starain diversity in fecundity could be utilized by selecting more fecund iso-female lines for parental stock. The methods to utilize the climatic stress adapted strains of Trichogramma are being refined**.** For cold adapted native strains GIS-based systems to assemble them and selectively conserving the iso-female lines to upkeep their reproductive fitness are promising.

REFERENCES

Abraham, C. 1970. Exploration of the feasibility of developing races of *Trichogramma australicum* Girault (Hymenoptera: Trichogrammatidae) suitable for different environments. Ph.D. thesis, IARI, New Delhi, p.126.

Babi, A. 1990. *Bioecologie de Trichogramma cacoeciae Marchal et T. daumalae Dugast & Voegele (Hymenoptera: Trichogrammatidae). Utilisation en lute biologique contre Lobesia botrana Den. & Schiff. (Lep.: Tortricidae)*. Ph.D Thesis, Aix-Marseille, France, p.143.

Ballal, C. R., S. Joshi, S.K. Jalali and N.S Rao. 2001. Quality control parameters in mass produced bioagents. In: *Augmentative biocontrol: proc. ICAR-CABI workshop on augmentative biocontrol*, (eds: Singh, S. P., Murphy, S. T. and Ballal, C. R.), CABI, Wallingford, pp. 141–161.

Baya, J. M., S. Sithanantham, L.M, Gitonga, E.O. Osir and V. Agong. 2007. Scope for genetic enhancement of the parasitisation potential of four native strains of *Trichogrammatoidea sp.nr.lutea* Girault (Hymenoptera: Trichogrammatidae) in Kenya. *Biocontrol Science and. Technology.*, 17: 743-755.

Jalali, S. K., T. Venkatesan and M. Nagesh. 2009. Development of genetically improved strain of egg parasitoid *Trichogramma chilonis* with combined tolerance to insecticide and high temperature for the biological control of lepidopterous pests. Final Technical Report, DBT project. NBAII, Bangalore, pp. 117.

Jalali, S. K. and S.P. Singh. 1992. Differential response of four *Trichogramma* species to low temperatures for short term storage. *Entomophaga*, 37: 159-165.

Judy, S., S. Sithanantham, K.P. Sanjayan, V. Thamaraiselvi and K.R. Manikandan. 2013. Reproductive attributes of a warm–temperature tolerant strain of *Trichogramma chilonis*. *Hexapoda*, 2 (1&2): 11-13.

Larralde, A.G and E.C. Chavez. 2014. Genetic variation and the performance of a mass-reared parasitoid, *Trichogramma pretiosum* (Hymenoptera: Trichogrammatidea), in laboratory trials. Journal of Applied Entomology, 138 (5): 346-354.

Mimouni, F. 1991.Genetic variations in host infestation efficiency in two *Trichogramma* species from Marocco. *Redia*, 74: 394-400.

Roitberg, B. D.1990. Variation in behaviour of individual parasitic insects: bane or boon? In: Critical Issues in Biological Control (Eds.): Mackauer, M., L..E Ehler and J. Roland), Jonh Wiley and Sons, New Jersey, U.S.A, pp. 25-39.

Sithanantham, S. C.R Ballal and S.K. Jalali. 2013. Future Thrusts for Egg Parasitoids Research in India, (Eds.) S.Sithanantham, Biological Control of Insect Pests Using Egg Parasitoids. Springer, India: 1-10.

Sithanantham, S., S. Judy, K.R Manikandan, C. Thamaraichelvi, R. Pandiyan, S. Jeyarajan Nelson and K.P. Sanjayan. 2014. Characterization, adaption and utilization of beneficial insect biodiversity, *Trichogramma chilonis* R&D in bio control of crop pests. In: P*roc. National seminar on "Biodiversity conservation status, Future and way forward"* , KSR college of Technology, Thiruchengode, Tamil Nadu, India, pp. 657-672.

Smith, S. M. 1996. Biological control with *Trichogramma*: advances, successes and

potential of their use. *Annual Review of Entomology*, 41: 375-406.

Wajnberg, E. 1994. Intra-population genetic variation in *Trichogramma*, Biological Control with Egg parasitoids . In: Genetics, Evolution and Biological Control, (Eds.) Ehler, L. E., R. Sforza and T. Mateille, CABI Publishing, Oxfordshire, pp. 245-271.

Consoli, F. L., J. R. P. Parra and R. A. Zucchi. 2010. Egg parasitoids in agro ecosystem with emphasis on *Trichogramma*. In: *Progress in biological control*, Springer, Heidelberg, London, New York, 479p.

Singh, S. P. and S. K. Jalali. 1994a. Trichogrammatids. *Tech.Bull* (7), Project Directorate of Biological Control, Bangalore, Karnataka, India,47p.

Li, L.Y. 1994. Worldwide use of *Trichogramma* for biological control on different crops: a survey. In: *Biological control with egg parasitoids*, (Eds.) Wajnberg, E. and S.A Hassan, C.A.B. International Oxon, U.K., pp. 37–54.