Management of Tephritid flies: A Review

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Abstract
A wide number of Agricultural and horticultural crops infested by Tephritid flies and able to caused economic damage. Cucurbits like Bitter gourd, Bottle gourd, Gherkin, Pumpkin are the major host of tephritid flies along with that it also attack on fruit crops like Cherry, Apple, Citrus, Peach, Guava etc. Rare host i.e., Kinnow Mandarin infested by tephritid flies at Punjab Region. Many management practices were discussed and their positive points to control the tephritid population and also about how new techniques were being introduced into the IPM of fruit fly control by understanding the consequences of already implementing management practices. Collecting all the reviews about the management practices can give a new innovative idea for best control of tephritid population. This paper can give a good review about the researches made on Tephritid flies till 2019.
Key words: Tephritid flies, yield loss, botanicals, biopesticides and management

Introduction

Fruit flies are also well known as Tephritid flies can causes both qualitative and quantitaive losses by depositing the eggs inside mature fruits resulting fruit dropping. The infected fruits produce foul smell which reduced fruit price in market (Allwood and Leblanc, 1997). Phytalminae, Dacinae, Ceratitidinae, Tephritine and Trypetine are the major subfamilies of Tephritid flies among them subfamily Dacinae is most important one (Kapoor 2002). In bitter gourd 42% yield loss was reported by Barba *et. al.*, (2014), about 60% yield losses were due to attack of Mango Fruit fly at Kenya region (Mugure, 2012). Stonehouse *et. al.*, (1998) reported that Annual losses of estimated $200 million was due to infestation of Tephritid flies in Pakistan.

By obsreving the intensity of infestation in horticultural commodities efforts were made to gather the information of yield losses caused by fruit fly species and management of Tephritid flies with different non chemical and chemical methods.

Losses caused by tephritid flies in different crops

Stonehouse *et. al.*, (1998) reported that Annual losses of estimated $200 million was due to infestation of Tephritid flies in Pakistan. Guava Market was majorly affected by the same flies. **Mugure (2012)** reported about 60% yield losses were due to attack of Mango Fruit fly at Kenya region. **Barba *et. al.*, (2014)** conducted their experiments on the control of tephritid flies infested in bitter gourd crop using organic based attractant i.e., Coco sugar. It was observed that yield loss was up to 42% under control practices. Yield losses were reduced to 30% using Coco sugar attractant. **Sohrab *et. al.*, (2018)** investigated about the level of infestation of melon flies in different cucurbit crops. Bitter gourd was most susceptible and Bottle gourd was least susceptible for fruit fly infestation**.**

Management of tephritid flies

Managing Fruit flies effectively and Showing minimum negative impact on the environment must be the aim to get Integrated Module of Fruit Fly Management. In this Paper, Separate effects were mentioned and that can provide an idea about practices can be used to reduce cost of production and environmentally safe practices. In general, Biological control (29%), Chemical control (20%), Behavioral control, including SIT (18%), and quarantine treatments (17%). This data refers to 41 countries infested by 43 economically important fruit fly species. **(Dias *et al.*, 2018).** Recent experiments were conducted by **Villasenor (2019)** to control the fruit flies using SIT (Sterile

Insect Technique) and He gave his protocol to sterile the flies by using Gamma radiations and mark the sterile flies with Fluorescent coloured powder and finally release them into fields through auto disseminator devices. **Deguine *et. al.*, (2015)** listed the Agro ecological techniques for the control of fruit fly such as sanitation using Augmentoria; trap plants, e.g., maize; adulticide bait; and the creation of habitats for predatory arthropods. Advanced Technique was mentioned as Sterile Insect Technique, which require technically sound people to handle and also figured out protocols for sterilizing the insect, role of irradiation on the insect survival & field dispersal etc. **(Caceres *et al.*, 2007)**. **Ingoley (2001)** reported that planting maize crop as trap crop had less damage of fruit fly on cucumber.

Effect of Botanicals on tephritid flies

Sarkar *et. al.*, (2017) studied the fruit fly infestation level at various stages of the bitter gourd crop and also studied about the efficacy of pesticidal products and some oils as botanicals with the concentrations of 0.25%, 0.50%, 0.75% and 1.00% respectively and noted down the mortality rates at different time intervals oil treatment with furadan with combination of bagging of fruits showed significantly lowest infestation (9.46%) which was ten times lower than that of untreated control (91.43%). **Khan *et. al.*, (2016)** reported the botanicals targeted the fruit flies viz, *Tagetes minuta* showed the mortality rate of 73% in male fruit flies, *C. camphora* and *Isodon rugosus* showed the mortality rate of 16.6% in female fruit flies, Repellent effect was maximum by *Boenninghausenia albiflora* extract (44.4%). Pupal inhibition was observed to be 94.6% for *T. minuta* extract and Adult emergence was also low due to *T. minuta*. **Saptoka *et. al.*, (2010)** conducted experiment on managing the melon fly at Nepal. It was reported that local botanical product known as 'Jholmal' gave the best performance for controlling melon fly in spring-summer squash with fruit size (895 g), quality and yield (62.8 t/ha).This extract was eco-friendly but the consequence would be the rate of application because it was a Laborious management practice.

Effect of Chemicals on tephritid flies

Shivangi *et. al.*, (2017) conducted her studies for preparation of bio intensive management module for fruit fly management. Modules have different treatments involved like use of NSKE, Azadirachitin and Spinosad. After evaluation of modules, best module was 3 sprays of Spinosad: 1st spray immediately after noticing the oviposition marks and next sprays subsequently with twelve days interval was found to be effective treatment**. Sohrab *et. al.*, (2018)** conducted his studies on four different cucurbit crops like Bitter gourd, Pumpkin, Bottle gourd and ridge gourd. It was observed that Cue-Lures were more effective for trapping the fruit flies in cucurbitaceous crops than Methyl eugenol. Higher yield was also observed in the cue-lure installed plots. **Abrol (2017)** reported that Lambda-cyhalothrin was superior over Spinosad and Delta methrin in Bitter Gourd and Bottle Gourd Fields. **Sharma *et. al.*, (2016)** field experiments was experimented for the management of fruit flies at organic farm of CSK Himachal Pradesh, Agriculture University, Palampur. Comparative evaluation was done among the organic treatments like nimbecideine @5ml/litre and synthetic pyrethroid cyper methrin 25 EC and lowest infestation was recorded in cypermethrin followed by nimbecideine but that was not recorded because it is chemical one that may have side effects and resurgence**. Sunil *et. al.*, (2016)** evaluated that Delta methrin 2.8EC in combination with Jaggery (0.0028 + 0.015 %) gave the best control against Melon Fly in Bitter Gourd. **Ullah *et. al.*, (2015)** reported that no Cue lure, Methyl Eugenol, Protein Hydorlysate (GF120) and PPr product baits attracted the Melon Fly (*Myopardalis Pardalina* Bigot) because of the difference in race from the normal one. *Myopardalis spp* belongs to Afghanistan Race. **Praveen *et. al.*, (2012)** conducted his experiments on managing the melon fly in gherkin ecosystem. He

introduced an area wide control programme which included field sanitation, male annihilation technique (MAT) through para-pheromone, Cue lure, and bait application technique (BAT). **Hsu *et. al.*, (2011)** conducted his experiment at Hawaii and Taiwan region about the monitoring the resistance of fruit flies for Spinosad. It was observed that level of Spinosad application was higher for obtaining maximum mortality in topical method but dose of Spinosad was comparatively low than the organophosphate insecticides. **Guaman (2009)** conducted a bioassay on different insecticides viz, Cypermethrin, Malathion, Fipronil, Methomyl, Carbonsulfan and Abamectin against fruit flies. Results displayed that no resistance was developed against treated insecticides**. Vargas *et. al.*, (2000)** conducted experiments for evaluation of the effect of attractant kairomones such as Methyl eugenol and Cue- lure for supressing the oriental flies and melon flies. Oriental flies were captured more in number after the dispensing the Methyl eugenol while the melon flies were more attractive to Cue-lures. However maximum Effective chemical control will be achieved only after the addition of appropriate bait and controlled releasers for the long -term effect. Petroleum jelly, Edible oils and Glycerine were considered as best controlled releasers for the sustainability of attraction. **(Bharathi *et al.*, 2004).**

Effect of Biopesticide on tephritid flies

In the era of Resurgence of Insecticides, People showed interest in the Biopesticides which were producing Quality Rich Fruits and that gave scope to many scientists for practicing their experiments for determining the role of biopesticides on different insect-pests of different crops**. Chaneiko *et. al.*, (2019)** reported that *Beauveria bassiana* was more effective than *Metarhizium anisophilae* for the control of *Anastrepha fraterculus*. **Nehra *et. al.*, (2019)** conducted experiments on the management of fruit fly using the biopesticides and bio efficacy of newer pesticides in Jaipur region during summer 2016. Results displayed the maximum control was achieved by using Spinosad**. Thaochan and Ngampongsai (2018)** conducted experiments for controlling melon fly under angled luffa crop by using some treatments like *Metarhizium guizhouense* PSUM02, petroleum oil, and *Azadirachta excelsa* seed kernels extract. These treatments in combination gave negative impact on oviposition and maggots of fruit flies. **Thaochan and Ngampongsai (2018)** reported the susceptibility of *Bactrocera correcta* to microorganisms infesting Guava orchads. **Hernández *et. al.*, (2017**) studied about the role of *Metarhizium anisophilae* on the mortality of Mexican fruit fly (*Anastrepha ludens*). It was observed that amount of food consumption was reduced by 17% that set for the mortality of the fruit flies. **Toledo *et. al.*, (2017)** used sterile males as vectors for controlling *Ceratitis capitata* and observed 90% population control after using the sterile males as vectors for inoculating *Beauveria bassiana*. **Hanawi *et. al.*, (2016)** reported the efficacy of *Beauveria bassiana* and *Metarhizium anisophilae* in controlling the *Dacus ciliatus. B. bassiana* had high control than *M. anisophilae*. **Ndii *et. al.*, (2015)** reported the role of *Beauveria bassiana* along with the Insect Growth Regulator (IGR) of Lufenuron Against *B. carambolae* adults. Decline in egg amount was observed till 16th day of treatment. **Qazzaz *et. al.*, (2015)** conducted his experiments on the use of entomopathogenic fungi *Beauveria* bassiana for controlling Mediterranean fruit fly under both lab and field conditions. His studies revealed that mortality of adults was high after using higher conidial concentrations**. Rashad *et. al.*, (2015)** investigated the role of different nematodes and fungi for controlling Peach fruit fly. However, His experiments were only held under the lab conditions by evaluating the mortality of fruit flies treated with nematode species: *Heterorhabditis bacteriophora*, *Steinernema carpocapsae* and *Steinernema riobrave* and fungi: *Metarhizium anisophilae* and *Beauveria bassiana*. It was observed that Nematodes killed the pupae of fruit flies

inside the soil and Fungal effect was malformation of adults from pupae and some were not emerged from the pupae, that finally led to reduction in population**. Ali (2014)** evaluated the role of different entomopathogenic fungi on the mortality of fruit fly. Efficacy of *Metarhizium anisophilae, Beauveria bassiana* and *Verticillium lecanii* were 40%, 26.6% & 46.6% respectively. **Daniel and Grunder (2012)** investigated about the management of fruit flies and use of Beauveria bassiana made his way to support organic agriculture that had a positive impact on environment. **Mar and Lumyong (2012)** evaluated the effect of *Metarhizium flavoviride* CMUCDCT01, *Paecilomyces lilacinus* CMUCDMT02 and *Beauveria bassiana* CMUCDMF03 against pupa of fruit fly. Out of them, *Metarhizium flavoviride* CMUCDCT01 gave mortality rate in controlling fruit fly population**. Daniel and Wyss (2010)** reported that Naturalis-L (*Beauveria bassiana*) under field conditions @ 250 ml per 100 l in 7-day intervals gave adult mortality of European cherry Fruit Fly. Present Naturalis is the registered chemical used against Fruit flies in Italy and Switzer land. **Ekesi *et. al.*, (2007)** made attempt to control fruit fly population by using entomopathogenic fungi like *Metarhizium anisophilae* and *Beauveria bassiana*. Their studies revealed that the fungal spores affected the fecundity and fertility of the fruit flies. Fruit fly population was declined**. Konstantopoulou and Mazomenos (2005)** conducted a bioassay of fungal isolates viz, *Mucor hiemalis, Penicillium aurantiogriseum, P. chrysogenum* and *B. bassiana* in controlling *B. oleae* and *C. capitata* adults. *C. capitata* adults have high death rate when treated with *Beauveria* isolates.

Effect of Biological agents on tephritid flies

After introducing many Practices to control the Tephritid population, Only Very few scientists contributed their work upon the biological control i.e., Parasitoids like Egg parasitoid: *Fopius arisanus* and Larval parasitoid: *Psyttalia fletcheri.* **Rathnayake *et. al.*, (2019)** reported that both sterile and fertile males of Queensland fruit fly were more susceptible to predators than female flies. **Baustita *et. al.*, (2004)** reported the parasitization of *Fopius arisanus* and *Psyttalia fletcheri* on Melon Fly and the host crops were Cucumber, Zucchini squash, Tomato and Bitter Gourd. **Wong *et. al.*, (1984)** monitored the data about the parasitization of the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), and the oriental fruit fly, *Dacus dorsalis* (Hendel) by deciduous trees grown in the Kula area of Maui, Hawaii for 4 years by parasitoids. 80% of the total parasitization was done by *Biosteres oophilus* (Fullaway), an egg-larval parasitoids. larval-pupal parasitoids such as *B. longicaudatus* Ashmead and *B. tryoni* Cameron performed parasitization of 32 % and 8 % respectively. They suggested that use of parasitoids can be effective and eco-friendly.

Conclusion

Even after the many number of researches were done on tephritid flies, there is still necessity for advancement of research in terms of identifying the diversity of tephritid flies that must provide us the key basic differences in between species and their survival potential in different regions. A basic review about the biology can give an idea about the strategy to control the fruit fly population and also provide an information about the survival rate of fruit flies at different climatic factors. Advancements must also give us a knowledge about the most effective management practice under every circumstance. Earlier it was attained by use of pesticides but now people are much interested in quality rich fruits that laid a foundation for the invention of different Advanced techniques like SIT (Sterile Insect Technique) and use of Biopesticides. These will lead to huge incline in the productivity of horticultural

commodities and can also be helpful for increase in economic income through trade and export of high-quality horticultural commodities.

References

Abrol, D. (2017). Evaluation of some insecticides, biopesticides and clay for the management of fruit fly, *Bactrocera spp*. infesting bitter gourd and bottle gourd. M.Sc. Thesis, Dr. Y S Parmar University of Horticulture and Forestry Nauni, Solan, HP.

Ali. (2004). Investigation of Entomopathogenic Fungi (*Beauveria bassiana* and *Metarhizium anisophliae*) for Control of *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae), and Development of Formulation. PhD Thesis, Indian Agricultural Research Institute, New Delhi.

Allwood, A.J. and Leblanc, L. (1997). Losses Caused by Fruit Flies (Diptera: Tephritidae) in Seven Pacific Island Countries. pp. 208-211.

Barba, R.B. and Tablizo, R.P. (2014). Organic-Based Attractant for The Control of Fruit Flies (Diptera: Tephritidae) Infesting Ampalaya (Momordica charantial.). *International Journal of Scientific & Technology Research;* **3**(3), 2277-8616.

Baustita, R.C., Harris, E.J., Vargas, R.I. and Jang, E.B. (2004). Parasitization of Melon Fly (Diptera: Tephritidae) by *Fopius arisanus* and *Psyttalia fletcheri* (Hymenoptera: Braconidae) and Effect of Fruit Substrates on Host Preference by Parasitoids. *Biological Control*; **30**: 156-164.

Bharathi, T.E., Sathiyanandam, V.K.R. and David, P.M.M (2004). Attractiveness of some food baits to the melon fruit fly, *Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae). *International Journal of Tropical Insect Science;* **24**(2): 125–134.

Caceres, C., Mcinnis, D., Shelly, T., Jang, E., Robinson, A. and Hendrichis, J. (2007). Quality Management Systems for Fruit Fly (Diptera: Tephritidae) using Sterile Insect Technique. *The Florida Entomologist*; **90**(1).

Chaneiko, S.M., De Brida, A.L., Bassa,P.G., Telles, M.H.F., Santos, L.A.D., Pereira, D.I.B., Pereira, R.M. and Garcia, F.R.M. (2019). Pathogenicity of *Beauveria bassiana* and *Metarhizium anisophliae* to *Anastrepha fraterculus* (Diptera: Tephritidae) and Effects on Adult Longevity. *Journal of Agricultural Science*; **11**(16): 132-140.

Daniel, C. and Grunder, J. (2012). Integrated Management of European Cherry Fruit Fly *Rhagoletis cerasi* (L.): Situation in Switzerland and Europe. *Insects*; 3, 956-988.

Daniel, C. and Wyss, E. (2010). Field applications of *Beauveria bassiana* to control the European cherry Fruit Fy *Rhagoletis ceras. Journal of Applied Entomology;* **134** :675–681.

Deguine, J.P., Nurbel, T.A., Aubertot, J.N., Augusseau, X., Atiama, M., Jacquot, M. and Reynaud, B. (2015). Agroecological Management of Cucurbit-infesting Fruit Fly: A Review. *Agronomy Sustainable Development*; **35**:937–965.

Dias, N.P., Zotti. M.J., Montoya. P., Carvalho, I.R. and Nava, D.E. (2018). Fruit fly management research: A systematic review of monitoring and control tactics in the world. *Crop protection*; 112: 187-200.

Ekesi, S., Dimbi, S. and Maniania, N.K. (2007). The Role of Entomopathogenic fungi in the Integrated Management of Fruit Flies (Diptera: Tephritidae) with emphasis on Species occurring in Africa. ISBN: 978-81-308-0192-6.

Guaman, V.M. (2009). Monitoring and pest control of Fruit flies in Thailand: new knowledge for integrated pest management. *Examensarbete;* **15**.

Hanawi, B.S., Hamad, M.J. and Habbeb, A.A., (2016). Efficacy of some local isolates of *Beauveria bassiana* (Bals.) and *Metarhizium anisophliae* (Met.) in controlling of cucurbit fruit fly *Dacus ciliatus. European Academic Research;* **4**(1).

Hernández, R.A.T, Toledo, J. and Sánchez, D. (2018). Effect of *Metarhizium anisopliae* (Hypocreales: Clavicipitaceae) on food consumption and mortality in the Mexican Fruit Fly, *Anastrepha ludens* (Diptera: Tephritidae). *International Journal of Tropical Insect Science*; 1-7.

Hsu, J.C., Haymer, D.S., Chou, M.Y., Feng, H.T., Chen, H.H., Huang, Y.B. and Mau, R.F.L. (2011). Monitoring Resistance to Spinosad in the Melon Fly (*Bactrocera cucurbitae*) in Hawaii and Taiwan. *The Scientific World Journal;* Article ID 750576.

Ingoley, P. (2001). Management of fruit fly, *Bactrocera cucurbitae* Coquillett on Cucumber. M.Sc. Thesis. CSKHP Krishi Vishvavidyalaya, Palampur (H.P) India.

Kapoor, V.C. (2002). Fruit fly pests and their present status in India., Proceedings of 6th International Fruit fly Symposium. pp. 23-33.

Khan, S., Shah, M.M., Ahmad, R. and Haq, A.U. (2016). The insecticidal potential of botanical extracts for management of Peach fruit fly, *Bactrocera zonata* Saunders, 1842 (Diptera: Tephritidae). *Turkish Journal of Entomology*; **40** (4): 445-453.

Konstantopoulou, M.A. and Mazomenos, B.E. (2005). Evaluation of *Beauveria bassiana* and *B. brongniartii* strains and four wild-type fungal species against adults of *Bactrocera oleae* and *Ceratitis capitata. Biocontrol*; 50: 293–305.

Mar, T.T. and Lumyong, S. (2012). Evaluation of Effective Entomopathogenic Fungi to Fruit Fly Pupa, *Bactrocera spp*. and Their Antimicrobial Activity. *Chiang Mai Journal of Sciences*; **39**(3): 464-477.

Mugure, M.C. (2012). Economic Assessment of Losses Due to Fruit Fly Infestation in Mango and The Willingness to Pay for An Integrated Pest Management Package in Embu District, Kenya. M.Sc. Thesis. University of Nairobi.

Ndii, A.M., Rahardjo, B.T. and Himawan, T. (2016). The Combination of Entomopathogenic Fungus of *Beauveria bassiana* (Balls) Vuill. with the Insect Growth Regulator (IGR) of Lufenuron Against Reproductive of *Bactrocera carambolae* Fruit Flies (Diptera: Tephritidae). *Journal of Experimental Life Sciences*; 6(1): 2087-2852.

Nehra, S., Singh, S., Samota, R.G. and Choudhary, A.L. (2019). Bio-efficacy of Newer insecticides and Biopesticides against Fruit Fly, *Bactrocera cucurbitae* (Coquillett) on Round Gourd. *Journal of Entomology and Zoology Studies*; **7**(4): 97-101.

Praveen, H.M., Nandeesh, M., Mouli, M.R.C., Rao, G.V.G. and Vijaysegaran, S. (Management of Melon Fly, *Bactrocera cucurbitae* (Coquillett) infesting Gherkin: An Area Wide Control Programme adopted in Peninsular India. *Journal of Horticultural Science*; **7**(1):68-74.

Qazzaz, F.O., Al-Masri, M.I. and Barakat, R.M. (2015). Effectiveness of *Beauveria bassiana* Native Isolates in the Biological Control of the Mediterranean Fruit Fly (*Ceratitis capitata*). *Advances in Entomology*; 3, 44-55.

Rashad, M.M., Heneidy, A.H.E., Djelouah, K., Hassan, N. and Shaira, S.A. (2015). On the Pathogenicity of Entomopathogens to the Peach Fruit Fly, *Bacterocera zonata* (Saunders) (Diptera: Tephritidae). *Egyptian Journal of Biological Pest Control*; **25**(3), 2015, 649-654.

Rathnayake, D.N., Lowe, E.C., Rempoulakis, P. and Herberstein, M.E. (2019). Effect of natural predators on Queensland fruit fly, Bactrocera tryoni (Froggatt) (Diptera: Tephritidae) control by Sterile Insect Technique (SIT). doi: 10.1002/ps.5477.

Saptoka, R., Dahal, K.C. and Thapa, R.B. (2010). Damage assessment and management of cucurbit fruit flies in spring-summer squash. *Journal of Entomology and Nematology*; **2**(1): 7-12.

Sarkar, R., Das, S., Kamal, M.M., Islam, K.S. and Jahan, M. (2017). Efficacy of Management Approaches against Cucurbit Fruit Fly (*Bactrocera cucurbitae* Coquillett) of Bitter Gourd. *Bangladesh Journal of Agricultural Research*; **42**(4): 757-766.

Sharma, S.K., Punam, and Kumar, R. (2016). Management of Fruit Fly (*Bactrocera spp*.) in Cucumber (*Cucumis sativus Linn*.) grown organically. *Journal of Biopesticides;* **9**(1): 73-79.

Shivangi, Lekha and Swami, H. (2017). Bio-intensive Management of Fruit Fly, *Bactrocera cucurbitae* (Coquillett.) in Cucumber. *Journal of Entomology and Zoology Studies;* **5**(3): 1823-1826.

Sohrab, Hasan, W. and Prasad, C.S. (2018). Investigation on Level of Infestation and Management of Cucurbit Fruit Fly, *Bactrocera cucurbitae* (Coquillett) in Different Cucurbit Crops. *International Journal of Pure Applied Bioscience*; **6** (5): 1276-1288.

Sohrab, Prasad, C.V. and Hasan, W. (2018). Study on the biology and life cycle of cucurbit fruit fly, *Bactrocera cucurbitae* (Coquillett). *Journal of Pharmacognosy and Phytochemistry;* SPI: 223-226.

Stonehouse, J.M., Mumford, J.D. and Mustafa, G. (1998). Economic losses to Tephritid Fruit Flies (Diptera: Tephritidae) in Pakistan. *Crop Protection*; **17**(2):159-164.

Sunil, Thippaiah, M., Jagadish, K.S. and Chakravarthy, A.K. (2016). Efficacy of insecticides against Melon Fruit Fly *Bactrocera cucurbitae* (Coquillett) in Bitter Gourd. *Entomon*; **41**(3): 233-238.

Thaochan, N. and Ngampongsai, A. (2018). The effects of *Metarhizium guizhouense* PSUM02, petroleum oil, and Azadirachta excelsa seed kernels extract against *Zeugodacus cucurbitae*. *Songklanakarin Journal of Science and Technology;* **40** (6), 1336-1345.

Toledo, J., Flores, S., Campos, S., Villasenor, A., Enkerlin, W., Liedo, P., Valle, A. and Montoya, P. (2017). Pathogenicity of three formulations of *Beauveria bassiana* and Efficacy of Auto Inoculation Devices and sterile Fruit Fly males for dissemination of Conidia for the Control of *Ceratitis capitata*. *Entomologia Experimentalis et Applicata;* 1-10.

Ullah, F., Andar, A.U., Badshah, H. and Younus, M. (2015). Management of Melon fruit fly (*Myopardalis Pardalina* Bigot) In Badghis, Afghanistan. *Journal of Entomology and Zoology Studies*; **3**(4): 24-27.

Vargas, R.I., Stark, J.D., Kido, M.H., Ketter, H.M. and Whitehand, L.C. (2000). Methyl Eugenol and Cue-Lure Traps for Suppression of Male Oriental Fruit Flies and Melon Flies (Diptera: Tephritidae) in Hawaii: Effects of Lure Mixtures and Weathering. *Journal of Economic Entomology*; **93**(1):81-87.

Villaseñor, A., Flores, S., Campos, S.E., Toledo, J., Montoya, P., Liedo, P. and Enkerlin, W. (2019). Use of Entomopathogenic Fungi for Fruit Fly Control in Areawide SIT Programmes. Food and Agriculture Organization of the United Nations/International Atomic Energy Agency. Vienna, Austria. 43 pp.

Wong, T.T.Y., Mochizuki, N., and Nishimoto, A.I. (1984). Seasonal Abundance of Parasitoids of the Mediterranean and Oriental Fruit Flies (Diptera: Tephritidae) in the Kula Area of Maui, Hawaii. *Environmental Entomology*; **13**: 140-145.