

Sustainable recultivation and land use on karst regions—shrub system

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Key words : fodder tree, reforestation, screening, China

Introduction The karst area because of its special geological structure creates a number of environmental problems including water loss, drought, thin soils, desertification, and soil collapse, resulting in a fragile and unstable environment. The karst area in Guangxi spreads across the entire province. Carbonate rock is distributed 40% of and accounts for 17% of China's karst region. Some of it is degrading like the stony deserts, thus it is urgent to select suitable plants for re-vegetating it.

Material and methods We screened a large number of shrubs in order to make selections for re-establishing the shrub system. Nine cultivars have been tested including shrub fodder types, flowering shrubs and fruit trees et al., among them 3 strains of Japanese camellia, 6 strains of Japanese and Chinese chestnut, Japanese peach blossom and including 6 native species, two strains of mountain grapes, *Zenia*, *Morus*, *Broussonetia*, *Leuceana* and *Cinnamomum*. We used five reforestation methods to plant seedlings only, branches, seedlings with soil, nutrition cup seedlings and directly seeding with seed.

Results Three foreign varieties have shown good adaptability. They are the Japanese prunus and Japanese camellia. Six domestic species did well: *Zenia* grew the fastest, reaching a height of 220cm in 10 months, the large seedlings of camellia planted with the soil grew relatively slowly, only 14cm in height over the same period. Growth rate were in the following order: *Zenia* > *Leucaena* > grapes > *Broussonetia* > *Morus* > *Cinnamomum spp* et al. Reforestation results were strongly influenced by soil preparation. Plowing prior to planting loosened the soil and the young shrubs had adequate water, fertility of soil, sun light, and heat to promote rapid growth. At the same time, the planting-hole method had the poorest results. For example, *Zenia* grew 285cm tall in all ploughed areas and was 2.2 times taller than shrubs placed in planting holes. The basal diameter (BD) of trees was 2.58 cm and 2.1 times bigger when planted on ploughed land. Biomass aboveground was 840 g and 3.8 times heavier, and the belowground biomass was 520 g and 4.3 times heavier for the planting-hole method. For grapes, height was 138 cm in ploughed areas, 2.5 times higher than for the planting-hole method, BD was 0.5 cm, or 7% greater. To chestnut, height was 106 cm in all plough, 1.4 times higher than in planting-hole method, BD was 1.80 cm, 25% bigger than the planting-hole method (Table 1).

Table 1 Different soil preparation and biomass of trees (cm) (Average for all species).

Soil preparation	Main root		Side root			Canopy of root	Biomass (g)	
	Length	BD	Length	No	Mean		Branch	Root
Tractor-plough	67	2.2	284	5	1.12	80	840	520
Planting-hole	60	1.2	147	4	0.87	65	220	120

Conclusions The better shrubs for recultivation were *Zenia*, *Leuceana* and *Broussonetia*. The best soil preparation was planting-hole method as it protects the soil surface from eroding and reduces water lose. This method of reforestation is expected to provide better results, even though initial plant growth is not as great as is shown in this research.