Identifying Proper Application of Compost Produced in Mixed Crop-Livestock Farming for Rice Cultivation at Wanju Eco-Farming Complex

Lee, S.J.[1], Lee, S. H.[2], Kim, K. C.[3], Moon, Y. H.[4], Lee, K. D.[5] & Hwang, S. W.[6]

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Abstract

The test was carried out at a test field at the Wanju Eco-Farming Complex from 2009 to 2010 to figure out the proper application of fertilizers when growing rice at the Eco-Farming Complex. The result showed that when compared to the basal application of compost as fertilizer, applying supplementary compost after natural re-seeding of chinese milk vetch (CMV) helped balance soil nutrition and maintained rice yields.

Introduction

A large, environmentally sound farming complex was built in Wanju-gun, North Jeolla Province from 2006 to 2007, establishing a basis for organic farming such as Mixed Crop-Livestock Farming Center and Rice Processing Complex. Despite this, there has been no standard compost application in the Mixed Crop-Livestock Farming Center. Consequently, there have been concerns over soil-nutrition imbalance when cultivating organic rice. To address this concern, the present study aims to identify the proper application amounts of compost produced in the Mixed Crop-Livestock Farming Center.

Materials and methods

Chemical properties of the rice paddy and the composition of fertilizers used in the Wanju Eco-farming Complex were first analyzed. Basal fertilizer application and supplement application was applied at a ratio of 8:2. The basal fertilizers included only compost and compost after reseeding of Chinese milk vetch (CMV). They used oil cake as top dressing. The test was designed using four plots on the basis of 9kg/10a of nitrogen. The first rice plot was applied with compost as basal fertilizer and oil cake as top dressing. For the second plot, after applying CMV as basal fertilizer, compost and oil cake as top dressing was supplemented. The third plot was applied with chemical fertilizer. The forth plot was not fertilized.

[1] Wanju-gun Agricultural Development & Technology Center, Wanju, 565-860, Korea, E-Mail: agnes2050@korea.kr
[2] As above
[3] Jeollabuk-do Agricultural Research and Extension Services, Iksan, 570-704, Korea
[4] As above
[5] Department of Rice and Winter Cereal Crop, NICS, Iksan, 565-860, Korea
[6] As above

Results

Chemical properties of rice paddies and fertilizers at Wanju Eco-Farming Complex

Rice paddies at Wanju Eco-farming Complex had higher organic matter and phosphoric acid than conventional paddies that use chemical fertilizers and the amount exceeded the proper range (Tab. 1). The analysis of fertilizers showed that the nitrogen:phosphoric acid ration of the compost, CMV, and oil cake produced in the Mixed Crop-Livestock Farming Center was 1:1.9 , 1:0.1, and 1:0.5 (Tab. 2). The CMV can substitute 5.5kg/10a of nitrogen when it is returned to the field. (Tab. 3).

Tab. 1: Chemical properties of rice paddies at Wanju Eco-farming Complex (50 farms)

Properties	pH	EC	OM	Av.P_2O_5	Ex, Cation($cmol^+ kg^{-1}$)			Av.SiO_2
	(1:5)	($dS\,m^{-1}$)	($g\,kg^{-1}$)	($mg\,kg^{-1}$)	K	Ca	Mg	(mg/kg)
Organic Farming	6.1	0.7	35	232	0.5	4.9	1.5	151
Conventional Farming	5.6	0.6	25	146	0.4	4.5	1.2	112
Adequate Range	5.5-6.5	-	25-30	80-120	0.25-0.30	5.0-6.0	1.5-2.0	157-180

Tab. 2: Fertilizer composition (%)

Fertilizers	T-N	P_2O_5	K_2O
Compost	1.4	2.7	2.1
Chinese Milk vetch	1.4	0.2	3.0
Oil Cake	4.0	2.0	1.0

Tab. 3: Reseeding CMV and the amount of fertilizer (kg/10a)

Fresh Weight(A)	Dry Weight(B)	B/A	N	P_2O_5	K_2O	CaO	MgO
2,317	383	16.5	5.5	0.8	11.5	2.4	0.9

Changes in rice yield and chemical properties of soil according to organic fertilizer applications

In the case of applying compost after reseeding CMV as basal fertilizer, phosphoric acid levels fell greatly when compared to the rice plot applied with compost only. The plot applied with chemical fertilizer had the highest amount of rice yield followed by the plot that used compost only and the plot that used compost after reseeding CMV.

Tab. 4: Chemical properties of soil before and after the test (2009-2010)

Application	Time	pH (1:5)	EC (dS/m)	OM (g/kg)	Av.P_2O_5 (mg/kg)	Ex. cations($cmol^+/kg$)		
						K	Ca	Mg
Compost after CMV as basal fertilizer	Before	6.3	0.2	28	251	0.34	3.2	0.73
	After	6.0	0.1	26	223	0.23	3.0	0.55
Compost Only as basal fertilizer	Before	6.2	0.1	27	210	0.30	3.0	0.64
	After	6.1	0.1	31	198	0.15	3.1	0.45
Conventional Application (Chemical Fertilizer)	Before	6.3	0.1	28	173	0.25	2.6	0.60
	After	6.0	0.1	26	161	0.15	2.4	0.43
No Fertilizer	Before	6.2	0.1	27	158	0.23	2.6	0.48
	After	5.9	0.1	24	136	0.13	1.9	0.33

Tab. 5: Rice Yield per Each Test Field (2009-2010)

Application	Brown rice (kg/10a)	Tiller's number	Leaf number	1000-brown rice weight (g)	Percentage of ripened grains (%)
Chinese milk vetch as basal fertilizer (N5.5kg/10a) and Compost (N1.7kg/10a)	455	14	80	25.0	75
Compost only as basal fertilizer (N7.2kg/10a)	464	14	80	24.6	77
Chemical fertilizer (9-3-3kg/10a)	472	14	81	24.6	77
No fertilizer	422	13	77	24.7	79

Discussion

Wanju Eco-farming Complex has used compost for organic farming by nitrogen application standard, so phosphoric acid level in the soil rose (Tab. 2). Concentrated phosphoric acid in soil can affect the aquatic systems of rural areas, threatening the ecosystem of rivers and lakes. Therefore, there is a need to apply green fertilizers such as CMV (Tab. 3) that has a low property of phosphoric acid as basal fertilizer and use compost as supplement. Rice yield was 2% higher under the compost-only plot, but taking into the economic factors such as fertilizer expenses, CMV reseeding supplemented with compost application is more profitable as it effectively reduces phosphoric acid levels in the soil.

Conclusions

When Wanju Eco-farming Complex uses compost produced in the Mixed Crop-Livestock Farming Center for organic rice cultivation, based on 7.2 kg/10a of nitrogen in basal fertilizer, reseeding CMV and applying compost is the most proper method for the rice production and soil environment.

References

Kim, P. J., S. M. Lee, H. B. Yoon, Y. H. Park, J. Y. Lee, S. C. Kim (2000): Characteristics of phosphorus accumulation in organic farming fields. J. Korean Soc.Soil Sci. Fert. 33:234-241. (In Korean)

Shin, C. W., J. J. Kim, J. H. Yoon (1988): Studies on the characteristics of phosphorus in the upland soil. 1. Composition of accumulated phosphorus forms and available phosphorus. J. Korean Soc. Soil Sci. Fert. 21:21-29. (In Korean)