Journal of Biological Control, 28(4): 210-213, 2014

Research Article

Standardisation of host-parasitoid ratio of *Plutella xylostella* (Linnaeus) and *Trichogrammatoidea bactrae* Nagaraja

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ABSTRACT: Host parasitoid ratio for *Plutella xylostella* and its egg parasitoid *Trichogrammatoidea bactrae* was worked out under in-vitro conditions, at 26+1oC and 65% RH. Host to parasitoid ratio of 35:1 was optimum with parasitism and adult emergence of >90%. The ratio was on par with ratio range from 21-30:1. Mass rearing of the parasitoid for would be more economical when reared at the optimum ratio. Effective dose for inundative releases of the parasitoid for suppression of *Plutella xylostella* could be determined based on the field evaluation of the optimum host – parasitoid ratio (35 host eggs:1 female parasitoid).

KEY WORDS: Host-parasitoid ratio, Parasitism, *Plutella xylostella, Trichogramma bactrae*

(Article chronicle: Received: 25-08-2014; Revised: 01-11-2014; Accepted: 28-11-2014)

INTRODUCTION

The diamondback moth (DBM) *Plutella xylostella* is a polyphagous pest of crucifer crops worldwide. It attacks cabbage, chinese cabbage, chinese kale, cauliflower, broccoli, mustard,,radish, pak-choy, and several others. An estimated US $1 billion per year was reported towards management costs of the pest worldwide by Talekar and Shelton (1993).

Resistance to every class of insecticide (Chawla and Kalra, 1976, Saxena *et al*., 1989 Reghupathy, 1996, Shelton *et al*., 2000, Sarfaz and Keddie, 2005, Dhumale *et al.,* 2009, Santos *et al.,* 2011), had resulted in environmental hazards and had warranted reliance on biological control agents (Li and Lui, 2001., Lui *et al.,* 2000), for successful management of the pest.

The egg parasitoids, Trichogrammatoidea bactrae Nagaraja, *Trichogramma pretiosum* Riley, *Trichogramma confusum, Trichogramma brassicae* Nagaraja, *Trichogramma pintoi* Voegele, *Trichogramma embryophagum* (Liu, *et al.,* 2000, Chen Ke Wei *et al.,* 2002, Wuhrer and Hassan, 2009., Fatemeh Akbari *et al.,* 2012), *have been reported to be effective on the pest.* Krishnamoorthy and Mani (1999) reported that among these *Trichogrammatoidea bactrae*, was found to be a potential parasitoid. The parasitism ranged from 30–75% (Liu *et al.,* 2004), 55% (Petechart, 1999., He YuRong *et al.,* 2001., Jalali *et al.,* 2001), 69-72% (Vasquez *et al*., 1997**)** and 90.04% (Nadeem and Hammed, 2008) upon

Under stressed conditions, effective strains of biocontrol agents are necessary to have a density dependent relation with the pest for the high performance of bioagent (Wajnberg and Hassan, 1994, Liu *et al*., 2000, Nofemola and Kfir, 2005). Population of parasitoids in nature are prone to several abiotic stresses, resulting in their mortality to a greater extent, which often necessitates their augmentative releases for effective suppression of the pest. The quantum of parasitoids required for field releases and optimum dosage depend up on the ratio of host to parasitoid population. *In-vitro* studies were therefore contemplated to determine the optimum host to parasitoid ratio for *P.xylostella* and *T.bactrae* to determine the effective dose for field releases.

MATERIALS AND METHODS

Laboratory studies were carried out at the Division of Molecular entomology, NBAIR, Bengaluru during 2013-14. Cabbage seedlings raised in pots placed in acrylic rearing cages (1 cu.ft) were utilised for maintaining the diamondback moth. Field collected population of DBM obtained was utilised for the initial culture.

Determination of host – parasitoid ratio for *Plutella xylostella* and *Trichogrammatoidea bactrae*

DBM eggs of 12-24 hours post emergence was utilised for parasitism studies. The treatments comprised of releasing one mated female parasitoid to a specified number of eggs of the host (on leaf bits of cabbage) placed in test tubes (20 x 4 cms). The experiment was initiated by exposing 15 eggs (T_1) to a female parasitoid, followed by a unit rise in host eggs in the successive treatments up to 100 (T_{29}). Each treatment was replicated thrice and the experiments were carried out 26+1°C and 65% RH. A fine streak of honey (50%) solution was provided as food for the adults in the tube. The DBM eggs were allowed to be parasitized for 24 hours and the parasitized eggs on leaf bits were placed in fresh tubes for further development and adult emergence. Observations were recorded on per cent parasitism and adult longevity.

RESULTS AND DISCUSSION

The per cent parasitism in the various host – parasitoid ratios ranged from 31.53 (100:1) to 100.00 (15:1). Cent per cent parasitism was recorded in the host parasitoid ratios of 15:1 and 21:1. The treatments with an additional host egg from 16 to 20 registered 95.3 -97.8 per cent (Table 1). Similarly, 94.14 - 98.48% parasitism was recorded in the ratios of 22-32:1. The levels of parasitism declined when the ratios were in the range of 33 – 45:1 (92.1 to 69.33). The parasitism was low (31.5%) when 100 eggs were offered to a single parasitoid, Earlier, maximum parasitism of 83% was reported (Singh *et al*., 2004) when the host to parasitoid ratio was 100:5, which was on par with ratios of 100:10 and 100: 20. Innate capacity of the parasitoid and inherent differences among them would have contributed to the variation in levels of parasitism and adult emergence in the different ratios. The levels of parasitism by *T.bactrae*

Table 1. Parasitism of *Trichogrammatoidea bactrae* at different host parasitoid ratios on *Plutella xylostella* eggs.

Treatment	Host –parasitoid ratio	Mean parasitism of eggs/parasitoid	Mean parasitism (%)	Mean % adult emergence
T1	15:1	15.0	100.00	81.00
T2	16;1	15.6	97.50	82.0
T3	17:1	16.20	95.20	86
T4	18:1	17.40	96.66	86.0
T5	19:1	18.60	97.09	87.0
T6	20:1	19.20	96.00	87.0
T7	21:1	21.00	100.00	87.0
T8	22:1	21.66	98.48	87.0
T9	23:1	22.06	95.94	87.0
T10	24:1	23.20	96.66	88.0
T11	25:1	24.2	96.80	89.0
T12	26:1	24.50	94.23	89.0
T13	27:1	26.20	97.03	90.0
T14	28:1	26.13	93.33	89.0
T15	29:1	28.06	96.78	89.0
T16	30:1	29.00	96.66	90.0
T17	31:1	29.80	96.12	90.0
T18	32:1	30.13	94.16	89.0
T19	33:1	30.40	92.12	90.0
T20	34:1	31.20	91,76	90.0
T21	35:1	31.60	90.0	91.0
T22	36:1	31.80	88.33	90.0
T23	37:1	31.53	85.22	91.0
T24	38:1	31.90	83.94	90.0
T25	39:1	31.73	81.36	90.0
T26	40:1	32.13	80.33	91.0
T27	45:1	31.20	69.33	91.0
T28	50:1	31.0	62.00	91.0
T29	100:1	31.53	31.53	90.0

S,Em: 0.362 CV% 2.415 CD at 5% 1.007 CD at 1% 1.270

on DBM eggs, under *in-vitro* conditions varied viz., 71.9% (Vasquez *et al.,* 1997), 25.67% (Klemn *et al*., 2001), 89.6% (Jalali *et al*., 2001).

In areas of high pesticide usage, effective pest suppression could be achieved only, when augmentative releases of parasitoids are made to supplement the natural population. Timing of release and optimum dose of parasitoid releases are crucial in all Integrated pest management strategies. Field releases of *T.bactrae* at varying dosages have been earlier reported by several workers. Krishnamoorthy and Mani (1999), suggested releases of 2,50,000 adults of the parasitoid @ 40,000-50,000 adults/week/ha-1 for 6-7 weeks on cabbage after transplanting. A total of six releases @50,000 adults/ha-1/release was recommended (Krishnamoorthy, 2003, 2012). Five releases @50,000 adults/ha at an interval of 5-7 days was recommended by the Directorate of Plant Protection, Quarantine and Storage (2001), while Singh *et al*., (2004) reported releases of *T.bactrae* @ 5 adults/plant twice on cabbage.

Standardisation of host –parasitoid ratios is required to determination the optimum dosage for parasitoid releases in the field. Our current studies had indicated that a single female of *T.bactrae* has the potential to parasitise 21-35 eggs effectively with 90.2 to 100.0 % parasitism resulting in an adult emergence of 87-91%, during an average female longevity of 5-6 days. Mass production of the parasitoid would therefore be more effective with a host parasitoid ratio of 30-35:1.

Field parasitism may vary over those under laboratory conditions. Proximity of the host and availability under ambient conditions (25-27^{o}C and 65% RH) results in greater parasitism unlike under field conditions where the predisposing ecological factors, host searching ability, dispersion range and susceptibility to insecticides, often influence the levels of parasitism. Increase in distance was reported to decrease percent parasitism of host (Nadeem *et al.,* 2004., Abdurrahman *et al*., 2008). Nevertheless, field evaluation of the optimum host-parasitoid ratio, would add to our knowledge on the release rates of the parasitoid, for effective suppression of DBM.

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