Evaluating Root Distribution Pattern of Selected Coconut Cultivars at Seedling Stage Under Different Climatic and Soil Conditions

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Introduction

Coconut is one of the main commercial plantation crops in Sri Lanka. Annual National Coconut Production (ANCP) in Sri Lanka is more or less stagnant or with only a slight increase during last two decades. Human inhabitation and climatic change are the main contributory factors that affected on reducing extent of coconut growing lands in traditional areas and led to promote coconut cultivation in non-traditional areas. Therefore, identification of a coconut cultivar/s with putative drought tolerance is of a paramount importance.Strong and well distributed root system is of extremely important in withstanding frequent dry spells experienced in marginal areas especially in dry zone. This led to the present investigation on root distribution pattern of selected, improved coconut cultivars grown under different climatic and soil conditions. The experiment was conducted (i) to identify the root distribution pattern of *CRISL 98* (a cross between Tall and San Ramon) and *Kapruwana* (a cross between Dwarf Green and San Ramon) cultivars at seedling stage under different climatic and soil classes and also (ii) to identify their active root zones and their variation under different environments.

Methodology

Experiment was conducted as a three factor factorial using around 3 year old coconut seedlings of *Kapruwana* and *CRISL 98*cultivars under intermediate zone (IZ) and wet zone (WZ) in S1/S2 and S3/S4 land suitability classes (LSC). Soil core samples were taken from different distances (50, 100 and 150 cm) from the base of the seedling and at five depths in two opposite directions (20, 40, 60, 80 and 100 cm). They were separated in to two groups*viz.* primaries and secondariesafter washedthe root samples.Then, number, dry weight, total root length (Tennant, 1975) and root volume (Herath, 2004) were measured for primary and secondary roots separately. Data were analyzed using ANOVA and means were separated using Duncan's new multiple range test (DNMRT) using SAS (version 8) computer software.

Result and Discussion

Number of roots, Dry weight of roots, length of roots and volume of secondary roots were significantly higher ($p<0.001$) in IZ than those in WZ when considered both cultivars together. There were no significant differences in number of primaries, secondaries and total roots between cultivars as well as between LSCs. However, dry weight and total length of all roots were significantly higher in S1/S2 LSC than S3/S4 LSC ($p<0.001$). Most roots were accumulated within the first50 cm distance from the bole of the palm with highest number of roots, dry weight of roots, volume (secondary roots) and total length of roots.The same parameters were significantly ($p<0.001$)reduced with the increase of the distance. *CRISL 98* showed slightly higher root length than *Kapruwana*in IZ though the difference was not statistically significant ($p<0.05$). However, the hybrid *Kapruwana* showed higher ($P<0.05$) root length compared to that of *CRISL 98* inWZ (Figure 1).

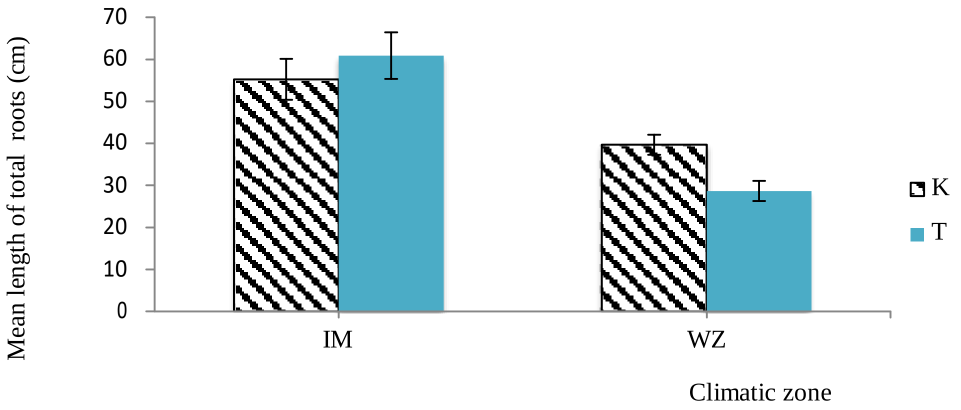

Figure 1. Variation of mean length of totalroots of different cultivars under different climatic zones.

When the distribution at different depths was considered, the number of roots, volume (secondary roots), dry weight and total length of roots significantly ($p<0.001$) decreased with the increasing the depth. Although there was no significant difference($p<0.05$) in the number of primary roots and volume of secondary roots in the cultivar *Kapruwana* in both LSC, *CRISL 98* showed significantly higher($p<0.05$) number in the LSC of S1/S2 compared to that of S3/S4. The interaction between climatic zone and the LSCs showed that there were significantly high ($P<0.05$) number of primary roots, total dry weights and volume of secondary roots in IZ with S1/S2 LSC.

Observation on the number of roots, dry weight, total root length and volume as a whole revealed that palms grown in IZ had higher values compared those in WZ. Availability of water in sufficient amounts within the root zone during the most part of the year in WZ may have created a situation where intensive root growth into wider and deeper areas is not compulsory. However, palms grown in IZ may be experiencing comparatively more frequent moisture deficit conditions. This may have subsequently contributed to a comparatively intensive root growth under such conditions.

Conclusions

Two improved cultivars showed significantly higher root distribution in IZ compared to those in WZ with respect to all root parameters investigated. Differences in root growth between coconut cultivars were marginal at this age. Horizontal distribution of roots decreased with increasing distance from the base of the palm while having more than 60% of roots within the first 50 cm and more than 80% within the 100 cm. Thus the application of agronomic practices should be limited to this root zone area at the age of 2 to 3 years. Vertically downward root growth decreased with increasing depth in both cultivars having more than 70% of roots within the top 60 cm layer of soil and more than 80% within the top 80 cm depth. Accordingly, roots of coconut palms are mostly within a shallow layer of top 80 cm soil profile at this age.Therefore, palms are substantially vulnerable for abiotic stress conditions thus need more attention and care specially during the periods of abiotic stress conditions until their roots grow far distances from the base and into deeper layers of the soil.

References

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