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RESEARCH ARTICLE

Effect of Moisture Absorbent Hydro Polymer on Growth of Nursery Coconut Seedlings in Sri Lanka

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ABSTRACT

Coconut palm is one of the most important plantation crops in the world. Selecting the best planting materials for field planting assures higher productivity. Cost of production of coconut seedling is very high in coconut nurseries, because as coir dust is becoming scarce even within the Coconut Triangle. The use of coir dust in the potting mixture might not be feasible in the near future. Therefore, it is important to test the suitability of other options available for replacing coir dust. Moisture absorbent hydro polymer (Zeba) is one of the best alternatives to be used instead of coir dust in potting media of coconut seedlings. Thus, this experiment was conducted to investigate the effect of moisture absorbent hydro polymer on growth of coconut seedlings and water retention characteristics of the growth media.

The experiment was carried in a plant house and the laboratory at the Agronomy Division, Coconut Research Institute of Sri Lanka (CRI), Lunuwila. The treatments were laid according to Completely. Randomized Design (CRD) with twelve replicates. Different potting mixtures were used as treatments. Growth parameters of the seedlings and the moisture parameters of the growth media; moisture content and the water holding capacity were measured and analyzed.

There was no significant difference (P>0.05) between the tested treatments in seedling girth and root volume. The results revealed that there were significant ($P<0.05$) differences between the treatments on seedling height, number of fully opened leaves, leaf area, dry shoot weight, dry root weight, soil moisture content and soil water retention capacity. The highest plant growth rate was recorded in T_1. There were significant (P<0.05) differences between the treatments on number of fully opened leaves at 10th and 12th weeks after planting. T_1 (Top soil 4 kg + coir dust 4 kg + organic manure 4 kg) exhibited the highest seedling height, number of fully opened leaves, leaf area, dry shoot weight and dry root weight. Same as the T_1 potting mixture, the T_3 potting mixture also showed a considerable increase in plant height, number of fully opened leaves, leaf area, dry shoot weight, dry root weight of coconut seedlings. T_3 exhibited the highest soil moisture content and water retention capacity. Therefore, the application of moisture absorbent hydro polymer can be used to get maximum growth and soil moisture characteristics of coconut seedlings.

Keywords: Coconut, planting material, coir dust, moisture absorbent hydro polymer

INTRODUCTION

Success of coconut plantation establishment starts with the production of good quality planting materials. Selecting the best planting materials for field planting assures higher productivity. A good quality seedling has the ability of producing an economically viable crop through the entire productive life, on reaching a stable yield of the palm. The production of good quality planting materials can be accomplished by laying selected coconut seed nuts in nursery beds or polybags and selecting only healthy seedlings for field planting (Liyanage, 1999). The vigor of seedling is highly correlated with characters of adult palm such as early flowering, nut yield and copra production (Liyanage and Abeywardena, 1957). Carefully selected high quality planting material will sustain the coconut tree's productivity and economic lifespan of 60-100 years (Paul and Ramkhelawan, 2016). Therefore, the high quality and vigorous seedlings are required to establish a proper coconut plantation. In order to obtain high quality, vigorous seedlings, nursery management is an essential practice in coconut plantations (Remison and Iremiren, 1990).

Raising of coconut seedlings in polythene bag is famous in Sri Lanka (Peiris and Everard, 2010) due to its revealed benefits to the farmer. Poly bag nursery can be adopted for producing more vigorous seedlings with better root system. Compared to the nursery in the field, watering, weeding and routine operations for the elimination of unwanted seedlings are easier in poly bag nursery. The common potting media for raising coconut seedlings in polybags is 1:2:3 mixture of top soil, cow dung and coir dust (Peiris and Everard, 2010). Various types of plant residues can be used as potting media. Rice husk contains a high content of silicon and potassium, nutrients which have great potential for amending soil, while those with a relatively higher carbon content (e.g. wood or nut shells) are currently used for the production of activated carbon (Varela Milla *et al.*, 2013). Saw dust can be used instead of coir dust. However, when using saw dust as a moisture conservation material it is important to aware on fungal diseases which seedlings are prone to be (Perera *et al.*, 1997).

Coir dust is the best popular potting media in coconut nurseries. Availability of coir dust is a great constraint in the non-traditional coconut growing areas, especially in dry zone, where other materials such as saw dust, paddy husk, straw and weed thrash are in abundance (Perera *et al.*, 1997). Although coir dust is recommended in the current potting mixture for raising coconut seedlings in polybags, coir dust is becoming a scarce resource even within the Coconut Triangle. Coir dust increases the cost of production of the poly bagged seedlings because of its increasing demand in the export market (Perera *et al.*, 1997). Given these due to the extra possible uses of coir dust and brown fiber, the cost required for the production of coconut seedling in coconut nursery will be very high in the near future. Therefore, the use of coir dust in the potting mixture might not be feasible (Perera *et al.*, 1997). Hence, it is important to test the suitability of other options available to replace coir dust (Perera *et al.*, 1997) and cost-effective cultivation practices to be applied during the commercial nursery management.

A starch-based superabsorbent polymer (SAP) was invented and developed by a team of USDA chemists 30 years ago. In 2003, a company called Absorbent Technologies Inc (ATI) commercially developed the original invention and came up with a product with the trade name of Zeba, specifically designed for agricultural use as a soil amendment agent. Zeba is a unique superabsorbent polymer. This hydro polymer is based on copolymerized natural corn starch. Superabsorbent polymers (SAPs) are macromolecules with the ability to absorb water and release it slowly to the surroundings (Esposito *et al*., 1996). SAP hydrogels can be used as soil moisture conditioners which act as water reservoirs and release water depending on the need of plant roots (Parvathy *et al.,* 2014). When powdered SAP particles were soaked in water they transform themselves into hydrogels, which can release the absorbed water slowly to the surrounding medium. Hydrophilic polymers exist in three forms, viz., natural (polysaccharide derivatives), semi-artificial (cellulosic primitive derivatives) and artificial (Mikkelsen, 1999). The importance of using natural polymer based SAPs are due to their biodegradability, non-toxicity of the base component and their sustainability (Stahl *et al.,* 2000; Weerawarna, 2009). Superabsorbent hydrogels can be used to retain moisture in the surrounding soil during plant growth and transportation. Hydrogels act as 'miniature water reservoirs' in soil, releasing water into the soil and maintaining moisture balance in the soil (Zohuriaan-Mehr and Kabiri, 2008). Hence, the objective of this study was to study the effect of hydrogel on growth of coconut seedlings in nursery and reduce the cost of production of coconut seedlings.

MATERIALS AND METHOD

Description of the Experimental Site

The experiment was carried out from July to October, 2017 in plant house and the laboratory at the Agronomy Division, Coconut Research Institute of Sri Lanka (CRI), Lunuwila (latitude of 7^0 33' N and the longitude of 79^0 88'E IL_{1a}). The mean annual rainfall in this area is greater than 1400 mm while the mean annual air temperature and mean annual soil temperatures are 28^0C and 32^0C respectively. The mean annual sunshine duration is 7 h day^{-1}. During the experimental period, in the plant house, poly bags received photosynthetically active radiation (PAR) ranging from 500-1150 $\mu molm^{-2}s^{-1}$ and the average day and night temperature in the range of 30-34 ^{0}C and 26-30 ^{0}C respectively during the experimental period. Relative humidity varied between 35-60% during the day and 20-70% during the night. The soil group of this area is red yellow podzolic with strongly mottled sub soil. Black polythene bags with 28 cm diameter and 40 cm length made of 500 gauge were used for this study.

Preliminary study

The optimal quantity of moisture absorbent compound needs to incorporate into the soil was determined after conducting a preliminary study two weeks prior to the commencement of the experiment. Physical characteristics; moisture content and water holding capacity in the moisture absorbent amended soil were compared against the dry soil. The optimum amount of moisture absorbent to be incorporate into 500 g of dry soil was determined in this study. In order to conduct the preliminary study, two sets of soil samples were prepared. One set of soil samples contained weight series of soils without any replicates (10g, 20g, 30g, 40g, 50g, 60g, 70g, 80g, 90g and 100g). Same as the previous set another set of soil series were also prepared. Then one gram of moisture absorbent was applied to each soil sample in set two.

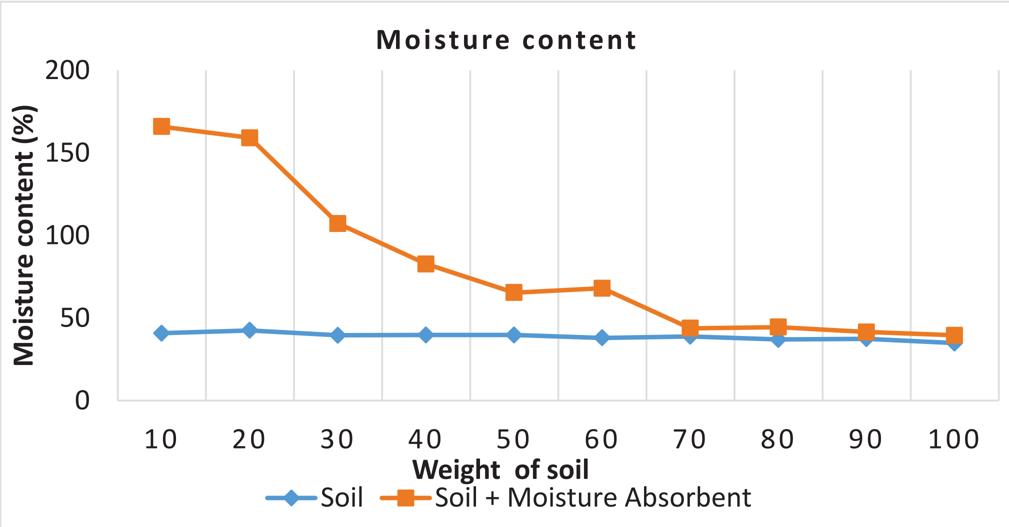


Figure 1: Moisture content of the soil and soil with added moisture absorbent

Then 50 ml of water was applied into both sets of soil. After that, moisture content and water holding capacity at field capacity in two sets of soil were measured. The results obtained from these two experiments are expressed in Figure 1 which shows that, the moisture content in the soil set 1 has decreased, with the increasing of the weight of soil samples. However, the moisture content of the soil samples has reduced down to a certain level and which then continued.

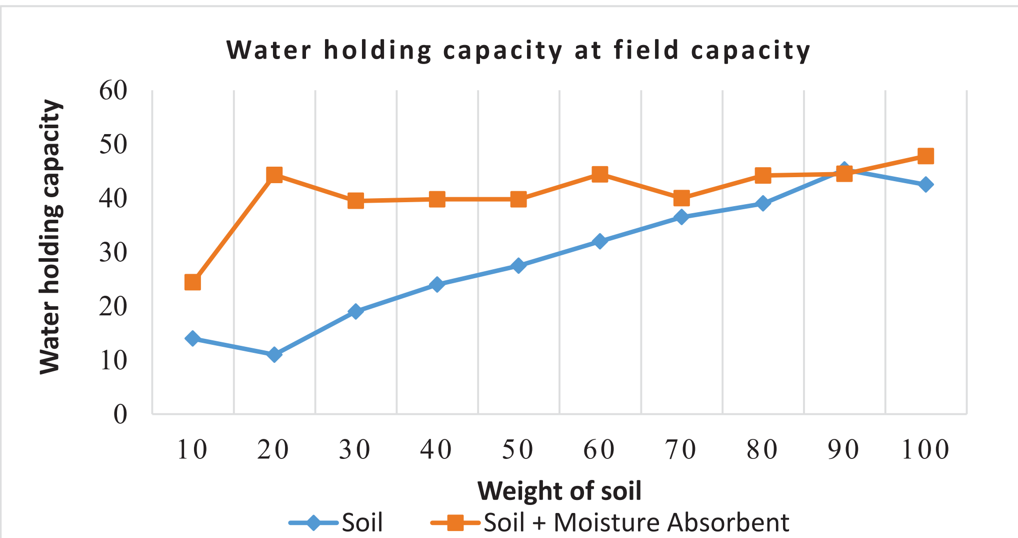


Figure 2: Water holding capacity of soil and soil with moisture absorbent at field capacity.

According to the Figure 2 the water holding capacity in the soil set 1 and soil set 2 has increased, with increasing weight of soil samples. However, the water holding capacity of the soil samples has been increased and reached to equal level at a certain point.

According to the results obtained from these experiments, certain assumptions were developed. The result of the preliminary study has revealed that 1 g of moisture absorbent compound is sufficient to be incorporated nearly into 90 g of soil. Therefore, by considering the practical feasibility, it was concluded that 1 g of moisture absorbent should be incorporated into 100 g of soil. Accordingly, 5 g of moisture absorbent is sufficient for 500g of soil. Based on that, 60 g of moisture absorbent was applied to each potting medium in treatment 2 and 120 g of moisture absorbent was applied to each potting medium in treatment 3.

Pot culture experiment

A bulk soil sample was collected at 30 cm depth and air dried for a day. The air-dried soil was sieved to avoid the soil heterogeneity. Organic manure, coir dust and moisture absorbent in the appropriate amounts were thoroughly mixed with the sieved soil. The mixing was done according to the proportions of the treatments.

Treatments

Coconut seed nuts from *var.*CRIC 60 (T × T) were used for the experiment. Coir dust, organic manure and moisture absorbent were mixed together according to the given proportions in the different treatments and each treatment was replicated twelve times. The combinations of the treatments were as follows.

T_1: Top soil 4 kg + coir dust 4 kg + organic manure 4 kg

T_2: Top soil 6 kg + organic manure 6 kg + moisture absorbent 60 g

T_3: Top soil 12 kg + moisture absorbent 120 g

T_4: Top soil 6 kg + coir dust 6 kg (control)

The poly bags were placed in triangular spacing of 75 cm× 75 cm× 75 cm and treatments were arranged according to Completely Randomized Design (CRD) at plant house. Watering was done to each treatment according to the water requirement of the media. All the other agronomic practices were applied according to the recommendation of Nursery Management Guide, Coconut Research Institute, Sri Lanka.

DATA COLLECTION:

Sampling and sample preparation

Destructive samples were taken at three weeks intervals. Three coconut seedlings were uprooted randomly from each treatment. First the shoot growth parameters such as seedling girth and seedling height were measured. Then roots were separated from the shoot and categorized into primary, secondary, tertiary and quaternary roots

Root measurements

Root volume (cm^3) was measured using Archimedes theorem. Separated root samples were oven dried at 80°C temperature to a constant weight.

Shoots measurements

Final seedling girth (cm) was measured at the point where the shoot was emerged from the nut. Final seedling height (cm) was recorded by measuring the distance between the point of shoot sprung the nut to the tip of the longest leaf using a measuring tape.

Then the shoots were oven dried at 80°C temperature to a constant weight and the dry weights (g) were recorded. Leaf area is the one-sided projected surface area of a single leaf expressed in cm^2. Leaf area was taken within four months interval, by the method of leaf tracing. Leaves were separated from the petiole and traced in to the papers. The traced papers were cut into the pieces and sent through the Leaf Area Meter (Li 3100, USA) in order to measure the area of the leaves (cm^2).

Moisture content of the potting media

Moisture content in every potting media was determined daily using gravimetric method. This involved drying to a constant weight in an oven at 100-110°C for 24 hours (Majumdar and Singh, 2008). Percentage of moisture content was expressed on a dry weight basis.

$$\text{Soil moisture content} = \frac{\text{Loss in weight on drying}}{\text{Weight of soil after oven drying}} \times 100$$

Water retention capacity of potting media at field capacity level

The water retention capacity of each potting media was measured at every irrigation and the readings were expressed in ml (Gessert, 1976).

Statistical analysis

Data were analyzed using Statistical Analysis System (SAS) and Minitab. Duncan's Multiple Range Test (DMRT) and Chi square procedures were followed.

RESULT AND DISCUSSION

Seedling height

The soil amendments, which are included in the potting media, were used to modify the rate of crop growth and pattern of growth during seedling stage of a plant. Effect of different potting mixtures on average seedling heights at 6th, 8th, 10th, 12th, 14th and 16th weeks after planting (WAP) are shown in Table of which showed no significant effect ($P<0.05$) of the different treatments on the average seedling height at 2nd and 4th WAP. However, there was a significant effect ($P<0.05$) of the treatments at 6th WAP on average seedling height and the difference among treatments persisted throughout the experimental period thereafter.

The highest average seedling height was recorded in T_1 (108.58 cm), followed by T_3 (91.42 cm), T_4 (87.61 cm) and while the minimum was observed in T_2 (85.72cm). The highest seedling height in T_1 might be due to the optimum growing condition for coconut seedlings created by combination of organic manure and coir dust. Samsuddin *et al*. (2014) stated that organic manure supplies nutrients to the plants where coir dust helps to hold all nutrients and water and also supports root systems of the plants. Earlier studies by Smith and Ayenigbara (2001) and Ojeniyi (2000), showed that organic manure improves N, P, K, Ca and Mg status of soil and a balanced rooting media contains an adequate supply of nutrients essential for plants to attain maximum height. Among the tested treatments, T_3 had taller seedlings compared to the T_4 and T_2. The results obtained by Parvathy *et al*. (2014) were agreeable with the findings of this study. They have stated that, due to the continuous and controlled supply of water and nutrients by the Superabsorbent compound (SAP), plant biological activities like cell division, cell expansion and cell elongation can be enhanced leading to an increase in plant height.

Table 1: Effect of different potting mixtures on coconut seedling height

Treatment	Seedling height (cm)							
	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP	14 WAP	16 WAP
T_1 (Top soil 4 kg + coir dust 4 kg + organic manure 4 kg)	46.1 ± 0.95^{a}	51.3 ± 0.94^{a}	60.6 ± 1.00^{a}	69.8 ± 1.17^{a}	80.5 ± 1.46^{a}	89.7 ± 1.51^{a}	97.0 ± 1.63^{a}	108.6 ± 1.37^{a}
T_2 (Top soil 6 kg + organic manure 6 kg + moisture absorbent 60 g)	43.0 ± 0.93^{a}	47.5 ± 0.81^{a}	51.0 ± 0.86^{c}	54.4 ± 1.02^{c}	63.0 ± 1.33^{c}	69.6 ± 1.34^{b}	77.2 ± 1.43^{b}	85.7 ± 1.43^{b}
T_3 (Top soil 12 kg + moisture absorbent 120 g)	44.5 ± 1.24^{a}	49.8 ± 1.12^{a}	57.0 ± 1.15^{ab}	64.2 ± 1.28^{ab}	72.5 ± 1.31^{ab}	77.6 ± 1.6^{b}	85.6 ± 0.73^{b}	91.4 ± 0.90^{b}
T_4 (Top soil 6 kg + coir dust 6 kg)	42.0 ± 0.89^{a}	48.1 ± 0.81^{a}	53.8 ± 0.82^{bc}	59.4 ± 0.95^{bc}	70.9 ± 0.99^{bc}	77.7 ± 1.06^{b}	82.1 ± 0.91^{b}	87.6 ± 0.96^{b}
F test	ns	ns	*	*	*	*	*	*
CV	15.251	13.261	13.035	14.238	15.199	15.772	13.488	12.375

WAP = Weeks after planting

F test: *:= Significant at 5% level of probability, ns: = not significant

Mean values in a column having the dissimilar letter/letters indicate significant difference at 5% probability level (DMRT).

NUMBER OF FULLY OPENED LEAVES

The Table 2 shows the number of fully opened leaves in different treatments. At 10th and 14th weeks after planting, there is a significant effect of treatments on the number of opened leaves (Table 2). There was no significant difference (P>0.05) between the tested treatments with respect to number of fully opened leaves at 2nd, 4th, 6th, 8th, 12th, 16th weeks after planting.

The maximum number of fully opened leaves was observed 10 weeks after planting in T_1, T_3 and T_4 while lowest median number of fully opened leaves was recorded in T_2. The median number of fully opened leaves at 10 weeks after planting was not significantly different with the median number of fully opened leaves in T_1, T_3 and T_4. Perera *et al.* (1997) stated that the media which contained high amount of coir dust have produced the highest leaf number in coconut seedlings.

Leaf area

Recorded leaf area at monthly intervals is shown in Table 3. Growing media has significantly affected (P<0.05) the average leaf area as T_1 has produced maximum leaf area of 4499 cm^2 followed by T_3 and T_2 producing leaf area of 4425 cm^2, 2294 cm^2, respectively at 4th month. The minimum leaf area 2007 cm^2 was recorded in T_4.

Table 2: Effect of different potting mixtures on number of fully opened leaves of coconut seedlings

Treatment	Number of fully opened leaves							
	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP	14 WAP	16 WAP
T_1	2	2	2	2	3	3	4	4
T_2	2	2	2	2	2	3	3	3.5
T_3	1	1	2	2	3	3	3	4
T_4	2	2	2	2	3	3	3	4
P value	0.892	0.603	0.429	0.429	0.025	0.132	0.017	0.061
Chi square	0.62	1.86	2.77	2.77	9.32	5.61	10.18	7.37

WAP = Weeks after planting

Table 3: Effect of different potting mixtures on leaf area of coconut seedlings

Treatments	2 MAP	3 MAP	4 MAP
T_1	279 ± 5.00^a	1340 ± 6.00^a	4499 ± 2.00^a
T_2	191 ± 5.00^b	654 ± 3.00^c	2294 ± 3.00^b
T_3	170 ± 3.00^b	898 ± 5.00^b	4425 ± 4.00^a
T_4	177 ± 3.00^b	583 ± 2.00^c	2007 ± 0.00^c
F test	*	*	*
CV	28.129	17.020	4.827

MAP = Months after planting

F test: *:= Significant at 5% level of probability, ns: = not significant

Mean values in a column having the dissimilar letter/letters indicate significant difference at 5% level of significant (DMRT).

The highest leaf area was recorded in the treatment which contains top soil: organic manure: coir dust at a ratio of 1:1:1. These results are in agreement with Al-Wasfy and El-Khawaga (2008) who stated that increasing organic-N levels had an influence on a gradual significant promotion in area of pinnae of Zaghloul date palm. Mohamed and Gobara (2004) and Diab (2006) had reported positive vegetative growth responses of various date palm cultivars to the annual application of organic fertilizers.

Shoot dry weight

The analysed data for shoot dry weight was given in the Table 4. A significant difference (P<0.05) was observed for shoot dry weight among T_1, T_2, T_3 and T_4 at 2 MAP and 4 MAP. The lowest shoot dry weight was recorded in T_2 (56.2 g) while the highest (97.7 g) was in T_1.

The studies done by Rosenani *et al*. (2016) have revealed that the shoot dry weight of oil palm seedlings are related to the amount of compost added. Among the treatments, T_3 had higher seedling height compared to the T_4 and T_2. These results are in agreement with the results obtained by Orikiriza *et al*. (2013) who reported that shoot biomass of seedlings of the three plant species were generally higher in hydrogel amended soils compared to the controls.

Root dry weight

According to the Table 5, the average root dry weight was significantly different (P<0.05) in the different potting mixtures. Four months after planting (MAP), the coconut seedlings grown in T_1 gave the highest root dry weight (60.10 g) followed by T_3 and T_4 and the lowest (27.36 g) was in T_2.These findings are coinciding with the results of Perera *et al*. (1997) for coconut seedlings. According to their results, the treatments with coir dust had better anchorage than the saw dust, paddy husk, partially decomposed straw and weed trash and the normal mixture (Top soil, Cow dung, Coir dust) had the best holding ability on roots. With respect to the efficacy of each mixture, the best one found to be the normal potting mixture. The seedlings in coir dust mixture exhibited sufficient root growth, especially feeder roots to absorb moisture and for better anchorage to the

Table 4: Effect of different potting mixtures on shoot dry weight of coconut seedlings

Treatments	2 MAP	4 MAP
T_1	41.45 ± 0.11^a	97.7 ± 0.34^a
T_2	30.19 ± 0.38^b	56.2 ± 1.19^b
T_3	37.64 ± 0.33^a	94.72 ± 0.75^a
T_4	32.46 ± 0.33^b	92.17 ± 0.71^a
F test	*	*
CV	5.052	8.101

MAP= Months after planting

F test: *:= Significant at 5% level of probability, ns: = not significant

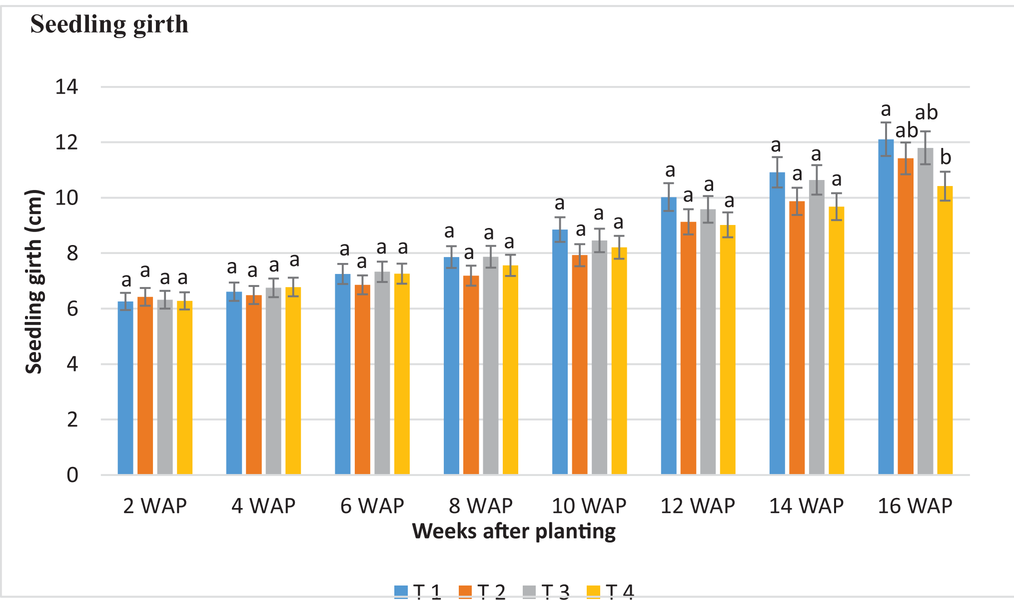
Mean values in a column having the dissimilar letter/letters indicate significant difference at 5% level of significant (DMRT).

media. It had a low decomposition rate and a good authentic nature when pressed. Parvathy *et al*. (2014) have stated that the increased dimension in the swollen form of the hydrogel has resulted in an increased porosity of the soil and increased availability of oxygen to the roots which was confirmed by having higher root dry weight in the T3 compared to T2 and T4. According to Khayyat *et al*. (2007) reduced porosity in a medium is a factor which may restrict root formation.

Table 5: Effect of different potting mixtures on root dry weight of coconut seedlings

Treatments	2 MAP	4 MAP
T_1	14.72 ± 0.87^a	60.10 ± 0.36^a
T_2	8.77 ± 0.01^a	27.36 ± 0.75^c
T_3	11.82 ± 0.47^a	43.68 ± 0.66^b
T_4	13.42 ± 1.10^a	43.46 ± 1.33^b
F test	ns	*
CV	22.443	12.531

MAP = Months after planting
F test: *:= Significant at 5% level of probability, ns: = not significant
Mean values in a column having the dissimilar letter/letters indicate significant difference at 5% level of significant (DMRT).

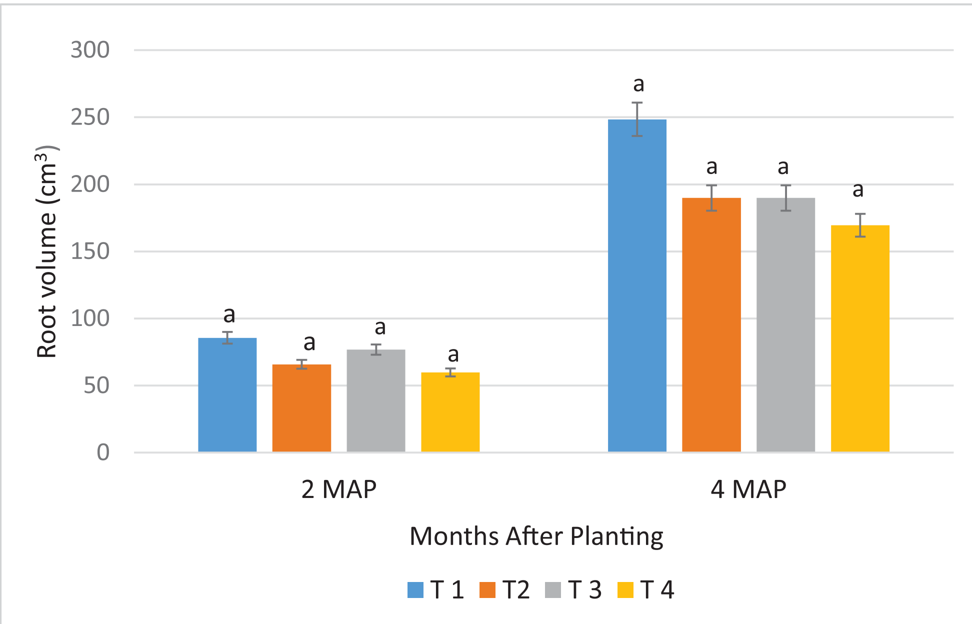


WAP= Weeks after planting
Mean values in a column having the dissimilar letter/letters indicate significant difference a t 5% level of significant.

Figure 3: Effect of different potting mixtures on coconut seedling girth

There is no significant difference ($P>0.05$) in girth of seedlings among the treatments during the experimental period. The results have indicated that the coir dust and moisture absorbent were similar in action for the growth of the seedling girth. A similar trend can be found in the study of improvement of seedling quality in polybags through manipulation of potting media, which was carried out by Perera *et al*. (1997) for coconut seedlings. They have indicated that, seedling girth was not significantly different ($P>0.05$) in the potting media which consisted of river sand, organic manure and coir dust at a ratio of 3:2:1 and in the potting media which consisted river sand, organic manure and coir dust at a ratio of 1:2:3 ratio at 8 months and the said difference was maintained up to 10 months (10 MAP). According to a study of the suitability of optional material as a replacement for coir dust in raising coconut seedlings in polybags by Perera *et al*. (1997) revealed no significant difference ($P>0.05$) between the girth at collar in coconut seedling in different potting media.

Volume of roots



MAP= Months after planting
Mean values in a column having the dissimilar letter/letters indicate significant difference at 5% level of significant (DMRT).

Figure 4: Effect of different potting mixtures on root volume of coconut seedlings

Significant difference ($P>0.05$) was not observed among the treatments on root volume throughout the experimental period. According to the results, the effect of coir dust and moisture absorbent were similar on the growth of the root volume. However, opposite results have also been reported. For example, Abd-El Hamied, (2014), who recorded that, a media consisted with goat manure and sandy soil at a ratio of 1:2 on the volume basis, produced the highest offshoots roots length in first and second season. These results are in paralleled with Al-Mana *et al*. (1996) who indicated that the highest rooting percentages are affected by the constituents of the planting media. El- Kosary *et al*. (2008) stated that the planting media affects significantly on root length, root diameter and roots number of Zaghloul date palm cultivar in the nursery. The increase of roots system volume could be due to the application of organic matter in the soil (Zydlik and Zydlik, 2008).

Moisture content of the potting media

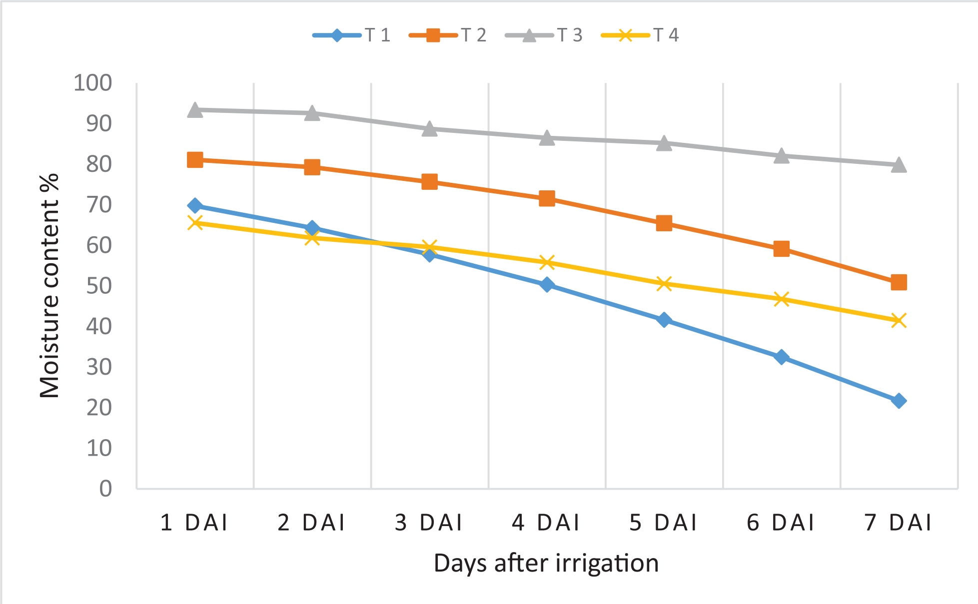
The result indicated that the moisture content is significantly highest in the potting medium received moisture absorbent compound (T_3) than the application of coir dust at 5% significant level. These findings are in agreement with the findings of Parvathy *et al*. (2014) who showed the amount of moisture retained in the soil has been increased with the increasing concentration of Super Absorbent Polymer (SAP) in the soil. The increased moisture retention ability of the hydrogel amended soil may be due to the fact that these hydrogels released the absorbed water slowly to the surroundings which resulted in an optimum moisture content of the soil. However, in the study by Parvathy *et al*. (2014) found that 0.5% of the starch based hydrogel gave maximum soil moisture retention.

Treatment 2 had higher moisture retention capacity when compared to the T_4. This result was strengthened by Thennakoon *et al*. (2013) that the organic manure treated solid showed an increase in soil moisture compared with the control. This might be due to soil aggregation. The lowest moisture retention was recorded in T_1 (21.71%).

Figure 5 shows the changes in moisture retention during a period of a week. It is noticeable that the reducing rate of moisture retention was decreased in the soils treated with the moisture absorbent compound. The reasons for these trends have been explained by Huttermann *et al.* (2009) who stated that the structure of most SAPs resembles that of humus in the soil. SAPs have the capacity to release the absorbed water depending on the moisture equilibrium change of the soil or on the requirement of plant roots. Hence, SAPs can release the absorbed water slowly to the surrounding medium.

Water retention capacity of potting media

The results revealed that there is a significant influence (P<0.05) of ingredients on the capacity of water retention potting media's at field capacity level.



DAI= Days after irrigation

Figure 5: Changes in moisture content of soil with time

Table 6: Effect of different ingredients on water retention capacity of potting media at field capacity level

Treatments	Water retention capacity (ml)
T_1	830 ± 2.0^d
T_2	1143 ± 1.0^c
T_3	1618 ± 4.0^a
T_4	1458 ± 2.0^b
F test	*
CV	7.126

F test: *:= Significant at 5% level of probability, ns: = not significant
Mean values in a column having the dissimilar letter/letters indicate significant difference at 5% level of significant (DMRT).

According to the results shown in the Table 6, the water retention capacity is significantly higher in the soil treated with moisture absorbent compound. Even though the T_2 was amended by the moisture absorbent compound, the water retention capacity of the T_2 was lower than the T_4. This may be due to the fact that low amount of moisture absorbent that has been incorporate into the soil in T_2 and high amount of coir dust (50%) that has been applied into the soil in T_4. The amount of moisture absorbent and the coir dust in the medium have a positive interrelationship with water retention capacity of medium. The water retention capacity decreases with decreasing amount of coir dust in the medium and the T_1 has a lower water retention capacity than the other treatments. Similar results were observed by Priyadarshani *et al*. (2013) who has pointed the fact that water holding capacity is increased with increasing the proportion of coir dust.

CONCLUSION

The present study addressed several aspects of different potting mixtures on soil moisture characteristics and growth of the coconut seedlings. In this study, moisture absorbent hydro polymer (soil amendment) was introduced, which is commercially known as Zeba. The moisture absorbent compound tested during this study is based on natural corn starch. The importance of using natural polymer based moisture absorbents is due to their biodegradability, non-toxicity of the base component and their sustainability. Application of different potting mixtures had significant effects on tested growth parameters of coconut seedlings. The T_1 potting mixture which was consisted with top soil: organic manure: coir dust in 1: 1: 1 ratio has increased plant height, number of fully opened leaves, leaf area, dry shoot weight and dry root weight. In the same manner, T_3 potting mixture which was consisted with top soil and 120 g of moisture absorbent has caused considerable increase in plant height, number of fully opened leaves, leaf area, dry shoot weight, dry root weight of coconut seedlings, moisture content and water retention capacity of soil. Plant growth rate was highest in T_1 (4.546) followed by T_3 (3.4378). There was no significant difference found in seedling girth and root volume among treatments. Results also indicate that there was a significant difference among treatments in number of fully opened leaves at 10th weeks after planting. Similarly, results confirmed that there is a significant difference among the tested treatments ($P<0.05$) in relation to number of fully opened leaves at 14th weeks after planting.

Incorporation of different potting ingredients had no significant effect on coconut seedling growth at first four weeks. This may be due to the availability of enough nutrients in the soil at initial stage. The treatment 1 had a pronounced effect on average seedling height and dry root weight. Average leaf area of T_1 and T_3 did not have a significant difference. Median number of fully opened leaves was not significantly different in T_1, T_3 and T_4 and so was the average dry shoot weight T_3 has been able to maintain the highest moisture content as well as the highest water retention capacity. According to the above given results it can be concluded that T_3 potting mixture which consisted with top soil and 120g of moisture absorbent has increased the seedling growth, moisture content and water retention capacity in the growth media. Therefore, this potting mixture can be used in profitable coconut seedling production programmes.

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