



Tephritid workers of Asia, Australia and Oceania

# NEWSLETTER

Issue 10

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## TO OUR READERS

Welcome to the 10<sup>th</sup> issue of TAAO Newsletter! We hope you enjoy this way to keep you informed of the exciting news of our newsletter.

Firstly, this issue contains welcome note to new Chair of TAAO, Dr Zhihong Li, an eminent scientist at China Agricultural University, Beijing (Pg. 2) and message from immediate past chair of TAAO steering committee (Pg. 3). Then you may enjoy reading about the visit of Dr Sandeep Singh to Ohio State University (OSU), Columbus, USA for participation in *American Hort Cultivate Program* held in July 2025 (Pg. 4). There is article on how heat stress and cold stress effect *Bactrocera dorsalis* survival, how it survives, and what are the molecular mechanisms behind this (Pg. 5-6). Then, there is an article on managing fruit flies in north central Sri Lanka (Pg. 7-8). A semi-synthetic diet for mass rearing five species of genus *Bactrocera* (Insecta: Diptera: Tephritidae) of agricultural and quarantine significance has been discussed (Pg. 9-12). Innovative strategies for melon fly Management in Sri Lanka is on Pg. 13-14. Field studies and farmer perceptions on managing Chinese Citrus fly (*Bactrocera minax*) in Nepal is discussed on Pg. 15-16. Training on Molecular Identification of Economically Important Fruit Flies was conducted in Beijing, China (Pg. 17-20). Finally there is information on upcoming events (Pg. 21). A heartfelt thanks to Dr Alvin Hee for his dedicated service and leadership as the former chair of TAAO. Your contributions have been invaluable and deeply appreciated. The current editorial committee is extremely thankful to Md. Hasanuzzaman and team for doing wonderful work in publishing past 9 issues of TAAO Newsletter. With very best wishes to all of you.

**Sandeep Singh**

TAAO SC Member, EC Chair and Social Media Admin

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## Welcome to Dr Zhihong Li: New Chair of TAAO

Dr. Zhihong Li is the leading professor at Department of Plant Biosecurity, College of Plant Protection, China Agricultural University (CAU). She received B.S (in 1991), M.S (in 1994) and Ph.D. (in 1997) in Agricultural Entomology and Insect Pest Management from CAU. From Jun. 1997, she has worked at CAU for plant quarantine science and invasion biology. From 2022, she has been the director of Key Laboratory of Surveillance and Management for Plant Quarantine Pests, Ministry of Agriculture and Rural Affairs (MARA). From 2024, Dr. Zhihong Li has been the Chair of Steering Committee in Tephritid Workers of Asia, Australia and Oceania (TAAO) and the member of International Fruit Flies Steering Committee (IFFSC). In the meantime, she is the executive director for Chinese Society of Exit and Entry Biosafety, and the member of National Technological Committee of Standards, the Expert Steering Group of Plant Protection in MARA.

Dr. Zhihong Li has worked on the education, research and society service of invasion mechanism and key phytosanitary technology more than 28 years, including stress adaptation mechanism, risk analysis, species diagnosis and monitoring tracing, and phytosanitary treatment of main fruit flies and stored insect pests. As the first author or corresponding author, she has published 190 research papers in Annual Review of Entomology, Journal of Advanced Research, BMC Biology etc. As one of main members, Dr. Zhihong Li received the National Science and Technology Progress Award in 2013. As the leading member, she received



the main extension technology for crop pests quantitative risk assessment of MARA in 2023.

As the chief scientist, Dr. Zhihong Li accomplished the FAO-IPPC Global Project under the framework of the FAO-China South-South Cooperation (SSC) Programme (GCP/INT/291/CPR) in the Pilot Country of Sri Lanka (2019-2023). As the Chair, she organized the second International Symposium "Management of Tephritid Fruit Flies in Current Globalization Era" (TAAO 2024) in Beijing, China. During 7-11 July 2025, as the director, she had accomplished the FAO/IAEA Regional Training Course on Molecular Identification of Economically Important Fruit Flies in Beijing, China. A warm welcome to Dr Zhihong Li as the new chair of TAAO. We look forward to your guidance and vision as we embark on this next chapter together.

**Message from Immediate Past Chair of TAAO Steering Committee- Alvin KW Hee, Universiti Putra Malaysia**

Greetings to all TAAOers!

When Dr Sandeep Singh, the Chief Editor of TAAO Newsletter recently invited me to share a message with you all, I realised that TAAO has grown a lot. Thus, it is indeed a great honour for me to have served TAAO as the Chair of the Steering Committee (SC) since 2016. Looking back with fond memories, TAAO was reinvigorated during the sidelines of the 9<sup>th</sup> International Symposium of Fruit Flies of Economic Importance (ISFFEI) in Bangkok, Thailand that took place on one fine evening on May 13<sup>th</sup>, 2014. A decision was made then for Malaysia to host the inaugural TAAO Symposium with myself as the organizing chair, and formation of a new TAAO SC. Fuelled by enthusiasm and dedication to TAAO, within 6 months, the new committee was already formed with Dr. Mark Schutze of Australia who was instrumental in reviving TAAO networking, elected as the Chair of the SC. The TAAO Newsletter Editorial Committee was also formed. Close networking and teamwork amongst the SC members under the inspiring leadership of Dr. Mark Schutze contributed to the successful 1<sup>st</sup> TAAO Symposium that took place in Putrajaya, Malaysia from August 15-18<sup>th</sup> in 2016. As Organising Chair, it was a proud moment for me to witness the participation of 90 participants from 23 countries. A new SC was formed then and Mark passed me the baton of SC Chair. The dream to have our 2<sup>nd</sup> TAAO Symposium 2020 in China was derailed by the onslaught of Covid-19 pandemic. Not having lost any touch with one another, we prepared for the 2<sup>nd</sup> TAAO Symposium that took place successfully in Beijing last May 2024 under the excellent organization of Prof. Zhihong Li. We

now even have our own TAAO catchy theme song simply titled “T-A-A-O”. In TAAO, the spirit of camaraderie is very much celebrated, and I often receive requests for joining TAAO. Serving TAAO has given me immense satisfaction having done my best in fos-



tering better networking amongst tephritid workers. I am also proud of the fact that the reinvigoration of TAAO has now resulted in the formation of successive SC that is now in the third term under the able leadership of Prof. Zhihong Li as the new TAAO SC Chair. This SC will oversee the hosting of our 3<sup>rd</sup> TAAO Symposium that will take place in Hanoi, Vietnam in 2028 with Dr. Nguyen Thi Thanh Hien as the Organizing Chair. Last but not least, the future is very bright for TAAO due to the solid groundwork that was laid especially by my fellow past and present SC colleagues (Mark Schutze, Suksom Chinvinijkul, Phil Taylor, Kenji Tsurata, Bonifacio Cayabyab, Zhihong Li, Suk Ling Wee, Tati Suryati Syamsudin, Sujinda Thanaphum, Sandeep Singh, M. Hasanuzzaman, Sunyanee Srikachar, Melissa Starkie, Nguyen Thi Thanh Hien, Peter Leach and Anastasia Kawi) plus unceasing support from Dr Rui Cardoso Pereira (Insect and Pest Control Section, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture), Dr Jorge Hendrich, Profs Anthony Clarke and Keng-Hong Tan. I wish TAAO the very best and certainly my contribution will not end here.

## Dr Sandeep Singh visited Ohio State University, USA as a Visiting Professor

Dr. Sandeep Singh, Principal Entomologist (Fruits) at the Department of Fruit Science, Punjab Agricultural University (PAU), Ludhiana, brought laurels to the institution and the country by representing India as the only Indian scientist invited to Ohio State University (OSU), Columbus, USA. Dr. Singh was invited as a Visiting Professor and also participated in the prestigious *American Hort Cultivate Program* held in July 2025, which saw the participation of 50 delegates from 24 countries. The visit was facilitated and sponsored by Ohio State University under the leadership of Dr. Luis Canas, Director, Food, Agriculture and Environmental Sciences International Programs, and Mr. Michael Chrisman, Assistant Director and Responsible Officer, Ohio International Intern Program (TOP), College of Food, Agriculture, and Environmental Sciences.

During his visit, Dr. Singh toured various departments, laboratories, and research facilities at OSU, including private greenhouses, and explored potential collaborative research opportunities. He also visited the Wooster Centre of the university, where he interacted with entomologists and participated in seminars. A notable highlight of his visit was a meeting with Dr. Rattan Lal, globally acclaimed soil scientist and a proud alumnus of PAU, who is currently serving at OSU. Dr. Singh also travelled to Old Westbury Park, Long Island, New York, as part of his academic engagements as a Visiting Professor.

In recognition of his contributions and participation, Dr. Singh was awarded a *Certificate of Appreciation* by the Ohio State University, presented by Mr. Michael Chrisman, Assistant Director.



**Tissue-specific transcriptome followed by RNAi elucidates the functional roles of phenoloxidase and gustatory receptor in *Bactrocera dorsalis* to cold and heat stress**

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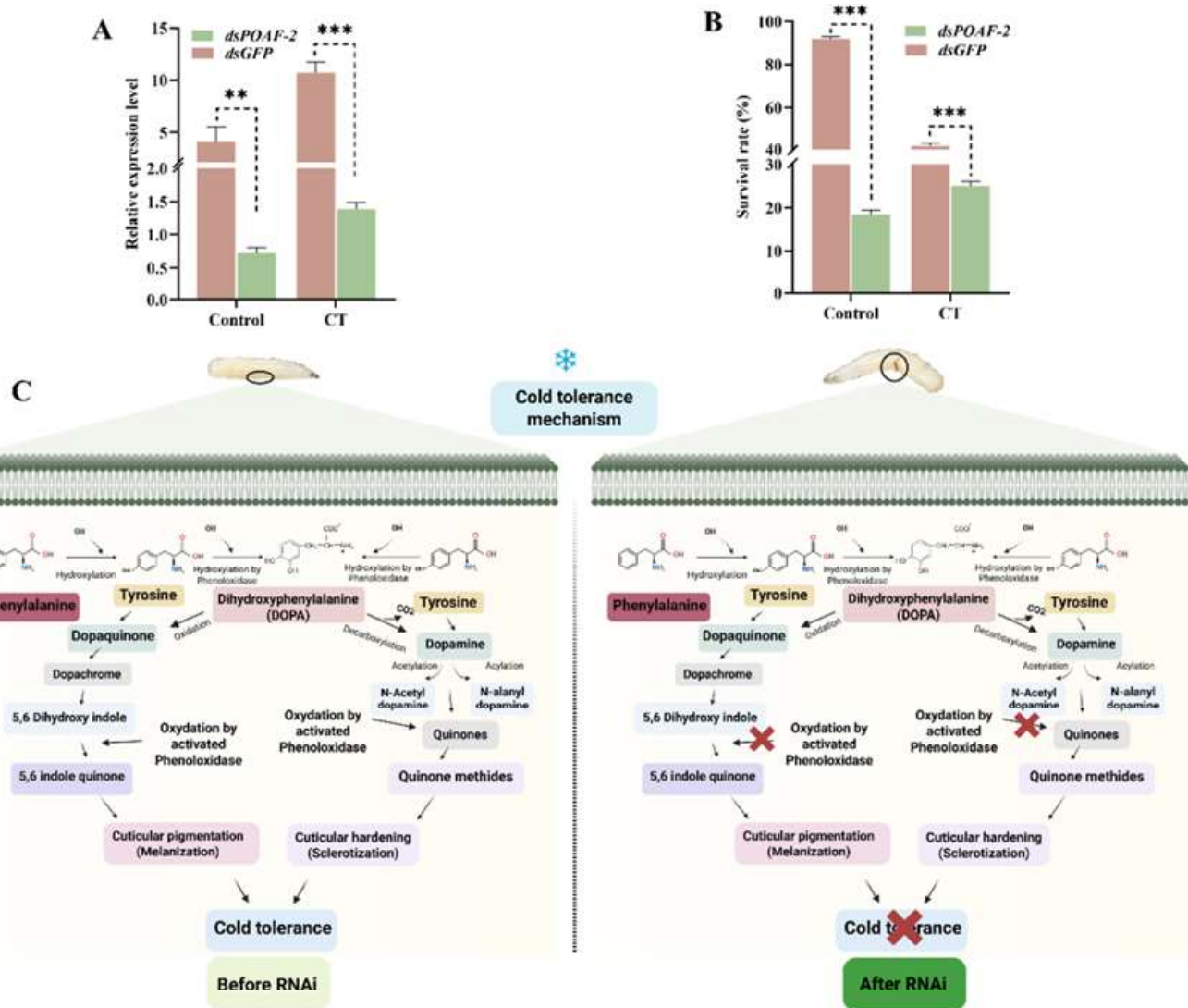
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Rising global temperatures and their associated shift in precipitation patterns are expected to alter the geographical distribution, developmental rates, and reproductive success of insects. So, we experimentally studied how heat stress and cold stress effect *Bactrocera dorsalis* survival, how it survives, and what are the molecular mechanisms behind this. The results reveal that both stress treatments could significantly affect survival rates. The transcriptome results showed that the cold stress in the cuticle activated structural and metabolic pathways as determined by

Kyoto Encyclopedia of Genes and Genomes (KEGG) pathway analysis, while heat stress in the gut resulted in downregulation of protein processing and upregulation of autophagy. The differential gene expression (DEGs) analysis showed a total of 193 cuticle (141 genes upregulated and 52 genes downregulated) under cold stress, while in gut the total of 211 DEGs (108 upregulated and 103 downregulated) under heat stress, respectively. Notably, RNAi-mediated knock-down of *POAF2* in the cuticle and *Gr89a* in the gut significantly reduced larval survival, which is attributable to the critical roles of these genes in stress response. The relative expression of *POAF2* was drastically lower after RNAi, whereas in *Gr89a* expression was also significantly lower as compared to control. These findings demonstrate that *B. dorsalis* has evolved distinct molecular adaptations to thermal stress and tissue-specific regulatory mechanisms. In general, the study reveals important insights into the genetic basis of insect adaptation to fluctuating environmental conditions, which offers potential for application to strategies for the management of insect populations under climate change.

Results of this research has been published as a full article in Journal of Pest Science, 2025. Available online

<https://doi.org/10.1007/s10340-025-01921-2>



**Fig. 1** Relative gene expression analysis of *Bactrocera dorsalis*. (A) Relative expression levels of *dsPOAF2* post-RNAi in the cuticle under cold treatment (CT). (B) Percentage survival of *Bactrocera dorsalis* after feeding on solution containing dsRNA of *GFP* and *POAF2*. (C) Role of PO in insect cuticle melanization and sclerotization (Marieshwari et al., 2023) and impact of gene silencing on thermal tolerance mechanism before and after RNAi. Data are expressed as mean±SD. (\*P<0.05, \*\*P<0.01, \*\*\*P<0.001)

## Fighting Fruit Flies: What to know and how to control them in North Central Sri Lanka

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Fruit flies are a major challenge for fruit and vegetable growers across Sri Lanka-particularly in the North Central Province (NCP), Sri Lanka where warm temperatures and year-round cultivation provide the perfect environment for these pests to thrive. Understanding their biology and behavior is the first step in protecting crops and ensuring farmers' livelihoods remain secure.

The most damaging species in this region are the Oriental fruit fly (*Bactrocera dorsalis*) and the melon fly (*Zeugodacus cucurbitae*). These pests lay eggs inside ripening fruit, and their larvae, commonly known as maggots, feed on the fruit from the inside. This feeding causes the fruit to rot, drop prematurely, and become unsellable. Fruit flies attack a wide range of crops, including mango, guava, papaya, banana, watermelon, and even certain vegetables. If left untreated, infestations can cause crop losses ranging from 30 to 80 percent. Because the fruit fly's life cycle can be completed in just two to three weeks under warm conditions, their populations can increase rapidly if not properly managed.

Fruit flies are most active during the early morning and late afternoon and are strongly attracted to the smell of ripe or ripening fruit. Although adult flies usually travel only short distances, infestations often spread when infested fruits are transported from one area to another.

In North Central Province, field sanitation is one of the most commonly practiced and effective methods for fruit fly control. This involves the regular collection and destruction of fallen or infested fruit to break the pest's life cycle. In larger-scale farming operations, integrated fruit fly management strategies are increasingly being used. These include the Male Annihilation Technique (MAT), which uses male attractants like methyl eugenol combined with insecticide to reduce breeding populations. Protein bait sprays are also used to attract and kill adult female flies, while bagging fruit with paper or plastic when it is still young prevents females from laying eggs.

However, biological control methods, such as supporting the activity of natural enemies like parasitoid wasps, are not commonly practiced in NCP. This may be due to a lack of awareness or because of the widespread use of broad-spectrum insecticides, which not only target pests like caterpillars and bugs but also harm beneficial insects. Educating farmers about the dangers of overusing these chemicals and promoting environmentally friendly alternatives is urgently needed.

Managing fruit fly populations in the NCP is made even more difficult by local agricultural conditions. Mixed cropping patterns, dependence on seasonal rains, and the presence of alternative host plants in nearby jungle areas provide continuous breeding opportunities for fruit flies throughout the year. Besides all the above major problems identified at the national level, the lack of baseline data under the Sri Lankan

setting also limits the implementation of effective control measures. The most important problem identified is that there is not enough information or literature related to fruit fly species abundance, distribution, and density in the Sri Lankan setting. Therefore, there is a clear and major research gap in studies conducted on the *B. dorsalis* and *Z. cucurbitae* in Sri Lanka. Thus, studies are urgently needed for their population characteristics and habitat selection particularly in their favorable host plant, the impact of their damage to individual host plant species, density and spatial distribution of both fruit fly species and host plants within isolated fruit and vegetable production areas of NCP,

Sri Lanka, in order to estimate its damage severity and regulatory challenges.

In summary, fruit flies pose a serious threat to the productivity of farms in North Central Sri Lanka. However, with the right knowledge, tools, and cooperative efforts among farming communities, these pests can be managed effectively. A combination of good field sanitation, strategic trapping, reduced pesticide use, and increased farmer awareness can significantly reduce damage and help protect valuable harvests. Let's fight fruit flies together.



**Fig. 1.** Farmer field survey and awareness program conducting under the IAEA supported melon fly control program in NCP, Sri Lanka.

**A semi-synthetic diet for mass rearing five species of genus *Bactrocera* (Insecta: Diptera: Tephritidae) of agricultural and quarantine significance**

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Patent No. 565462 granted for “A semi-synthetic diet for mass rearing five species of genus *Bactrocera* (Insecta: Diptera: Tephritidae) of agricultural and quarantine significance” by The Patent Office, Government of India on 23.04.2025. This patent relates to compositions and methods for preparing semi-synthetic spongy diet for fruit fly and use of diet as such for egg laying receptacle, and in particular aspects to compositions, preparation of diet for five species of fruit flies.

## **BACKGROUND**

Fruit flies (Diptera:Tephritidae) are important horticultural pests. The female flies deposit their eggs into fruits and vegetables and subsequently their developing maggots will consume the nutritious pulp. Thus, their infestation renders the produce unmarketable. Globally, about 4,000 different species of fruit flies are reported. Adult fruit flies have high reproductive potential, fast mobility or dispersive powers and extreme polyphagy. Members of *Bactrocera dorsalis* complex of fruit flies are recognized as being the most destructive and quarantine pests of fruits and vegetables worldwide. India alone has nearly 200 species of fruit flies, which is about 5% of the known tephritid fauna of the world. From an economic point of view and as quarantine pest, Oriental fruit fly *B. dorsalis* (Hendel), Peach fruit fly *B. zonata* (Saunders), Guava fruit fly *B. correcta* (Bezzi), Melon fruit fly *B. cucur-*

*bitae* (Coq) and Pumpkin fruit fly *B. tau* (Walker) are significant (Fig. 1). The first three species mainly attack fruit crops, while *B. cucurbitae* and *B. tau* attacks different species of cucurbits. Many fruits and vegetables are host of fruit flies that are considered as a quarantine risk by many importing countries. Japan, Australia, New Zealand and USA have imposed ban on import of Indian fresh fruits and vegetables due to infestation of fruit flies.

India is the second largest producer of fruits and vegetables in the world after China. But we are lagging behind in actual exports of these products due to quarantine regulation, sanitary and phytosanitary measure, associated with host plants. For fresh fruits and vegetables to be accepted by many importing countries, the commodities must be treated to ensure that it is free of fruit flies known as disinfestation treatments such as vapour heat treatment, hot water treatment, cold treatment and irradiation etc. This requires an establishment of laboratory colonies and mass rearing of multi-host species of fruit fly, to provide insects for the disinfestation research, as well as for sterile insect release. Normally, fruit flies are reared on its natural host but feeding of maggots *deteriorates the fruits leading to foul odour, contamination and unhygienic conditions in rearing facilities*. Moreover, natural hosts have short shelf life, availability crisis and storage limitations. Besides, most of fruits/vegetables are not available round the year. Furthermore, the quality of fruit flies reared on these natural hosts varies a lot. Thus, an artificial diet/feed for mass production of fruit flies is mandatory.

Many researchers have been tried to develop semi-synthetic/artificial diet for maggot rearing. The first artificial diet developed by Hagen *et al.* (1963) for the olive fruit fly was based on dehydrated carrot powder and brewer's yeast.

Since then, several artificial diets were reported as satisfactory for rearing fruit flies (Tzanakakis *et al.* 1966, Peleg *et al.* 1970, Rey 1970, Tsitsipis and Kontos 1983, Genc 2008). Clare (1997) developed a papaya pulp based semi-synthetic diet for *Bactrocera melanotus* and *Bactrocera xanthodus*, which was stored up to only one month at 4°C. Chang *et al.* (2004) prepared a Brewer's yeast based liquid diet for *B. cucurbitae*. Sponge cloth was used as support substrate for maggots. Later on, Chang *et al.* (2006) reared maggots of *B. dorsalis* on liquid diet without mill feed (biological bulking agent). Further, Chang (2008) described a technology of larval diet for fruit fly, where the liquid diet consisted of sugar, yeast, nipagen, sodium benzoate, streptomycin, citric acid, wheat germ oil, which was later mixed with water to make liquid diet and spread on sponge cloth. In this technology, they used plastic trays of different sizes held on the racks and the eggs were seeded on the diet. Chang (2009) further evaluated the liquid diet meant for *B. dorsalis*, medfly *Ceratitis capitata*, and *B. cucurbitae* by modifying it by adding yeast and yeast products. Genc (2008) tested five larval diets for laboratory rearing of *Bactrocera oleo* Gmelin. These diets were based on soy hydrolysate, yeast, sugar, casein, wheat germ, micro cellulose and agar. The agar-based diet was found better than cellulose-based diet for mass rearing olive fruit fly. Afoula (2009) evaluated cheaper alternatives like canola oil, vegetable oil to wheat germ oil in the larval diet of the melon fruit fly *B. cucurbitae*.

There are patents reported for artificial feed of *B. dorsalis* (CN103300257), *B. cucurbitae* (CN103315183) and *B. minax* (CN104095151). The artificial diet for first two *Bactrocera* species primarily consisted of beer yeast and sugar, wheat bran, corn powder, acid regulator and paper pulp, while *B. minax* diet is based on soybean powder, corn powder, sugar, yeast, vitamins, citrus juices and spirulina etc. For rearing technology, there are patents for *Bactrocera* species (CN102640867).

Another patent application MX2009005347 discloses a process for the manufacture of mixed texturing agents resulting from the dry structures of maize plants with cobs (cobs and grains) using special sow, cut, dry and crush processes for obtaining the specific granulometry required by the companies of massive growth of fruit flies and the novel formulations that will replace the texturing agents currently used for the manufacture of balanced diets for fruit fly maggots in plants for the production, growth and sterilization of fruit flies intended to control fruit fly plagues through the best known Sterile Insect Technique. Patent application KR20090075325 discloses a fruit fly feed composition containing hemp seed powder to accelerate pupation and improve growth rate of the fruit fly. The feed composition is prepared by mixing of 5-20 weight% of hemp seed powder, 0.5-2 weight % of agar, and 0.1-2 weight% of yeast in the water; followed by heating and boiling the mixture of the first step; and adding malt extract and starch syrup in the mixture; then cooling the mixture at 60-80 °C; and adding a preservative. There has been work done regarding dietary requirements of fruit fly maggots for rearing worldwide, there are few studies related to this

field on single species is reported in India (Chawla, 1966; Srivastava, 1975). Moreover, there is no common diet reported or patented so far for rearing all the five *Bactrocera* spp. on common diet.

The principal objective of the present invention is to develop a standard semi-synthetic spongy diet which can be used as egg laying receptacle and having good shelf life, easy storage, high nutritive value, higher production of adults with prolific fecundity, at par life cycle with natural host, time and labour efficient under hygienic condition, for mass rearing of fruit fly belonging to genus *Bactrocera*.

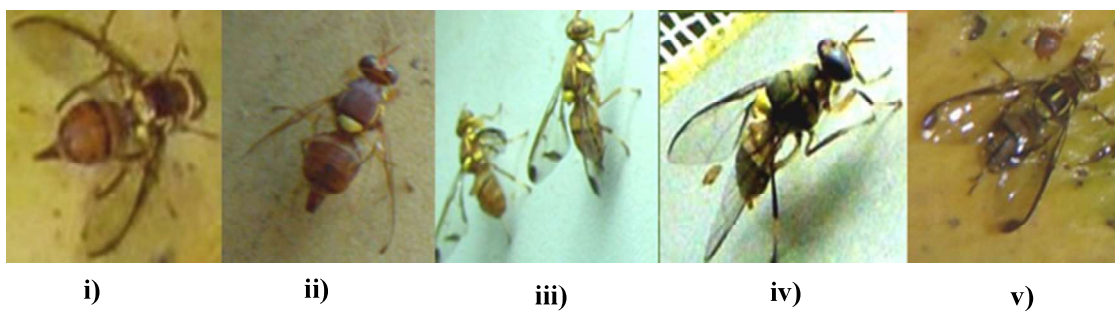
### REGARDING PATENT

The present invention describes composition as well as method of preparation of semi-synthetic spongy diet for mass rearing five species of fruit fly belonging to genus *Bactrocera* and rearing for the same from egg laying till pupation. This semi-synthetic spongy diet consists of vegetables, which include either Bitter gourd (*Momordica charantia*) or cucumber (*Cucumis sativus*) or Ivy gourd (*Coccinia grandis*) to give a natural flavour along with other dietary ingredients such as sugar, yeast, methyl-p-hydroxy benzoate citric acid, agar, formaldehyde, multivitamin and distilled water (Refer published patent for detailed description).

Diet is prepared by mixing and cooking the right quantities of essential nutrients in agar and yeast-based media to form a pulpy sponge like consistency. After setting diet could be stored up to 3 months at 8-10 °C till use. Furthermore, the semi-synthetic spongy diet is filled in the container and used as egg laying receptacle and rearing media for hatching maggots (Fig. 2-4). The consistency of diet is an important factor that matters a lot, it should not be so dense that

hinders larval movement and feeding but not be too wet that larvae may drown. The consistency of present diet is giving the softness that is suitable for maggot movement as well as feeding and pupation. Besides the spongy consistency of diet is suitable for adults to lay eggs and on hatching larvae starts feeding on diet so it overcome the process of seeding eggs into diet. On maturation the larvae easily jump out from diet and pupate outside as tephritid maggot naturally move out of the fruit to pupate. Thus, this rearing technology leads to maximal production of insects in a given time under most hygienic conditions as compared to natural host.

Above all, the diet is economical, simple to prepare, labour efficient for sustainable large-scale production of fruit flies. So far, no such diet and rearing method is available in the market for mass production of fruit flies of economic importance in India. This invention expects a bright future both for researchers and concerned commercial entrepreneurs.



**Fig. 1.** Adults of fruit fly (i) *B. dorsalis*; (ii) *B. zonata*; (iii) *B. cucurbitae*; (iv) *B. correcta*; and (v) *B. tau*



**Fig. 2.** 2a. Pair of mating adults of *Bactrocera*; 2b. Females laying eggs on the diet receptacles

**Fig. 3.** Eggs of *Bactrocera* laid by females on diet receptacles



**Fig. 4.** 4a. Maggot of *Bactrocera* feeding on diet; 4b. the mature maggot jumping out of the diet for pupation; 4c. Pupae collected from the housing container

## Innovative strategies for Melon Fly management in Sri Lanka: Optimizing male lure blends and food bait traps for *Zeugodacus cucurbitae* in Cucurbits

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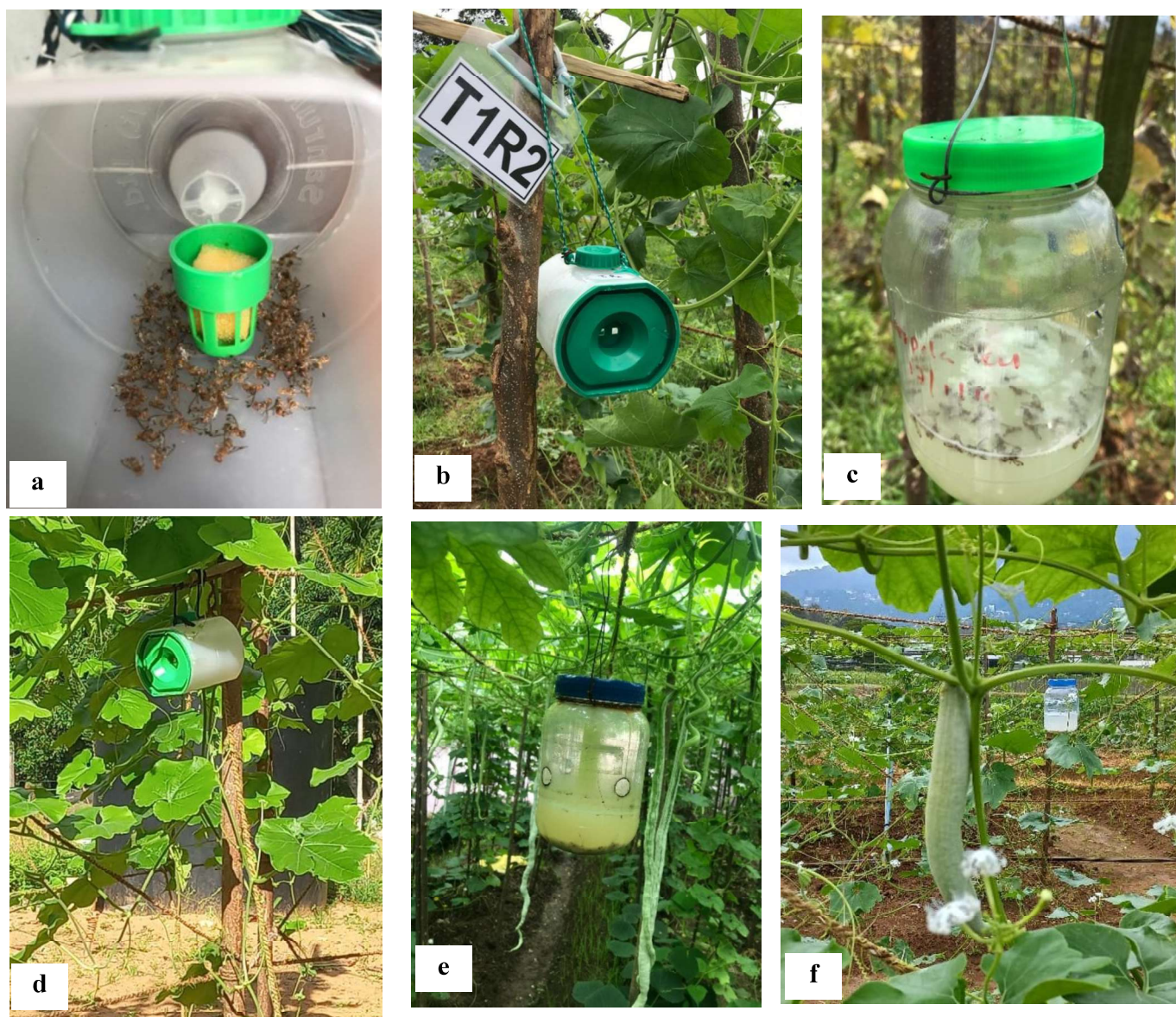
Melon fly (*Zeugodacus cucurbitae*), a major pest of cucurbit crops in Sri Lanka, continues to pose challenges for sustainable cultivation. Addressing this issue, recent studies conducted at the Horticultural Crops Research and Development Institute (HORDI), Gannoruwa, Sri Lanka have focused on optimizing male lure blends and developing effective food bait traps for female flies. These innovative approaches have demonstrated promising results in reducing the pest population under field conditions.

The male fruit fly attractant cuelure (CL) is essential for monitoring and managing melon flies in cucurbits. To enhance male fly attraction, traps baited with different ratios of CL and methyl eugenol (ME), as well as traps baited solely with CL (commercial lure), were assessed in snake gourd (*Trichosanthes anguina* L.) fields at HORDI during the 2023 and 2024 *Yala* seasons. The combination of CL and ME (0.5 ml: 0.5 ml) significantly increased the capture rates of *Z. cucurbitae* and *Bactrocera tau* male flies, surpassing the catch efficiency of commercial traps. The blended traps also attracted other fruit fly species, including *B. dorsalis*, *B. correcta*, *Z. cucurbitae*, and *B. tau*, demonstrating significantly higher capture rates than the single-lure CL traps. These results indicate that using a combined CL and ME lure in a single trap markedly improves male fly capture efficiency in cucurbit cultivation.

Female *Z. cucurbitae* pose significant challenges, as no direct trapping technique existed in Sri Lanka. A

developed food bait trap to attract female flies, tested in snake gourd (*Trichosanthes cucumerina* L. and ridge gourd (*Luffa acutangula* L.) ecosystems at HORDI and farmer fields during the 2022-2023 *Maha*, 2023 *Yala*, and 2023-2024 *Maha* seasons. Field trials at HORDI and farmers' fields confirmed that the blend of base bait (cucumber and water) with vinegar and sugar consistently attracted the highest number of female flies. These combinations extended the bait's effectiveness to 12 days.

The combined use of CL and ME blends significantly enhances male fly capture, while the developed food bait trap with sugar and vinegar additives effectively attracts female melon flies. These management strategies are practical and promising for reducing *Z. cucurbitae* populations in Sri Lanka's cucurbit fields.



**Fig. 1.** a) Attracted flies to CL+ME trap; b) Blend CL+ ME trap 2; c) Food bait 1; d) CL+ME blended trap; e) Food bait 6; f) Food bait trap in the field

## Area-Wide control of Chinese Citrus Fly (*Bactrocera minax*) in Nepal: Insights from field studies and farmer perceptions

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Citrus cultivation in the mid-hill regions of Nepal plays a pivotal role in sustaining rural livelihoods, providing both nutritional security and economic benefits to farming households. Among the most widely grown citrus fruits are mandarin orange (*Citrus reticulata*), sweet orange (*Citrus sinensis*), lime (*Citrus aurantifolia*) and lemon (*Citrus limon*). However, this important horticultural sub-sector is increasingly threatened by a range of biotic stresses, most notably the fruit fly complex (Diptera: Tephritidae). Among them, the Chinese citrus fly, *Bactrocera minax* (Enderlein, 1920), is one of the most destructive pests in citrus orchards of Nepal, causing severe direct damage through oviposition and larval feeding, which leads to fruit drop, reduced fruit marketability and significant yield losses. Chinese citrus fly, *Bactrocera minax* is native to China and is now geographically distributed across Bhutan, India and Nepal too. It is an oligophagous species with a strong preference for citrus fruits, and unlike other economically important *Bactrocera* species such as *B. dorsalis* and *B. zonata*, *B. minax* does not respond to common parapheromone male lures like methyl eugenol. Instead, it is attracted only to protein-based hydrolysate baits, posing challenges to monitoring and trapping systems. The species exhibits a univoltine life cycle, completing only one generation per year, with overwintering occurring in the pupal stage under soil for  $\pm 6$  months. Its lifecycle is tightly synchronized with citrus fruiting

phenology, making timely interventions are critical to effective management.

Morphological and molecular identification of *B. minax* in Nepal has confirmed its presence in several citrus-growing districts. The sequence can also be accessed in NCBI Genbank with accession no. ON619567.1. Molecular characterization based on COI gene sequencing has validated species identity, helping establish effective quarantine and surveillance protocols. Morphometric studies have further revealed regional variations in wing and body size, which can aid in field-level diagnostics and understanding local population dynamics. In addition, oviposition studies indicate that *B. minax* lays eggs predominantly during green fruit stage, underscoring the need for early-season in time intervention.

Given its invasive behavior and destructive impact, *B. minax* management requires an integrated and area-wide approach. Past initiatives in the sweet orange orchards of Sindhuli district in Nepal and other districts have demonstrated that integrated strategies combining spot application of protein bait sprays for adult fly management and orchard sanitation to break life cycle can significantly suppress populations. Area-Wide Control Program (AWCP) have proven to be an effective model by synchronizing interventions across neighboring orchards, thereby disrupting the pest's lifecycle and preventing re-infestation. Citrus grower's awareness and stakeholder's consultation and sensitization have further enhanced community engagement and long-term adoption of these techniques.

**For more information, please refer**

Adhikari, D., Thapa, R.B., Joshi, S.L. and Du, J.J. 2021. Area-Wide Control Program in management of Chinese citrus fly, *Bactrocera minax* (Enderlein) (Diptera: Tephritidae), in citrus orchards, Sindhuli, Nepal. The Journal of Agriculture and Environment, 22: 41-50.

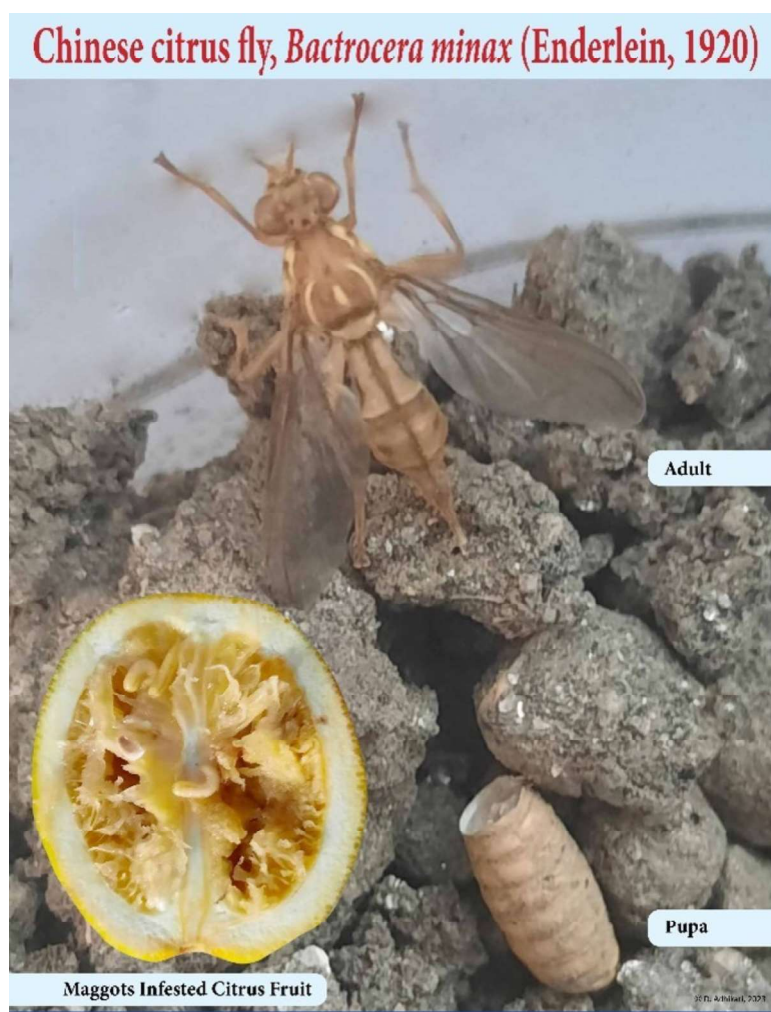
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**Fig. 1.** Chinese citrus fly (female and male)



**FAO/IAEA regional training course on molecular identification of economically important Fruit Flies successfully held in Beijing, China**

**Zhihong Li, Lijun Liu, Shaokun Guo and Yujia Qin**

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From July 7 to 11, 2025, the regional training course jointly organized by the Food and Agriculture Organization of the United Nations (FAO) and the International Atomic Energy Agency (IAEA) was successfully held in Beijing. Focusing on the theme of “Molecular Identification of Economically Important Fruit Flies”, the training aimed to enhance participants’ capabilities in using molecular tools for species identification, and to further strengthen the regional capacity in fruit fly surveillance and control. A total of 20 trainees from 13 countries, including three from China, participated in the training (Fig. 1). The opening ceremony was chaired by Professor Zhihong Li (Fig. 2), Chair of the Technical Advisory Committee of Tephritid Workers of Asia, Australia and Oceania (TAAO), Director of the Key Lab of Surveillance and Management of Plant Quarantine Pests (Ministry of Agriculture and Rural Affairs, China), and Professor at the College of Plant Protection, China Agricultural University.

Tephritid fruit flies pose significant economic threats to global fruit and vegetable production and international trade, drawing widespread international

attention. Species from the genera *Bactrocera* and *Zeugodacus* are particularly harmful in South Asia, Southeast Asia, and the Pacific Islands, threatening regional livelihoods and biosecurity. Under the IAEA technical cooperation project “Strengthening and Harmonizing Surveillance and Suppression of Fruit Flies”, this training was hosted by the IAEA and organized by the Plant Quarantine and Invasion Biology Laboratory, College of Plant Protection, China Agricultural University. Twenty participants from national fruit fly programs and plant protection institutions across 13 member countries received hands-on training. Ten student volunteers from the host laboratory actively contributed to the organization and operation of the event.

The training program featured a combination of teaching formats, including thematic lectures, laboratory experiments, and technical demonstrations. Professors Zhihong Li, Lijun Liu, and Shaokun Guo from the host laboratory delivered in-depth presentations on the principles and methodologies of morphological and molecular identification of economically important fruit fly species (Figs. 3, 4). Their lectures also explored the application and development of cutting-edge identification technologies in pest management. During the training, participants visited the Entomological Museum and Insect Specimen Collection Hall of China Agricultural University, enriching their understanding of Tephritid taxonomy and morphological diversity. The student volunteers worked closely with the trainees, assisting with experimental procedures and facilitating communication, greatly enhancing

both efficiency and the overall learning experience. After five days of intensive instruction, the training concluded successfully with presentations from participants showcasing their learning outcomes and receiving highly positive feedback. At the closing session, several participant representatives expressed sincere gratitude to the IAEA and China Agricultural University for providing a valuable platform for learning and exchange, as well as to the experts for their detailed explanations and technical guidance. They highlighted the training's solid scientific foundation and practical applications, specifically singling out the molecular identification components. In addition, the participants extended special thanks to the student volunteers for their enthusiastic support, which contributed significantly to the smooth operation of the program.

Professor Zhihong Li awarded training certificates to all participants at the closing ceremony and extended her appreciation to the IAEA and China Agricultural University for their strong support in organizing the course. She commended the participants for their active engagement and expressed heartfelt thanks to all involved (Figs. 5, 6). Professor Li emphasized that this training provided an important opportunity to deepen international collaboration and technical exchange in the field of plant protection. She encouraged all participants to apply the knowledge and skills gained during the course to their national fruit fly control programs, thereby contributing to agricultural development and regional biosecurity efforts. She also called for joint efforts to promote sustainable agriculture and global biosecurity.

The successful completion of this training significantly enhanced the professional capacity of fruit fly workers in the Asia-Pacific region in the field of mo-

lecular identification and control technology. It also established a new platform for cross-border technical cooperation. The program facilitated the exchange of experience and the sharing of resources within the region, while highlighting the vital role of international cooperation in addressing transboundary plant pest challenges. This training established important channels for international collaboration among technical personnel, reinforcing regional partnerships and driving forward the global agenda for integrated fruit fly management.



**Fig. 1.** Opening Ceremony of the Regional Training Course: 20 Participants from 13 Member Countries Attend the Program.



**Fig. 2.** Professor Zhihong Li from China Agricultural University chairs the opening ceremony of the FAO/IAEA Regional Training Course



**Fig. 3.** Professor Zhihong Li (upper left), Associate Professor Lijun Liu (upper right), and Associate Professor Shaokun Guo (bottom left) from China Agricultural University are conducting diversified training sessions, volunteers and trainees engaged in joint learning and exchange (bottom right).



**Fig. 4.** Participants engaged in a multifaceted training program that included lectures, laboratory experiments, and hands-on demonstrations.



**Fig. 5.** Professor Zhihong Li presented certificates to the trainees from member countries.



**Fig. 6.** Group photo of delegates to the FAO/IAEA Regional Training Course on Molecular Identification of Economically Important Fruit Flies Successfully Held in Beijing, China, 7-11 July 2025.

## UPCOMING EVENTS AND DATES TO REMEMBER

### ISCE-APACE 2025

Dear TAAO community,

If you have not seen this earlier, the ISCE-APACE 2025 Joint Conference of the International Society of Chemical Ecology and the Asia-Pacific Association of Chemical Ecologists ISCE-APACE 2025 will be held in Christchurch New Zealand 18-22 August. Of particular interest may be the session on Fruit Fly Chemical Ecology. Information is available at: <https://scienceevents.eventsair.com/isce-apace-2025/>

Sincerely,

Lloyd Stringer (Local Organising Committee for ISCE-APACE 2025)

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### ISoI 2025

The 6th International Symposium on Insects (ISoI) will be held on 2-4 September, 2025 at Terengganu, Malaysia. Information is available at: <https://www.entomologymalaysia.com/isoi2025>

### 12th INTERNATIONAL SYMPOSIUM ON FRUIT FLIES OF ECONOMIC IM- PORTANCE

We are pleased to announce the organization of the 12<sup>th</sup> International Symposium on Fruit Flies of Economic Importance, to be held from [REDACTED] 10-15 May 2026, in Agadir, Morocco.

The meeting will be conducted in-person format to stimulate innovation, create new synergies, and strengthen links within the scientific community. Since the first symposium in Athens, Greece (1982), the aim of these meetings is to gather scientists, researchers, and those involved in plant protection agencies and phytosanitary operational programs to share their knowledge, technologies and experiences regarding tephritid fruit flies. It is with great satisfaction to underline that in the past 40 years, these symposia have contributed to the development and improvement of environmental-friendly control methods and management strate-

gies that minimize the negative effects of fruit fly pests worldwide, as well as the conformation of a very strong and friendly community of tephritidologists.

The symposium sessions will be in English and the programme will cover all relevant disciplines ranging from basic knowledge to applied research such as Area-wide Integrated Pest Management and Social, Economic and Policy Issues in Action Programmes, Biology, Ecology, Physiology, Behavior, Taxonomy, Genetics, Biotechnology, Chemical Ecology, Sterile Insect Technique, Biological Control and other disciplines.

Participants are welcome to present their work as an oral presentation or as a poster. The fruit steering committee and organizing committee will evaluate all the abstracts and organize the agenda of the Symposium.

Further information about the registration fees, abstract and poster guidelines, the programme, technical tours and other useful general information, will be soon available at: [www.12isffe.com](http://www.12isffe.com)

Looking forward to seeing you all in Morocco.

Best regards,

Ahmed Mazih (Chair of the Local Organizing Committee)

Rui Cardoso Pereira (Chair of the International Fruit Fly Steering Committee)

### 3rd TAAO SYMPOSIUM

We are very pleased to announce that the Third Symposium of Tephritid Workers of Asia, Australia, and Oceania (TAAO) will be held in October, 2028 in Hanoi, Viet Nam. Novel technologies, achievements and knowledge in fruit fly area will be introduced in the symposium. This event is also a wonderful chance to discuss issues on fruit fly "face to face". Your paper, posters, products are very valuable in this event. The detail of this event will be update to you on the newsletter of TAAO. We warmly welcome you to participate in 3rd TAAO symposium.

Organizing Committee of 3rd TAAO symposium

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## TAAO NEWSLETTER

The TAAO Newsletter is produced by the TAAO editorial committee from contributions made by fruit fly workers from across the region encompassing Asia, Australia, and Oceania. While focused on this region, contributions are also welcome from tephritid workers. The newsletter is distributed electronically and free of charge to members of the TAAO mailing list. Please contact the TAAO EC Chair, Dr Sandeep Singh (India) (sandeep\_pau.1974@pau.edu) if you wish to be added or removed from this list, or if you have a note that you would like to contribute to future issues of the Newsletter.

All issues of the **TAAO Newsletter** are available here:

<https://nucleus.iaea.org/sites/naipc/twd/Pages/Newsletters.aspx>

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