Influence of irrigation frequency and different combinations of the potting mixture on shoots and root growth of betel

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ABSTRACT

Betel is an export agriculture crop in Sri Lanka. In the traditional propagation method, orthotropic cuttings were taken from high yielding mother bushes. These healthy cutting can be planted directly in the field or planted in poly bags nurseries. A mixture of topsoil, cattle dung, coir dust and compost was used in equal portions. Usually, potting mixtures and irrigation frequencies are used unorganised by betel growers at a nursery in Sri Lanka. Therefore, this study was conducted using grower practices to determine the optimum level of irrigation frequency and to identify a lower cost potting mixture for obtaining the best quality nursery plants for planting. The research was conducted at Vairavapuliyankulam, Vavuniya district, during *Yala* season 2019. Orthotropic cuttings with three nodes were selected from a healthy and high yielding mother bush of Maneru variety, popular among betel varieties with high export quality. The experimental design was a Randomized Complete Block Design with twelve treatments and five replicates. Four types of the potting mixture were used with four different components at equal ratio (1:1:1:1), such as topsoil, sand, cattle dung, and coir dust for control (M1), topsoil, sand, cattle dung, paddy husk for (M2), topsoil, sand, cattle dung, and sawdust for (M3), topsoil, sand, compost and coir dust for (M4) were used. Irrigation was done on a daily basis (I1), at three-day intervals (I2) and at five-day intervals (I3). Data were collected at 3, 6 and 8 weeks after planting of cuttings in poly bags. The treatment combination of M1 and M4 with I1 was recorded for better growth performance compared to other treatments. At eight weeks after planting, treatment M1M1 was significantly showed the highest values (*p*-value) for shoot length (7.9 cm), fresh weight (102.7 mg), dry weights (15.4 mg), roots number (18 per plant), total root length (12 cm) dry weight (2 mg). This study revealed that coir dust used for the potting media could not be replaced by sawdust or paddy husk, but cattle dung can be replaced by using compost for the potting media. Daily irrigation gave better growth in the nursery plants compared to other irrigation intervals.

Keywords: Betel, Irrigation, Potting mixture, Nursery.

INTRODUCTION

Betel (*Piper betle* L.) is an export agriculture crop in Sri Lanka. The leaf is mainly used for chewing with Areca nut, slaked lime, tobacco ingredients. Betel grows as an intercrop and is widely grown all over Sri Lanka, usually propagated by using stem cuttings. The demand for betel and its products is getting increased year by year in the world market. In Sri Lanka, Betel is cultivated in an area of 1427 ha (Agstat, 2020) and mostly grown in low and mid-country wet and intermediate agro-climatic zones. In the traditional propagation method, healthy orthotropic branch cuttings were taken from high yielding mother vines and can directly be field planted or can be planted as rooted cuttings established in poly bags filled with a mixture of topsoil, cattle dung, coir dust and sand with the ratio 1:1:1:1 (DEA, 2017). The Sri Lankan growers are unorganized and not used to maintaining proper production practices (Herath, 2015). Growers use different potting mixtures and irrigation frequencies in betel propagation nurseries. In the traditional propagation method, three-node cuttings are planted in poly bags with a size of 10x15 cm, filled with a potting mixture (DEA, 2017). A propagator is used for easy rooting. The nursery period takes about ten weeks. A shoot of 35 cm in length is are sufficient for field planting. Generally, 50% of cuttings will be suitable for field planting due to poor cultural practices. Therefore, the study was conducted using grower practices to determine the optimum level of irrigation frequency and to identify a lower cost potting mixture for obtaining the best quality nursery plants for planting.

METHODOLOGY

The research was conducted at Vairavapuliyankulam, Vavuniya district, during Yala season of 2019. Using a sharp knife, three nodal cuttings were taken for the experiment from a healthy orthotropic branch from high yielding mother vines of a variety of Maneru. Before planting in pots, the cuttings were immersed in a fungicide mixture (copper sulphate and lime) for 2 minutes, and commercial rooting hormone (Rootone® 0.3% w/w Indole butyric acid) was used for root development of cuttings. The leaf located below the second node was removed, and the lower node of the cutting was buried in the pot contain fumigated a moist rooting medium

Table 1: Treatments and treatment combinations

Treatments		Combinations
T1	M1I1	Topsoil:sand:cattle dung:coir dust 1:1:1:1 with irrigation intervals of daily
T2	M1I2	Topsoil:sand:cattle dung: coir dust 1:1:1:1 with irrigation in three-day intervals
T3	M1I3	Topsoil:sand:cattle dung:coir dust 1:1:1:1 with irrigation in five-day intervals
T4	M2I1	Topsoil:sand:cattle dung:paddy husk 1:1:1:1 with irrigation intervals of daily
T5	M2I2	Topsoil:sand:cattle dung:paddy husk 1:1:1:1 with irrigation in three-day intervals
T6	M2I3	Topsoil:sand:cattle dung:paddy husk 1:1:1:1 with irrigation in five-day intervals
T7	M3I1	Topsoil:sand:cattle dung:sawdust 1:1:1:1 with irrigation intervals of daily
T8	M3I2	Topsoil:sand:cattle dung:sawdust 1:1:1:1 with irrigation in three-day intervals
T9	M3I3	Topsoil:sand:cattle dung:sawdust 1:1:1:1 with irrigation in five-day intervals
T10	M4I1	Topsoil:sand:compost:coir dust 1:1:1:1 with irrigation intervals of daily
T11	M4I2	Topsoil:sand:compost:coir dust 1:1:1:1 with irrigation in three-day intervals
T12	M4I3	Topsoil:sand:compost:coir dust 1:1:1:1 with irrigation in five-day intervals

Table 2: Layout of experimental plots

Treatment	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
T1	M1I1	M3I3	M2I1	M1I3	M1I2
T2	M1I2	M4I1	M2I2	M2I1	M1I3
T3	M1I3	M4I2	M2I3	M2I2	M2I1
T4	M2I1	M4I3	M3I1	M2I3	M2I2
T5	M2I2	M1I1	M3I2	M3I1	M2I3
T6	M2I3	M1I2	M3I3	M3I2	M3I1
T7	M3I1	M1I3	M4I1	M3I3	M3I2
T8	M3I2	M2I1	M4I2	M4I1	M3I3
T9	M3I3	M2I2	M4I3	M4I2	M4I1
T10	M4I1	M2I3	M1I1	M4I3	M4I2
T11	M4I2	M3I1	M1I2	M1I1	M4I3
T12	M4I3	M3I2	M1I3	M1I2	M1I1

15 cm filled with the potting mixture according to the treatment. An experiment was conducted in Randomized Complete Block Design with twelve treatments (Table 1) and five replicates (Table 2), resulting in 60 pots to reduce the coefficient of variation, which is a statistical measure of the relative dispersion of data points in a data series around the mean in the experiment.

Potted cuttings were placed in a propagator for 21 days to induce root initiation. The propagator was opened after 21 days, and all the 60 pots were transferred to a plant house with a 300-gauge polythene cover to protect them from rain. Data were collected at 3, 6 and 8 weeks after planting of cuttings. New shoot height was measured by using a measuring tape from the axillary base to the tip of the cutting. A number of new leaves of the plant were counted, and leaf area was measured. A number of roots were counted, which arose from the cutting node closer to the potting media surface. Shoot fresh weight was measured by using an electronic balance. Shoot dry Shoots of plants were put into the oven at 70 °C temperature until weights of the shoots became constant. Root length was taken by using tape. Root fresh weight was measured by using an electronic balancer. Root dry weight was obtained by putting into an oven at 70 °C temperature until the weights of roots became constant. Data were analysed using the analysis of variance (ANOVA) to evaluate the differences among treatments, and the means were separated using the least significant difference at the 5% level of significance (Gomez and Gomez, 1984). All the collected data were analysed statistically by the ANOVA technique using the SAS version 9.3. Where there were significant effects, post hoc analysis was made with Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Cuttings were started sprouting between 14-21 days in all treatments. Potting mixtures M1 and M4 with I1 treatment gave better results compared to other treatments. At eight weeks after planting, the most extended new shoot length of 7.9 cm, highest fresh weight of new shoot 102.7 mg, highest dry weights of new shoot 15.4 mg (Table 3), highest number of roots of 18 per plant, total root length of 12 cm per plant, highest dry weight of 2.0 mg were observed from the treatment M1I1. There was no significant difference observed between potting mixtures M2 and M3 and irrigation in three-day intervals (I2) and irrigation in five-day intervals (I3). At eight weeks after planting, the highest number of 05 new leaves of the plant and the largest leaf area of 138.6 cm^2 were observed from the treatment M1I1 (Table 4).

Table 3: The shoot length, fresh weight of shoot, dry weights of the shoot, at eight weeks after planting

Treatments	Shoot length (mm)	Shoot weight (mg)	Shoot dry weight (mg)
M_1I_1	79^a	102.7^a	15.4^a
M_2I_1	70^b	91.0^b	13.6^c
M_3I_1	71^b	92.3^b	13.8^c
M_4I_1	79^a	102.7^a	15.4^a
M_1I_2	76^{ab}	98.8^{ab}	14.8^b
M_2I_2	68^{bc}	88.4^c	13.2^{cd}
M_3I_2	67^{bc}	87.1^c	13.0^{cd}
M_4I_2	76^{ab}	98.8^{ab}	14.8^b
M_1I_3	72^b	93.6^b	14.0^{bc}
M_2I_3	65^c	85.8^{cd}	12.8^d
M_3I_3	65^c	85.8^{cd}	12.8^d
M_4I_3	72^b	93.6^b	14.0^{bc}

Significantly not different treatments share a letter/s in common adjusted p-value < 0.05

Table 4: The number of new leaves and total leaf area at eight weeks after planting

Treatments	Number of new leaves of the plants	Total leaf area (cm^2)
M_1I_1	5^a	138.6^a
M_2I_1	5^a	133.2^b
M_3I_1	4^b	$126.0^b c$
M_4I_1	4^b	122.4^c
M_1I_2	4^b	118.8^{cd}
M_2I_2	3c	115.2^d
M_3I_2	4^b	124.2^c
M_4I_2	3c	117.0^{cd}
M_1I_3	3c	115.0^d
M_2I_3	5^a	138.2^a
M_3I_3	5^a	133.0^b
M_4I_3	4^b	126.4^{bc}

Significantly not different treatments share a letter/s in common adjusted p-value < 0.05

CONCLUSION

The study showed that potting mixture containing topsoil:sand:compost:coir dust (1:1:1:1) in daily irrigation showed similar high growth performances of betel as in control mixture with topsoil:sand:compost:coir dust (1:1:1:1) in daily irrigation. Replacing coir dust with sawdust or paddy husk in pot mixture showed significantly low growth performances in daily irrigation. Daily irrigation showed good performances compare to other irrigation frequencies. This study revealed that coir dust for potting media could not be replaced by paddy husk, but compost cannot replace cattle dung. When considering irrigation frequency, daily irrigation gave a better growth in the nursery plants than other irrigation intervals.

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