NEYRAUDIA REYNEDIANA – EXCELLENT SOIL CONSERVATION GRASS

Zhao Yongjian
Forestry Scientific Research Institute of Longyan Municipality, Fujian Province 364000, PRC

Abstract
Neyraudia reynediana is the excellent grass species for soil conservation. In South China, adopting *Neyraudia reynediana* as main conservation species in the water-eroded desert, it can effectively control soil erosion by covering the ground within six months, facilitating the improvement on poor ecological environment in water-eroded desert, creating the favorite conditions for introduction and propagation of *Dicranopteris dichotoma* and other local grass species, so as to accelerate the recovery of vegetation in water-eroded desert. The physiologic and biochemical criterion measurement to moisture threaten treatment of four grass species – *Neyraudia reynediana*, vetiver, Bahia grass and *Miscanthus floridulus* – shows that *Neyraudia reynediana* enjoys the best capacity of drought resistance and adversity adaptability. By using the *Neyraudia reynediana* as a fast afforestation technique, it successfully solved the difficult problems of vegetation recovery management in the waste mines of kaolin, gold and gangue.

Additional Keywords: soil conservation, plant, grass, environment

Biological Features of *Neyraudia reynediana*
Belonging to the Gramineae herb, *Neyraudia reynediana* is naturally distributed in 13 provinces of south China. The grass is very good at resisting the drought, with the strong adaptability to various poor environment conditions. It enjoys the developed root system, strong cluster development capacity, large amount of leaf and stem growth, and great amount of seeds, easy to be naturally renovated. Planted in water-eroded desert of South China, it can be growing for 2 m high, and will be continuously developed depending on itself. It facilitates the improvement on poor ecological environment in water-eroded desert, creating the favorite conditions for introduction and propagation of *Dicranopteris dichotoma* and other local grass species. All these unique features help the *Neyraudia reynediana* become the most ideal grass for recovery management in the water eroded desert of South China.

Effect of a *Neyraudia reynediana* Plantation in a Water Eroded Desert
Site
The site is situated at 25º42’ N, belonging to middle subtropical area, with the annual rainfall of 1800 mm, annual mean temperature of 19.2 . The site is at the low hill with 10º degree slope, 290-300 m above the sea level. The runoff plot is designed as 10 x 30 m, equipped with three spreader pool. 300 clusters of *Neyraudia reynediana* were planted in April 2000, the measurement was started from June of the same year.

Results
From the third year, the *Neyraudia reynediana* coverage has reached 100%, great different from the comparison area. Concerning the ground runoff, planting *Neyraudia reynediana* may reduce 22.3% amount of ground runoff in the first years, 31.2% in the second year, 69.0% in the third year. About the soil erosion volume, planting *Neyraudia reynediana* may reduce 23.5% amount of soil eroded in the first year, 78.4% in the second year, and 100% in the third year.

Table 1. Statistic Statement of Runoff Experimental Site of Zhuxi, Hetian Township of Changting County

Measured Project	Experimental Zone*	2000 (Jul-Dec)	2001 (Jan-Dec)	2003 (Jan-Dec)
Vegetation Coverage (%)		80	95	100
		8	10	12
Ground Runoff (m^3)		38.81	87.3	48.8
		50.07	126.84	157.4
	Reducing Range (%)	22.3	31.2	69.0
Soil Erosion ($kg/300m^2$)		258.77	114.28	0
		327.80	529.09	485.32
	Reducing Range (%)	23.5	78.4	100

* I is experimental zone, and II is comparison zone

Ecological changes in the conservation area
Three years after the plantation of *Neyraudia reynediana* was established, the ecological environment in the managed area had changed greatly. It appeared as follows: the soil organic matter increased about 0.68%, total soil poral lacuna increased 14.24%, total water retention amount of forest is 2.4 times higher than that of the comparison area, the daily mean comparative moisture of forest in summer increased 19.3% than that of the comparison area, and daily mean temperature reduces 2.0ºC than that of the comparison area, the temperature of ground reduced 5.1 ºC

Biodiversity changes in the conservation area
Adopted the *Neyraudia reynediana* as main herb species for management in the water-eroded desert, the flora community changed fundamentally after 3 years. The investigation of sampling sites shows that the newly increased herb and shrub in the management zone reached 14 species, and the total amount increased from 9,450 clusters/ha to 71,550 clusters/hs, the total coverage increased from 15% to 96%. We have conducted investigation for 7 days, it has found four families and six kinds of birds, four families and five kinds of animals and 24 families 35 genus of insects, while in the unmanaged area, there were only found two families two kinds of birds, two families three kinds of animals and 22 families 30 genus insects. It seems that further cultivation of *Neyraudia reynediana* changed the local ecological environment of mountain land to provide the good place for the resident of animals and plants, and help the protection of biodiversity.

Analysis on Dicranopteris dichotoma growth in the conservation area
Dicranopteris dichotoma is widely distributed in the provinces south to Changjiang River of China, is the familiar vegetation in the water-eroded desert of south China. It needs five to seven months for *Dicranopteris dichotoma* from the mature of spore to a new clusters. During the period, it needs a suitable moisture, shading and refuge conditions. Although *Dicranopteris dichotoma* can produce great amounts of spores, not many can finally grow to be the sporophyte. Growing of *Neyraudia reynediana* can duly provide the favorable moisture, shading and refuge conditions for the flushing of spores. Thus, second year after planting *Neyraudia reynediana*, *Dicranopteris dichotoma* can develop in the gross. Only three years, the coverage of *Dicranopteris dichotoma* raised from 0.6% up to 25%, becoming the main community herb and further spread to the spacing of underlayer of *Neyraudia reynediana,* which form the dense and comparatively stable brushwood, providing the way for fast recovery of vegetation in the water-eroded desert.

Research on Resistance Mechanism of *Neyraudia reynediana*
In order to reveal drought resistance and excellent features of *Neyraudia reynediana* at adversity, systematic research was conducted to its resistance mechanism in 2001. By using nutrient bags, 180 stocks of *Neyraudia reynediana*, 180 stocks of vetiver, 180 stocks of Baia grass and 180 stocks of *Miscanthus floridulus* (one stock in each pot) were planted, and moved to a greenhouse for regularly watering and management. On 25 September 2001, the moisture treatment (medium and intensive) was initiated with three replications. It is measured 14 recessive indicators related with the drought resistance of seedlings. When threaten treatment reached the expected standard, take three pots of each herb for rehydration treatment, to observe the recovery degree and sampling analysis.

Ecological features of drought resistance moisture of herbs
From three aspects – water conservation capacity, water retention ability and water absorption power, the moisture recessive characteristics of flora reflect the drought resistance capacity. From the experiment result, it shows that the water retaining capacity, carnification degree and bound water content of *Neyraudia reynediana* leaves are higher than Bahia grass, vetiver and *Miscanthus floridulus* in order, while the size and transpiration speed are lower than bahiagrass, vetiver and *Miscanthus floridulus,* appearing the strong water retention ability. The regulating power of leaf air hole is also stronger than Bahia grass, vetiver and *Miscanthus floridulus,* with excellent water conservation capacity. From the water absorption power potential, the slope of water release curve of *Neyraudia reynediana* is greater than that of Bahia grass, vetiver and *Miscanthus floridulus,* followed by the flow of water in soil, the flow of water on leaves frequently reducing range is smaller, and the capacity of turgor pressure maintaining through osmo regulaton and cell modulus of elasticity is also higher than that of Bahia grass, vetiver and *Miscanthus floridulus*. In a word, *Neyraudia reynediana* tops the list of drought resistance of herbs, Bahia grass and vetiver seconded, *Miscanthus floridulus* lower.

Comparison of drought resistance and productivity of herbs
Through the comparison of drought resistance of herbs for experiments, it is easy to find out that there are great differences among the herbs on drought resistance. Threatened by moisture, the net speed of photosynthesis, moisture use efficiency, content of chlorophyll and P/O value of chlorophyll a fluorescence all higher than that of Bahia grass, vetiver and *Miscanthus floridulus*, while the osmotic permeability degree of plasmalemma and degree of panniculus adiposus peroxidation were at weak side. Thus, *Neyraudia reynediana* tops the list of various herbs for drought resistance, Bahia grass and vetiver second, *Miscanthus floridulus* lower. Such conclusion is the same as the order of various herbs in drought resistance, and basically the same as the actual situation of herbs at field.

Drought resistance mechanism of Neyraudia reynediana
In the long-term system development under the tropical and subtropical environment, *Neyraudia reynediana* appears the feature of drought and salinity resistance. The experiment shows that threatened by medium degree salinity or moisture, although the growing of *Neyraudia reynediana* appeared slowed, it basically recovered to be original status after the threat relieved. This explains that *Neyraudia reynediana* enjoys the strong adaptability to the adversity. The anti-adversity of *Neyraudia reynediana* represent in two aspects, one is the disaster resistance of morphology, the structure of *Neyraudia reynediana* adapted to the environment in the long-term evolution, air hole gets into the surface of leaf blade, leaf blade become thicker, all these help it to strengthen the capacity of disaster resistance. The other one is the capacity of anti-disaster, that is through the series of recessive process, it may help the recovery of recessive functions after the relief of drought.

The features of adversity resistance of Neyraudia reynediana is related with its recessive base. The moisture and salinity not only restrain the growing of *Neyraudia reynediana*, but also change the recessive process inside the cell. Within the threaten scope, the *Neyraudia reynediana* enjoys the feature of drought resistance, and will still grow after the relief of threat. Osmoregulation is the adaptive reaction to the adversity, and also a mechanism for drought and salinity resistance. Threatened by the moisture and salt, the content of soluble protein is reduced, explains that *Neyraudia reynediana* may maintain certain turgor prossure through osmoregulation so as to help the normal physiological process of cell growing, stomatal movement and photosynthesis. Threatened by the adversity, *Neyraudia reynediana* may maintain cell osmotic potential through the accumulation of proline, to relieve the poison by the ammonia produced by the diminution of protein, which have the good functions to prevent the loss of water and relief of active oxygen. Another important mechanism of *Neyraudia reynediana* in drought and salinity resistance is the stability of cytolemma system threatened by the adversity. A mass of MDA accumulation is the main symbol of *Neyraudia reynediana* harmed by the threat of adversity, while the activating of SOD and CAT may effectively eliminate the damage of free radical to the cytolemma. Herbs with feature of strong anti-disaster enjoys the strong self renovation capacity since the cells protective enzyme has been less affected. Thus it may maintain the relation of production and elimination of the active oxygen in the cell, to help the stability of cytolemma system.

The important resistance recessive mechanism of *Neyraudia reynediana* under the threaten of adversity means that through threaten, the dissociative proline increase and soluble protein decrease for osmo regulaton to maintain the cell turgor pressure, and through the activation of enzyme such as SOD and CAT, to eliminate the harm of free pump to the cytolemma, to maintain the stability of cytolemma system.

Application of *Neyraudia reynediana* in Soil Conservation of Mine Areas
Fast recovery conservation of vegetation in mine spoil zone is still the problem concerned by the soil conservation staff. Due to the complex of different mine refuse component, there is almost no soil organic matter that resulted in the difficult growing of flora. Duns zone was selected for experiment. Some soil dressing was put on the duns zone, sowed with more than 10 species of grass with features of drought resistance and anti-barren including *Neyraudia reynediana*, although they could sprout out, all these grasses died in the hot summer. Then it changed to cultivate roots of *Neyraudia reynediana* with soil dressing, the *Neyraudia reynediana* can grow up to 1.8 m high in the same year and quickly change the poor environment of duns zone. Most of various seeds sowed in the next year can survive and grow up. At the moment, fluorid natrium liquor often used to extract the gold in the gold mine, so there are lots of fluorid natrium left in the mine refuse with the pH value higher than 8.0, hardening the soil. Within such environment conditions, use roots of *Neyraudia reynediana* with soil dressing still achieved success also shows that the *Neyraudia reynediana* enjoys the strong adaptability to strong alkalescent soil. Such technology can also be applied in the afforestation of mines of kaolin, rare earth, quarry and revetment, which can reach the reasonable effect facilitating the vegetation recovery management of mine waste zones.

Extension of *Neyraudia reynediana* and Ecological Environment Protection

Featuring the advantages of drought resistance and anti-barren, *Neyraudia reynediana* enjoyes the strong adaptability to the poor ecological environment. It produces large size and amount of seeds, with the capacity of natural renovation, but it is no need to worry about the overrunning of *Neyraudia reynediana*. As the photophilous herb, the growing of *Neyraudia reynediana* seedling need the abundant sunshine. Among the flourishing herbs such as *Dicranopteris dichotoma*, it is difficult for seeds of *Neyraudia reynediana* to grow up. When arbor and shrub grow up, the *Neyraudia reynediana* will be faded and eventually be eliminated.

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