Potential of Spent Mushroom Substrate as Growing Media for Seed Germination and Seedling of Melon (*Cucumis melo* L.)

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ABSTRACT

Mushroom industry in Malaysia is booming nowadays. The demands keep increasing due to benefits from mushroom towards health. However, the used materials lead to unmanageable waste. Hence, this research focusing on the waste called spent mushroom substrate (SMS) to investigate the potential of it reducing the dependency on peat moss as main growing media. Three main objectives of this study are to produce compost of SMS, to identify the germination rate of melon (Cucumis melo L.) by using spent mushroom substrate compost; and to measure the seedling growth of melon (Cucumis melo L.) by using spent mushroom substrate. The treatments evaluated were peat moss (control), mixtures of spent mushroom substrate and peat moss with ratio 1:1 and SMS. This research was conducted with Complete Randomize Design (CRD) with five replications. The percentage of seed germination and the seedling growth of melon had been recorded. Result shows the positive impact towards the germination rate with the highest value recorded by peat moss media, 92% followed by 88% of mixed media and 82% of SMS compost media only. One Way ANOVA had been done and there was significant difference between types of media and growth performance of seedling p=0.01 for all parameters. Hence, SMS media had great potential as growing media in agriculture.

INTRODUCTION

In Malaysia, 1.2 million tonnes of agricultural waste was disposed into landfills annually. An estimated 15% of total waste generation consists of Agro Waste. Spent mushroom waste (SMW), otherwise known as spent mushroom substrate (SMS) is leftover after different flushes of mushrooms have been harvested [1]. Normally, at the end of each production cycle, “spent” (used) mushroom substrates are left abandoned or discarded. One of the major environmental problems in the mushroom producing countries remains the treatment and disposal of SMW [2]. About 5 kg of SMS is produced for each kilogram of mushroom [3]. The SMS contains nutrients which that could be used for the growth of plants. These materials are generally nontoxic to plants and therefore, could be employed as a soil amendment for different crops [1]. The SMS is already used in horticulture as a component of potting soil mixes, soil amendment to improve grass in wetlands for remediation of contaminated water, stabilizing severely disturbed soils, bedding for animals, and control plant diseases. Apart from that, SMS can be successfully used as a medium for vermiculture, in agriculture or landscape to enrich soils and as a matrix for bioremediation of contaminated soils [4]. If spent mushroom waste is used in proper proportion, it can act as a peat substitute in a soilless culture [5]. SMS is an effective soil amendment and conditioner, and addition of SMW has been found to considerably increase yield of many crops [6]. The positive impact of using SMW as a growing substrate component on the productivity and quality of

different vegetables and other horticultural crops has been confirmed by many researchers worldwide [2][6]. Spent mushroom substrate (SMS) grows independent of sunlight, feed on organic matter and does not require fertile soil. They can be grown or cultivated easily and can be harvested within 2.5 weeks. SMS also contain a lot of nutrients [7]. On the other hand, a lot of peat moss in the Malaysian market is imported from New Zealand, Canada and Holland. The cheapest imported peat moss comes from China, but it is low in quality because it rots easily. Peat moss is currently considered an expensive, non-renewable resource with undesirably variable properties [8]. The use of peat causes ecological damage to the environment and economic disadvantages to ornamental plant producers

Therefore, attempts are being made to reduce the use of peat most in search of cheaper, high quality, locally available growing media alternative like Spent Mushroom Substrate (SMS) [9]. Peat moss will continue to be a major component of growing substrate over the next decades because of its unique qualities, low cost and availability [10]. Meanwhile, this mushroom substrate has the potential to be developed because it contains high cation exchange; high nutrient value; and low mineralization rates. This advantage makes it able to maintain the quality of organic matter or source nutrients found in the residue of the substrate [11].Thus, this research focus on making compost from spent mushroom substrate component, second to identify the germination rate of melon (*Cucumis melo* L.) by using of spent mushroom substrate's compost and third to measure the seedling growth of melon (*Cucumis melo* L) spent mushroom substrate's compost as growing media.

EXPERIMENTAL

Sample Preparation

Preparation of compost from SMS substrate: The materials used were 50ml of molasses mixed with 5ml of water, 5kg of SMS and 2.5kg chicken manure. Mixed all the component until well mixed and put under shade area. The mixture needs to be turn upside down every week. The mixture will be completely degraded and become composed after 4 weeks period.

Preparation of growing media: Six germination trays containing of different media; two trays of a spent mushroom substrate (SMS) compost media, two trays of peat moss media and two trays of the spent mushroom substrate (SMS) mixed with peat moss media with ratio 1:1. Meanwhile, 150 seed of Melon had been selected and used.

Research Design and Statistical Analysis: This research was conducted using experimental design of Complete Random Design (CRD) with three treatments and five replication. Each replication consists of ten seedlings. 150 seeds were treated differently using SMS only; combination of SMS and peat moss; and peat moss only(control) where each treatment consisted of 50 melon seeds. Data for seed germination had been collected daily for seven days. After seven days, data of seedling growth were measured with parameter of height of seedling (cm), length and width of leaves (cm), stem length (cm) for fifteen days (until day 22 from a day of sowing). All the collected data were analysed using the Shapira-Wilk Test for the normality test and shown not significant difference ($p > 0.05$), this indicates that the data were normally distributed thus parametric analysis was performed. Then the data were analysed by using Analysis of Variance (ANOVA) by using Statistical Packages for Social Science (SPSS) IBM (version 24) at P-value 0.005 to determine the significant differences between the growing media (SMS media, mixture of SMS media and peat moss and peat moss only) and germination rate and seedling growth of melon. Then, Post hoc Tukey test was carried out to establish the relationship between variables to determine the best media types for seedling growth of melon.

RESULTS AND DISCUSSION

Germination Rate of Melon

Germination rate of melon had been recorded from day 0 until day 7. The result showed percentage of seed germination for three media type which is SMS media, mixture of SMS and peat moss and peatmoss media. Based on Figure 1, percentage of seed germination for SMS media was 82%, a mixture ofSMS and peatmoss media shown 88% and peatmoss media shown 92%. Thus this can be seen as the best media for seed germination of melon is recorded by the peatmoss with the highest percentage compared to SMS media. Basically, peatmoss is widely used in the seed germination of many types of plants.

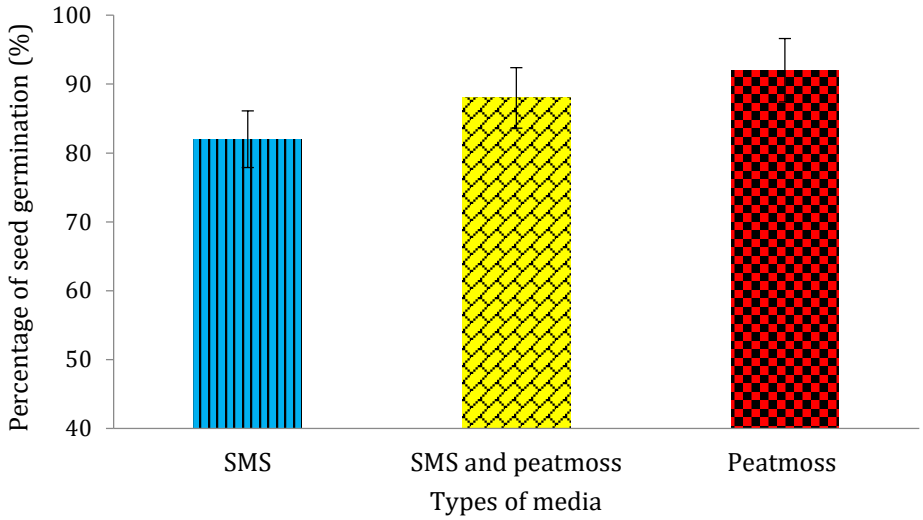

Figure 1. Percentage of seed germination (%) for different types of media.

Result has shown a high percentage of seed germination from peat moss media with 92%. In this case, peat moss shows the highest value because it has the appropriate physical properties which are more porous, proper moist condition, good infiltration and aeration [12]. Meanwhile, it was found that spent mushroom substrate (SMS) decreased the growth of kohlrabi plant due to the salt concentration [13]. Moisture content is the main factor that may influence the completion of seed germination [14]. Based on observation, the melon seed starts to germinate as early as day 2 for peat moss media compared to SMS media solely. The seed germination was vigour in peatmoss compared to SMS media. However, for the mixture of SMS and peat moss media show more active germination compared to SMS media only. Thus the combination of SMS and peat moss media can be used for melon seed germination as alternative ways in reducing the dependency on peat moss media.

Seedling Growth of Melon

After sowing, the germination of the seedling is recorded until day 7, then day 8 until day 22, the growth of seedling is recorded. Based on Table 1, the height of seedling, length and width of leaves and number of leaves is recorded for three different types of media. Overall the data for the mixture of SMS and peatmoss media shown the highest mean value for the height of seedling, length and width of leave and number of leaves compared to SMS media and peatmoss media only.

Table 1 Mean Measurement for Seedling Growth of Melon

Types of media	Growth Parameter (Mean ± SD) (cm)			
	Height of seeding	Length of leave	Width of leave	Number of leave
SMS	7.57±0.80	3.16±0.49	2.87±0.50	2.93±0.25
SMS and Peatmoss	9.83±1.30	4.21±0.45	4.07±0.54	3.60±0.48
Peatmoss	9.81±1.42	3.58±0.80	3.72±0.64	3.53±0.48

One Way ANOVA had been done, there were significance difference between types of media and parameter for growth performance including height of seedling ($p<0.05$) [$F(2,12) = 12.6$, $p = 0.01$], length of leaves ($p<0.05$) [$F(2,12) = 17.13$, $p = 0.01$], ($p<0.05$), width of leave [$F(2,12) = 13.8$, $p = 0.01$] and number of leaves ($p<0.05$) [$F(2,12) = 13.5$, $p = 0.01$]. Thus, the Post hoc Tukey test had been done and shown a great significance for mixture of SMS and peatmoss media compared to SMS media and peatmoss media for seedling growth performance of melon. Thus this can be claimed that the mixture of SMS and peat moss media was a good combination of media for the seedling growth of melon. The reuse of SMS as soil improvements has become the focus of attention as it is rich in nitrogen [15]. SMS can modify soil structure to prevent the transport of pesticides or facilitate their dispersion [16]. The SMS contains nutrients that could be used for the growth of plants. These materials are generally nontoxic to plants and therefore, could be employed as a soil amendment for different crops [1]. The SMS is claimed to be a source of humus formation, and humus provides plant micronutrients, improves soil aeration, and helps maintain soil structure [17]. SMS has been shown to increase the nutrient availability of growth media [2]. However, the overall nutrient status of SMS was not enough to support normal plant growth, which is further confirmed by the poor growth of melon seedlings grown in SMS media only compared to other media. Nevertheless, this may not limit the use of SMS as a growing media but it will lead to higher cost involvement associated with fertilizer inputs [18].

As a result, chicken manure was used in this research since it was cheap compared to other chemical fertilizer inputs. Indeed, the nutrient status of a growing substrate depends on the base material. Thus, a balanced growing medium that contains an adequate supply of nutrients is essential for plants to attain potential height [19]. However, based on observation seedlings that grow on the spent mushroom substrate has less pathogen attack than peat moss although the growth of seedling is low. Besides that, the seedling growth was the best with the mixture of SMS and peat moss media due to the texture of peat moss that is good enough for easy root penetration. Higher water content and nutrient (nitrogen) found in the combination of peat moss and SMS also contributed to longer roots [20][21]. The mixed mediums containing peat have more water holding capacity in the root zone and create a more aerated environment [22].

CONCLUSION

In conclusion, compost of SMS can be done within one month and beneficial for seed germinationand seedling growth of melon. The highest percentage of melon seed germination is recorded by peatmoss media with 92%. However, the SMS media still compatible for seed germination of melon since the germination rate overall more than 80%. Next, media from mixture of SMS compost and peatmoss with ratio 1:1 is the best media for seedling growth shown a very significant difference for all seedling growth parameters including height of seedling plant, lenghtand width of leave and number of leaves. Thus this can be concluded that the SMS compost are capable of growing media especially for seed germination and seeling growth of melon. This research is beneficial in reducing waste from mushroom industries, safe to the environment and affordable for alternative media for planting.

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