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Effect of Rooting Media, Cutting Types and Watering Frequency on Root Parameters of Long Pepper *(Piper cappense)* at Jimma

Gebreslassie Hailu*

Ethiopian Institute of Agricultural Research; Jimma Agricultural Research Center, PO Box 192, Jimma, Ethiopia

**Corresponding author*

Abstract

Long pepper cuttings are traditionally planted in a trench & covered with plastic sheet to get large number of transplantable seedlings. But the success of the transplant is often low hence; it is common to retain cuttings for more than a year to synchronize their stage of transplanting with start of main rainy season. The present study was conducted at Jimma Agricultural Research center (JARC) to investigate the influence of rooting media, cutting types and Watering Frequency on Nursery performance of Long pepper cuttings to identify best alternatives for production of adequate planting material. Four types of media, composed of sub soil(Ss), top soil(Ts), farm yard manure(FYM) and fine sand with the following proportion, 2Top soil + 1Farm yard manure + 2Fine sand recommended for coffee Cutting, 6Top soil + 3Farm yard manure + 2Fine sand recommended for coffee Nursery, 1/3rd SS upper + 2Top soil + 1Farm yard manure + 1Fine sand recommended for Tea media and 2Top soil + 1Farm yard manure + 1Fine sand recommended for coffee nursery, three level of cutting type soft wood (SW), semi hard wood(SHW) and hard wood (HW) and four level of watering frequency were combined in split plot design with three replications, where four watering frequency levels were assigned to main plots, four media type levels were assigned to sub plot and three types of cutting (soft wood, semi hard wood and hard wood) levels were assigned to sub- sub plot were combined with factorial arrangement (4 x 4 x 3) with 48 treatments. Data was collected for root parameters after six months of planting. The highest average fresh root weight (30g) was recorded for watering frequency every three weeks, hard wood cutting grown in rooting media 1/3 top SS and 2TS:1FYM:1FS. The largest number of roots per cutting (13) was produced by watering interval every week with soft wood cutting type. On the other hand under the interaction of media and cutting type the largest number of root per cutting (13) was produced by same cutting type and grown in (6TS: 3FYM:2FS) media proportion. In general, the observed differences among the main effects soft wood could be due to its succulent part the accumulation of growth hormone in the succulent part of the wood.

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Keywords

Cutting, soft wood, semi hard wood, hard wood, root and watering.

Introduction

Long pepper derived from two species of piper (piper *officinarum* Decandolle (more)(*chavica officinarum, Miqual*) producing the java long pepper, and piper longum, Linne (more) (*chavaica Roxburghii, Miquel*) producing the India long pepper. The long peppar of India and Indonesia comes from slender climber that has sparser looking foliage than piper *nigram*. The most

noticeable difference between the two is that the fruit of Indian long pepper (*P. longum*) are smaller and less pungent than those java long peppers (*Piper retrofractum*). The commercial part of Long pepper is widely used by every Ethiopian in the preparation of 'Wot' and also serves as ingredient for other spice ingredients. In Ethiopia This spice is both the exotic species (by introducing the dried spike) and the locally produced long pepper spikes, apart from pepper (p. *nigrum L*.) are being utilized for seasoning and provide oil which to a certain extent is used as an aromatic in the drinks industry and for medicine. In Ethiopia, field surveys have shown both the utilized and the wild species of long paper found growing under story the natural forest area of Ethiopia. The plant can be propagated using either by cutting or by seed.

The first alternative, i.e., using cutting is preferably recommended. This type of propagation method as observed from other plant species helps to shorten the period from planting to the start of productive years. Cutting can be planted directly to the field. Relatively younger cutting (clumps) is suitable for propagation. When the regular rain season starts and the soil gets reliable moisture, cutting (clumps) with two stems each can be planted in a well prepared pit at least (20 x 20 cm) depth and width.

The crop is a short shrub that can be disturbed if appropriate cultural practices are not applied. The field where long pepper should be planted during the rainy seasons since much undergrowth is expected. When the dry season commence mulching and sometimes watering advisable.

This spice is growing under the shade of natural forest and sometimes when the shade become very dense and this time it needs to remove some of the branches to let in light inside for effective flowering, pollination, fruiting, and maturity. Long pepper grows under natural forest but from experience, this plant has the tendency to moves towards the open areas or margin of the forest or shade of the forest. According to Gordon (1992), an ideal rooting medium provides sufficient porosity to allow good aeration and has a high water holding capacity, yet is well- drained, and free from pathogens.

Propagation media used in horticulture and forestry consists of a mixture of organic and in organic components, which have different but complementary properties (Hartmann *et al.,* 1997). Roots in waterlogged soils have no root hairs and are swollen and abnormal in appearance (CHB, 1987).The rate and direction of root growth are determined, principally, by water gradient. Roots grow from areas of low water concentration where they have low survival rate, to areas of greater water concentration, where they have a higher survival rate (CHB, 1987). In coffee nurseries, optimum soil water levels and a medium to low soil bulk density are necessary to enhance healthy root and shoot growth (Pawl and Lee, 1976). Long pepper cuttings are traditionally planted in a trench & covered with plastic sheet to get large number of transplantable seedlings.

But the success of the transplant is often low. Hence; it is common to retain cuttings for more than a year to synchronize the transplanting time with the beginning of the rainy season. This requires extra costs for nursery operation & maintenance. This can be alleviated by identifying the best growing media, suitable type of cutting type & identifying appropriate watering frequency.

However, no research work has been carried out on cutting propagation of long pepper and hence, much of the information on nursery practices and improved long pepper propagation technologies is lacking in the growing area of Ethiopia. Therefore, this study is designed to address the above mentioned gaps with the following objectives indicated below.

Materials and Methods

Description of the Study Area

The study was conducted at Jimma Agricultural Research Center (JARC) located 365 km South West of Addis Ababa, and 12 km away from Jimma town. The Nursery site is located at $7^0$40' N latitude and $36^0$47'E longitudes with an altitude of 1753 meters above sea level. It is situated in the tepid to cool humid-mid highlands of south-western Ethiopia. The long-term (ten years) mean annual rainfall of the area is 1639 mm with a maximum and minimum air temperature 26.6 ^{o}C

and 13.9° C respectively. According to JARC 2010 meteorology data the relative humidity of the area ranges from 35 to 95 percent.

Experimental Treatments

The experimental materials used in this study include, rooting media composed of top soil, sub soil, farm yard manure, Fine sand, stem cutting obtained long pepper accession among from the 1979 collection batch and Watering frequency.

Rooting media proportions (types)

The basic media used for the preparation of the potting mixes were top soil, sub-soil, Farm yard manure and fine river sand.

Top soil was collected from the upper 25 cm layer of uncultivated land and the sub soil next to the layer of the top soil at about 30-35 cm depth was also collected from the same area. Well decomposed animal dung were collected from dairy farming privet enterprise around Jimma town, these materials were sun dried, crushed and also sieved through mesh before mixing with other media categories. Finally, a total of four rooting media types with the following proportion (v/v) were prepare.

Rooting media (1-4 types)

M1 = Top soil + Farm yard manure + Fine sand at 2:1:2 ratios recommended for coffee Cutting

M2 = Top Soil + Farm yard manure + Fine Sand at 6:3:2 ratios recommended for coffee Nursery

M3 = 1/3 sub soil upper +Top Soil +Farm yard manure + Fine Sand at 2:1:1 ratio Tea media

M4 = Top Soil + Farm yard manure + Fine Sand at 2:1:1 ratios recommended for coffee Nursery

Preparation of cutting types

Long pepper already established in the clone garden of Tepi Agricultural Research Center vertically grow orthotropic shoots was used as a source of stem cutting, uniform and healthy cuttings with 2-4 nodes were harvested early in the morning when the shoot and the leaves are turgid From the soft wood (upper part of the shoot), semi hard wood (middle part of the shoot) and hard wood (nearer to the main stem) were taken using sharp and clean pruning shear cleaned with alcohol. The cuttings were placed immediately in the plastic bug to prevent dehydration and then transported to the actual propagation site where the whole operation is carried out under shaded condition to provide protection against sun light. Double node cutting of soft wood, semi hard wood and hard wood cutting were prepared by cutting the shoot just above each node and the woody and young parts from the lower and upper ends of the shoot, respectively. The leaves on both types of cutting were trimmed all in all to reduce the rate of transpiration. Slant cut at the base of each cutting were made before setting them in the rooting media. To maintain internal turgidity, all the cuttings were kept in a plastic bug. Finally, they were inserted to a depth of 3-4 cm into the potted media in February 2012 and watered up to field capacity. The polythene sheet was then buried along the edges of the bed to provide humidified environment for the cuttings.

Watering frequency

The quantity of water applied to a plot at a time (per irrigation) was Equivalent to the amount required to replenish or maintain the moisture content of the growth medium at field capacity. Entrance of water into adjacent plots upon irrigating a plot was controlled by carful application using fine-holed standard watering can. Water from external sources, particularly rain fall was prevented by white transparent plastic film spread over wooden poles and string to cover the whole main plot, the plastic film was closed all the time except during watering hours of the day.

Propagator Structure

Eucalyptus wood, elephant grass and 30 micron thick white plastic sheet was used to contract the propagator. Raised nursery beds with 1.2m width x 10m length were prepared to arrange the treatments. Then, simple and inexpensive non-mist propagator was made from wooden frame (eucalyptus tree post). The frame was covered with 30 micron thick white translucent plastic sheet.

Artificial shade supported with wooden poles were made at a height of 2 meter above the ground level and covered with elephant grass to provide approximately 70 to 75% shade (Behailu *et al.*, 2006), and both sides of the propagator was also protected with the elephant grass to avoid direct sunlight.

Experimental Design and Treatment Layout/Arrangement

The Experiment was conducted in the nursery at melko (JARC) using stem cutting of long pepper in split plot design with three replications, where Four watering frequency levels were assigned to main plots, four media type levels were assigned to sub plot and three types of cutting (Soft wood, semi hard wood and hard wood) levels were assigned to sub- sub plot were combined with factorial arrangement (4 x 4 x 3) with 48 treatments (Table 1).

Each treatment contains 12 cuttings and a total of 1728 cuttings were used for the experiment. The cutting were inserted directly in the media filled in 16 cm wide and 25 cm long black polyethylene bags and randomly assigned in the propagator with in main plot with two rows and 10 cm spacing between treatments.

After Planting Care

To maintain the required level of moisture, temperature and relative humidity, water application manually using 10 liter capacity plastic watering cane was done depending upon the time of watering Frequency (every Week, every Two Weeks, every Three Weeks and every Month) was carried out accordingly by opening and closing back the polyethylene sheet.

A daily minimum and maximum temperature inside the propagator was recorded using thermometer and the range was 22-23^{0}C, 20-21^{0}C, 21-22^{0}C and 29^{0}C under watering interval every week, every two weeks, every three weeks and every Month respectively. The relative humidity (RH) inside the propagator was also recorded daily and the average was 66-70 percent, 80-81 percent, 81-83 percent and 87 percent watering interval every week, every two weeks, every three weeks and every four weeks respectively.

Data Collection

Destructive data were collected 185 days after planting. Rooting percent was determined based on all survived cuttings per plot and the average was taken.

Five selected sample cutting from each plot were considered and separated in to root and shoot part and evaluated for the different parameters. The parameters measured and the methods used each are presented as follows.

Soil Analysis

Prior to the nursery experiment, the soil was sampled from each rooting media and prepared before planting the cuttings and analyzed for the physical and chemical properties.

The analysis was determined in the laboratory using the procedure outlined by Sahlemedhin and Taye (2000). The analysis was carried out at JARC soil laboratory (Appendix Table 1).

Physical Properties (before planting)

Texture

Media texture was determined by the modified Bouyucous Hydrometer method

BULK density (g/ml)

Mass of dried media (g)/volume of dried media (ml) was Calculate and taken for analysis.

Water holding capacity(%)

It was calculated using the following formula

$$WHC = \frac{\text{weight water in the saturated media(g) X 100}}{\text{Weight of saturated media(g)}}$$

Chemical properties

P^H

The P^H of the rooting media was determined by meters, from a 1:2.5 soil-water suspension.

Organic carbon (%)

organic carbon content of the soil was determined by the wet combustion procedure of Walkley and Black method (1934).

Total nitrogen (%)

Total nitrogen content of the rooting media was determined by wet-oxidation procedure using modified kjeldahl method.

Available phosphorus(ppm)

The available phosphorus content of the rooting media was determined by 0.5M sodium bicarbonate extraction solution (PH 8.5) method of Olsen(1954)

Available potassium (ppm)

The available potassium content of the rooting media was determined by using atomic absorption or flame photometer.

Root parameters

Root Number

The newly growing roots were counted for five randomly selected sample roots per plot and the average was taken.

Root length (cm)

The length of the longest root for the sample cutting was measured from the point of emergence to the tip by using a ruler and the average was taken.

Root fresh weight (g)

Newly growing sample roots were carefully detached from the point of attachment to the cutting and thoroughly washed to remove the soil. Then, weight was measured using sensitive balance.

Root dry weight (g)

After drying the root in an oven drier (at a temperature of 100 ^{o} C to constant weight) weight was measured using a sensitive balance and the average was calculated for each treatment.

Root volume (ml)

Root volume was measured after 185 days by water displacement method using graduated cylinder half with filled with water. The volume of water displaced due to the immersion of each sample was calculated and the average was taken as root volume.

Root to shoot dry weight ratio

Root to shoot dry weight ratio was determined by dividing dry weight of root to shoot of each sample cuttings and the average was calculated for each treatment.

Data analysis

Data collected for various root and shoot parameters were checked for meeting the assumption for ANOVA.

Except for percentage of sprouted cuttings the results are presented for discussion per plant basis. The percentage data (percentage of sprouting) was transformed using the Arc sign transformation method before analysis.

Data were analyzed using SAS software (SAS, 2008). Mean comparison were perform using the Duncan's Multiple Range Test (DMRT) method. A significant level of 5% was used for all statistical analysis.

Linear statistical model for split-split-plot design

$$y_{ijkh} = \mu + A_i + \beta_j + d_{ij} + B_k + (AB)_{ik} + f_{ijk} + C_h + (AC)_{ih} + (BC)_{kh} + (ABC)_{ikh} + \varepsilon_{ijkh}$$

Where

$y_{ijkh=}$ *The response measurement for the ijkhth* observations

μ = the experiment mean

A_i = the main plot treatment effect

β_j = the block effect

dij = the main plot error (error a)

B_k = the subplot treatment effect

$(AB)_{ik}$ = the treatment interaction effect

Fijk = the subplot error (error b)

C_h = the sub subplot treatment effect

$(AC)_{ih}$ = the treatment interaction effect

$(BC)_{kh}$ = the treatment interaction effect

$(ABC)_{ikh}$= the treatment interaction effect

ε_{ijkh} = the sub subplot error (error c)

i, k, h = a particular treatment

j = a particular block

Results and Discussion

Root growth parameters

The analysis of variance for most of the root growth parameters revealed the presence of highly significant differences for main factor, two-way interaction and three-way interaction (Appendix Table 2-5). The results therefore, are discussed in detail below.

Root fresh weight (g)

In this study, root fresh weight of long pepper stem cutting was significantly influenced by watering frequency, rooting media and cutting types. The interaction between rooting media and cutting type and three way interaction of watering frequency, rooting media and cutting type showed significant($P<0.05$) difference. However, the main effect of watering frequency, rooting media, cutting type and the interaction effect of watering frequency with rooting media and rooting media with cutting did not show significant differences for root fresh weight of stem cutting of long pepper (appendix Table 2).

Significant ($P \leq 0.05$) differences among treatments were observed for root fresh weight of stem cutting (Table 2).The highest root fresh weight (30g) was recorded for watering frequency every three weeks, hard wood cutting type grown in media composed of 1/3rd SS top + 2TS:1FYM :1FS. However, this value were statistically similar with the root fresh weight (27g) obtained for the same watering frequency and rooting media, soft wood cutting type also for watering frequency every two weeks, soft wood cutting type grown in rooting media composition of 2TS:1FYM :1FS.

The lowest root fresh weight (6g, and 7g), on the other hand, was observed for watering frequency every week, hard wood cutting type grown in rooting media composition 2TS:1FYM:2FS, watering frequency every four weeks, semi hard wood cutting grown in rooting media composition 6TS:3FYM:2FS and the same watering frequency, soft wood cutting grown in rooting composition 2TS: 1FYM:2FS respectively.

Root number

The analysis of variance has showed very highly significant ($P< 0.001$) difference among main effect of watering frequency, rooting media and cutting type, the interaction between watering frequency and rooting media, watering frequency and cutting type and three way interaction of watering frequency, rooting media and cutting type for average number of roots per cutting (appendix Table 3).

The largest number of root per cutting (18) was recorded under watering frequency every week, soft wood cutting grown in rooting media composition of 6TS:3FYM :2FS (Table 2a and Table 2b). The least root number (6) was observed for watering frequency every four weeks, all cutting types grown in rooting media composition of 2TS:1FYM :1FS (Table 2). In general, watering frequency every week, soft wood cutting type grown in media composition of 6TS:3FYM :2FS produce higher number of roots per cutting.

This could be duo to the suitability of the media in supplying essential nutrients and micro climates around the root zone which might have favored good rooting.

Root Length (g)

Analysis of variance for root length was recorded significance ($P \leq 0.05$) difference for watering

frequency and rooting media, watering frequency and cutting type interaction. However, non-significant(P>0.05) difference for watering frequency, rooting media and cutting types interaction.

Table.1 Details of Treatment Combination with in main plot

Treatment No	Watering Frequency	Media	Cutting types
1.	Every week	TS : FYM : FS (2:1:2)	SW
2.	Every week	TS : FYM : FS (2:1:2)	SHW
3.	Every week	TS : FYM : FS (2:1:2)	HW
4.	Every week	TS: FYM : FS (6:3:2)	SW
5.	Every week	TS: FYM : FS (6:3:2)	SHW
6.	Every week	TS: FYM : FS (6:3:2)	HW
7.	Every week	1/3 SS+TS: FYM : FS (2:1:1)	SW
8.	Every week	1/3 SS+TS: FYM : FS (2:1:1	SHW
9.	Every week	1/3 SS+TS: FYM : FS (2:1:1	HW
10.	Every week	TS : FYM : FS (2:1:2)	SW
11.	Every week	TS : FYM : FS (2:1:2)	SHW
12.	Every week	TS : FYM : FS (2:1:2)	HW

Media; TS= top soil, FYM= farm yard manure, FS= fine sand. Cutting type; SW=soft wood, SHW=semi hard wood, HW=hard wood

Table.2 Interaction effect of watering frequency, rooting media and cutting types on various root parameters of long pepper accessions

Watering Frequency	Rooting media	Cutting type	RFW(g)	RN	RV(ml)
Every week	2TS:1FYM:2FS	SW	21 a-k	13 bc	42 bcd
Every week	2TS:1FYM:2FS	SHW	19 b-k	9 h-m	21 s-v
Every week	2TS:1FYM:2FS	HW	6 lm	8 k-p	32 g-m
Every week	6TS:3FYM:2FS	SW	23 a-i	18 a	32 i-n
Every week	6TS:3FYM:2FS	SHW	14 f-m	13 bc	32 i-n
Every week	6TS:3FYM:2FS	HW	16 b-m	9 h-m	37 d-h
Every week	1/3 SS+2TS:1FYM:1FS	SW	23 a-i	11 d-h	20 s-v
Every week	1/3 SS+2TS:1FYM:1FS	SHW	14 f-m	10 f-k	25 p-u
Every week	1/3 SS+2TS:1FYM:1FS	HW	16 b-m	9 h-m	35 f-j
Every week	2TS:1FYM:1FS	SW	23 a-i	10 f-k	42 bcd
Every week	2TS:1FYM:1FS	SHW	21 a-k	9 h-m	35 e-l
Every week	2TS:1FYM:1FS	HW	24 a-g	11 d-h	26 o-r
Every two week	2TS:1FYM:2FS	SW	17 b-l	10 f-k	20 tuv
Every two week	2TS:1FYM:2FS	SHW	17 b-l	9 h-m	24 p-u
Every two week	2TS:1FYM:2FS	HW	26 a-d	8 k-p	18 v
Every two week	6TS:3FYM:2FS	SW	22 a-i	15 b	32 i-n
Every two week	6TS:3FYM:2FS	SHW	15 d-m	10 f-k	37 d-i
Every two week	6TS:3FYM:2FS	HW	26 a-d	10 f-k	56 a
Every two week	1/3 SS+2TS:1FYM:1FS	SW	13 h-m	8 k-p	29 m-q
Every two week	1/3 SS+2TS:1FYM:1FS	SHW	16 c-m	12 cde	29 m-q
Every two week	1/3	HW	14 e-m	13 bc	32 h-n

	SS+2TS:1FYM:1FS				
Every two week	2TS:1FYM:1FS	SW	27 ab	11 d-h	23 r-u
Every two week	2TS:1FYM:1FS	SHW	18 b-k	10 f-k	33 g-m
Every two week	2TS:1FYM:1FS	HW	13 g-m	7 m-p	34 f-k
Every three week	2TS:1FYM:2FS	SW	21 a-k	11 d-h	41 cde
Every three week	2TS:1FYM:2FS	SHW	21 a-k	10 f-k	30 j-o
Every three week	2TS:1FYM:2FS	HW	15 d-m	8 k-p	24 p-u
Every three week	6TS:3FYM:2FS	SW	22 a-i	9 h-m	29 m-q
Every three week	6TS:3FYM:2FS	SHW	16 b-m	8 k-p	25 o-s
Every three week	6TS:3FYM:2FS	HW	23 a-i	12 cde	29 k-p
Every three week	1/3	SW	24 a-g		24 q-u
	SS+2TS:1FYM:1FS			11 d-h	
Every three week	1/3	SHW	27 abc		34 f-k
	SS+2TS:1FYM:1FS			9 h-m	
Every three week	1/3	HW	30 a		29 l-q
	SS+2TS:1FYM:1FS			11 d-h	
Every three week	2TS:1FYM:1FS	SW	16 c-m	7 m-p	41 cd
Every three week	2TS:1FYM:1FS	SHW	25 a-e	10 f-k	33 g-m
Every three week	2TS:1FYM:1FS	HW	12 ijklm	10 f-k	44 bc
Every Four Weeks	2TS:1FYM:2FS	SW	7 lm	8 k-p	32 i-n
Every Four Weeks	2TS:1FYM:2FS	SHW	22 a-i	11 d-h	28 m-q
Every Four Weeks	2TS:1FYM:2FS	HW	16 c-m	7 m-p	20 uv
Every Four Weeks	6TS:3FYM:2FS	SW	20 a-k	10 f-k	38 def
Every Four Weeks	6TS:3FYM:2FS	SHW	6 lm	7 m-p	28 m-r
Every Four Weeks	6TS:3FYM:2FS	HW	14 e-m	8 k-p	37 d-g
Every Four Weeks	1/3	SW	18 b-k		34 f-l
	SS+2TS:1FYM:1FS			9 h-m	
Every Four Weeks	1/3	SHW	25 a-f		34 f-k
	SS+2TS:1FYM:1FS			10 f-k	
Every Four Weeks	1/3	HW	13 g-m		47 b
	SS+2TS:1FYM:1FS			8 k-p	
Every Four Weeks	2TS:1FYM:1FS	SW	11 j-m	6 p	33 g-m
Every Four Weeks	2TS:1FYM:1FS	SHW	10 klm	8 k-p	27 n-r
Every Four Weeks	2TS:1FYM:1FS	HW	14 e-m	6 p	25 o-t
C.V %			16.81	13.72	6.18
LSD 0.05% level			14.39	2.14	3.38

RFW (g)=Root fresh weight (g), RN =root Number, RL= root length , RV=root volume

Appendix Table.1 physical and chemical properties of deferent rooting media used in the present study

Rooting media	Chemical properties						Physical properties
	$P^{H\ water(1:2.5)}$	P (ppm)	% OC	% OM	% N	Available K(Meq k/100	Bulk density(g/cm^3)
TS : FYM : FS (2:1:2)	5.8	90.31	4.10	7.06	0.27	2.69	1.48
TS : FYM : FS (6:3:2)	5.67	153.95	5.29	9.12	0.41	3.32	1.44
TS : FYM : FS (2:1:1)	5.6	153.95	5.06	8.73	0.33	3.32	1.49
FYM	6.44	441.62	23.96	41.30	0.52	11.64	1.54
Top soil(TS)	5.2	3.11	3.93	6.77	0.25	1.41	1.36
Sub soil(SS)	5.3	13.06	2.68	4.62	0.21	1.53	1.33
Fine Sand(FS)	5.74	15.43	0.75	1.30	0.02	0.56	1.64

OC=organic carbon, OM=organic matter, P=Phosphorus, N=nitrogen, K=Potassium

Appendix Table.2 Analysis of Variance for Fresh root weight per cutting of long pepper

Source	DF	Sum of Squares	Mean Square	F-Ratio	p-Value	Significant
Rep	2	0.1970	0.0985	0.7493	0.5123	NS
WF	3	0.8892	0.2964	2.2542	0.1825	NS
Error(a)	6	0.7889	0.1315	.	.	
MEDIA	3	0.1858	0.0619	1.1273	0.3578	NS
WF*MEDIA	9	0.5177	0.0575	1.0471	0.4338	NS
Error(b)	24	1.3183	0.0549	.	.	
CUTTING	2	0.0344	0.0172	0.4040	0.6693	NS
WF*CUTTING	6	0.2752	0.0459	1.0777	0.3852	NS
MEDIA*CUTTING	6	0.6514	0.1086	2.5507	0.0281	*
WF*MEDIA*CUTTING	18	1.5570	0.0865	2.0321	0.0201	*
Error(c)	64	2.7242	0.0426	.	.	
Total	143	9.1393	.	.	.	

* - Significant at 5% (level of significance opted by user), NS - Non Significant
p-Value < 0.05 - Significant at 5%, p-Value < 0.01 - Significant at 1%

Appendix Table.3 Analysis of Variance for root number per cutting of long pepper

Source	DF	Sum of Squares	Mean Square	F-Ratio	p-Value	Significant
rep	2	5.0139	2.5069	2.6873	0.1468	NS
WF	3	159.1319	53.0440	56.8610	<.0001	*
Error(a)	6	5.5972	0.9329	.	.	
MEDIA	3	73.0764	24.3588	13.6132	<.0001	*
WF*MEDIA	9	64.2292	7.1366	3.9884	0.0032	*
Error(b)	24	42.9444	1.7894	.	.	
CUTTING	2	46.2639	23.1319	13.0117	<.0001	*
WF*CUTTING	6	79.1806	13.1968	7.4232	<.0001	*
MEDIA*CUTTING	6	92.0694	15.3449	8.6315	<.0001	*
WF*MEDIA*CUTTING	18	172.0417	9.5579	5.3763	<.0001	*
Error(c)	64	113.7778	1.7778	.	.	
Total	143	853.3264	.	.	.	

* - Significant at 5% (level of significance opted by user), NS - Non Significant
p-Value < 0.05 - Significant at 5%, p-Value < 0.01 - Significant at 1%

Appendix Table.4 Analysis of Variance for root length per cutting of long pepper

Source	DF	Sum of Squares	Mean Square	F-Ratio	p-Value	Significant
rep	2	1543.9652	771.9826	1.9769	0.2190	NS
WF	3	1615.3372	538.4457	1.3789	0.3366	NS
Error(a)	6	2343.0148	390.5025	.	.	
MEDIA	3	125.7699	41.9233	0.7684	0.5230	NS
WF*MEDIA	9	1396.4221	155.1580	2.8439	0.0197	*
Error(b)	24	1309.3981	54.5583	.	.	
CUTTING	2	31.5155	15.7578	0.5350	0.5883	NS
WF*CUTTING	6	459.3175	76.5529	2.5989	0.0257	*
MEDIA*CUTTING	6	291.4829	48.5805	1.6493	0.1482	NS
WF*MEDIA*CUTTING	18	904.4829	50.2491	1.7059	0.0614	NS
Error(c)	64	1885.1736	29.4558	.	.	
Total	143	11905.8798	.	.	.	

* - Significant at 5% (level of significance opted by user), NS - Non Significant
p-Value < 0.05 - Significant at 5%, p-Value < 0.01 - Significant at 1%

Appendix Table.5 Analysis of Variance for root volume of long pepper

Source	DF	Sum of Squares	Mean Square	F-Ratio	p-Value	Significant
rep	2	26.3472	13.1736	1.9658	0.2205	NS
WF	3	45.3542	15.1181	2.2560	0.1822	NS
Error(a)	6	40.2083	6.7014	.	.	
MEDIA	3	823.7431	274.5810	59.8481	<.0001	*
WF*MEDIA	9	2767.0625	307.4514	67.0126	<.0001	*
Error(b)	24	110.1111	4.5880	.	.	
CUTTING	2	217.3889	108.6944	28.8250	<.0001	*
WF*CUTTING	6	570.8333	95.1389	25.2302	<.0001	*
MEDIA*CUTTING	6	1494.9444	249.1574	66.0749	<.0001	*
WF*MEDIA*CUTTING	18	1837.5000	102.0833	27.0718	<.0001	*
Error(c)	64	241.3333	3.7708	.	.	
Total	143	8174.8264	.	.	.	

* - Significant at 5% (level of significance opted by user), NS - Non Significant
p-Value < 0.05 - Significant at 5%, p-Value < 0.01 - Significant at 1%

Fig.1 Propagator structure frame work

In addition the interaction effect of rooting media and cutting type and the main effect of watering frequency, rooting media and cutting types shows non-significant difference. ($p > 0.05$) difference (Appendix Table 4).

Root Volume (ml)

The analysis of variance has showed very highly significant ($P < 0.001$) difference among main effect of rooting media and cutting type, the interaction between watering frequency and rooting media, watering frequency and cutting type and three way interaction of watering frequency, rooting media and cutting type for root volume of roots per cutting (Appendix Table 5). However, main effect of watering frequency showed not significant ($P > 0.05$) difference for root volume of roots per cutting. The highest root volume (56 ml) was recorded under watering frequency every two weeks, hard wood cutting grown in rooting media composition of 6TS:3FYM :2FS (Table 2). The lowest value (18 ml) was observed for same watering frequency and cutting type grown in rooting media composition of 2TS:1FYM:2FS (Table 2). In general, watering frequency every two weeks, hard wood cutting type grown in media composition of 6TS:3FYM :2FS produce higher root volume per cutting, This could be duo to the suitability of the media in supplying essential nutrients and higher internal carbohydrate concentration in the hard wood cutting which could be attributed to higher number of roots.

The results of the present investigation suggested that the rooting of leafless hard wood cuttings of long pepper is related to all the factors studied: rooting media, cutting type and watering frequency of the stock plant at the time of taking cuttings. The other major factor affecting rooting of long pepper stem cuttings was the growth media type. The result of this study suggest that for the establishment of fever long pepper stem cuttings, both soft wood and semi hard wood cutting type can be used but composted is the ideal propagation medium. Therefore the results obtained from the present study shown that vegetative propagation of long pepper could be successfully attained by raising two node cuttings. In general, as far as rooting ability of long pepper and also the simplicity of media preparation locally availability of the materials is concerned, both types of cuttings showed encouraging rooting percentage when grows in media mixes of 6:3:2 and 10cm top SS 2:1:1. This indicates that the above media types could be used alternatively to propagate long pepper through rooting of stem cutting.

References

Gordon, I. 1992. A review of materials for propagation media. Combined Proceedings International Plant Propagators Society, 42: 85-90.

Hartmann, H.T., D.E. Kester, F.T. JR. Davies, and L.R. Geneve, 1997. Plant propagation: Principles and practices. 6th Edition. Prentice-Hall International Editions, Englewood Cliffs, New Jersey, USA.

CHB. 1987. Coffee Hand Book (CHB). Coffee Growers Association, Harare, Zimbabwe, Canon Press (Pvt) Ltd.

Pawel, J. L. and C. I. Lee. 1976. Relation between growth of chery san the mums and aeration of various container media. J. Hort. Soc. Sci. of America, 101:500-503.

Behailu Atero, Gibramu Temesgen and Bayetta Belachew. 2006. Effect of type of cutting and media mixture on rooting ability on Arabica coffee hybrid. In proceeding of the eleventh conference Crop Science Society of Ethiopia,pp135-138. Addis Ababa, Ethiopia.

Sahlemedhin Sertsu and Taye Bekele, 2000. Procrdures for soil and plant anlysis. National Soil Research Centre, Ethiopian Agricultural Research Organization, Addis Ababa, Ethiopia. 110p.

Olsen, S. R., Cole, C. V., Watanabe, F. S. & Dean. L. A. (1954). Estimation of available phosphorus in soils by extraction with NaHCO3, USDA Cir.939. U.S. Washington.

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