Fertilizer Quality of Co-Composting of Typical Agricultural Wastes in China

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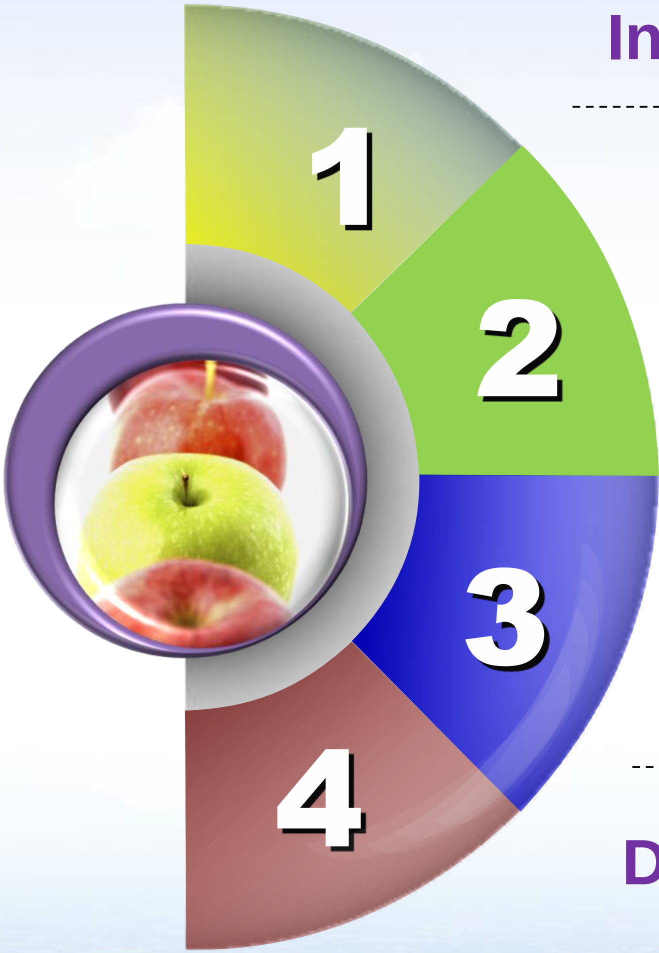
Content



Introduction

Material and Method

Result and Discussion

Conclusion

► Your text

Demonstration project

Introduction

- deterioration of rural ecological environment.
- degradation of ecosystem services in rural area

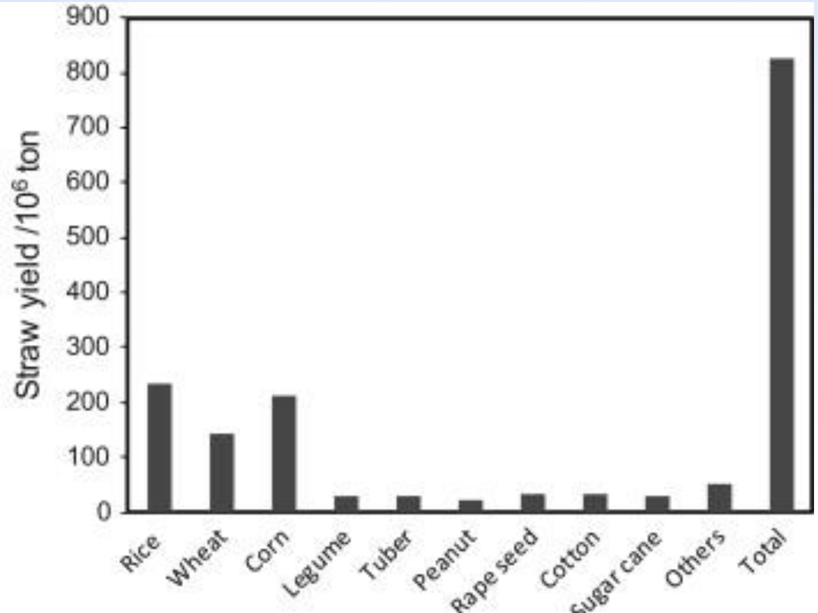
????? What can we do to

Household waste

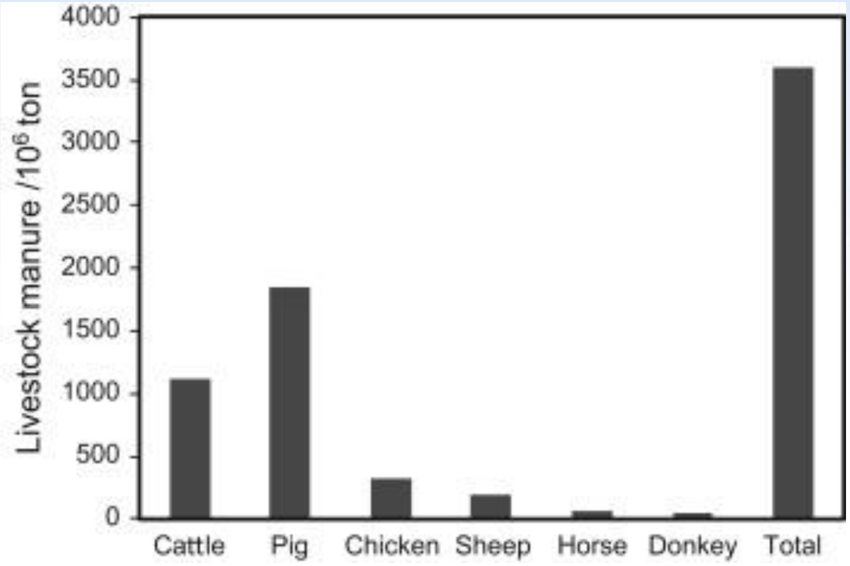
Livestock and poultry wastes

Crop straws

Introduction



Crop straw yield in China in 2010



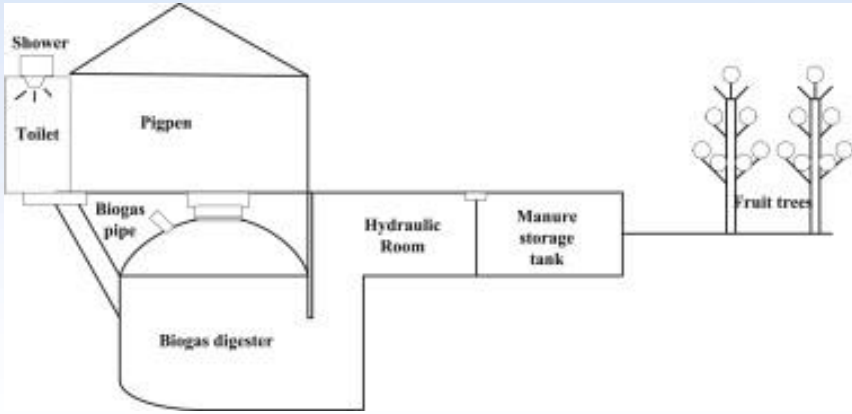
Livestock manure yield in China in 2010

Date from: National Bureau of Statistics of China China statistical yearbook of 2010 China Statistics Press, Beijing (2011)

Corn stalk +Rice straw: 66% of the total crop straw

swine manure : the largest livestock wastes, contribute to 46.3%

Introduction



anaerobic biogas fermentation system

anaerobic biogas fermentation defects:

- higher investment and operation cost
- influenced by low temperature in winter.

aerobic compost system

aerobic compost characters:

- short time period
- high degree of harmless
- good sanitation conditions
- easy mechanized operation

Introduction

little attention has been given to provide technical reference for the farmers on some problems :

- how to select material and rational matching them
- how to measure the compost quality
- how to control and manage compost process
- necessary or unnecessary addition of biological agent
- how to measure the compost quality

This study provide a reference basis for the application of microbial fermentation technology on agriculture wastes.

Material and Method

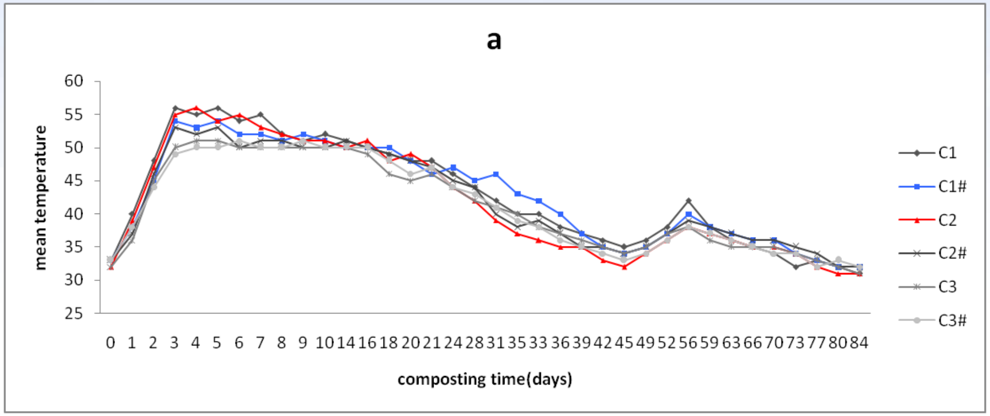
- Vessel: compost bucket with 30% holes on lid
- Time: 84 days
- Method: artificial turning and sample (once a week)
- Index : maturity indicators (temperature, C/N, GI),organic nutrient indicators (OM content , TN ,TP and TK) and hygienic indicators (value of Faecal coliforms and rate of roundworm egg destroyed)

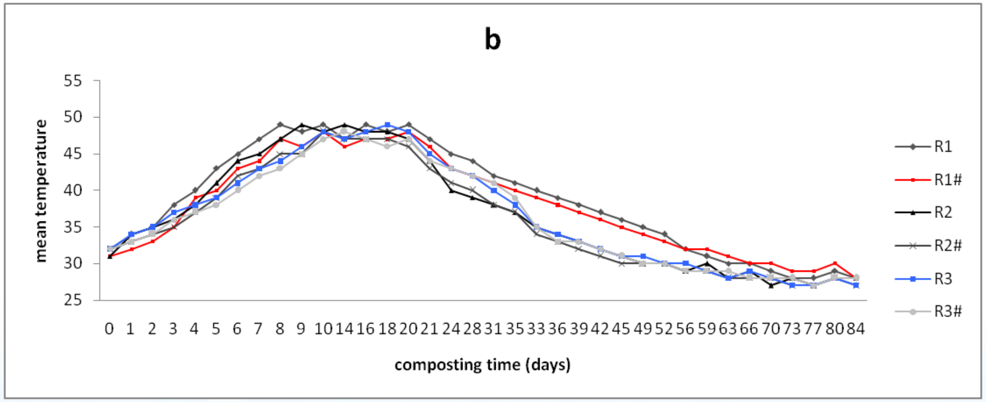
Raw material proportions for composting（wet weight，unit: gram）

treatment scheme	symbolic names	swine waste	corn stalk	rice husk	biological agent
corn stalk: swine waste=1:1	C1	2000	750.5	-----	13.75
corn stalk: swine waste=1:1(without addition)	C1#	2000	750.5	-----	-----
corn stalk: swine waste=1:1.5	C2	2000	500.3	-----	12.5
corn stalk: swine waste=1:1.5(without addition)	C2#	2000	500.3	-----	-----
corn stalk: swine waste=1:2	C3	2000	375.3	-----	11.9
corn stalk: swine waste=1:2(without addition)	C3#	2000	375.3	-----	-----
rice husk: swine waste=1:1	R1	2000	-----	750.5	13.75
rice husk: swine waste=1:1(without addition)	R1#	2000	-----	750.5	-----
rice husk: swine waste=1:1.5	R2	2000	-----	500.3	12.5
rice husk: swine waste=1:1.5(without addition)	R2#	2000	-----	500.3	-----
rice husk: swine waste=1:2	R3	2000	-----	375.3	11.9
rice husk: swine waste=1:2(without addition)	R3#	2000	-----	375.3	-----

Result and Discussion

⊕maturity indicators---temperature





1)corn stalk:

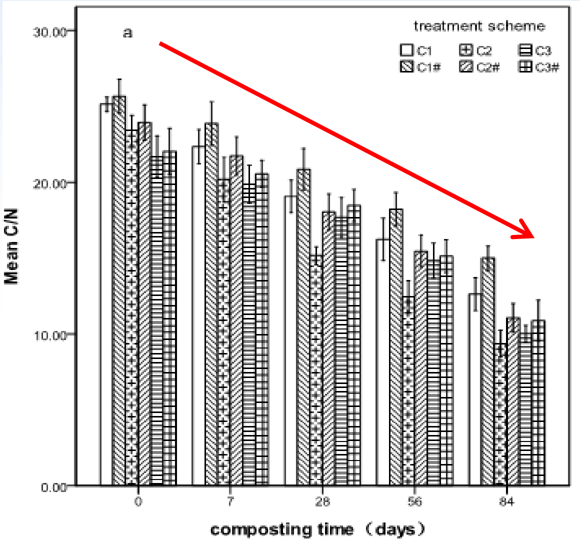
- rapid heating stage(0~7day), pyrolysis stage (8~16 day) and cooling maturation stage (after the 17day)
- C1 treatment reached the above 50℃ firstly
- All treatments satisfied Chinese hygienic standards

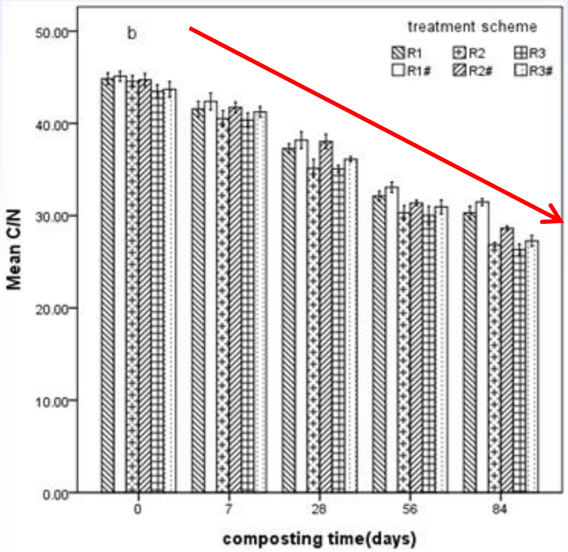
2)rice husk:

didn't reach 50℃ under the poor microorganism fermentation.

Result and Discussion

⌖maturity indicators---C/N





●corn stalk treatment with addition biological agent had significant difference （p=0.034）

●there were no significant difference among all the treatments of rice husk （p=0.257)

●downside during compost process

●corn stalk were below 20

●rice husk were above 25

●researches took C/N below 20 as maturity standard (Zhang,X.F.,Wang,H.T,2002; Larney, F.J., Hao ,X,2007)

Result and Discussion

⌖maturity indicators---GI

The significance test of seed germination index in different treatment schemes (mean±SD)

treatment scheme	7days	28days	56days	84days
C1	25.1±3.2(c)	34.6±4.3(bc)	42.7±5.9(bc)	73.7±9.3(ab)
C1#	21.4±2.4(c)	25.6±2.6(c)	38.5±5.1(d)	65.6±7.1(c)
C2	37.8±5.2(a)	45.7±6.3(a)	59.4±7.6(a)	76.1±8.5(a)
C2#	29.8±4.1(bc)	33.4±4.2(bc)	40.8±5.4(cd)	73.2±8.1(bc)
C3	33.5±4.6(ab)	39.5±4.5(ab)	47.5±6.3(b)	74.8±8.7(ab)
C3#	30.3±3.4(ab)	35.3±3.9(ab)	43.1±4.3(bc)	70±7.4(b)
R1	13.5±1.5(ab)	23.6±2.4(ab)	32.7±3.4(ab)	36.9±4.1(bc)
R1#	10.1±1.1(ab)	18.9±2.0(b)	26.3±2.8(b)	32.1±3.4(c)
R2	16.3±1.7(ab)	25.7±2.7(ab)	34.6±3.2(ab)	40.3±4.5(b)
R2#	15.2±1.9(ab)	23.4±2.5(ab)	31.5±2.9(ab)	39.6±4.2(bc)
R3	23.5±2.1(a)	32.8±3.4(a)	41.7±3.7(a)	50.4±8.3(a)
R3#	18.7±1.9(ab)	29.5±3.1(ab)	38.4±3.5(ab)	42.4±4.6(ab)

Researches considered compost product maturity when GI value reached 50%(Chefetz, B,et al,2003; .Riffaldi,R,et al,1996)

Result and Discussion

⌖maturity degree comparison

Classification of compost maturity level

	Best -maturity	Better- maturity	Basic-maturity	Immaturity
days for maintaining above 50℃/d	16	13	10	7
degradation rate of C/N/%	60	50	30	12
GI%	80	60	50	30

(the table was based on Zhang,H.Y,2013; Wang, D.Q.,Pan,S,2005)

Some conclusion were drawn by contrast-------

◆C2: best –maturity

◆C1#: basic- maturity

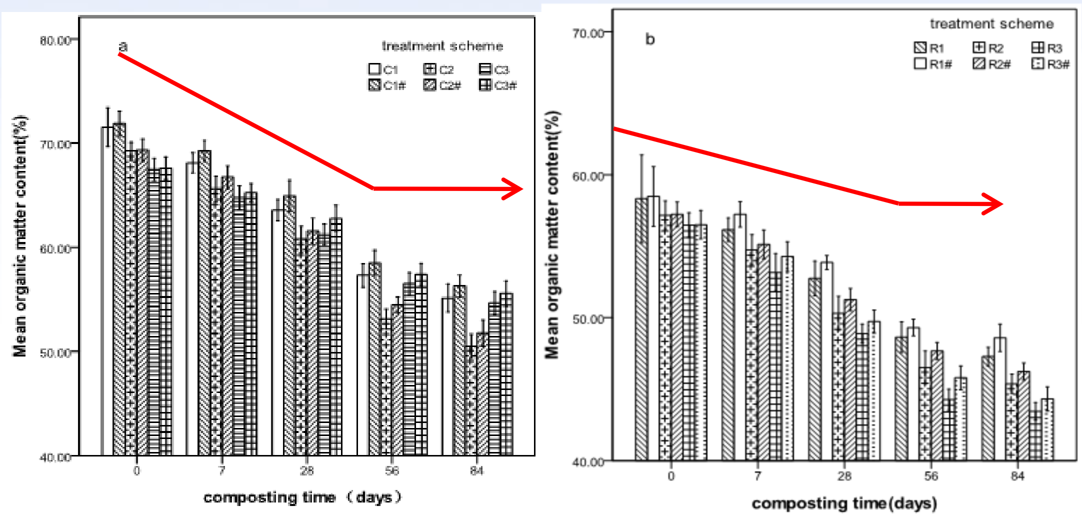
◆R1 and R1# were immaturity ,others were basic-maturity level

◆results illustrated organic matter got stability with the action of mineralization and humification

◆compost product of rice husk were in lower maturity.

Result and Discussion

⌖Organic nutrient indicators---OM content

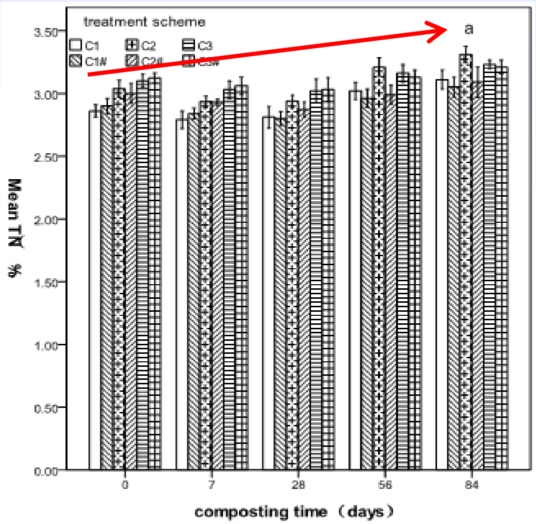


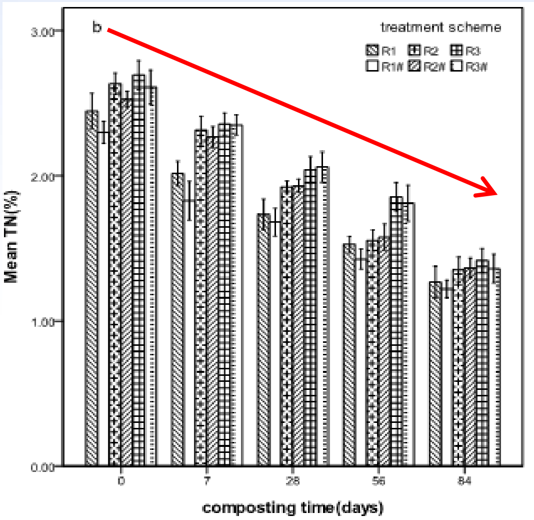
declining-ascending trend before 56days,then began to flatten

- OM content was in range 40.0%~75.0%(suitable scope)
- Variable amplitude of OM content of corn stalk was 12％～20％, rice husk was 10%~13%.
- C2 was lighter than C1and C3（p=0.026）
- C1#,C2#,C3# had no difference(p=0.067)
- there were no difference among rice husk treatments(p=0.103)

Result and Discussion

⊕Organic nutrient indicators---TN





TN changes of corn stalk and rice husk were in the opposite direction

✓corn stalk treatments with addition agent in proper order were C2>C3>C1

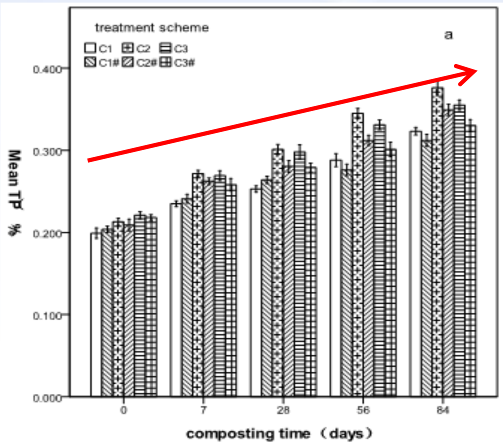
✓There were no difference in treatments without addition agent（p=0.127）

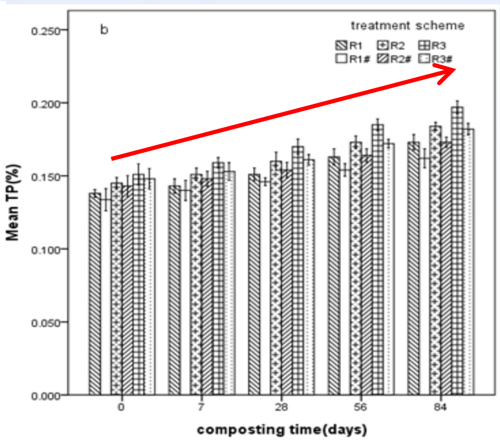
✓treatment with addition agent was lighter than treatment without addition in the same proportions

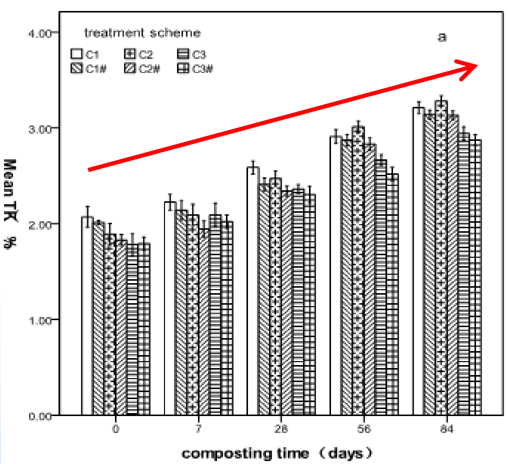
✓difference in rice husk treatments were not obvious（p=0.078）.

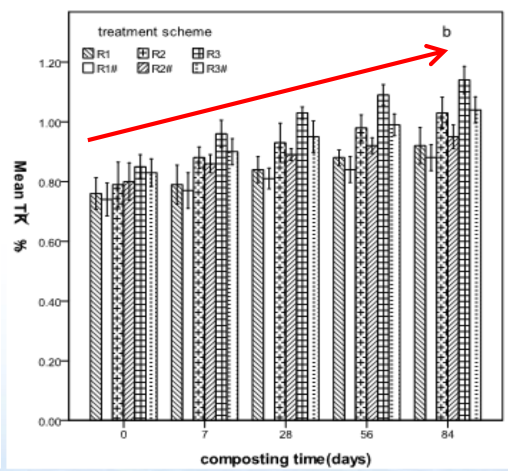
Result and Discussion

⊕Organic nutrient indicators---TP ,TK









●TK and TP promoted each other

●C2 was significantly larger than C1 and C3 （p=0.041）

●C1#,C2#,C3# had no difference (p=0.067)

● Difference in rice husk treatments were not obvious（p=0.351）

● there was negative correlation between TP and OM content （corn stalk :r=-0.938，p<0.01;rice husk: r=-0.847，p<0.001）

Result and Discussion

⌖Organic fertilizer quality comparison

grade standard of organic fertilizer quality and score grade standard

Rank	OM		TN		TP		TK		Total scores
	content/%	score	content/%	score	content/%	score	content/%	score	
1 level	>80	25	>3.0	40	>1.0	15	>4.0	20	86~100
2 level	50~80	20	1.5~3.0	32	0.5~1.0	12	2.0~4.0	16	71~85
3 level	30~50	15	0.5~1.5	24	0.3~0.5	9	1.0~2.0	12	56~70
4 level	15~30	10	0.3~0.5	16	0.1~0.3	6	0.6~1.0	8	41~55
5level	≤15	5	≤0.3	8	≤0.1	3	≤0.6	4	21~40

(the table was based on Organic fertilizer resources in China. China Agricultural Press.40-41,43(1999)

organic fertilizer quality grading of treatment schemes

	C1	C1#	C2	C2#	C3	C3#	R1	R1#	R2	R2#	R3	R3#
rank	2	2	2	2	2	2	4	4	3	4	3	3

◆organic fertilizer quality of all the corn stalk treatment up to 2 level;

◆R1、R1# and R2# treatment of rice husk were as worse as 4 level.

Result and Discussion

⌖Hygienic indicator

the number of E.coli and roundworm egg during the co-composting of corn stalk with swine waste

treatment scheme	value of E.coli					rate of roundworm egg destroyed(%)
	0 day	3 days	7 days	14 days	84 days	
C1	0.000001	0.0056	0.105	0.6	1.1	100.00
C1#	0.000001	0.0046	0.053	0.4	1.0	100.00
C2	0.000001	0.0036	0.046	1.1	3.6	100.00
C2#	0.000001	0.001	0.043	0.6	3.6	100.00
C3	0.000001	0.0006	0.036	0.1	0.6	100.00
C3#	0.000001	0.0001	0.01	0.1	0.4	100.00

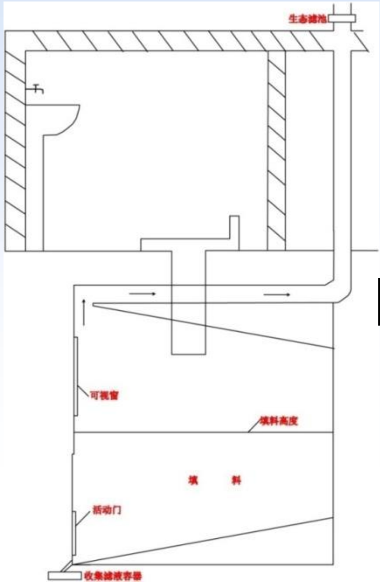
- ◆value of E.coli was within the scope of 0.01~0.1
- ◆rate of roundworm egg destroyed achieved in range of 95~100%.
- ◆Rice husk co-composting with swine waste didn't reach the set temperature, so hygienic indicators of them weren't in determination
- ◆hygienic indicators of corn stalk treatment schemes could satisfy the national standard.

Conclusion

- a good effect was proved by co-composting swine waste with corn stalk.
- corn stalk 1:1.5 ratio with addition of biological agent was the best treatment,1:1 ratio without addition was the worst .
- effect of biological agent on acceleration of degradation got verification.
- rice husk compost didn't reach ideal high temperature.
- except the treatment of rice husk mix swine manure as 1:2 ratio with agent, other treatments had lower and less effective products ,positive effect had no seen in the rice husk compost.

- corn stalk can be selected as a promising candidate for co-composting.
- efficient cellulose - decomposing microorganisms are suggested to separated and purified
- measures are taken to reduce productive and sale cost of biological agent

Demonstration project



Mentougou district , Beijing

Ecological toilet project
-----urine separate
----- faeces compost

human faeces

crop straws

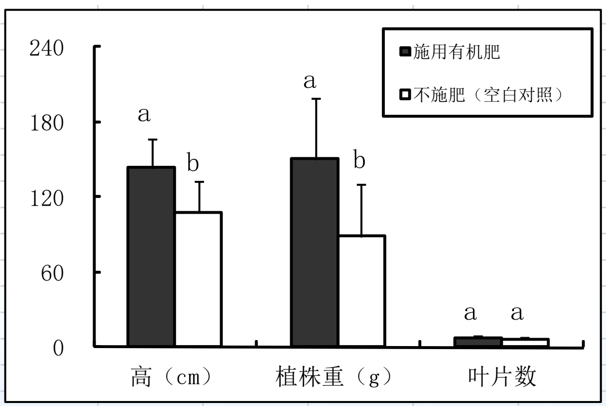
ashes

co-compost with the effect of biological agent

organic fertilizer

Demonstration project

Rural organic wastes in-situ aerobic biological treatment ---Zhejiang Province, China



effect contrast of organic fertilizer

- different seasons have different organic waste fruit(summer),crop straw(autumn)
- household waste co-compost with agriculture organic waste
- increase effect of maize growth

Thanks for attentions