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# Experimental Study on Planting Soil Preparation by Improving River & Lake Silt with Plant Wastes

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**Abstract.** The physicochemical properties of river & lake silt are complex, and whether it can be directly used as planting soil is worth studying. The calliopsis pot experiment is carried out with planting soil prepared by amendment material, i.e. the organic matrix which is made by fermentation of high-nutrient sludge of a river in Nanjing, the dry excavating sludge in a lake and its flocculated and dewatered sludge together with plant wastes such as wood chips, to study the effects of different types of amendment materials and compounding ratio on plant growth. The results showed that the basic properties and fertility index of the planting soil could be adjusted directionally by adding wood chips or matrix. The overall growth of calliopsis in the planting soil formed by the high-nutrient silt in a river and its compound is the best, but some of the fertility indexes of the planting soil are too high and need to be further adjusted before use; the growth of calliopsis in the improved soil made of dry-excavation silt in a lake is better than that in the original silt, such situation is positively correlated with the amount of improved materials mixed; the difference between the growth of calliopsis in the flocculated silt in a lake and that in its improved planting soil is not significant, but some of the fertility indexes are higher than the standard indexes, and such silt can be slightly adjusted and improved into the planting soil. The field cultivation experiment study of calliopsis is carried out with the dry-excavation silt in a lake mixed with 4% wood chips and the original loess soil in the experimental field, and the growth of calliopsis planted in the dry-excavation silt in a lake is better compared with that of calliopsis planted in original loess soil. The research results can provide ideas and basis for the study on improving river & lake silt into planting soil with plant wastes.

**Keywords.** River & lake silt, planting soil, wood chips

## 1. Introduction

With the requirements of urban water environment quality becoming more and more stringent, the dredging projects of rivers and lakes have produced a large amount of waste silt [1, 2], which usually has the advantages of high organic matter content and

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sufficient nutrients for plant growth, and improving silt into planting soil is an important direction for the resource utilization. For example, the pot experiment and field experiment carried out by Zhu Benyue [3] et al. using the West Lake silt show that the West Lake silt can improve the soil organic matter and nitrogen content, and obviously promote the increase of vegetable yield. Bai Ying [4] et al. tested the physicochemical indexes of silt from five typical rivers in Shanghai Region, and pointed out that the nutrient content of river silt meets the requirements of relevant standards and can replace the soil for landscaping use to produce green structural soil, which opens a new way to solve the problem of soil resource shortage and resource utilization of silt in Shanghai Region. However, river & lake silt has characteristics such as fine silt particles, poor structure, poor penetrability and poor permeability. It often needs to be improved in texture before it can be used as planting soil. For example, Xue Qiang [5], in order to solve the problem of difficult silt dissipation in Ezhou area, used the amendment materials such as solidifying agent, straw and chicken manure to get the planting soil with excellent performance and conducted the field planting experiment. Zhang Mao et al. [6] selected straw, sawdust and rice husk as modified materials for curing the silt in Wangjia River, Wuhan, and clarified the improvement process for green grass planting soil on river and lake embankments through planting experiments. At the same time, with the rapid progress of urban greening, the production of plant wastes is increasing. Nutrient-rich plant wastes, after being subjected to certain processes and returning to soil, can significantly improve soil fertility [7]. Improving the silt using plant wastes can not only provide nutrients to the silt, but also reduce the unit weight of the silt and improve the penetrability and permeability of the silt, which has a broad application space.

In this paper, with three kinds of typical river & lake silt in Nanjing area taken as study objects, and the plant wastes wood chips and the organic matrix made of wood chips through fermentation used as amendment materials, calliopsis pot experiment is carried out with the mixing ratios being 2%, 4% and 6% respectively, to study the effects of the two different amendment materials and compound ratios of wood chips and matrix on the growth characteristics of calliopsis. Based on the pot experiment, dry-excavation silt in a lake mixed with 4% wood chips is selected for the calliopsis field cultivation experiment, a comparative study is conducted with the original loess soil in the experimental field, and a method of compounding gardening soil using silt and plant residues is obtained.

## 2. Material and Test Method

### *2.1. Material*

The river and lake silts are respectively the high-nutrient dredged silt from a river in Nanjing, the dry dredged silt from a lake in Nanjing and the silt after flocculation and dehydration of the lake, where, the flocculant added is a mixture of polyaluminum chloride and polyacrylamide. Dry and crush the river and lake silt and then pass it through a 1-cm sieve; for the field experiment, select silt from a certain lake, and then mix it with 4% wood chips, mechanically mix them well, and then, dry and crush it and pass it through a 5-cm sieve. The loess used for control is the original loess in the experimental field.

The improved materials are organic matrix for greening made by fermenting wood chips and crushed wood chips from plant wastes, which are mainly dry branches and fallen leaves, grass clippings and other greening trims from a park of Nanjing. The wood chips are made after two crushing (coarse crushing and fine crushing). For fine crushing, the sieving size is 1 cm. The organic matrix is made by composting and fermentation. Auxiliary materials for composting include urea, cow dung and microbial inoculants.

The test seedlings are calliopsis, which are sun-loving, cold-intolerant and frost-intolerant. Coreopsis seeds are purchased from a company in Nanjing, and they are full-grained and of excellent quality. For pot experiment, the seeds shall be selected one by one to ensure that all seeds (100%) can germinate. For field experiment, the germination percentage of the seeds shall be above 95%.

## *2.2. Method*

After sampling, the river and lake silt shall be immediately sent to a park in Nanjing for testing. The experimental study will be performed from April to September, 2020, which is in the rainy season, with heavy rainfall and high average temperature, thus can provide a good growth environment for the calliopsis, which is conducive to the development of the planting experiment. According to the meteorological data of adjacent weather stations, the average monthly rainfall, average monthly minimum temperature and average maximum temperature in the experimental site from April to September are shown in figure 1.

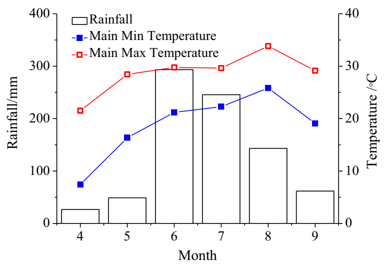


**Figure 1.** Meteorological data of the experimental site from April to September, 2020.

The density in physical and chemical indexes of material is determined with the method specified in GB/T 50123-2019 Standard for geotechnical testing method, and the infiltration rate (cutting-ring method), field capacity, non-capillary porosity, pH value (water to soil ratio of 2.5:1), electrical conductivity (EC) (water to soil ratio of 5:1), available phosphorus (AP), available K (AK), available nitrogen (AN), soil organic matter (SOM) and texture are determined with the methods specified in CJ/T 340-2016 Planting soil for greening.

For evaluation of physical and chemical indexes of soil, please refer to the relevant requirements of CJ/T 340-2016.

For the pot experiment, the indexes to be determined are the germination percentage and plant height. The germination percentage shall be determined by visual inspection and calculation. The plant height shall be measured with a steel ruler (50cm). The distance between the root of the plant and the top of the main stem shall be measured. And the average of 10 sets of data (from large to small) shall be taken as the plant height. For the field experiment, the indexes to be determined are the diameter of seedling, breadth and fresh weight. From the silt planting soil area and loess planting area of the experimental field, randomly select 5 plants, each with a height of 35 cm [measure them with a steel ruler (50 cm)], carefully dig out the complete plants with a shovel, put them on a tray, and bring them back to the laboratory in time. Then, measure their diameter of seedlings with a vernier caliper (0.01 mm) at a position 5 cm above the roots, and then measure the top breadth with a steel ruler. For the diameter of seedling and breadth, take the average of two measurements in the vertical direction; after that, rinse the roots gently with water, until the whole and clean root hairs are exposed, dry them indoors, weigh the fresh weight of the whole plant with a balance (0.01 g), then cut the calliopsis from the roots, and weigh the fresh weight of the roots and that of the upper parts.

The planting frame used in the pot experiment is 65 cm, 40 cm, and 30 cm in length, width and height respectively. The bottom of the pot is equipped with an overhead water filter grid and multiple water outlets, and a non-woven geotextile is laid on the grid. The pot experiment was performed as follows:

a) In February 2020, three kinds of river and lake silt samples were taken, and the physical and chemical properties of the silt, wood chips and matrix were tested;

b) Dry and crush the silt, and sieve it with a 1-cm sieve to remove the impurities and large particles, if any;

c) Mix the three types of silt into wood chips and matrix with the converted dry mass ratio of 2%, 4%, and 6% respectively and prepare them into wood chips planting soil and organic matter planting soil, and then test the physical and chemical properties of these different soils;

d) Spread the unimproved dried silt and improved planting soil into flower pots, with a thickness of 20 cm, and then place them neatly in the open air. Water them thoroughly and smother them for 1 d, and then water them thoroughly again, and drain them for 2 d;

e) On June 19, 2020, 32 calliopsis seeds were planted at equal intervals in each pot, with a planting depth of 1 cm, and then water was sprayed on the surface, on Day 5, the germination rate of the seeds were checked;

f) After the calliopsis was planted for 21 days, 54 days, and 77 days, the data on their growth status was collected and the growth of the calliopsis were compared and analyzed.

The field experiment was performed as follows:

a) Divide the same experimental field into 2 identical blocks, and then lay them with loess and prepared silt respectively, where the prepared silt is a kind of improved soil obtained by mixing wood chips with a mass ratio of 4% into the dry-excavation silt of a lake, during this process, it shall be mechanically mixed evenly, and then dried and crushed to remove the debris and large particles, if any;

b) Level the experimental field and ensure that there are no obvious low-lying places and waterlogged areas, and then lay the two blocks loosely with 20 cm of improved soil and loess respectively, and then spray them with water;

c) On April 14, 2020, calliopsis seeds were sown in the field with the same density, and then the field was sprayed with water;

d) On Day 70, the growth of the calliopsis was compared and checked.

## 3. Results and Analysis

### 3.1. Physical and Chemical Properties of Soil

See tables 1 and 2 for the basic properties and fertility indexes of river & lake silt and its improved planting soil respectively.

**Table 1.** Basic properties of dried river & lake silt and its improved planting soil

| Sample type | Improvement method | Density $g/cm^3$ | pH | Infiltration rate mm/h | Field capacity (Mass)% | Non-capillary porosity % |
|---|---|---|---|---|---|---|
| High-nutrient silt in a river | Dried silt | 1.52 | 7.86 | 34.67 | 34.06 | 6.35 |
| | Add 2% of wood chips | 1.36 | 7.18 | 42.72 | 33.26 | 20.65 |
| | Add 4% of wood chips | 1.35 | 7.14 | 59.55 | 35.38 | 23.86 |
| | Add 6% of wood chips | 1.26 | 7.20 | 76.39 | 38.52 | 22.75 |
| | Add 2% of matrix | 1.43 | 8.17 | 41.78 | 35.31 | 21.87 |
| | Add 4% of matrix | 1.37 | 8.07 | 63.21 | 36.45 | 21.29 |
| | Add 6% of matrix | 1.33 | 7.94 | 91.66 | 40.40 | 24.53 |
| Dry-excavation silt in a lake | Dried silt | 1.51 | 8.02 | 20.76 | 38.85 | 6.69 |
| | Add 2% of wood chips | 1.32 | 7.19 | 38.67 | 31.71 | 19.15 |
| | Add 4% of wood chips | 1.27 | 7.42 | 49.22 | 39.22 | 24.80 |
| | Add 6% of wood chips | 1.24 | 7.32 | 59.97 | 44.19 | 30.73 |
| | Add 2% of matrix | 1.35 | 8.15 | 43.41 | 32.14 | 16.37 |
| | Add 4% of matrix | 1.32 | 8.05 | 55.90 | 35.36 | 20.67 |
| | Add 6% of matrix | 1.27 | 8.05 | 75.75 | 40.07 | 27.52 |
| Flocculated silt in a lake | Dried silt | 1.63 | 8.24 | 15.45 | 40.32 | 8.72 |
| | Add 2% of wood chips | 1.4 | 7.48 | 36.57 | 40.41 | 23.76 |
| | Add 4% of wood chips | 1.32 | 7.51 | 51.22 | 42.42 | 25.85 |
| | Add 6% of wood chips | 1.26 | 7.67 | 70.53 | 45.82 | 28.98 |
| | Add 2% of matrix | 1.38 | 7.90 | 34.71 | 44.02 | 13.90 |
| | Add 4% of matrix | 1.35 | 7.89 | 53.69 | 49.38 | 15.71 |
| | Add 6% of matrix | 1.33 | 7.85 | 88.68 | 56.27 | 16.90 |
| Loess | / | 1.48 | 7.00 | 24.60 | 36.79 | 12.05 |

**Table 2.** Soil fertility indexes of river & lake silt and its improved planting soil.

| Sample type and improvement method | | Electrical conductivity (EC) | Available nitrogen (AN) | Available phosphorus (AP) | Available K (AK) | Soil organic matter (SOM) | Texture |
|---|---|---|---|---|---|---|---|
| Type | Improvement method | (mS/cm) | (mg/kg) | (mg/kg) | (mg/kg) | (g/kg) | / |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| High-nutrient silt in a river | Dried silt | 0.786 | 244 | 932.4 | 254.0 | 27.48 | Loam |
| | Add 2% of wood chips | 1.197 | 284 | 1045.2 | 295.0 | 29.87 | |
| | Add 4% of wood chips | 1.172 | 310 | 1100.1 | 389.0 | 35.25 | |
| | Add 6% of wood chips | 1.418 | 464 | 1110.9 | 408.0 | 37.58 | |
| | Add 2% of matrix | 1.291 | 268 | 1110.9 | 310.0 | 34.29 | |
| | Add 4% of matrix | 1.478 | 310 | 1143.2 | 384.0 | 36.11 | |
| | Add 6% of matrix | 1.577 | 480 | 1207.8 | 402.5 | 38.62 | |
| Dry-excavation silt in a lake | Dried silt | 0.296 | 154 | 184.5 | 163.0 | 10.36 | Loam |
| | Add 2% of wood chips | 0.354 | 172 | 216.8 | 219.0 | 11.69 | |
| | Add 4% of wood chips | 0.373 | 182 | 227.6 | 250.0 | 12.88 | |
| | Add 6% of wood chips | 0.463 | 196 | 238.4 | 295.0 | 15.37 | |
| | Add 2% of matrix | 0.357 | 110 | 227.6 | 233.0 | 12.04 | |
| | Add 4% of matrix | 0.371 | 140 | 227.6 | 256.0 | 15.88 | |
| | Add 6% of matrix | 0.434 | 169 | 249.2 | 284.0 | 19.11 | |
| Flocculated silt in a lake | Dried silt | 0.291 | 180 | 146.8 | 226.0 | 26.20 | Loam |
| | Add 2% of wood chips | 0.451 | 210 | 206.1 | 300.0 | 27.60 | |
| | Add 4% of wood chips | 0.458 | 266 | 227.6 | 340.0 | 36.04 | |
| | Add 6% of wood chips | 0.517 | 276 | 249.2 | 347.0 | 38.14 | |
| | Add 2% of matrix | 0.614 | 240 | 206.1 | 294.0 | 36.75 | |
| | Add 4% of matrix | 0.625 | 308 | 216.8 | 336.0 | 38.06 | |
| | Add 6% of matrix | 0.628 | 350 | 216.8 | 375.0 | 40.14 | |
| Loess | / | 0.090 | 266 | 0.0 | 189.0 | - | Loam |

Electrical conductivity (EC): The EC value of the high-nutrient silt in a river meets the EC indexes specified in CJ/T 340-2016, but that of its improved soil exceeds the limit; the EC values of dry-excavation silt and its improved soil, and flocculated silt and its improved soil in a lake range from 0.291 mS/cm to 0.628 mS/cm, which all meet the requirements for planting soil for greening; the EC value of the contrasted loess is lower than that specified in the aforesaid standard.

Available nitrogen (AN): The AN values of high-nutrient silt in a river and its improved soil, the improved soil of the flocculated silt in a lake and the contrasted loess are higher than the maximum limit of 200 mg/kg specified in CJ/T 340-2016, and increases with the wood chip or matrices content; the AN values of dry-excavation silt in a lake and its improved soil range from 154 mg/kg to 196 mg/kg, which meets those specified in the aforesaid standard.

Available phosphorus (AP): All AP values of river & lake silt and its improved planting soil exceed the AP index specified in CJ/T 340-2016, among which the AP values of the high-nutrient silt in a river and its improved planting soil range from 932.4 mg/kg to 1,207.8 mg/kg, and the maximum value exceeds the maximum limit of

60 mg/kg specified in the standard by 20 times; the AP value of the contrasted loess is lower than that specified in the aforesaid standard.

Available K (AK): All AK values of the three kinds of dried river & lake silt and the improved soil of dry-excavation silt in a lake as well as the contrasted loess meet the AK indexes specified in CJ/T 340-2016; the AK values of improved soils of the high-nutrient silt in a river and the flocculated silt in a lake mostly exceed those specified in the aforesaid standard.

Soil organic matter (SOM): The SOM contents of river & lake silt and its improved soil meet the SOM indexes specified in CJ/T 340-2016; compared with the original soil, the SOM content of soil for greening added with wood chips or matrices increases, and the SOM content increases with the addition of wood chips or matrices.

To sum up, the high-nutrient silt and its improved soil in a river are rich in nutrients, but the available phosphorus (AP) is abnormally high. The main reason is that the river is located in urban residential areas, and the discharge of domestic water, especially laundry wastewater, from surrounding residents leads to an increase in phosphate content in the bottom sediment, which make it necessary to take further improvement measures; the physical properties of dry-excavation silt and flocculated silt in a lake as well as the prepared soils basically meet the requirements of relevant codes. Comparing the data in tables 1 and 2, it can be found that the physical indexes and fertility indexes of soil can be adjusted directionally by adding improved materials. See table 3 for the content of heavy metals in river & lake silt.

**Table 3. C**ontent of heavy metal elements in river & lake silt. In: mg/kg

| Type of silt and reference standard | | Cadmium | Mercury | Lead | Chromium | Arsenic | Nickel | Copper | Zinc |
|---|---|---|---|---|---|---|---|---|---|
| High-nutrient silt in a river | | 0.31 | 0.32 | 88 | 84 | 23 | 25 | 14 | 36 |
| Dry-excavation silt in a lake | | 0.28 | 0.24 | 196 | 115 | 29.0 | 17 | 16 | 44 |
| Flocculated silt in a lake | | 0.26 | 0.27 | 210 | 111 | 30.5 | 18 | 15 | 45 |
| CJ/T 340-2016 | Class I | 0.40 | 0.40 | 85 | 100 | 30 | 40 | 40 | 150 |
| | Class II | 0.8 | 1.2 | 300 | 200 | 30 | 80 | 300 | 350 |
| | Class III | 1.2 | 1.5 | 450 | 250 | 35 | 150 | 400 | 500 |
| | Class IV | 2 | 2 | 530 | 400 | 45 | 220 | 600 | 800 |

Against the upper limit of heavy metal control indexes in CJ/T 340-2016, the content of heavy metals in the three kinds of river & lake silt satisfies the requirements of Classes II, III and IV planting soil, and meets the requirements of "botanic gardens, parks, schools, residential areas and other green (forest) lands in close contact with people" for the content of heavy metals in the standard.

### *3.2. Results of Pot Experiment*

During pot experiment, on Day 5, the germination percentage was inspected after the seeds were planted and on Day 21, Day 54 and Day 77, 10 plants with maximum height were selected and inspected. The related results are shown in table 4. See figure 2 for the physical map of planting and growth of calliopsis in pot experiment.

**Table 4.** Inspection results about growth of calliopsis in pot experiment

| Planting soil | High-nutrient silt in a river | | | | Dry-excavation silt in a lake | | | | Flocculated silt in a lake | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Germination percentage (%) | Average plant height/cm | | | Germination percentage (%) | Average plant height/cm | | | Germination percentage (%) | Average plant height/cm | | |
| | | 21 d | 54 d | 77 d | | 21 d | 54 d | 77 d | | 21 d | 54 d | 77 d |
| Dried silt | 96.9 | 11.0 | 54.8 | 78.7 | 87.5 | 7.1 | 21.0 | 40.4 | 90.6 | 9.5 | 41.1 | 57.4 |
| Add 2% of wood chips | 90.6 | 7.1 | 39.2 | 60.4 | 90.6 | 8.3 | 23.0 | 42.1 | 93.8 | 8.9 | 40.5 | 58.3 |
| Add 4% of wood chips | 93.8 | 8.5 | 42.5 | 62.8 | 87.5 | 8.7 | 25.6 | 45.5 | 93.8 | 10.1 | 41.5 | 55.8 |
| Add 6% of wood chips | 93.8 | 9.4 | 49.4 | 69.3 | 93.8 | 9.0 | 28.0 | 49.3 | 100.0 | 9.2 | 42.5 | 60.2 |
| Add 2% of matrix | 90.6 | 8.5 | 45.6 | 83.5 | 93.8 | 9.0 | 26.5 | 47.7 | 90.6 | 8.7 | 37.4 | 54.2 |
| Add 4% of matrix | 93.8 | 8.6 | 45.5 | 78.1 | 90.6 | 9.2 | 28.8 | 48.8 | 90.6 | 9.3 | 42.0 | 58.5 |
| Add 6% of matrix | 96.9 | 8.5 | 50.0 | 96.1 | 87.5 | 9.5 | 31.1 | 52.5 | 96.9 | 9.5 | 39.0 | 56.3 |
| Contrasted loess | 90.6 | 6.3 | 35.3 | 55.9 | 93.8 | 7.1 | 38.2 | 50.3 | 87.5 | 6.5 | 33.8 | 52.1 |


a) Preparation of planting soil b) Germination on Day 5 c) Growth on Day 54

**Figure 2**. Physical map of growth of calliopsis in pot experiment.

It can be seen from table 4 that the germination percentage of three kinds of river & lake silt and their improved planting soil and contrasted loess is above 85%, and the germination is in good condition; the calliopsis planted in high-nutrient silt in a river and in its improved planting soil grows best, and the plant height could reach more than 60 cm at Day 77; the calliopsis grows better after the dry-excavation silt in a lake was improved, and the growth is positively correlated with the amount of improved materials. The average plant height of calliopsis could be increased by 4%~30% at Day 77 by using the improvement method in this paper; there is little difference in growth of calliopsis in the flocculated silt in a lake and improved silt, so it may not be improved.

## *3.3. Results of Field Experiments*

Collect and test the growth of calliopsis at Day 70 after seeding in field experiment. The testing indexes of calliopsis in the improved soil area of dry-excavation silt in a lake and loess area at Day 70 are shown in table 5. See figure 3 for the physical map of the planting and growth of calliopsis in field experiment.

**Table 5.** Testing index values of calliopsis in experimental field at Day 70.

| Plant number | Field diameter (mm) | | Width (cm) | | Fresh weight of whole plant (g) | | Fresh weight of root segment (g) | | Fresh weight of upper segment (g) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Improved soil | Loess | Improved soil | Loess | Improved soil | Loess | Improved soil | Loess | Improved soil | Loess |
| 1 | 5.69 | 6.45 | 20.0 | 14.0 | 12.30 | 19.20 | 1.28 | 3.51 | 10.72 | 15.14 |
| 2 | 6.38 | 5.18 | 18.5 | 20.0 | 18.12 | 15.60 | 2.93 | 3.10 | 14.75 | 11.62 |
| 3 | 6.88 | 5.50 | 13.5 | 14.5 | 26.60 | 14.79 | 5.17 | 2.20 | 21.54 | 12.07 |
| 4 | 6.57 | 4.08 | 18.5 | 11.5 | 16.36 | 7.37 | 2.45 | 1.13 | 14.17 | 6.29 |
| 5 | 5.86 | 5.03 | 18.0 | 15.5 | 14.01 | 13.00 | 1.76 | 2.96 | 11.69 | 10.06 |
| Average value | 6.27 | 5.25 | 17.7 | 15.1 | 17.48 | 13.99 | 2.72 | 2.58 | 14.57 | 11.04 |


a) Emergence on April 19, 2020.

b) Comparison of growth at Day 70.

c) Intact and clean calliopsis plants at Day 70.

**Figure 3**. Physical map of planting and growth of calliopsis in field experiment.

It can be seen from table 5 that the field diameter, width, fresh weight and other indexes of the improved soil are basically superior to those of the original loess at Day 70, and the improvement effect is obvious. It can be seen from figure 3 b) that the growth of calliopsis in silt-improved soil area is better than that in loess area, and the germination and growth density are also higher than that in loess area; it can be seen from figure 3 c) that the plants grown from silt-improved soil are stronger than those in loess area as a whole.

## 4. Conclusions and Suggestions

1) The experimental results show that the basic properties and fertility indexes of planting soil can be directionally adjusted by adding wood chips or other organic matrices made by fermentation of plant wastes such as wood chips.

2) Calliopsis grows well in high-nutrient silt from a river in Nanjing and its improved planting soil. However, it is suggested that the soil should be conditioned (specially to reduce the phosphorus content) before being used as planting soil due to the excessive nutrient content in the high-nutrient silt. The effect of planting calliopsis in the improved planting soil of dry-excavation silt from a lake in Nanjing is better than that of the original dried silt, and most of its fertility indexes meet the requirements of Planting soil for greening (CJ/T 340-2016), which can be directly improved into planting soil by the method in this paper; there is little difference in the growth of calliopsis planted in flocculated silt from a lake in Nanjing and its improved planting soil, but some of its fertility indexes are slightly higher than the standard indexes, so it

is suggested that it should be turned into planting soil after being slightly conditioned. The results of field experiments show that the growth of plants planted in silt-improved soil is better than that in loess. The research results provide a reference solution for the resource disposal and utilization of silts and plant wastes.

3) The content of heavy metals in the three kinds of river & lake silt meets the requirements for content of heavy metals in Classes II, III and IV planting soil in CJ/T 340-2016 Planting soil for greening, and some indexes exceed the limits required for Class I planting soil. In order to ensure the safe utilization of river & lake silt and meet the requirements of human health and eco-environmental protection, it is suggested to pay attention to the detection of heavy metal content in the process of silt resource utilization.

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