

Short Communication

CHINESE CITRUS FLY, *Bactrocera minax* (Enderlein) OVIPOSITION PERIODS IN CITRUS ORCHARD, NEPAL

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ABSTRACT

Chinese citrus fly, *Bactrocera minax* (Enderlein) is a major pest of citrus fruits that causes significant fruit losses in citrus orchards in Nepal, China, Bhutan and India. In 2021, a field study was conducted to know the oviposition period of this pest in a sweet orange orchard in Sindhuli, Nepal. The pest deposits its eggs on 25-50 mm citrus fruits during June-July. The timing of egg laying is crucial in designing and deploy adult fly management such as protein bait in citrus orchards.

Key words : Chinese citrus fly, citrus, fruit size, oviposition

INTRODUCTION

Citrus is one of the most common fruit grown and traded around the world (FAO, 2020). The sweet orange, *Citrus sinensis*, suitably grown in 7.4 – 8.6 pH soil in orchards (Lakshmi *et al.*, 2017), is a commonly cultivated but commercially valued citrus fruit in the subtropical to temperate regions of the world (Etebu & Nwauzoma, 2014; Dahal *et al.*, 2020). Citrus is widely cultivated in Nepal's mid-hills (800-1400 m asl) from east to west by virtue of a conducive mountainous climate prevailing in the country (Acharya & Shrestha, 2021). Mandarin, sweet orange, lime, lemon, pommelo, and grapefruits are among the commercially popular citrus fruits in Nepal (MoALD, 2021; Amgai *et al.*, 2016; Bhandari *et al.*, 2016; Tomiyasu *et al.*, 1998). Citrus crops cover nearly 28% of the total fruit area in Nepal. Thus, the area under citrus cultivation, productive land, production and productivity in Nepal are 46,715 ha, 27,339 ha, 2,74,140 mt and 10.03 mt/ha, respectively (MoALD, 2021).

Citrus production and productivity in Nepal are remarkably poor largely because of the poor management and improper application of crop protection measures in orchards (FAO, 2011). In addition, the epidemics of Chinese citrus fly, citrus greening, and foot/root rot have geared to a lower citrus quality and production in Nepal (Adhikari *et al.*, 2019; Adhikari & Joshi, 2015). Bajracharya *et al.* (2008) reported fruit flies incurred citrus production losses up to 97% in citrus orchards in the eastern hilly regions of Nepal.

The Chinese citrus fly (CCF), *Bactrocera minax* (Enderlein) (Diptera: Tephritidae), is one of the most devastating insect pests of citrus in Asia from southwestern China to Nepal, India (Sikkim, West Bengal), and Bhutan (EPPO, 2021; Bhandari *et al.*, 2016; Wang *et al.*, 2016; Drew & Roming, 2013).

The CCF feeds only on citrus fruits (Xia *et al.*, 2018) preferably tight skin than those of loose skin (Drew *et al.*, 2007; Dorji *et al.*, 2006; Drew *et al.*, 2006). This invasive fruit fly is reported to be spreading from the eastern mid-hill citrus orchards to the central mid-hills and, further, extending to the western mid-hill citrus orchards in Nepal (Joshi, 2019).

Determining egg laying period in citrus fruits in orchards is important to design and deploy adult fly management tactics included with lethal protein bait application or insecticide spray to reduce CCF population under economic level. This paper highlights the assessment of oviposition period of *B. minax* in sweet oranges in citrus orchard, Sindhuli district, Nepal.

MATERIALS AND METHODS

This study was carried out to determine the oviposition period of the Chinese citrus fly, *B. minax* in sweet oranges in citrus orchard (N 27.29027, E 85.9754271, 1171 m asl) in Golanjor-5, Bijayachhap, Sindhuli, Nepal. Sweet orange branches containing at least 5 fruits were selected and used as experimental units for the treatments. Each of the selected fruit branches was covered with a piece of nylon net (mosquito net). Then, after exposing the developing fruits in the tree branch for 15 days, the branches were again enclosed in the nylon net. The duration of exposure of fruits is presented in Table 1. Sweet orange fruit diameter was measured in fifteen days interval using Calibrated Digital Verneer Caliper (BERRLION, No: 070501150), and maggots infested fruits were recorded at matured fruit stage after their harvesting by cutting fruits for maggots presence. Then, percentage fruit infestation (PFI) was calculated using the following formula.

$$\text{PFI} = (\text{No. of fruits infested} / \text{No. of fruits under study}) \times 100$$

Table 1. Fruit exposure periods allowing *B. minax* oviposition in fruits in citrus orchard, Sindhuli, Nepal

Treatment	Duration of oviposition exposed developing fruits
T1	1-15 May
T2	16-30 May
T3	31 May-14 June
T4	15-29 June
T5	30 June-14 July
T6	15-29 July
T7	Net enclosed branches with developing fruits

RESULTS AND DISCUSSION

Fruit Size of Sweet Orange during the Reproductive Tree Phenology

The sizes of the sweet orange fruits measured in 15 days interval for a period of three months from 1 May, 2021 to 30 July, 2021 are presented in Table 2. The average sweet orange fruit size (diameter) was measured 10.74 ± 0.36 mm on 1 May, 2021, and the subsequent fruit size measurements in 16 May, 31 May, 15 June, 30 June, 15 July and 30 July were to the tune of 18.31 ± 0.58 , 25.45 ± 0.41 , 32.85 ± 0.56 , 44.27 ± 0.68 , 50.12 ± 0.47 , and 54.80 ± 0.68 mm, respectively.

Table 2. The average size (mm) of sweet orange fruits (n = 5) in Sindhuli, Nepal

Measurement	1 May	16 May	31 May	15 June	30 June	15 July	30 July
Average fruit size	10.74 ± 0.36	18.31 ± 0.58	25.45 ± 0.41	32.85 ± 0.56	44.27 ± 0.68	50.12 ± 0.47	54.80 ± 0.68
Size range	8.41-14.47	15.24-24.87	22.27-29.45	27.10-32.85	38.23-48.75	47.20-54.62	50.22-61.36

n = number of fruits, Numerical with ± sign indicates the standard error (SE) of the respective mean

***B. minax* maggot infested fruits of sweet oranges**

The maximum (60 percent) *B. minax* maggot infestation was observed on fruits in the exposed sweet orange tree branches, while the average fruit size ranged from 32.85 ± 0.56 mm to 44.27 ± 0.68 mm between a period of 15 and 29 June followed by the fruits (50 percent) from the branches exposed on 30 June to 14 July where average fruit sizes ranged from 44.27 ± 0.68 mm to 50.12 ± 0.47 mm. Similarly, 15% fruit infestations were recorded from the branches exposed on May 31 to June 14 where fruit sizes ranged from 25.45 ± 0.41 mm to 32.85 ± 0.56 mm and 5% fruit infestation was recorded from branches that were exposed during July 15 to July 30 with fruit sizes ranged from 50.12 ± 0.47 mm to 54.80 ± 0.68 mm) (Fig. 1).

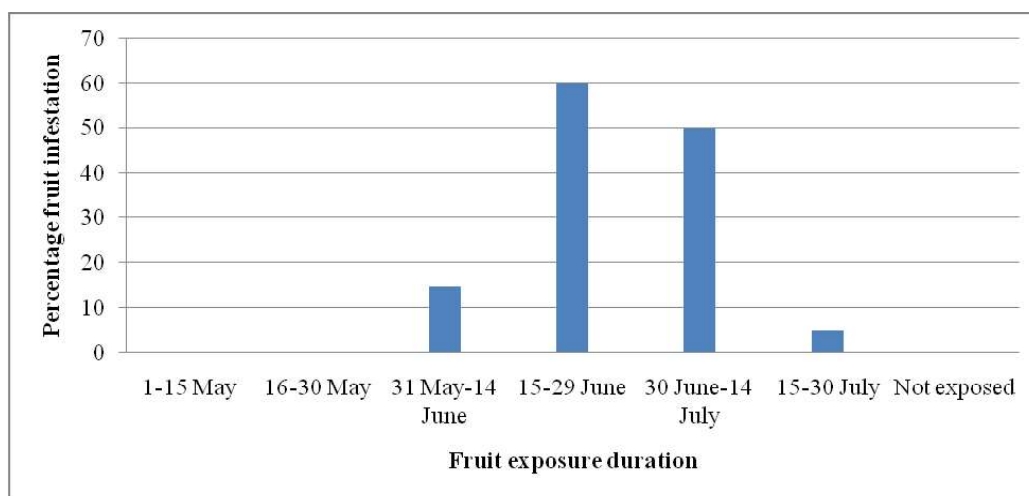


Fig. 1. *B. minax* maggot infested fruits (%) in sweet orange orchard, Sindhuli district, Nepal.

National Citrus Research Programme, Paripatle, Dhankuta, in 2014 reported the highest oviposition by the Chinese citrus fly during the month of June. Rasid *et al.* (2021) mentioned an appropriate citrus fruit size of 20-30 mm for *B. minax* oviposition. Citrus fruit's epicarp thickness had no impact on the oviposition from any type of fruit fly (*Anastrepha fraterculus* and *Ceratitis capitata* (Dias *et al.*, 2018). The inherent practice of the female Chinese citrus fly laying eggs in citrus fruits of 25 to 50 mm in size indicates that this fruit fly is very much fruit size specific for laying eggs for making generation proliferation. Understanding the proper period of egg laying in sweet orange in orchard is thus a very critical part in the field management of the Chinese citrus fly, *B. minax*.

CONCLUSIONS

The study on the oviposition preferences of *B. minax* revealed its preference of laying eggs on the developing sweet orange fruits of size 25 to 50 mm in diameter during the citrus crop cycle period of June and July. Typically, lethal protein bait must be deployed without delay in citrus orchards during the citrus crop cycle period of June and July.

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