

Studies on the quick enhancement of abilities of water and soil conservation in the pre-engineering of Vetiver

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Abstract: The soil pot experiment of vetiver was carried out. The results indicated that application of fertilizer had a distinct effect on the growth of vetiver root system in the infertile soils during rejuvenation period, but the developmental emphasis of vetiver root system is different. Applying the chicken manure not only has no bad effect on the rejuvenation of vetiver but also supplies the diversity nutrients needed in shallow soil, makes vetiver grow a large number of new roots and branch roots in the shallow soil, and increases more surface area of root system. So applying the chicken manure is better than applying the other fertilizers to vetiver, and produce better effect on the water and soil conservation.

Key words: *Vetiveria zizanioides*, root, rejuvenation period, fertilizer experiment

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1 INTRODUCTION

Vetiver grass (*Vetiveria zizanioides*) is a perennial grass of Gramineae, which is originated from Southeast Asia, India and tropical Africa. At present, there are more than 100 countries or areas cultivating and using vetiver. Cultivated vetiver hedge has been taken as the effective measures of the water and soil conservation in provinces of Southern China since 1988 (Chen, 1998; Xia *et al*, 1996). There is a prospected future by using the bio-measured. But vetiver has a long rejuvenation period and the growth of vetiver root system is slow. Especially in the infertile soils on the sloping field, the effect of the water and soil conservation during vetiver field planting forepart period was destroyed. If there are rainstorms sometimes in the construction and shallow soil was eroded, the construction of vetiver hedge would be failure. In order to search for the measures that accelerate the growth of vetiver root system in shallow soil, the comparative experiments of different fertilizers were carried out. It may be help to find out the fertilizer that can better improve the root system of vetiver and strengthen eco-engineering of vetiver during the rejuvenation period.

2 MATERIALS AND METHODS

2.1 Soil Materials

In the experiment, infertile red soil originated from granite was provided. The basic, physical and chemical properties of the experiment soil can be found in Table 1.

2.2 Methods

These experiments had been done by mean of soil pot experiment. Four types of fertilizer were collected in experiment. They are respectively organic fertilizer (chicken manure, from market), compound fertilizer (BB fertilizer, 25.7-7.8-20, come from NongZi company of Guang Dong), organic and inorganic compound fertilizer (KangBao fertilizer, 10-2.5-6 from LiangTian compound fertilizer factory in Guangzhou), NaCl (containing iodide salt, from market). Five treatments were chosen in the experiment. Each treatment and the quantity of fertilizer show as follows: T1: CK (no fertilizer), T2: chicken manure (15 g/kg soil), T3: BB fertilizer (0.3 g/kg soil), T4: KangBao fertilizer (0.6 g/kg soil), T5: chicken manure (15 g/kg soil)+ BB fertilizer (0.3 g/kg soil)+NaCl (0.5 g/pot, hole fertilization). Each treatment was the

mean of three replicates.

Table 1 Physical and chemical properties of the experiment soil

Indexes	Determination method	Value	Classification
pH	Electro-potential method	6.05	-
O.M. (%)	K ₂ Cr ₂ O ₇ volumetric procedure out-heating method	0.10	Very low
Available N (mg/kg)	Alkali-solute diffusion method	30.75	Very low
Available P (mg/kg)	0.05N HCl-0.025N H ₂ SO ₄ infusion, molybdate antimony colorimetry	2.14	Very low
Available K (mg/kg)	1N NH ₄ OAC infusion, flame photometry	64.57	Very low
Total N (%)	HClO ₄ -H ₂ SO ₄ boiling, diffusion method	Vestige	Very low
Total P (%)	HClO ₄ -H ₂ SO ₄ boiling, molybdate antimony colorimetry	0.03	Very low
Total K (mg/kg)	NaOH fusion, flame photometry	0.73	Very low

10 kg clay pots were chosen in the experiment. Soil and fertilizer were mixed and filled into the pots. Each vetiver with three tillers was planted and NaCl was fertilized besides vetiver in T5. Before transplanting planted, shoot parts (stem and leaf) of vetiver were reserved 15 cm high and root parts of vetiver were reserved 10 cm long. During plant growth, each pot was irrigated. After 2 months planting, the experiments were terminated and the vetiver was harvested. The traits such as plant height, tillers, the number of new root, root depth, shoot and root biomass were measured. Then special photo-analysis software (WinRHizo, Canada, Regent Instruments company) was used to quantitatively measure total length, total surfaces area, average diameter and total volume.

2.3 Data Analysis and Statistic Analysis

All data were done according to software Microsoft Excel and SAS, including variance analysis and multiple comparisons.

3 RESULTS AND ANALYSIS

3.1 Shoot Growth of Vetiver in Different Treatments During Rejuvenation

The results of experiment indicated that fertilization had distinct effect on Shoot growth of vetiver and the effects were different with different fertilizers. The results of variance analysis showed there were significant difference within the traits, such as the plant height tillers and shoot biomass, in different treatment. The effect of chicken manure was better than others. Take plant height as example, the effects of T2 and T5 were better than T1 and T4. Tillers of vetiver dealt with chicken manure were approximately seven after two months and more than others. To the shoot biomass of vetiver, the effect of treatment by chicken manure was best which can be seen from Table 2.

3.2 Root Growth of Vetiver in Different Treatments During Rejuvenation

The result of experiment indicated from the table 3 that fertilization during rejuvenation not only increased the number of new root and facilitated the new roots anchored but also helped to enhance the amount of root biomass and increase the survival rate of transplanting. There aren't significant differences in new root biomass among different treatments. The number of new roots of vetiver treated by chicken manure was most in all treatments. On the other hand, KangBao fertilizer was in favor of the growth of root system and the root of vetiver treated by KangBao fertilizer was most depth. Thus it can be seen that chicken manure makes for the increase of the number of new roots, while KangBao fertilizer makes for the

vertical growth of new root.

Table 2 Shoot growth of vetiver in different treatments

No.	Treatment	Plant height (m)	Tillers	Shoot biomass (g)
T1	CK	0.79c	3.1c	4.45c
T2	Chicken manure	1.55a	6.7a	13.76a
T3	BB fertilizer	1.34ab	4.3b	10.75ab
T4	Kangbao fertilizer	1.17b	4.7b	7.55b
T5	Chicken manure+ BB + NaCl	1.27ab	5.3b	9.98ab

Each datum is the mean of three replicates. Values with the same letter in each column are not significantly different (Dunnean test, P=0.05).

Table 3 Root growth of vetiver in different treatments

No.	Treatment	Root depth (cm)	No. of new root	Root biomass (g)
T1	CK	50.00c	10.0c	0.82b
T2	Chicken manure	66.67b	26.3a	1.76a
T3	BB fertilizer	75.33ab	14.3b	1.33a
T4	Kangbao fertilizer	81.33a	15.0b	1.70a
T5	Chicken manure+BB+NaCl	70.00ab	18.0b	1.19a

Each datum is the mean of three replicates. Values with the same letter in each column are not significantly different (Dunnean test, P=0.05).

3.3 Some root morphology traits of vetiver in different treatments during rejuvenation

According to some root morphological traits of vetiver, fertilization had distinct effect on the growth. No matter of any fertilizers, there were positive effects on root morphological traits of vetiver, such as new root total length, total surface area, average diameter and total volume. The number of new roots significantly increased in the chicken manure treatment in contrast to others.

It can be seen from four root morphology traits that new root total surface area is greater in T2 treatment than in T5, whereas new root average diameter of T2 treatment is greater than T3. It is obvious that the amount and diameter of new root increased by fertilizing chicken manure, but there aren't significant differences in other two traits.

Table 4 Some root morphological traits of vetiver in different treatments

No.	Treatment	Total length (cm)	Total surface area (cm ²)	Average diameter (mm)	Total volume (cm ³)
T1	CK	3138.42b	333.72c	0.69c	7.23b
T2	Chicken manure	4889.16a	1152.18a	2.41a	22.78a
T3	BB fertilizer	4006.43a	999.86ab	1.77b	21.22a
T4	Kangbao fertilizer	4882.55a	990.12ab	1.91ab	16.36a
T5	Chicken manure + BB + NaCl	4048.67a	846.99b	1.95ab	14.50a

Each datum is the mean of three replicates. Values with the same letter in each column are not significantly different (Dunnean test, P=0.05).

4 RESULTS AND DISCUSSION

Vetiver is used to plant in reclaimed bare sloping field, two sides of mountainous roads and dyke as a very desirable plant hedge for the water and soil conservation. The main soil characteristic in these areas is very infertile. The quality of soil is bad and the content of sands and in-differentiation parent rock are more. There aren't any plants and the raw soil is deep. The soil are just collected from bare sloping field in this study and is very infertile. The content of total N even is at the level of vestigial character and contains

much of parent rock. So fertilization produce good effect on the growth of plant.

Chicken manure contains various organic nutrients with appropriate proportion and continually provides nutrition during the rejuvenation. Moreover, the chicken manure already is fully pythogenic and soft. The chicken manure mixed with the soil improves the structure of soil and enriches the poor soil. When vetiver was fertilized with chicken manure the growth of root and root biomasses had better development than BB fertilizer. Though KangBAo is a mixture of organic and inorganic fertilizer, the content of N, P, K is low, especially the content of P which significantly affects the growth of vetiver is very low. So KangBAo fertilizer doesn't play a good role even its organic part.

According to experimental data the number of roots treated by chicken manure was most in all treatments and the roots were tend to distribute in shallow soil in prophase and the root diameter appeared remarkably big and robust. But the traits which reflect the speed of root growth, such as new root biomass, total length, total surface area and total volume of vetiver, were not significantly different in contrast to others treatment.

This phenomenon would benefit the water and soil of conservation after vetiver field planting. The reason may be the amount of penetration chicken manure is little and the depth of penetration is shallow after decomposed. Inorganic fertilizer is prone to mobility and penetrates deeply. Because the growth of plant root is fertilizer tropism, the growth of root extends to shallow soil in the case of using chicken manure and grows down with inorganic fertilizer. The effect of the water and soil conservation in the early of vetiver eco-construction can be enhanced when the chicken manure is used.

Besides, the literature indicated that NaCl could help weak vetiver rejuvenation (Hu and Chen, 1999) In this study of T5, there was better effect to improve the growth of vetiver by using NaCl and chicken manure and BB fertilizer. To sum up, the results of experiment indicated that treatment of T2 and T5 were better than T1, but in contrast to treatment only using by chicken manure, the effect isn't desirable.

The results showed that fertilizing organic fertilizer based on chicken manure instead of fertilizing chemical fertilizer in the pre-engineering of vetiver, which improved the effect of water and soil consevation, avoided the impact of bad soil environment and rainstorm in the pre-engineering and guaranteed the success of engineering.

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A Brief Introduction to the First Author

Xiurong Wang, female, the Han nationality, was born in November 1971. She is the lecturer now and engaged in the study on the plant nutrition and fertilizer.