KURAPIA: A VERSATILE GROUND COVER WITH UNIQUE GEOTECHNICAL PROPERTIES

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Updated: December 16th, 2013, Email: navin@dri.edu

INTRODUCTION

Looking briefly into the history of land use, it seems that human interference by clearing of natural vegetation covers result in serious soil erosion. Excessive runoff generated from logging activities, golf courses and highway constructions usually moves directly from drainage structures into waterways and cause considerable sedimentation in nearby streams and lakes. Without taking proper mitigation, high intensity rainfall strike on denuded slope causing a spate of landslides in the country. Traditional methods have been devised to combat erosion such as retaining wall, sheet piles and concrete embankments. However, such solutions may not be acceptable mainly due to the cost implications. An alternative approach is bioengineering, a method using life plants alone or combined with dead or inorganic materials to arrest and prevent slope failures and erosion (Franti, 1996). Advantages of bioengineering solutions are 1) less expensive and lower maintenance than structural measures; 2) environmental compatibility with landscape and limited access sites; 3) strengthen the soil by binding action of vegetation roots; 4) environment friendly of wildlife habitat, water quality improvement and aesthetics; 5) use of natural by-products such as rice straw, jute, coconut fibres etc. Kurapia S1 is a new ground cover that has been recently introduced as an alternative ground cover that can help reduce the water demand and grow in different soil conditions and climates. Apart from being a sturdy plant with excellent water-efficiencies, our research has shown that Kurapia provides excellent soil stability and therefore, be an ideal candidate to reduce soil erosion. The goal of this study was to compare the impact of Kurapia and Bermuda grass on the soil stability and any changes in runoff and soil loss.

RESULTS AND DISCUSSION

Bermuda grass and Kurapia S1 were each grown in long rectangular containers with sufficient vertical depth to allow for free expansion of roots. Bermuda grass was established using sod while Kurapia S1 was propagated using plant cuttings. The plants were allowed to establish themselves for two months. Plants were located where they received unobscured sunlight throughout most of the day, and pots were arranged in a way so that each plant was allowed to grow without restrictions. The plants were placed in a greenhouse with the following environmental conditions: day/night temperature: 25°C (±2°C), humidity: 50% (±20%), natural lighting with peak irradiance at midday of about 1,700 mol m^{-2} s^{-1}.

Root Distribution

We compared the distribution of root diameters as a function of depth for Bermuda and Kurapia. A good distribution of root diameters at various depths would allow for improved soil stability and reduced soil erosion. Figure 1 shows the distribution of root diameters with depth. The diameters of the roots were estimated using imaging software. One can notice that the larger dimaters exist in Kurapia (above 0.5mm) which are negligible in Bermuda grass. The distribution of different diameters of root at various depth gives Kurappia excellent geotechnical properties that can reduce erosion.

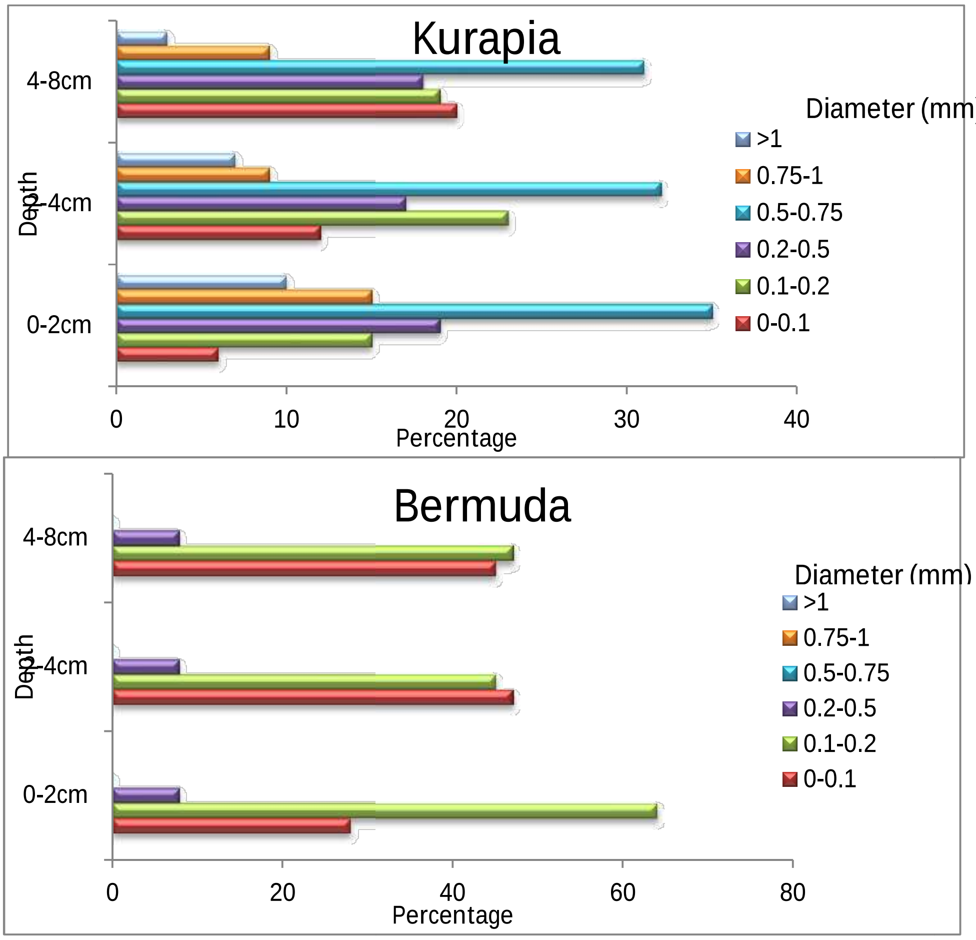

Figure 1. Distribution of root diamaters with depth for Bermuda and Kurapia.

Figure 2 shows the root structure of Kurapia after the roots were cleaned properly and the soil was removed. It is very clear that the thick mat-like structure of Kurapia's roots makes it an excellent geo-textile for slope stability and anti-erosion applications.

Figure 2. Figure showing the thick, well-stitched root structure of Kurapia.

Runoff and Soil Erosion Experiments

We also performed soil loss and runoff-generation characteristics of soils that were (a) bare, (b) covered with Bermuda grass and (c) covered with Kurapia. The experiment consisted of three standard Universal Soil Loss Equation (USLE) plots, which measure 0.5 m wide by 1m long, on 9 % slope. The soil was classified as sandy clay. These plots were provided with 25 cm deep, 10 cm wide reinforced impermeable partition to form the perimeter on three sides, with 10 cm depth extended into the ground. At the downslope end was placed a series of metal roof covered with lids to prevent the direct entry of rainfall. The metal roof acts as a divisor, which divided the runoff into equal portions and passed one part or one-fifteenth through the central slot of the metal roof, into a calibrated, covered divisor tank, while the remaining 14/15 flowing to waste. The excessive runoff from the divisor tank was then subdivided further where one-fourth of the flow was collected in a second calibrated, covered tank. The weight of soil in both tanks was adjusted in accordance with the proportion of the total runoff passing into the tanks. Thus, the total soil loss from each plot was fifteen times the weight of soil in the divisor tank plus sixty times the weight of soil in the second tank. Both tanks were carefully emptied and cleaned after each measurement. We applied 100 cm of rainfall at an intensity of 5cm/h to all the plots. Table 1 lists the results of the experiment below. It can be seen that while Kurapia generates a similar runoff to other cases, the soil loss is exceedingly small by orders of magnitude.

Table 1. Soil erosion and runf-off generation experiments.

	Runoff (%)	Soil Loss(Kg/Ha)
Bare	31.9	170,305
Bermuda	38.1	4,530
Kurapia	32.3	200