Government of Nepal
Ministry of Agriculture, Land Management and Cooperatives
Food Security, Agri-Business Promotion and
Environment Division
Environment and Climate Change Section
Singh Durbar, Kathmandu

Telephone: 00977-1-4211940
Fax: 00977-1-4211935
Website: www.moad.gov.np
Email: fsed.moad@gmail.com

The Journal of AGRICULTURE AND ENVIRONMENT 2018

"BEAT PLASTIC POLLUTION: IF YOU CAN'T REUSE IT, REFUSE IT"

"प्लाष्टिक प्रदुषण निर्मुल पारौं, पुनर्प्रयोग गर्न नसके वहिष्कार गरौं"

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POPULATION DYNAMICS OF FRUIT FLIES IN SWEET ORANGE (*Citrus sinessis* L.) ORCHARDS IN SINDHULI, NEPAL

Debraj Adhikari[1], Dinesh Babu Tiwari[2] and Samundra Lal Joshi[3]

ABSTRACT

Fruit fly is an important pest of citrus both in relation to production and trade. Fruit fly surveillance was conducted based on protocol endorsed by National Plant Protection Organization (NPPO) Nepal from May 2014 to May 2015. Collection of fruit fly trapped in male lure traps were carried out from the selected sweet orange orchard 64 ha. of Sindhuli district. The trapped fruit flies were collected fortnightly and species were identified. The result shows that the number of fruit flies trapped were higher in methyl eugenol lure than cue lure. The maximum number of fruit flies trapped was found during June, July and August. Bactrocera dorsalis was predominant in Methyl eugenol. Whereas, Bactrocera tau was found major species trapped in cue lure. Besides, other species such as Bactrocera zonata, B. cucurbitae, B. scutelaris and Dacus longicornis were also detected in traps.

Key words: *Bactrocera*, Cue lure, fruit fly, methyl eugenol, population dynamics, sweet orange

INTRODUCTION

Citrus, a commercially grown fruit crop in the middle mountain region of Nepal, is cultivated in 38988 ha (25497 ha productive area) with a production of about 224,357 mt in 2014 (MoAD, 2014). Sweet orange (*Citrus sinensis* L.) Osbeck) is the second important citrus fruit after mandarin (*Citrus reticulata* B.) in the country (Paudyal and Subedi, 2008), and recently citrus fruits, particularly mandarin from Syangja and sweet orange from Sindhuli, were to move to China from Nepal with a bilateral agreement in 2012 (Sharma *et al.*, 2015). But fruit flies in citrus as fruit infestants remained hurdles in export (Adhikari, 2013). Fruit flies, *Bactocera cucurbitae* C., *B. dorsalis, B. zonata, B. tau, B. scutellaris, B. yashimotoi, B. minax, B. caudatus, B. correcta and B. diversus* are predominantly occurring flies in horticultural ecosystem and infesting fruits (Sharma *et al.*, 2015). Fruit flies of *Bactrocera* (*Dacus*) spp. remained the cause of mandarin decline typically due to fly initiating fruit droppings in the western hills of Nepal (Budathoki and Pradhanang, 1992). In this context, a survey of the citrus orchards of the hilly districts of Nepal namely Sindhuli and Syangja was conducted to identify orchard maundering fruit flies, their occurrences and seasonal abundance that might pose major threats to sweet orange cultivation in Sindhuli district.

These days, export of citrus fruits from Nepal is facing phytosanitary restrictions due to the fruit fly problem in the orchards. So, the citrus growers are facing problems to export fruits and fetch higher price of their produce. A study by Sharma et al.(2015) revealed that there are ten species of fruit fly species namely *Bactocera cucurbitae C., B.dorsalis, B.zonata, B.tau, B.scutellaris, B.yashimotoi,*

1 Senior Plant Protection Officer, Ministry of Agriculture, Land Maangement and Cooperative, Nepal
2 Senior Agriculture Development Officer, District Agriculture Development Office, Rasuwa, Nepal
3 Former Principal Scientist, Entomology Division, Nepal Agriculture Research Council, Khumaltar, Nepal
Corresponding author: D. Adhikari (E-mail: debhorti@yahoo.com)

B. minax, B. caudatus, B. correcta and *B. diversus* in Nepal. The management measures of fruit fly practiced by the farmers were use of para-pheromone (methyl eugenol and cue lure) traps, application of chemical measures and field sanitation of attacked fruits (Jaisawal et al., 1997). Besides, the application of botanical insecticides, exclusion measures (bagging and netting), application of food lures/baits and cultural measures such as soil treatment/tillage, removal of host plants and crop rotation were also the recommended practices to manage fruit fly in Nepal.

Fruit flies are considered as devastating pest in most of the fruits and fruit vegetables (cucurbits and solanaceous). These are polyphagous, having higher rate of fecundity and ability to quickly spread over a wide area that makes them real vexatious pests for fruits and vegetable growers (Gillani et al., 2002). Han et al., (2011) mentioned four to five generations of *Bactrocera dorsalis* per year in Wuhan, Hubei Province, Central China. Chinese citrus fly (*B. minax*) is very serious fruit fly species causing great loss to citrus fruits i.e. sweet orange, hill lemon and mandarin too in the eastern hills of Nepal (NCRP, 2012). The information on fruit fly species abundance in citrus orchard of Sindhuli district was not available yet. This study was undertaken with the view to identify the diversity of fruit flies prevalent in citrus ecosystem in Sindhuli district and to know the distribution pattern of fruit fly population in that location. The work towards compliance after Nepal-China agreement 2012 by National Plant Protection Organization (NPPO) Nepal was presented in Table 1.

Table 1: Work towards compliance in Nepal

Related ISPM	Major Criteria	Procedrure followed
International Standards for Phytosanitary Measures (ISPM) 4 -Requirements for PFA	- Systems to establish freedom - Phytosanitary measures to maintain freedom - Checks to verify freedom has been maintained	- Pest detection survey carried out as a basic step to support Pest Risk Analysis (PRA) and Pest Free Area (PFA) - Pest data recording
ISPM 6 - Guidelines for surveillance	- Guidelines for general and specific survey	- Followed in pest specific survey protocol preparation
ISPM 8 - Determination of Pest status in an area	- Presence of the pest - Absence of the pest - Transience of the pest	- Pest detection survey to support the pest determination
ISPM 10 - Requirements for the establishment of PFPP and PFPS	- Systems to establish pest freedom - Systems to maintain pest freedom - Verification that pest freedom has been attained or maintained - Product identity and phytosanitary security of the consignment	- Work to support Pest Free Place of Production (PFPP) - Orchard selection, registration - Pest detection survey - Pest recording - Pest management activities
ISPM 26 Establishment of Pest Free Area for fruit flies (Tephritidae)	- The characterization of the Fruit Fly - Pest Free Area (FF-PFA) - The establishment and maintenance of the FF-PFA	- Mainly pest monitoring work - Realized very difficult task to these locations - Only Chile has made PFA for FF

ISPM 29 Recognition of Pest free area and Area of Low pest prevalence	- Procedure for PFA recognition	- Preparation for dialogue with trading partner after the agreement

The activities accomplished by NPPO Nepal after Nepal China agreement were:

- Discussion, review, guidelines preparation and field works to support agreement.
- PPD as NPPO has focused on specific survey to detect the concerned pests.
- Pest survey protocols for quarantine pests and survey plans are prepared.
- Orchard selection and registration by District Agriculture Development Office (DADO)
- Field surveys for the particular pests are continued since May 2014.
- Internal Quarantine Directive

MATERIALS AND METHODS

Fruit fly (FF) monitoring based on the fruit fly surveillance protocol to detect the stated quarantine fruit flies in Nepal-China Agreement 2012 was conducted during May 2014 to May 2015 in the citrus orchards of Sindhuli district. FFs male lures originated from para-pheromones, methyl eugenol (ME) and cue-lure (CL) were used with malathion (Malathion 50 EC) to knock-down flies inside the Steiner traps provided by National Plant Protection Organization/Nepal (Plant Protection Directorate, Hariharbhawan, Lalitpur). Sixty-four traps randomly placed in the sweet orange orchards of Ratanchura, Jalkanya, Baseswor and Tinkanya Village Development Committees (VDCs) (Figure 1) Sindhuli district in tree branches at a height of 2 meters from the ground level each at a distance of minimum 5 meters from ME and CL trap and 100 meters from each sets of traps in the orchard. Trapped fruit flies were fortnightly collected, and lures along with Malathion soaked cotton swab were replaced in every fifteen days. Identities of each trapped FFs were made based on their morphological traits on body by means of 20 x pocket lens in laboratory, Ratanchura, Sindhuli. Data of FFs' abundance, distribution and species composition were analyzed by means of Excel data analysis package.

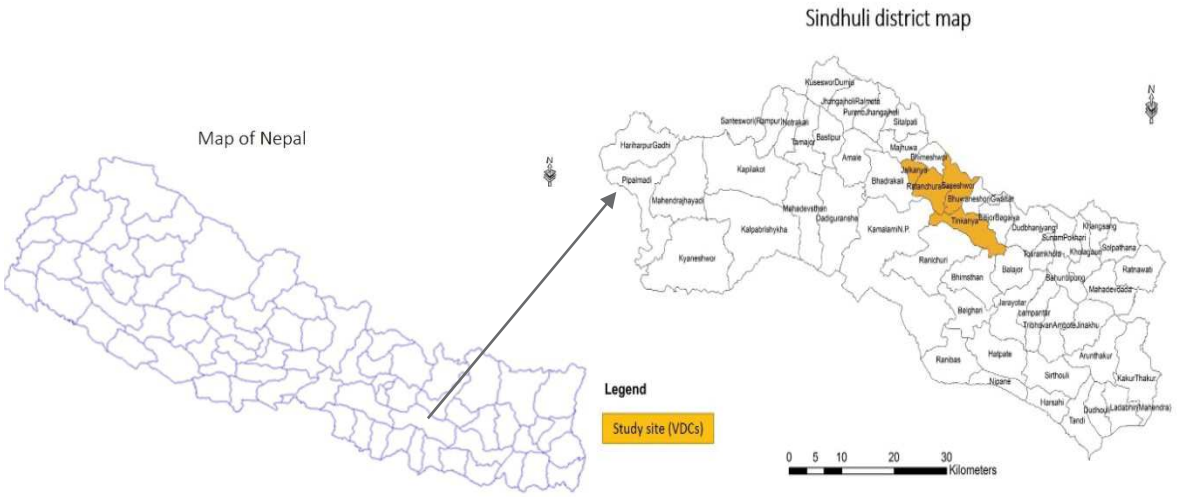

Figure1. Study sites in Sindhuli district

RESULT AND DISCUSSION

Fruit fly is an important pest of horticultural crops. In Nepal, farmers are practicing the integrated measures of management. Though, the yield loss has not been reduced satisfactorily, fruit fly surveillance in Nepal is officially initiated by National Plant Protection Organization after the agreement with China on 2012 to export Nepalese citrus fruits (Sharma et al., 2015).

a. ABUNDANCE OF FRUIT FLY

Fruit flies were observed throughout the year in the orchard. The number of fruit flies trapped in Methyl Eugenol was found higher than the Cue Lure trap. The highest number of fruit fly trapped in Methyl Eugenol was found during 24th July, 2014 i.e. 32415 from 64 traps. Whereas, highest number of fruit fly trapped in Cue Lure was found in the collection of 9th July, 2014 i.e. 2258. As a whole, the largest number of fruit flies trapped in para-pheromone lures were during June, July and August in both traps (Figure 2). This might be due to the weather condition, i.e. higher temperature and humidity during June to August that is favorable for the fruit fly. The greater numbers of fruit flies were trapped from May to August in guava and nectrin in Islamabad, Pakistan (Gillani et al., 2002). Similar result was found by Sarwal et al. (2014) in mango orchard in Faisalabad, Pakistan. The availability of preferred host fruits and the low winter temperature are key factors influencing population fluctuations (Han et al., 2011).

Average number of fruit flies trapped in different lures and standard deviation from May 2014 to May 2015 in sweet orange orchard of Sindhuli, Nepal is presented in Figure 3 which shows that on an average the larger numbers of fruit flies were found in Methyl eugenol i.e. 4689 than Cue lure i.e. 844. Likewise, the standard deviation is higher in Methyl eugenol than Cue lure i.e. 8890 and 679, respectively. There were very low number of fruit fly trapped during winter months might be due to the cold temperatures. Similar result was found by Peng and Hui in 2007.

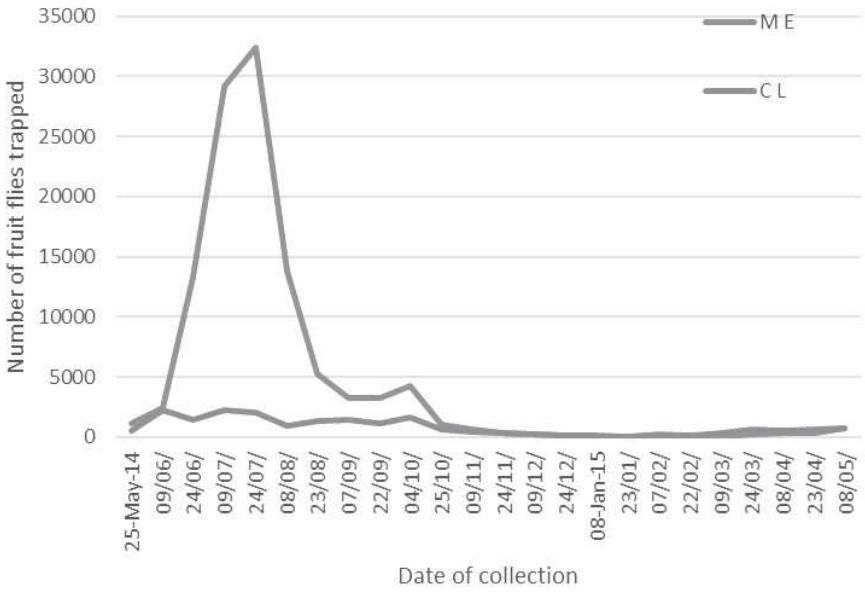

Figure 2. Number of fruit flies trapped in different lures from May 2014 to May 2015 in sweet orange orchard of Sindhuli, Nepal

b. DISTRIBUTION OF FRUIT FLY

Bactrocera dorsalis H.was the most abundant fruit fly species trapped in Methyl Eugenol followed by *Bactrocera zonata, B. tau, B. scutelaris* and *B. cucurbitae*. Whereas, the *Bactrocera tau* was the most abundant fruit fly species trapped in Cue Lure followed by *Bactrocera dorsalis, B. cucurbitae, B. scutelaris, B. zonata* and *Dacus longicornis*. The highest numbers of fruit flies were recorded in Methyl eugenol trap during 24th July, 2014 (Figure 3). Whereas, In Cue Lure trap the fruit fly species *Bactrocera dorsalis* were recorded highest during 9th July, 2014 and the Bactrocera tau during 4th Oct., 2014 (Figure 4).

Among the ten fruit fly species reported from Nepal by Sharma et al. in 2015, five species namely *B. dorsalis, B. zonata, B. cucurbitae, B. tau* and *B. scutelaris* were found trapped and the species *Dacus longicornis* was also reported. Only four fruit flies were diagnosed as *Dacus longicornis* that were trapped in Cue Lure trap on 22nd Feb. i.e. 2 and 1 each on 9th and 24th March, 2015. Methyl eugenol (4-allyl-1,2-dimethoxybenzene -carboxylate) and cue-lure [4-(p-acetoxyphenyl)-2-butanone] are highly attractive male pheromone lures to oriental fruit fly, *Bactrocera dorsalis* (Hendel), and melon fly, *B. cucurbitae* (Coquillett), respectively (Vargas et al., 2000). Population dynamics of the Oriental fruit fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae), were monitored year-round using methyl eugenol-baited traps in 2003 to 2006 in Baoshanba, Yunnan Province, China. The result showed that, the environmental factors such as air temperature, rainfall, sunlight hours, relative humidity and host-plant species were found affecting the population dynamics. The *Bactrocera dorsalis* occurred only during April–November, with one yearly peak in August (Peng and Hui, 2007). The seasonal increase in population size also coincided with

the fruiting period of the host plants. The temperature and relative humidity significantly influenced the fruit fly population (Appiah et al., 2009; Peng and Hui, 2007).

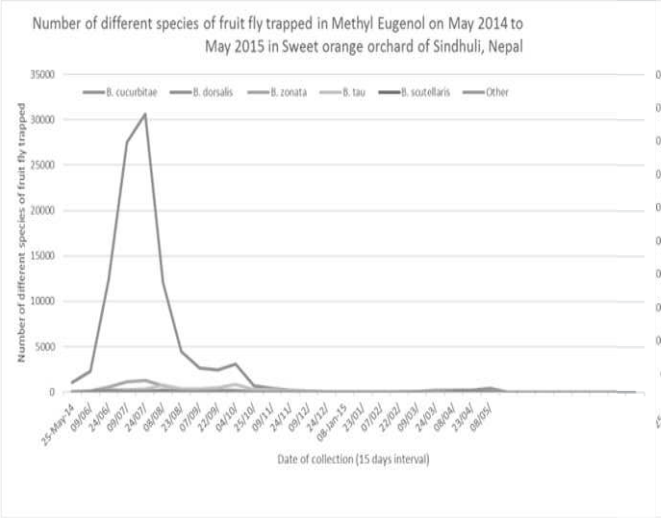

Figure 3. Number of different species of fruit fly trapped in Methyl Eugenol from May 2014 to May 2015 in Sweet orange orchard of Sindhuli, Nepal

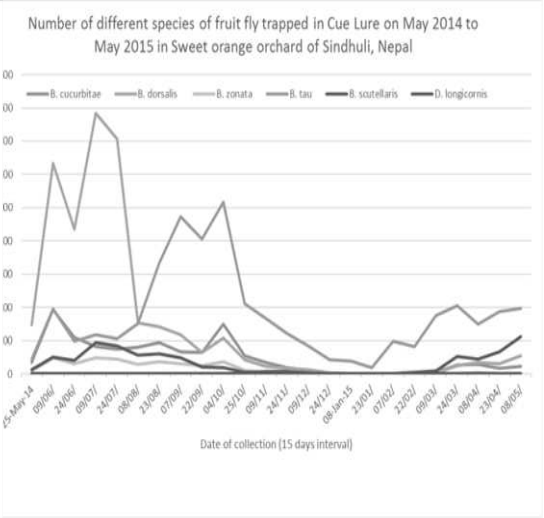

Figure 4. Number of different species of fruit fly trapped in Cue Lure from May 2014 to May 2015 in Sweet orange orchard of Sindhuli, Nepal

c. COMPOSITION OF TRAPPED SPECIES

The composition of fruit fly species trapped in Methyl Eugenol is presented in Figure 5. *Bactrocera dorsalis* were trapped highest i.e. 90.07% followed by *B. zonata, B. tau, B. scutelaris* and *B. cucurbitae* 4.56%, 4.21%, 0.66% and 0.49%, respectively. Similarly, the composition of fruit fly species trapped in Cue Lure is presented in Figure 6. *Bactrocera tau* were trapped highest numbers followed by *B. dorsalis, B. cucurbitae, B. Scutellaris, B. zonata* and *Dacus longicornis* i.e. 35.05%, 11.67%, 7.91%, 3.55% and 0.02%, respectively. This variation in the species of fruit flies attracted and trapped is must be due to the differences in para-pheromone lure and agro-ecological condition of the orchard. Fruit flies are attractive to the specific male lures (para-pheromones). Each lure is specific to a fruit fly group or in some case certain species of fruit fly. Methyl eugenol, cue lure and trimed lure are commonly used to monitor oriental, melon and mediterrean fruit flies, respectively (HAW-FLYPM, 2016). The mixing of fruit fly species in ME and CL might be due to handling of both lures together and placement of traps nearer i.e. +- 5 m. Steiner (1952) reported the attraction of male oriental fruit flies to ME from as far as 800 m.

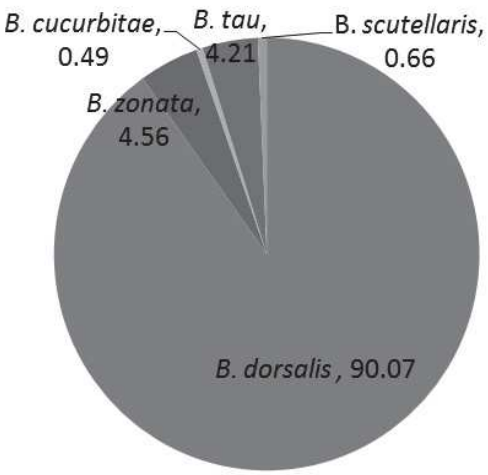

Figure 5. Percentage of fruit fly species trapped in Methyl Eugenol from May 2014 to May 2015 in Sweet orange orchard of Sindhuli, Nepal

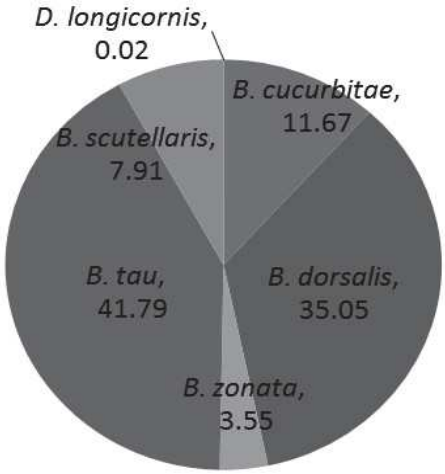

Figure 6. Percentage of fruit fly species trapped in Cue Lure from May 2014 to May 2015 in Sweet orange orchard of Sindhuli, Nepal

CONCLUSION

Fruit fly surveillance in the sweet orange orchard of Sindhuli district, Nepal is important for the study of population dynamics, species diversity and also for the planning of management strategy. It showed that the seasonal variations produce the great influence in fruit fly population. There was less abundance of fruit flies during winter months and highest population during June-August. The result supports the previous findings that the fruit fly population depends upon the environmental factors and host availability. *Bactrocera dorsalis* is the predominant species of fruit fly in sweet orange orchard of Sindhuli Nepal. Though, the damage due to *Bactrocera minax* was observed by the farmers during the harvest of 2015. This emphasizes the need of continuous surveillance also for the other host plants of fruit fly and management measures to minimize fruit loss and for quarantine purpose.

ACKNOWLEDGEMENT

National Plant Protection Organization (NPPO), Plant Protection Directorate (PPD), Hariharbhawan, Lalitpur is highly acknowledged for overall supports to conduct surveillance of fruit flies of sweet orange in Sindhuli. We would like to acknowledge the help rendered by all the Junar facilitators during fruit fly surveillance. Supports from District Agriculture Development Office, Sindhuli and Regional Plant Protection Laboratory, Hariharbhawan, Lalitpur are also acknowledged.

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