Organic Germinating Media for Vegetable Seeds

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ABSTRACT

Field experiment was conducted in the greenhouse at the Agriculture Research Station -Faculty of Agriculture, University of Jordan, during the growing season of 2010. This research was directed towards comparing various mixtures of composted organic materials with peat moss used for germination of various vegetable crops. Seeds of six vegetable crops were investigated in germinating media of 100% peat moss and peat moss amended with 25% of cow, layer, broiler, sheep manure or olive pumice. Field soil was also added as a check media. Evaluation was performed on seed germination percentage, seedling height and number of leaves. Results indicated that the used mixtures were capable of showing good to very good germinating percentages when compared to peat moss. Seedling height and leaf number of most used vegetables were affected negatively with pumice when added at 25% in peat moss. Best results were recorded for germination in cow or poultry layer mixed at 25% with peat moss. Therefore, it is important to carry out test trials before selecting the proper media for specific crop seed germination**.**

Keywords: Germination; composting; vegetable crops; cow, layer, broiler, sheep manures; olive pumice.

INTRODUCTION

A wide range of materials can be used to germinate seeds, from plain vermiculite or mixtures of soilless media to the various amended soil mixes. Most mixes are rather fine and uniform, yet well-aerated and loose but capable of holding and moving moisture in order to stimulate plant growth by improving seepage and root development (Bernai *et al*, 1998). The growing media industry provides a broad range of peat, peat-based growing mixes, soil amendments and other growing media products to plant growers (Wilson *et al*, 2001). Plants from transplanted seedlings grown in peat moss were more vigorous and had an extended harvest period (Ofuso- Anim *et al*, 2000).

The unaffordable costs of high quality peat especially in importing developing countries, and the drive for recycling and reclaiming solid wastes, various organic residues generated by agriculture, livestock farming, lead scientists to search for a new peat substitute (Robertson, 1993).

Composted organic materials seemed to be a suitable substitute for improving soil structure (L'Hermite, *et al*, 1993). Manure composting improves the media tilth, water-holding capacity, and provides a long-term supply of nutrients (Evanylo and Daniels, 1999). It is an appreciable method for recycling organic wastes, particularly animal manures (Parr, *et al*, 1986; Abu Rayyan and Abu Irmaileh, 2004). Composting animal manure has a central role in efforts to decrease the undesirable environmental impacts of farming wastes (Brown, 1995). Compost reduces weed seed viability

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and infestation by parasitic plants (Abu Irmaileh and Abu Rayyan, 2004; Bahman and Leosoing, 1999).

Composting and recycling organic wastes in cultivated fields have been widely adopted in many countries (Esse *et al*, 2001).The chemical composition of fresh manure varies according to the type of feed and location. The reported percentages of N, P_2O_5, K_2O, Ca, Mg, organic matter, and moisture were 0.5, 0.5, 0.3, 0.1, 16.7 and 81.3% for cow manure; 0.9, 0.5, 0.8, 0.2, 0.3, 30.7 and 64.8 % for sheep manure; and 0.9, 0.5, 0.8, 0.4, 0.2, 30.7 and 64.8% for poultry manure; respectively (Anonymous, 2007).

Several composts from vegetal material were assessed by many authors: sea grass and seaweed residues were tested with yard waste for horticultural purposes (Pryce, 1991, Orquin *et al*, 2001). Consequently, it seemed advantageous to develop seed germinating and growing media from already available agricultural residues. Compost production not only reduces the volume of wastes but also offers a high potential substrate in the market of crop growing media (Zoes *et al*., 2001). Seed germination is affected by various conditions including light, temperature, moisture and the physical and chemical composition of the germination media. It is reasonable to believe that the crop germination responses are adaptive traits in a particular environment which prevail in the growing habitat (Gairola *et al,* 2011).

It is worth to say, as justifications that this research contributes effectively in reducing the negative effects associated with negligence in recycling organic wastes. Not only this, but also open the door for developing inexpensive and nutrient-rich organic media as alternative to the expensive commercial potting media containing peat. This can potentially reduce the chemical fertilization rates, irrigation rates and ultimately, nursery cost.

The objective of this research was to develop an environmentally friendly- germinating media, specifically suitable for organically grown vegetables without the need for fertilizing with synthetic chemicals.

MATERIALS AND METHODS:

The experiment was conducted during the growing season of 2010 in one of the Greenhouses at the Agriculture Research Station, Faculty of Agriculture at the University of Jordan. Peat moss, soil, olive pumice, and other four kinds of composted manures (sheep, cow, layer and broiler) were used as germinating media. Composting was carried out by covering the wet organic matter with plastic sheets for two months in the greenhouse as described by Abu Rayyan *et al*. (2010). Treatments were replicated four times and arranged in a Complete Randomize Design (CRD). Certified seeds were bought from the original dealers in Amman. Seed germination of cucumber, eggplant, lettuce, pepper, tomato and squash were evaluated in the following media: peat moss, peat moss containing 25% of cow, layer, broiler, sheep manures or pumice. Field soil was added as a check medium. Seed germination percentage, seedling height and number of leaves were recorded after 40 to 45 days when seedlings were ready for transplanting.

Analysis of variance (Table 1) and mean separation using $LSD_{0.05}$ according to the general linear model (GLM) were conducted using SAS version 7.0 (SAS Institute Inc., 1998).

Table 1. Mean squares for seed germination, seedling height and number of leaves on seedlings of each crop in different types of fermented manure (df=16 for each crop)

Crop	Germinating percent (%)	Seedling Height (cm)	Leaf No.
	Mean square*	Mean square*	Mean square*
Cucumber	4150.9	63.4	16.7
Eggplant	7325.4	195.0	20.9
Lettuce	6294.7	78.9	17.6
Pepper	5358.2	207.9	28.3
Tomato	6804.2	269.9	17.6
Squash	4058.8	43.089	24.5

* Mean squares for seed germination, seedling height and number of leaves on seedlings of each crop show high significant differences at $P \leq 0.001$ among treatments.

RESULTS AND DISCUSSION

The analysis of variance showed that the overall average percent of germination was the highest in peat moss containing 25% pumice (Table 2), but seedling development in this medium, in terms of seedling height and number of leaves, was significantly the poorest. This indicated that pumice is not a suitable amendment in the germinating medium, due to its high phenolic content which negatively affects growth and development of many plants (Bernal *et al*; 2009). The best germination percentage was obtained in peat moss followed by peat moss amended with 25% cow and layer manures, as seedling height was significantly better compared to other germinating media (Table 2). Germination of certain crops such as cucumber, squash and lettuce was significantly low in peat moss amended with broiler manure. This result might be due to that broiler manure contains high nitrogen percent that could be converted to volatile nitrogen oxides and ammonia which are known as plant toxicants, specifically during early growth stages. It seems that the mentioned crops are sensitive to the high percent of nitrogen content in the broiler manure (Webb *et al,* 2010; Doydora *et al,* 2011).

Table 2. Overall analysis of germination percent, seedling height, and leaves number of various crops by using different kinds of growing media.

Growing media	Germination percent	Seedling height	Leaves number
Control	75.7 E	12.7 B	5.0 A
Peat moss	86.3 B	10.4 C	4.8 A
Cow25%	83.4 C	11.0 C	5.1 A
P.Broiler25%	51.4 G	9.1 D	4.3 B
P.Layer25%	76.9 D	15.3 A	5 A
Pumice25%	89.8 A	6.2 F	4.1 B
Sheep25%	72.8 F	8.4 E	5.0 A
$LSD_{0.05}$	0.99	0.61	0.38

Growing media	Germination percent	Seedling height	Leaves number
	Crop		
Cucumber	67.0 E	8.0 D	4.7 B
Eggplant	89.6 B	12.0 C	4.4B
Lettuce	70.5 D	8.2 D	4.6 B
Pepper	74.6 C	12.9 B	4.6 B
Tomato	93.7 A	15.5 A	4.5 B
Squash	64.2 F	7.0 E	5.7 A
$LSD_{0.05}$	0.92	0.56	0.36

Within each column, means for each treatment having different letters are significantly different at the 5% level according to LSD test.

Seed germination of different vegetable crops varied in their responses to different growing media (Table 3). Amending peat moss with cow manure was useful in germinating seeds of cucumber, tomato, lettuce and eggplant. Amending peat moss with sheep manure was useful in germinating cucumber, lettuce and eggplants, while amending peat moss with layer manure was useful for germinating tomato and lettuce. Seedling emergence was the highest in soil followed by peat moss with pumice and lowest in peat moss amended with cow manure. Tomato emergence was the highest in soil, peat moss amended with layer, or pumice and was the lowest in peat moss amended with sheep manure. Pepper emergence was the highest in peat moss amended with pumice and lowest in peat moss amended with sheep. Lettuce emergence was the highest in peat moss amended with cow or sheep and the lowest in peat moss amended with broiler. The variation in crop emergence reflects the sensitivity of various plants to various organic matters. This goes along with Eliab (2010), who said that seeds can be germinated in many different substrates. Each medium has particular qualities that will either enable or hinder adequate germination and growth, and so growers must familiarize themselves with their medium of choice in order to ensure high germination and seedling success rates.

Table 3. Germination percent of various crops by using different kinds of growing media.

treatment	Cucumber	Eggplant	Lettuce	Pepper	Tomato	Squash
Control (soil)	44.5 E	99.3 A	60.8 C	83.1 B	100 A	66.7 D
Peat moss	85.0 A	99.3 A	83.6 B	82.8 B	89.2 C	77.7 C
Cow25%	76.4 C	78.7 D	89 A	78.4 C	94.6 B	83.1 B
P.Broiler25%	37.0 F	83.1 C	5.5 D	61 D	89 C	33.1 G
P.Layer25%	66.9 D	77.9 D	82.8 B	77.9 C	100 A	55.5 E
Pumice25%	77.8 C	100 A	83.1 B	89 A	100 A	89 A
Sheep25%	81.5 B	89 B	89 A	50 E	83.1 D	44.5 F
$LSD_{0.05}$	2.7	1.84	2.8	2.58	1.9	2.8

Within each column, means for each treatment having different letters are significantly different at the 5% level according to LSD test.

In addition to high percentage of emergence, it is of paramount importance in nursery industry to produce a vigorously growing rigid healthy seedling that can be suitable for planting. In this research, number of developed leaves per seedling and seedling height were measured as indicators of seedling health. Seedling height was best in peat moss amended with layer manure for eggplant, lettuce, pepper and tomato (Table 4) while the shortest seedlings were obtained in peat moss amended with pumice. However, seedling height in cucumber and squash were best in peat moss and in peat moss amended with pumice, respectively.

Table 4. Seedling height of various crops by using different kinds of growing media

treatment	Cucumber	Eggplant	Lettuce	Pepper	Tomato	Squash
Control	5 D	18 B	10.6 B	16.5 B	21.9 A	4.5 D
Peat moss	10.5 A	10 D	7.2 CD	11.5 D	14.3 B	9 B
Cow25%	6.9 C	14 C	10.1 B	13.6 C	11.1 C	10.2 A
P.Broiler25%	5.0 D	10.5 D	8.3 C	14.1 C	13.0 BC	3.5 D
P.Layer25%	8.5 B	20 A	12.8 A	20.5 A	24 A	6 C
Pumice25%	10.5 A	3.9 F	2.6 E	5.3 F	5 D	9.8 AB
Sheep25%	9.6 A	7.8 E	6 D	9 E	12 BC	6 C
$LSD_{0.05}$	1.06	1.1	1.55	1.45	2.5	1.1

Within each column, means for each treatment having different letters are significantly different at the 5% level according to LSD test.

Number of leaves per seedling varied in various media for each crop. The highest number of leaves in cucumber was obtained in peat moss, and peat moss amended with cow, layer and sheep; while in squash number of leaves was the highest in peat moss, peat moss amended with pumice or sheep. The highest number of leaves in pepper was obtained in soil, peat moss amended with cow, broiler, layer and sheep (Table 5).

Table 5. Number of leaves per seedling of various crops by using different kinds of growing media

treatment	Cucumber	Eggplant	Lettuce	Pepper	Tomato	Squash
Control	4.2 C	4.5 BC	5.4 A	5.4 A	6.1 A	4.6 B
Peat moss	5.3 A	3.2 D	5.1 A	3.7 B	4.7 B	7.2 A
Cow25%	4.9 AB	5.9 A	4.5 ABC	5.9 A	4.8 B	4.4 B
P.Broiler25%	4.7 B	3.7 D	4.7 AB	5 A	3 C	4.5 B
P.Layer25%	5 AB	5 B	5.1 A	4.8 AB	5 B	5 B
Pumice25%	4.0 C	3.8 CD	3.5 C	2.3 C	3.3 C	7.5 A
Sheep25%	5 AB	5 B	4 BC	4.9 A	4.3 B	6.5 A
$LSD_{0.05}$	0.45	0.8	1.08	1.2	0.94	1.2

Within each column, means for each treatment having different letters are significantly different at the 5% level according to LSD test.

CONCLUSION

It was obvious that partial replacement of the peat moss seed germinating media is possible. However, Seed germination of different vegetable crops varied in their responses to different growing media, as seed germination of different crop species is affected by various conditions including the chemical composition of the germination media. It could be economically advantageous to develop seed germinating and growing media from already available agricultural residues. But it is recommended that media modification for seed germination, seedling emergence and seedling development for various crops should be based on previous testing, taking into account the varied sensitivity of different crops to different modified media.

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تأثير إنبات بذور الخضروات في المواد العضوية

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ملخـــص

تم إجراء دراسة اثر خلائط الوسط الزراعي مع المخلفات العضوية لانبات وتربية اشتال بعض محاصيل الخضار داخل البيوت الزجاجية التابعة لكلية الزراعة في الجامعة الأردنية خلال فترة الصيف من العام 2010، من أجل خفض تكاليف الوسط الزراعي المستخدم في المشاتل. كان الهدف من التجربة إجراء مقارنة بين خلطات مختلفة من بعض المخلفات العضوية المخمرة من جهة وبين البيتموس من جهة أخرى عند استخدامها في إنبات بذور بعض أنواع محاصيل الخضروات. اشتملت بنود المقارنة على نسبة الإنبات وارتفاع الاشتال وعدد الأوراق. زادت نسبة إنبات البذور في الخلطات المختلفة من المخلفات العضوية بنسبة 25% زيادة معنوية بدرجات متفاوتة بين أنواع الخضروات قيد الدراسة مقارنة مع البيتموس، ما عدا الخلطة التي احتوت على 25% جفت الزيتون حيث انخفض ارتفاع الاشتال وعدد الأوراق في معظم انواع الخضروات انخفاضا معنويا. تحققت أفضل النتائج باستخدام اليتموس الذي خلط معه مخلفات الأبقار أو مخلفات الدجاج البياض العضوية بنسبة 25%. وبناء على ذلك ، فإنه يجب تحديد خلطة الوسط الزراعي المناسبة لإنبات أي نوع من محاصيل الخضروات بإجراء تجارب مبدأية قبل الشروع باستخدامها او التوصية بها.

الكلمات الدالة: الإنبات، التخمير، البقر، الدجاج البياض، الدجاج اللاحم، الغنم، المخلفات العضوية، جفت الزيتون، محاصيل الخضروات.

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