EFFECT OF GROWING MEDIA ON GROWTH AND YIELD OF POTTED PAKCHOI

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CERTIFICATE

This is to certify that the thesis entitled ***"EFFECT OF GROWING MEDIA ON GROWTH AND YIELD OF POTTED PAKCHOI"*** *submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE in HORTICULTURE****, embodies the result of a piece of authentic research work carried out by* ***SAIMOON NESA SHATHY,*** *Registration No.* ***18-09215*** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

Dated: December, 2020
Dhaka, Bangladesh

Prof. Dr. A. H. M. Solaiman
Supervisor

It is a fact that the remembrance of Allah brings peace in the heart. It is better to ponder over the verses to bring us even closer to Allah (swt).

DEDICATED TO-

MY BELOVED PARENTS

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BY

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ABSTRACT

An experiment was accomplished in the rooftop of Dr. M A Wazed Miah central laboratory of Sher-e-Bangla Agricultural University, Dhaka during the period from December 2020 to February 2021 to study on effect of different growing media on the growth and yield of potted Pakchoi. The experiment comprised of eight levels of different growing media viz., T_0 – Control(100% soil), T_1 – Vermicompost (90%), T_2 - Cocodust + Vermicompost (45%+45%), T_3 – Mushroom Spent Compost(90%), T_4 – Vermicompost + Cowdung (45%+45%), T_5 – Vermicompost + Mushroom Spent Compost (45%+45%), T_6 – Vermicompost + Mushroom Spent Compost + Cowdung (30%+ 30%+ 30%) and T_7 – Vermicompost + Biochar (45%+45%). Treatment T_0 was 100% soil and 10% soil were added in rest 7 treatment equally. This experiment arranged in Completely Randomized Design (CRD) with three replications. Data on different growth and yield attributes parameters were taken in which all the treatment showed significant variations. The tallest plant (24.50 cm), the maximum number of leaves (20), the maximum leaf length plant^{-1} (23.00 cm), the maximum leaf breadth (13.00 cm), the highest fresh weight with root (415.00), the maximum fresh weight without root (410.00 gm), the maximum root length (13.00 cm), the maximum shoot diameter (8.90 cm), the maximum stem diameter (1.10 cm), the maximum stem length (4 cm) were counted in T_1 (Vermicompost) treatment but the maximum dry weight (12.36 gm) and the maximum root weight (10.00 gm) were found from T_3 (Mushroom Spent Compost) treatment. The highest yield of pakchoi (18.22 t ha^{-1}) was recorded from T_1 (Vermicompost) treatment. Significantly higher yield (18.22 t ha^{-1}) was recorded from T_1 (Vermicompost) treatment while the lowest yield (1.67 t ha^{-1}) was recorded from T_7 (Vermicompost + Biochar) treatment. It was apparent from the above results that the treatment of T_1 was more suitable than rest of treatment. The total soluble solids (12.50 ^{0}Brix) was higher in T_7, maximum Vitamin-C (37.30 mg/100g) was recorded in T_2 treatment and maximum moisture percentages (92.42%) were found in T_1 treatment.

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ABBREVIATIONS

BAC	Bangsai Agricultural Center
NRCS	Natural Resources Conservation Service
AKA	Agricultural Knowledge Article
NFT	Nutrient Film Technique
DFT	Deep Flow Technique
BAU	Bangladesh Agricultural University
AEZ	Agro-ecological Zone
Agric.	Agricultural
ANOVA	Analysis of Variance
BARI	Bangladesh Agricultural Research Institute
Biol.	Biology
CV	Coefficient of variance
DAS	Days After Sowing
et al.	And others
Ex.	Experiment
t ha^{-1}	Tonnes per Hectare
Hort.	Horticulture
LSD	Least Significance difference
CRD	Completely Randomized Design
Res.	Research
SAU	Sher-e-Bangla Agricultural University
Sci.	Science
Technol.	Technology
BINA	Bangladesh Institute of Nuclear Agriculture
NCT	Non-Aerated Vermicompost Tea
ACT	Aerated Vermicompost Tea
ACTME	Aerated Vermicompost Tea Augmented With Microbial Enhancer
MSTAT	Michigan State University Statistical Package for Data Analysis
WHC	Water Holding Capacity
BD	Bulk Density

CHAPTER I

INTRODUCTION

Pakchoi (*Brassica rapa* L. *Chinensis*), including a short-lived plant and contains many nutrients that we need in everyday life, one of them is beta carotene. On 100 grams (3.53 oz) Pakchoi plants contain a variety of nutrients and vitamins that are needed by the body: proteins (25%), potassium (6%), calcium (36%), iron (15%), vitamin A (7%), as well as vitamin C (9%). Nowadays, the public demands of Pakchoi vegetable are increases. The availability of vegetable production should be enhanced through farming technologies. In Bangladesh the daily requirement of vegetable for a person is 200 g. Pakchoi can be grown on a wide range of soil types, ranging from light sand to heavy loam or, even clay that are well supplied with organic matter. Successful production of Pakchoi depends on various factors. Fertilizer matter. Successful production of Pakchoi depends on various factors. Fertilizer management is one of the most important factors, which assured crop production. Use of chemical fertilizers in crop production is one of the important causes of environmental pollution. Now-a-days, there is growing awareness among the scientists in various parts of the world regarding the problems of environmental pollution through the use of chemicals in crop production. As an alternative to chemicals, scientists in the developed nations are trying to develop various bio-fertilizers for reducing environmental pollution and for obtaining pollution free crop production, especially vegetables. Use of organic manure in crop production has many advantages over chemical fertilizers. Organic manure saves the crop plants from adverse environment.

Organic manures such as cowdung, poultry manure and vermicompost improves the soil structure, aeration, slow-release nutrient which support root development leading to higher growth and yield of tomato plants. The macronutrients calcium

and micronutrients boron, manganese, molybdenum and iron are important for tomato cultivation. Biologically active soils with adequate organic matter usually supply enough of these nutrients.

Edible mushroom is grown commercially using lignocellulosic waste by applying a biological process. However, after the harvesting season about 70% of the substrate remain as a spent mushroom compost (SMC). SMC can be the source for retrieving value-added products which support zero waste approach. In this paper, the fate of SMC from agricultural production will be discussed focusing on its utilization. Based on the previous reports, major uses of SMC were in the agricultural field as mushroom media, animal feed, plant compost, fertilizer and others. Extended usage of SMC, i.e., for second cultivation is proposed in this review. In addition, the SMC was also applied in renewable energy production, e.g., feedstock for biogas, bioethanol or biohydrogen (Umor *et al.,* 2021). Organic amendments, such as biochar and green manure, could be a useful strategy to sustainably maintain or increase soil organic matter content, preserve the physical nature of the soil and improve soil fertility and crop yield. Biochar is the product of the thermochemical conversion of organic materials with a small amount of oxygen at high, low, or intermediate temperatures. Biochar is stable, rich in nutrients, and it can persist in soil for many years. Biochar also provides a number of soil health benefits, such as; increased soil organic matter, improved soil structural stability, reducing nutrient leaching, provide greater nutrient availability in soil, and improve the efficiency of nutrient utilization in crops, increasing the amount and structural diversity of microbes in applied soils (Adekiya *et al.,* 2020).

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It is widely acknowledged that using composts and vermicomposts as amendments, rather than industrialized fertilizer and raw manure, could improve soil nutrients and promote soil health (Jack and Thies, 2006). Manure compost has been widely applied as it is highly accessible at low price (Hepperly *et al.,* 2009;

Ramirez-Guerrero and Meza-Figueroa, 2014), and greatly improved most of the characteristics of crop plants compared with mineral fertilizer (Da Silva et al., 2011). Vermicomposts are finely divided, peat-like materials produced through a non-thermophilic process involving the biodegradation and stabilization of organic materials through interactions between earthworms and microorganisms. Vermicomposts are characterized by high porosity, aeration, drainage, water-holding capacity and microbial activity. Many studies have demonstrated positive effects of vermicompost on a wide range of crops, including cereals and legumes, ornamental, and flowering plants (Chan and Griffiths, 1988) and field crops (Mba, 1996). Application of compost and vermicompost can also increase soil organic carbon, nitrates, phosphates, exchangeable calcium and some other nutrients for plants (Orozco et al., 1996; Garcia-Gil *et al.,* 2000; Bulluck *et al.,* 2002; Jindo *et al.,* 2016). Most of these investigations have confirmed that manure compost and vermicompost usually has significant beneficial effects on plant growth. (Lundegårdh *et al.,* 2008). Zhao *et al.* (2008) reported that organic fertilization (compost + fish emulsion) resulted in higher phenolic concentrations for pakchoi (*Brassica rapa* L. Chinensis group) compared with conventional fertilization with mineral fertilizers. In Bangladesh, there are two varieties are grown. Hence in order to improve the present situation of Pakchoi production in Bangladesh, it is essential to promote better varieties to the growers of Bangladesh.

Considering the above-mentioned facts, the present investigation was undertaken with the following objectives:

i) to find out the suitable growing media for optimum growth and yield of Pakchoi

ii) to find out the suitable combination of organic manure for ensuring the higher yield of Pakchoi.

iii) To investigate nutritional cinstituents of Pakchoi in different growing media.

CHAPTER II

REVIEW OF LITERATURE

A number of researches works of Pakchoi have been performed extensively in several countries especially in the South East Asian countries for the improvement of yield and quality. In Bangladesh, little attention has so far been given for the improvement of Pakchoi varieties or their cultural management. Pakchoi is one of the important leafy vegetables' crops grown under field and greenhouse condition, which received much attention to the researchers throughout the world. Among various research works, investigations have been made in various parts of the world to determine the suitable organic manure and variety for practices for its successful cultivation. The organic manure plays an important role in Pakchoi production. In Bangladesh, there are a little study on the influence of organic manure and variety on the growth and yield in Pakchoi. However, the relevant literature on Pakchoi and some other related crops available in these connections have been reviewed here with the hope that this might contribute to the present study. Currently Sher-e-Bangla Agricultural University (SAU), Bangladesh Agricultural University (BAU) and Bangladesh Institute of Nuclear Agriculture (BINA) have started extensive research on varietals development and improvement of Pakchoi. Findings of various experiments related to the present study at home and abroad have been reviewed and discussed in this chapter.

2.1 Effect of different growing media on growth and yield of Pakchoi

Adrian (2019) The study was conducted in a Greenhouse at Tshwane University Nursery owned by the TUT (Department of Horticulture) to determine the best mulching types on growth and yield of B. rapa subsp Chinensis. Five mulching materials (Peachpips, Wood shavings Coffee grounds, Newspaper, Control fertilized with Multifeed) and control (no treatment) were used to test the effect of

mulching on growth and yield of B. rapa subsp. Chinensis seedlings. The experiment was laid out in Completely randomized block design with three replicates. Seeds of B. rapa subsp. Chinensis were sown in mid-May and two weeks after seedling have emerged some were then transplanted. Fertilizers were applied after one week after transplanting. Data was collected once a week on plant height (cm) and number of leaves but irrigating twice a week for duration period of 6 weeks. At harvest data was collected again on plant height (cm), number of leaves, and root length (cm). At harvest. results show that fertilizer treatments did not significantly differ from the control, however seedlings applied with Multifeed and Vita veg fertilizer resulted with the highest average number of leaves. Seedlings applied with LAN had tall roots followed by control, while peachpips and Control resulted with short roots This is a quantitative study undertaken with statistical tests.

Liao *et al.* (2019) a pot trial for Pakchoi (*Brassica campestris* ssp. chinensis L.) was conducted under greenhouse conditions with: (1) control; (2) chemical fertilizer; and (3) organic fertilizer. The responses of the plant, soil properties, and rhizobacterial community were measured after 45 days of cultivation. Fertilization increased soil nutrient levels and Pakchoi productivity and the reshaped rhizobacterial community structure, while no differences in rhizobacterial abundance and total diversity were observed. Generally, most plant antioxidants were negatively correlated with inorganic nitrogen (N) and positively correlated to organic N in soil. The genera of Arthrospira and Acutodesmus contained differential rhizobacteria under chemical fertilizer treatment, which are known as copiotrophs. In addition, the addition of a chemical fertilizer may stimulate organic substance turnover by the enrichment of organic compound degraders (e.g., Microbacterium and Chitinophaga) and the promotion of predicted functional pathways involved in energy metabolism. Several beneficial rhizobacteria were associated with organic fertilizer amended rhizosphere

including the genera Bacillus, Mycobacterium, Actinomycetospora, and Frankia. Furthermore, Bacillus spp. were positively correlated with plant biomass and phenolic acid. Moreover, predictive functional profiles of the rhizobacterial community involved in amino acid metabolism and lipid metabolism were significantly increased under organic fertilization, which were positively correlated with plant antioxidant activity. Overall, our study suggests that the short-term application of chemical and organic fertilizers reshapes the rhizobacterial community structure, and such changes might contribute to the plant's performance.

Yusuk *et al.* (2018) this research was aimed at study the effects of season and harvesting time on the quality of organic Pak choi (*Brassica rapa* var. *chinensis*). Pak choi was harvested from a farmer's greenhouse at different times of the day: morning (05:00 am–08:00 am), afternoon (12:00 pm–2:00 pm) and evening (4:30 pm–6:30 pm) in the winter, summer and rainy season. Season affected on total sugar, glucosinolate, vitamin C and crude fiber content while harvesting time affected on glucosinolate, vitamin C content and leaf color. After 3–day storage at ambient temperature, it was revealed that season affected all parameters, whereas harvesting time only affected reducing and total sugar contents, glucosinolate, vitamin C and respiration rate. Nevertheless, the interaction of both factors affected sugar contents, glucosinolate and respiration rate. This study suggested that rescheduling planting dates depending on the season and selecting a suitable time in the day for harvest can positively affect the quality of organic Pak choi. For nutritional benefits, Pak choi has the highest glucosinolate content when it is harvested in the morning. On the other hand, the produce harvested in the evening has the highest vitamin C content. The summer season may affect the quality due to the highest respiration rate and weight loss at that time.

Ramnarain *et al.* (2017) conducted the experiment from January to May 2016 at the Anton de Kom University of Suriname, Paramaribo. The experiment was carried out (Completely Randomized Block Design) in a greenhouse for six weeks. The treatments were vermicompost (V), cow manure (S), chemical fertilizer (K) and control (C). Plant growth parameters were recorded during the experiment (plant height and number of leaves) and after harvest (root and shoot biomass, leaf area). Nutrient analysis (Ca and Fe) of Pak choi was also conducted followed by pre and post experiment soil analysis (pH, EC, TOC, N, P, K and C/N ratio). The results were collected and analyzed using Sigma Plot 12.0 tools. In the white Pak choi, the number of leaves, root length and weight of fresh plants showed no significant differences among the four treatments using Tukey's test ($P \leq 0.05$). In the green Pak choi the number of leaves and root length showed no significant differences among the four treatments by Tukey's test ($P \leq 0.05$). Furthermore, the soil parameters (pH, OC, N) did not indicate a significant increase or decrease of the elements in the soil. P did decrease significantly and K increase in the treatments in the soil was not relevant. The evaluation of the use of vermicompost on the crop production of 2 varieties of Pak choi (Brassica rapa var. chinensis) proved that the plants treated with vermicompost had similar results as those treated with cow manure and chemical fertilizer.

Koesriharti and Istiqomah (2016) conducted a study in Tegalweru village Dau Malang from February until July 2016. The research was using factorial randomized block design with 3 replications. First factor were composition of growing media consist of 3 levels: (M_1) sand and rice husk 1:1, (M_2) sand and cocopeat 1:1, and (M_3) sand, rice husk and cocopeat 1:1:1. Second factor were nutrient solution consisting of 5 levels: (P0) AB Mix 100%, (P_1) T. diversifolia liquid manure 25% + cow liquid manure 75%, (P_2) T. diversifolia liquid manure 50% + cow liquid manure 50%, (P_3) cow liquid manure 50% + AB Mix 50%, and (P_4) T. diversifolia liquid manure 25% + cow liquid manure 25% + AB Mix 50%.

The result of this research showed that using composition of growing media M_1 had higher result to length of plant and stem diameter than growing media M_2. Using composition of the growing media M_1 showed higher result to number of leaves, than growing media M_3. Nutrient solution P_3 and P_4 significantly affect to length of plant higher than nutrient solution P_0.

Archana *et al.* (2012) conducted a study on effects of various extraction ratios on the growth, mineral nitrogen (N), and phytonutrient content of pak choi (*Brassica rapa*, Chinensis) and on soil biological properties. In greenhouse experiments, plants were fertilized with a single rate of chicken manure-based thermophilic compost. In field trials, three fertilizer treatments: 1) rendered meat byproduct or Tankage (Island Commodities, Honolulu, HI); 2) soluble fertilizer (16:16:16); and 3) chicken manure-based thermophilic compost were applied. Aerated vermicompost teas were prepared using chicken manure-based vermicompost and water at various ratios. Pak choi plants were treated weekly for 4 weeks with 10%, 5%, 3%, and 1% vermicompost teas in the greenhouse experiments and 10% and 5% teas in the field trials. Applications of vermicompost tea significantly increased plant growth, N content, total carotenoids, and total glucosinolates in plant tissue; this response was greatest in chicken manure-fertilized treatments. Increases in yield and phytonutrient content were associated with increased N uptake. Vermicompost tea also increased soil respiration and dehydrogenase activity over the control (water). Plant growth, phytonutrient content, and microbial activities in soil increased with increasing concentrations of vermicompost tea. Within the range of concentrations evaluated (1%–10%), greatest plant growth response was observed with 5% and 10% vermicompost tea, indicating that the optimal water-to vermicompost ratio for extraction is lower than 50:1 and is likely in the range of 10:1 to 20:1. The findings suggest that vermicompost tea could be used to improve plant nutrient status and enhance soil biological properties in vegetable production.

Archana *et al.* (2009) multiple studies have been reported on the effect of compost tea on suppression of certain plant diseases. However, relatively little work has been done to investigate the effect of vermicompost tea on yield and nutritional quality of vegetable crops. In this study, experiments were conducted to determine the effect of extraction method on vermicompost tea quality and subsequent effects on growth, mineral nutrients, phytonutrients and antioxidant activity of pak choi plants grown under organic (vermicompost) and synthetic (Osmocote) fertilisation. Three vermicompost teas obtained by different extraction methods, namely non-aerated vermicompost tea (NCT), aerated vermicompost tea (ACT) and aerated vermicompost tea augmented with microbial enhancer (ACTME), were applied to the plants. Aerated water served as control. Results: Mineral nutrients were significantly higher in ACTME compared with other teas, but total microbial population and activity did not differ with extraction method. All vermicompost teas similarly enhanced plant production, mineral nutrients and total carotenoids, and this effect was most prominent under organic fertilisation. Antioxidant activity and total phenolics were higher under organic compared with synthetic fertilisation. Vermicompost teas generally decreased phenolics under organic fertilisation and increased them under synthetic fertilisation compared with the control. The effect of vermicompost tea on crop growth is largely attributable to mineral nutrient, particularly N, uptake by plants. Non-significant differences among extraction methods on plant response within fertiliser regimes suggest that aeration and additives are not necessary for growth promotion and nutrient quality under the conditions reported here.

2.2 Effect of growing media on different crops

Abdani (2020) was conducted at Mindanao State University-Main Campus, Marawi City. Results of the study showed that T2 (Recommended Rate (RR) Inorganic Fertilizer) plants are the tallest while T1 (Control) plants are the shortest with a mean height of 14.56 and 8.66 cm, respectively. T2 plants also have the

highest mean growth rate of 3.015 mm/day, and T7 (50% RR Organic Fertilizer + 50% RR Foliar Fertilizer) as the shortest with a mean growth rate of 1.237 mm/day. Further, T5 (50% RR Inorganic Fertilizer + 50% RR Organic Fertilizer) plants show the highest mean number of leaves of 10.197, and T1 plants are the least with a mean number of leaves of 6.867. Yield was also highest in T2 and lowest in T1 with a mean weight of 225.863 g and 50.853 g, respectively. Moreover, the results of the study are recommended to the Philippines' Department of Agriculture (DA) and Local Government Units (LGUs) to guide the farmers and consider adopting the recommendations of this study.

Cig (2019) the objective of this study was to investigate the effects of different growing media on plant growth and nutrient contents of petunia (*Petunia hybrida*). The experiment was conducted in a chamber room under controlled conditions at the laboratory. Seven different media (soil, 3:1 soil: peat (P_1), 2:1 soil: peat (P_2), 3:1 soil: barnyard manure (BYM_1), 2:1 soil: barnyard manure (BYM_2), 3:1 soil: sugar beet pulp (SBP_1), 2:1 soil: sugar beet pulp (SBP_2)) were used as plant growing media. The experiment was ended after three months following transplanting of seedlings. Plant growth and flower parameters and macro-micro nutrient contents were determined in harvested plants. The highest stem diameter, branch number, flower diameter, flower stalk diameter, plant fresh weight and plant dry weight were in 2:1 ratio of soil: peat mixture as 7.00 mm, 6.33, 8.91 cm, 3.59 mm, 48.47 g and 4.52 g while the highest plant length, lateral branch number and flower number means were found as 27.43 cm, 24.67 and 24.67 in ratio of 3:1 soil: peat growing media respectively. The highest potassium, magnesium and zinc means of plants were obtained as 6.6%, 2.2% and 32.50 mg kg^{-1} in soil: barnyard manure (2:1) growing media while the highest phosphorus and calcium means of plants were found as 0.27% and 4.5% in soil and peat growing media respectively. The highest iron and copper means of plants were determined as 231 mg kg^{-1} and

32.50 mg kg^{-1} in ratios of 2:1 and 3:1 of soil: sugarbeet pulp growing media respectively.

Aslanpour *et al.* (2019) an experiment was performed to investigate the factors affecting the growth and flowering in this plant. The first experiment investigates three growing media (peat, cocopeat: perlite and peat moss: perlite). All experiments were performed as a factorial experiment in a completely randomized factorial design with five replications. Most of the measured traits were significantly affected by the treatments of these three experiments. The use of peat moss: perlite growing medium with equal ratio along with the application of phosphate fertilizer provided the best yield.

Sardoei and Shahdadneghad (2015) the study was conducted to evaluate the effect of different growing media on the growth and flowering of Zinnia elegans. Seven different growth media including coconut compost, silt, soil loam, leaf manure, (leaf manure+silt; 2:1), (coconut compost+soil loam; 1:1) and (leaf manure+soil loam+silt; 1:1:1) were used for growing Zinnia. The experiment was laid out in Complete Randomized Design (CRD) giving equal importance to treatments. Number of flowers, length of lateral branches, number of lateral branches, stem diameter, plant height (cm), diameter of flower, vase life (day) and fresh and dry root, shoot and total were determined. The present study confirms the fact that selection of the appropriate medium of growth for potted flowering plants in this case Zinnia elegans was very important from aesthetic and marketing point of view. The medium must ensure the production of plants of the required quality on cost effective basis. In the present study, leaf manure produced significantly the maximum vase life and diameter of flower while the maximum vase life and diameter of flower was obtained with mix (coconut compost+soil loam; 1:1).

Ghehsareh (2015) the experiment was conducted as factorial in a completely randomized block design with 9 treatments and 3 replications. Treatments included three sizes (S_1 = <0.5, S_2 = 0.5–1, and S_3 = 1–2 cm) and three composting times (C_1 = 0, C_2 = 3, and C_3 = 6 months) of date palm waste. Statistical analysis showed that the values of bulk density (BD) and water holding capacity (WHC) were significantly increased at the end of cultivation from culture media without plant in comparison to before and after planting ($p < 0.05$). Amounts of F t (total porosity) in culture media without plant were significantly higher than those in culture media before planting and with plant ($p < 0.05$). Also, during the experiment, an apparent shift in physical properties was recorded. The overall results of this research indicated that composting process changed the physical properties of the media before planting. Also, during the experiment, an apparent shift in physical properties was recorded. The results of the study showed that composting processes continued in culture media with and without plant, in the mean time, the composting processes were higher in culture media without plant.

.Waseem *et al.* (2013) a pot experiment was conducted to investigate the effect of different growing media on the growth and development of stock (Matthiola incana). Seven different growing media including soil (100%), leaf mold (100%), coconut husk (100%), soil + leaf mold (50:50), soil + coconut husk (50:50), leaf mold + coconut husk (50:50) and soil + leaf mold + coconut husk (33:33:33) were used to check the growth of Stock plants in pots. Data was recorded for different parameters including days to flower initiation, days to flowering, plant height (cm), leaves per plant, branches per plant, flowering clusters per plant, flowers per cluster, flowers per plant and flower persistence life (days), during this course of study. The overall performance of Stock was better in media having leaf mold as it took least days to flower initiation (75.83), maximum plant height (21.43 cm), flowering clusters per plant (4.11), number of flowers per cluster (8.45 days),

flowers per plant (34.66). For better growth and flowering of Stock plant, leaf mold can be used as growing media in pots.

Riaz *et al.* (2008) the study was conducted to evaluate the effect of different growing media on the growth and flowering of Zinnia elegans cv. Blue Point. Five different growth media including coconut compost, silt, soil, leaf manure, leaf manure mix (silt + leaf manure + coconut compost; 1:1:1) were used for growing zinnia. The experiment was laid out in Complete Randomized Design giving equal importance to treatments. Number of flowers, blooming period, number of lateral branches per plant, number of leaves per plant, plant height (cm), leaf area(cm^2), days to first flower emergence, size of flower and flower quality were determined. The properties of each medium, including water holding capacity (saturation percentage), pH, total nitrogen, available phosphorus and available potassium were also determined. Plant height (cm), number of leaves per plant, number of side branches, days to first flower emergence and number of flowers were affected significantly when plants were grown in leaf manure mix. It is therefore opined that the utilization of coconut compost, silt and leaf manure is a good source of NPK. Therefore, utilization of growing media in combinations proves more effective for the good growth and flowering of zinnia.

Gül *et al.* (2007) the research was carried out between the dates of October 30, 2002 and January 27, 2003. The objective was to compare the effects of clinoptilolite, which is a kind of zeolite, and perlite on growth and nutrient status of lettuce plants. Plant material was Lactuca sativa var. capitata cv. Brogan. Five different growing media; (1) perlite, (2) 3:1 perlite + zeolite, (3) 1:1 perlite + zeolite, (4) 1:3 perlite + zeolite and (5) zeolite were tested. Results showed that zeolite gave rise to increased plant growth and to reduced nitrate and nitrite contents in plant tissues. Mixing zeolite into the growing medium resulted in increased K, Fe, Cu and Mn, and decreased Mg content of the plants.

CHAPTER III

MATERIALS AND METHODS

The experiment was conducted to find out the effect of different growing media on the growth and yield of potted Pakchoi. The materials and methods include for this experiment are a short description of the experimental site, climatic and soil condition, materials used for the experiment, design of the experiment, data collection and analysis procedure. The details materials and methods for this experiment have been presented in this chapter under the following headings-

3.1 Experimental period

The experiment was conducted during the period from December 2020 to February 2021.

3.2 Experimental site

The experiment was conducted in the rooftop of Dr. M A Wazed Miah central laboratory of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh. The location of the site is $23^0$74/N latitude and $88^0$35/E longitude with an elevation of 8.2 meter from sea level.

3.3 Characteristics of soil

The soil of the experimental area belongs to the Modhupur Tract (UNDP, 1988) under AEZ No.28 and was dark. It was medium high land and the soil series was Tejgoan (FAO, 1988). The soil was having a texture of sandy loam with pH and CEC were 5.6 and 2.64 meq/100g soil, respectively. The recorded soil characteristics are showed that the soil composed of 27% sand, 43% silt and 30% clay, which have been presented in Appendix I.

3.4 Climatic condition

The climatic condition of experimental site is subtropical and characterized by three distinct seasons, the post-monsoon from November to February and the pre-monsoon period or hot season from March to April and the monsoon period from May to October. The monthly average f temperature (^{O}C), rainfall (cm) and relative humidity (%) during crop growing period were collected from Weather Yard, Bangladesh Meteorological Department, Agargoan Dhaka-1207 and presented in Appendix II.

3.5 Treatments of experiment

The research work was conducted with one set of treatment consisting of eight growing media. The factor with their growing media is as follows:

Factor: Different growing media

T_0 – Control (100% soil)

T_1 – Vermicompost (90%)

T_2 - Cocodust + Vermicompost (45%+45%)

T_3 – Mushroom Spent Compost (90%)

T_4 – Vermicompost + Cowdung (45%+45%)

T_5 – Vermicompost + Mushroom Spent Compost (45%+45%)

T_6 – Vermicompost + Mushroom Spent Compost + Cowdung (30%+ 30%+ 30%)

T_7 – Vermicompost + Biochar (45%+45%)

Note: 10% soil were added in rest 7 treatment equally.

3.6 Experimental design and layout

The one factorial experiment was laid out in a Completely Randomized Design (CRD) with three replications. The experimental area was divided into three equal blocks containing 8 pots in a block. There were 24 pots in total. The size of each pot is 16 cm x 30 cm.

3.7 Preparation of the pot

The experimental pots were first filled at 08 December, 2020. The pots were filled with treated soil and organic nutrients 15 days before seed sowing. Silt loam soils were used for pot preparation. Weeds and all stubbles were completely removed from the soil. Potted soil was brought into desirable fine tilth by proper hand mixing. The final pot preparation was done on 15 December, 2020. The soil was treated with insecticides (Cinocarb 3G @ 4 kg/ha) at the time of final pot preparation to protect young plants from the attack of soil inhibiting insects such as cutworm and mole cricket.

3.8 Seed collection

There are two developed variety from BARI (Bangladesh Agricultural research Institute) namely BARI china Shak-1 and BARI Batishak-1 It is a high yielding variety developed by Bangladesh Agricultural Research Institute (BARI). For this experiment seeds were collected from BARI germplasm and variety selected as BARI Batishak-1.

3.9 Seed sowing

For this experiment dry seeds were collected and seeds were air-dried before sowing since water soaked to facilitate germination. Subsequently, the collected variety seeds for the experiment were sown on the prepared pot. Seed were sown on 22 December, 2020. Before sowing they were soaked in water for 24 hours. For soaking small (1.5 cm deep) holes were made at 3-4 cm distance and two seeds were placed in each hole which was then covered with soil. Seed testing experiment conducted earlier revealed that the percentage of germination of the seeds was about 85%. Hence, two to five seeds per hole was planted in order to ensure a uniform stand of the crop.

3.10 Germination of seeds

Germination of the seeds started from 4 days of sowing. On the 5 to 6 day of sowing all the seeds were germinated.

3.11 Intercultural operation

Various intercultural operations such as thinning out, irrigation, weeding, tagging, pest and disease control etc. were accomplished for better growth and development of the Pakchoi.

3.11.1 Thinning out

Emergence of seedlings started within 4 days from the date of sowing. Two to five seeds were placed per hole and all the seeds were germinated that is why thinning out was done to get the desire number of plant per pot. The extra seedlings were thinned out at 14DAS. Only desire number and well growth seedlings were kept in the pot.

3.11.2 Irrigation

Light watering was provided with water cane immediately after sowing seeds and this technique of irrigation was used as every day at early morning and sometimes also in evening throughout the growing period. But the frequency of irrigation became less in harvesting stage. So last ten days irrigation was done every alternate day. The amount of irrigation water was limited up to that quantity which does not leached out through the bottom.

3.11.3 Weeding

The hand weeding was done 10, 15 and 20 DAS Pakchoi seedlings to keep the pots free from weeds. Thar was also done to reduce the crop weed competition.

3.12 Pest and disease control

Melathion 57 EC was applied @2 ml L^{-1} of water against the insect pests like cutworm, leaf hopper, leaf borer and others. The insecticide application was made fortnightly after transplanting and was stopped before second week of first harvest. Furadan 10G was also applied during pot preparation as soil insecticide. During foggy weather precautionary measure against disease attack of Pakchoi was taken by spraying Diathane M-45 fortnightly @2 gm L^{-1} of water at the early vegetative stage. Ridomil gold was also applied @ 2 gmL^{-1} of water against blight disease of Pakchoi.

3.13 Harvesting

Harvesting of all the Pakchoi was not possible on a certain or particular date because the vegetables initiation as well as maturing in different plants were not uniform. Harvesting was started from January 24, 2021 and was continued up to February 03, 2021. Harvesting of the crop was done pot wise by uprooting the plants by hand carefully and plant were tagged separately.

3.14 Data collection

Experimental data were recorded from 14 days after sowing Pakchoi plant growth as well as Pakchoi production in different growing media and continued until harvest. The data was recorded from 14 DAS and it was continued in every 7 days gap up to the day of harvesting. Data on the following parameters were recorded after harvesting at 42 DAS. Three plants were sampled randomly from each unit pot for the collection of per plant data while the crop of whole pot was harvested to record per pot data. The plants in the outer rows and at the extreme end of the middle rows were excluded from the random selection to avoid the border effect.

3.14.1 Plant height (cm)

Plant height was measured using a meter scale from ground level to the tip of the plant. From each pot three plants were measured and averaged. The plant height was recorded at every 7days gap at 14, 21, 28, 35 and 42 days after sowing (DAS).

3.14.2 Number of leaves plant^{-1}

Number of leaves plant of three randomly selected plants were counted after harvesting. All the leaves of each plant were counted separately. Only the smallest young growing leaves at the tip of the plant were excluded from counting. The average number of leaves were calculated and recorded. Number of leaves per plant was counted at 14, 21, 28, 35 and 42 days after sowing (DAS). The number of leaves plant^{-1} was counted from each plant excluding the small leaves.

3.14.3 Leaf length (cm)

A meter scale was used to measure the length of leaves. Leaf length of three randomly selected plants were measured in centimeter (cm) during data collection. It was measured from the base of the petiole to the tip of the leaf. All the leaves of each plant were measured separately. Only the smallest young leaves at the growing point of the plant were excluded from measuring.

3.14.4 Leaf breadth (cm)

Leaf breadth of three selected plants per pot were measured in centimeter (cm) entire experiment and after harvesting from the widest part of the lamina with a meter scale and average breadth was recorded in centimeter (cm). All the leaves of each plant were measured separately. Only the smallest young leaves at the growing point of the plant were excluded from measuring.

3.14.5 Fresh weight with root (gm)

All fresh weight with root of selected plant were collected. Then these were placed on the digital balance for the calculation of weights. At harvest, fresh weight of three plants pot was weighed by balance and their mean value was calculated as plant fresh weight was expressed in gram.

3.14.6 Fresh weight without root (gm)

All fresh weight without root of selected plant were collected. Then these were placed on the digital balance for the calculation of weights.

3.14.7 Root weight (gm)

All root of selected plant were collected. Then these were placed on the digital balance for the calculation of weights.

3.14.8 Root length (cm)

The length of root was measured using a meter scale and was expressed in centimeter.

3.14.9 Shoot diameter (cm)

The diameter of the shoot was measured at the point where the central shoot was cut off. Shoot diameter was recorded in three dimensions with scale and the average of the three values was taken in centimeter (cm).

3.14.10 Stem diameter (cm)

The diameter of the stem was measured at the point where the central stem was cut off. Stem diameter was recorded in three dimensions with scale and the average of the three values was taken in centimeter (cm).

3.14.11 Stem length (cm)

Stem length was measured from the base of the stem to the tip after harvest. A meter scale was used to measure the stem length of stem and expressed in centimeter (cm).

3.14.12 Dry weight plant^{-1}

Plants were kept for drying as a natural condition and after sun drying; Sundry weight of plants was measured from each treatment and then weighted which expressed as g. Three plants of each pot were cut down and oven dried at temperature of 60°C for 72 hours and was weighed in gram by an electrical balance and the weights were converted into gram plant

3.14.13 Yield (t ha^{-1})

A balance was used to record the gross weight of the harvested plants and weight of the plants was taken in t ha^{-1} from each unit pot.

3.14.14 Measurement of total soluble solids (^{0} Brix)

Degrees Brix (symbol °Bx) is the sugar content of an aqueous solution. One degree Brix is 1 gram of sucrose in 100 grams of solution and represents the strength of the solution as percentage by mass. Brix percentages were measured by Portable Refractometer. Every single pakchoi was blend and juice was collected to measure brix percentage. Mean was calculated for each treatment. Brix percentage of pakchoi was measured at room temperature.

3.14.15 Ascorbic acid content (Vitamin-C) (mg/100g)

Ascorbic acid content was analyzed by the indophenol titration method (Ranganna, 1986). About 10 g of ground pakchoi sample was weighed then 0.4% oxalic acid was added and made up to a volume of 100 ml. The sample solution

was filtered Whatman[@] No.1 paper. 10 ml of the filtered sample solution was titrated with 0.40% 2,6-di-chlorophenol indophenol until the end point. The volume of 2,6-dichlorophenol indophenol solution at the end point was used to calculate ascorbic acid content.

3.14.16 Moisture content (%)

Immediately after harvesting, plants were cut to small pieces and weighed quantity of the samples was taken in by electrical balance. Then the samples were placed in an oven maintained at 60±5°C for 72 hours. The final weights of plants were taken by electrical balance. Percent moisture accumulation was computed using the following formula on fresh weight basis moisture content (%).

$$\textbf{Moisture content (\%)} = \frac{\textbf{Fresh Weight} - \textbf{Oven dry weight}}{\textbf{Fresh Weight}} \times \textbf{100}$$

3.15 Statistical analysis

The data in respect of yield, quality and yield components were statistically analyzed to find out the significance of the experimental results. The means of all the treatments were calculated and the analysis of variance for each of the characters under study was performed by "F" test. The difference among the treatment means were evaluated by Least Significant Difference (LSD) test and interpretation of the results were determined by Duncan's Multiple Range Test (DMRT) according to Gomez and Gomes, (1984).

CHAPTER-IV

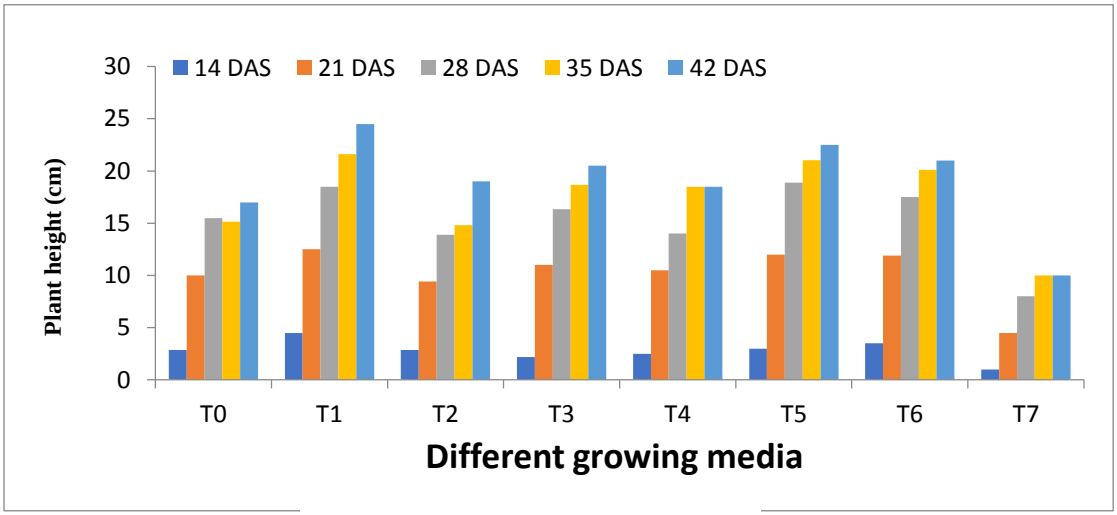
RESULTS AND DISCUSSION

The present experiment was conducted to find out the "effect of growing media on growth and yield of potted pakchoi", conducted during Rabi season 2020-2021 at Dr. M A Wazed Miah central laboratory, Sher-e-Bangla Agricultural University, Dhaka is presented in this chapter. The observations pertaining to growth and yield attributes of pakchoi recorded during the course of investigation were statistically analyzed and significance of results verified. The analyses of variance for all data have been presented in Appendices III to VIII at the end. The results of all the main effects and only significant data have been presented in succeeding paragraphs. Some of the characters have also been represented graphically to show the treatment effect wherever necessary to provide better understanding of the results.

4.1 Plant height (cm)

Plant height was significantly influenced by different growing media of pakchoi at different days after sowing (DAS) (Fig. 2). At 14 DAS, the maximum plant height (4.50 cm) was recorded from T_1 (Vermicompost) treatment which was statistically identical to T_6 (3.50 cm) treatment and minimum plant height (1.00 cm) was observed from T_7 (Vermicompost + Biochar) treatment (Fig. 1). At 21 DAS, the tallest plant (12.51 cm) was recorded from T_1 (Vermicompost) treatment which was statistically identical with T_5, T_6, T_3, T_4 and T_0 (12.00, 11.90, 11.00, 10.50 and 10.00 cm) treatment. On the other hand, the lowest plant height (4.50 cm) was observed from T_7 (Vermicompost + Biochar) treatment. At 28 DAS, the tallest plant (18.90 cm) was recorded from T_5 (Vermicompost + Mushroom Spent Compost) treatment followed by T_1 (18.50 cm) treatment while the lowest plant height (8.00 cm) was observed from T_7 (Vermicompost + Biochar) treatment. At

35 DAS, the tallest plant (21.61 cm) was recorded from T_1 (Vermicompost) treatment followed by T_5 (21.04 cm) treatment while the lowest plant height (10.00 cm) was observed from T_7 (Vermicompost + Biochar) treatment. At 42 DAS, the tallest plant (24.50 cm) was recorded from T_1 (Vermicompost) treatment followed by T_5 (22.50 cm) treatment while the lowest plant height (10.00 cm) was observed from T_7 (Vermicompost + Biochar) treatment.



Different growing media

Figure 1. Effect of different growing media on plant height of pakchoi at different days after sowing (DAS)

Here, T_0 – Control (100% soil), T_1 – Vermicompost (90%), T_2 - Cocodust + Vermicompost (45%+45%), T_3 – Mushroom Spent Compost (90%), T_4 – Vermicompost + Cowdung (45%+45%), T_5 – Vermicompost + Mushroom Spent Compost (45%+45%), T_6 – Vermicompost + Mushroom Spent Compost + Cowdung (30%+ 30%+ 30%), T_7 – Vermicompost + Biochar (45%+45%),
Note: 10% soil were added in rest 7 treatment equally.

4.2 Number of leaves plant^{-1}

Number of leaves per plant is an important parameter for crop plant because of its physiological role in photosynthetic activities. Number of leaves varied significantly due to different growing media of pakchoi at 14, 21, 28, 35 and 42 DAS (Fig. 2). At 14 DAS, the maximum number of leaves (5.00) was recorded from T_1 (Vermicompost) treatment, while the minimum number of branches (2.00) was obtained from T_7 (Vermicompost + Biochar) and T_3 (Mushroom Spent

Compost) treatment. Again at 21 DAS, the highest number of leaves (8.00) was recorded from T_1 (Vermicompost) treatment and the minimum number of leaves (4.00) was obtained from T_7 (Vermicompost + Biochar) treatment. At 28 DAS, the maximum number of leaves (12.00) was recorded from T_1 (Vermicompost) treatment which was statistically identical to T_2, T_5 and T_6 (11.00, 11.00 and 11.00) treatment. On the other hand, the minimum number of leaves (7.00) was obtained from T_4 (Vermicompost + Cowdung) which was statistically identical to T_7 treatment. At 35 DAS, the maximum number of leaves (17.00) was recorded from T_1 (Vermicompost) treatment, while the minimum number of leaves (8.00) was obtained from T_7 (Vermicompost + Biochar) treatment. At 42 DAS, the maximum number of leaves (20.00) was recorded from T_1 (Vermicompost) treatment which was statistically similar with T_5 treatment, while the minimum number of leaves (10.00) was obtained from T_7 (Vermicompost + Biochar) which was statistically similar with T_0 (Control) treatment.

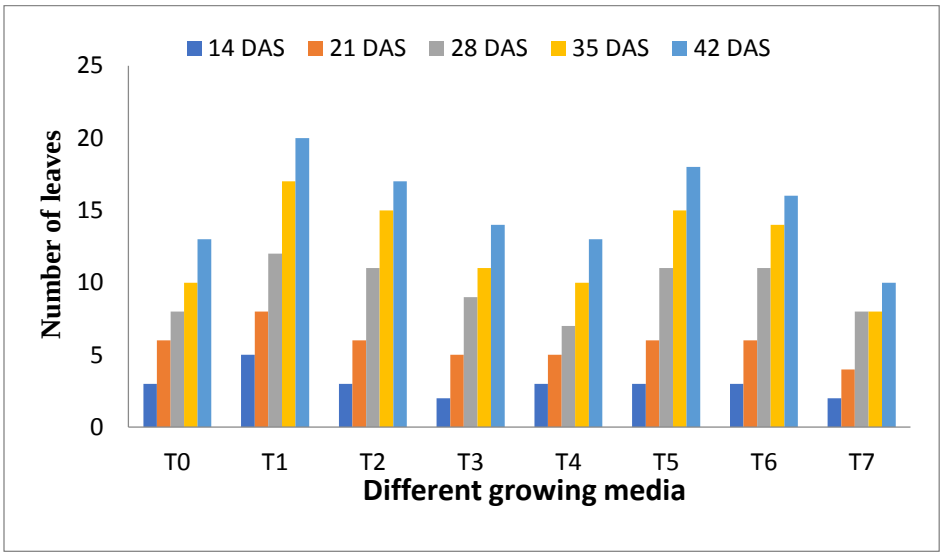


Figure 2. Effect of different growing media on number of leaves of pakchoi at different days after sowing (DAS)

Here, T_0 – Control (100% soil), T_1 – Vermicompost (90%), T_2 - Cocodust + Vermicompost (45%+45%), T_3 – Mushroom Spent Compost (90%), T_4 – Vermicompost + Cowdung (45%+45%), T_5 – Vermicompost + Mushroom Spent Compost (45%+45%), T_6 – Vermicompost + Mushroom Spent Compost + Cowdung (30%+ 30%+ 30%), T_7 – Vermicompost + Biochar (45%+45%),
Note: 10% soil were added in rest 7 treatment equally.

4.3 Leaf length plant^{-1}

Leaf length plant^{-1} of pakchoi showed statistically significant differences for different growing media of pakchoi at 14, 21, 28, 35 and 42 DAS (Table 1). At 14 DAS, the maximum length of leaf (4.00 cm) per plant was recorded from T_1 (Vermicompost) treatment which was statistically identical with T_6 (3.20 cm), while the minimum length of leaf (.80 cm) was obtained from T_7 (Vermicompost + Biochar) treatment (Table 1). At 21 DAS, the maximum leaf length (12.00 cm) per plant was recorded from T_1 (Vermicompost) treatment that was statistically similar with T_6 and T_5 (11.40 and 11.10 cm) treatment while the minimum leaf length (4.40 cm) was obtained from T_7 (Vermicompost + Biochar) treatment. Again at 28 DAS, the maximum leaf length (17.50 cm) per plant was recorded from T_5 (2% urea solution) treatment which was statistically similar with T_1 and T_6 (17.00 and 17.00 cm) treatment. On the other hand, the minimum leaf length (7.50 cm) was obtained from T_7 (Vermicompost + Biochar) treatment. At 35 DAS, the maximum leaf length (21.33 cm) per plant was recorded from T_1 (2% urea solution) treatment which was statistically similar with T_6 (15.70 cm) treatment. On the other hand, the minimum leaf length (8.80 cm) was obtained from T_7 (Vermicompost + Biochar) treatment. At 42 DAS, the maximum leaf length (23.00 cm) per plant was recorded from T_1 (2% urea solution) treatment which was statistically similar with T_6 (19.00 cm) treatment. On the other hand, the minimum leaf length (9.00 cm) was obtained from T_7 (Vermicompost + Biochar) treatment.

Table 1. Effect of different growing media on leaves length of pakchoi at different days after sowing (DAS)

Treatments	Leaves length (cm) at				
	14 DAS	**21 DAS**	**28 DAS**	**35 DAS**	**42 DAS**
T_0	1.80 bc	9.50 c	14.00 b	14.50 c	16.00 de
T_1	4.00 a	12.00 a	17.00 a	21.33 a	23.00 a
T_2	2.50 abc	9.30 c	11.00 c	13.50 d	17.60 cd
T_3	2.00 abc	10.50 abc	13.10 bc	13.90 c	18.00 c
T_4	2.20 abc	10.10 bc	12.30 bc	15.50 b	17.00 cd
T_5	2.80 abc	11.10 ab	17.50 a	12.50 d	13.50 e
T_6	3.20 ab	11.40 ab	17.00 a	15.70 b	19.00 b
T_7	0.80 c	4.40 d	7.50 d	8.80 e	9.00 e
LSD $_{(0.5\%)}$	**2.08**	**1.73**	**2.87**	**1.52**	**2.66**
CV $_{(\%)}$	**9.53**	**10.17**	**12.13**	**7.58**	**9.75**

Means followed by same letter(s) within each column did not significantly different (DMRT, $p < 0.05$)

Here, T_0 – Control (100% soil), T_1 – Vermicompost (90%), T_2 - Cocodust + Vermicompost (45%+45%), T_3 – Mushroom Spent Compost (90%), T_4 – Vermicompost + Cowdung (45%+45%), T_5 – Vermicompost + Mushroom Spent Compost (45%+45%), T_6 – Vermicompost + Mushroom Spent Compost + Cowdung (30%+ 30%+ 30%), T_7 – Vermicompost + Biochar (45%+45%),
Note: 10% soil were added in rest 7 treatment equally.

4.4 Leaf breadth (cm)

The breadth of leaf of pakchoi varied significantly with different growing media at 14, 21, 28, 35 and 42 DAS (Table 2). At 14 DAS, the maximum breadth of leaf (2.00 cm) was found from T_1 (Vermicompost) treatment which was statistically identical to T_6 (1.96 cm) treatment and the lowest leaf breadth (0.53 cm) was measured in T_7 (Vermicompost + Biochar) treatment. Again at 21 DAS, the highest leaf breadth (7.00 cm) was measured from T_1 (Vermicompost) treatment and statistically identical result was found from T_6 (7.00 cm) treatment. On the other hand, the lowest leaf breadth (2.50 cm) was recorded from T_7 (Vermicompost + Biochar) treatment. At 28 DAS, the maximum leaf breadth (11.00 cm) was measured from T_1 (Vermicompost) treatment which was statistically identical to T_6 (11.00 cm) treatment and on the other hand, the minimum leaf breadth (4.50 cm) was recorded from T_7 (Vermicompost + Biochar)

treatment. At 35 DAS, the maximum leaf breadth (12.80 cm) was measured from T_1 (Vermicompost) treatment which was statistically identical to T_2 and T_6 (11.00 and 11.50 cm) treatment and on the other hand, the minimum leaf breadth (5.10 cm) was recorded from T_7 (Vermicompost + Biochar) treatment. At 42 DAS, the maximum leaf breadth (13.00 cm) was measured from T_1 (Vermicompost) treatment which was statistically identical to T_5 (12.50 cm) treatment and on the other hand, the minimum leaf breadth (5.50 cm) was recorded from T_7 (Vermicompost + Biochar) treatment.

Table 2. Effect of different growing media on leaves breadth of pakchoi at different days after sowing (DAS)

Treatments	Leaves breadth (cm) at				
	14 DAS	**21 DAS**	**28 DAS**	**35 DAS**	**42 DAS**
T_0	1.00 bc	5.60 b	8.00 b	8.50 c	9.50 bc
T_1	2.00 a	7.00 a	11.00 a	12.80 a	13.00 a
T_2	1.50 ab	6.40 b	9.80 ab	11.00 ab	11.50 abc
T_3	1.00 bc	5.70 b	9.10 ab	10.00 bc	8.50 cd
T_4	1.10 bc	5.50 b	7.80 b	8.13 c	9.50 bc
T_5	1.76 ab	6.10 b	9.50 ab	9.50 bc	12.50 ab
T_6	1.96 a	7.00 a	11.00 a	11.50 ab	11.00 abc
T_7	0.53 c	2.50 c	4.50 c	5.10 d	5.50 d
LSD (0.5%)	**0.82**	**1.03**	**2.42**	**2.42**	**3.09**
CV (%)	**8.97**	**7.67**	**9.43**	**15.04**	**8.76**

Means followed by same letter(s) within each column did not significantly different (DMRT, $p < 0.05$)

Here, T_0 – Control (100% soil), T_1 – Vermicompost (90%), T_2 - Cocodust + Vermicompost (45%+45%), T_3 – Mushroom Spent Compost (90%), T_4 – Vermicompost + Cowdung (45%+45%), T_5 – Vermicompost + Mushroom Spent Compost (45%+45%), T_6 – Vermicompost + Mushroom Spent Compost + Cowdung (30%+ 30%+ 30%), T_7 – Vermicompost + Biochar (45%+45%),

Note: 10% soil were added in rest 7 treatment equally.

4.5 Fresh weight with root (gm)

Growing media exhibited a significant influence on fresh weight with root of Pakchoi plants (Table 3). The maximum fresh weight with root (415.00 gm) was measured from T_1 (Vermicompost) treatment which was statistically identical to that of T_2 and T_5 (306.00 and 306.00 gm) treatment while the minimum fresh

weight with root (43.00 gm) was recorded from T_7 (Vermicompost + Biochar) treatment.

4.6 Fresh weight without root (gm)

Growing media exhibited a significant influence on fresh weight without root of Pakchoi plants (Table 3). The maximum fresh weight without root (410.00 gm) was measured from T_1 (Vermicompost) treatment which was statistically identical to that of T_2 and T_5 (296.20 and 296.20 gm) treatment while the minimum fresh weight with root (37.50 gm) was recorded from T_7 (Vermicompost + Biochar) treatment.

Table 3. Effect of different growing media on fresh weight with root, fresh weight without root, root length and root weight of Pakchoi

Treatments	Fresh weight with root (gm)	Fresh weight without root (gm)	Root length cm)	Root weight (gm)
T_0	195.00 de	187.50 d	11.00 c	7.50 ab
T_1	415.00 a	410.00 a	13.00 a	5.00 c
T_2	306.00 b	296.50 b	12.00 b	9.50 a
T_3	170.00 e	160.00 e	11.50 b	10.00 a
T_4	210.00 d	202.10 d	11.00 c	7.90 ab
T_5	306.00 b	296.20 b	13.00 a	9.80 a
T_6	250.00 c	243.00 c	12.00 b	7.00 ab
T_7	43 f	37.50 f	4.00 d	5.50 b
LSD $_{(0.5\%)}$	**28.71**	**16.53**	**1.24**	**1.12**
CV $_{(\%)}$	**7.00**	**4.17**	**7.53**	**9.18**

Means followed by same letter(s) within each column did not significantly different (DMRT, $p < 0.05$)

Here, T_0 – Control (100% soil), T_1 – Vermicompost (90%), T_2 - Cocodust + Vermicompost (45%+45%), T_3 – Mushroom Spent Compost (90%), T_4 – Vermicompost + Cowdung (45%+45%), T_5 – Vermicompost + Mushroom Spent Compost (45%+45%), T_6 – Vermicompost + Mushroom Spent Compost + Cowdung (30%+ 30%+ 30%), T_7 – Vermicompost + Biochar (45%+45%),
Note: 10% soil were added in rest 7 treatment equally.

4.7 Root length (cm)

The effect of different growing media was significant influenced on root length of Pakchoi plants (Table 3). T_1 and T_5 treatment produced the maximum root length (13.00 cm) which was statistically identical to T_2, T_3 and T_6 (12.00, 12.00 and 11.50 cm) treatment and the minimum root length (4.00 cm) was measured in T_7 (Vermicompost + Biochar) treatment.

4.8 Root weight (gm)

Growing media exhibited a significant influence on root weight of pakchoi plants (Table 3). The maximum root weight (10.00 gm) was measured from T_3 (Mushroom Spent Compost) treatment which was statistically identical to that of T_2 and T_5 (9.50 and 9.80 gm) treatment while the minimum root weight (5.50 gm) was recorded from T_7 (Vermicompost + Biochar) treatment.

4.9 Shoot diameter (cm)

Significant variation among the growing media had been observed in diameter of shoot of Pakchoi plant (Table 4). The maximum shoot diameter (8.90 cm) was found from T_1 (Vermicompost) treatment followed by T_6 (7.10 cm) treatment while the minimum stem diameter (2.10 cm) was recorded from T_7 (Vermicompost + Biochar) treatment.

4.10 Stem diameter (cm)

Significant variation among the different growing media had been observed in diameter of stem of Pakchoi plant (Table 4). The maximum stem diameter (1.10 cm) was measured from T_1 (Vermicompost) treatment followed by T_6 (1.00 cm) treatment while the minimum stem diameter (0.02 cm) was recorded from T_7 (Vermicompost + Biochar) treatment.

Table 4. Effect of different growing media on shoot diameter, stem diameter, stem length and dry weight of pakchoi

Treatments	Shoot diameter (cm)	Stem diameter (cm)	Stem length (cm)	Dry weight (gm)
T_0	4.80 c	0.90 ab	2.50 bc	11.70 b
T_1	8.90 a	1.10 a	4.00 a	7.58 d
T_2	4.80 c	0.95 ab	3.50 ab	8.60 c
T_3	6.10 bc	0.80 b	1.00 d	12.36 a
T_4	5.70 bc	0.89 ab	0.70 d	9.11 c
T_5	6.80 b	0.95 ab	0.80 d	12.19 a
T_6	7.10 b	1.00 ab	0.60 d	7.65 d
T_7	2.10 d	0.02 c	1.50 cd	12.30 a
LSD $_{(0.5\%)}$	**1.33**	**0.20**	**1.12**	**1.03**
CV $_{(\%)}$	**7.48**	**11.44**	**8.64**	**9.82**

Means followed by same letter(s) within each column did not significantly different (DMRT, $p < 0.05$)

Here, T_0 – Control (100% soil), T_1 – Vermicompost (90%), T_2 - Cocodust + Vermicompost (45%+45%), T_3 – Mushroom Spent Compost (90%), T_4 – Vermicompost + Cowdung (45%+45%), T_5 – Vermicompost + Mushroom Spent Compost (45%+45%), T_6 – Vermicompost + Mushroom Spent Compost + Cowdung (30%+ 30%+ 30%), T_7 – Vermicompost + Biochar (45%+45%),
Note: 10% soil were added in rest 7 treatment equally.

4.11 Stem length (cm)

The effect of different growing media was significant influenced on stem length of Pakchoi plants (Table 4). T_1 (Vermicompost) treatment produced the maximum stem length (4.00 cm) which was statistically identical to T_2 (3.50 cm) treatment and the minimum stem length (0.60 cm) was measured in T_6 (Vermicompost + Mushroom Spent Compost + Cowdung) treatment.

4.12 Dry weight (gm)

Different growing media exhibited a significant influence on dry weight of Pakchoi plants (Table 4). The maximum dry weight (12.36 gm) was found from T_3 (Mushroom Spent Compost) treatment which was statistically identical to that of T_7 and T_5 (12.30 and 12.19 gm) treatment while the minimum dry weight (7.50 gm) was recorded from T_1 (Vermicompost) treatment.

4.13 Yield of Pakchoi (t ha-^{1})

Growing media exhibited a significant influence on yield of pakchoi (Figure 3). The maximum yield of Pakchoi (18.22 t ha^{-1}) was found from T_1 (Vermicompost) treatment which was statistically identical to that of T_2 and T_5 (13.18 and 13.16 t ha^{-1}) treatment while the minimum yield (1.67 t ha^{-1}) was recorded from T_7 (Vermicompost + Biochar) treatment.

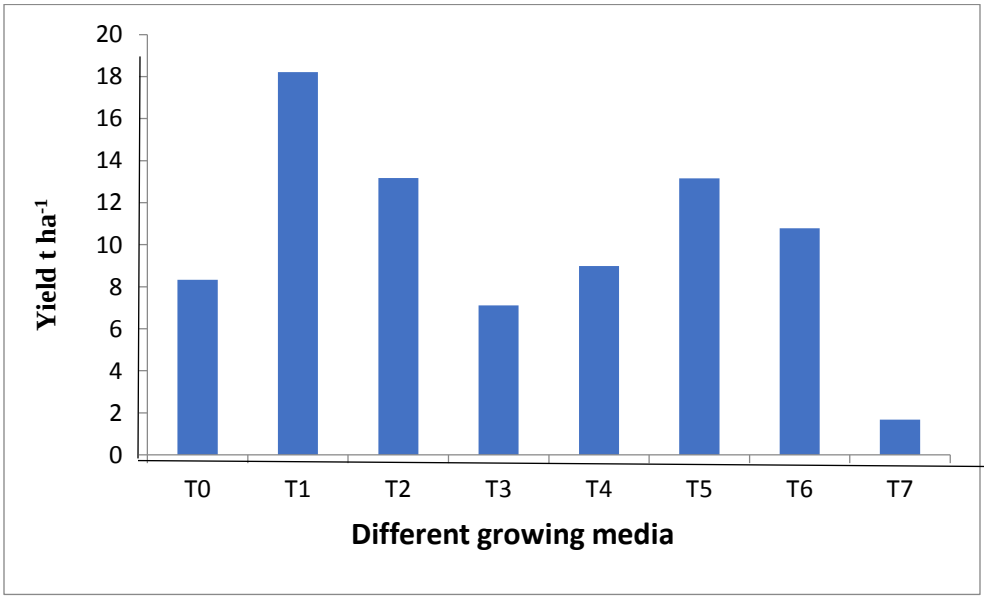


Figure 3. Effect of different growing media on yield of pakchoi

Here, T_0 – Control (100% soil), T_1 – Vermicompost (90%), T_2 - Cocodust + Vermicompost (45%+45%), T_3 – Mushroom Spent Compost (90%), T_4 – Vermicompost + Cowdung (45%+45%), T_5 – Vermicompost + Mushroom Spent Compost (45%+45%), T_6 – Vermicompost + Mushroom Spent Compost + Cowdung (30%+ 30%+ 30%), T_7 – Vermicompost + Biochar (45%+45%),
Note: 10% soil were added in rest 7 treatment equally.

4.14 Total soluble solids (^{o}Brix)

Considering the brix content of Pakchoi significant variation was found in different growing media (Table 5). Maximum total soluble solids 12.50 ^{0}Brix were observed in T_7 which was statistically similar to T_0, T_3 and T_2 (12.00, 11.20 and 9.50 ^{0}Brix) treatment whereas minimum (3.90 ^{0}Brix) in T_1.

4.15 Vitamin-C (mg/100g)

Considering the Vitamin-C percentages of pakchoi no significant variation was found in different growing media (Table 5). Maximum Vitamin-C percentages (37.30 mg) were observed in T_1 which was statistically similar with others except T_2 treatment whereas minimum (36.00 mg) in T_2.

4.16 Moisture content (%)

Considering the moisture content percentages of pakchoi significant variation was found in different growing media (Table 5). Maximum moisture content percentages (92.42%) were observed in T_1 which was statistically similar with others except T_2 treatment whereas minimum (87.10%) in T_5.

Table 5. Effect of different growing media on brix value, vitamin-C content and moisture content of pakchoi

Treatments	Brix value (°Bx)	Vit-C (mg/100g)	Moisture content (%)
T_0	12.00 a	36.90	88.29 c
T_1	3.90 d	37.30	92.42 a
T_2	9.50 a	36.00	91.40 b
T_3	11.20 a	37.10	87.64 cd
T_4	6.80 bc	36.40	90.89 b
T_5	5.40 cd	36.55	87.10 e
T_6	8.20 b	36.49	92.35 ab
T_7	12.50 a	36.99	87.70 cd
LSD $_{(0.5\%)}$	**1.02**	**0.64**	**2.12**
CV $_{(\%)}$	**11.22**	**9.30**	**3.41**

Means followed by same letter(s) within each column did not significantly different (DMRT, $p < 0.05$)

Here, T_0 – Control (100% soil), T_1 – Vermicompost (90%), T_2 - Cocodust + Vermicompost (45%+45%), T_3 – Mushroom Spent Compost (90%), T_4 – Vermicompost + Cowdung (45%+45%), T_5 – Vermicompost + Mushroom Spent Compost (45%+45%), T_6 – Vermicompost + Mushroom Spent Compost + Cowdung (30%+ 30%+ 30%), T_7 – Vermicompost + Biochar (45%+45%),
Note: 10% soil were added in rest 7 treatment equally.

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was conducted during the period from December 2020 to February 2021 at Rabi season in the rooftop of the Dr. M A. Wazed Miah central laboratory of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh to find out the effect of different growing media on the growth and yield of potted pakchoi. The experiment was comprised of T_0: Control, T_1: Vermicompost, T_2: Cocodust + Vermicompost, T_3: Mushroom Spent Compost, T_4: Vermicompost + Cowdung, T_5: Vermicompost + Mushroom Spent Compost, T_6: Vermicompost + Mushroom Spent Compost + Cowdung and T_7: Vermicompost + Biochar. The experiment was laid out in a Completely Randomized Design (CRD) with three replications. Data were recorded on different growth, yield and yield attributes of Pakchoi and significant variation was observed for different treatment.

Plant height of pakchoi at 14, 21, 28, 35 and 42 DAS, the longest plant (4.50, 12.51, 18.50, 21.61 and 24.50 cm) was observed in T_1, while the shortest plant (1.00, 4.50, 8.00, 10.00 and 10.00 cm) was observed from T_7. The maximum number of leaves (5.00, 8.00, 12.00 17.00 1nd 20.00) was found from T_1, while the minimum number of leaves (2.00, 4.00, 8.00, 8.00 and 10.00) was observed from T_7. The maximum number of leaves length (4.00, 12.00, 17.00 21.00 and 23.00 cm) was found from T_1, while the minimum leaves length (0.80, 4.40, 7.50, 8.80 and 9.00 cm) was observed from T_7. The maximum leaves breath (2.00, 7.00, 11.00, 12.80 and 13.00 cm) was observed in T_1 treatment, while the minimum leaves breath (0.53, 2.50, 4.50, 5.10 and 5.50 cm) in T_7 treatment.

The maximum fresh weight with root (415.00 gm) was observed in T_1 treatment, while the minimum fresh weight with root (43.00 gm) was observed in T_7 treatment. The maximum fresh weight without root (410.00 gm) was found from T_1, while the minimum fresh weight without root (37.50 gm) was observed from T_7. The maximum root length (13.00 cm) was found from T_1, while the minimum root length (4.00 cm) was observed from T_7. The maximum root weight (10.00 cm) was found from T_3, whereas the minimum (5.50 cm) was observed from T_7. The maximum shoot diameter (8.90 cm) was found from T_1 (Vermicompost) treatment, while the minimum stem diameter (2.10 cm) was recorded from T_7 (Vermicompost + Biochar) treatment. The maximum stem diameter (1.10 cm) was measured from T_1 (Vermicompost) treatment, while the minimum stem diameter (0.02 cm) was recorded from T_7 (Vermicompost + Biochar) treatment. T_1 (Vermicompost) treatment produced the maximum stem length (4.00 cm), while the minimum stem length (0.60 cm) was measured in T_6 (Vermicompost + Mushroom Spent Compost + Cowdung) treatment. The maximum dry weight (12.36 gm) was found from T_3 (Mushroom Spent Compost + Soil) treatment, while the minimum dry weight (7.50 gm) was recorded from T_1 (Vermicompost) treatment.

The maximum yield of pakchoi (18.22 t ha^{-1}) was found from T_1 (Vermicompost + Soil) treatment, while the minimum yield (1.67 t ha^{-1}) was recorded from T_7 (Vermicompost + Biochar) treatment. Maximum total soluble solids 12.50 ^{0}Brix was observed in T_7 treatment whereas minimum 3.90 ^{0}Brix was found in T_1 treatment. Maximum Vitamin-C (mg/100g) 37.30 mg was observed in T_1 treatment whereas minimum 36.00 mg was found in T_2 treatment. Maximum moisture content percentages (92.42%) were observed in T_1 which was statistically similar with others except T_2 treatment whereas minimum (87.10%) was found in T_5 treatment.

CONCLUSION

It was revealed that Vermicompost was more potential in regarding yield contributing characters and yield of pakchoi.

Considering the above results of this experiment, further studies in the following areas may be suggested:

- Such study is needed in different agro-ecological zones (AEZ) of Bangladesh for regional compliance and other performances.
- More experiments may be carried out with other organic, inorganic and also macro nutrients.

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APPENDICES

Appendix I. Characteristics of the soil used in pot

- Morphological characteristics of the experimental site

Morphological features	Characteristics
Location	Horticulture Farm, SAU, Dhaka
AEZ	Madhupur Tract (28)
General Soil Type	Shallow red brown terrace soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled

- Physical and chemical properties of the initial soil

Characteristics	Value
% Sand	27
% Silt	43
% clay	30
Textural class	Silt loam
pH	6.1
Organic matter (%)	1.13
Total N (%)	0.03
Available P (ppm)	20.00
Exchangeable K (me/100 g soil)	0.10
Available S (ppm)	23

Source: Soil Resources Development Institute (SRDI), Khamarbari, Farmgate, Dhaka

Appendix II. Monthly record of air temperature, relative humidity, rainfall and sunshine hour of the experimental site during the period from December 2020 to January 2021

Month	*Air temperature (^{o}c)		*Relative humidity (%)	Total Rainfall (mm)	*Sunshine (hr)
	Maximum	Minimum			
December, 2020	25.8	16.0	78	00	6.8
January, 2021	22.4	13.5	74	00	6.3
February, 2021	24.5	12.4	68	00	5.7

- Monthly average,
- Source: Bangladesh Meteorological Department (Climate & weather division) Agargoan, Dhaka – 1207

Appendix III. Factorial ANOVA for plant height

Source of variation	Degree of freedom	Mean square				
		Plant height (cm) at				
		14 DAS	21 DAS	28 DAS	35 DAS	42 DAS
Growing media	7	3.28*	19.41*	36.89*	46.08*	57.37*
Error	16	0.57	2.95	5.01	12.41	5.65

*means significant at 5%

Appendix IV. Factorial ANOVA for number of leaves

Source of variation	Degree of freedom	Mean square				
		Number of leaves at				
		14 DAS	21 DAS	28 DAS	35 DAS	42 DAS
Growing media	7	2.57	4.07*	10.23	30.00*	31.23*
Error	16	1.00	1.00	2.87	3.62	5.25

*means significant at 5%

Appendix V. Factorial ANOVA for leaves length

Source of variation	Degree of freedom	Mean square				
		Leaves length (cm) at				
		14 DAS	21 DAS	28 DAS	35 DAS	42 DAS
Growing media	7	2.78089	17.29*	36.15*	38.76*	50.38*
Error	16	1.44	1.00	2.75	5.07	5.21

*means significant at 5%

Appendix VI. Factorial ANOVA for leaves breadth

Source of variation	Degree of freedom	Mean square				
		Leaves breadth (cm) at				
		14 DAS	21 DAS	28 DAS	35 DAS	42 DAS
Growing media	7	0.84	6.13*	13.44*	16.96*	18.20*
Error	16	0.23	1.00	2.12	2.07	3.62

*means significant at 5%

Appendix VII. Factorial ANOVA for fresh weight with root, fresh weight without root, root length, root weight and shoot diameter

Source of variation	Degree of freedom	Fresh weight with root	Fresh weight without root	Root length	Root weight	Shoot diameter
Growing media	7	36854.1	36817.8*	25.37*	10.96*	12.03*
Error	16	275.1	91.3	3.62	3.25	1.00

*means significant at 5%

Appendix VIII. Factorial ANOVA for stem diameter, stem length, dry weight, yield, brix value, vita-C and moisture content

Source of variation	Degree of freedom	Stem diameter	Stem length	Dry weight	Yield	Brix value	Vita-C	Moisture content
Growing media	7	0.34*	5.39*	13.89*	72.68*	32.47*	0.55	15.30
Error	16	0.01	0.44	1.00	4.87	1.00	11.66	9.35

*means significant at 5%

PLATES

Plate 1: Growing media preparation

Plate 2: Seed sowing in growing media


Plate 3: Visit of my honorable Supervisor and some visitors during experiment


Plate 4: Sample preparation and processed pakchoi (Curry)

Plate 5: Experimental view

Plate 6: Laboratory experiment