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Minimization of Insect Pest Attacks with the Concept of *Urban Farming Agriculture*

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Abstrak

Urban Farming is an agricultural system without the use of soil media that utilizes narrow land in urban areas and is free from the use of synthetic pesticides. This study aims to identify the types and abundance of insects that attack cultivated plants in *Urban Farming*. Data collection was carried out by observation using the yellow pan, netting, and hand picking methods. Insect identification is carried out on the basis of morphological features of insects. The data were analyzed with the insect abundance index (Di). The results showed that the highest insect abundance found at the *Urban Farming* Surabaya agricultural location was Aphis gossypii with an abundance index value of 26.37% and the lowest insect abundance was Hishimonus spatulatus, Meniscus midge, Murgantia histrionica, Mylabris phalerata with an abundance index value of 0.34%. Where found 34 species of insects with 27 families namely the family Acrididae, Agromyzidae, Aleyrodidae, Aphididae, Apidae, Calliphoridae, Chrysomelidae, Cicadelloidae, Coccinellidae, Crambidae, Dixidae, Dolichopodidae, Gryllidae, Hesperiidae, Meloidae, Muscidae, Noctuidae, Pentatomidae, Pieridae, Pseudococcidae, Psilidae, Sapygidae, Staphylinidae, Stratiomyidae, Syrphidae, Tetranychidae and Thripidae.

Keywords: insects, abundance, *Urban Farming*

INTRODUCTION

Conventional agriculture or inorganic agriculture in Indonesia is characterized by agriculture with a dependence on the use of chemical fertilizers, synthetic pesticides and overgrowth regulators and requires a large area of land (Othman, 2007). Conventional agricultural systems aim to increase crop production quickly but can have a negative impact on the agricultural ecosystem itself due to habitat destruction and disruption of ecosystem balance in the cultivation system carried out (Aryantha, 2002). This conventional agricultural product is also harmful to human health because it is the result of the use of chemical pesticides (Biao, 2003).

The organic farming system or *Urban Farming* is different from the conventional farming system. *Urban Farming* is a form of agricultural activity to process, distribute, and increase the amount of food crop availability that utilizes abandoned land in urban areas (Lanarc, 2013). In Indonesia, *Urban Farming* with hydroponic methods has been widely applied to various big cities such as Surabaya, Jakarta, Bandung and others by utilizing narrow land in urban areas (Widyawati, 2013).

The Urban Farming farming system is widely carried out because it has various advantages such as being able to provide solutions to the problem of decreasing agricultural land productivity in Indonesia, easy maintenance, and being able to overcome the problem of declining environmental quality (Lanarc, 2013). *Urban Farming* in its application prioritizes the balance of ecosystems and environmental friendliness by utilizing natural materials so as to affect the abundance of insects including predators (natural enemies) (Green, 2012).

Sembel (2010) stated that the presence of insects as natural enemies on *Urban Farming* lands plays an important role in controlling and reducing pest populations, so that insect attacks can be controlled and the ecosystem becomes stable. The abundance of these insects can affect the quality and quantity of agricultural products produced (Suheriyanto, 2008).

So it can be known that insects play an important role in the ecosystem and are very influential in agriculture, because the stability of agriculture can be known through the large abundance of insects in agricultural locations (Lavelle et al, 2006). Previous research conducted by Samudra (2013) also showed the same thing that the presence of insects functions in minimizing pest attacks and creating ecosystem balance in *Urban Farming farmland*.

Based on the background described above, it is necessary to conduct further research on minimizing insect pest attacks with the concept of *urban farming*. This research was conducted with the hope of providing information so that the results of this study can be used as considerations in agricultural land management in Indonesia.

METHOD

In the first stage of the study, field observations were carried out to determine several observation sites of insect samples. This research was conducted in the *Urban Farming* area of Surabaya for 7 months, from May to October 2019. There are four stations where insect samples are observed to represent the *Urban Farming* Area in Surabaya, namely:

a) Location 1 (*Urban Farming* production on conventional land)

Urban Farming on conventional land is Tunas *Urban Farming* which is an urban farm using the concept of hydroponic farming in open land and equipped with a roof made of UV plastic. Tunas *Urban Farming* is located on Jl. Gayungsari Barat I No.30, Pagesangan, Jambangan District, Surabaya City surrounded by vacant land that is overgrown with wild plants. Tunas *Urban Farming* produces several types of vegetables including curly green lettuce, *red oak leaf* lettuce, *romaine green lettuce* , and pakcoy.

b) Location 2 (*Urban Farming* of household-scale production on conventional land)

Household-scale urban farming on conventional land, one of which is Jawara Farm which is a hydroponic garden in urban areas with the concept of hydroponic farming located in the front yard of the house and equipped with a roof made of UV plastic. Jawara Farm is located on Jl. Ketintang No.23, Wonokromo, Kec. Wonokromo, Surabaya City and is surrounded by housing. Jawara Farm produces several types of vegetables including batik spinach, curly green lettuce (green curly lettuce), romaine green lettuce (green romaine lettuce), kale, mint, mustard caisim, mustard samhong, melon, celery, pakcoy, and spinach batik.

c) Location 3 (*Urban Farming* of household-scale production on the upper terrace of the house)

Urban Farming household-scale production on the upper terrace of the house, one of which is 632 Hydroponic Homefarm which is a hydroponic garden in urban areas with the concept of hydroponic farming which is on the upper terrace of the house and without being equipped with a roof. 632 *Hydroponic Homefarm* located on Jl. Raya Taman Indah VI No.32, Menanggal, Gayungan, Surabaya is still classified as a small scale household located surrounded by housing. 632 *Hydroponic Homefarm* produces several types of vegetables including kale, pakcoy, celery, romaine green lettuce (green romaine lettuce), and mustard samhong.

d) Location 4 (*Urban Farming* production on the roof of the building)

Urban Farming on the land on the top of the building, one of which is the Hydrofarm Roof Garden which is a hydroponic garden in urban areas with the concept of hydroponic agriculture which is on the roof of the building with open conditions without being equipped with a cover. Kebun Atap is located on Jl. Kepanjen No.15A, Krembangan Selatan, Krembangan, Surabaya which is surrounded by housing and close to the highway. The roof garden produces several types of vegetables including Brazilian spinach, curly green lettuce, curly red lettuce, romaine green lettuce , romaine *red lettuce, romaine red lettuce*, kailan, pakcoy, and mustard caisim.

The next stage is the Installation of *Yellow Pan* Traps and Insect Retrieval Hand *Picking* and *Netting* Methods. *Yellow pan* traps are placed in the morning between cultivated plants at each observation point that has been filled with water and soap. This trap is taken the next day (□24 hours) then the caught insect is inserted into a film vial tube that has contained 70% alcohol and 20% glycerol to be subsequently observed in a microscope.

In addition to using the *yellow pan* method, insect picking is also carried out directly on plants (*hand picking)* and insect retrieval by sweeping the net *(netting).* Hand picking on plants is carried out on non-flying insects by picking up insects using tweezers and inserting them into vial tubes. As for the actively flying seranngga, insect collection is carried out by sweeping the net (netting).

After all the insects have been collected, insect observations are carried out using a microscope and identified with the identification keybook compiled by Borror et al. (1996). After identification, the number of insects in each species is calculated. The insect data that has been obtained will then be analyzed to be used as information in the management of crop cultivation in *Urban Farming* land.

Based on the identification results, an index of insect abundance is calculated. In addition, the data in this study were carried out using descriptive and statistical analysis techniques. Statistical analysis is used to determine the index of insect abundance at each predetermined point by identifying the number of types at each observation point. Then the data was analyzed using the Krebs abundance index.

Abundance index:

$$D1 = \frac{ni}{N} x100\%$$

Information:
D1 = Index of abundance of insect type i
Ni= Number of insects of type i
N = Total number of all observed insects
According to Krebs (1989), the level of abundance can be analyzed in several categories, namely:
D1 < 15% : abundance belongs to the low category
15% ≤ D1 ≤ 20%: abundance belongs to the category of medium
D1 > 20%: abundance belongs to the high category

RESULT AND DISCUSSION

Based on the results of observations at these four locations, it can be seen that in the *Urban Farming* area of Surabaya, 34 species of insects were found in several plants planted such as pakcoy, kailan, mint, curly green lettuce, *curly lettuce, red curly* lettuce, red leaf lettuce , green romaine *lettuce,* Red romaine lettuce *(Romaine Red Lettuce).* The identification results showed that as many as 34 types of insects were members of 26 families, namely *Acrididae, Agromyzidae, Aleyrodidae, Aphididae, Apidae, Calliphoridae, Chrysomelidae, Cicadelloidae, Coccinellidae, Crambidae, Dixidae, Dolichopodidae, Hesperiidae, Meloidae, Muscidae, Noctuidae, Pentatomidae, Pieridae, Pseudococcidae, Psilidae, Sapygidae, Staphylinidae, Stratiomyidae, Syrphidae, Tetranychidae* and *Thripidae* (Table 1.) .

Table 1. Abundance of Insects in *Urban Farming* Surabaya

No.	Order	Family	Species	Ni	%
1	*Coleoptera*	*Chrysomelidae*	*Epitrix cucumeris*	6	2.05
2			*Psylliodes punctulata*	4	1.37
3		*Coccinellidae*	*Coccinella septempunctata*	7	2.40
4		*Meloidae*	*Mylabris phalerata*	1	0.34
5		*Staphylinidae*	*Paederus littoralis*	3	1.03
6	*Diptera*	*Agromyzidae*	*Liriomyza huidobrensis*	11	3.77
7		*Calliphoridae*	*Pollenia rudis*	3	1.03
8		*Calliphoridae*	*Chrysomya megacephala*	2	0.68
9		*Dixidae*	*Meniscus midge*	1	0.34
10		*Dolichopodidae*	*Condylostylus similis*	10	3.42
11		*Muscidae*	*Musca domestica*	4	1.37
12		*Psilidae*	*Psila fimetaria*	7	2.40
13		*Stratiomyidae*	*Hermetia illucens*	2	0.68
14		*Syrphidae*	*Eristalis tenax*	10	3.42
15			*Toxomerus geminatus*	2	0.68
16	*Hemiptera*	*Aleyrodidae*	*Bemisia tabaci*	7	2.40
17		*Aphididae*	*Aphis gossypii*	77	26.37
18			*Toxoptera aurantii*	22	7.53
19		*Pentatomidae*	*Murgantia histrionica*	1	0.34
20		*Pseudococcidae*	*Planococcus citri*	12	4.11
21	Homoptera	*Cicadelloidae*	*Hishimonus spatulatus*	1	0.34
22	Hymenoptera	*Apidae*	*Apis mellifera*	5	1.71
23		*Sapygidae*	*Krombeinopyga pumila*	2	0.68
24	Lepidoptera	*Crambidae*	*Anania funebris*	3	1.03
25		*Hesperiidae*	*Achalarus casica*	2	0.68
26		*Noctuidae*	*Amphipoea oculea*	2	0.68
27		*Noctuidae*	*Chrysodeixis chalcites*	11	3.77

No.	Order	Family	Species	Ni	%
28			*Spodoptera litura*	10	3.42
29		*Pieridae*	*Pieris rapae*	12	4.11
30			*Valanga nigricornis*	2	0.68
31	Orthoptera	*Acrididae*	*Oxya yezoensis*	6	2.05
32			*Dissosteira carolina*	2	0.68
33	Thysanoptera	*Thripidae*	*Thrips tabaci*	5	1.71
34	Trombidiformes	*Tetranychidae*	*Tetranychus urticae*	37	12.67
Total Number of Insects				**292**	

Based on the results of the calculation of the abundance index according to Krebs (1989), the highest insect abundance in *urban* farming surabaya is *Aphis gossypii* with an abundance index value of 26.37% and the lowest insect abundance in urban *farming* surabaya is *Hishimonus spatulatus, Meniscus midge, Murgantia histrionica, Mylabris phalerata* with an abundance index value of 0.34% (Table 1.). The abundance index is at a value of D1>20% which indicates a high level of abundance category and is at a value of D1<15% which indicates a low level of abundance category (Krebs, 1989).

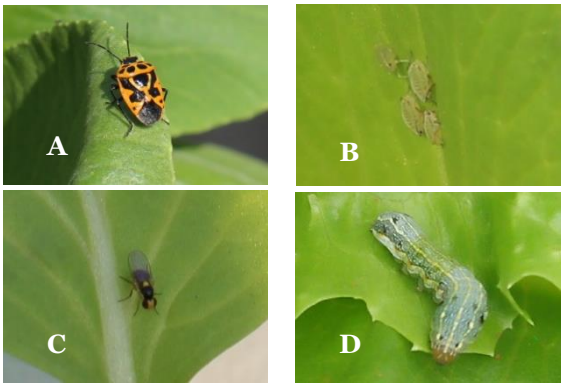

Figure 1. Insects found in all four Urban Farming farming sites: (A) *Murgantia histrionica* (Family Pentatomidae), (B) *Aphis gossypii* (Family Aphididae), (C) *Lirimomyza huidobrensis* (Family Agromyzidae), (D) *Spodoptera litura* (Family Noctuidae)

Aphididae is a family of insects most commonly found in the *Urban Farming* area under the species name *Aphis gossypii* or aphids with a total abundance of 26.37%. This insect acts as a pest because it damages plants which can cause stunted plants, curly leaves, curling and mosaics as well as a vector of plant diseases (Capinera, 2007). This insect is a cosmopolitan phytophagous insect that can be found in tropical, subtropical and temperate regions (Schirmer et al, 2008).

According to Afshari et al (2009), that the abundance of A. gossypii populations can occur because it is influenced by biotic and abiotic factors, abiotic factors especially temperature and rainfall, biotic factors such as host plants and predatory insects. The abundant presence of aphids in several Urban Farming areas is thought to be caused because the Aphididae family can live in various plant varieties because it has a wide host plant including host plant types such as mustard plants, lettuce, pakcoy which are widely grown in the *Urban Farming* area, besides that the level of diversity of the family Aphididae is very high and also the life cycle is short (Byers, 2005).

There are several insects whose abundance is the least found in *Urban Farming's* farmland, including *Mylabris phalerata* which is an insect of the family Meloidae. Meloidae have striking and distinctive body color features on their bodies, namely yellow and black and sometimes their color changes to metallic black. These insects act as herbivorous insects or plant eaters so that they have great potential as plant pests (Suhara, 2010).

Murgantia histrionica (harlequin beetle) is an insect of the family Pentatomidae. Pentatomidae is a dispersed and well-known family (more than 200 North American species) that has the characteristics of filiform antennae consisting of 5 segments, short, non-prickly legs and wing membranes that have many blood vessels (Metcalf and Flint, 1962). This beetle acts as an insect pest that feeds on the leaves and stems of plants with punctures that will produce turbid and discolored spots. In addition, these insects also cause plants to wither and brown in color (Anonim, 2019). These insects are found on pakcoy plants.

Hishimonus spatulatus is a leafhopper whose slender body with a length of 2-4 mm is brown

with various patterns on its body (Kamitani et al, 2011). These insects act as pests that attack plants by piercing the underside of the leaves then sucking the liquid in the plant causing white spots, yellowing, leaf curling, stunting, and plant distortion (Li and Wang, 2004). Later found Meniscus midge which is a species similar to mosquitoes (Culicidae) measuring about 3-4 mm. The head is relatively wide, the antennae is thin, has 14 flagellum segments, and the proboscis is thick and short. This species can thrive in habitats such as urban gardens (Wagner, 2004).

Some of these insects are found in small numbers on *Urban Farming* land, this is due to certain factors, one of which is the presence of habitats that are not in accordance with the natural habitat of these insects. The existence of natural habitats is important in agricultural habitats because it is a source of diversity which is a refugia for insects. This is in accordance with the research of Bianchi et al (2006) which states that natural habitats are the main providers of resources, such as food, alternative host sources, shelters or nesting sites. In addition, the abundance of an insect can decrease and be found less as the distance of natural habitat in an agricultural habitat becomes farther apart (Jauker et al, 2009).

The abundance of insect populations in an ecosystem is different from other exosystems. One of them is influenced by the environmental conditions of the ecosystem, where the abundance of insects tends to be low in a physically controlled ecosystem, namely those that have strong limiting factors according to the conditions that insects prefer to carry out their lives and will be high in an optimum environmental ecosystem that is regulated naturally (Odum, 1996).

Based on this, the thing that can be done to maintain the balance of the ecosystem to affect the quality of crop cultivation is to minimize insect pests through the concept of *Urban Farming* while maximizing natural habitat conditions using natural materials so that insect attacks can be controlled and the ecosystem becomes stable (Sembel, 2010). In addition, it can be helped by plant maintenance efforts, namely the control of Plant Disturbing Organisms (OPT) on *Urban Farming* land (Wagiman, 1987).

Controls that can be carried out include sanitizing the environment around the planting land by cleaning the surface of the planting media and cleaning the place where the water will be used, then adjusting the planting distance between plants (Suryani, 2015). Physically, pest control can be done by installing insect nets and yellow bottle traps to anticipate and prevent in hydroponic fields, while mechanically it can be done taking pests directly using hands or tweezers (Rahayu et al, 2013). In addition, control can be carried out using vegetable pesticides made from natural ingredients. One of the ingredients that is easily available and known to damage the development of eggs, larvae, and pupae and repel insects is to use garlic that is mashed and soaked in water for 24 hours then applied to plants (Rosliani and Sumarni, 2005)

CONCLUSION

Based on the research conducted, it can be concluded that the highest insect abundance found in urban *farming* surabaya is Aphis gossypii with an abundance index value of 26.37% and the lowest insect abundance is *Hishimonus spatulatus, Meniscus midge, Murgantia histrionica, Mylabris phalerata* with an abundance index value of 0.34%. The results showed that there were 34 species of insects with 26 families. Pest insect control in *Urban Farming* land can be done through environmental sanitation around the planting land, installation of *insect net*, and *yellow bottle trap* and can be taken directly using hands or tweezers.

REFERENCES

Aryantha, I. P dan D. Guest. (2000). Pengendalian Fungi Pathogen *Phytophthora cinnamomi* Rands dengan Menggunakan Mikroba Antagonist. *Seminar MIPA 2000*. Bandung: Kampus ITB.

Bianchi FJJA, Booij CJH, Tscharntke T. (2006). Sustainable Pest Regulation Inagricultural Landscapes: A Review on Landscape Composition, Biodiversity and Natural Pest Control. Proceedings of the Royal Society B: *Biological Sciences*. 273: 1715–1727.

Biao, X., Xiaorong, W., Zhuhong, D., dan Yaping, Y. (2003). Critical Impactassessment of Organic Agriculture. *Journal of Agricultural and Environmental Ethics*. 16: 297-311.

Butler, L, Moronek, D. M. (2002). Urban and Agriculture Communities: Opportunities for Common Ground, Ames, Iowa: Council for Agricultural Science and Technology.

Byers, J. A. (2005). A Cost of Alarm Pheromone Production in Cotton Aphids, *Aphis gossypii*. *Naturwissenschaften*. 92: 69-72.

Capinera, J. L. (2007). Melon Aphid or Cotton Aphid, *Aphis gossypii* Glover (Insecta: Hemiptera: Aphididae). http://creatures.ifas.ufl.edu. 21 Juli 2019.

Green, Jared. (2012). Urban Agriculture Isn't New. https://dirt.asla.org/2012/05/09/urban-agriculture-isnt-new/. 3 Maret 2019.

Jauker F, Dieko T, Schwarzbach F, Wolters V. (2009). Pollinator Dispersal in an Agricultural Matrix: Opposing Responses of Wild Bees and Hoverflies to Landscape Structure and Distance from Main Habitat. *Landscape Ecology*. 24: 547–555.

Kamitani, S., in Kamitani, S., Ubaidillah, R., Kahono, S., Herwint, S. & Partomihardjo, T. (2011). Two New Species and a New Record of the Genus *Hishimonus* (Hemiptera: Auchenorrhyncha: Cicadellidae) in the Krakatau Isls. and Java, Indonesia. Esakia. 50: 75–80.

Krebs, C. J. (1989). *Ecological Methodology*. New York: Harper & Row Inc. Publisher.

Krismawati, A. (2012). *Teknologi Hidroponik dalam Pemanfaatan Lahan Pekarangan*. Malang: BPTP.

Lingga, P. (2004). *Bercocok Tanam Tanpa Tanah*. Jakarta: Penebar Swadaya.

Lanarc, HB. (2013). The *Urban Farming* Guidebook. British Columbia: Eco Design Resource Society.

Lavelle, P., Decaens, T., Aubert, M., Barat, S., Blouin, M., Bureau, F., Margerie, P., Mora, P., dan Rossi, J. P. (2006). Soil Invertebrata and Ecosystem Services. *European Journal of Soil Biology*. 42: S3-S15.

Metcalf, C.L dan Flint, W.P. (1962). *Destructive and Useful Insects: Their Habits and Control*. New York: McGraw Hill.

Othman, N.M. (2007). Food Safety in Southeast Asia: Challenges Facing the Region. Asian *Journal of Agriculture and Development*. 4(2): 83-92.

Rahayu, S., C.T. Maryani, P. Yusnani. (2013). Pengaruh Perangkap Warna Berperekat Aroma Rempah untuk Mengendalikan Hama Gudang *Lasioderma serricorne* Fabricius (Coleoptera: Anobiidae) di Gudang Tembakau. *Jurnal Agroteknologi*. 1(4): 1382-1390.

Roidah, Ida Syamsu. (2014). Pemanfaatan Lahan dengan Menggunakan Sistem Hidroponik. *Jurnal Universitas Tulungagung Bonorowo*. 1(2).

Rosliani, R., dan Sumarni, N. (2005). Budidaya Tanaman Sayuran dengan Sistem Hidroponik. *Monografi*. 27.

Samudra, F. B., M. Izzati., dan H. Purnaweni. (2013). Kemelimpahan dan Keanekaragaman Arthropoda Tanah di Lahan Sayuran Organik *Urban Farming*. Prosiding Seminar Nasional Pengelolaan Sumberdaya Alam dan Lingkungan 2013.

Sembel, Dantje, T. (2010). *Pengendalian Hayati*. Yogyakarta: Penerbit Andi.

Suhara. (2010). *Famili Meloidae*. Universitas Pendidikan Indonesia.

Suheriyanto, Dwi. (2008). *Ekologi Serangga*. Malang: UIN Press.

Suryani, R. (2015). *Hidroponik Budidaya Tanaman Tanpa Tanah*. Arcitra. Yogyakarta.

Susila, A. D dan Y. Koerniawati. (2004). Pengaruh Volume dan Jenis Media Tanam pada Pertumbuhan dan Hasil Tanaman Selada (*Lactuca sativa*) Pada Teknologi Hidroponik Sistem Terapung. *Bul. Agon*. 32(3): 16-21.

Sutiyoso, Y. (2006). *Hidroponik Ala Yos*. Jakarta: Penebar Swadaya.

Wagiman, F.X. (1987). *Pengendalian Hayati. UGM*. Press. Yogyakarta.

Wagner R. (2004). Insecta: Diptera, Dixidae. In: Yule C.M. & Yong H.S. (eds), Freshwater Invertebrates of the Malaysian Region, Selangor, Malaysia: Aura Productions, pp. 634-637.

Widyawati, Nugraheni. (2013). *Urban Farming Gaya Bertani Spesifik Kota*. Yogyakarta: Penerbit Andi.