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# Use of Palm Waste Cellulose as a Substitute for Common Growing Media in Aglaonema Growing

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Abstract

In order to evaluate the possibility use of palm waste cellulose as a substitute substrate for growing pot plants, an experiment was conducted in completely randomized block design with 6 replication and six treatments on *Aglaonema sp*. The treatments were 5 levels including 0, 25, 50, 75 and 100 palm celluloid wastes mixed with different rates of some amendments such as peat, coconut coir, perlite, vermiculite, rice husk and sugarcane waste compost. The trial was conducted in a research greenhouse at certain environmental condition during 14 month. Before experiment, the chemical and physical properties of organic substrates were measured. To determine superior media the vegetative indexes were measured and data statistically analyzed. Results showed that the palm celluloid wastes had significant impact on the growth and total dry weight of plants that grown in mixing media in comparison with peat and peat- perlite potting media. Also peat and coir had not significant differences in most growth indices but palm celluloid wastes had greater increase in plant dry weight if it used as a 50-50 v/v percent mixing amendment in all treatments. Data indicated that palm celluloid wastes can be used as a media individually; and also as an amendment for other media such as sugarcane compost.

**Keywords:** Compost, Palm, Peat, Potting media, Substrate, Waste Cellulose.

## INTRODUCTION

The first bed which had total suitable physical and chemical properties for most of the plant and quickly popularized was moss peat which is the residual a kind of moss which had been transformed into a most stable of organic matter over hundreds years and it is one of the most suitable bed to culture plant. Over the past 2 hundreds years ago, some kinds of peat had been used as the best resource.

But peat mine is increasingly exhausted in the world and it is concentrated on small part of the world, namely northern Europe and Scandinavia region. This problem had been caused to quick increase its global price. So that, only in England, the annually consumption of kinds of peat had been had about 3.4 $mm^3$ (Drakes *et al*., 2001).

Fortunately, about half a century ago, the new applications of fiber filament of husk of coconut fruit had been investigated. Since then, fiber waste of coconut shell had been replaced with peat in the world and production of this waste in India had been reached to 275000 million ton in 2002 and also Seri Lanka country with production of 35 billion fruit have in strong competition with India, Indonesia and Malaya in the export of culture bed of fiber of coconut fruit. It is interesting that, in trading flower and plant in the world, where currently Netherlands has in the first place, use of both bed in production of potted plant and culture nursery, vegetable and seasonal flower in Iran are related to imports from the other countries.

By increasing import cost, use of this compound is not meet by producers because of raising production cost in production of potted ornamental plant moreover it was possible to enter and out break of pests and disease in import samples of coconut fiber in the country. This problem had been created some concerns in relation with quarantine infection out boreal in the country so that the intent to use of inters substitution resources become the main challenges of the practitioners. About 30 million date palm had been planted in the country (Agriculture ministry senses; 2002-2003), and annually pruning of palms in palm-striking provinces in the wither cause to produce a waste amount on 300 thousand ton in the year which major part are remove.

Cellulose, hemicelluloses and lignin sheath in non-prune branches indicate high similarity of this plant tissue with fiber of coconut fruit hull. The meaning of this waste is a completed mass of fiber which had been formed from cellulose, hemicelluloses and lignin structure. This tissue is riches in lignin and fiber which its microbial decomposition is not simple and if it cause as a potted bed, it will enjoy suitable stability.

During their study, Pustjarvi and Robertson (1975) indicate that if the rate of peat bed particles be less than 0.01mm, the particles become so small that the pot aeration capacity is reduced. Therefore the diameter of bed ingredient particle must be in 0.01-0.8 mm, until it can have the highest aeration space, while also water holding capacity is maximum in the moss peat bed. Although low density of moss peat which is about 350-400 g/l and its acidic pH is consider as excellent characteristic (Drakes *et a1.,* 2001). But in more cases is consumed as mixing. According to researches, adding the other material such as sand or perlite in 30% cause to increase the water rancidity and better water permeability in this kind of medium, but it reduced water holding capacity. On this regard, perlit is superior than sand (Beardsell & Nichols, 1982)

The comparison rate of components in coconut fiber indicate that it have high cholera, sodium, potassium and phosphorus which also sometimes cause to express calcium and magnesium deficiency. Kriej & Leeuwen (2000) comprised peat and coco peat media and observed that the plants cultured in coconut fiber suffered from calcium and magnesium deficiency and also sometimes the concentration of chlorine can reach to 100 ppm. Drakes et a1. (2001) concluded that having high water holding capacity, well porosity and low density (2500-300 g/l) of coconut fiber cause to use as the certain cultural best in propagation the kind of species. The studies of Eleni *et al.* (2000) indicated that combination of coco peat-perlit enjoy the best result to rose development comparing to peat bed.

Comparing two varieties of Biance and First Red in rose by using 3 kind of culture bed, indicated that using perlit: zeolite (3:1) and coconut fiber: perlite (3:1), First red variety have the best flower quality (Maloupa *et al.,* 2000). According to Robins researches (2006), a good bed must have a pH between 5.5-6.5, EC about 300-500 μmhos/cm based on SEM method or saturated extract method, and nitrogen, phosphorus, calcium, magnesium and sulfur concentrations is about 40-200, 5-50, 50-200, 30-120, 20-75 and 5-20 mg/kg, respectively. According this report, the least cation exchange capacity with about 1.5 meq/100 g is related to perlit and the highest CEC is related to peat and vermiculite that is 125meq/100 g.

Jensen *et al.* (2007) by the comparison of coconut fiber, peat and perlit in tomato culture at system (Grow-bag) indicated that the performance of coconut fiber bed was similar with perlit and peat. While high water holding capacity of coco peat caused to reduce the water consume rate in the profile where temperature was high and to increase water consume efficiency.

According to the results of Samiei *et al*. (2005) on tow potted plant, coco peat pure bed generated the highest growth level and it was not observed a significant difference on the leave surface index, root and shoot dry weight between peat pure bed and palm cellulose wastes. He pointed out that a regression relationship has indicated that humidity holding capacity had been the most effect on the studied plant developmental indexes. Although his research demonstrated the ability of this compound to replacing with moss peat medium, but it was not identified its mixing effects with the other popular compounds, especially to improve physical and chemical properties.

## MATERIALS AND METHODS

In order to compare cellulose loss of palm (peat light (brown)) with other popular bed in production of *Aglaonema commutatum* plant, a RCBD experiment had been arranged in 6 replication. Treatments including 1. Moss peat- perlit, 2. Palm fiber-moss peat, 3. Palm fiber-coconut fiber, 4. Palm fiber-vermiculite, 5. Palm fiber-rice and 6. Palm fiber-sugar cane bagasses with ratio of 0, 25, 50, 75 and 100 percent of palm with each mixture except control treatment which is a mixture of moss peat and perlite. Each experimental unit was include one *Aglaonema commutates*. The numbler of treatment was 24 and the number of experimental unit was 144 pots. This experiment had been carried out in a greenhouse with controlled condition in April in a period of 14 months.

After size measurement, whole substrates was measured in the determined proportions and filled into 2.5 L pots. Coconut fiber prepared in condensed 11L blacks which initially had been immersed into water in 24 hours. Then they had been treated with calcium nitrate and magnesium sulfate 2 M. In order to prepare palm litter, palm pruned branches had been used in the Jiroft research stations, Kerman, Iran at the end of winter. First, branches (petiole) were separated and then they chipped into the size of 0.1-2mm.

The proportion of chipped particle size of palm waste was between 0.1 mm (about 10%) and 2 mm (about 90%). Peat bed which was the positive control was from light peat type without reaching nutrients. Double leave seedlings of *Aglaonema commutatum* were selected taking into consideration root and shoot and planted in the pots. Beds disinfected with 2:1000 benomil fungicide before the plantation and irrigated to potted capacity rate, daily.

Total marco/micro nutrients had been gave to potted once a weak and in the first month after establishing the seedling in 100 L water based on formula include: $KNO_3$=100gr, $Ca(NO_3)_2$=85, $MgSO_4$=20g, $KH_2PO_4$=20g, FeEDTA=4g, ZnEDTA=1g, MnEDTA=1/5g, $CuSO_4$=72g, $H_3BO_3$=0/5g, $(NH_4)_2MoO_4$=0.1 (chlorine of irrigation water was sufficient).

### Studied properties

Then vocational developmental indexes such as total wet weight , aerial argon and root weight, dried weight, leaves number, roots length and the mean of roots greater than 3cm. the rate and green intensity by SPAD set and physical and chemical properties including the measurement of particle measure by certain dye, nutrients, organic carbon, EC, PH by method of saturation extract in ratio of 1:1 (one part of culture medium and one volume of distilled water in weight ratio), cation exchange capacity by Inako & Harvard method (1980), organic carbon percent by Walkey-Black method, C/N ratio, porosity, bulk density and particle density and bed humidity percent by Banijamali *et al*., (2005) investigation.

**Data analysis**

Statistical analysis had been carried out with SAS statistical software and according to analyzing from ANOVA test and comparing data mean to Duncan test. Diagrams was depicted with excel software.

**RESULTS AND DISCUSSION**

The results of Table 1 indicate that the nitrogen amount of sugar cane bagasse and palm fiber was more than the other beds, but the rate of K in sugar cane bagasse and coconut fiber was more than peat moss and the amount of organic carbon of all 3 beds was approximately in the same level. The EC rate for sugar cane bed and coconut fiber bed was higher than allowed rate. The greatest CEC rate was related to coconut fiber and peat.

The results of physical properties of the used organic beds had been presented in Table 2. The greatest porosity is related to palm cellulose waste and rice hull. The highest moisture volume percentage is related to coconut fiber, palm cellulose waste and peat. The least density is related to rice hull and is highest rate is related to palm cellulose waste, coconut fiber and sugar cane bagasse.

Results of Table 2 indicates that porosity percentage had been highest in rice hull and the second highest porosity is related to palm fiber which course, one of its reasons is lack to sugar cane bagasse which its particle size is almost more than 1mm, but it has high wetting absorption. One of the most important physical index of a bed, is moisture holding capacity, which comparing to the other beds, the moisture holding capacity in coconut fiber had been higher than peat moss and this two fiber are higher than palm fiber and the least one is rice hull and perlite.

Figure 1 showed that the intensity of plants green leafy was significant in different treatments ($P<1\%$). Most green leaves is related to mixture of peat and perlite and lowest are related to coconut fibers and palm waste; its major reason is a high proportion of C/N compounds. Low nitrogen in high-carbon organic substrates cause to relative decrease in plant growth and plant green.

Figure 2 indicates that there are significance differences between the dry weights of treatments. The highest dry weight is related to palm fiber bed-sugar cane bagasse compost, palm fiber-peat, palm fiber-coconut fiber and the least is related to palm and vermiculite fiber, of course, vermiculite bed because of excess holding water cause to plant root rot and so it is not a suitable bed. The beds which had suitable water holding capacity and nutrient, had the best results and the other light beds which were free of nutrient or had low CEC, didn't indicate a suitable performance (Table 1).

Figure 3 showed that in palm fiber + sugar cane bagasse, coconut fiber and peat, the highest shoot dry weight was observed and the lowest dry bed related to rice husk and vermiculite. Root and shoot organ dry weight to a certain extent had been influenced by the type of culture substrate. Compared with the average length of roots plants tested previous similar results were obtained, because the status of root growth also has been affected by the bed.

Incorporation levels were compared in each treatment in Figure 5 a 1:1 ration peat moss and palm fibers had been the most influence on increased of dry matter. Similarly, the mixture of waste palm with, coconut fibers the best result is derived with the mixing ratio of 50 percent of palm waste and 50 percent of the coconut fiber.

Figure 6 demonstrates that although the incorporation of rice husk cause to lightness and decreased density in the soil substrates, but mixing it with palm fiber, had a negative effect on growth parameters, particularly dry weight. Figure 7 shows that adding fiber to the Palm fiber to bagasse bed is reduced performance; according to a table 1 can be seen that the CEC was low in both composition and more mixing of these two led to nonsignificant results. Despite the high percentage of nitrogen in both medium than the other mixing, lowing cation exchange capacity is not achieved the desired result. A more CEC tend to higher nutrients.

Since peat moss and perlite mixture has been considered as control, the comparison its the results (Figure 2) with figure 4 show that the mixing ratio of 50-50 is created the best conclusion in terms of physical and chemical properties. Of course, the yield in palm fibers and Pete treatment had been much higher.

Results showed that there is not significant difference between the use of coconut fibers and peat. This explains why the peat had been replaced by coconut fibers in the world. Moreover, comparing data of figure 8 show that the incorporation of beds achieve better result than their pure applications, so that, 1:1 ratio of peat moss and palm fiber had a suitable response than lonely application. Their pure application has equally been affected on the growth and dry matter production per pot plant.

Results proved that use of palm cellulosic fibers can replace with imported peat moss and coconut fiber that agreed with the results of Samii et al (1383). On the other hand, his results have shown that coconut fiber also is a good alternative to peat moss, which results of this research, is satisfy this subject. But in Samii et al (1383) research, they emphasized that the coconut fiber substrate had the most efficient output to plant production, which the results of this project shows that the use of peat moss and coconut fibers or palm fiber alone, not only have not efficiency, but also it is effective when is used in bed as a mixture. Proof of this claim can be observed from the results of mixing it with sugar cane bagasse compost which cause to improve medium properties. Despite reports of Samii et al (2005) cane compost medium improve yield and medium due to the incorporation of sustainable palm cellulosic fibers in compared to other beds. On the other hand, palm fiber beds has low cation exchange capacity (57 me/100 g) that the use of it without composting, will not cause to the same results of peat moss or coconut fiber, which respectively have 124 and 121 CEC me/100 g (Table 1). It is recommended that this bed should not be used as common substrates when they have not been composted.

Some suggestions: 1. Use of palm waste cellulosic substrate need to appropriate processing (aggregation and composting) to generate a suitable bed; 2. The bed of palm cellulosic wastes can not only good alternative to imported peat moss, but it can be used instead of coconut fibers; 3. A suitable processing mill must be designed for this product. Since aggregation size has a special role in physical properties and microbial decomposition process. So, access to appropriate equipment for this research is very important; 4. It is suggested that some research must be done about how to compost palm fibers and its effects on the physical and chemical properties.



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**Tables**

Table1. Chemical compositions of organic substrates

| Substrates | CEC | C/N | EC | pH | OC | $K_{ava}$ | $P_{ava}$ | N |
|---|---|---|---|---|---|---|---|---|
| | meq/100gr | | dS/m | | (%) | | | |
| Peatmoss | 124 | 86 | 0.57 | 4.6 | 53 | 0.16 | 0.07 | 0.65 |
| Coconut coir | 121 | 121 | 1.29 | 5.9 | 52 | 0.73 | 0.05 | 0.48 |
| Palm coirs | 57 | 95 | 0.9 | 6.2 | 49 | 0.18 | 1.15 | 1.25 |
| Cane Bagasse | 83 | 89 | 1.85 | 6.7 | 31 | 0.56 | 0.19 | 1.35 |
| Husk rice | 19 | 101 | 0.87 | 7.1 | 45 | 0.05 | 0.03 | 0.05 |

Table 2. Physical properties of organic substrates

| Substrates | Bulk density ( $gr/cm^3$) | Apparent bulk density ($gr/cm^3$) | Air volume (%) | Water Holding Capacity (%) | Porosity (%) |
|---|---|---|---|---|---|
| Peatmoss | 1.519 | 0.079 | 30.67 | 62.98 | 93.89 |
| Coconut coir | 1.438 | 0.083 | 25.12 | 67.08 | 93.42 |
| Palm coir | 1.567 | 0.126 | 40.5 | 54.68 | 94.10 |
| Bagasse | 1.523 | 0.06 | 60.50 | 29.87 | 91.35 |
| Husk rice | 1.231 | 0.03 | 79.44 | 16.67 | 95.56 |

## Figures

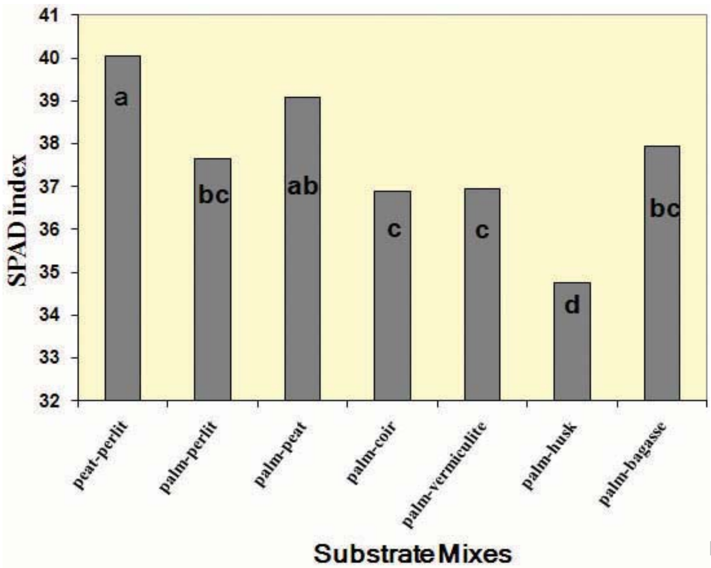


Fig. 1. Effect of different mixes media on leaf greenness in Aglonema

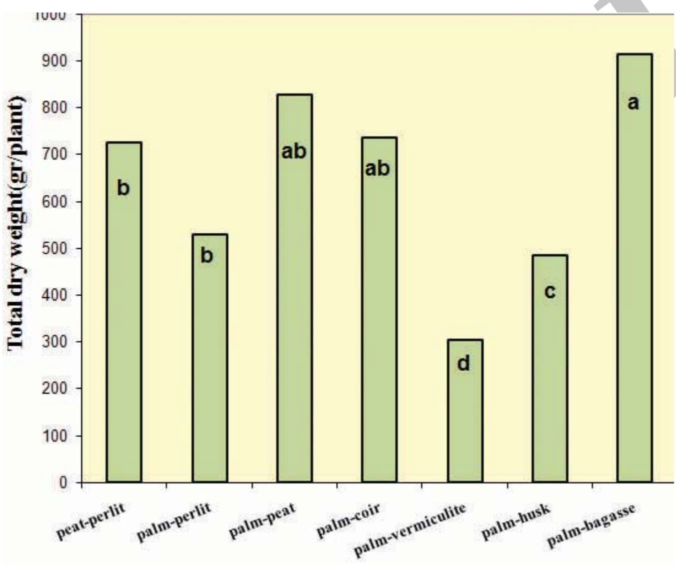


Fig. 2. Effect of different media treatments on total dry weight

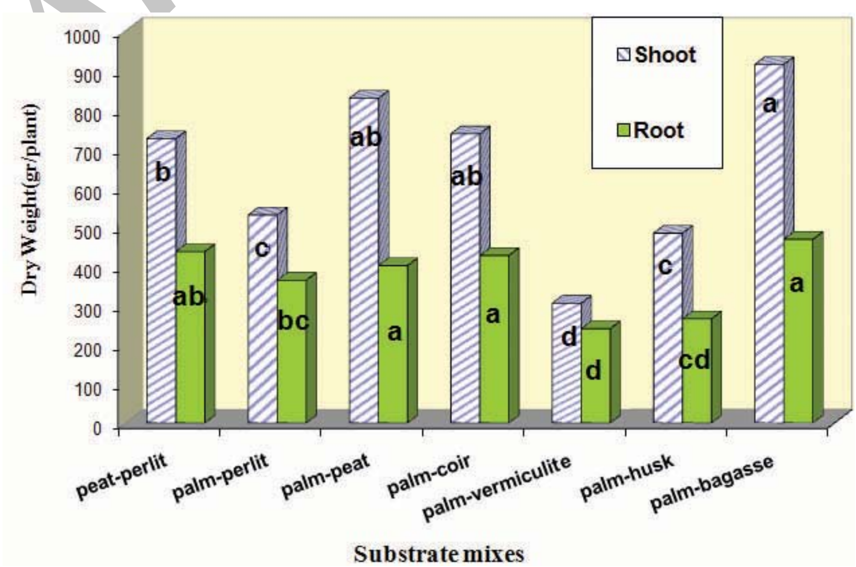


Fig. 3. Effect of different media treatments on shoot and root dry weight of Aglonema plants

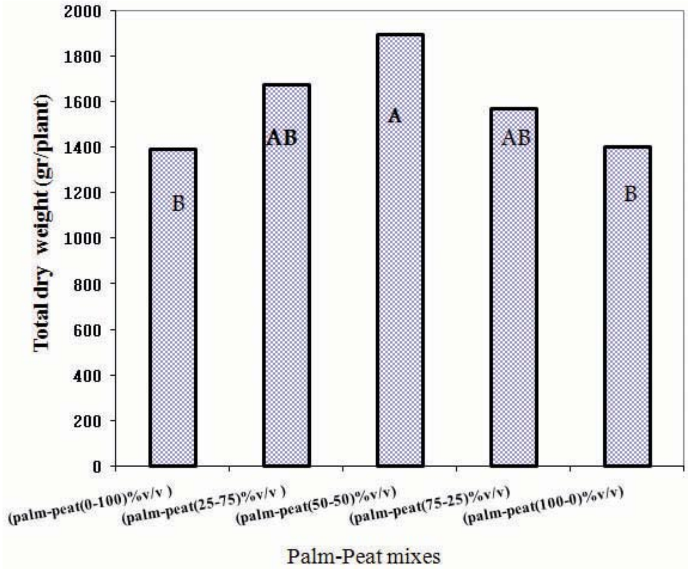

Fig. 4. Effect of different palm-peat mixes on dry weight of Aglonema plants

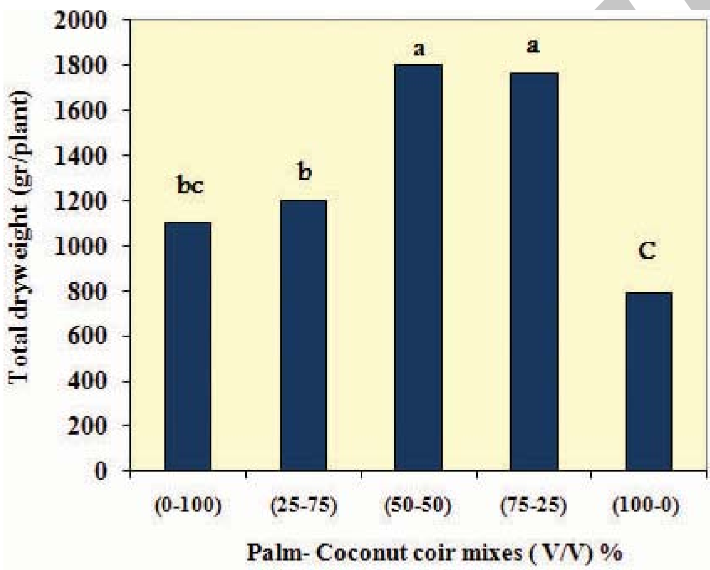

Fig. 5. Effect of Palm- coconut coir mixes on total dry weight of Aglonema plant

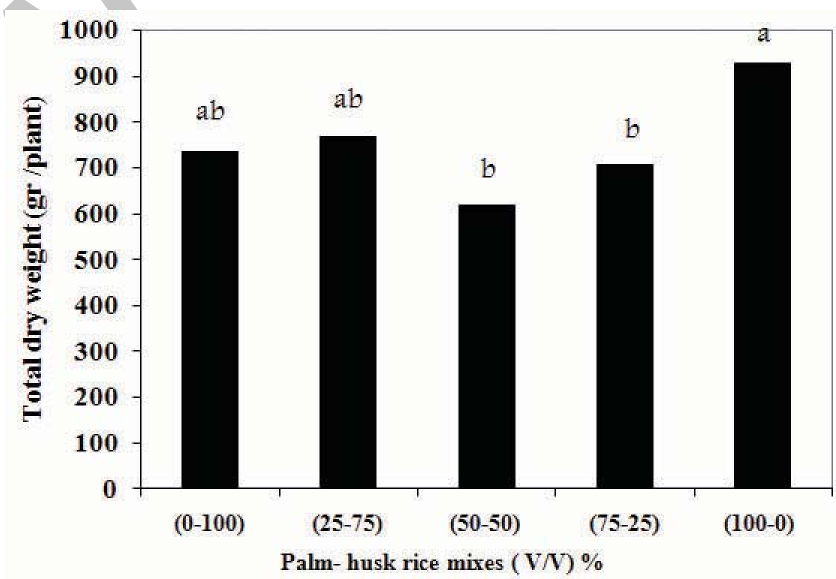

Fig. 6. Effect of Palm- husk rice mixes on total dry weight of Aglonema plant

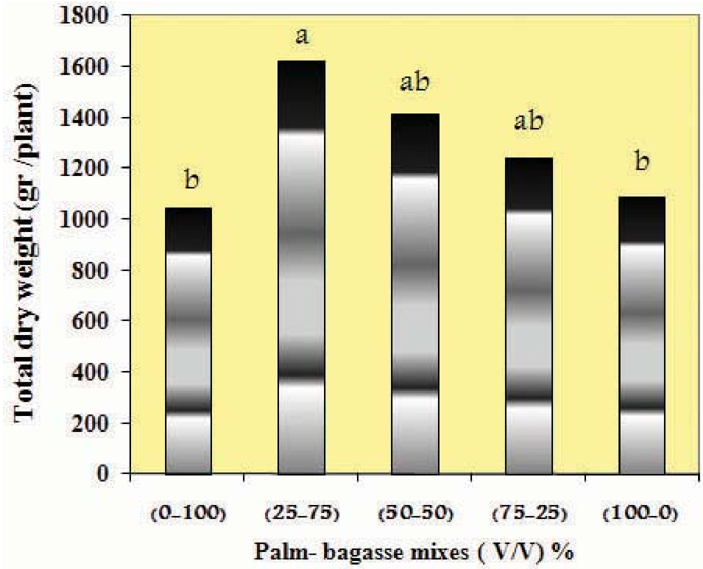


Fig. 7. Effect of Palm- bagasse mixes on total dry weight of Aglonema plant

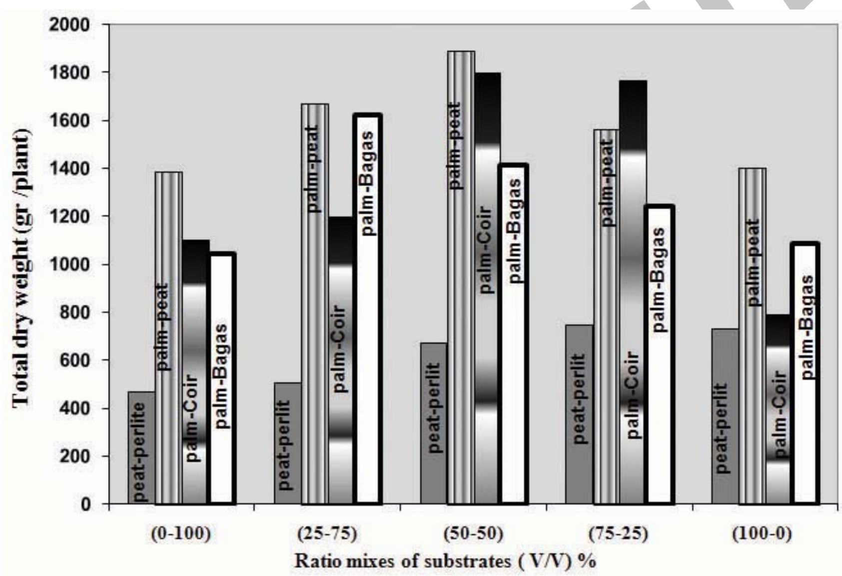


Fig. 8. Effect of different mixes on total dry weight of Aglonema plant


| | | |
|---|---|---|
| Palm- Bagasse (100-25) | Palm- Bagasse (100-0) | Palm- Bagasse (0-100) |

Fig. 9. Aglonema plants in palm coir-bagasse mixes


| Palm- Coco (0-100) | Palm- Coco (25-75) | Palm- Coco (50-50) | Palm- Coco (100-0) |
|---|---|---|---|

Fig. 10. Aglonema plants in palm coir -coco coir mixes

Fig. 11. Degradation of Bagasse substrate in the pots


Fig. 12. Aglonema growth in palm-peat mixes
Left (0-100) and right(50-50) V/V% mix ratio