EFFECT OF SUB-SOILING ON SOIL PHYSICAL CONDITIONS, ROOT DISTRIBUTION AND YIELD OF SUGARCANE UNDER RAIN-FED CONDITIONS

By

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ABSTRACT

Sugarcane (*Saccharum* hybrid spp.) is mainly grown in the dry zone of Sri Lanka where the major soil group is well drained Reddish Brown Earth soils (RBE-Rhodustalfs). A gravel layer occurs in the B horizon of this soil at a depth of one meter or less which impede sugarcane root growth and distribution. This study was conducted to determine the effect of gravel layer and associated soil physical properties on root distribution and growth of sugarcane as a rain-fed crop in Rhodustalfs in Uda Walawe area where a well developed gravel layer is found at shallow depths. Three sugarcane varieties specifically recommenced for rain-fed / irrigated conditions were used to ascertain their behaviour of root growth and distribution in soils having a gravel layer and effects of mechanically disturbing it using a subsoiler. Gravel layer was disturbed by sub-soiling to about 65 cm depth and in the control plots disc ploughing was practiced to about 25 cm depth. The parametric value changes induced by sub-soiling as against shallow ploughing on soil physical properties and any associated root growth and distribution characteristics were used as criteria in assessing improvements on sugarcane yields.

Ploughing reduced the bulk density and soil strength in the surface horizon from 1.7 to 1.59 Mg m^{-3} , and from 588 to 343 kPa respectively. Sub-soiling had a similar effect on the bulk density and soil strength in the surface layer with a reduction of bulk density from 1.76 to 1.63 Mg m^{-3} and soil strength from 834 to 539 kPa in the B1 horizon. In the gravel layer, sub-soiling increased the total porosity from 32.9% to 39.2% and macro-porosity from 8.9% to 20.4% while micro-porosity and available water were not significantly affected. The steady infiltration rates increased from 0.71

cm h^{-1} before tillage to 1.76 and 19.78 cm h^{-1} after ploughing and subsoiling, respectively. Under ploughing treatment, over 60% of the roots were confined to the top 30 cm of soil, during the first four months of growth in all the varieties tested. After ninth month of growth, in varieties CO 775 and SL 8306, 66% and 59% of their total root system, respectively, were confined to the surface horizon while the remainder had spread in the rest of the soil profile down to C horizon. However, in variety (var) SLI 121, root distribution was confined to a soil depth down to 88 cm (B horizon) with 45% of roots being present in the surface layer. Root distribution in the gravel layer and beyond was significantly increased by sub-soiling, with the highest improvement in var SLI 121 and least effect in the var SL 8306. Sub-soiling had significantly increased the total root length and weight, shoot dry weight and shoot to root ratio in all the varieties. Regardless of the tillage treatments, var SL 8306 had the highest total root length, while var SLI 121 had the least total root length. At maturity, the highest and the lowest shoot dry weight was recorded in var SL 8306 and var SLI 121 respectively. The shoot to root ratio was highest in var SLI 121 while var SL 8306 showed the lowest shoot to root ratio. Neither cane nor sugar yields were significantly increased by sub-soiling. The highest and the lowest percentage increase in cane and sugar yields were recorded with var SLI 121 and with var SL 8306, respectively. When only ploughing was used, var SL 8306 resulted in deepest feeding root system and higher cane yields compared to others can be recommended as the appropriate var for rain-fed cultivation. Sub-soiling of RBE soils was observed to enhance root penetration to depths below the gravel layer which could be due to improvement of soil physical conditions brought about by sub-soiling. Among the varieties of

sugarcane tested, var SLI 121 and var CO 775 which show shallow rooting habit were observed to perform better in the fields where sub-soiling was carried out.