Planting Effect Test Report

Develop

November 2023

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Directory Table

1.0 Project Experiment Purpose

Testing the actual composting effect of kitchen waste processors through plant seed germination and emergence experiments, and evaluating the fertility of kitchen waste after composting Detect and quantify indicators.

2.0 Project Experimental Design

Project Experimental Design: This experiment analyzes and compares the fertility effects of five garbage treatment methods. Samples of 400 g each were selected from direct drying and crushing, as well as from fermentation in garbage treatment tanks for 2, 3, 7, and 14 days. The ripening effects of each garbage treatment method were evaluated through cucumber seed germination and seedling emergence experiments. The details of each processing setting are shown in Table 1.

Table 1: This experiment involves various types of waste treatment

Process type						
type 1 （CK）	type 2	type 3	type 4	type 5	type 6	type 7
Raw soil	Soil+drying and crushing garbage	Soil+2-day fermentation waste (10%，m/m)	Soil+3-day fermentation waste (10%，m/m)	Soil+7-day fermentation waste (10%，m/m)	Soil+14-day fermentation waste (10%，m/m)	Soil+ commercially available organic fertilizer (10%，m/m)

3.0 Project implementation details

Personnel: Zhang Xin (guidance), Gu Jiaying, Xu Weijie, and Shou Jijie;

Time: March 2023 to March 2023;

Location: Room 408, College Building 6, Zhejiang A&F University.

4.0 Project experimental results

4.1 Seed germination test

4.1.1 Experimental methods

The experimental method uses plant seed germination and seedling emergence tests to detect the actual composting effect of kitchen waste processors, and to detect and quantify the fertility indicators of kitchen waste after composting.

4.1.2 Data statistics

The seed germination index is calculated using the following formula:

A1: Seed germination rate of organic fertilizer extract,%

A2: Average root length of seeds cultured in organic fertilizer extract, mm

B1: Seed germination rate of blank experiment,%

B2: Average root length of seeds in blank experiment, mm

4.1.1 Experimental methods

Test the actual composting effect of kitchen waste disposal through plant seed germination and seedling emergence experiments, and detect and quantify the fertility indicators of kitchen waste after composting.

4.1.3 Experimental result

The experimental results show that the effects of different soil treatments on cucumber seed germination are shown in Table 2. From Table 2, it can be seen that the treatment 1 (CK) without adding any garbage fermentation substances to the soil Compared to other treatments, the fermentation of kitchen waste in the processor for 3 days (treatment 4) and 7 days (treatment 5) can promote cucumber seed germination and significantly improve cucumber quality Germination index of; Among them, treatment 5 has the best effect. Treatment 2 (direct drying and crushing of garbage) will make it difficult for cucumber seeds to germinate (with a germination rate of 0), Direct drying and crushing of garbage can have a toxic effect on seeds. In summary, kitchen waste is beneficial for plant germination after 3 days of fermentation in the processor， The effect is better after 7 days of growth during the bud stage.

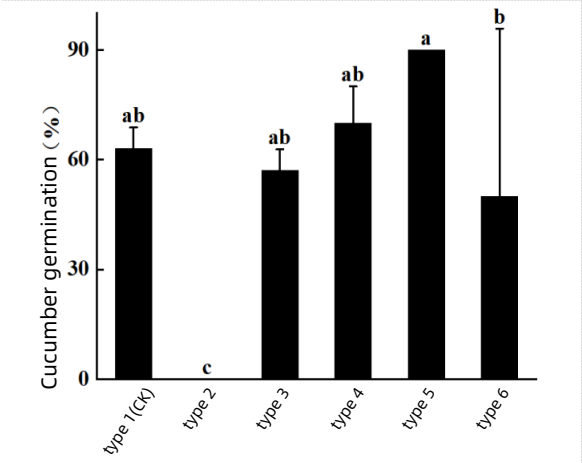


Figure 1 Cucumber germination rate of different treatment groups

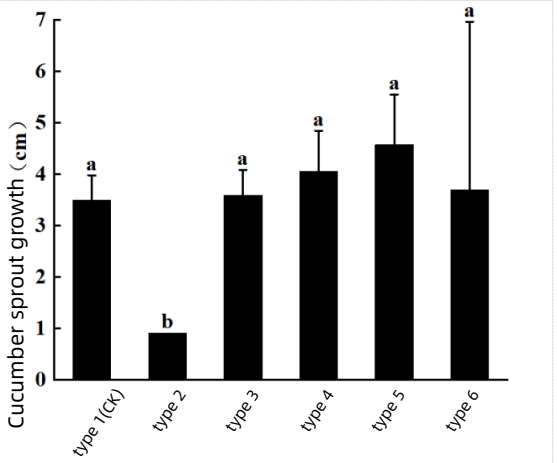


Figure 2 Cucumber Bud Length in Different Groups

Note: The lowercase letters above the column indicate the significance of differences between different treatments($p<0.05$)

Table 2: Effects of Different Soaking Solutions on Cucumber Seed Germination

Soil treatment group	germination percentage (%)	Germination index	Hair length (cm)
type 1(CK)	63.33%	100.00	3.49
type 2	0.00%	0.00	0.90
type 3	56.67%	92.05	3.59
type 4	70.00%	128.27	4.05
type 5	90.00%	186.09	4.57
type 6	50.00%	83.48	3.69

4.2 Seedling growth test（5.12-5.30）

4.2.1 Experimental methods

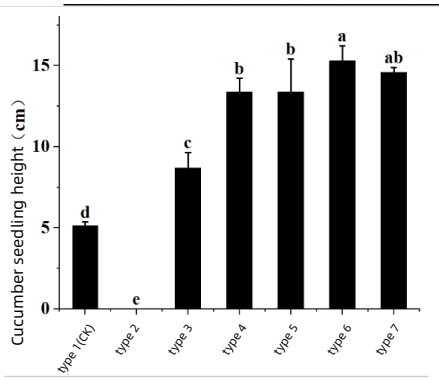
Weigh 400.0g of air dried and sieved soil and place it in a flower pot. Put an average of 20.0g of kitchen waste treatment samples into each flower pot, mix well, and have four pots for each treatment plant. During this period, water regularly and place them in rotation. Observe the growth of cucumber seedlings the next day after emergence, measure the average seedling length, and take photos to record.

4.2.2 Experimental result

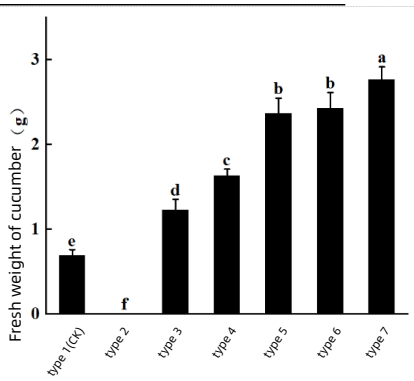
Biomass is an important indicator of plant growth, so this experiment mainly evaluates the growth of cucumber based on its seedling height and fresh weight. Sowing 20,The experimental results after days showed that adding commercially available organic chicken manure to the soil had the most significant promoting effect on seedlings, with the average seedling height and fresh weight reaching their maximumvalues.The fermentation treatment of kitchen waste can also improve the growth of seedlings to varying degrees, with a significant increase in seedling height and fresh weight after 3 days of fermentation treatment,The longer the fermentation time, the better the fertilizer efficiency, but there was no significant difference between the 7th and 14th days of fermentation. Based on the above performance, kitchen wastecan be fermented for 3 days,To achieve the purpose of detoxification and fertilization, but if you want better results, you can use it after 7 days of fermentation.

Table 3 Effect of Different Soil Treatments on Cucumber Seedling Height

Soil treatment group	seedling height(cm)	Fresh weight(g)
type 1(CK)	5.13	0.69
type 2	0	0
type 3	8.69	1.23
type 4	13.38	1.63
type 5	13.38	2.37
type 6	15.29	2.43
type 7	14.58	2.77

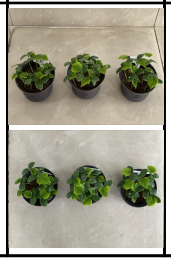


Cucumber Seedling Height in Different Treatment Groups



Fresh weight of cucumber in different groups

Note: The lowercase letters above the column indicate the significance of differences between different treatments($p<0.05$)

Group	type 1(CK)	type 2	type 3	type 4	type 5	type 6	type 7
seedling length	5.13cm	0	8.69cm	13.38cm	13.38cm	15.29cm	14.58cm
Actual planting photos							

4.3 Soil physicochemical properties under different experimental treatments

Taking into account the impact of each treatment on the growth of cucumber seedlings and the convenience of actual utilization, we selected treatment 1 (only containing soil), treatment 2 (soil+drying and crushing waste), treatment 4 (soil+kitchen waste fermentation for 3 days), and treatment 5 (soil+kitchen waste fermentation for 7 days) for soil physicochemical properties determination. The results are as follows:

4.3.1 Determination of soil pH value (6.26)

Test the actual composting effect of kitchen waste disposal through plant seed germination and seedling emergence experiments, and detect and quantify the fertility indicators of kitchen waste after composting.

4.3.1 (1) Experimental methods

Experimental method: Take 10.0g of air dried soil sample passing a 2mm sieve and place it in a 100mL beaker. Add 25mL of 0.01mol/L $CaCl_2$ solution, stir vigorously with a glass rod or a magnetic stirrer for 1-2 minutes, and then let it stand for 30 minutes. Subsequently, insert the glass electrode and saturated calomel electrode into a standard buffer solution with a pH value close to that of the soil extract, so that the pH value of the standard buffer solution is consistent with the pH value on the pH meter scale. Then remove the electrode, rinse with water, and then rinse with filter paper. After the filter paper is dried, let it stand by.

Immerse the glass electrode bulb into the lower suspension of the soil sample to be tested, gently shake it, and then insert the saturated calomel electrode into the upper clear liquid. After the pH meter reading stabilizes, record the pH value of the solution to be tested. After each sample is tested, immediately rinse the electrode with water and dry it with filter paper before measuring other samples. During precise measurement, after every 5-6 samples are measured, the top of the saturated electrode needs to be soaked in a saturated potassium chloride solution to maintain the top part saturated with the potassium chloride solution. Then, the equipment needs to be recalibrated with a standard grade flushing solution.

4.3.1（2）Data statistics

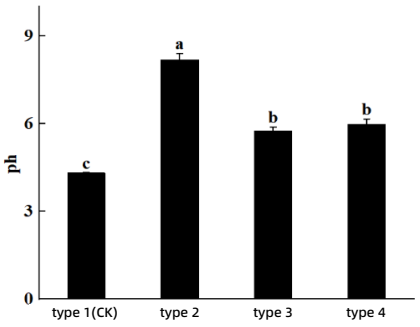
The data statistics acidity meter can directly read the pH value without the need for conversion. Perform two parallel measurements on the sample, take the arithmetic mean and take one decimal place.

4.3.1（3）xperimental result

According to the "2023 National Technical Index Requirements for Organic Fertilizers", the pH range of organic fertilizers should be between 5.5 and 8.5, and excessive acidity and alkalinity can have adverse effects on plant growth. According to Table 4 and Figure 5, it can be found that the soil pH of the original soil (treatment 1) is 4.3, indicating that the soil is slightly acidic, which can easily lead to poor plant growth. Adding kitchen waste can achieve the goal of improving soil. In this experiment, adding fermented kitchen waste for 3 days (treatment 4) and 7 days (treatment 5) resulted in a soil pH of around 6, which meets soil planting standards and national standard requirements, indicating that the waste treatment has no adverse effects on plants. In the treatment of direct fragmentation of garbage (treatment 2), the soil pH value is greatly increased, posing a risk of salinization.

PH of different soil treatments

Soil treatment group	PH
type 1(CK)	4.31
type 2	8.18
type 3	5.75
type 4	5.98



PH of different soil treatments

Note: The lowercase letters above the column indicate the significance of differences between different treatments($p<0.05$)

4.3.2 Determination of soil conductivity (7.5)

Test the actual composting effect of kitchen waste disposal through plant seed germination and seedling emergence experiments, and detect and quantify the fertility indicators of kitchen waste after composting.

4.3.2（1）Experimental methods

Weigh 50.0g of air dried soil sample passing a 2mm sieve and place it in a dry 500mL conical flask. Add 250 mL of ultrapure water, stopper, and place on a duplex horizontal shaker to oscillate for 3 minutes. Subsequently, centrifugation was carried out to obtain a clear leaching solution to be tested, while conducting a blank control experiment. Connect the platinum electrode lead to the corresponding terminal of the conductivity meter, turn on the power supply, turn on the power switch, adjust the conductivity meter, rinse the platinum electrode with the test solution several times, insert it into the test solution, turn on the measurement switch, read the conductivity value, take out the platinum electrode, rinse it with water, dry it with filter paper, and then measure the temperature of the test solution for the next soil sample.

4.3.2（2）Data statistics

Determination of soil conductivity

Calculate the conductivity of 1:5 soil water extract at 25 ℃ using the following formula:

$$L = C \times F_t \times \mathrm{K}$$

The conductivity of 1:5 soil water extract at L: 25 C, mS/cm;

C: Measured conductivity value, mS/cm;

Ft: Temperature correction coefficient;

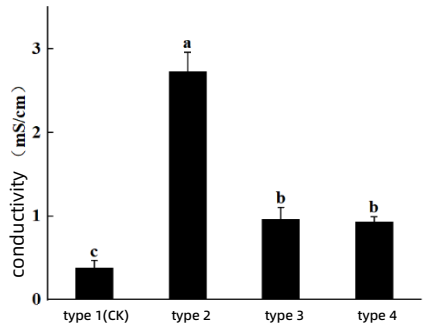
K: Electrode constant.

4.3.2（3）Experimental result

Soil water-soluble salts are strong electrolytes, and their aqueous solutions have a conductive effect. By measuring the conductivity, the concentration of water-soluble salts in the soil can be measured and the degree of salinity in the soil can be determined. In general, the soil conductivity range should be between 0.5 and 2 mS/cm. Below this concentration, it indicates low levels of nutrients in the soil, while above this range, it indicates possible salinization of the soil. According to Table 5 and Figure 6, it can be seen that after 3 and 7 days of fermentation treatment of kitchen waste, the soil conductivity was increased from the initial 0.38 to around 1.00, reaching the appropriate range of conductivity for cultivated soil, indicating that this method of kitchen waste treatment may have improved soil fertility levels. The conductivity of treatment 2 reached 2.73 mS/cm, indicating severe soil salinization and unfavorable for plant growth and development.

Electrical conductivity of different soil treatments

Soil treatment group	conductivity(mS/cm)
type 1(CK)	0.38
type 2	2.73
type 3	0.96
type 4	0.93



Electrical conductivity of different soil treatments(mS/cm)

Note: The lowercase letters above the column indicate the significance of differences between different treatments($p<0.05$)

4.3.3 Total nitrogen, available phosphorus, and available potassium contents of different soil treatments (6.22)

Test the actual composting effect of kitchen waste disposal through plant seed germination and seedling emergence experiments, and detect and quantify the fertility indicators of kitchen waste after composting.

4.3.3 (1) Experimental methods

Different soil treatments were sent to Yangling Xinhua Ecological Technology Co., Ltd. for entrusted testing.

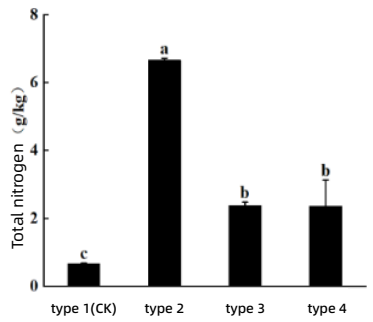
4.3.2 (2) Data statistics

Soil total nitrogen (STN) refers to the sum of various forms of nitrogen content in the soil, including organic and inorganic nitrogen. Effective phosphorus is the phosphorus component in soil that can be absorbed by plants, including all water-soluble phosphorus, partially adsorbed phosphorus, and organic phosphorus. Some soils also include some precipitated phosphorus.

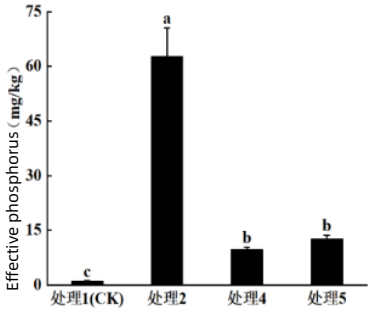
Available potassium refers to the potassium in the soil that is easily absorbed and utilized by crops. Including soil solution potassium and soil exchangeable potassium. Therefore, generally speaking, if the content of total nitrogen, available phosphorus, and available potassium in the soil is high, then the soil fertility level is good.The determination of soil fertility indicators for four treatments (Table 6 and Figure 7) showed that adding fermentation treatment to kitchen waste for 3 and 7 days significantly increased the levels of total nitrogen, available phosphorus, and available potassium in the soil, with significant differences ($P<0.05$), and the treatment effect was better after 7 days. Although garbage is directly crushed and added with higher measurement values, considering its toxic effects on seeds and seedlings, it is recommended to abandon it in this experiment.

Total nitrogen, available phosphorus, and available potassium content of soil treatments with different conductivity

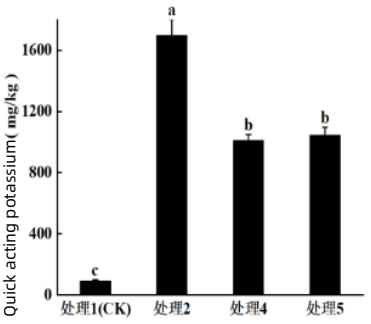
Soil treatment group	Total nitrogen(g/kg)	Effective phosphorus content(mg/kg)	Quick acting potassium content(mg/kg)
type 1(CK)	0.66	1.04	93.83
type 2	6.66	62.71	1698.33
type 3	2.37	9.77	1011.67
type 4	2.36	12.71	1045.00



Total nitrogen content of different groups(g/kg)



Effective phosphorus content in different groups(mg/kg)



Content of available potassium in different groups(mg/kg)

Note: The lowercase letters above the column indicate the significance of differences between different treatments($p<0.05$)

5.0 Summary

Taking into account the results of cucumber seed germination experiments, cucumber seedling growth experiments, and soil physicochemical properties measurements, we have come to the following conclusion: direct crushing of garbage by drying has physiological toxicity and can inhibit seed germination and seedling growth, which is not advisable. And kitchen waste can be turned into treasure after being fermented by a waste processor, but the treatment time is required to exceed 3 days, preferably 7 days. After 3 days, the fermentation substrate can promote seed germination and improve plant seedling growth. The reason for the increase is that the by-products of kitchen waste treatment significantly increase the soil's total nitrogen, available phosphorus, and available potassium levels.