Available online at www.agrifarming.org

DOI: http://dx.doi.org/10.18782/2582-7146.231

ISSN: 2582 – 7146

Current Research in Agriculture and Farming

Curr. Rese. Agri. Far. (2023) *4*(5), 48-54

Review Article

Peer-Reviewed, Refereed, Open Access Journal

Overview of Life Cycle, Losses and Integrated Management Strategy of Melon Fruit Fly on Bitter Gourd - A Review

Vikas Kumar*, Gurpreet Singh, Kanwar Kumar, Anurag Malik, Vishwas Deep, Harshit Bansal, Raveena

Bhai Gurdas Degree College, Sangrur, Punjab-India

*Corresponding Author E-mail: vkb453@gmai.com

Received: 15.06.2023 | Revised: 29.07.2023 | Accepted: 13.08.2023

ABSTRACT

Bitter gourd (Momordica charantia) is the emerging commercial vegetable crop and is very well known for its medicinal properties. The melon fruit fly, Bactrocera cucurbitae Coquillett (Diptera: Tephritidae) is prominent insect pest in bitter gourd. The fly females oviposit their egg inside the fruit, after emerging of maggots instantly begins to excavate and feed the fruit. Due to the voracious feeding of maggots, fruit starts to decay and emits bad odour. Oviposition puncture of female flies also damage the fruit quality in market. The yield losses tend to vary between 30 to 100%, depending on the cucurbit species and the season (Rabindranath and Pillai 1986). Melon fruit fly can be managed or suppressed in the farmer fields, by local area and wide area management programmes (Dhillon et al., 2005). Local area management programme, which aims at suppressing, rather than eradicating the melon fruit flies, involves the integration of various management tactics, including, bagging fruits, application of field sanitation measures, installation of protein baits and cue lure traps, growing fruit fly resistant genotypes, augmentation of bio-control agents and cover spray of soft insecticides (Chinajariyawong et al., 2003; 2004; & Dhillon et al., 2005).

Keywords: *Bitter gourd, bio-control agents and cover spray, fruit fly.*

INTRODUCTION

Cucurbits, belongs to family Cucurbitaceae, which mostly possess trailing habit, are the vegetable crops which are primarily consumed as food worldwide. They constitute the largest group of the summer vegetables. Cucurbits are rich in iron, vitamins, proteins and minerals. They are known for numerous medicinal properties as bitter gourd juice being used to cure diabetes; bottle gourd fruit juice has high blood pressure and heart valve blockage ameliorating properties. Cucurbit seeds are valued for their high oil and protein contents comparable to that of legumes and are richer in methionine, a crystalline amino acid containing sulphur and essential for nutrition. Fruit fly (*Bactrocera cucurbitae*) is the most destructive pests of cucurbits causing direct yield loss. In India, because of the polyphagous nature of their larvae, fruit flies are considered as one of the ten most serious insect pests of the entire agriculture.

Cite this article: Kumar, V., Singh, G., Kumar, K., Malik, A., Deep, V., Bansal, H., & Raveena (2023). Overview of Life Cycle, Losses and Integrated Management Strategy of Melon Fruit Fly on Bitter Gourd - A Review, *Curr. Rese. Agri. Far. 4*(5), 48-54. doi: http://dx.doi.org/10.18782/2582-7146.231

Out Of 207 species of fruit flies found in India, nine are identified to be the major and economically important.The melon fruit fly has more than 80 hosts plants and their economic importance cannot be evaluated entirely from standpoint of the direct damage to the various crops attached. Its abundance increases when the temperature falls below 32 °C and the relative humidity ranges from 60% to 70% (Dhillon et al., 2005 & Sapkota et al., 2010).

Life cycle of fruit fly:

The melon fruit fly remains active throughout the year on one or the other host. During the severe winter months, they hide and huddle together under dried leaves of bushes and trees. During harsh winters, they hide and huddle under the dry leaves of bushes and trees. During the hot and dry seasons, the flies take refuge in moist, shady places and feed on the honeydew of aphids that live on fruit trees. The lower and upper developmental thresholds for eggs were 11.4 and 36.4° C (Messenger & Flitters, 1958). This species actively breeds when the temperature falls below 32.2° C and the relative humidity ranges between 60 to 70%. Fukai (1938) reported that adults survived for one year at room temperature when fed fruit juice. In general, its life cycle lasts from 21 to 179 days (Fukai, 1938; Narayanan and Batra, 1960). Development from egg to adult stage takes 13 days at 29° C in Solomon Islands (Hollingsworth et al., 1997).

High temperatures, long hours of sunshine, and plantation activity affect the abundance of B. cucurbitae in northeastern Taiwan (Lee et al., 1992). Bhatia and Mahto (1969) reported that the life cycle is completed in 36.3, 23.6, 11.2 and 12.5 days at 15, 20, 27.5 and 30 °C, respectively. Eight to ten generations occur per year (White and Elson-Harris, 1994; Weems and Heppner, 2001).Egg incubation time for Pumpkin, bitter gourd, and squash gourd has recorded 4.0–4.2 days at 27 ± 1 °C (Doharey, 1983);, 1.1 to 1.8 days on bitter gourd, cucumber and sponge gourd (Gupta and Verma, 1995), and 1.0 to 5.1 days on bitter gourd (Koul & Bhagat, 1994; & Hollingsworth et al., 1997). The larval period lasts for 3 to 21 days (Renjhan, 1949; Narayanan & Batra, 1960; & Hollingsworth et al., 1997), depending on temperature and the host Larval duration varies from 3 to 6 days in different cucurbit species (Chawla, 1966; Chelliah, 1970; Doharey, 1983; Koul & Bhagat, 1994; & Gupta & Verma, 1995). Egg viability and larval and pupal viability in cucumber were reported to be 91.7, 86.3 and 81.4%, respectively. In pumpkin, these were 85.4, 80.9, and 73.0%, respectively, at 27 ± 1°C (Samalo et al., 1991). Adult larvae emerge from the fruit by burrowing one or two exit holes in the ground for pupation. The larvae pupate in the soil at a depth of 0.5-15 cm. The depth to which larvae migrate to pupate and survive in the soil depends on soil conditions and moisture (Jackson et al., 1998; & Pandey & Misra, 1999). Doharey (1983) observed a pupal period of 7 days in bitter gourd and 7.2 days in pumpkin and squash gourd at 27 ± 1 °C. The pupation period generally lasts 6 to 9 days in the rainy season and 15 days during winter (Narayanan & Batra, 1960). Depending on the temperature and the host, pupation time can vary from 7 to 13 days (Hollingsworth et al., 1997). On different hosts, the pupation period ranges from 7.7 to 9.4 days for bitter gourd, cucumber and sponge gourd (Gupta & Verma, 1995) and 6.5 to 21.8 days for bottle gourd (Koul & Bhagat, 1994; & Khan et al., 1993).

Loss caused by fruit flies in different cucurbit crops:

Global and India yield loss typically ranges between 30 to 100% depending on cucurbit species and season. Fruit attack by melon fruit fly in bitter gourd ranges from 41 to 89% (Lall; Kushwaha et al., 1973; Gupta & Verma 1978;). Dhillion et al. (2005) reported 33% damage on bitter gourd and 29% on watermelon in India. Hollingsworth et al. (1997) reported that the melon fruit fly attacked 95 percent of bitter gourd fruits in Papua New Guinea.

Strategies for integrated management of melon fruit fly:

The fruits of cucurbits, of which the melon fly is a serious pest, are collected at short intervals for marketing and self-consumption. Therefore, it is difficult to rely on insecticides as a means of controlling this pest. In situations where chemical control of melon fruit fly is necessary, soft insecticides with low residual toxicity and short withdrawal periods must be relied upon. Thus, considering the importance of the pest and the crop, management of melon fruit fly could be done using local management or large area management.

Local area management

Local area management means the minimum extent of pest control in a limited area such as field level/crop level/village level which has no natural protection against reinvasion. The goal of local management is to suppress the pest rather than eradicate it. Under this management option, a number of methods such as fruit bagging, field sanitation, protein baits and baited traps, host plant resistance, biological control and soft insecticides can be used to maintain pest populations below economic thresholds in a particular crop for a period of time to it prevented crop losses without endangering health and the environment, which is the immediate concern of farmers.

Bagging of fruit

Bagging fruit on the tree (3 to 4 cm long) with 2 layers of paper bags at 2 to 3 day intervals minimizes fruit fly infestation and increases net yields by 40 to 58% (Fang, 1989a, b; & Jaiswal et al., 1997). Akhtaruzzaman et al. (2000) suggested that cucumber fruits should be bagged 3 days after anthesis and the bags should be kept for 5 days for effective control. This is an environmentally safe way of controlling this pest.

Field sanitation

The most effective method in melon fruit fly management is the primary component – field sanitation. To break the reproductive cycle and increase the population, growers must remove any unharvested fruit or vegetable from the field by completely burying it deep into the soil. Burying damaged fruit 0.46 m deep into the soil prevents adult fly eclosion and reduces population growth (Klungness et al., 2005).

Monitoring and control with parapheromone lures/cue-lure traps

The principle of this particular technique is to deny the resources needed for laying female flies, such as protein food (protein bait control) or parapheromone baits, which eliminate males. There is a positive correlation between baited trap catches and weather conditions such as minimum temperature, precipitation and minimum humidity. The sex attractant cue-lure traps are more effective than the food attractant tephritlure traps for monitoring the B. cucurbitae in bitter gourd. Methyleugenol and baited traps have been reported to attract male B. cucurbitae from mid-July to mid-November (Ramsamy et al., 1987; Zaman, 1995; & Liu & Lin, 1993). Ocimum sanctum leaf extract containing eugenol (53.4%), beta-caryophyllene (31.7%) and beta-elemene (6.2%) as major volatiles when placed on cotton pads (0.3 mg) attract flies from a distance of 0.8 km (Roomi et al., 1993). So, melon whitefly can also be controlled by using O. sanctum as a border crop sprayed with a protein bait (protein obtained from corn, wheat or other sources) containing spinosad as a toxicant. A range of commercially produced attractants (Flycide® with 85% cue-lure content; Eugelure® 20%; Eugelure® 8%; Cue-lure® 85% + naled; Cue-lure® 85% + diazinon; Cue-lure® 95% + naled) are commercially available and have been found to be effective in controlling this pest (Iwaizumi et al., 1991). Chowdhury et al. (1993) caught 2.36 to 4.57 flies/trap/day in poison baits containing trichlorfon in bitter gourd. The use of male bait cearlure B1® (Ethylcis-5-Iodo-trans-2-methylcyclohexane-1carboxylate) was found to be 4-9 times more effective than trimedlure® for attracting male medfly, Ceratitis capitata (Mau et al., 2003b), and thus could be tried for male annihilation strategies of area-wide melon fruit fly control programs. A new protein bait, GF-120 Fruit Fly Bait® containing spinosad as a toxicant,

has been found to be effective in area management of the melon fruit fly in Hawaii (Prokopy et al., 2003, 2004). GF-120 Fruit Fly Bait® would be highly effective when applied to sorghum plants surrounding cucumbers against protein-hungry melon flies, but would be less effective in preventing protein-fed females from landing on cucumbers. Corn can also be used as a marginal crop to attract melon fruit flies by applying protein bait. Although protein baits, parapheromone baits, lures, and baited traps have been successful in monitoring and controlling the melon fruit fly, immigration of protein- satiated females is a risk. In principle, the risk of immigration of already satiated female could be managed by increasing the distance these satiated immigrants have to travel (Stonehouse et al., 2004).

Chemical Control

Chemical control of the melon fruit fly is relatively ineffective. However, insecticides such as malathion, dichlorvos, phosphamidon and endosulfan are moderately effective against melon fly (Agarwal et al., 1987). Bhatnagar and Yadava (1992) reported malathion (0.5%) to be more effective than carbaryl (0.2%) and quinalphos (0.2%) on bottle gourd, sponge gourd and ridge gourd. Application of molasses + malathion (Limthion 50 EC) and water at a ratio of 1:0.1:100 provides good control of melon fly (Akhtaruzzaman et al., 2000). Application of either 0.05% fenthion or 0.1% carbaryl at 50% male flower emergence and again 3 days after fertilization helps reduce damage to melons (Srinivasan, 1991). Gupta and Verma (1982) reported that fenitrothion (0.025%) combined with protein hydrolyzate (0.25%) reduced fruit fly damage to 8.7% compared to 43.3% damage in the untreated control. Application of carbofuran granules at 1.5 kg a.i./ha at seeding, vine and flowering time provided 83.35% protection of bitter gourd against B. cucurbitae (Thomas & Jacob, 1990). Formathion is more effective than trichlorfon (Talpur et al., 1994). Diflubenzuron has also been reported to be effective in controlling melon fly (Mishra & Singh, 1999). The highest yield and lowest damage were observed in pumpkin when treated with carbofuran at 1.5 kg a.i./ha 15 days after germination (Borah, 1998). Acorus calamus extract (0.15%) reduced the lifespan of adults from 119.2 days to 26.6 days when fed continuously with sugar mixed with the extract (at a concentration of 1 ml/g sugar) (Nair & Thomas, 1999). Neem oil (1.2%) and neem cake (4.0%) were also reported to be as effective as dichlorvos (0.2%) (Ranganath et al., 1997).

Acknowledgement:
I would like to sincerely thank my co-authors for their support and kind gesture to complete this manuscript in time.

Funding: NIL.

Conflict of Interest:
There is no such evidence of conflict of interest.

Author Contribution
All authors have participated in critically revising of the entire manuscript and approval of the final manuscript.

REFERENCES

Agarwal, M. L., Sharma, D. D., & Rahman, O. (1987). Melon fruit fly and its control. *Indian Horticulture 32*, 10-11.

Akhtaruzzaman, M., Alam, M. Z., & Ali-Sardar, M. M. (2000). Efficiency of different bait sprays for suppressing fruit fly on cucumber. Bulletin of the Institute of Tropical Agriculture, *Kyushu University 23*, 15-26.

Bhatia, S. K., & Mahto, Y. (1969). Influence of temperature on the speed of development of melon fly, Dacus cucurbitae Coquillett (Diptera: Tephritidae). *Indian Journal of Agricultural Sciences 40*, 821-828.

Bhatnagar, K. N., & Yadava, S. R. S. (1992). An insecticidal trial for reducing the damage of some cucurbitaceous fruits due to Dacus cucubitae Coq. *Indian Journal of Entomology 54*, 66-69.

Borah, R. K. (1998). Evaluation of an insecticide schedule for the control of red pumpkin beetle and melon fruit fly

on red pumpkin in the hills zone of Assam. *Indian Journal of Entomology 60*, 417-419.

Chawla, S. S. (1966). Some critical observations on the biology of melon fly, Dacus cucurbitae Coquillett (Diptera: Tephritidae). *Research Bulletin of Punjab University* (Science) *17*, 105-109.

Chelliah, S. (1970). Host influence on the development of melon fly, Dacus cucurbitae Coquillett. *Indian Journal of Entomology 32*, 381-383.

Chinajariyawong, A., Kritsaneepaiboon, S., & Drew, R. A. I. (2003). Efficacy of protein bait sprays in controlling fruit flies (Diptera: Tephritidae) infesting angled luffa and bitter-gourd in Thailand. *Raff. Bull. Zool*., *51*, 7–15.

Chowdhury, M. K., Malapert, J. C., & Hosanna, M. N. (1993). Efficiency of poison bait trap in controlling fruit fly, Dacus cucurbitae in bitter gourd. *Bangladesh Journal of Entomology 3*, 91-92.

Dhillon, M. K., Naresh, J. S., Singh, R., & Sharma, N. K. (2005a). Evaluation of bitter gourd (Momordica charantia L.) genotypes to melon fruit fly, Bactrocera cucurbitae (Coquillett). *Indian Journal of Plant Protection 33*, 55-59.

Doharey, K. L. (1983). Bionomics of fruit flies (Dacus spp.) on some fruits. *Indian Journal of Entomology 45*, 406-413.

Fang, M. N. (1989a). Studies on using different bagging materials for controlling melon fly on bitter gourd and sponge gourd. *Bulletin of Taichung District Agriculture Improvement Station 25*, 3-12.

Fukai, K. (1938). Studies on the possibility of life of the Formosa melon fly in Japan. *Nojikairyo-shiryo 134*, 147-213.

Gupta, D., & Verma, A. K. (1995). Host specific demographic studies of the melon fruit fly, Dacus cucurbitae Coquillett (Diptera: Tephritidae). *Journal of Insect Science 8*, 87-89.

Gupta, J. N., & Verma, A. N. (1978). Screening of different cucurbit crops for the attack of the melon fruit fly, Dacus cucurbitae Coq. (Diptera: Tephritidae). *Haryana Journal of Horticulture Science 7*, 78-82.

Gupta, J. N., & Verma, A. N. (1982). Effectiveness of fenitrothion bait sprays against melon fruit fly, Dacus cucurbitae Coquillett in bitter gourd. *Indian Journal of Agricultural Research 16*, 41-46.

Hollingsworth, R., Vagalo, M., & Tsatsia, F. (1997). Biology of melon fly, with special reference to the Solomon Islands. In: Allwood AJ and Drew RAI editors. Management of fruit flies in the Pacific. *Proceedings of Australian Country Industrial Agricultural Research 76*, 140-144.

Iwaizumi, R., Sawaki, M., Kobayashi, K., Maeda, C., Toyokawa, Z., Ito, M., Kawakami, T., & Matsui, M. (1991). A comparative experiment on the attractiveness of the several kinds of the cue-lure toxicants to the melon fly, Dacus cucurbitae (Coquillett). *Research Bulletin Plant Protection Service Japan 27*, 75-78.

Jackson, C. G., Long, J. P., & Klungness, L. M. (1998). Depth of pupation in four species of fruit flies (Diptera: Tephritidae) in sand with and without moisture. *Journal of Economic Entomology 91*, 138-142.

Jaiswal, J. P., Gurung, T. B., & Pandey, R. R. (1997). Findings of melon fruit fly control survey and its integrated management 1996/97.

Kashi, Nepal. *Lumle Agriculture Research Centre Working Paper* 97/53, pp 1-12.

Khan, L., Haq, M. U., Mohsin, A. U., & Inayat-Tullah, C. (1993). Biology and behavior of cucurbit fruit fly, Dacus cucurbitae Coq. (Diptera: Tephritidae). *Pakistan J. Zool. 25*, 203-208.

Klungness, L. M., Jang, E. B., Mau, R. F. L., Vargas, R. I., Sugano, J. S., & Fujitani, E. (2005). New approaches to sanitation in a cropping system susceptible to tephritid fruit flies (Diptera: Tephritidae) in Hawaii. *Journal of Applied Science and Environmental Management 9*, 5-15.

Koul V K and Bhagat K C. 1994. Biology of cucurbit fruit fly, Bactrocera (Dacus) Cucurbitae Coquillett (Diptera: Tephritidae) on bottle gourd. *Pest Manag. Econ. Zool*. *2*, 123-125.

Kushwaha, K. S., Pareek, B. L., & Noor, A. (1973). Fruit fly damage in cucurbits at Udaipur. *Udaipur University Research Journal 11*, 22-23.

Lall, B. S., & Singh, B. N. (1969). Studies on the biology and control of melon fly, Dacus cucurbitae (Coq.) (Diptera: Tephritidae). Labdev *Journal of Science and Technology 7B*, 148-153.

Lee, L. W. Y., Hwang, Y. B., Cheng, C. C., & Chang, J. C. (1992). Population fluctuation of the melon fly, Dacus cucurbitae, in northeastern Taiwan. *Chinese Journal of Entomology 12*, 285-292.

Liu, Y. C. & Lin, J. S. (1993). The response of melon fly, Dacus cucurbitae Coquillett to the attraction of 10% MC. *Plant Protection Bulletin Taipei 35*, 79-88.

Mau, R. F. L., Sugano, J. S., & Jang, E. B. (2003b). Farmer education and organization in the hawaii areawide fruit fly pest management program. Recent Trends on Sterile Insect Technique and Area-wide Integrated Pest Management: Economic Feasibility, Control Projects, Farmer Organization and Dorsalis Complex Control Study, pp. 47-57. *Research Institute of Subtropics*, Okinawa, Japan.

Messenger, P. S., & Flitters, N. E. (1958). Effect of constant temperature environments on the egg stage of three species of Hawaiian fruit flies. *Annals of the Entomological Society of America 51*, 109-119.

Mishra, P. N., & Singh, M. P. (1999). Studies on the ovicidal action of diflubenzuron on the eggs of Dacus (Bactrocera) cucurbitae Coq. damaging cucumber. *Annals of Plant Protection Science 7*, 94-6.

Nair, S., & Thomas, J. (1999). Effect of Acorus calamus L. extracts on the longevity of Bactrocera cucurbitae Coq. *Insect Environment 5*, 27.

Narayanan, E. S., & Batra, H. N. (1960). Fruit Flies and Their Control. *Indian Council of Agricultural Research*, New Delhi, India, 1-68 pp.

Prokopy, R. J., Miller, N. W., Pinero, J. C., Barry, J. D., Tran, L. C., Oride, L. K., & Vargas, R. I. (2003). Effectiveness of GF-120 Fruit Fly Bait spray applied to border area plants for control of melon flies (Diptera: Tephritidae). *Journal of Economic Entomology 96*, 1485-1493.

Prokopy, R. J., Miller, N. W., Pinero, J. C., Oride, L., Perez, N., Revis, H. C., & Vargas, R. I. (2004). Hoe effective is GF-120 fruit fly bait spray applied to border area sorghum plants for control of melon flies (Diptera: Tephritidae). *Florida Entomologist 87*, 354-360.

Rabindranath, K., & Pillai, K. S. (1986). Control of fruit fly of bitter gourd using synthetic pyrethroids. *Entomon 11*, 269-272.

Ramsamy, M. P., Rawanansham, T., & Joomaye, A. (1987). Studies on the control of Dacus cucurbitae Coquillett and Dacus d'emmerezi Bezzi (Diptera: Tephritidae) by male annihilation. *Revue Agricole et Sucriere de ltle Mauriee 66*, 1-3.

Ranganath, H. R., Suryanarayana, M. A., & Veenakumari, K. (1997). Management of melon fly (Bactrocera (Zeugodacus) cucurbitae in cucurbits in South Andaman. *Insect Environment 3*, 32-33.

Renjhan, P. L. (1949). On the morphology of the immature stages of Dacus (Strumeta) cucurbitae Coq. (the melon fruit fly) with notes on its biology. *Indian J. Entomol*. *11*, 83–100.

Samalo, A. P., Beshra, R. C., & Satpathy, C. R. (1991). Studies on comparative biology of the melon fruit fly, Dacus cucurbitae Coq. *Orissa Journal of Agricultural Research 4*, 1-2.

Sapkota, R., Dahal, K. C., & Thapa, R. B. (2010). Damage assessment and management of cucurbit fruit files in springsummer squash. *J. Entomol. Nematol. 2*(1), 7-12.

Srinivasan, K. (1991). Pest management in cucurbits – An overview of work done under AICVIP. In: Group Discussion of Entomologists Working in the Coordinated Projects of Horticultural Crops, 28-29 January 1991, pp. 44-52. Central Institute of Horticulture for Northern Plains, Lucknow, Uttar Pradesh, India.

Stonehouse, J. M., Mumford, J. D., & Verghese, A. (2004). Returns to scale in pest suppression and eradication: Issues for the wide-area management of fruit flies in India. In: Subramanyam, B., Ramamurthy, V. V., & Singh, V. S. editors. Proceedings of the National Symposium on Frontier Areas of Entomological Research, November 5-7 2003, pp. 151-158. *Indian Agricultural Research Institute*, New Delhi, India.

Talpur, M. A., Rustamani, M. A., Hussain, T., Khan, M. M., & Katpar, P. B. (1994). Relative toxicity of different concentrations of Dipterex and Anthio against melon fly, Dacus cucurbitae Coq. on bitter gourd. *Pakistan Journal of Zoology 26*, 11-12.

Thomas, C., & Jacob, S. (1990). Bioefficacy and residue dynamics of carbofuran against the melon fruit fly, Dacus cucurbitae Coq. infesting bitter gourd, Momordica charantia L. in Kerala. *Journal of Entomological Research 14*, 30-34.

Zaman, M. (1995). Assessment of the male population of the fruit flies through kairomone baited traps and the association of the abundance levels with the environmental factors. *Sarhad Journal of Agriculture 11*, 657-670.