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PREFERENCE OF COMMON GARDEN PEST TOWARDS EDIBLE PLANTS

***Atikah Fukaihah Amir[1] & Nur Huzeima Mohd Hussain[2]**
***Corresponding author**
[1,2,3]Centre of Studies for Landscape Architecture,
Department of Built Environment Studies and Technology,
University Teknologi MARA, Perak Branch, Seri Iskandar Campus,
32610 Seri Iskandar, Perak, Malaysia

atika250@uitm.edu.my, nurhu154@uitm.edu.my
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ABSTRACT

Growing edible plants in the home gardens has proven to help improve the quality of life. However, the appearance of garden pests in the home garden may be a problem, causing loss of productivity and spreading diseases. Therefore, this paper aims to investigate the changing patterns of common garden pests among different species of edible plants in the home garden. The research was carried out approximately 8 months (June 2020 until January 2021) with 33 species of edible plants have been tested. All tested plants in the home garden were ranged at 2 to 8 months matured growth. Data sampling were carried out in two-phases, November 2020 and January 2021 when the plants were ready to harvest and the garden pest was active. The outcome of this paper was the pattern or preferences made by garden pests towards edible plants in the home garden. Recommendations are made with biological control approach with the presence of ladybirds as predatory insects to the common garden pest.

Keywords: *Garden pest, Edible plants, Home garden, Cultural practices,*

INTRODUCTION

Growing edible plants in home gardens is one of the community strategies to overcome household demand nowadays. Furthermore, it can improve food security and enhance family economic growth. According to Galhena (2013), based on the projection year 2050, there is a continuous need to increase food production and home gardens as a local strategy that is widely adopted and practised. As stipulated by MARDI researcher Mohd Salleh (2006), popular vegetables in Malaysia that need to be promoted in sequence are Leaf mustard Brassica Juncea var. Foliosa, Long bean Vigna Sesquipedalis, Cucumber Cucumis Sativus, water convolvulus Ipomoea Aquatica, Spinach Spinacia Oleracea, Capsicum Annuum, Lady's finger Abelmoschus Esculentus, Luffa Acutangula, French bean Phaseolus Coccineus, Chinese kale Brassica Oleracea var. Alboglabra, Cabbage Brassica Oleracea, Lettuce Lactuca Sativa, and Tomato Solanum Lycopersicum. Similar vegetables listed has been supported by Othman (2013), who stated, chilli, cabbage, cucumber, leaf mustard, tomatoes and water convolvulus are among the top five highest consumption vegetables in Malaysia. All vegetables listed are from lowland and highland areas and can be grown in the home garden area too. The difference between home garden growth and commercial planting is the use of chemical pesticides in the vegetables to control major pest infestations. The presence of garden pests may cause plant disease, thus, reduce the yield of edible plants.

A garden pest is a situation where a garden is threatened by pests. A pest is defined as any living thing, whether animal, plant, or fungus, which humans consider troublesome to themselves, their possessions, or the environment (Bergland, 2010). Therefore garden pests is a loose concept, where there will be a pest in both conditions; (i) beneficial, domesticated, and acceptable; and (ii) harmful, diseases and unacceptable in an environment. The best way to maintain a healthy garden would be easier through identifying the common 'bad bugs' and the 'good bugs'. Thus, handling garden pests in the aesthetical garden are less hustle as compared to the edible garden.

Most edible plants, especially in a hot tropical climate like Malaysia. are susceptible to at least a few diseases. Sharon (2001) listed common patterns of damage on the leaves such as leaf spots, mildew, blotch, leaf

blister, shot-hole and anthracnose that can indicate possible causes of a plant's problem.

Sharon (2001) points out that plants die or decline usually because they suffer from a combination of stress factors, while insects or disease are often secondary, attacking the weakened tree. She added plant health problems can be categorized into two groups which are living agents (biotic: such as fungi, bacteria, viruses, and nematodes, insect pests, mites, and other animals) and non-living agents (abiotic: such as temperature and moisture extremes, mechanical injuries, chemical injuries, and mineral deficiencies). This was an experimental study that focused on edible plants. This research adopted a close observation of the living agents. All plants in this research were clustered in the same area to minimise the cause factor made by non-living agents.

In addition, Sharon (2001) also listed a correct plant diagnosis based on this namely 6 steps including; 1) accurately identify the plant, 2) look for a pattern of abnormality, 3) careful examine the site, 4) note the colour, size and thickness of foliage, 5) check the stem part, and 6) examine the roots and root collar. Besides, as aptly put by Atikah (2011), there are several needs to be considered in dealing with plants. The plants need to be planted in an adequate planter box size that may affect the plant growth. Providing enough rooms for healthy roots could bring a healthy shoot. Furthermore, preparing a maintenance schedule such as watering, pruning, fertilizing and weeding are important to keep the plants healthy, especially in maintaining the edible plants as these plants are food to feed people.

Therefore, this research made observations in diagnosing the common garden pests in edible plants and followed closely the cultural practices suggested by Elizabeth (2017). She suggested in order to control or manage disease in the home garden, the researcher needs to consider site selection, crop rotation, disease-free seed and transplants, disease-resistant varieties, planting date management, proper spacing and trellising, proper watering, mulch, proper fertilization and organic matter, weed control, nematode control, sanitation, pesticides, and organic management. Hussain (2021) asserted self-sustenance in agriculture is needed to fulfil the individual's needs for a better living. In general, the research paper aims to investigate the movement pattern of common garden pests towards different species of

edible plants in the home garden. This research is beneficial to understand the sustenance and maintenance of edible plants in the home garden. The objectives of this study were to 1) analyse the preference made by garden pests towards edible plants in home garden, and 2) locate and analyse the movement pattern made by garden pests in the home edible garden.

METHODOLOGY

The home garden has become more than just a hobby and habit to the community. This activity has provided convenient access to various affordable and nutritious food within the community living. Therefore, as the home garden is the fundamental element in garden practices, this research has chosen adequate home garden areas to conduct the plants and pests diagnosification. Besides, this research adopted an experimental analysis through site observation.

The observation was carried out approximately 6 months with 33 species of common edible plants were tested. The list of plants that were planted are from common vegetables found in the lowland area and based on the suggestion by Mohd Salleh (2006) and Othman (2013) in the Malaysian context. However, some of the plants like cucumber, luffa, french bean, cabbage, lettuce, and tomato are not being tested due to the limitation sources and some of them were categorised as highland vegetables. When the data were collected, all tested plants in the home garden were ranged at 2 to 8 months matured growth. Data sampling were observed from June 2020 until January 2021, while data collection were carried out in two-phases, which were in November 2020 and January 2021. The selected period was chosen as the plants were all fully grown, ready to harvest and the garden pests were active mostly in the rainy and hot seasons. Malaysian Meteorological Department (2021), stated that during the month of October until November is the maximum primer of rainy season in the South-West Coast area. In addition, according to Elizabeth (2017), common diseases of vegetables occur mainly in the hot climate when the insects carry these diseases are most active.

The case study was selected in the non-attached residential house in Perak with approximately 40m2 area of the experimental site for

observation. The observation tools being used in this research were eye-sight observations, recordings by the camera and document into a systematic grid line for image analysis. A systematic grid line was used for data sampling to monitor the pests movement (Pias, 2017). The plant management practices were carried out following technical recommendations by Sharon (2001) for the particular plants, except for the control of any insecticides, which was not performed for this study (Pias, 2017). The data were analysed through descriptive information with cross-tabulation data in Microsoft Excel.

Edible Plants

There are 33 plant species that has been grown by phase during the eight month study. These plants were selected based on their functions, needs in daily usage, high survival rate, accessible for non-frequent intake and beneficial in food, goods and medicinal value.

As for the research purposes, these plants were carefully handled and supported with a good irrigation and fertigation system in order to raise the survival potential and prepare a natural environment setting for the observation. This research had categorized the plants species based on their types namely vegetables and herbs in lower shrub type. The list of plants involved in this research were Brazilian Spinach (Althernanthera Sisso), Bayam Hijau (Amaranthus Tricolor), Bayam Merah (Amaranthus Tricolor), Bebuas (Premna Foetida), Beluntas (Pluchea Indica), Bendi (Abelmochus Esculentus), Capa (Blumae Balsmifera), Cili api (Capsicum Frutescens), Cili merah (Capsicum Annum), Daun kari (Murraya Koenigii), Daun sup (Apium Graveolens), Terung (Solanum Melongena), Inai (Lawsonia Inermis), Kacang Panjang (Vigna Unguiculata Sesquipedalis), Kacang Botor (Psophocarpus Tetragonobulus), Kaduk (Piper Sarmentosum), Kailan (Brassica Ooleracea), Kangkung (Ipomoe Aquatica), Kesum (Persicaria Odorata), Ketumbar jawa (Eryngium Foetidum), Kucai (Allium Tuberosum), Kunyit (Curcuma Longa), Lengkuas (Alpinia Galangal), Pandan (Pandanus Amarylifolus), Pegaga (Centella Asiatica), Peria (Momordica Charantia), Peria pantai (Colubrina Asiatica), Pudina (Mentha Spicata L.), Sambung Nyawa Ungu (Gynura Procumbens), Selasih (Ocimum Basilicum), Serai (Cymbopogon Citratus), Timun Tikus (Zehneria) and Ulam Raja (Cosmos Ccaudatus).

There are several considerations in planting, managing and observing these plants. The considerations include (i) the location of planting; (ii) the suitability of plants arranging (locating one plants to another); (iii) the plants conditions; (iv) the plants structures and (v) the plants growths' needs.

RESULTS AND DISCUSSION

Within the 8th month of observations, it was observed that not all plants were affected by the insect's infestation. There were 11 out of 33 plant species wre affected by the insects infestations (33.3% of species), which were Brazilian spinach, Green spinach, Red spinach, Okra, Bird's eye chilli, Chilli pepper, lengkuas, kesum, mint, ulam raja and sambung nyawa ungu. The remaining 22 plant species (66.7% of species) were in a good condition, and the plants survived without plant injuries. The total of edible plants in the home garden is 58 nos. The list is shown in Table 1.

The researcher categorised infected plants into four categories, namely major infestation (65% and above symptoms), moderate infestation (40% symptoms), minor infestation (20% symptoms) and no infestation. The level of major, highly moderate, moderate, minor and no infestation was grouped based on the researchers' observation on the plant's part such as from bud, leaves, flower, fruit, stem and root collar. Refer to Figure 1.

Statistically, there were 30 nos plants being infested (51.6%) and 28 nos plants were not being infested (48.4%). All plants survived during the experiment, except okra. Plants were being treated when the symptoms appeared such as the infected part was removed and the researchers used non-toxic organic pesticide such as Baba Mr Garnick and aerosol H2O based for ants (Amir 2011). Major infestations were seen on several chilli pepper plants and okra at 17.2% (10 nos) from the overall plants in the home garden. This was followed by moderate infestation on bird's eye chilli, several chilli pepper plant, red and green spinach, and kesum at 24.1% (14 nos) of overall planting. Minor infestation were seen at brazilian spinach, mint, sambung nyawa ungu, ulam raja and lengkuas at 10.3% (6 nos) of overall planting. Refer to Figure 1.

Data showed chilli pepper and some bird's eye chilli were the most

prone to insects infestation such as aphids, mealybug, scale, thrips, whiteflies and spider mites. This phenomenon mostly appeared in November 2020. Based on the observations, the mealybug, scale and aphids were associated with the red ants (Figure 2 and Figure 3). The observations were supported by Jahn (2003) elaborated on the symbiotic pattern made by mealybug and ant. The ants have a primary role in promoting mealybug infestation on plants (Jahn, 2003) that is by protecting mealybug from natural enemies. Beside, the ants too were seen to protect the mealybug by building a shelter around mealybug. In return, the mealybug benefitted the ants by providing honeydew as one of the food resources.

The researcher observed the appearance of garden pests by taking routine checks every morning and evening. Mealybug is often found on the stem and below the leaves part. Jahn (2003) asserted that the ants transported mealybugs from one plant to another. It can be seen the mealybugs are affecting the same plant species and other plant species (ulam raja and okra) which are located on the side of chilli plants. However, mealybugs do not affect pandan and curry trees which also were planted on the side of the chilli pepper plant (Figure 1).

Table 1. Preference Made by Garden Pests to Host the Plants. Data Observed and Taken by Researcher on the Routine Check Every Morning and Evening on November 2020 and January 2021

No	Local name	Botanical Name	Nos	Affected	Aphids	Mealybug	Scale	Thrps	Leafminer	Grass hopper	White flies	Vinegar fly	Spider mite	Loopers	Rice leafroller
1	Bayam brazil/ Brazilian spinach	Althernanthera Sisso	1	/					/						
2	Bayam Hijau / Green spinach	Amaranthus Tricolor	1	/								/			
3	Bayam Merah / Red spinach	Amaranthus Tricolor	2	/								/			
4	Bebuas	Premna Foetida	1	X											
5	Beluntas	Pluchea Indica	1	X											
6	Bendi / Okra	Abelmochus Esculentus	1	/		/									
7	Capa / Sambong	Blumae Balsmifera	1	X											
8	Cili api / Bird's eye chilli	Capsicum Frutescens	9	/	/	/	/	/				/	/		
9	Cili merah / Chilli pepper	Capsicum Annum	11	/	/	/	/	/				/	/		
10	Daun kari/ curry tree	Murraya Koenigii	2	X											

11	Daun sup	Apium Graveolens	1	X											
12	Terung / Eggplant	Solanum Melongena	1	X											
13	Inai	Lawsonia Inermis	1	X											
14	Kacang Panjang / Long bean	Vigna Unguiculata Sesquipedalis	1	X											
15	Kacang Botor / Winged bean	Psophocarpus Tetragonobulus	1	X											
16	Kaduk	Piper Sarmentosum	1	X											
17	Kailan	Brassica Oleracea	1	X											
18	Kangkung / Water spinach/ Water convolvulus	Ipomoe Aquatica	1	X											
19	Kesum	Persicaria Odorata	1	/		/									
20	Ketumbar jawa	Eryngium Foetidum	2	X											
21	Kucai	Allium Tuberosum	1	X											
22	Kunyit	Curcuma Longa	1	X											
23	Lengkuas	Alpinia Galangal	1	/						/					

24	Pandan	Pandanus Amarylifolus	1	X											
25	Pegaga	Centella Asiatica	1	X											
26	Peria	Momordica Charantia	1	X											
27	Peria pantai	Colubrina Asiatica.	1	X											
28	Pudina / Mint	Mentha Spicata L.	5	/	/									/	
29	Sambung Nyawa Ungu	Gynura Bicolor	1	/											/
30	Selasih / Basil	Ocimum Basilicum	1	X											
31	Serai wangi / Lemongrass	Cymbopogon Nardus	1	X											
32	Timun Tikus	Zehneria	1	X											
33	Ulam Raja	Cosmos Ccaudatus	1	/		/									
		Total	58												

Source: Author

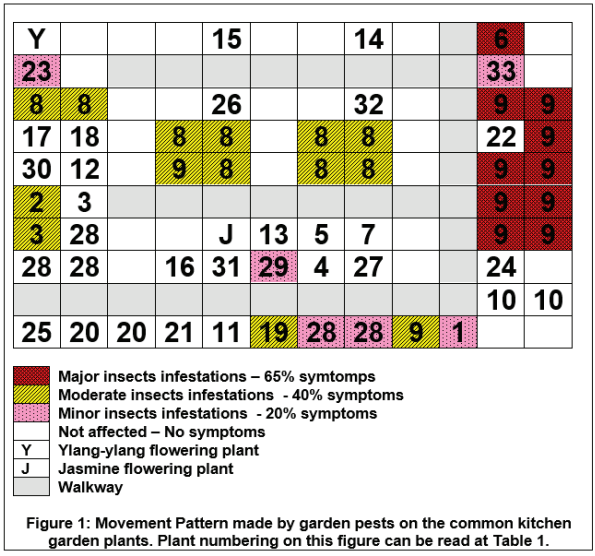

Figure 1: Movement Pattern made by garden pests on the common kitchen garden plants. Plant numbering on this figure can be read at Table 1.

Source: Author

Figure 2. Mutualism of Mealybug with Red ants on Kesum Plant

Figure 3. Mutualism of Scale Insects with Red Ants on Bird's Eye Chilli

Source: Author

Bird's eye chilli and chilli pepper which were infested by mealybug, white scales, thrips, white flies and spider mite were overcome during phase 1 observations in November 2020. During phase 2 observations in January 2021, other infestations appeared to other plants which were aphids, leafminer, grasshopper, vinegar fly, loopers and rice leafroller.

The second categories that were prone to the insects infestations were okra which was infested by mealybug, green and red spinach were infested by vinegar fly (Figure 4), and kesum was infested by mealybug (Figure 2). Followed by sambung nyawa ungu that was infested by rice leafroller (Figure 5); mint was infested by aphids and loopers (Figure 6), brazilian

spinach was infested by leafminer (Figure 7), ulam raja was infested by mealybug and lastly lengkuas was infested by grasshopper. This sequence were categorised based on the level of plants being infested by garden pests (Refer Figure 3).

Aphids and mealybug fed by piercing the plant cells and sucking out the contents (Sharon, 2001). Symptoms of this feeding type were seen on the plants such as wilted leaves and plant growth distortion. Based on the observations, the chilli fruits are in low production and distort growth (Figure 8).

During phase 1 observations, the researchers removed the infested leaves and plant part to which the garden pests appeared. This was done as to keep the damage from spreading to other plants. The researchers made a routine check on the plants especially on the bottom part of leaves and stem part, where the common garden pests usually settled. This daily routine checked was to indicate the initial problem or symptom before it will be treated accordingly.

During phase 2 observations, the researchers overcame the problem by introducing natural predators of garden pests like ladybirds. The researcher used flowering plants like jasmine (Jasminum Sambac) and ylang-ylang (Cananga Odorata) to lure the good insects in the kitchen garden located at the centre of the home garden and the edge of the home garden. According to Amirul Amin (2017), the sensual fragrance of flowers could elevate the sense of humans too. Based on the observations, ladybirds start to appear in the kitchen garden. The larva of the ladybird appeared indicating a life cycle of ladybirds in the kitchen garden. Both adult and larva of ladybird are good predatory insects to the most garden pests. Figure 9 showed biological control on the aphids feeding by the larva of ladybirds. This statement was supported by Francessena (2019) as ladybird is a good predatory insect to aphids. In addition, Velemir (2013) stated as aphids respond to ladybird tracks, this prevent the aphids to avoid plants on which predators have not been recently active. Larva of ladybird consumes more than adult ladybird. Thus, the ladybird and its larva played an important role to reduce the population of mites, scales and other soft-bodied insects. Based on research by Schwarz (2018), temperature also plays an important role in ladybird feeding patterns. The higher the temperature the greater the potential to

increase feeding on aphids by ladybirds.

Figure 4. Green Spinach has been Infested by Vinegar Fly

Figure 5. Sambung Nyawa Ungu on the Bottom Leaves was Infested by Rice Leaf Roller

Figure 6. Mutualism of Aphids and Black Ants on Mint

Figure 7. Brazilian Spinach has been Infested by Leafminer Larva

Figure 8. Examples of Plant and Fruit Distortion due to Insect's Infestation. Wilted is also one of the Symptom

Figure 9. Predatory Larva of Ladybird Appearance at Mint Plant

In summary, the ladybird and its larvae are good predatory insects to aphids, mealybugs and most soft bodied insects. Aphids, mealybugs and other soft-bodied insects can be reduced significantly through this

biological control. The appearance of ants to protect aphids (mutualism) can be reduced by introducing another biological control. However, in a short period of research, the researchers were only able to use aerosol H20 based to control the appearance of ants.

During phase 2, the researchers also realized that the fruit production of chilli doubled as the aphids, scale, and mealybugs appearance on chilli were reduced. The cause of this phenomenon has not yet been identified whether it was due to the introduction of flowering plants to lure the predatory ladybirds or due to other intercropped plants that have been introduced in the home garden.

CONCLUSION AND FUTURE RECOMMENDATIONS

In conclusion, the main contribution of plants being infested by insects is due to the plant's location and plants structure. Most of the plants that were infected are located at the boundary of the home garden. The plants at the edge act as a shield to the middle of the home garden on small scale. This phenomenon was supported by Mohamad Roftr (1991) as he used maize as a barrier crop to reduce aphids on chilli plants in Malaysia. He added, intercropped planting is an effective way to reduce the aphids as it could be due to visual effects and physical barriers against the vector. This paper also elaborated on the chilli intercropped with maize that could reduce pesticide application by 50%.

This method has been used for a long time, in a different region until the current study at Yogyakarta (Friarini, 2016) to reduce Bemisia tabacci or whiteflies by using maize as a barrier crop for chilli; in India (Saha, 2016) to reduce virus attacked (carried by aphids) by using maize as a barrier crop for okra and chilli. Maize is a popular choice as a crop barrier as the plant structure is tall, non-host to the virus and the vector, and has rough texture leaves. The vector (carried by those soft bodied insects), is not interested to feed on this plant and as a result, their entry towards inside the core area were restricted. Other choices for crop barriers are sorghum (Swati, 2016).

Plants structure has also contributed to the favourite spot for garden pests to settle. For example, aphids, mealybugs, and scales congregate

were seen mostly in the hidden part of plants or on the lower leaves of chilli, kesum and mint where the leaves are covering most of the stem part. Compared with the not affected plant like kailan, kunyit, kucai, daun sup, ketumbar jawa, kaduk, kangkung, pandan and pegaga, the plants part consist of a soft stem (no sweet sap), thick leaves cuticle, and not many leaves covering the stem. However, the discussion of this plant anatomy requires further observations and discussion in the future research.

For future research, these findings recommend, a longer duration of the site observation is needed for the researchers to be able to observe a complete cycle or season in investigating the pattern made by the common garden pests. This research has a limitation in measuring the weight of crop harvest. Thus, in future reference, every harvest of edible plants need to be weighted and standardized for a complete data guidance. Other limitations like the selection of plants too need to be broaden and categorized by narrowing the research by plants structure characteristics. Other potential plants including cucumber, luffa, french bean, cabbage, lettuce, and tomato as suggested by Mohd Salleh (2006) that have not been tested in this study due to the research limitation, can further be investigated.

Besides, the investigations on good predatory insects and biological control need to be deepen as well as to have an in-depth understanding of mutualism in agriculture in a micro-home garden context. Edible plants need consistency in managing the plants' maintenance especially to survive upon the appearance of garden pests. Thus, the arrangement of plants in a plot or grid systems with plant interval from the stem is 500mm for low herb/ shrub planting is suggested as this interval is easier for the researchers to monitor every part of the plants.

The introduction of bird, dragonfly and prayer mantis as predatory in the home garden was seen as a good approach for biological control during research. Dragonflies will prey on flies, bees, beetles, moths, and other flying insects that are harmful to the edible garden. The larger the dragonfly, the larger the prey insect it can consume. The dragonfly habitat can be created by ensuring the appearance of shallow slow-moving fresh water that has no fish in the environment. Birds also prey on the insects in the garden and can be introduced by planting berry or fruit plants like bitter melon and papaya. In addition, prayer mantis has enormous appetites and

will eat on various lists of insects like aphids, grasshoppers, caterpillars and other soft-bodied insects.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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