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Effect of Propagation Media on the Rooting of Leafy Stem Cuttings of *Irvingia wombolu* (Vermoesen).

[1]Dickens E. Dolor, [2]Felix O. Ikie and [2]Godwin U. Nnaji

[1]Department of Forestry & Wildlife, Delta State University Asaba, Nigeria.
[2]Department of Agronomy, Delta State University Asaba, Nigeria.

Abstract: The effect of propagation media on the rooting potentials of juvenile stem cuttings of *Irvingia wombolu* was assessed in an experiment conducted at the Teaching and Research Farm of the Delta State University, Asaba Campus, Nigeria. Seven different propagation media namely fine sand (FS), a 50:50 mixture of fine sand and sawdust (FS+SD), medium sand (MS), a 50:50 mixture of medium sand and sawdust (MS+SD), coarse sand (CS), a 50:50 mixture of coarse sand and sawdust (CS+SD), and sawdust (SD) were used for the experiment. The results revealed a significant (P = 0.05) effect of media on rooting percentage with fine sand recording 52.7 %, coarse sand + sawdust (51.6 %), Medium sand + sawdust (48.9 %), medium sand (46.1 %), fine sand + sawdust (43.9 %), coarse sand (42.9 %) and sawdust (41.5 %). Similarly, root length and cutting mortality were significantly (P < 0.002) influenced by media. From the results of this study, fine sand is recommended as an appropriate media for optimum rooting of *I. wombolu* stem cuttimgs. However, coarse sand-sawdust mixture may be an alternative.

Key words: *Irvingia wombolu*, vegetative propagation, soil media.

INTRODUCTION

The tropical rainforest of West and Central Africa are endowed with high value multipurpose trees. Many rural household of these regions depend heavily on these resources for their food, medicinal and construction needs [1,5,6,25,33]. *Irvingia. gabonensis* and *I. wombolu* have enormous potential, both in economic terms and as species for sustainable production[2]. The trees are valuable sources of income for West and Central African farmers through the sales of kernels which fetch a price higher than the fruits[5].

The high value of the species to farmers[18], long gestation period of seed sown trees[19,30], poor germination capacity[31], variability of fruits, kernel characteristics and tree size[19,34] and limited knowledge base[37], indicates the need for improvement of the species for domestication. Vegetative propagation may greatly facilitate the process of domestication of *Irvingia* and other fruit trees by enabling the rapid multiplication of selected genotypes and the production of superior planting stock[13,22, 24,28], and shortening fruiting time for farmers[30]. It is against this backdrop that efforts are being made to domesticate this species through participatory approaches which places greater emphasis on the social and economic needs of the farmer by involving them in all the stages of the domestication process, which include identifying the improvement objective they desire and the rapid multiplication of selected genotype and production of superior planting stock for farmers through clonal means. A wide variety of factors may influence the rooting ability of a number of tropical trees[10,11,17,20,21,27,28]. According to Loach[26], the percentage rooting and the quality of the roots produced are directly influenced by the medium, which is an integral part of the propagation system. Poor rooting might be a consequence of the rooting media used and despite its apparent disadvantages, pure sand has recently become more popular for economic reasons[17].

This study was to assess the effect of different media on the rooting of the juvenile stem cuttings of *I. wombolu*.

MATERIALS AND METHODS

The experiment was carried out at the Delta State University, Asaba Campus (06º14´N and 06º49´E) in Oshimili South local Government Area of Delta State, Nigeria. Asaba lies in the tropical rainforest zone with annual rainfall range of 1500mm to 1849.3mm. Mean temperature are 23.3ºCelsius with a maximum of 37.3ºCelsius. Mean monthly soil temperature at 100cm depth and sunshine is 28.3ºCelsius and 4.8 hours respectively[4].

A propagation unit was established in the Department of Forestry and Wildlife for the experiments. The propagator consisted of a metal frame measuring 3.05m x 6.10m x 2.14m and enclosed in a

Corresponding Author: Dickens E. Dolor, Department of Forestry & Wildlife, Delta State University Abraka, Nigeria.
E-mail: dickensdolor@ yahoo.co.uk.

clear polyethylene with a water-tight block work base. The base of the propagator was covered in a thin layer of sand (10cm depth) and then successive layers of small and medium size granite (0.5-5cm, to a depth of 25cm) and filled with water. The access to the propagator is was a hinge fitted metal gate which was also clad in polyethylene. The low-technology non-mist propagator was a modified design described by Leakey *et al.*[20], was used for the study. The propagation unit was cited in a shade-house.

One hundred and fifty fruits of *I. wombolu* were procured from collectors in Ossissa, Delta State. The fruits were depulped and sun dried for three days and sown afterwards in 0.20 litter polythene pots filled with top soil. Two weeks after germination the seedlings were sown directly in the field with a spacing of 20cm x 20cm and raised under shade. The vigorous seedlings were cut back to maintain a supply of coppice shoots and used as stock plants. Plants were watered daily to field capacity. Stock plants were sprayed with a systemic fungicides and insecticides (Imidacloprid 10%+Metalaxyl 10%+Carbendazim 10% WS) prior to severance.

Seven different propagation media namely fine sand (FS), a 50:50 mixture of fine sand and sawdust (FS+SD), medium sand (MS), a 50:50 mixture of medium sand and sawdust (MS+SD), coarse sand (CS), a 50:50 mixture of coarse sand and sawdust (CS+SD), and sawdust (SD) were prepared. The particle size for FS, MS and CS were 0.25-0.1mm, 0.5-0.25mm and 1-0.5mm respectively. The particle size was established based on the United States Department of Agriculture (USDA) particle size classification. The sand was obtained from a nearby River Niger dumpsite, while the composted sawdust from Asaba wood village sawmills. All media except sawdust were sieved, and cleaned prior to use. The different media were sprayed with a systemic fungicide (Carbendazim 12% + Mancozeb 63%W.P.) prior to insertion of cuttings. The different media were placed in 43cm by 43cm by 10cm perforated plastic trays and randomly assigned to the propagator.

Five hundred and sixty single node terminal soft wood cuttings, four from each shoot were harvested from the stock plants and randomly allocated to 7 media (FS, FS+SD, MS, MS+SD, CS, CS+SD and SD) described above. After applying 200ppm of IBA dissolved in 50% industrial alcohol to the base of the cutting applied by dipping the base of the cuttings for 5 seconds. Thereafter, the alcohol was evaporated in a gentle air prior to insertion in the propagator. The cutting were inserted in the seven media and arranged in a randomized complete block design with 4 replicates in the propagator. Cuttings were assessed weekly for the presence and number of roots ($\geq$2mm in length), rooting percentage, root length leaf abscission, cutting mortality and shoot formation. Data collected were subjected to analysis of variance (ANOVA) and significant means were separated by Fisher's Least Significant Difference (LSD) at 5% level of probability, using Genstat 3 Discovery edition[12]. Prior to ANOVA, all percentage data were arcsine transformed, root length data was log transformed while number of roots, leaf abscission, cutting mortality and shoot formation data were square root transformed[14].

RESULTS AND DISCUSSION

The effect of rooting media on rooting percentage was negligible when rooting was observed at Week 3. Treatment effect on rooting percentage was significant ($p < 0.05$) thereafter. At Week 4, treatment effect was highly significant ($P<0.01$) with FS displaying higher rooting percentage than CS and CS+SD which were not different from FS+SD, MS and SD. However, FS was not different from MS+SD which in turn was not different from CS and CS+SD. Similarly, a highly significant ($P<0.01$) treatment effect was recorded at Week 5. FS exhibited a significantly higher rooting percentage (not different from MS+SD and CS) than CS+SD and FS+SD, which in turn were not different from MS+SD and CS which were not different from MS. Treatment effect was significant ($P = 0.03$) at Week 6 with FS recording a significantly higher rooting percentage than FS+SD and MS, though not different from CS, CS+SD and MS+SD which in turn were not different from FS+SD and MS. At the final assessment at Week 7, treatment effect was significant ($P = 0.05$) with FS displaying higher rooting percentage than FS+SD and CS, though not different from CS+SD, MS and MS+SD which were in turn not different from FS+SD and CS, (Figure 1).

There was no treatment effect ($P > 0.05$) on number of roots at Week 3. At Week 4 treatment effect was highly significant ($P < 0.01$) with FS recording significantly higher number of roots than CS and MS+SD, which were not different from CS+SD and FS+SD which in turn were not different from MS and SD. Treatment effect was highly significant ($P < 0.01$) at Week 5, displaying a similar trend with the result at Week 4. The effect of media on number of roots per rooted cuttings tended to diminish after Week 5. At Week 7 there was no treatment effect ($P > 0.05$) with number of roots ranging between 1.20 in FS + SD to 1.64 in FS, (Figure 2)

No significant effect of rooting media on root length was observed at Week 5, ($P > 0.05$). At Week 6, media effect on root length was highly significant ($P < 0.01$) with FS, recording significantly higher root length than CS, CS+SD, FS+SD, MS and MS+SD, between which there were no significant differences, which in turn was different from SD.. A highly significant ($P < 0.01$) treatment effect was also observed at Week 7, with FS recording significantly higher root length than CS, CS+SD, MS and MS+SD, between which there were no significant differences which were in turn different from SD, (Figure 3).

Leaf abscission was not significantly affected by rooting media, ($P>0.05$). Leaf shedding was not noticed until Week 3, in FS and MS. At Week 4, three treatments (CS+SD, FS+SD and SD) were yet to lose a leaf. At the final assessment at Week 7, leaf death ranged from 1.2 to 15% in CS+SD and CS respectively.

Cutting mortality was very low and was not significantly influenced ($P > 0.05$) by rooting media up till Week 5. At this time, the mean cutting death was 3.6% and rose markedly afterwards. At Week 6, rooting media effect on cutting mortality was highly significantly ($P < 0.01$). MS+SD was not different from CS but recorded significantly higher cutting death than the rest treatments. However, CS+SD and FS recorded significantly lower cutting mortality than CS, SD, FS+SD and MS, between which there were no significant differences. At Week 7, treatment effect on cutting mortality was highly significant ($P < 0.01$). CS recorded the highest cutting death, which was not different from MS + SD, which in turn was not different from MS+SD which was not different from the rest treatments, between which there were no differences. At this time, cutting mortality ranged between 2.5% in both CS+SD and FS to 18.75% in CS, (Figure 4).

Shoot formation was unaffected by rooting media ($P >0.05$). At Week 1 and Week 2, all the rooting media except CS and SD were yet to form any shoot. From Week 3 to the final assessment at Week 7, FS recorded the highest value for cutting forming new shoots. At this time, the proportion of cuttings forming new shoots ranged between 16.1% in CS and SD to 39.3% in FS.

Discussion: The pronounced effect of media on rooting percentage indicates that fine sand is the most suitable medium for propagating *I. wombolu*. This contradicted the result by Shiembo *et al.* [35], who obtained the best result in sawdust. Researchers have long recognized a wide variation in the rooting potentials[32] and a contrasting requirement with respect to propagation media between different species of a family and even between varieties of a species[15,16,21,23,26]. An ideal propagation media according to Hartmann *et al.*[16] should provide porosity to allow good aeration. They stated further that rooting is reduced when cuttings are stuck in highly water saturated propagation media with small air pore space. Poor aeration becomes an impediment to plant growth when more then 80% to 90% of the soil pore spaces is filled with water. This high soil water content not only leave little pore space for air storage, but more importantly, the water blocks the pathways by which gases could exchange with the atmosphere[7]. Carter and Slee[8] recommended the inclusion of coarse mineral components to increase air filled pores and drainage .The best result obtained in fine sand with small air pore space which is similar to clayey soils which are usually poorly drained and aerated is therefore confusing. The high rooting percentage obtained in fine sand may be explained by the report of Tchoundjeu and Leakey,[36]. They asserted that species adapted to wet conditions root better in media with high water holding capacity. Wright *et al.*[38] investigated the effect of propagation medium moisture level on rooting of woody stem cuttings and observed that cutting survival and percentage of rooted cuttings was highest in the medium with the highest moisture level. They therefore concluded that incidence of cutting basal rot was not directly related to the medium's moisture level, but was related to the growth stage of the stock plant. The poor rooting obtained in sawdust is unusual given that Shiembo *et al.*[35] obtained the best result with *I. gabonensis* in sawdust. The contrast may be due to the difference in the source of sawdust (different tree species) and the degree and mode of composting. One interesting trend the study revealed is that rooting was enhanced in coarse sand and medium sand by the addition of sawdust whereas the reverse is the case with fine sand. A similar result with sand-perlite mixture was obtained by İsfendiyaroğlu *et al.*[17], citing the good water holding capacity as being responsible for significantly improved rooting of the mixture compared to sand alone. Similarly, coarse sand which recorded the poorest rooting after sawdust was significantly enhanced; producing the second best result when sawdust was added to the medium. This trend is also evident in the number of roots and root length data. The application of sawdust to fine sand may have increased the macro–pore space, thereby increasing soil drainage and aeration, while reducing the macro-spore space in coarse sand with a resultant increase in the mediums moisture retention capacity.

The absence of pronounced effect of media on number of roots is surprising although the cutting in fine sand recorded a non-significant higher mean number of roots while sawdust recorded the least, thereby maintaining a similar trend with rooting percentage.

Significantly higher root length recorded in fine sand could be because this medium provided the most suitable environment for root extension. Misra *et al.* [29] and Diaz–Zorita *et al.* [9] asserted that the proportion of total root length penetrating soil aggregates decreases with increasing size and strength of the aggregate. Rooting medium not only affects the percentage of cuttings rooted but also the quality and quantity of roots produced. This is a function of available moisture and air in the rooting medium[32].

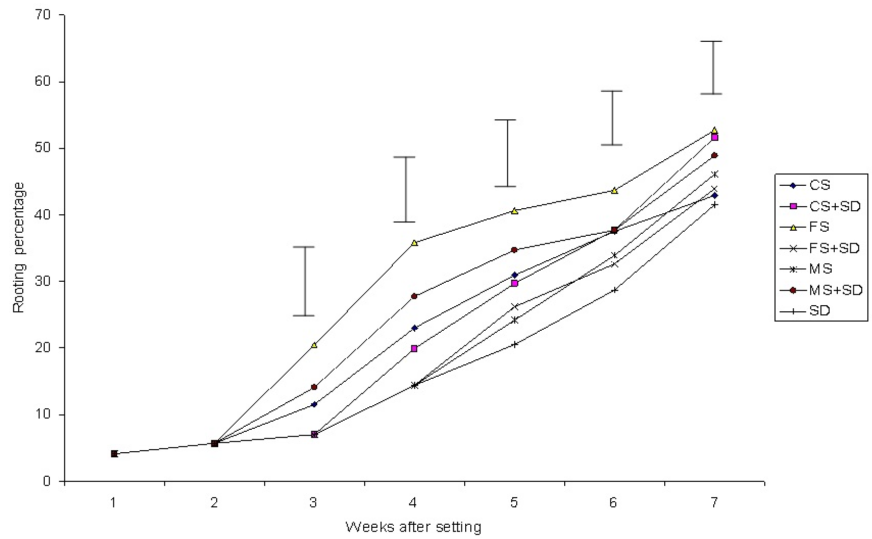

Fig. 1: Effect of media on the rooting percentage of leafy stem cutting of *Irvingia wombolu*.

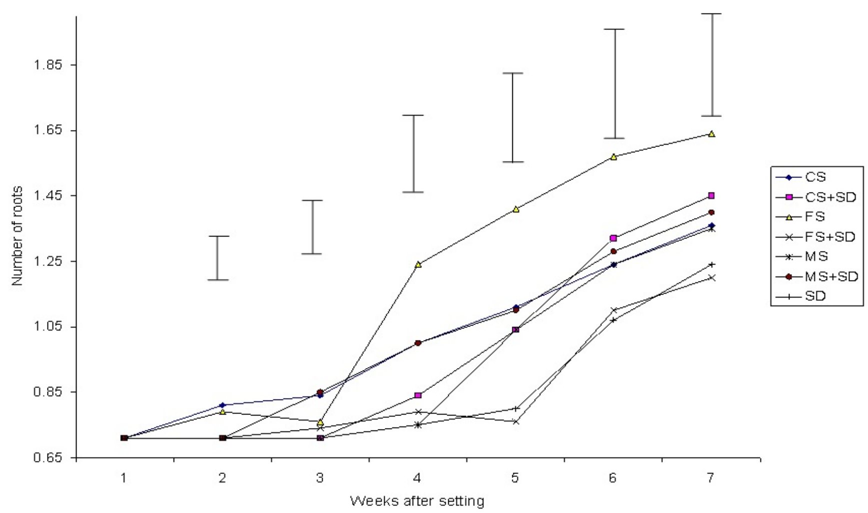

Fig. 2: Effect of media on the number of roots of leafy stem cuttings of *Irvingia wombolu*

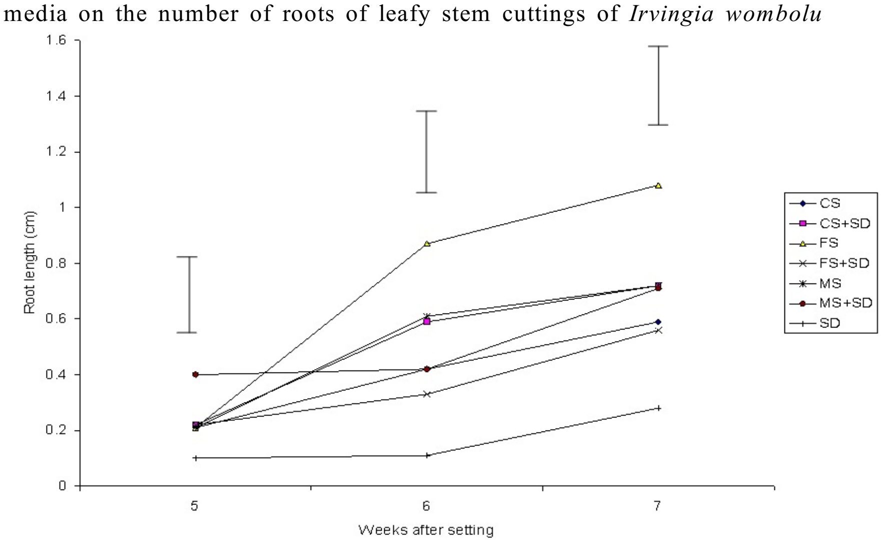

Fig. 3: Effect of media on the root length of leafy stem cuttings of *Irvingia wombolu*

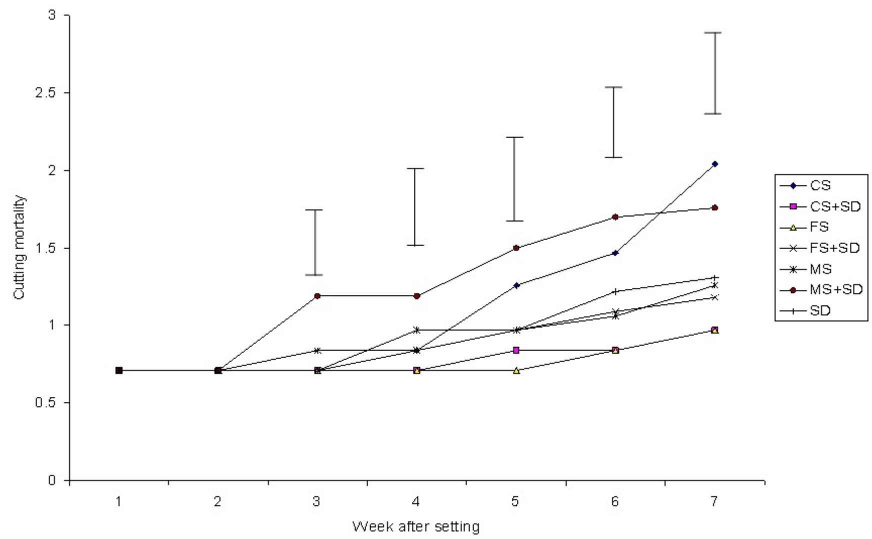

Fig. 4: Effect of media on the cutting mortality of leafy stem cuttings of *Irvingia wombolu.*

Although leaf abscission and cutting mortality were not significantly influenced by media; coarse sand recorded a non-significant higher mean values for both. This may be linked to foliar water deficit caused by the low water content of this medium[35]. Similarly, the high proportion of cuttings forming new shoots in fine sand and the poor results recorded in coarse sand may be related to the improved transpiration[3] facilitated by the high water content of the fine sand medium and the reverse in coarse sand.

Conclusion: The study has demonstrated that fine sand is the most suitable medium for propagating *I. wombolu* by stem cuttings in a non mist propagation system designed for use in rural areas, with no requirement for electricity or piped water. This is in spite of the long held view that rooting is reduced when cuttings are stuck in highly water saturated media with small air pore space. Also rooting of this species in coarse sand and medium sand can be enhanced by the application of composted sawdust.

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