A Preliminary Experiment on Slope Rehabilitation with Vetiver and Native Plants in South China

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Abstract: Vetiver has been used very successfully in erosion control in many countries. It is therefore an excellent plant for slope works. In addition, it is much cheaper using vetiver grass than alternative measures. The cost of embankment stabilization with conventional engineering methods can be reduced by 90% when vetiver is used as an alternate. But Vetiver grass has a weakness that is brown off in winter; as a result the landscape effect is not effective. So some Highway Administrative Departments have not accepted Vetiver grass. In order to solve this problem, a mixed planting technique combining Vetiver and native plants was conducted in Baiyun District, Guangzhou. Eight native species were selected mainly for their suitability to grow on exposed sites and in poor soil conditions. Based on the survival and growth rate of the seedlings, the trial indicated that the Vetiver and Native Plants Technique (VNPT) is a simple, practical, low maintenance and very effective method for slope works.

Key words: Vetiver grass, native plant species, erosion control, Rehabilitation, slope

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1 INTRODUCTION

Guangdong Province is located at the southernmost end of China's mainland. It covers a land area of 178,000 km^2. Out of the total land area, 69% is hilly and mountainous lands. The erosion hazard applies particularly to sloping lands. The area of water erosion is about 2000 km^2, especially in the cities of Zhaoqing and Yunfu, which account for 88% of the total area impacted by water erosion. The total amount of soil erosion has reached 85 million tons annually. Water and soil erosion, and land desertification are still not under control. Soil erosion results in serious land degradation in many areas and the complete loss of soil organic material and finally exposure of the bedrock in some mountainous areas. Where rocky desertification landscape appear, soil erosion often leads to the silt-up of reservoirs, lakes and rivers. Desertification caused by soil erosion seriously affects the development of the agricultural economy. Poverty-stricken counties located in the severe soil erosion areas account for 78 percent of 200 poverty counties in China.

Since 1980's, Vetiver Grass Technology has sought to solve the problems of soil erosion and water run-off, instead of earthworks and engineered construction. Vetiver Grass (*Vetiveria zizanioides*) has been internationally demonstrated to be a very effective species for steep slope stabilization and flood mitigation (Xia *et al.*, 1997; Hengchaovanich, 1998). Vetiver grass, a perennial grass, has broad adaptability and strong resistance to adverse conditions. Because it grows rapidly and forms a massive root system, it is ideal for soil and water conservation when planted as a hedgerow along contour lines (National Research Council, 1993; Truong, 1994). This experiment's objective was to select native plants, which can survive the extremes of drought, heat, barren soil conditions, and apply the mixed planting technique of Vetiver and native plants for slope rehabilitation.

2 ENVIRONMENTAL APPLICATIONS

2.1_ Dongsheng County, Baiyun District

Dongsheng County is located at the northern suburbs of Guangzhou, about 35 km from the downtown. The highest annual rainfall is 2100 mm, the mean annual temperature is 21.4_. There were 51 quarries in Baiyun District, Guangzhou, which account for 73% of the total quarries in Guangzhou city. Soil erosion is very serious problem in these quarries. The trial site, had a gradient of 50°, and was located near Dongsheng quarry.

2.2 Soil Properties of Slopes

The soils in the slope above were acidic, very infertile, and contained almost no nutrients or organic matter.

Table 1_Basic characteristics of soils in slopes

Locality	pH	Organic matter	Total N (g/kg)	Available P (g/kg)	Gravel to soil (mg/kg)	(%)
Up-slope	6.02	1.56	0.19	0.06	25	
Down-slope	5.25	2.98	0.26	0.08	36	

3 RESULTS AND DISCUSSION

3.1 Selection of the Native Plants for the Slope Rehabilitation

Guangdong, Located on the line of the Tropic of Cancer and between the north latitudes 20° 09' - 25°31' and the east longitudes 109°45' - 117°20', has mainly a warm and humid subtropical climate with mild winters. With plenty of rainfall and sunshine grows a very large diverse range of vegetation including crops, vegetables, fruit as well as plants. There are over 5000 kinds of vascular plants. 128 of China's exclusive species out of 75 genera of 40 families are distributed in this province.

The species used in the trial have been selected from within all the provinces, mainly for their suitability to grow on exposed sites and in poor soil conditions (Table 2).

Table 2 The Species Selected for the Slopes Rehabilitation

Species	Description	Flowers	Blossom	Propagation
Psychotria asiatica	Evergreen shrub	Pale pink	All year round	Seeds
Melastoma sanguineum	Evergreen shrub	Pink	All year round	Seeds or cutting
Rhaphiolepis indica	Evergreen shrub	Dark pink	March	Seeds, semi-hardwood cuttings
Gardenia Jasminoides	Evergreen shrub	White	April to July	Seeds or cuttings
Mussaenda pubescens	Evergreen shrub	White	April to July	Seeds
Rhodomyrtus tomentosa	Evergreen shrub	Pink red	April to July	Seeds or cutting
Gordonia axillarisye	Evergreen shrub	White	October	Seeds
Melastoma candidum	Evergreen shrub	Red	May to August	Seeds or cutting

3.2 Growth Situation of Native Plants in the Slopes

In 2002 and 2003, we conducted a trial on the slope at Dongsheng County in collaboration with Shunde Ming Zhi Xing Floritech Co., Ltd. and Guangzhou Hongri Landscape-Gardening Company to plant native shrubs species on steep (50°) land slopes. The slope was all lateritic red soil developed from granite. Eight native plants were planted after Vetiver grass had been established. The experiment will last for two to three years. So far, the growth situation of the plants is satisfactory.

4 SUMMARY

Eight native species, *Psychotria asiatica, Melastoma sanguineum, Rhaphiolepis indica, Gardenia Jasminoides, Mussaenda pubescens, Rhodomyrtus tomentosa, Gordonia axillarisye,*and *Melastoma candidum* were selected to grow on exposed sites and in poor soil conditions. The result of this experiment has shown that Vetiver grass was a cheap, safe, and effective technique to slow erosion and retain soil moisture. Vetiver acts as a pioneer plant growing where other plants would not survive and provides micro-climatic conditions where native species may become established. The trial indicates that a mixed planting technique of Vetiver grass and native plants can be used to stabilize soils on slopes.

The climate of South China is not suitable for planting trees on slopes steeper than 50° because the trees are prone to damage by typhoon winds.

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A Brief Introduction to the First Author

Xuhui Kong, an Associate Professor in Engineering in Landscape-Gardening, is a Vice-Director of the Floricultural Research Institute of GAAS. He has undertaken a wide range of Landscape-Gardening and environmental protection related research projects, including new ornamental plants introduction, acclimatization, wastewater purification and slope work. He has had over 15 academic papers published in this area.