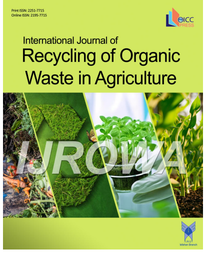

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Using different organic wastes as growing substrate for the production of crop seedlings-An exploratory study

Seyed Ali Ghaffari Nejad, Seyed Majid Mousavi*

Soil and Water Research Institute, Agricultural Research Education and Extension Organization (AREEO), Karaj, Iran.

***Corresponding author:** majid62mousavi@gmail.com

Original Research

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Abstract:

Purpose: This study was conducted to find a suitable growing substrate for the production of crops (corn, cotton, and canola) seedlings.

Method: This experiment was conducted as a completely randomized design with six treatments including different levels of organic wastes (peat moss, perlite, rotted cow manure, palm peat, vermicompost, sugarcane bagasse compost, tea waste compost) on the status of the production of corn, cotton and canola seedlings in the research greenhouse of the Soil and Water Research Institute, Karaj Iran in 2022.

Results: The results showed that the superior substrate for the production of corn and cotton seedlings is the substrate containing tea waste compost (shoot fresh weight 4.91 and 4.31 gr respectively for corn and cotton). But the superior substrate for the production of canola seedlings was the substrate containing vermicompst (shoot fresh weight 5.56 gr). Although tea waste compost has a higher production cost than other treatments, it causes seedlings to ripen up to one week early, and this partially justifies the high cost of its production.

Conclusion: It is concluded that the substrates containing tea compost were more effective than the other substrates for the production of corn and cotton seedlings, while the substrates containing vermicompost were superior to the other substrates for the production of canola seedlings. However, more research on its application for different crops and under various conditions is needed to approve the results of this study.

Keywords: Growing substrate; Seedlings cultivation; Cotton; Corn; Canola

1. Introduction

Limiting the supply of irrigation water is one of the biggest constraints of Iranian agriculture, which located in arid and semi-arid regions. Therefore, any method that leads to reducing water consumption and increasing the water use efficiency is of great importance. Seedlings cultivation is known as an efficient strategy in this regard. A seedling is a very young plant that is grown from a seed, which spends a part of its growth period in a suitable and controlled environment and is transferred to the mainland after the environmental conditions are favorable. One of the main problems in the development of seedlings cultivation is the introduction of effective substrate for the production of healthy and strong seedlings. A wide range of materials are used as growing media for seedlings production. Based on physical, chemical and biological properties, peat is one of worldwide accepted substrates (Tüzel et al., 2020). Peat origin led to ecological and environmental concerns, then efforts have been made to introduce high-quality, low-cost and readily available substrates as an alternative. Research to find native substrates of organic origin that respond to specific plant requirements is of particular importance. The quality of the growing substrate plays a major role in producing healthy seedlings. Then choosing the right substrate is one of the main factors in improving plant growth. Materials that are light, less expensive, and available and have low transportation costs should be considered for the production of growing substrates. On the other hand, using agricultural residues and returning them to the production cycle is one of the ways to return capital in the agricultural sector. Every year, millions of tons of different agricultural wastes and residues are produced in Iran, which can be used in the composting process. The physical and chemical properties of growing substrates have a direct and indirect effect on the plant growth and yield (Rivera et al., 2022). The effect of the substrate on the production of healthy and strong seedlings, prevention of germination shock, and therewith, the increase in the yield is evident. Compost from various sources is a suitable renewable resource to replace peat, which reduces the environmental impact of their disposal and also takes them into consideration to be environmentally friendly, at the same time.

There is little research on the production of suitable growing substrates for the production of crop seedlings in Iran. In China, a mixture of soil and organic fertilizer in the ratio (1:9) was used to prepare the substrate for cotton seedlings (Dai and Dong, 2014). Rivera et al. (2022) reported that the best watermelon seedlings were found with cocoa husk and vermicompost that were similar to peat moss. Other research conducted is related to the introduction of the substrate for hydroponic cultivation of vegetables and the cultivation of seedlings of these products and ornamental plants, which are currently mainly imported. Basirat et al. (2022) introduced two substrates for hydroponic cultivation in the greenhouse using aged wood bark and date palm wastes. These substrates were tested by Basirat and Davoudi (2020) in the greenhouse cucumber cultivation and obtained acceptable results. Omidi et al. (2019) reported that the replacement of peanut cocoon compost in the soilless culture medium by 75% can increase the growth index of the violet plant. The reason for this result is the reduction of the ratio of carbon to nitrogen, the improvement of ventilation, and the supply of nutrients by this culture medium.

Due to its excellent physical, chemical and biological properties, sphagnum peat is the raw and initial material for production of seedlings substrate. High demand for peat and its origin resulted in the increasing environmental and ecological concerns. Then new alternatives should be proposed for seedlings substrate. The effect of the growing substrates on the production of healthy and strong seedlings, prevention of germination shock, and therewith, the increase in the yield is evident. There is little research on the production of suitable growing substrates for the production of crop seedlings in Iran. Therefore, considering the prospects of the development of seedlings cultivation in Iran, the little data on this area of research, the abundance of less expensive organic materials in different regions of the country, and the urgent need for the existence of a suitable substrate for the cultivation of crops, this study was conducted to find a suitable composition of growing substrate for the production of seedlings of cotton, corn, and canola.

2. Materials and methods

To achieve the objectives of this research, available and less expensive organic materials such as farm yard manure, palm peat, vermicompost, sugarcane bagasse compost, and tea waste compost were used in combination with perlite, zeolite, and greenhouse sand to make a suitable substrate for the production of seedlings of different crops. In Fig. 1 a picture including the summary of the steps of the experiment was shown. A greenhouse experiment was conducted in the form of a completely randomized design in three replicates in the research greenhouses of Soil and Water Research Institute, Karaj, Iran, in 2022, with the following treatments: i) a mixture of 50% peat moss + 50% fine perlite (positive control); ii) a mixture of 60% farm soil + 20% rotted cow manure + 20% greenhouse sand (conventional substrate); iii) a mixture of 60% palm peat + 30% perlite + 10% zeolite; iv) a mixture of 60% vermicompost + 30% perlite + 10% zeolite; v) a mixture of 60% sugarcane bagasse compost + 30% perlite + 10% zeolite; vi) a mixture of 60% tea waste compost + 30% perlite + 10% zeolite. The percentages mentioned about the substrates are volume percentages (i.e., v/v%).

Each plot included a seed tray (72 cells per tray with a depth of seven centimeters). Some properties of substrates such as electrical conductivity (in 1:10 extract using a conductivity meter equipped with a temperature compensator), pH (in 1:10 extract read by pH meter), cation exchange capacity (CEC) (determined by the method of Bower et al. (1952)), carbon-to-nitrogen ratio, and bulk density were measured by standard methods (Sparks et al., 1996) (Table 1). On May 18, 2022, one seed of cotton (*Varamin*vr.) and corn (*Single Cross 704*vr.) and two seeds of canola (*OKP*vr.) were planted in each cell of trays and kept under greenhouse conditions. The temperature of the greenhouse was between 18 and 24 °C during the storage of seedlings. Irrigation of the seeds was done in all the beds in such a way that there was no stress on the plant. In the third week after planting, all seedlings were sprayed with a 1% solution of 20 – 20 – 20 fertilizer, which contained micronutrients. One month after planting, the seedlings were ready to be transplanted. At this stage, plant height, fresh weight of shoots and roots,

Figure 1. The summary of the steps of the experiment.

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Table 1. Some characteristics of the studied substrates in the greenhouse culture.

Cultivation bed type	EC dS/m	pH (1:10 extract)	OC (%)	Total N (%)	C/N Ratio	CEC Cmol/kg	Bulk density g/cm
T1 = 50% peat moss + 50% fine perlite (positive control)	0.61	6.23	21.34	1.94	11.00	53.92	0.19
T2 = 60% farm soil + 20% rotted cow manure + 20% greenhouse sand (conventional substrate)	0.65	8.61	2.33	0.34	6.85	17.84	1.22
T3 = 60% palm peat + 30% perlite + 10% zeolite	2.88	7.45	14.40	0.61	23.61	49.93	0.47
T4 = 60% vermicompost + 30% perlite + 10% zeolite	2.40	7.44	7.40	0.69	10.72	45.83	0.60
T5 = 60% sugarcane bagasse compost + 30% perlite + 10% zeolite	2.53	7.00	7.02	0.19	36.94	54.59	0.27
T6 = 60% tea waste compost + 30% perlite + 10% zeolite	3.23	6.44	16.14	1.50	15.37	60.40	0.44

and dry weight of shoots and roots were measured. Variance analysis of obtained data was done using the F test and mean comparison was done using Duncan's multi-range test at the five percent level by SAS software.

3. Results and discussion

The properties of the studied substrates

The electrical conductivity (EC) of the substrates, which were used in the greenhouse cultivation experiment varied from 0.61 to 3.23 dS/m. Pascual et al. (2018) consider the most appropriate substrate hydraulic conductivity to be between 0.33 – 0.51 dS/m. The lowest EC belonged to the control treatment and the highest value was related to the treatment containing tea waste compost. The pH of these substrates varied from 6.23 to 8.61. The lowest pH (6.23) was observed in the control treatment and the highest value (8.61) was recorded in the conventional treatment. Based on the findings of Pascual et al. (2018), desired substrate pH level is 5.5 – 6.5. The ratio of carbon to nitrogen in the substrates varied from about 7 in the farm soil treatment to 37 in the treatment containing sugarcane bagasse compost. The CEC of the substrates varied between 18 and 60 Cmol charge/kg. In terms of the bulk density, the control treatment had the lowest value and the conventional substrate had the highest value (Table 1). After the control treatment, the treatments containing sugarcane bagasse, tea waste compost, and vermicompost had the lowest bulk density. Pascual et al. (2018) believe that the apparent specific gravity of the substrate should not exceed 0.4 gr/cm. In transferring the seedlings to the main farm, the bulk density of the substrate is an important factor. The lower this factor is, due to the lower weight of the tray containing the seedlings, it is easier to work with, and its transferring to the main farm is done more easily.

The effect of the substrates on the growth of corn seedlings

The studied substrates significantly affected the growth parameters of corn seedlings (Table 2). Both the control treatment and the tea waste compost treatment caused the highest seedlings height (34.3 and 32.2 cm, respectively) and they were significantly different from the other treatments (Table 3). The lowest seedling height (8.4 cm) was measured in the conventional substrate. The control treatment and the treatment containing tea compost (i.e., T6 treatment) caused the highest fresh weight of the shoot, which had a significant difference with other treatments (Table 3). The lowest shoot fresh weight (0.53 gr), which was significantly different from other treatments, was measured in the conventional substrate.

The control treatment and T6 treatment were selected as the superior substrates in terms of the root fresh weight (11.34 and 10.26 gr, respectively). The lowest root fresh weight (2.43 gr) was recorded in the conventional treatment, which had a significant difference with other treatments. The control and T6 treatments produced the highest amount of shoot dry weight (0.46 and 0.50 gr, respectively) and the lowest value (0.08 gr) was measured in the conventional treatment (Table 3).

The highest root dry weight (0.97 and 0.89 gr, respectively) was measured in the control and T6 treatments. The lowest

Table 2. The results of variance analysis of the growth of corn seedlings in the substrates.

Source of variation	df	Mean Squares					
		plant height	shoot fresh weight	root fresh weight	shoot dry weight	root dry weight	chlorophyll index
Treatment	5	270.0**	8.1**	29.2**	0.07**	0.05*	136.1**
Error	12	11.9	0.3	2.0	0.003	0.01	10.8
CV	-	14.85	18.9	18.6	18.0	14.8	14.47

** and *: the difference between the treatments is significant at one and five percent level, respectively.

Table 3. The means comparison of the effect of the substrates on the growth of corn seedlings.

Treatment	Seedlings height (cm)	Shoot fresh weight (gr)	Root fresh weight (gr)	Shoot dry weight (gr)	Root dry weight (gr)	Chlorophyll index
T1 = 50% peat moss + 50% fine perlite (positive control)	34.3a*	4.47a	11.34a	0.46a	0.97a	29.9a
T2 = 60% farm soil + 20% rotted cow manure + 20% greenhouse sand (conventional substrate)	8.4c	0.53d	2.43c	0.08c	0.64c	12.07b
T3 = 60% palm peat + 30% perlite + 10% zeolite	20.9b	2.92b	7.24b	0.33b	0.69bc	29.4a
T4 = 60% vermicompost + 30% perlite+ 10% zeolite	24.8b	2.76bc	6.72b	0.33b	0.74bc	29.6a
T5 = 60% sugarcane bagasse compost + 30% perlite + 10% zeolite	19.0b	1.79c	7.30b	0.24b	0.77abc	28.6a
T6 = 60% tea waste compost + 30% perlite + 10% zeolite	32.2a	4.91a	10.26a	0.50a	0.89ab	27.6a

*: Treatments that have a common letter in each column do not have significant difference at 5% level.

root dry weight (0.64 gr) was obtained in the conventional treatment. In terms of the chlorophyll index, the conventional treatment caused the lowest amount of chlorophyll index (12.7), while the other treatments did not have any significant difference from each other (Table 3).

In general, based on the measured data, the T6 treatment was comparable to the control treatment and it can be used in preparing the substrate for the production of corn seedlings. In terms of the germination time, the T6 treatment acted at the same time as the control treatment, and as the vegetative growth data shows, the T6 treatment had better growth than the other treatments, and due to its better growth than the other treatments, for the T6 treatment, the needed time for the seedlings that be prepared for transplanting was one week earlier than the other beds and at the same time as the control treatment. Germination time in the conventional treatment was three days later than the control treatment. The germination of other substrates was at the same time as the control treatment, but due to their slower growth, they were delayed by one week to the transplantation stage. These results also showed that other substrates (substrate containing palm peat, vermicompost, and sugarcane bagasse) can be used in the areas where access to this material is not possible, and this substrate, compared to the conventional treatment, had better results.

The proper growth of the seedlings in T6 treatment can be attributed to its suitable physical, chemical, and biological properties. The lower ratio of carbon to nitrogen, and as a result, the supply of nitrogen for seedlings, the high CEC, and the suitability of the physical characteristics of this substrate, including ventilation in the production of seedlings are other reasons. The appropriate watermelon seedlings were found with vermicompost substrate that was similar to peat moss (Pascual et al., 2018).

The effect of the substrates on the growth of cotton seedlings

The studied substrates significantly affected the growth characteristics of cotton seedlings (Table 4). The highest seedlings height (14.7 cm) was measured in the control treatment, which had a significant difference with other treatments. The minimum value of seedlings height was recorded in the conventional treatment, which was 1.8 times shorter than the control treatment (Table 5).

The greatest shoot fresh weight was recorded in the treatment containing tea compost (4.31 g), which was not significantly different from the control treatment (3.87 g). The lowest value of shoot fresh weight was obtained in the conventional treatment (about 2.4 times less than the control), which was significantly different from other treatments.

The highest root fresh weight was measured in control, tea compost, and sugarcane bagasse compost treatments (2.55, 2.81, and 2.30 grams, respectively), which had significant differences with other treatments. The minimum value of root fresh weight was measured in the conventional treatment (0.64 g) and had a significant difference with other treatments. The highest value of shoot dry weight was measured in the control treatment and the treatment con-

Table 4. The results of variance analysis of the growth of cotton seedlings in the substrates.

Source of variation	df	Mean Squares					
		plant height	shoot fresh weight	root fresh weight	shoot dry weight	root dry weight	chlorophyll index
Treatment	5	17.2**	2.9**	2.0**	0.06**	0.02**	51.0*
Error	12	1.0	0.1	0.2	0.004	0.002	16.3
CV	-	9.19	11.2	22.1	12.8	21.8	7.8

** and *: the difference between the treatments is significant at one and five percent level, respectively.

Table 5. The means comparison of the effect of the substrates on the growth of cotton seedlings.

Treatment	Seedlings height (cm)	Shoot fresh weight (gr)	Root fresh weight (gr)	Shoot dry weight (gr)	Root dry weight (gr)	Chlorophyll index
T1 = 50% peat moss + 50% fine perlite (positive control)	14.7a*	3.87ab	2.55a	0.62a	0.20ab	49.6ab
T2 = 60% farm soil + 20% rotted cow manure + 20% greenhouse sand (conventional substrate)	8.1d	1.62e	0.64c	0.27c	0.07c	55.5a
T3 = 60% palm peat + 30% perlite + 10% zeolite	9.9cd	3.01cd	1.48b	0.47b	0.11bc	50.4ab
T4 = 60% vermicompost + 30% perlite+ 10% zeolite	10.8c	3.58bc	1.48b	0.47b	0.09c	57.4a
T5 = 60% sugarcane bagasse compost + 30% perlite + 10% zeolite	9.3cd	2.54d	2.30a	0.43b	0.24a	51.9ab
T6 = 60% tea waste compost + 30% perlite + 10% zeolite	12.6b	4.31a	2.81a	0.64a	0.21a	46.1b

*: Treatments that have a common letter in each column do not have significant difference at 5% level.

taining tea compost (0.62 and 0.64 grams, respectively), which had a significant difference from other treatments. The lowest amount of shoot dry weight was recorded in the conventional treatment, about 2.3 times less than the control treatment, which was significantly different from other treatments.

The control treatments, the treatment containing tea compost, and the treatment containing sugarcane bagasse produced the highest root dry weight (0.20, 0.21, and 0.24 g, respectively) and there was no significant difference together.

The highest amount of chlorophyll index was observed in the treatment containing vermicompost (57.4) and the lowest index, with about 24.51% decrease compared to the control treatment (Table 5).

In general, no significant difference was observed between the positive control (i.e., 50% peat moss + 50% fine perlite) treatment and the treatment containing tea compost in most of the vegetative traits. Tea compost can compete with the positive control treatment in the production of seedlings. In terms of germination time, tea compost was at the same time as the control treatment. As the vegetative growth data shows, this treatment had also a better growth than the other treatments, and due to its better growth than the other treatments, the needed time for the seedlings to be prepared for transplanting was five days earlier than the other substrates and at the same time as the control treatment.

Germination time in the conventional treatment was two days later than the control treatment. The germination of other substrates was at the same time as the control treatment, but due to their slower growth, the needed time for the seedlings to be prepared for transplanting was delayed by one to five days. The other treatments were also significantly different from the conventional treatment in most of the traits. Therefore, where tea compost is available, it is preferred over other treatments in cotton seedlings production, but if this material is not available, other substrates used in this experiment can be used for cotton seedlings production. The minimum amount of growth of cotton seedlings in the studied substrates was observed in the conventional treatment.

The effect of the substrates on the growth of canola seedlings

The studied substrates significantly affected the vegetative growth of canola seedlings (Table 6). The highest height of canola seedlings was measured in the treatment containing tea compost; with about 30.52% increase compared to the control and had no significant difference with the treatment containing vermicompost (10.8 cm) (Table 7). The lowest seedlings height was measured in sugarcane bagasse treatment and conventional treatment (with about 50.8% and 97.92% decrease compared to the control, respectively). The highest fresh weight of the shoot was observed

Table 6. The results of variance analysis of the growth of canola seedlings in the substrates.

Source of variation	df	Mean Squares: plant height	shoot fresh weight	root fresh weight	shoot dry weight	root dry weight	chlorophyll index
Treatment	5	23.9**	6.6**	4.8**	0.09**	0.02**	66.8**
Error	12	1.2	0.74	0.6	0.008	0.001	2.3
CV	-	12.33	28.3	26.3	27.3	17.8	5.9

** and *: the difference between the treatments is significant at one and five percent level, respectively.

Table 7. The means comparison of the effect of the substrates on the growth of canola seedlings.

Treatment	Seedlings height (cm)	Shoot fresh weight (gr)	Root fresh weight (gr)	Shoot dry weight (gr)	Root dry weight (gr)	Chlorophyll index
T1 = 50% peat moss + 50% fine perlite (positive control)	9.5b*	2.19c	3.59a	0.25bc	0.22b	27.6bc
T2 = 60% farm soil + 20% rotted cow manure + 20% greenhouse sand (conventional substrate)	4.8c	1.71c	0.60b	0.19c	0.07c	36.3a
T3 = 60% palm peat + 30% perlite + 10% zeolite	9.0b	2.86bc	4.07a	0.31bc	0.30a	24.9c
T4 = 60% vermicompost + 30% perlite+ 10% zeolite	10.8ab	5.56a	3.22a	0.63a	0.22b	35.7a
T5 = 60% sugarcane bagasse compost + 30% perlite + 10% zeolite	6.3c	1.96c	3.09a	0.16c	0.24ab	34.4a
T6 = 60% tea waste compost + 30% perlite + 10% zeolite	12.4a	4.0b	3.84a	0.41b	0.24ab	30.0b

*: Treatments that have a common letter in each column do not have significant difference at 5% level.

in the treatment containing vermicompost (about 153.88% increase compared to the control), and it was significantly different from the other treatments. After this treatment, the substrate containing tea compost had the highest fresh weight (about 82.65% increase compared to the control), which was significantly different from other treatments except the treatment containing palm peat (Table 6). The other treatments had no significant difference.

The conventional treatment had the lowest root fresh weight (5.98 times less than the control) and it was significantly different from the other treatments.

The treatment containing vermicompost had the highest dry weight of shoot (about 152% increase compared to the control) and it was significantly different from the other treatments. The lowest dry weight of the shoot was observed in the treatment containing sugarcane bagasse and conventional treatments. The highest and the lowest root dry weights were observed in the treatments containing palm peat and the conventional treatments, respectively (0.30 and 0.07 gr, respectively), which were significantly different from each other. The chlorophyll index was maximum in conventional treatment, vermicompost treatment, and sugarcane bagasse compost (36.3, 35.7, and 34.4, respectively) and these three treatments did not differ significantly from each other, but there was a significant difference from the other treatments. The lowest amount of chlorophyll index was recorded in the treatment containing palm peat (24.9).

In general, Table 8 shows that canola seedlings grew better in the substrate containing vermicompost compared to the other treatments, which may be related to its lower EC, lower carbon-nitrogen ratio, and high CEC. Germination and growth of seedlings in this treatment and tea waste compost treatment were at the same time as the control treatment. The conventional treatment had a two-day delay in germination, and the rest of the treatments had germination at the same time as the control treatment, but the completion of the needed time for transplanting the seedlings was delayed by one week compared to the control treatment. Mahboob Khomami (2010) reported that vermicompost made from 80% animal manure and 20% sawdust can replace the substrate containing peat moss and perlite in Dieffenbachia cultivation. Using 20 percent by volume of vermicompost improved the vegetative growth characteristics of tomato and marigold seedlings, but did not affect the vegetative growth characteristics of cabbage and pepper seedlings (Bachman and Metzger, 2008).

The lowest values of vegetative growth indices were observed in the conventional treatment. The rest of the treatments were better than the conventional treatment in terms of these indicators. Therefore, it is recommended to use the substrates containing vermicompost for the production of canola seedlings, and if vermicompostis not available, other substrates studied in this experiment can be used. Table 8 shows the cost of production for each unit of seedlings.

Table 8. The cost of substrate per 1000 transplants in treatments.

Treatments	Cost of substrate per transplant unit ($)
T1 = 50% peat moss + 50% fine perlite (positive control)	1.25
T2 = 60% farm soil + 20% rotted cow manure + 20% greenhouse sand (conventional substrate)	0.03
T3 = 60% palm peat + 30% perlite + 10% zeolite	0.67
T4 = 60% vermicompost + 30% perlite + 10% zeolite	0.47
T5 = 60% sugarcane bagasse compost + 30% perlite + 10% zeolite	0.32
T6 = 60% tea waste compost + 30% perlite + 10% zeolite	0.82

As shown in this Table, the highest cost of substrate production is related to the substrate composed of peat moss and perlite, which is because peat moss is imported. The lowest cost is related to the substrate composed of animal manure + farm soil + greenhouse sand (as the conventional substrate), although this substrate is the most economical substrate, but as the previous data showed, this substrate did not have acceptable results. Also, its high bulk density makes it difficult to work with it, especially in the conditions of mechanized farming. Among the substrates composed of internally organic materials, the substrate containing tea waste compost had the highest cost, but it also showed interesting results and there was no significant difference with the control substrate in most of the measured traits. The substrate made of sugarcane bagasse compost was the most economical substrate after the conventional substrate, which had the lowest bulk density and the highest ratio of carbon to nitrogen but the seedlings produced in this substrate had better vegetative growth than the conventional substrate, but compared to the seedlings produced in other substrates used in this research had less growth. Palm peat and vermicompost substrates had no much difference in terms of the final price and they can compete together regarding their effect on the growth of corn, cotton, and canola seedlings.

4. Conclusion

As the results of this work show, the characteristics of an ideal substrate can be observed in the positive control treatment (i.e., 50% peat moss + 50% fine perlite), which is well-known to grow substrate producers. This study was conducted to compare the potential of some newer, more available, and less expensive growing substrates with that substrate as the positive control on the growing indices of some crop seedlings. The results of the greenhouse experiment showed that the corn and cotton seedlings produced in tea waste compost (T6) had good vegetative growth and were similar to the positive control treatment.
The substrates containing tea compost were more effective than the other substrates for the production of corn and cotton seedlings, while the substrates containing vermicompost were superior to the other substrates for the production of canola seedlings. The important point about tea waste compost is its production cost, if the cost can be reduced, this substrate has a good potential for the production of seedlings and even the production of substrate for soilless cultures. Another noteworthy point is that although this substrate has a higher production cost than other treatments, it causes seedlings to ripen up to one week early, and this partially justifies the high cost of its production. However, more research and studies on different crops and under different conditions are needed to approve the finding of this work.

Authors contributions
Conceptualization, Methodology, Investigation, Visualization and Data Curation were performed by Seyed Ali Ghaffarinejad; Conceptualization, Investigation, Writing- Original draft preparation, Reviewing and Editing were performed by Seyed Majid Mousavi. All authors read and approved the final manuscript.

Availability of data and materials
The datasets generated during and/or analyzed during the current study are not publicly available due to personal reasons but are available from the corresponding author on reasonable request.

Conflict of interests
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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