Pakistan Entomologist

Journal homepage: www.pakentomol.com

SELECTIVITY OF SOME NOVEL INSECTICIDES AGAINST TRICHOGRAMMA CHILONIS ISHII. (HYMENOPTERA: TRICHOGRAMMATIDAE)

Muhammad Asrar[1], Tahreem Shanawar[1], Muhammad Dildar Gogi[2], Muhammad Azeem1, Dilbar Hussain[3] , Hina Anwar[4], Sami Mubarik[1] and Muhammad Saleem[3]

[1]Department of Zoology, Government College University, Faisalabad, Pakistan
[2]Department of Entomology, University of Agricultute, Faisalabad, Pakistan
[3]Entomological Research Institute, Ayub Agriculture Research Institute, Faisalabad, Pakistan
4Department of Applied Chemistry, Government College University, Faisalabad, Pakistan

ARTICLE INFORMATION

Received: May 07, 2019
Received in revised form: September 10, 2019
Accepted: October 21, 2019

***Corresponding Author**:
Muhammad Asrar Chaudhary
E-mail: asrar_agri@yahoo.com

ABSTRACT

The main objective of present study was to assess comparative selectivity of seven insecticide viz., Belt, Pyriproxyfen, Voliam flexi, Nitenpyrum, Lufenuron, Chlorantraniliprole and Flonicamid at their recommended doses against Trichogramma chilonis by egg card bioassay and dipped surface residue bioassay under laboratory conditions. The experiment was conducted in the toxicological laboratory Entomological Research institute Ayub Agricultural Research Institute (AARI) Faisalabad. The insecticides were catagorized into harmless (< 30% mortality), slightly-harmful (30-79%vmortality), moderately-harmful (80-99% mortality) and harmful (> 99% mortality) categories according to the International Organization for Biological Control (IOBC) codes for beneficial species investigsted under laboratory. The results of egg card bioassay revealed that Tight® (Lufenuron) demonstrated 71.5% T. chilonisiadult emergence (28.5% mortality) and was categorized as harmless insecticides T. chilonisi. However, egg card bioassay reveal 65.5% (34.5% mortality), 42% (58% mortality), 39.5% (60.5% mortality), 58% (42% mortality), 63.5% (36.5% mortality) and 62% (38% mortality) T. chilonisiadult emergence from eggs treated with Belt® (Flubendiamide), Nylar® (Pyriproxyfen), Sega® (Nitenpyrum), Voliam-Flexi® (Chlorantraniliprole and thiamethoxam), Tight® (Lufenuron), Coragen® (Chlorantraniliprole) and Nicotinamid® (Flonicamid). On the basis of these results, Belt®, Nylar®, Sega®, Voliam-Flexi®, Coragen® and Nicotinamid® were categorized into slightly harmful insecticides against T. chilonisi in egg card bioassay.Similarly, the results of dipped surface residue bioassay reveal that Tight® (Lufenuron) (28% mortality)proved harmless while Belt® (44% mortality),Nylar®(72% mortality), Sega®(48% mortality), Voliam-Flexi®(68% mortality), Coragen® (44% mortality) and Nicotinamid® (44% mortality) proved slightly harmful insecticides against T. chilonisiwhen T. chilonisiadult were exposed to treated surface 4hrs post application interval. However, at 24 hrs post application exposure, all tested insecticides (0-8% mortality) proved harmless against T. chilonisadults. Above finding show that augmentative releases of T. chilonis adults can be recommended 24 hours post application of these insecticides

Keywords: Insecticides, Parasitoid, selectivity, laboratory bioassay

INTRODUCTION

Genus *Trichogramma* (Hymenoptera: Trichogrammatidae) are major biological agent which are significantly applied in integrated pest management throughout the world (Hassan *et al.* 1993; Smith *et al.* 1996). About 200 species of *Trichogramma* have been known in which 25 species play major role in biological control in agricultural crops (Parra and Zuchi, 1997). Atmost 15 million hacters of agriculture crops and forest are treated with *Trichogramma* per year (Van Lanteren *et al.* 2000). Some species *Trichogramma* are generalist egg parasitoid with wide range of host including Lepidoptera, Diptera, Coleoptera, Hymenoptera, Neuroptera and Megaloptera (Thomson and Stinner, 1989; Li *et al.* 2004; Hoffmann *et al.* 1995; McGregor *et al.* 1998; Orr *et al.* 2000; Wright *et al.* 2002; Mansfield and Mills, 2004). The

Cite this article as: Asrar, M., T. Shanawar, M.D. Gogi, M. Azeem, D. Hussain, H. Anwar, S. Mubarik and M. Saleem, 2019. Selectivity of some novel insecticides against *Trichogramma chilonis* Ishii. (Hymenoptera: Trichogrammatidae). Pak. Entomol., 41(2):121-126.

conservation of natural enemies in crops is become maximum by using selective insecticides. The efficiency of important biological agents is reduced by wide using of insecticides. It is doubtful, to find the tolerable range of insecticides for some non-target organisms. Large-scale application of potent insecticides has increased concern about risks to ecosystem functions provided by a vast range of species and environment affected by these insecticides (Preetha *et al.,* 2010). Some insecticides are eco friendly but show lethal effect on pests, hence involve in conservation of biological agent in agriculture. In integrated management, some particular pesticides application have deterious results when they applied on biological control species (Hill and Foster, 2000).A basic rule of integrated pest management is to increase the control of pest with the aid of natural enemies agent. *Trichogramma* activity reduce by excessive use of insecticides (Brar *et al.* 1991; Consoli *et al.* 1998; Schuld and Schmuck 2000). *Trichogramma* spp. Wasps show volunarble effect to large used of pesticides in field and laboratory. Due to harmless effects *Trichogramma* showed negative result. *Trichogramma chilonis* Ishii (Hymenoptera: Trichogrammatidae) has been used to control the various lepidopteran insect pests which caused damage in corn (*Zea mays* L.), cotton (*Gossypium hirsutum* L.), and vegetables (Chang *et al.* 2001; Ballal *et al.* 2009; Preetha *et al.* 2009). The combination of biological and chemical control techniques need to understand the effects on biological control agents. A gradual outcomes from laboratory applied into field, with appropriate preventions of both direct and dangerous outcomes is encourage in the application of pesticides against biological control agents (Croft *et al.*1990). it is therefore, to assess the selective toxicity of new insecticides against *T.chilonis* under laboratory conditions for induction in integrated pest management programs. Thus, the aim of present research was to illustrate the comparative toxicity of insecticides.

MATERIALS AND METHODS

The research work was conduct on the comparative toxicity of insecticides against *Trichogramma chilonis* under laboratory conditions at the Eco-toxicological laboratory, Ayub Agricultural Research Institute, Faisalabad in 2018.

Insecticides

Seven insecticides (Table 1) were selected which are used in insect pest control. A control treatment of water of water application was also prepared. Micro pipette were used to measure quantity of each insecticide and concentrations were prepared in a beaker by diluting up to 500 ml with distilled water.

Egg card bioassay

Egg card bioassay research was performed to check the effect of parasitism. In this study the effect of dipping parasitized *Sitotroga cerealella* eggs in chemicals were investigate in development stages of immature *T. chilonis*. Five egg-cards each having 40 parasitized eggs were selected and treated with each chemicals dipping for ten seconds in insecticide solutions on 1st, 2nd, 3rd, 4th, 5th, 6th and 7th days of age of parasitized eggs. The treated cards were now dried at room temperature. The dried egg-cards were placed into 5 cm diameter and 5 cm deep petri dish and maintained in a condition of 25 $\pm$2 °C temperature and 52 $\pm$ 5 RH humidity till exclusion of parasiods. The eggs were examined the eggs with the help of microscope.

Dipped surface residue bioassay

Dipped surface residue bioassay was performed in aereated glass bio-assays chambers measuring 15x4cm. Whatman filter paper was dipped in a chemical and dried and put into the glass bio-assays tube. The dead wasps were counted after applying the treatments. Every treatment repeated five times.

Data Analysis

The data are analyzed by ANOVA technique and means were compared by using Fisher's least significant difference (LSD) test at 5% significant value.

The percent emergence regarding immature stages was calculated by using following formula.

$$\text{Percent emergence} = \frac{\text{Total number of emerged adult}}{\text{Total number of parasitized eggs}} \times 100$$

The percentage mortality was calculated in each treatment by following formula.

$$\text{Percent Mortality} = \frac{\text{Number of died adults}}{\text{Total number of adult}} \times 100$$

All statistical analysis was carried out using computer software STATISTIX.

RESULTS AND DISSCUSSION

Table 2 shows that the exposure of nitenpyrumand pyriproxyfen to parasitoids, *T. chilonis*, resulted in the lowest emergence39.5% and 42%and showed high mortality 60.5% and 58% respectively, while the highest emergence 71.5% and low mortality 28.5 % was observed after exposure to lufenuron. The parasitoid emergence showed after the treatments ofchlorantraniliprole 63.5% , voliam flexi 58% , belt 65.5% and flonicamid 62% with 36.5%, 42%, 34.5% and 38% mortality. Belt, flonicamid and chlorantraniliprole observed to be safer as compared to voliam flexi and lufenuron. Voliam flexi and lufenuron observed safer as compared to nitenpyrum and pyriproxyfen.

According to Sattar *et al.* (2011) lufenuron were moderately toxic According to Huggi and Mallapur (2016) it is less toxic According to Hussain et al 2012 lufenuron were safer but according to our lufenuron also show moderately toxic and it may be compatible due to exposure of time difference or different dose rate but after 4 hours adult of *Trichogramma* effect to lufenuron is also very less toxic from all other insecticides. Lufenuron was not safer for *Trichogramma chilonis* adult after 24 hours.According to Hussain *et al.* (2012) belt was less toxic , According to Sattar et al (2011) belt was moderately toxic, According to Sudhanan et al 2016 belt show no harmful effect and in our experiment it also show moderately toxic. The present research work showed same as (Hussain *et al.*, 2012). Chlorantraniliprole show less toxic, According to (Uma *et al.*, 2014) it is harmless and in our experiment it showed comparatively less.

According to (S.E *et al.*, 2014) voliam flexi were moderately

toxic and in our experiment it also showed moderately toxic. However after four hours (4h) all adults showed less toxicity while after twenty four hours (24h) all adults proved highly toxic. However new chemistry insecticides with different mode of action are proved to be mostly used for their target host and their effect on the host was greater than the natural enemies. Therefore, they are rare biological control agents in the environment of agriculture % in IPM.

All insecticides were significantly different in result in present study regarding survival of adults of *T. chilonis* 3 h application (Table 3). Pyriiproxyfen and nitenpyrum showed 72% and 68% survival respectively after 4 h application. Lufenuron was resulted as lethal insecticide with resultlow survival (28%) in adult parasitoids and show nonsignificant difference from belt, chlorantraniliprole and flonicamid, where survival rate are 22.0% commonly. All the insecticides showed non-significant result with respect to each other regarding the survival of *T. chilonis* adults is 0 to 8% with regarding to control 90.5% after 24h post application.

Belt, flonicmid and chlorantraniliprole showed least toxic effect in contrast to other and at 24 h post treatment, all of them show similar effect to the parasitoid at adult stage in this result (Fig. 1). The present result similar to the finding of Preetha *et al.* (2009) which explain that chlorantraniliprole was harmless to *T. chilonis.* Our study shows same resultto those Hussain *et al.* (2010) which explain that at adult *Trichogramma* revealed 70.0, 27.6, and 18.4% survival after use of imidacloprid, emamectin benzoate and lufenuron, after 3 h, but for 24 h, any insecticides was not found to compatible to adult of *T. chilonis.* The results obtain from earlier finding showed that belt, flonicamid and chlorantraniliprole was observed harmful as compared to by voliam flexi and lufenuron.

Authors' contributions

MAC, TS and DH designed the study and wrote the manuscript with input from all authors. MDG and SM analyzed the data. MA, HA and MS gave their suggestions for improvement in the manuscript. All authors read and approved the final manuscript.

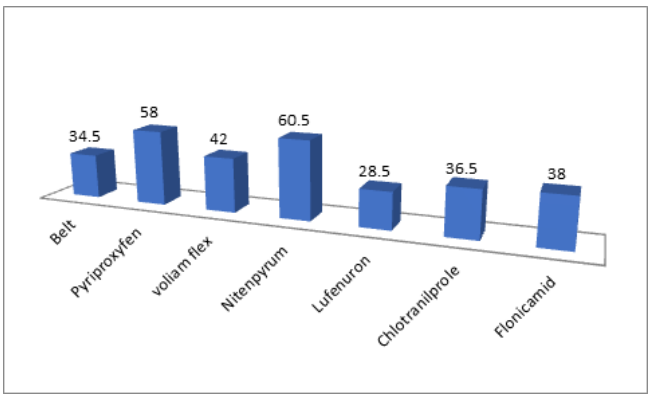

Fig. 1
Percent mortality of *Trichogramma chilonis* at different post treatment intervals of insecticide**.**

Table 1
The insecticides with their common and brand name, recommended dose/acre and concentration in ppm.

Insecticides/Common name	Trade name	Recommended field dose/ acre
Chlorantraniliprole, + Thiamethoxam	Voliam Flexi	200ml/Acre
Pyriproxyfen	Nylar	200ml/Acre
Belt	Flubendiamide	50ml/Acre
Flonicamid	Belt	60g/Acre
Lufenuron	Tight	200ml/Acre
Nitenpyram	Sega	250ml/Acre
Chlorantraniliprole	Coragen	50ml/Acre

Table 2
Adult emergence (%) of *Trichogramma chilonis* at different post treatment intervals.

Treatments	1st observation Mean±SE	2nd observation Mean±SE	3rd observation Mean±SE	4th observation Mean±SE	5th observation Mean±SE	6th observation Mean±SE	7th observation Mean±SE
Control	94.5±0.52a	90.5+0.40d	91.5±0.30cd	92.5±0.79c	93.5±0.94c	91.5±0.72c	92.5±0.75b
Belt @ 50ml/Acre	44.5±0.91c	44.5+0.91a	52.5±1.18ab	52±0.63b	65.5±0.37a	30±0.67c	35±0.25b
Pyriiproxyfen@200ml/Acre	26.5±1.21ef	16+0.41cd	42±0.98bc	12±0.31dc	3±0.31d	33.5±0.86bc	32±0.05b
Voliam flexi@200ml/Acre	39.5±1.10f	28+0.38d	29.5±0.86e	22.5±0.42e	58±0.41d	54.5±0.31ab	52±0.17a
Nitenpyrum@250 ml/Acre	25.5±0.95c	12.5±0.73bc	10±0.44cd	8.5±0.86d	5.5±1.17c	37.5±0.53bc	39.5±0.09b
Lufenuron@200ml /Acre	32±0.97de	20±0.62cd	35.5±0.79cd	71.5±1.50a	34.5±0.35bc	30.5±0.71c	34.5±0.04b
Chlorantraniliprole @50ml/Acre	33.5±0.50b	41±1.15	57.5±0.60a	63.5±0.87a	43.5±0.67bc	53±0.89bc	56±0.04b
Flonicamid@60g/ Acre	52±0.61b	18.5±0.52cd	21±0.56de	45.5±0.40e	62±0.42ab	40±0.61a	43±0.15b
LSD at 0.05%	2.037	2.037	2.037	2.037	2.037	2.037	2.037
P-value	0.000	0.00	0.00	0.00	0.00	0.0072	0.0068
F-value	123	7.03	8.78	48.5	12.9	3.46	3.49
Df	7a/32b	7a/32b	7a/32b	7a/32b	7a/32b	7a/32b	7a/32b

Table 3
Survival (%) of *Trichogramma chilonis* adults at different post treatment intervals of insecticides.

Insecticides	Survival (%)	
	After 4 h	After 24 h
Belt	44cd	8b
Pyriiproxyfen	72bc	0b
Voliam flexi	48c	4b
Nitenpyrum	68b	4a
Lufenuron	28e	0b
Chlorantraniliprole	44de	0b
Flonicamid	44a	0b
Control	88c	90.5a
F.value	9.36	2.35
P.value	0.0000	0.0467
C.V %	26.27	275.21%

REFERENCES

Baehaki, A., D. Syah, S. Setyahadi and M.T. Suhartono, 2014. Production and characterization of collagenolytic protease from *Bacillus licheniformis* F11.4 originated from Indonesia. Asian J. Chem., 26(10): 2862-2864.

Baehaki, S.E., E.C. Surahmat, A. Susetyo and R. Senn, 2017. Safety selected insecticides to predators and egg parasitoids of planthoppers in rice ecosystem. Amer. J. Engineer. Res., 6(6): 174-182.

Ballal, C.R., R. Srinivasan and S.K. Jalali, 2009. Evaluation of an endosulfan tolerant strain of *Trichogramma chilonis* on cotton. BioContr., 54(6): 723.

Brar, K.S., G.C. Varma and M. Shenhmar, 1991. Effect of insecticides on *Trichogramma chilonis* Ishii (Hymenoptera: Trichogrammatidae), an egg parasitoid of sugarcane borers and cotton bollworms. Entomon, 16(1): 43-48.

Chang, S.C., N.T. Hu, C.Y. Hsin and C.N. Sun, 2001. Characterization of differences between two Trichogramma wasps by molecular markers. Biol. Contr., 21(1): 75-78.

Consoli, F.L., J.R.P. Parra and S.A. Hassan, 1998. Side effects of insecticides used in tomato fields on the egg parasitoid *Trichogramma pretiosum* Riley (Hymenoptera: Trichogrammatidae), a natural enemy of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). J. Appl. Entomol., 122(15): 43-47.

Croft, B.A., 1990. Arthropod Biological Control Agents and Pesticides. Wiley, New York. Crops. CAB International.

Delpuech, J.M., B. Froment, P. Fouillet, F. Pompanon, S. Janillon and M. Boulétreau, 1998. Inhibition of sex pheromone communications of *Trichogramma brassicae* (Hymenoptera) by the insecticide chlorpyrifos. Envir. Toxicol. Chem., 17(6): 1107-1113.

Hassan, S.A. and M.F. Guo, 1993. Selection of effective

strains of egg parasites of the genus *Trichogramma* (Hymenoptera: Trichogrammatidae) to control the European corn borer *Ostrinia nubilalis* Hb. (Lepidoptera: Pyralidae). Z. Angew. Entomol., 111: 335–341.

Hill, T.A. and R.E. Foster, 2000. Effect of insecticides on the diamondback moth (Lepidoptera: Plutellidae) and its parasitoid *Diadegma insulare* (Hymenoptera: Ichneumonidae). J. Econ. Entomol., 93: 763-768.

Hoffmann, M.P., P.R. Ode, D.L. Walker, J. Gardner, S. van Nouhuys and A.M. Shelton, 1995. Performance of *Trichogramma ostriniae* (Hymenoptera: Trichogrammatidae) reared on factitious hosts, including the target host, *Ostrinia nubilalis* (Lepidoptera: Crambidae). Biol. Contr., 21(1): 1-10.

Hussain, D., M. Akram, Z. Iqbal, A. Ali and M. Saleem, 2010. Effect of some insecticides on *Trichogramma chilonis* (Ishii) (Trichogrammatidae: Hymenoptera) immature and adult survival. J. Agric. Res., 48(4): 531-537.

Hussain, D., A. Ali, M. Mushtaq-ul-Hassan, S. Ali, M. Saleem and S. Nadeem, 2012. Evaluation of toxicity of some new insecticides against egg parasitoid *Trichogramma chilonis* (Ishii) (Hymenoptera: Trichogrammitidae). Pak. J. Zool., 44(4): 1123-1127.

Yuan-xi, L.I., 2004. Effects of insecticides on Trichogramma wasps. Chinese J. Biol. Contr., 2:235-241.

Lingathurai, S., M. Pushpalatha, R. Raveen, P.V. Priyatharsini, R. Sathikumaran and P.S. Narayanan, 2015. Ecotoxicological performances and biochemical effect of selected pesticides on *Trichogramma chilonis* (Ishii). (Hymenoptera: Trichogrammatidae). J. Entomol. Zool. Stud., 3(1): 109-114.

Mansfield, S. and N.J. Mills, 2004. A comparison of methodologies for the assessment of host preference of the gregarious egg parasitoid *Trichogramma platneri*. Biol. Contr., 29(3): 332-340.

McGregor, R.R., R.P. Prasad and D.E. Henderson, 1998. Searching behaviour of Trichogramma wasps (Hymenoptera: Trichogrammatidae) on tomato and pepper leaves. J. Entomol. Soc. British Columbia, 99: 93-98.

Nadeem, F., V. Kvicera, M.S. Awan, E. Leitgeb, S.S. Muhammad and G. Kandus, 2009. Weather effects on hybrid FSO/RF communication link. IEEE J., 27(9): 1687-1697.

Orr, D.B., D.A. Landis, D.R. Mutch, G.V. Manley, S.A. Stuby and R.L. King, 1997. Ground cover influence on microclimate and *Trichogramma* (Hymenoptera: Trichogrammatidae) augmentation in seed corn production. Envir. Entomol., 26(2): 433-438.

Parra, A., R. Madrid, D. Echevarria, S. Del Olmo, C. Morenilla-Palao, M.C. Acosta and C. Belmonte, 2010. Ocular surface wetness is regulated by TRPM8-dependent cold thermoreceptors of the cornea. Nat. Medic., 16(12): 1396.

Parra, J.R.P., R.A. Zucchi and R.S. Neto, 1997. Biological control of pests through egg parasitoids of the genera Trichogramma and/or Trichogrammatoidea. Memórias do Instituto Oswaldo Cruz, 82: 153-160.

Preetha, G., J. Stanley, S. Suresh, S. Kuttalam and R. Samiyappan, 2009. Toxicity of selected insecticides to *Trichogramma chilonis*: assessing their safety in the rice ecosystem. Phytoparasitica, 37(3): 209-215.

Reznik, D., K. Lokshin, D.C. Mitchell, D. Parshall, W. Dmowski, D. Lamago and B.C. Sales, 2009. Phonons in doped and undoped $BaFe_2As_2$ investigated by inelastic x-ray scattering. Phys. Rev., B80: 214534.

Saber, M., 2011. Acute and population level toxicity of imidacloprid and fenpyroximate on an important egg parasitoid, *Trichogramma cacoeciae* (Hymenoptera: Trichogrammatidae). Ecotoxicol., 20(6): 1476-1484.

Sarwar, M. and M. Salman, 2015. Toxicity of oils formulation as a new useful tool in crop protection for insect pests control. Int. J. Chem. Biomol. Sci., 1(4): 297-302.

Sattar, S., A. Farmanullah, M. Arif, H. Sattar and j.i. Qazi, 2011. Toxicity of some new insecticides against *Trichogramma chilonis* (Hymenoptera: Trichogrammatidae) under laboratory and extended laboratory conditions. Pak. J. Zool., 43: 1117-1125.

Schuld, M. and R. Schmuck, 2000. Effects of Thiacloprid, a new chloronicotinyl insecticide, on the egg parasitoid *Trichogramma cacaoeciae*. Ecotoxicol., 9(3): 197-205.

Singhamuni, S.A.A., K.S. Hemachandra and U.G.A.I. Sirisena, 2015. Potential for mass rearing of the egg parasitoids, *Trichogramma chilonis* and *Tricogramma achaeae* (Hymenoptera: *Trichogramma*tidae) on *Corcyra cephalonica* eggs. Trop. Agric. Res., 27(1): 1-12.

Smith, S.M., 1996. Biological control with *Trichogramma*: advances, successes, and potential of their use. Ann. Rev. Entomol., 41:375-406

Sudhanan, V.M., R. Choudhary, A. Bhukaria and S.S. Chaudhary, 2015. Woolly hair with complete atrioventricular dissociation: A rare association. Int. J. Trichol., 7(2): 82.

Suzuki, T. and G.R. Waller, 1984. Biosynthesis and biodegradation of caffeine, theobromine, and the ophylline in *Coffea arabica* L. fruits. J. Agric. Food Chem., 32(4): 845-848.

Thomson, M.S. and R.E. Stinner, 1989. *Trichogramma* spp.(Hymenoptera: Trichogrammatidae): field hosts and multiple parasitism in North Carolina. J. Entomol. Sci., 24(2): 232-240.

Uma, S., S. Jacob and K.R. Lyla, 2014. Acute contact toxicity of selected conventional and novel insecticides to *Trichogramma japonicum* Ashmead (Hymenoptera: Trichogrammatidae). J. Biopestic., 7(4): 133-136.

van Lenteren, J.C., 2000. Quality control of natural enemies: hope or illusion?. *In*: Bigler, F. (ed.), Quality control of mass reared arthropods. Proceedings of Fifth Workshop of the IOBC Global Working Group, Wageningen, Netherlands, 1 - 14p.

Wang, H., O. Bloom, M. Zhang, J.M. Vishnubhakat, M. Ombrellino, J. Che and K.R. Manogue, 1999. HMG-1 as a late mediator of endotoxin lethality in mice. Sci., 285(5425): 248-251.

Wang, H., M. Naghavi, C. Allen, R.M. Barber, Z.A. Bhutta, A. Carter and M. Coggeshall, 2016. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. The lancet, 388(10053): 1459-1544.

Wright, M.G., M.P. Hoffmann, S.A. Chenus and J. Gardner, 2001. Dispersal behavior of *Trichogramma ostriniae* (Hymenoptera: Trichogrammatidae) in sweet corn fields: implications for augmentative releases against *Ostrinia nubilalis* (Lepidoptera: Crambidae). Biol. Contr., 22(1): 29-37.