CHINESE CITRUS FLY *(Bactrocera minax)* MANAGEMENT IN MID HILLS OF NEPAL

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ABSTRACT

Two sets of fruit fly management studies were conducted at NCRP, Dhankuta and Junar Super Zone, Sindhuli in the year 2018. Protein hydrolyzed product, Protein 17 with spinosad, Great fruitfly bait (GFF), Ceranock bait, locally made bear waste hydrolyzed protein with Spinosad, dimethoate spray and no spray treatments were replicated 4-5 times with single tree as a replication in both locations. The treatments were repeatedly sprayed on same fruiting sweet orange trees at 15 days interval and GFF bait was sprayed weekly. All the treatments were imposed within NCRP Station in Dhankuta while each treatment was applied at different farmer's orchard in Sindhuli. There was complete fruit loss from other treatments to less than 7% loss from the trees sprayed with GFF bait. The area wide management strategies with GFF bait at Tinkanya area showed reduced infestation with more fruit yield in Sindhuli.

Keywords: Area wide management, chinese citrus fly, ceranock bait, protein bait, sweet orange

INTRODUCTION

Citrus is an important fruit commodity in the mid hills of Nepal. Mandarin (*Citrus reticulata B.*) holds first position in terms of area and production followed by sweet orange (*Citrus sinensis L.*) in Nepal (Amgai *et al.,* 2016). Sweet orange is one of the important citrus fruits of Nepal and contributes for the nutritional supply and income for livelihood of Nepalese people at hilly region. Citrus fruits are generally consumed as fresh fruit and as well its processed products including different forms of juice (Adhikari and Rayamajhi, 2012). Fruits of sweet orange are popularly known as junar in Nepal. Sindhuli and Ramechhap are the two major sweet orange growing districts in Nepal.

Citrus growersof Sindhuli and Ramechhap districts are facing problem to manage fruit damage due to Chinese citrus fly (CCF) since 2014 that has been traveled from China through Bhutan and western hilly parts of India to Nepalese citrus orchards (Adhikari and Joshi, 2018). Indeed, fruit fly is one of the most important pests in fruits and fruit vegetables (Adhikari et al., 2016). A study by National Citrus Research Program (NCRP), Paripatle, Dhankuta in 2006 revealed

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that Chinese citrus fly (*B. minax*) was the species affecting the citrus fruits of NCRP, Dhankuta and its vicinity areas but not the Oriental fruit fly (NCRP, 2006). These results confirm previous studies that referred *B. minax* as the problematic fruit fly species in the eastern part of Nepal. Thus, there is need of further study for the surveillance and management of the pest (Sharma *et al.,* 2015). Nepalese citrus growers became forced to forget the tight skinned oranges such as sweet orange and lemon from the eastern hilly region due to heavy fruit damage by the maggots of fruit fly. The tight skinned oranges have been replaced by mandarin in the eastern region of Nepal where the problem of CCF is very high up to 100 %.

A field survey by a team of experts from National Citrus Research Program (NCRP), Dhankuta and Junar Super Zone, Sindhuli in 2017 in the sweet orange orchards of Sindhuli and Ramechhap reported at least 60% fruit drops caused by *Bactrocera minax* (NCRP, 2018). Farmers have tried a few ways of managing these fruitflies like burring dropped fruits in the orchard, feeding these to livestock, making compost and feeding CCF larvae to chickens, and very few farmers spraying systemic insecticide on trees during June and July. Farmer's effort in this aspect is observed not enough to combat with this insect on the said citrus decline. Therefore, a set of experiments were conducted at both locations to find out the suitable ways to control this malady of citrus decline due to CCF.

MATERIALS AND METHODS

Two sets of fruitfly management studies were conducted at orchard of NCRP, Paripatle, Dhankuta and Junar Super Zone, Sindhuli in 2018 (FY 2074/75). Protein 17 (a hydrolyzed protein product 17%) from Sentimol UK, Great fruitfly bait (from Ecoman Biotech, China), Ceranock bait station (from Russel IPM, UK) (80 traps/ha), locally made bear waste hydrolyses were replicated four times (single tree as a replication) in both locations. The treatments (Protein 17, Great fruitfly bait and beer waste hydrolyses with Tracer (a trade name of insecticide spinosad 48 SC @0.025 ml/l) were repeatedly sprayed on same marked twig of sweet orange trees at 15 days interval and Great fruit fly bait was sprayed weekly interval as spot 0.5 m^2 per three productive trees till 15 July starting from 1 May, 2018. The beer waste hydrolysed protein was prepared using method developed by Gopaul and Price (1999). All treatments were imposed in fruiting trees within NCRP in Dhankuta while each of other

treatment was applied at different localities in a single farmer's orchard in Sindhuli. Moreover, the Great fruit fly bait was applied on sweet orange orchard of 40 ha area in Golanjor-4, Tinkanya, Sindhuli. Similarly, Protein 17 trap (200 ml per trap with Tracer insecticide @0.025 ml/l) was installed one at each of the three altitude- regimes like 1100masl, 1200 masl and 1300 maslin Sindhuli, and, similarly, 3 altitudinal regimes, namely 1250, 1300, and 1350 masl were maintained at NCRP, Dhankuta. Trap was positioned at 1.5 m height in each location on sweet orange tree. Trapped fruit flies in each bait trap was collected at weekly interval starting from fourth week of March to second week of October. Data were collected for the number of fruit drops caused by fruit flies and marketable fruit yield per tree. Before statistical analysis, fruit drop percent data from both districts and yield data from Sindhuli were converted to arcsine values while the yield data from Dhankuta trail was not arcsine transformed. R (v3.3.1) statistical software with add in package ggstatplot (v 0.0.7) was used to analyze and present the graphical data.

RESULT AND DISCUSSION

SURVEILLANCE OF FRUIT FLIES

In Dhankuta, Chinese citrus fly (*Bactrocera minax*) was not trapped in the hydrolyzed protein (Protein 17) trap as well as in other traps. However, other five species of fruit flies, namely *B. scutellaris, B. tau, B. zonata, B. dorsalis and B. cucurbitae* were trapped in methyl eugenol bait traps mostly during May to July (Figure 1). This part of the season, fruit fly emergence coincides with the initial stage of sweet orange fruit in growth, and the phenological stage of citrus tree is very much favorable for oviposition on smaller fruits by *B. minax*. Unlike previous report (Bhandari et al. 2017a, NCRP 2015), no *B. minax* incidence in Dhankuta area observed that could be attributed to comparatively cooler temperature this year, 2018. As usual, five fruit fly species were observed in methyl eugenol baittrapat Sindhuli district. In addition, *B. minax* was observed in hydrolyzed protein bait trap at Sindhuli (Figure 2). The time and frequency of CCF trapping in hydrolysed protein bait (Protein 17) trap in Sindhuli district was confirmed as Bhandari et al. (2017a) and NCRP (2015) reported earlier. The time of first emergence of CCF was delayed with few days with increasing altitude which was merely due to lower temperature at higher altitude. Hence, the preventive baiting spray should be initiated earlier in the low altitude based orchards than higher altitude. Based on these result a combination of methyl eugenol and hydrolyzed protein bait spray is preferable in Dhankuta while hydrolyzed protein bait spray is recommended in May to July months for effective control of citrus fruit fly in Sindhuli district.

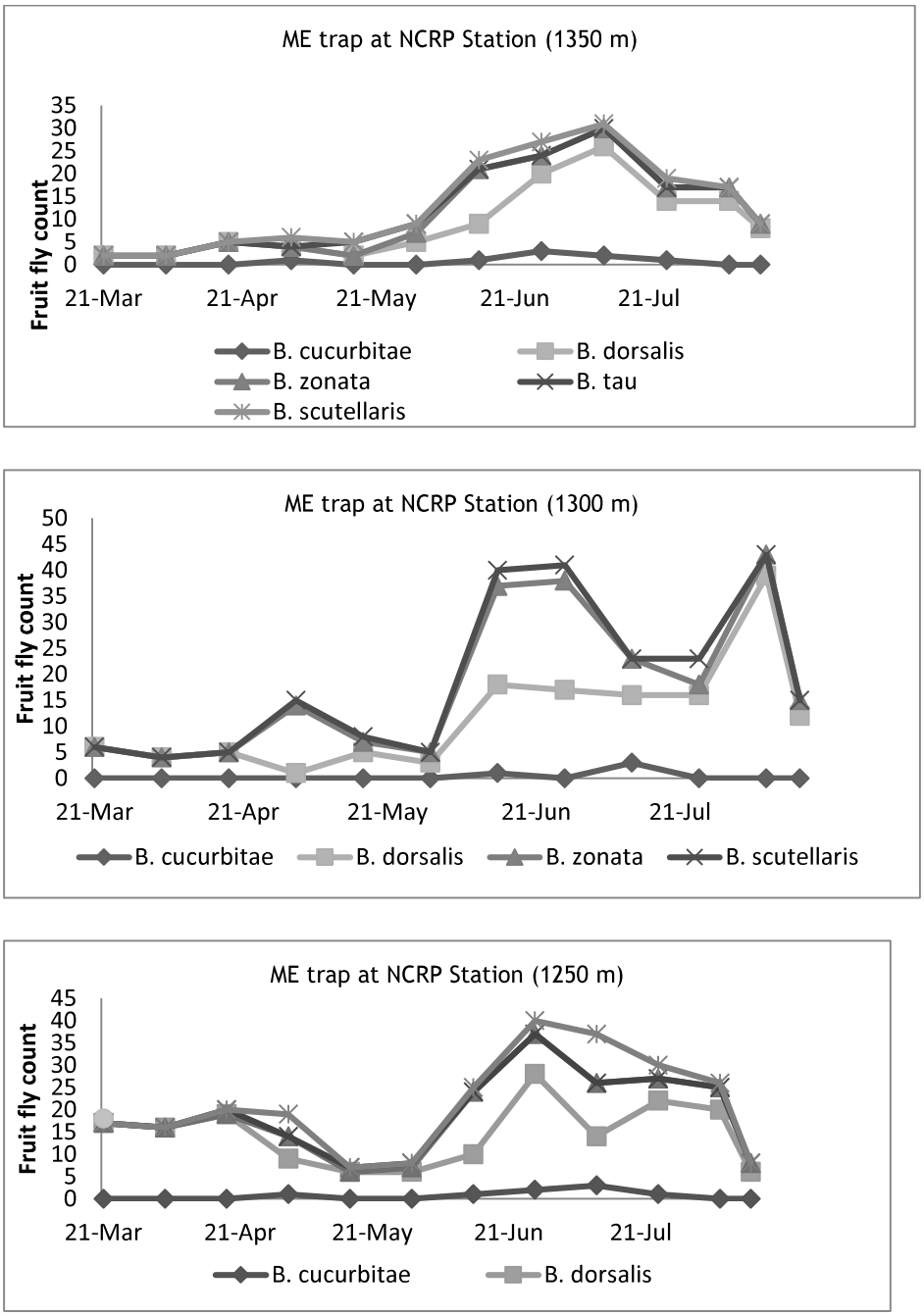


Figure 1. Fruit fly monitoringdata using methyl eugenol (ME) trap at various elevations in NCRP, Dhankuta

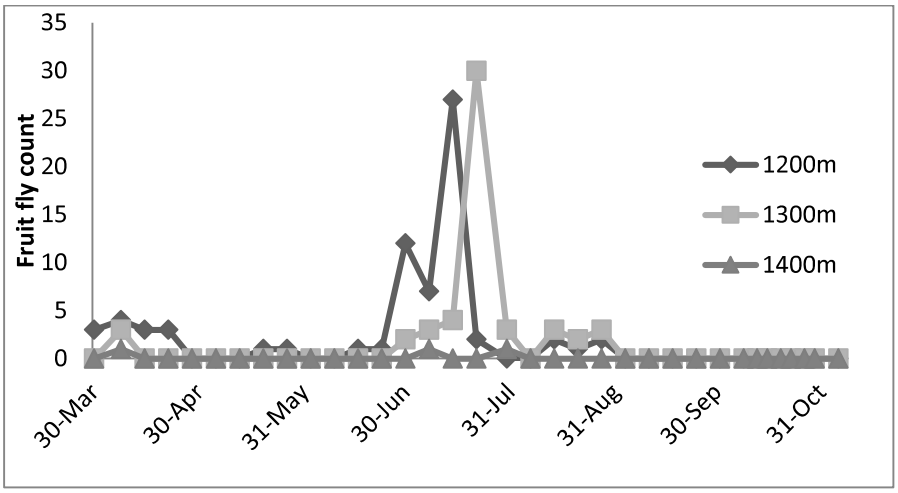


Fig. 2. Number of *B. minax* fruit flies in hydrolyzed protein bait (Protein 17) trap in sweet orange orchards at various altitudes (1200 – 1400 masl) in Sindhuli district.

CONTROL OF FRUIT DROPINGS

Differences in the fruit drop percent in various control measures recorded in Dhankuta was statistically non-significant (Figure 3). However, there was lower fruit drop in Great fruitfly (hydrolyzed protein) treatment. In contrast, the bear waste supernatant + slurry in honey bait spray and Ceranock bait station were as ineffective as negative control treatment. In contrary to Dhankuta trial, the treatment effect was highly significant to control fruit drop in Sindhuli trial (lsd= 0.051, cv= 4.64%, p value >0.001) with the use of arcsine transformed data (Figure 4a). It recorded 100% fruit drops in beer waste (supernatant with honey) and dimethoate treated plants in Sindhuli district (Figure 4b) while Ceranock bait station, hydrolyzed protein and Great fruitfly bait sprayed tree had below 7% fruit drops.

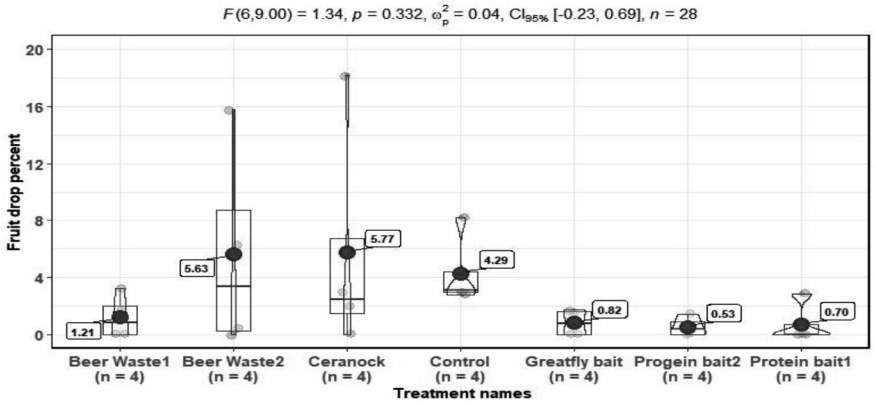
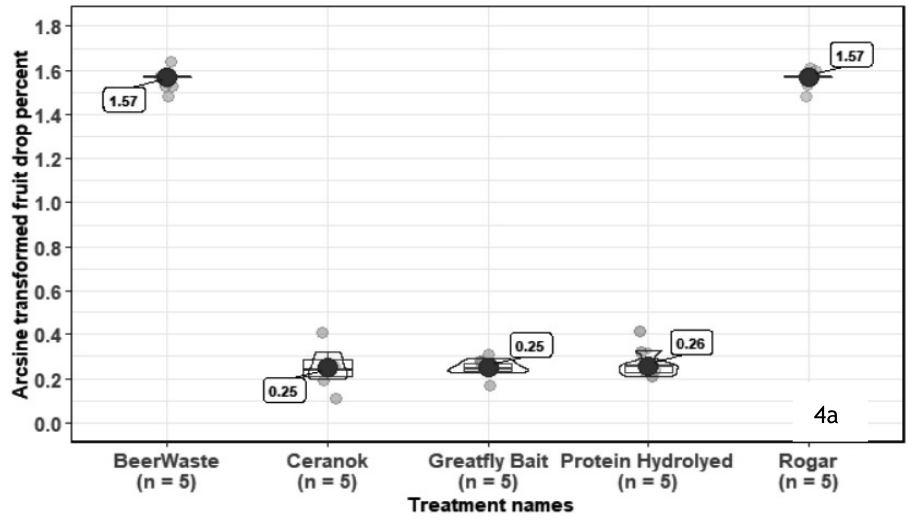


Fig. 3. Effect of various treatment on percent sweet orange fruit drop at NCRP,Dhankuta in year 2018 (circular area and number corresponding to it represent the mean fruit drop) (Beer Waste1= hydrolyzed supernatant+ water (1:1)+ honey 6 ml/l+ 0.025 ml Tracer; Beer Waste 2= hydrolyzed product supernatant+Slurry+ Water (1:1:1)+ honey 6 ml/l+ 0.025 ml Tracer/l; Ceranock= Ceranock bait station; Control= no any application; Great fruit fly bait= Great fruit fly bait +water (1:2)+ 0.025 ml Tracer/l; Protein bait 1= Protein hydrolyzed protein 50 ml/l water+ + 0.025 ml Tracer/l; and Protein bait 2= Protein hydrolyzed protein 25 ml/l water+ + 0.025 ml Tracer/l)



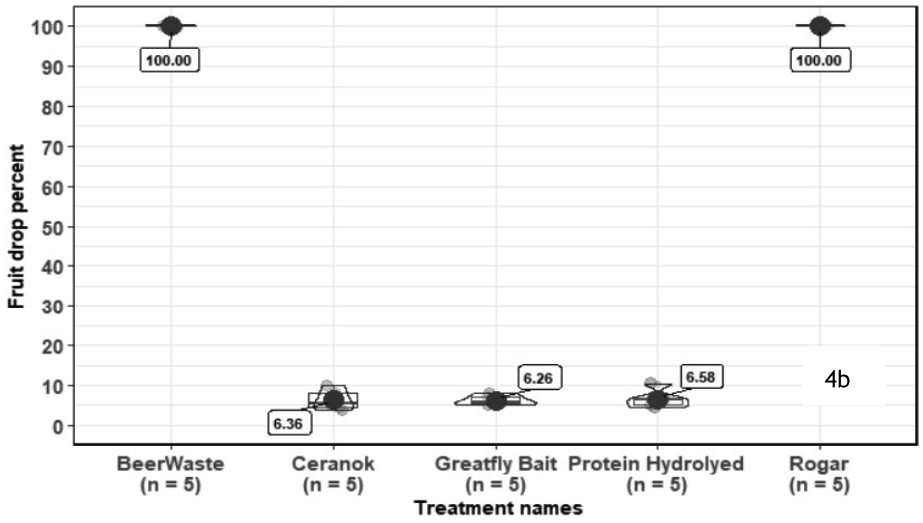


Fig. 4.Effect of various treatment on percent sweet orange fruit drop [a) arcsine transformed and b) original data] at Junar Super Zone, Sindhuli in year 2018 (circular area and number corresponding to it represent the mean fruit drop percent) (Beer Waste= hydrolyzed supernatant+ water (1:1)+ honey 6 ml/l+ 0.025 ml Tracer; Ceranock= Ceranock bait station; Great fruit fly bait= Great fruit fly bait +water (1:2)+ 0.025 ml Tracer/l; Protein bait= Protein hydrolyzed 50 ml/l water+ 0.025 ml Tracer/l; and Rogar= Rogar 1 ml/l whole tree application)

MARKETABLE FRUIT YIELD/ TREE (kg)

There was non-significant treatment effect on marketable fruit yield/tree in NCRP Dhankuta experiment (Figure 5). However, there was the highest fruit yield from hydrolyzed protein bait spray (50 ml/ l of water+ Tracer) treated plants. In contrary, the treatment effect was highly significant (lsd=0.197, cv= 26.32%, p value >0.001) in Sindhuli trial when used arcsine transformed yield data (Figure 6a). Further, there was nil fruit yield from Dimethoate (Rogar) and Beer waste (Suppernatant+ honey + Tracer) treated trees in Sindhuli district due to CCF damage fruit drop (Figure 6a and 6b). The maximum yield/tree was obtained from Great fruitfly bait spray treated trees followed by hydrolyzed protein bait sprayed and Ceranock bait station applied sweet orange trees. The yield result obtained with beer waste in this experiment was in contrary of the result obtained by Bhandari et al. (2017b) and NCRP (2015) where they obtained maximum yield with low number of fruit drop. This result could be attributed to the different technical expertise resulting difference in beer waste preparation and application method.

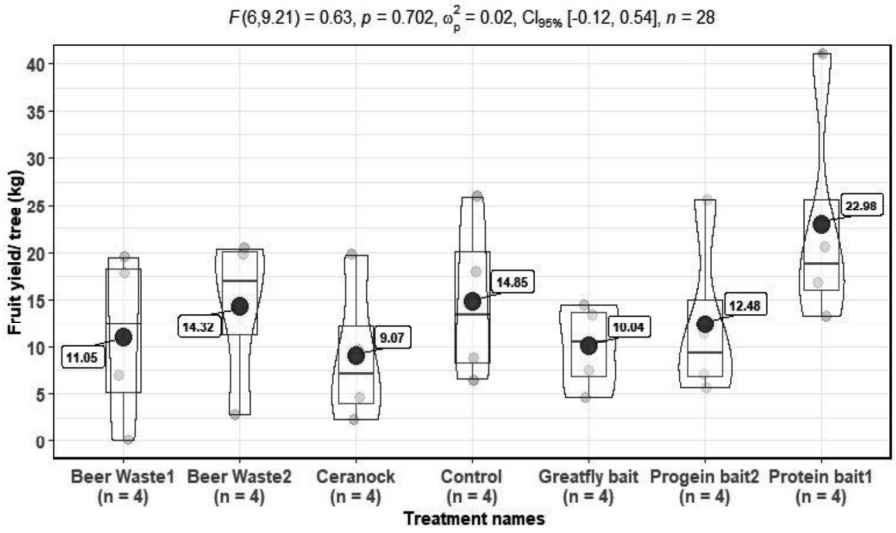


Fig 5. Effect of various treatment on sweet orange fruit yield (original data) at NCRP Dhankuta in year 2018 (circular area and number corresponding to it represent the mean fruit yield/ tree (kg))

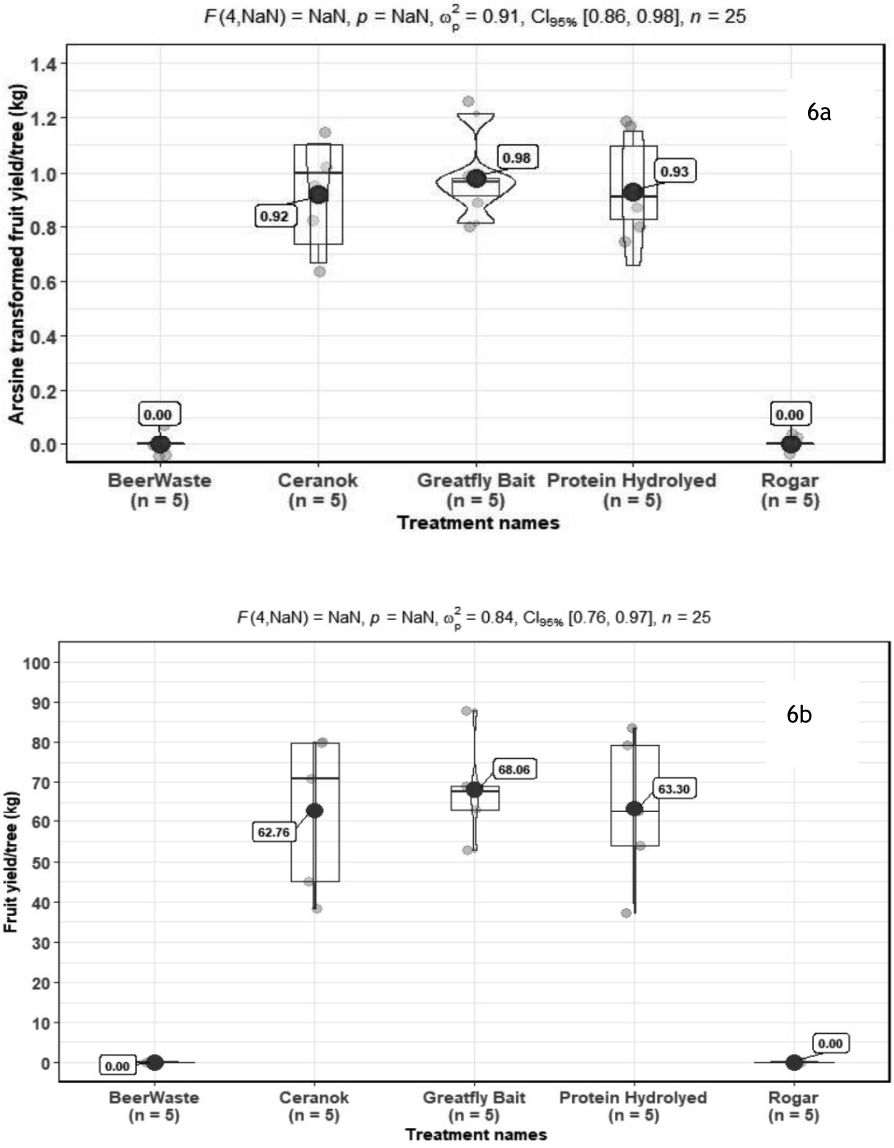


Fig 6. Effect of various treatment on sweet orange fruit production [a) arcsine transformed data and b) original data] at Junar Super zone, Sindhuli in year 2018 (circular area and number corresponding to it represent the mean fruit yield/ tree (kg))

CONCLUSION

A proper surveillance on the type of fruitfly in each year is needed to identify actual causal agent of sweet orange drop as the insect dynamics changes over time and environment. A selective bait application of protein supplemented pesticide is very effective than blanket application of systemic pesticide to whole tree and orchard. An area wide control program of insect pest is the only option which should be followed in managing sweet orange fruit drop caused by citrus fruitfly.

REFERENCES

Amgai, R. B., Prasai, H. K. and Pandey, Y. R., 2016. Hormonal effect on mandarin orange (*Citrusreticulata* Blanco) micro-propagation. Nepal Journal of Biotechnology Dec. 2016,4: 33-36.

Adhikari, D. and Rayamajhi, D. B., 2012. Status of sweet orange production in Sindhuli district of Nepal. Nepalese Horticulture. Nepal Horticulture Society, 9: 104-109.

Adhikari, D. and Joshi S. L., 2018. An issue of sweet orange fruit fly in Sindhuli, Nepal: Possible management measures. Workshop on Chinese Citrus Fly (*Bactrocera minax*).27th April, 2018, Sindhuli, Nepal.

Adhikari, D., Dougoud, J., Janner, W. and Schaffner, U., 2016. Assessment of performance of plant clinic in Nepal (A case of fruit fly management) MAS ICM Thesis. Université de Neuchâtel, Switzerland.

Bhandari, K. Ansari, A.R., Joshi, S.L., Subedi, H.P., and Thakur, M.K., 2017a. Fruit fly (Diptera: Tephritidae) diversity in citrus fruits in eastern hills of Nepal. In Gautam, I.P., Shrestha, S.L., Subedi, G.D., Bhattarai, D.R. Gotame, T.P., Upadhyay, K.P. (Eds). Proceedings of Ninth National Horticulture Workshop, May 31-June 1, 2017 (Jestha 17-18, 2074), NARC, HRD, Khumaltar, Lalitpur, Nepal. pp.50-60.

Bhandari, K. Ansari, A.R., Joshi, S.L., Subedi, H.P., and Thakur, MK., 2017b. Efficacy study of protein baits against *Bactrocera minax* and their potential use in spot spray in eastern hills of Nepal. In Gautam, I.P., Shrestha, S.L., Subedi, G.D., Bhattarai, D.R. Gotame, T.P., Upadhyay, K.P. (Eds). 2017. Proceedings of Ninth National Horticulture Workshop, May 31-June 1, 2017 (Jestha 17-18, 2074), NARC, HRD, Khumaltar, Lalitpur, Nepal. pp. 42-49.

Gopaul, S., and Price N.S. 1999. Local production of protein bait for use in fruit fly monitoring and control, In: 4th Annu. Meet. Agric. Sci. (AMAS), Food Agric. Res. Counc., Réduit, Mauritius, pp. 117-122.

NCRP. 2006. Annual Report. National Citrus Research Program, Paripatle, Dhankuta, Nepal.pp.18-20.

NCRP. 2015. Annual Report (2073/74). National Citrus Research Program, Paripatle, Dhankuta, pp. 40-44.

NCRP. 2018. Annual Report (2073/74). National Citrus Research Program, Paripatle, Dhankuta, pp.47-48.

Sharma, D. R., D. Adhikari, and D. B. Tiwari., 2015. Fruit fly surveillance in Nepal. Agricultural and Biological Sciences Journal USA1: 121-125