Faculty of Resource Science and Technology

Establishment of Chili Seedlings Using Different Types of Media

Joanna Joan Mandie (72286)

Bachelor of Science with Honours
(Plant Resource Science and Management)
2022

Establishment of Chili Seedlings Using Different Types of Media

Joanna Joan Mandie

A thesis submitted in partial fulfilment of The Requirement of Degree in Bachelor of Science with Honours
(Plant Resource Science and Management)

SUPERVISOR: DR. HOLLENA ANAK NORI

Programme of Plant Resource Science and Management
Faculty of Resource Science and Technology
UNIVERSITI MALAYSIA SARAWAK
2022

DECLARATION

UNIVERSITI MALAYSIA SARAWAK

Grade: 2022

Please tick (√)

Final Year Project Report ✓

Masters ☐

PhD ☐

DECLARATION OF ORIGINAL WORK

This declaration is made on the ......12th......day of.....July....... year ....2022.....

Student's Declaration:

I Joanna Joan Mandie, matric number of 72286 and from Faculty of Resource Science and Technology (PLEASE INDICATE NAME, MATRIC NO. AND FACULTY) hereby declare that the work entitled, ..Establishment of Chili Seedlings Using Different Types of Media.......... is my original work. I have not copied from any other students' work or from any other sources with the exception where due reference or acknowledgement is made explicitly in the text, nor has any part of the work been written for me by another person.

12th July 2022,Tuesday
Date submitted

Joanna Joan Mandie (72286)

Supervisor's Declaration:

I,----------------Hollena anak Nori------------------- (SUPERVISOR'S NAME), hereby certify that the work entitled, Establishment of Chili Seedlings Using Different Types of Media was prepared by the aforementioned or above mentioned student, and was submitted to the "FACULTY" as a * partial/full fulfillment for the conferment of ----------Bachelor of Science with Honours-------------- (PLEASE INDICATE THE DEGREE TITLE), and the aforementioned work, to the best of my knowledge, is the said student's work.

Received for examination by: Dr. Hollena anak Nori

Date: 12th July 2022, Tuesday.

I declare this Project/Thesis is classified as (Please tick (√)):

☐ CONFIDENTIAL (Contains confidential information under the Official Secret Act 1972)*
☐ RESTRICTED (Contains restricted information as specified by the organisation where research was done)*
☑ OPEN ACCESS

I declare this Project/Thesis is to be submitted to the Centre for Academic Information Services (CAIS) and uploaded into UNIMAS Institutional Repository (UNIMAS IR) (Please tick (√)):

☑ YES
☐ NO

Validation of Project/Thesis

I hereby duly affirmed with free consent and willingness declared that this said Project/Thesis shall be placed officially in the Centre for Academic Information Services with the abide interest and rights as follows:

- This Project/Thesis is the sole legal property of Universiti Malaysia Sarawak (UNIMAS).
- The Centre for Academic Information Services has the lawful right to make copies of the Project/Thesis for academic and research purposes only and not for other purposes.
- The Centre for Academic Information Services has the lawful right to digitize the content to be uploaded into Local Content Database.
- The Centre for Academic Information Services has the lawful right to make copies of the Project/Thesis if required for use by other parties for academic purposes or by other Higher Learning Institutes.
- No dispute or any claim shall arise from the student himself / herself neither a third party on this Project/Thesis once it becomes the sole property of UNIMAS.
- This Project/Thesis or any material, data and information related to it shall not be distributed, published or disclosed to any party by the student himself/herself without first obtaining approval from UNIMAS.

Student's signature ____________________ (12th July 2022, Tuesday)

Supervisor's signature: ____________________ (12th July 2022, Tuesday)

Current Address:
No 29, Lorong Stakan 6, Taman Meilee Villa, 93250, Jalan Stakan, Kota Sentosa, Kuching, Sarawak

Notes: * If the Project/Thesis is **CONFIDENTIAL** or **RESTRICTED**, please attach together as annexure a letter from the organisation with the date of restriction indicated, and the reasons for the confidentiality and restriction.

[The instrument was prepared by The Centre for Academic Information Services]

ACKNOWLEDGEMENTS

Thank you for the support of my final year project supervisor which is Dr. Hollena anak Nori for supervising me on ways to divide the topics into appropriate and right subtopics for this thesis. She had often consistently reminded me, of the certain due date for a certain task. Besides, she had provided me with the growing media such as holland peat moss, Jiffy-7 pellets, cocopeat, and palm shell biochar prior to starting the experiment for this study. She regularly went to the lab and checked the activities that I had done at the lab from the day of preparing media until the day of practicing for the final year project presentation. She advised me to keep searching for the proper journal on the internet in the midst of struggling to find one during the time of the pandemic and reminded me to never give up. This taught me to be a student with good integrity as the published, scholarly, and peer-reviewed journals are the journals that are produced academically from various higher institutions and that have been verified. She guided me on methods to calculate the average weight of granule fertilizer and the procedure to use the Minitab Statistical Software version 17.0. The printed raw data sheet with the categories of seedling replicates on each growing media and parameters such as the plant height (cm), shoot weight (g), root weight (g), and chlorophyll content (SPAD value) has been supplied by my supervisor on the day of starting to collect data. Dr. Hollena also provided me with all the tools used for this study when I conducted my experiment from the first until the last day of being present in her lab. She helped me to include the things that are important to be put inside the slide presentation to fit in the maximum time which was 10 minutes as instructed for the actual final year project presentation.

I give thanks to my supervisor and two other friends which are Mac Cheryl Sulan Charles Emparang and Romia Rona Tagang that helped me to dig out the seedlings from the growing media and cut and separate the shoot the root on the day of harvest to collect data for their shoot and root weight.

I appreciated the lesson that my friend, Romia Rona Tagang taught me on methods to create a paper basket using just A4 white blank paper. This was to load and place the shoot and root of seedlings separated to be put inside the oven for the drying process. Romia had thrice (three days) helped to water my chili seedlings when I was not available at the time.

I valued Mac Cheryl for she had passed the knowledge from Dr. Hollena to me about methods to use the Minitab Statistical Software version 17.0 to evaluate the significant value and standard error of the mean for every parameter. Mac Cheryl had put a big amount of effort into being patient and clear when explaining each step one by one.

I also want to give a big thank you to my father, Mandie anak Hili that he had bought me red topsoil to be mixed with the palm shell biochar. He also bought a camera tripod for me which was designed to hold the digital camera for a better angle of capturing pictures, for the experiment. I treasured my mother, Monica anak Jenek for she allowed me to borrow her digital camera to snapshot any pictures intended for my final year project.

I cherished Dr. Surisa Phornvillay for being a thoughtful examiner that she had opened my eyes to see the unrecognized mistakes, lack of information, and things that were unnecessary in the thesis.

Establishment of Chili Seedlings Using Different Types of Media

Joanna Joan Mandie

Plant Resource Science and Management
Faculty of Resource Science and Technology
Universiti Malaysia Sarawak

ABSTRACT

Chili is an important vegetable crop in Malaysia. Growing media support early crop growth through shoot and root establishment. Therefore, this study was executed to quantify early seedlings growth and development of chili plants grown using four types of media. A Completely Randomized Design experiment was initiated on four growing media (cocopeat, biochar mixture, peat moss and Jiffy-7) with 51 replicates per treatment. After 56 days from sowing, results found that peat moss media gave the best growth and development performance of chili seedlings. Individuals grown on peat moss had the tallest height of 18.8 cm and the heaviest shoot of 0.90 g/plant. Additionally, peat moss and Jiffy-7 media produced seedlings with similar performance in total leaf production (~18 leaves/plant), root weight (~0.15 g/plant) and chlorophyll content (~51.7 SPAD unit). In contrast, slower growth was observed in both cocopeat and biochar treatments in terms of plant height (~8.3 cm), shoot weight (0.14 g/plant) and root weight (0.04 g/plant). Furthermore, peat moss took the shortest time, for nine days among all growing media for the 50% of the seedlings to emerge and cocopeat gave a final satisfactory number of 16 seedlings population compared.

Keywords: Chili, growth, development, emerge, final seedlings population

ABSTRAK

Cili merupakan tanaman sayuran yang penting di Malaysia. Media penanaman menyokong pertumbuhan awal tanaman melalui penubuhan pucuk dan akar. Oleh itu, kajian ini dilaksanakan untuk mengukur pertumbuhan dan perkembangan awal anak benih cili yang ditanam menggunakan empat jenis media tanam. Eksperimen Corak Rawak Sepenuhnya telah dijalankan pada empat media tanaman (cocopeat, campuran biochar, lumut gambut dan Jiffy-7) dengan 51 replika setiap rawatan. Selepas 56 hari daripada menyemai, keputusan mendapati media lumut gambut memberikan prestasi pertumbuhan dan perkembangan terbaik anak benih cili. Individu yang ditanam di atas lumut gambut mempunyai ketinggian tertinggi setinggi 18.8 cm dan pucuk paling berat seberat 0.90 g/pokok. Selain itu, media tanam lumut gambut dan Jiffy-7 menghasilkan anak benih dengan prestasi yang sama dalam jumlah pengeluaran daun (~18 daun/pokok), berat akar (~0.15 g/pokok) dan kandungan klorofil (~51.7 unit SPAD). Sebaliknya, pertumbuhan yang lebih perlahan diperhatikan dalam kedua-dua rawatan cocopeat dan biochar dari segi ketinggian tumbuhan (~8.3 cm), berat pucuk (0.14 g/pokok) dan berat akar (0.04 g/pokok). Tambahan pula, lumut gambut mengambil masa yang terpendek selama sembilan hari antara semua media tanaman untuk 50% anak benih bercambah dan cocopeat memberikan hasil akhir yang memuaskan iaitu sebanyak 16 bilangan anak benih.

Kata kunci: *Cili, pertumbuhan, tumbesaran, cambah, bilangan akhir anak benih*

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviation	Meaning
g	Gram
SPAD	Soil-Plant Analysis Development
m	Metre
pH	Potential of Hydrogen
ppm	Parts Per Million
mm	Millimetre
dS/m	Decisiemens per metre
g/cm^3	Gram per cubic centimetre
cm	Centimetre
cm^2	Square centimetre
meq/g	Milliequivalent per gram
mg/kg	Milligram per kilogram
$cmol_c/kg$	Centimoles of charge per kilogram
kg/m^3	Kilogram per cubic metre
cm^3	Cubic centimetre
℃	Degree Celsius
P	Probability value of data occur by random chance
DMRT	Duncan’s Multiple Range Test
%	Percent
RM	Ringgit Malaysia

Chapter 1: Introduction

1.1 Background

Chili (*Capsicum annuum* L.) is among the most important and commonly grown spice and vegetable crops. This herbaceous plant has many branches, and the stem can reach a height between 0.25 to 1.5 m. Chili can be cultivated under a variety of soil conditions. Following Rivitra, Thevan and Norhafizah (2021), chili thrives better in well-drained, rich loamy soils with a pH of 5.5–6.8 and the growth duration takes about 3–6 months, with yields ranging from 10 to 24 metric tonnes /hectare/season depending on the type, growth period, and management. The fruits can be obtained in green or red.

The use of optimum growing media is one of the key significant crop husbandry activities in the cultivation of chili. This is because growing media has a significant impact on initial seedlings development. It should have adequate nutritional supply, good aeration, high water retention and easily transportable. There are several substances that may be utilized as a growing media.

Cocopeat is a versatile growth material manufactured from coconut fibre. The fibre is cleansed, mechanically dried, sieved, and purified to remove sands as well as other contaminants such as animals and flora leftovers (Karim, Nadhari and Lah, 2021). As stated by Nasir et al. (2021), because of its porosity for air and excellent water retention, it is a good growth platform for various plants, it is completely natural and environmental friendly, with no soil-borne pathogens or weeds, and it also has a pH range of 5.7 to 6.5. Moreover, as mentioned by Tsado et al. (2018), the mixture of cocopeat with soil performed better than pure cocopeat.

Peat moss is defined as a partly decomposed residue of sphagnum (Cox and Westing, 2022). Peat moss have well aeration properties and retains enough water (Kumar, 2017). Peat moss is formed by a slower decomposition process because of higher moisture concentration and acidic environment (Fritz et al., 2014). A pot study conducted by Rekani, Ameen and Ahmed (2016) reported that sweet pepper (*Capsicum annuum* L.) grown on peat moss had higher fresh weight (17.1 g/pot) than those enhanced with waste compost and control, with mean values of 0.67 g/pot and 1.031 g/pot respectively. The application of peat moss considerably enhanced plant dry matter with a mean value of 4.42 g/pot for peat moss whereas the mean values of both compost and control were 0.15 g/pot. The addition of peat moss promoted pepper plant development by expanding the quantity of leaves per plant, leaf size, plant tallness, and plant dry and fresh weight.

Jiffy is a type of pot or pellet and media itself to grow plants. It could be made of cocopeat or peat moss (Lid et al., 2010). Jiffy-7 pellet is a compressed product (Ariyawansa, Gamalath and Jayasekera, 2022). Jiffy-7 pellets offer a feasible approach to growers because they provide a hygienic and easy handling of seed cultivation. Nevertheless, a comparison study between Jiffy-7 pellets and peat medium reported that Jiffy-7 medium produced higher dry matter weight of pepper seedlings but those grown on peat had larger plant size, root length, chlorophyll content and leaf area (Peker, Özer and Eren, 2019).

Biochar is a carbon-enriched biomaterial made from the thermochemical transformation of biomass (pyrolysis process) under oxygen-limited circumstances that has improved chemical stability, temperature stability, and biological inactivity (Liang et al., 2021). When applied to soil, biochar helps to reduce nutrient loss. This as well relates to gaseous nitrogen losses gains, notably soil conditioner and bio - fertilizers, and hence rising carbon isolation, ground quality, microbial operations, pH level, reusing of crop nutrient content, water retention capability, soil pollution, and so forth. Additionally, biochar helps improve nutrient uptake via the adsorption action. At climatic conditions, biochar is employed as a bio-sequestration. Biochar is beneficial in soil treatment for agricultural purposes. The presence of natural carbon in the media is critical for the maintenance of crop output, and so is the storage of nutrients and water, notably potassium, phosphorus, and nitrogen, which provides a home for soil bacteria that progress soil formation. Being an adsorbent, biochar may be applied to remove hazardous contaminants from contaminated soils. In line with Oni, Oziegbe and Olawole (2019), relying on the origin of the medium, the biological carbon component of biochar can be as much as 90%, and this substance has improved carbon capture operations. According to the study conducted by Sung-Chang et al. (2020), the weight of red pepper seedlings increased after 30 percent biochar application.

1.2 Problem Statements

Growing media support the crop by stabilising their stature through their root. It also gives nutrients needed by the crops for the fitness and good maturation of the crop. Besides, through growing media, air exchange and water flow can occur to ensure growth of crop (Kaushal and Kumari, 2020). Moreover, growing substrate determines rate and time of seed germination (Tüzel et al., 2017). An ideal growing media should be light weight, able to support plant structure, good water retention and porosity, free from pathogens, contain adequate nutrients, optimal pH and able to maintain its shape under sunlight (Gruda, Qaryouti and Leonardi, 2013).

Cocopeat consists of good air flow, water retention and porosity. Furthermore, it can be used repeatedly and free from pathogens (Kaushal and Kumari, 2020). Gruda, Qaryouti and Leonardi (2013) reported that cocopeat contains larger amount of phosphorus (6 to 60 ppm) and potassium (170 to 600 ppm), and it shrink less. Based on Kaushal and Kumari (2020), peat moss has great water retention capability of around 60% and 6 to 14% of nitrogen, and its pH is from 3.2 to 4.5. In addition, peat moss has good characteristics such as light in weight, good aeration, high in cation exchange capacity, free from pathogens and weeds, has a stabilized structure and can be used repeatedly and recycled (Gruda, Qaryouti and Leonardi, 2013). Meanwhile, Jiffy decompose faster, has no limit on root proliferation and jiffy has adequate supply to absorb water (Thakur, Sharma and M., 2020). Jiffy has good aeration capacity and is an environmental-friendly type of media. Other than that, there is no need of transplanting when using Jiffy (Exabytes, 2022). Similarly, biochar has a high porosity, ion-exchange capacity and water retention (Massa et al., 2019). It enhances soil in low concentration (Steiner and Harttung, 2014). Each of these media have their own advantages. However, limitations of these media may exist. Therefore, the performance of these media on the establishment of chili seedlings will be compared.

1.3 Objectives

This study embarks on the following objectives:

1. To determine time to emergence and final population of chili seedlings grown using four growing media such as cocopeat, peat moss, Jiffy-7 pellets and biochar mixture.
2. To quantify growth and development performance of chili seedlings in relation to plant height, leaf output and root and above ground biomass.

Chapter 2: Literature Review

2.1 Growth and Development of Chili

Chili (*Capsicum annuum* L.) from *Solanaceae* family produces either green, yellow, or red fruits when mature. The fruit height can vary significantly among *Capsicum* species from 42 mm to 127 mm. Chili have white blooms with a solitary blossom per leaf axil and the corolla is white in colour. Life cycle of (*Capsicum annuum* L.) is shown in Figure 2.1:

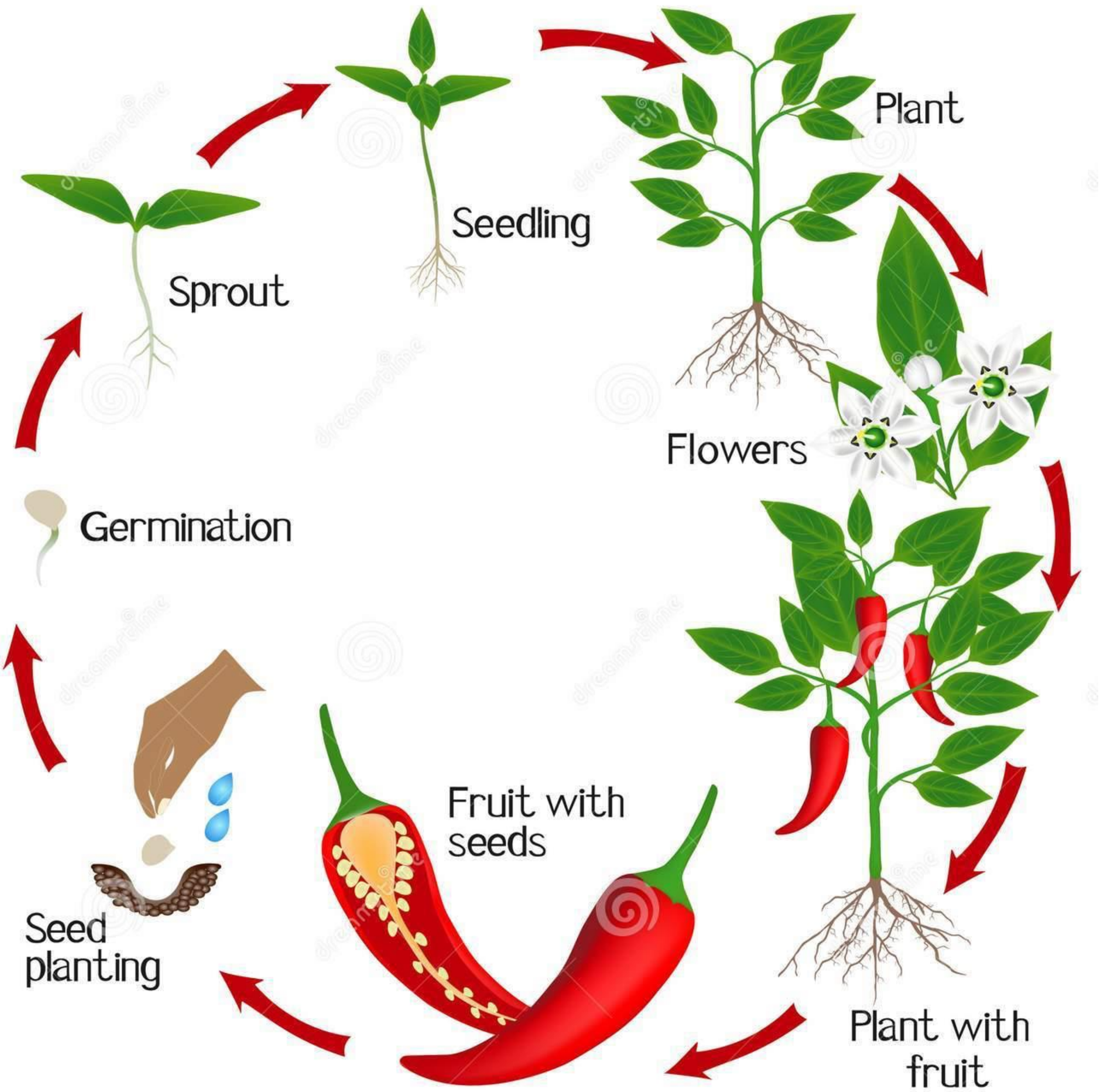

Figure 2.1: Life cycle of *Capsicum annuum* L. (Kharzhevska, 2018).

2.1.1 Seeds Germination

Germination is defined as the growth of primary root from seed (Bareke, 2018). Bareke (2018) determined that first phase in seed germination are imbibition and stimulant of metabolism. Imbibition is where seed begins to absorb water. The rise of water in seed reduce the strength of seed coats (Steinbrecher and Leubner-Metzger, 2016). Then, metabolism process will start through rise in respiration and release of protein. Second phase are consisted of digestion of stored food and translocation to embryo. Starch is digested to become sugar in cotyledon or endosperm. Sugars move to embryo for growth. Third phase is where cell divides and grow then develop to become seedling. Therefore, germination occurs between imbibition and radical (immature root of embryo) emergence. Germination process is complete if the covering of seed teared and the radicle emerge (Steinbrecher and Leubner-Metzger, 2016). Seeds will germinate only if conditions are optimal. Conditions in terms of growing media is that it must contain major nutrients like nitrogen, phosphorus and potassium. These nutrients develop the seed efficiently. Besides, growing media should supply enough water, have good air flow and have presence of microbial for decomposition of seed coat in order to germinate.

2.1.2 Seedling Emergence

The seedling is the youngest phase of a plant, after germination. Seedlings have a radicle (root) and hypocotyl, which hold the cotyledon and plumular bud (adventitious). The plumular bud creates stem and leaves that later become part of a mature plant. The cotyledons typically different from the first true leaves as the cotyledons only have a single vascular bundle (Rudall, 1992). Initially, cotyledon grows. The middle section of cotyledon elongates quickly, pulling the root that will grow next out from the seed (Leck, Parker and

Simpson, 2008). Once germination has started, the roots grow slowly. When optimal conditions are reached, the shoots and roots will grow and develop faster. Seedling become independent finding for food supply and starts photosynthesizing.

2.2 Production and Demands of Chili in Malaysia

In conformity with Food and Agriculture Organization of the United Nations [FAO] (2021), Malaysia's annual chili production has consistently increased from 1987, when it produced 1550 tonnes of chili, until 2019 when it produced 2370 tonnes of chili. Chili has become an essential spice in many cuisines in most nations. Apart from its commercial worth, the fruit has great nutritive and therapeutic qualities because of its great level of vitamin C, provitamin A, vitamin E, flavonoids, and capsaicinoids. These might be the factors driving consumer preferences for chili (Aris et al., 2017). Chili production is a societal tradition in Malaysia, where they can be planted on dirt beds or in containers. Nowadays, fertigation is used in the renowned chili farming.

Dato' Sri Dr. Mohd Uzir Mahidin (2021) declared that for Import Dependency Ratio, chili is included in eight items that exceed 50% in 2020. Import dependency ratio of chilies were 72.4% in 2020. Self Sufficiency Ratio (SSR) described the supply of local agricultural commodities could meet the demand of locals whereby the SSR of chilies were 30.9% which were less than 50% of SSR from the year 2016 to 2020. This might be the reason local agricultural community depended more on import for chilies as local production of chilies were less than 50% and compared to its Import Dependency Ratio.

Department of Statistics, Malaysia [DOSM] (2019) revealed that SSR of chili in 2017 was 39% whereby there were more imports needed for chili than exports. Local production of chili in Malaysia were insufficient for domestic consumption and chili needs to be imported to meet the demands. Additionally, Department of Statistics, Malaysia (DOSM) (2021) outlined that from year 2011 to 2020, per capita consumption for chilies were almost 80% and import dependency ratio was around 15% so there was a rise in local consumption and needs of imports for chilies. According to National SME Development Council (2007), land productivity was evaluated in terms of planting production reaped from each hectare of land while labour productivity was evaluated through the production of chili by a man or a worker per day. Chili has been chosen to be planted so it was evaluated with its land and labour productivity in 2007 which means it was targeted as an important crop for commercial purposes.

2.3 The Importance of Growing Media for Crop Establishment

Growing media is like a habitat where root of plant lives. It gives a condition for root to survive that depends on amount of air flow, water and nutrients that eventually affects whole part of the plant (Gruda, 2019). Different kinds of media can become parts of growing media (Gruda, Qaryouti and Leonardi, 2013). Each media has their own physical and chemical characteristics that determine the growth and development of a plant but growing media must have optimum physical and chemical properties to ensure the best result of establishment of seedlings. Excellent physical and chemical properties of growing media produce healthy and strong root. In congruence with Jaenicke (1999), physical properties can be divided into water retention capability, porosity, plasticity and bulk density. A good growing media must retain water in larger amount as possible to reduce need of external watering. Better porosity allows enough oxygen for respiration. More carbon dioxide is generated when adequate oxygen is received by the substrate for fast growing of the crops. In terms of plasticity, the growing substrate have to be in good condition that remain in structure despite drying to maintain the root system. For bulk density (weight per volume), a growing media has to be in moderate weight. The media will be easily blown away by wind if it is too light and consume extra energy of man when carrying if it is too heavy. Aside from that, Jaenicke (1999) stated that chemical properties of good growing substrate are divided into fertility, acidity and cation exchange capacity (CEC). In terms of fertility, a growing media should contain major nutrients such as nitrogen, phosphorus, potassium and minor nutrients. Moreover, a good growing substrate should have an optimal pH of 5.5 to 6.5 for excellent growth of plant. CEC is the potential of a substrate to adsorb cations and also micronutrients. It is a space to keep fertilizer in the media and affects the restoration of fertilizer. Besides, it determines the fertility of a crop. Main cations are calcium, magnesium, potassium and ammonium while micronutrients are iron, manganese, zinc and copper. Good growing substrate must absorb cations moderately so that the media will still be available for nutrition of plant.

2.4 Characteristics of Each Growing Media and Their Effects on Crop Establishment

Every growing media has their own feature and outcome on crop formation. Benefits, physical and chemical properties of each growing media and their impacts on crop establishment will be emphasized in this section.

2.4.1 Characteristics of Cocopeat and Its Effects on Crop Establishment

Cocopeat is regarded as a suitable growth media element because of its appropriate pH, ionic properties, and other chemical properties (Awang et al., 2009). Nevertheless, cocopeat have a great water retention capability, resulting in a bad air-water connection and limited aeration inside the media, impeding oxygen transport to the root system (Awang et al., 2009). Referring to Kalaivani and Jawaharlal (2019), cocopeat has a pH of 6.10, its electrical conductivity is 0.63 dS/m, nitrogen content is 0.41%, phosphorus is 0.81%, potassium is 1.32%, calcium is 0.21%, magnesium is 0.31%, iron is 23.00 ppm, zinc is 22.00 ppm, manganese is 17.00 ppm, and its content of copper is 5.00 ppm. Kotur (2014) specified that cocopeat has bulk density of 0.17 g/cm^3 .

Following Vavrina et al. (1996), cocopeat produced tomato seedling height of 10.70 cm, above fresh weight of 1.22 g, root fresh weight of 0.46 g, above dry weight of 0.12 g, root dry weight of 0.033 g and mean number of leaves of 4.07. These data of cocopeat were higher than that of media using MetroMix 220 except for the above dry biomass. Other than that, as stated by Mathowa et al. (2016), cocopeat produced no leaves on the first week. It produced mean number of leaves of 7.75 on second week, third week producing 15.65 and on week 4, 21.65 leaves of tomato seedlings were generated using cocopeat substrate. The leaf area was also calculated on fourth week whereby leaf area of tomato seedlings using cocopeat media was 31.70 cm^2. In terms of plant height, on first week, height of tomato seedlings is 0.00 cm, but increased on second week which was 6.50 cm, 13.77 cm on third week and kept rising on week 4 which was 15.32 cm. Fresh shoot weights per 100 tomato seedlings using cocopeat was 0.62 g while for its dry shoot weights per 100 seedlings is 0.46 g. In conclusion, cocopeat performed less well in relation to germination mix and hygromix in terms of height of crop and fresh above ground weight, but well towards dry weight of shoot of tomato seedlings.

Hence, on the report of Söylemez (2021), plant length produced by cocopeat was 126.00 cm with 100% water supply. Cocopeat performed well on dry root weight of pepper or (*Capsicum annuum* L.) where it produced the heaviest dry root weight which was 8.29 g compared to perlite. Dry above ground biomass was 87.89 g. Moreover, cocopeat also generated the greatest dry weight of leaves which was 81.56 g. Overall, all of these criteria using cocopeat as media with 100%, 75% and 50% water supply, with and no water pad (a polymer that store water for efficient water usage) were observed to be greater than that of perlite.

2.4.2 Characteristics of Peat Moss and Its Effects on Crop Establishment

Peat moss is commonly used as a soil additive. As a result, it was formerly combined with some other soil to increase ground and root performance. These then influence chili growth and yield (Vano et al., 2011). Peat moss enhances media gaseous exchange and structure while also retaining a lot of water (Landis, 1990). Furthermore, peat moss aid in the retention of nutrients without becoming saturated (Perry, 2021). Moradi, Mehrafarin and Badi (2014) described that peat moss has bulk density of around 0.13 g/cm^3, porosity around 87% and its water retention capacity is about 563%. In addition of this study, pH of peat moss is between 3.8 to 4.3. Its cation exchange capacity is 165 meq/100g and it contains 93 g of nitrogen, 176 g of phosphorus compound, 198 g of potassium compound, 8.8 g of magnesium compound, 0.44 g of zinc, 0.99 g of iron, 1.76 g of manganese and 1.32 g of copper.

In accordance with Khatiwada and Adhikari (2020), the species of plant used was cucumber (*Cucumis sativus* L.). It was found that germination was higher in peat moss which was 92.64% than vermicompost (84.54%) and control (70.00%). Peat moss produced the second maximum number of leaves which was 3.7 and vermicompost generate the highest which was 3.9. Peat moss produced the second widest leaf width (6.152 cm) of cucumber seedlings, which led by vermicompost producing the widest leaf width (6.160 cm). Besides, peat moss produced the heaviest overall fresh weight of cucumber seedlings which was

23.67 g while for root dry weight, peat moss being the second heaviest (0.8152 g). Dry shoot weight of cucumber seedlings using peat moss was 1.608 g, lesser than trichocompost (1.647 g) but more than vermicompost (1.346 g). Overall, peat moss performed well towards germination rate and total fresh weight of cucumber seedlings based on this literature but may slightly less well than vermicompost and trichocompost for some parts of growth.

Based on Abdalla et al. (2020), the least (380.5 g) in the year 2016 but heaviest (249.6 g) in the year 2017 mean of fruit weight were generated from application with peat moss. Moreover, based on this literature, peat moss alone performed well on the fruit length of eggplant whereby it had a mean of 13.6 cm from first harvest to third harvest, which was the highest length compared to spent mushroom compost and mixture of compost with peat moss (1:1). Peat moss produced the second highest plant height which its mean was 75.1 cm, the least number of branches per plant (mean of 3.812) and the greatest quantity of leaves for one plant which had a mean of 36.625 compared to spent mushroom compost and a mixture of compost and peat moss (1:1) from total of both years, 2016 and 2017. Overall, peat moss performed the greatest in terms of fruit length and quantity of leaves per plant of eggplants or (*Solanum melongena* L.) compared to spent mushroom compost and a composition of compost with peat moss (1:1). Furthermore, for pepper or (*Capsicum annuum* L.), peat moss performed better on number of branches per plant than that of spent mushroom compost and compost with peat moss (1:1).

According to Khandaker et al. (2017), peat moss was treated as an organic fertilizer. It was mixed with a topsoil (sand+compost). As a result, it produced a (*Capsicum annuum* L.) var. Kulai with a height of 50.0 cm, the third highest. Vermicompost as a led, chicken dung being the second highest and the rest were fermented fish waste and cow dung. The amount