

# Investigation on Jiji Grass carried out in north China

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Jiji grass (*Achnatherum splendens* (Trin.), Nevski) is a perennial grass in north China with similar features as vetiver. Jiji grass not only endure drought, salt and alkali, but also adapt to low temperature of north China. Experts found that the soil was completely conserved where the grass grew, even on the most seriously eroded Loess Plateau where gullies were distributed. It is a grass for animals, such as cattle and sheep. Farmers in Loess Plateau and northwest China characterized by cold and dry climate are fond of using jiji to make fences to clean their yards. Also, it can be used to make baskets and other objects. However its outstanding function on soil erosion control and slope stabilization has not fully understood and applied in practice.

## 1 China Vetiver Network and its study on Jiji grass

In 1994, a World Bank supported project was launched aiming at soil erosion control in Loess



Plateau which covers an area for 640 000km<sup>2</sup> (33°41'~41°16'N, 100°52'~114°33'E) with 7 provinces. It is the most erodible area with most fragile ecology in the world. In 1998 a mid-project evaluation was organized by the World Bank. Mr. Richard Grimshaw, the founder of The Vetiver Network International and Mr. Liyu Xu, coordinator of China Vetiver Network joined the evaluation. They paid special attention on erosion control by Jiji grass (photo 1). It is approved that, like vetiver, Jiji can fix slopes and control erosion in Loess Plateau area very successfully. Later, Soil Science

**Photo 1 World bank investigation (1998)** Institute of Chinese Academy of Sciences (China Vetiver Network) started a research titled *The effect of Jiji Grass on soil characteristics and its potential on erosion control in the cold and dry region*, supported by The Vetiver Network International and Wallace Genetic Foundation.

Water erosion has been the key problem which influences agriculture production in north China and in the world. Although multiple methods were selected or used in some region or by some people, such as check dam, terrace construction, and forestation, it usually costs too much and needs longer time or much labor. As a result erosion control with plants, grass in particular, became one of the top considerations. One of the most important issues concerned was to select suitable plants which can not only conserve soil but also grow easily with little management and adapt to living condition of the related area. For example, in Loess Plateau and northwest China the grass should stand cold and dry climate and can fix slopes effectively.

Jiji Grass grows in clumps with dense leaves and stems and deep roots. It is fond of growing at the edges of heavily eroded gully, fixing large amount of soil. Even if the roots became old and even death the steep slopes can be still stabilized. Like vetiver, Jiji Grass can grow even better after pruning or burning.

Based on field investigations followed by laboratory research Wang Ku (2001) indicated that since jiji grass had massive roots, <1 mm roots in particular, the *soil physical properties* such as pores was improved greatly which decreased soil bulk density, and enabled soil having higher capacity for water adjusting, reducing runoff, and increasing water penetration into soil; improved soil nutrient properties such as organic matter, nitrogen, phosphors, potassium, pH value, and cation exchange capacity. Jiji grass had higher root density than other local plants. The grass can fixed soil and had higher *anti-scourability* and *antierodibility* and therefore has high potential in soil erosion control and slope

stabilization. Jiji grass can increase *soil shear strength*, the upper soil shear strength in particular, with its strong and dense roots.

Based on field investigation, Wang Ku divided the distribution area into 3 ecozones:

1. **Meadow ecozone**, mainly in inner Mongolia with high ground water table. The soil has salt. Jiji Grass distributed on large area. It is mainly used as pasture.

2. **Semi-desert ecozon,** In this area the grass grows on chestnut soil, light chestnut soil on the undulating landform. Under more arid climate, or because underground water table is too low, the soil contains little moisture and usually contains some stone possibly because fine particles were blown off during strong wind erosion. The Jiji grass is scarcely distributed on the land accompanied by other draught and salt tolerance plants. The grass is around 60 cm high but the flowering stems are also hard and upset even in the winter, which can reduce wind speed and relief wind erosion.

3 **Serious eroded gully zone**. Loess plateau is a large plateau with 626.8 thousand km<sup>2</sup> covered by loess for 120 meter thick and has been the most serious eroded area in China, and possibly in the world. Because the soil contains carbonate (10%) and much silt particles (0.02-0.002mm) for 53-58% the slopes subject to collapse during raining season. Although there are some species of plants which can grow in this specific area, none of them can match with Jiji grass to stabilize the gullies and prevent further erosion. His research established a base for further study and applications.

## 2 Recent investigation in north China

Recent investigation on Jiji Grass was carried from Aug.31 to Sept.12, 2016, organized by China Vetiver Network and Tianpeng Lande Grass Ecological Technology of Jiangsu Province Co., LTD., aiming at understanding ecological and biological characteristics of Jiji Grass in order to use the grass for soil erosion control and national economy development. The investigation was arranged at this period as it is the time for the ripening of the seeds of the grass.

### 2.1 Investigation on the function of Jiji Grass on slope stabilization in Shanxi Province of Loess

The detailed area was selected at Datong City (N39°03'—40°44', E112°34'—114°33', )。 Like the result of former investigations the erosion control function was outstanding and obvious. The grass grows on the slope area and on the edges of eroded gullies and scarps, with few meters deep. It is fond of distributing around old houses in the villages. It can stop gullies from further cutting. The walls, yards and houses are well protected



Photo 2-3 (above) The house and yard are fixed by Jiji (photo 2, left and photo 3 right);

Photo 4-5 (below) The slope was fixed (photo 4, left) ; Jiji on the banks of ditch (photo 5, right)

by the grass (photo 2-5). The grass is 2m high or higher, with roots also 2m deep or more (photos 7).

It can grow on the banks of ditches (photo 5) to fix the banks. Most plants have seeds (Photo 6).



**Photo 6 Investigation on seeds**



**Photo 7 2m high (stems) and 2m deep (roots)**



**Photo 8 Talking to villagers**

The grass is widely used by farmers to make besoms (photo 8) because it is tough and not easily broken in Loess Plateau and northwest China. In Ningxia Province it costs 18 Yuan (USD2.7) for one besom. However, farmers do not pay any attention to its function on soil conservation and slope stabilization.



**Photo 9-11 High slopes and cuts fixed by Jiji**

The function of erosion control and slope stabilization is more obvious on the high slopes or cuts (Photo 9-11). No matter where it grows Jiji grass always grows in clumps. It may imply that the grass generated from seeds at first and then the plant developed itself through tillering. Furthermore, it is always found near or around old houses or yards. It is possibly caused by people's activity (clear yards with besom made from Jiji stems). On another hand, it may indicate that the grass grows slowly. As a

result, it is not easy to find the grass near newly built houses. Besides, all of the grass we found was grown automatically and farmers never reproduce it. However, it is obvious that the grass has outstanding function on soil conservation and slope fixing in the loess plateau area. Numerous pictures were taken to prove this feature. From pictures we can see that the slope was fully fixed by Jiji grass. As a result the houses on the top of the slope was safety (photo 2-3).

## **2.2 The growth and distribution of Jiji grass in Ningxia Province**

The investigation was carried out in Huinong of Ningxia Province (N38°21'39"25', E105°58'-106°39'). It started from the flat plain of Yellow River in the south to the foot of the mountains of Helanshan in the north, totaling about 50 km. On the plain the grass mainly scattered on the small pieces of land where no crops were grown. Also, it grew pretty well around old or even abandoned houses. The grass could be 210cm high and 200cm in diameter for one clump. In this area most of the land was used to produce crops.

Following the increases of height towards the mountains the soil moisture decreases with little fertility and lot of stones. The grass is distributed sparsely. The growth of the grass became poor and poor. It is about 100cm high and 50 cm in diameter. Some grow between stones (Photo 12) and stop the stone and sediments from further moving caused by both water and wind. The area is situated at the hinter land far from sea. It belongs to semiarid continental climate with annual precipitation for 200mm or less, but very high evaporation (around 2000mm). Natural disasters happen frequently. It indicates that the grass can grow on the semi-desert area. It can stand cold (about -32 °C ) and dry climate and conserve soil from water and heavy wind erosion.

However, even in this dry and sterile land we can still find relatively larger pieces of land (about 1/10 ha) where Jiji grass grew well because the soil was relatively thicker with much slope deposit. The grass was about 150 cm high.

Later, at the flat land about 20km from the foot of the mountains a large area of land was covered by Jiji grass, totaling about 2 hectares (Photo 13). In addition the grass was found along the banks of a ditch (photo5). It is said that the grass always grows between agriculture land and pasture land. In other words, it is fond of growing on the better land of pastures where moisture and fertility are not so bad. Therefore, when people are short of food they will reclaim Jiji land into crop land to solve food shortage.

## **2.3 The Jiji grass in Linhe of Inner Mongolia**

The investigation was carried in Linhe of Inner Mongolia (about N40°34' --41°17', E107°6' --107°44'). It is located at inner land with continental climate and annual precipitation of 138-156mm. But evaporation reaches 2236mm, 16 times of rainfall. It belongs to extreme dry climate, or semi-dry climate during humid August.



**Photo 12 Plant between rocks at semi-desert (Ningxia)      Photo 13 Large area distribution bordering crop land**

However on the other hand, Linhe is located on the alluvial plain of Yellow River, characterized by many river branches. Although it has altitude of 1029-1045m, the ground water is high (about 1.5-2m or deeper). The land was divided into many pieces, from 150m to 5000m wide by rivers. There are also a lot of moving dunes (2-20m high) or semi-moving dunes (1-1.5m high) caused by heavy wind, levees, abandoned ditches, lakes and depressions (0.5-2km<sup>2</sup>, 0.5-1m deep). As a result the soil moisture in this area may not low, while photosynthesis products are easily accumulated because of the big difference of daily temperature (about 13-16°C during growing season from April to September)

Therefore the “King” of Jiji grass was found in this area (photo 14). It is 3m high and 3-4m in diameter for a clump. It grows near farmers houses or on the small pieces of sand dunes. Old farmer said that some grass is 50 years old. It existed when he was a child. Now he is 60 years old.



**Photo 14 The “King” of Jiji**  
easy to collect them.

### 3 Reproduction of Jiji grass

The key issue concerned for this investigation is to understand the reproduction of Jiji grass artificially, in order that the grass can be applied for slope stabilization. It is said that the seeds would be ripened around September 7 which was just the time when our investigation was carried out. In the field some seeds were ripened with deep brown color, but some were still was then in milk. In general the seeds was very small and light. It looks fusiform and is about 3 mm long and 0.8 mm wide (photo 15). It is 0.77g for 1000 seeds (Wei Dong, 1998)<sup>1</sup>. As a result, it is not

Furthermore, it is found that on the flower spikes some seeds are empty, possibly caused by the shortage of soil moisture. Therefore, when we collect seed Linhe should be a good place. In addition, it was found that on the ground surface there were some empty seeds or hulls of the seeds around small holes. It was possibly transported by ants (Photo 16). Therefore, the collection of seeds should be done



**Photo15 Flowers and seeds**



**Photo 16 empty seed around holes**

to be fully developed.

It is reported that sowing seeds should be done at proper time with temperature of 25/15°C (Liu Jitang, 1998). The cover of soil should  $\leq 1.5\text{cm}$ . Besides, the soil should be kept with enough moisture for at least 2 weeks (Wei Dong, 1998). For further testing, it was arranged that reproduction test will be implemented in Shanxi,

Ningxia and Inner Mongolia respectively in order to get experience for extensions. After the young plants growing up, transplanting will be carried out for engineering application purpose. Former experiences indicated that the transplanting with tillers from large old clumps could not be successful.

### 4. Conclusions

- (1) To sum up, Jiji is a grass which can stand cold and dry climate and can fix slopes and embankments very successfully especially in Loess Plateau area . In semi-desert area the grass can also grow to conserve soil from water and wind erosion.
- (2) In general, the grass can be reproduced by seeds. The seeds should be collected at proper time and at relatively moist and fertile land to guarantee the seeds to be fully developed and ripen.
- (3) When sowing seeds, temperature should be around 25/15°C, the soil cover should not more than 1.5cm thick, and the soil moisture should be kept for 2 weeks.
- (4) The transplanting can be carried out only on young plants. Experiences indicated that old clumps

cannot be used for reproduction purpose.

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