

## Growth Performance of Chinese Cabbage using Soilless Cultivation Method

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### 〈Abstract〉

Growing plant in potting media without soil is known as Soilless cultivation. This method is used mostly in greenhouse cultivation to increase horticultural commodities production. Peat moss is commonly utilized as potting media substrate because of its characteristic. However, peat moss price is high because of the quantity of peat moss in nature has been decreased. Recently, most of the research is conducted to find the alternative growing medium to cultivate horticulture plant in potting media. Perlite and rice husk ash were mentioned that had a potent as alternative growing media for seasonal plants to increase agriculture production due to the lack of production area. This research aims to determine the growth of in rice husk ash, perlite and peat moss as growing substrates. The method used was the soilless cultivation. The chinese cabbage was planted in the pot with perlite media, rice husk ash media, and peat moss media. The chinese cabbage was measured after 35 days after planting. The result showed that peatmoss was more potentials in chinese cabbage growth performance than rice husk ash and perlite. Peat moss had the significant result of every research parameters such as plant height, plant weight, number of leaves, plant diameter, root length, and root weight. The best alternative for cultivation chinese cabbage without substrate based on this research was peat moss then rice husk ash and perlite.

*Keywords : Chinese cabbage, growth performance, growth substrate, soilless cultivation*

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## 1. Introduce

The need for land as agricultural land will continue to increase along with the increasing human population. Today the human population has exceeded 7 billion worldwide. The United Nations (2016) states that this population will continue to increase to 8.5 billion in 2030 and 9.7 billion in 2050. This increasing population will cause agricultural land to be used as residential land while land on earth is very limited. In addition to land requirements, the challenge in agricultural production is low water availability and land degradation [1][2]. Therefore, an appropriate crop production system must be used to achieve maximum production results. For example, efficient use of land, soil and water. So, this system can be used both in urban and rural areas. The popular crop production system to overcome the limitations of agricultural land is hydroponics, aquaponics. Both of these systems are very suitable to be applied in urban areas and areas lacking agricultural land. This system is also able to increase agricultural production productively [3].

Hydroponics is one way to cultivate plants that do not use soil as a medium for growing plants. Plants cultivated with hydroponic systems obtain nutrients from fertilizers that have been formulated [4]. While aquaponics is a system for cultivating plants that are created because of a combination of hydroponic and aquaculture

systems. Plants that are often cultivated with this system are plants of the type of aquatic species [5][6]. This study uses three different types of growing substrate. First, plants are grown using rice husk ash growing substrate. Rice husk ash is obtained from rice waste, which is burned and becomes charcoal. The researchers have a high interest in using rice husk ash as an alternative growing substrate to substitute soil and explore the potential of rice husk ash to be used appropriately. [7] [8].

Studies using rice husk ash showed that vegetable crop yields showed significant results when cultivated using rice husk ash [9] [10]. On the other hand, several studies show different results. The results of the study showed a decrease when compared with the control of the study [11] [12]. Second, plants are grown using perlite media. This media has been used as a growing medium for various types of horticultural plants such as cucumbers, tomatoes, melons, chili, and lettuce . Perlite can improve the development of plant roots, reduce root decay, avoid recording water and provide optimal air and water balance. Tomatoes that are cultivated using perlite show good growth compared to using rock wool. Likewise, melon, strawberry and orchid plants show good growth (Hanna, 2005, 2010).

Peat or peat moss is a dry sphagnum moss commonly used to increase soil capacity. Peat moss can hold water and nutrients needed by plants. In addition, Peat moss increases

capillary strength and cation exchange capacity. The high usage of peat moss causes availability and quality of peat moss to decrease. In the past few years, the quality of natural peat moss has decreased due to the large amount of peat harvesting in its natural habitat. In nature, peat can be found on peat lands and wet lands. Other kinds of peat are needed in conducting plant cultivation, but the amount of peat in nature is insufficient. This raises a new problem, namely environmental problems.

Many researchers conducted research to find new planting media to replace peat moss. This new planting medium is expected to be used in pot media in greenhouses. Finding planting media that can replace peat moss can reduce environmental problems and reduce peat moss price increases in the market. This research aims to determine the growth of in rice husk ash, perlite and peat moss as growing substrates.

## 2. Material and Methods

The research was conducted at the Bio Institute of Materials Manufacturing System Laboratory, Pusan National University, Miryang Campus, South Korea. This study used a completely randomized design with a single factor with three treatments that were repeated three times. The material used in this study was cabbage, rice husk, perlite, peat moss, and water. The tools used in this

study were water tank, hose, bed, ruler, paper, scale, bucket and camera. Seedlings of cabbage were obtained from agricultural shops in Miryang City. Then, the cabbage seeds were transplanted to the planting media.

Table 1. Lettuce growth under light treatment

Treatment	Root length (cm)	Length of leaf (cm)	Number of leaf	Diameter of cabbage (cm)	Root weight (mg)	Plant weight (mg)
Rice husk ash	23.26a	8.82b	11.20b	4.16b	617.90b	6102.80b
Perlite	9.62b	4.02c	4.20c	2.00c	1009.90b	653.99b
Peat moss	22.46a	22.46a	20.00a	28.84a	5463.90a	9400.00a

Cabbage plants were grown in three different types of planting media, namely rice husk, perlite and peat moss. Each planting medium consists of 5 cabbages. Plants were watered twice a day at 9am and 5pm. Plants were observed after 35 days after planting. Variables observed were plant height, plant weight, number of leaves, plant diameter, root length, and root weight. Ruler was used to measure plant height, leaf width, plant diameter and root length. Then, analytical scale was used to measure plant weight and root weight. Data that has been collected will be analyzed using a SPSS program with a 5% error rate. Calculation data showing significant results, will then be tested using the Duncan test.

### 3. Result and Discussion

The results showed that the application of several potting media substrates media affects the growth of (table 1). The growth variables of Chinese cabbage that are significantly influenced each research parameter. Peat moss growing substrate showed a greater result to plant height, plant weight, number of leaves, leaf width, plant diameter, root length, and root weight compared to another planting medium. While the perlite media showed a greater result to the root weight compared to rice husk ash growing substrate. In other hand, rice husk ash showed a greater result to the plant weight compared to perlite growing medium. Overall, the growing substrates that used in this research showed greatest results for four plant growth variables. Greenhouse cultivation is most widely method to increase agricultural production that can control the growth aspect.



Fig. 1 Chinese cabbage after harvested.

Greenhouse cultivation is usually used the growing substrate to grow horticultural commodities in potting media. Perlite, rice husk, and peat moss had been reported that

suitable as the substrate for growing plant in potting media. Perlite had been tested in several horticultural plants such as melon, cucumber, lettuce and rose. Perlite had been reported to have benefit for growing plant, which focuses on the root [13]. This research showed that perlite was more potent to Chinese cabbage root growth. The highest root length and root weight are indicated by the use of peatmoss media. However, the peat moss media that used in this research has perlite in its composition. in the peatmoss media there is perlite in it. Root weight of Chinese cabbage from peatmoss media was 5463.90 mg.

It was higher than root on rice husk ash and perlite. Perlite inside of the peat moss showed the positive trend against plant height, plant weight, number of leaves, plant diameter, root length, and root weight. The nutrient content in the perlite media causes a higher root value of the chinese cabbage plant. The nutrients contained in the perlite are 3.5% K, 0.6% Ca, 0.2% Mg, 33.8% Si, 7.2% Al, 3.4% Na, and 0.6% Fe. The plant diameters, number of leaf, of root value of Chinese cabbage grown using perlite media reaches 16.33 cm. The root length of Chinese cabbage is high because of the ability of perlite media to increase dissolved P, Ca and Mg concentration [14] and [15].

Plant weight of chinese cabbage that was planted on peat moss growing medium had a heavy weight (9400.00 mg) and had the higher stem diameter of Chinese cabbage

(28.84 cm). This finding showed that the value of plant weight has correlation on stem diameter of Chinese cabbage. In this study, peat moss ash showed the high potency of Chinese cabbage leaf length. The length of Chinese cabbage leaf planted with peat moss is 22.46 cm. This value is higher than the value of Chinese cabbage that grown with rice husk ash and perlite. Leaf length is influenced by the number of elements available on the growing media. The nutrient values of peat moss medium are 93.4% Si, 0.05% Al, 0.06% Fe, 0.31% Ca, 0.35% Mg, 1.4% K, 0.1% Na, 0.8% P.

Peat moss is also used to increase soil aggregates and macro aggregate compositions [16]. In addition, the use of peat moss can improve soil chemical and physical properties of soil [17]. The ability of peat moss as the aggregate regenerator, chemical content, and physical properties increase the growth of Chinese cabbage plants. The properties of peat moss growing substrate have been shown to influence plant growth and improve crop yields. Further more, the usage of rice husk ash showed a good performance. The result of research that is conducted by Hossain indicating that the use of rice husk ash can increase the height of tomato plants. Furthermore, Liu et al., 2014 reported that the sweet potato production increases by using rice husk ash.

## 4. Conclusion

In this research, Peat moss had more potential for than rice husk ash and perlite growing substrate according to its performance to growth. Peat moss growing substrate exposed the greatest performance for each research parameter. Peat moss type had the significant result of every research parameters, such as plant height, plant weight, number of leaves, plant diameter, root length, and root weight. The value of root length, leaf length, number of leaf, plant diameter, root weight, and plant weight of peat moss varian were 22.46 cm, 22.46 cm, 20.00 leaf, 28.84 cm, 5463.90 mg, and 9400 mg, respectively. The differences between the result of this research and other research may be due to the substrate condition and environmental condition. Further studies also should be made to identify and evaluate the effect of using the alternative substrate as potting media in physical and chemical properties.

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