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# Temporal Fluctuation of *Bactrocera dorsalis* Emergence and Its Association with Abiotic Factors in Pomelo Agroecosystem

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**Abstract**

**Background:** The decrease in the output and quality of pomelo oranges due to improper growing methods and fruit fly pests poses a challenging control problem. The objective of this study is to ascertain the impact of abiotic influences on the variations in the population of fruit flies. **Method:** Observations were conducted to determine the correlation between the emergence of adult fruit flies from contaminated fruit and the population of fruit flies in the field. The study was conducted in Sukomoro District, Magetan Regency, from January - May 2024. This study integrates two techniques, explicitly using traps (Steiner traps) and host rearing. Secondary data collection encompasses gathering information on rainfall, temperature, humidity, and agriculture patterns. **Results:** The research findings identified two species of fruit flies in pomelo orange plantations, specifically *Bactrocera carambolae* and *B. dorsalis*. The rate of imago emergence ranges from 86% - 92%. **Conclusion:** each emergence is accompanied by a substantial rise in the fly population. There is no association between abiotic elements like rainfall and humidity and the changes in the fruit fly population. A statistically significant moderate correlation exists between the emergence of imago and trapped fruit flies, namely (r) of 0.616 (p) of 0.001.

***Keywords:*** Abiotic factors; Fruit flies; Pomelo; Population fluctuations



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## Introduction

The government has designated pomelo as one of the superior fruit commodities and provided various supports to increase production and quality according to the Decree of the Minister of Agriculture No. 141 / Kpts / HK.150 / M / 2/2019. Pomelo is a mainstay commodity in Magetan Regency, famous for its variety of pomelo in Nambangan. The Central Statistics Agency of Magetan Regency recorded that pomelo production in Sukomoro District in 2019 reached 259.5 tons, but in 2020, it decreased to 79.5 tons.

Improper planting practices and pests resistant to plants may cause a decrease in yield and quality of pomelo. A vital pest that attacks pomelo plantations is fruit flies. It was reported by (Yusmaizah et al., 2022) that the average population of Bactrocera spp. Caught on pomelo plantations in Magetan Regency reached 385 individuals/day.

Fruit flies show high aggression towards plants in cool climates, high humidity, and moderate wind conditions (Susanto et al., 2017). Temperature, humidity, and rainfall are abiotic factors that affect changes in fruit fly populations (Pramanik et al., 2022). Fruit fly populations can be inhibited by rainfall below 50 mm/month or above 250 mm/month (Syahputera et al., 2022). Ideal conditions for pupal growth are a humidity range of 70-80% and a temperature range of 26-32°C (Chuang et al., 2014).

Updating accurate statistical data on fruit fly species and populations and abiotic influences on fruit fly population fluctuations is needed as basic data in developing practical and sustainable plant pest management strategies. This study aimed to determine the impact of abiotic influences on fruit fly population fluctuations. Further observations were made to determine the relationship between the emergence of adult fruit flies from contaminated fruit and the fruit fly population in the field.

## Methods

The research was conducted in January-May 2024. The study was conducted in 3 pomelo fields in 3 different villages: Tamanan Village, Tambakmas Village, Bibis Village, Sukomoro District, and Magetan Regency. This research was carried out in 2 series of activities: installing steiner traps in the field and host rearing in the laboratory. The traps were installed in the pomelo plantation, Sukomoro District, Magetan Regency. Host rearing and identification were conducted at the Plant Health Laboratory, Faculty of Agriculture, East Java Veteran National Development University. The tools used in this study were 1500 ml bottles, scissors, solder, gloves, pliers, transparent tubes, wire, 3 ml syringes, vials, clear plastic jars, 4 L plastic containers, gauze, paper cups, endoscope microscopes with resolution of 2 MP and stationery. The materials used in this study were cotton, water, methyl eugenol with the trademark petrogenol, soap, glue gun, 70% alcohol, sawdust, sugar, and yeast.

### *Steiner trap*

Traps will be installed on trees at a height of 1.5 meters above the ground. Traps are installed on tree branches closest to the middle trunk. Cotton is replaced every week, considering the persistence or duration of methyl eugenol's active period. Observations are made by counting the population and identifying the types of fruit flies trapped.

### *Host rearing*

Fruit samples from fruit fly-infested fields were collected and stored in plastic jars. The lids of the pots were covered with gauze, while the bottoms were lined with sterilized sawdust, which served as a substrate for fruit fly pupae. The fruit fly larvae inside the fruits were cultured until they underwent metamorphosis and became pupae. These pupae were then collected and transferred to net cages, where they were reared until adulthood as fruit fly imago. Fruit fly imago were fed sugar and yeast in a ratio of 1:4 (Aryuwandari et al. 2020; He et al., 2020).

### *Compost Quality Test*

The compost quality test includes color, odor, pH, electrical conductivity (EVC), organic C, water content, nitrogen, phosphorus, and potassium. The method used for characterization refers to the Soil Biology Lab guide, Faculty of Agriculture, UNUD.

### *Calculation of fruit fly population*

The fruit fly population was determined by counting the number of individual fruit flies per trap per day (F.T.D.), which is the number of individuals that estimates the average number of fruit flies caught in each trap installed in the field during one day.

$$\text{F.T.D} = \frac{F}{T \times D}$$

Note:
F = number of individual fruit flies trapped;
T = Total traps installed;
D = number of days of trap installation

### *Percentage of fruit fly imago emergence*

The total number of pupal shells and the number of hatched imagos are calculated to determine the percentage of imago emergence using the formula belonging to Aryuwandari et al. (2020):

$$\text{The Emergence of Imago} = \frac{\sum Imago}{\sum pupa} \times 100\%$$

## Result

### *Fruit Fly Identification*

Identification results showed two species of fruit flies captured in pomelo fields, namely Bactrocera carambolae and B. dorsalis. B. carambolae and B. dorsalis are considered endemic to subtropical and tropical areas (Susanto et al., 2022). B. carambolae has distinct morphological characteristics on its head, including prominent facial spots, black scutum, and parallel lateral postural vittae (Figure 1). B. carambolae shows a prominent 'T'-shaped black line pattern on tergum III of its abdomen, while a square black line pattern is seen at the tip of tergum IV. The costal band on the black wings slightly overlaps at $R_{2+3}$ then extends past $R_{4+5}$ around the wingtip. Siwi et al. (2006), Suputa et al. (2006), and Syahputera et al. (2022) stated that B. carambolae has a black line on the abdomen that looks thicker than the B. dorsalis type.

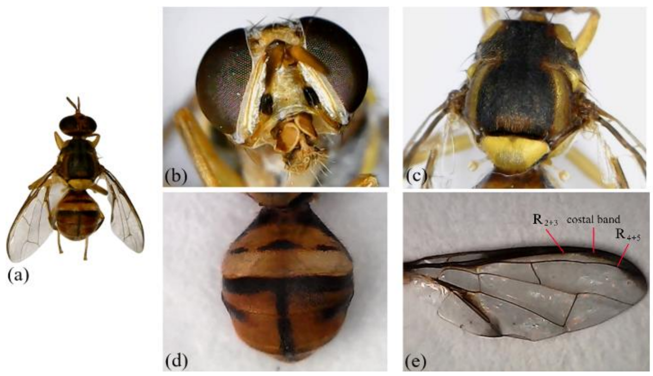


**Figure 1.** Morphology of Bactrocera carambolae found in the field, (a) Whole body, (b) Caput, (c) Thorax, (d) Abdomen, (e) Wings

The morphological characteristics of the facial spot and thorax of B. dorsalis are similar to B. carambolae. B. dorsalis is a major polyphagous fruit pest that attacks more than 300 hosts (Susanto et al., 2022). The distinguishing characteristic of these two species is that B. dorsalis has a black line on its abdomen that forms a "T" pattern. This line narrows towards the middle and has a thin black pattern at the tip of tergum IV (Figure 2). The wings of B. dorsalis have a thin black costal band that joins the $R_{2+3}$ vein and extends past the tips of $R_{2+3}$ and $R_{4+5}$ to the apex.

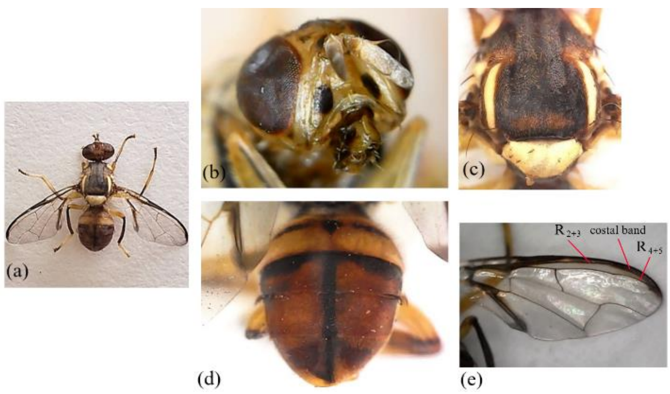


**Figure 2.** Morphology of Bactrocera dorsalis found in the field, (a) Whole body, (b) Caput, (c) Thorax, (d) Abdomen, (e) Wings

### *Ratio of Trapped Fruitfly Species*

The B. carambolae species has a higher average population than B. dorsalis. The large population of the B. carambolae species is because the pomelo plant is thought to be one of the host plant expansions of the species (Soares et al., 2023). Fruit flies look for host plants that are round, golden in color, and fragrant (Ghabbari & Jemâa, 2024). The existence of the B. dorsalis species is possible because there are host plants of the fruit fly species around the land. The host plant's phenology influences fruit flies' population density, alternative hosts' availability, and supportive environmental conditions (Kolopaking et al., 2023).

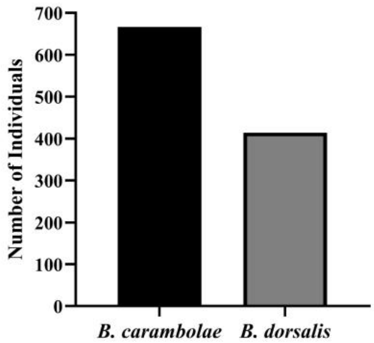


**Figure 3.** Graph of the ratio of trapped fruit fly species

### *Relationship between the emergence of fruit fly imago resulting from host rearing and traps*

The emergence of fruit fly imago from host rearing was 86.2-92.3% (Table 1). The observed pupal mortality rate was 7.7-13.8%. The high percentage of fruit fly imago emergence is possible due to the controlled environmental conditions in the laboratory that support the development of fruit fly larvae to the imago phase. The laboratory temperature is set at 20-30°C as a favorable temperature for development and survival (Michel et al., 2021).

**Table 1.** The number of pupae to imagine survival results from host-rearing

| Location | Number of Pupae | Adult Emergence (%) | Dead Pupae (%) |
|---|---|---|---|
| A | 46 | 89.2 | 10.8 |
| B | 38 | 92.3 | 7.7 |
| C | 61 | 86.2 | 13.8 |

Pupal mortality can be caused by parasitism and non-parasitism in the form of quality and variation of nutrients in the host fruit. Aryuwandari et al. (2020) stated that variations in fruit fly quality and variations of nutrients cause pupal mortality. Syamsudin et al. (2019) state that the growth environment in the host fruit affects the success rate of fruit fly imago. Abiotic factors in the form of soil moisture influence the viability of pupae from host rearing (Amaral et al., 2021). Another factor that can cause the failure of pupae to become imago is physical injury to the pupae, such as falling or being pinched when harvesting pupae from the host-rearing container to the imago cage. The emergence of imago from the maintenance of fruit attacked by fruit flies with the population of fruit flies trapped in the Steiner trap obtained the regression equation $Y = 11.716 + 0.277x$. A statistically significant moderate correlation exists between the emergence of imago and the population of trapped fruit flies, indicated by a p-value of 0.001. This information is presented in Figure 4. The relationship between the emergence of imago and the population of trapped fruit flies shows a moderate correlation with a correlation coefficient (R) of 0.616. A positive correlation indicates that an increase will follow each emergence of imago fruit flies in the number of fruit fly populations in the field.

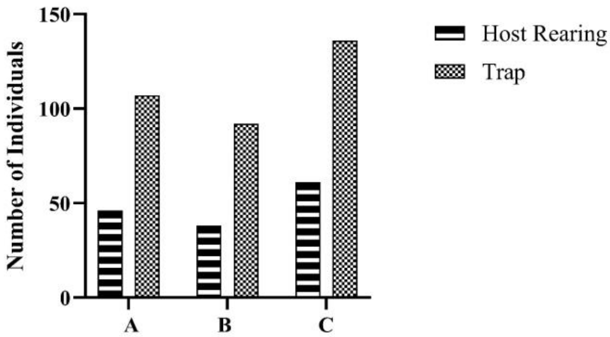


**Figure 4.** The number of fruit fly imago results from host rearing and trapping.

### *Sex Ratio of Fruit Fly Imago from Host Rearing*

Sex ratios can provide important information about the history of a population, current population conditions, and future population forecasts. Female fruit flies are characterized by an ovipositor (Figure 5). The ovipositor in female fruit flies is a posterior abdominal structure used to insert eggs into the flesh of the host fruit.

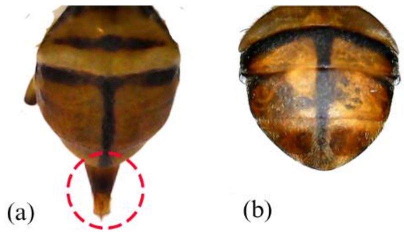


**Figure 5**. Differences in the morphology of the fruit fly sex, (a) Female, (b) Male

The observed sex ratio of fruit flies was 1.3:1, indicating a higher proportion of female flies than male flies, but the ratio was close to 1:1 (Figure 6). The sex of the offspring was determined by an equal probability of 50% between male and female offspring. Papach et al. (2019) reported that the sex ratio of insects is often the same, with an equal number of males and females. This aligns with the research of Kusumawati & Sudaryadi (2022), who found that the sex ratio of fruit flies was also 1:1, indicating an equal number of males and females. The sex-determining genes of an organism determine the potential sex potential.

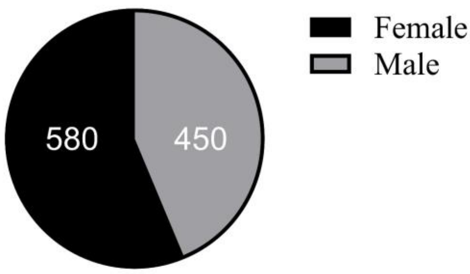


**Figure 6.** Sex ratio of fruit flies resulting from host rearing.

The emergence of female fly imagos that are higher than males will trigger a spike in the fruit fly population in the next generation. The potential for an increase in the fruit fly population in each generation is higher because more females are available to lay eggs. Pasinato et al. (2019) studied female Bactrocera carambolae and found they could lay eggs 2-3 times with 7-10 punctures on one host fruit. Pangihutan et al. (2022) said that the oriental fruit fly B. dorsalis lays eggs under the fruit's skin, then the larvae hatch and develop inside the fruit. During its life, female fruit flies can produce thousands of eggs (Clarke, 2019), and female flies choose fruits with high carbohydrate content to lay eggs (Syamsudin et al., 2022).

***Relationship of Abiotic Factors with Fruit Fly Population Fluctuations***

The first week produced the highest average fruit fly catch, 29 individuals. The number of catches decreased in the second to ninth weeks. The average temperature during the 9 weeks was relatively stable, fluctuating in the range of 26-28°C without significant variation. The ideal temperature range for fruit fly development is around 26-32°C (Syahputera et al., 2022). At the beginning of the trial, there was heavy rainfall, which decreased in the 5th to 9th weeks. Humidity ranged from 86% to 92% and remained relatively stable without significant fluctuation.

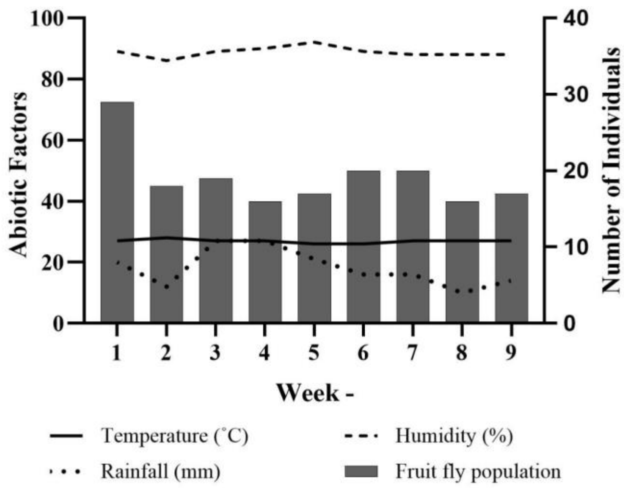


**Figure 7.** The influence of abiotic factors: temperature (˚C), rainfall (mm), and humidity (%) on fruit fly catches in the field

The relationship between abiotic factors such as rainfall and humidity with fluctuations in fruit fly populations showed no correlation, with a correlation coefficient of rainfall of 0.09 and moisture of 0.08. The relationship between temperature and fluctuations in fruit fly populations on pomelo showed a weak correlation with a correlation coefficient of 0.23.

**Table 2.** Relationship between abiotic factors and fluctuations in fruit fly populations in the field

| Abiotic Factors | Regression Equation | R | $R^2$ | df | t-count | Sig. |
|---|---|---|---|---|---|---|
| Temperature | 95.175 – 2.827x | 0.23 | 0.05 | 26 | -1.189 | 0.246 |
| Rainfall | 17.931 + 0.076x | 0.09 | 0.01 | 26 | 0.425 | 0.675 |
| Humidity | 44.785 – 0.287x | 0.08 | 0.01 | 26 | -0.423 | 0.676 |

The findings of this study differ from the studies conducted by (Danjuma et al., 2014 Jayanthi & Verghese, 2011; Khan et al., 2021), which stated that abiotic factors, including rainfall, humidity, temperature, duration of exposure, and wind speed have an impact on fluctuations in fruit fly populations. (Syahputera et al., 2022) This showed that variations in precipitation and moisture significantly impacted fluctuations in fruit fly populations, although temperature did not show a significant effect. Another study by (Putri et al., 2024) revealed changes in Bactrocera spp. Populations were closely related to variations in rainfall and relative humidity, but their relationship with temperature and wind speed was relatively weaker. The abiotic factors studied in this study showed a weak correlation ($r = 0.13$; $p > 0.05$), so they were not statistically significant to fluctuations in fruit fly populations in the field. The stability of abiotic factors during the study period is believed to be why these factors did not affect fluctuations in fruit fly populations. Fruit flies show a higher level of adaptation to consistent abiotic conditions at the study site, making them less responsive to small fluctuations in these parameters (Dineshkumar et al., 2023). The cumulative impact of constant abiotic elements can significantly impact fruit fly populations over a long study period. However, these long-term effects may not be immediately apparent in short-term studies. According to (Yin et al., 2018), in endemic areas of Bactrocera spp. Constant temperature and humidity are standard, and the factor that most influences the abundance and fluctuation of fruit fly populations is the availability of suitable hosts.

The maintenance treatment and cultivation patterns by farmers during the study also influenced the fluctuation of fruit fly populations in the field. Land maintenance, such as routine sanitation, impacts the number of fruit fly populations in the field. This is supported by research (Putri et al., 2024), which states that land with better sanitation and fewer host plants around it has a lower fruit fly population. Mutamiswa et al. (2021) noted that routine sanitation treatment can control fruit fly attacks in the following period.

### Conclusions

The research findings indicate the presence of two different species of fruit flies, namely Bactrocera carambolae and B. dorsalis. Variations influence the presence of fruit flies in an area in terms of vegetation and land conditions. There is a relationship between the number of fruit fly populations seen in the field and the percentage of adult fruit flies that emerge from being kept on the host. Abiotic elements such as rainfall and humidity do not affect changes in fruit fly populations in the field. However, there is a slight relationship between temperature and fluctuations in fruit fly populations.

### Acknowledgment

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### Declaration statement

The authors reported no potential conflict of interest.

## References

Amaral, E. J. F. do, Sousa, M. do S. M. de, Santos, J. E. V. dos, Costa, L. M., Melém Júnior, N. J., Toledo, J. J. de, & Adaime, R. (2021). Effect of soil class and moisture on the depth of pupation and pupal viability of *Bactrocera carambolae* Drew & Hancock (1994). *Revista Brasileira de Entomologia*, *65*(1), 1–8. https://doi.org/10.1590/1806-9665-RBENT-2020-0075

Aryuwandari, V. E. F., Trisyono, Y. A., Suputa, S., Faveri, S. D., & Vijaysegaran, S. (2020). Survey of Fruit Flies (Diptera: Tephritidae) from 23 Species of Fruits Collected in Sleman, Yogyakarta. *Jurnal Perlindungan Tanaman Indonesia*, *24*(2), 122–132. https://doi.org/10.22146/jpti.57634

Chuang, C.-L., Yang, E.-C., Tseng, C.-L., Chen, C.-P., Lien, G.-S., & Jiang, J.-A. (2014). Toward anticipating pest responses to fruit farms: Revealing factors influencing the population dynamics of the Oriental Fruit Fly via automatic field monitoring. *Computers and Electronics in Agriculture*, *109*, 148–161. https://doi.org/10.1016/j.compag.2014.09.018

Clarke, A. R. (2019). *Biology and management of Bactrocera and related fruit flies*. CABI. https://doi.org/10.1079/9781789241822.0000

Danjuma, S., Thaochan, N., Permkam, S., & Satasook, C. (2014). Effect of temperature on the development and survival of immature stages of the carambola fruit fly, *Bactrocera carambolae*, and the Asian papaya fruit fly, *Bactrocera papayae*, reared on guava diet. *Journal of Insect Science*, *14*(1), 126. https://doi.org/10.1093/jis/14.1.126

Dineshkumar, S., Kannan, M., Soundararajan, R. P., Boopathi, N. M., Jayakanthan, M., & David, K. J. (2023). Methyl eugenol (parapheromone) trapping system on diversity of fruit flies and influence of weather parameters on trap catches in mango and guava cropping systems. *International Journal of Environment and Climate Change*, *13*(9), 3027–3037. https://doi.org/10.9734/ijecc/2023/v13i92542

Pangihutan, J. C., Dono, D., & Hidayat, Y. (2022). The potency of minerals to reduce oriental fruit fly infestation in chili fruits. *PeerJ*, *1*(1), 1–14. https://doi.org/10.7717/peerj.13198

Ghabbari, M., & Jemâa, J. M. B. (2024). Infestation and evaluation of damage of the Mediterranean fruit fly (Medfly), *Ceratitis capitata* (Wied.) (Diptera: Tephritidae) on Citrus in Southern Tunisia. *Journal of Oasis Agriculture and Sustainable Development*, *6*(01), 113-122. https://doi.org/10.56027/JOASD.112024

He, Z., Gui, L., Wang, F., Shi, Y., Liang, P., Yang, X., Hua, D., & Du, T. (2020). Effect of male inflorescence of *Castanea mollissima* on the reproductive development and lifetime of *Bactrocera minax*. *Journal of Asia-Pacific Entomology*, *23*(4), 1041–1047. https://doi.org/10.1016/j.aspen.2020.08.017

Jayanthi, P. D. K., & Verghese, A. (2011). Host-plant phenology and weather based forecasting models for population prediction of the oriental fruit fly, *Bactrocera dorsalis* Hendel. *Crop Protection*, *30*(12), 1557–1562. https://doi.org/10.1016/j.cropro.2011.09.002

Khan, M., Khuhro, N., Awais, M., Asif, M. U., & Muhammad, R. (2021). Seasonal Abundance of Fruit Fly, Bactrocera species (Diptera: Tephritidae) with Respect to Environmental Factors in Guava and Mango Orchards. *Pakistan Journal of Agricultural Research*, 34(2), 266-272. https://doi.org/10.17582/journal.pjar/2021/34.2.266.272

Kolopaking, B., Rizali, A., Affandi, A., Hudiwaku, S., & Himawan, T. (2023). Population Dynamic and Distribution of Bactrocera carambolae and Bactrocera dorsalis in Orchard Habitat in Different Geographical Areas. *Research Journal of Life Science*, *10*(1), 1-12. https://doi.org/10.21776/ub.rjls.2023.010.01.1

Kusumawati, N., & Sudaryadi, I. (2022). Effect of feeding kiwifruit (Actinidia deliciosa) extract on survival rate and reproductive organ morphology of fruit fly (*Drosophila melanogaster* Meigen, 1830) ultraviolet light irradiation. *Berkala Ilmiah Biologi*, *13*(3), 9-18. https://doi.org/10.22146/bib.v13i3.5215

Michel, D. K., Fiaboe, K. K. M., Kekeunou, S., Nanga, S. N., Kuate, A. F., Tonnang, H. E. Z., Gnanvossou, D., & Hanna, R. (2021). Temperature-based phenology model to predict the development, survival, and reproduction of the oriental fruit fly *Bactrocera dorsalis*. *Journal of Thermal Biology*, 97, 102877. https://doi.org/10.1016/j.jtherbio.2021.102877

Mutamiswa, R., Nyamukondiwa, C., Chikowore, G., & Chidawanyika, F. (2021). Overview of oriental fruit fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) in Africa: From invasion, bio-ecology to sustainable management. *Crop Protection*, *141*, 105492. https://doi.org/10.1016/j.cropro.2020.105492

Papach, A., Gonthier, J., Williams, G. R., & Neumann, P. (2019). Sex ratio of small hive beetles: the role of pupation and adult longevity. *Insects*, 10(5), 2-5. https://doi.org/10.3390/insects10050133

Pasinato, J., Redaelli, L. R., Botton, M., & Jesus-Barros, C. R. de. (2019). Biology and fertility life table of *Bactrocera carambolae* on grape and acerola. *Revista Brasileira de Entomologia*, *63*(3), 217–223. https://doi.org/10.1016/j.rbe.2019.06.001

Pramanik, S., Debnath, P., Pandit, M. K., Gupta, A. K., & Naskar, M. K. (2022). Fruit fly species diversity, population dynamics and infestation rate during fruiting season of snake gourd. *South African Journal of Botany*, *145*, 303–312. https://doi.org/10.1016/j.sajb.2021.09.021

Putri, Y. D., Gunadi, R., Pranowo, D., Affandi, A., & Suputa, S. (2024). Population dynamic of fruit fly pests *Bactrocera* spp. in salacca orchard in relation to host plants and climate factors. *Journal of Agricultural Science*, *46*(1), 1–14. http://doi.org/10.17503/agrivita.v46i1.4257

Siwi, S., Hidayat, P., & Suputa, S. (2006). *Taksonomi dan Bioekologi Lalat Buah Penting di Indonesia (Diptera: Tephritidae)*.

Soares, G. K. A., Fidelis, E. G., Farias, E. S., Rodrigues, G. S., & Paes, J. L. A. (2023). Range expansion and population dynamics of *Bactrocera carambolae* in Roraima, Brazil. *Crop Protection*, *165*, 106167. https://doi.org/10.1016/j.cropro.2022.106167

Suputa, Cahyaniati, Kustaryati, A., Railan, M., Issusilaningtyas, U., & Mardiasih, W. (2006). *Pedoman Identifikasi Lalat Buah Hama*. Kementerian Pertanian, Jakarta, Indonesia. 32 p.

Susanto, A., Faradilla, M. G., Sumekar, Y., Yudistira, D. H., Murdita, W., Permana, A. D., Djaya, L., & Subakti Putri, S. N. (2022). Effect of various depths of pupation on adult emergence of interspecific hybrid of *Bactrocera carambolae* and *Bactrocera dorsalis*. *Scientific Reports*, *12*(1), 1–7. https://doi.org/10.1038/s41598-022-08295-w

Susanto, A., Fathoni, F., Atami, N. I. N., & Tohidin, T. (2017). Fluktuasi populasi lalat buah (*Bactrocera dorsalis* Kompleks.) (Diptera: Tephritidae) pada pertanaman pepaya di Desa Margaluyu, Kabupaten Garut. *Agrikultura*, *28*(1), 32-38. https://doi.org/10.24198/agrikultura.v28i1.12297

Syahputera, I., Susanto, A., & Permana, A. D. (2022). Fluktuasi populasi dan identifikasi lalat buah *Bactrocera* spp. pada pertanaman mangga varietas gedong gincu di Jatigede Sumedang. *Agrikultura*, *33*(1), 83-88. https://doi.org/10.24198/agrikultura.v33i1.37796

Syamsudin, T. S., Faizal, A., & Kirana, R. (2019). Dataset on antixenosis and antibiosis of chili fruit by fruit fly (*Bactrocera dorsalis*) infestation. *Data in Brief*, *23*, 103758. https://doi.org/10.1016/j.dib.2019.103758

Syamsudin, T. S., Kirana, R., Karjadi, A. K., & Faizal, A. (2022). Characteristics of Chili (Capsicum annuum L.) That Are Resistant and Susceptible to Oriental Fruit Fly (*Bactrocera dorsalis* Hendel) Infestation. *Horticulturae*, *8*(4), 1–15. https://doi.org/10.3390/horticulturae8040314

Yin, N. N., Theint, Y. Y., Myaing, K. M., S. S. Oo, O. Khin, M. Yin, M. T. Aye, H. H. Hlaing, K. Swe, & Naing Kyi Win. (2018). Relationship between population fluctuation of oriental fruit fly *Bactrocera dorsalis* Hendel and abiotic factors in Yezin, Myanmar. *Journal of Life Sciences*, *12*(3), 141-149. https://doi.org/10.17265/1934-7391/2018.03.004

Yusmaizah, Y., Sahputra, H., & Lizmah, S. F. (2022). Pengaruh perangkap sintetis metil eugenol untuk mengendalikan hama lalat buah *Bactrocera* spp. pada tanaman jeruk pamelo. *Jurnal Pertanian Agros*, *24*(1), 243-252. https://doi.org/10.37159/jpa.v24i1.1537