The effect of cow manure and neem compost toward NPK uptake, soil respiration, and rice production in organic paddy field in Imogiri Bantul, Indonesia

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Abstract. The research entitled "The Effect of Cow Manure and Neem Compost Toward NPK Uptake, Soil Respiration, and Rice Production in Organic Paddy Field in Imogiri Bantul" aims to recognize the effect of organic manure to soil respiration and the uptake of NPK and to compare between cow manure and neem compost which are able to provide NPK and efficiency of optimum uptake on rice. This research was conducted in Organic Field at Kebon Agung, ImogiriSubdistrict, Bantul Regency by using Randomized Complete Block Design (RCBD) with seven treatments and threereplications. The results showed that neem compost treatment has increased soil organic matter, soil CEC, total N, available N and K, P uptake, plant height and number of tiller. Using neem compost 15 ton/ha, showed better plant height, number of tiller and rice productivity.

1. Introduction

Paddy fields have been used intensively for more than a few decades to produce rice using inorganic fertilizers. Organic farming in principle focuses on nutrient cycling through harvesting by restoring some of the biomass into the soil, conserving water, and capable of delivering higher yields than conventional methods. Organic agriculture is the answer to the impact of modern agriculture that causes reduced soil fertility and environmental damage due to uncontrolled use of fertilizers and chemical pesticides [1]. All new potentials and technologies have been implemented in the fields but the results achieved do not match expectations. The growth of national rice production is slow, the productivity of paddy field is undergo declining process.

To meet the need for rice, the government has made many efforts to increase rice production nationally both quantitatively and qualitatively [2]. The presence of N, P and K in cow manure and neem compost, makes this waste become good organic fertilizer for the growth and development of rice crops. Superior varieties will not show their superiority without being supported by optimal cultivation techniques. One of them is fertilization. Proper use of fertilizers may support plant growth [3].

The soil is a complex and dynamic habitat for living large numbers of organisms, including representatives from all groups of microorganisms, algae, and almost all animal phyla. Each group of microorganisms has an important role in maintaining soil quality and ecosystem balance, potentially as a sensitive biological indicator of environmental change [4]. The way to calculate the population of the soil microorganisms is by measuring the respiration of the soil which is assumed that as the soil respiration becomes larger the number of microorganisms in the soil becomes larger.

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2. Materials and Methods

This research was conducted in May-September 2016 on organic rice field in Kebon Agung Village, Imogiri Sub-district, Bantul Regency. Analysis of soil chemistry and physical properties conducted at the Department of Soil, Faculty of Agriculture, Universitas Gadjah Mada, Yogyakarta. The experimental design used in this research is Randomized Complete Block Design (RAKL) with treatment factor the application of cow manure, neem compost and combination of cow manure & neem compost. The dose used are 7.5 ton/ha and 15 ton/ha. In each plot of treatment, three samples of plants were diagonally taken, the total number of plant samples are 63 plants. Observations were made nine times with once a week interval. The data of experimental results were analyzed by analysis of variance to determine the effect of treatments. The data obtained from the research were analyzed using analysis of variance (ANOVA) using SAS software to know the existence of the treatment that had significant difference at level α 0.05. If the results had significant different then continued with Duncan Multiple Range Test (DMRT) to investigate which treatment is significantly different.

3. Results and Discussion

3.1. Field general condition

Kebon Agung Village is one of the villages located at an altitude of 100 meters above sea level in Imogiri District. The highest temperature recorded in Imogiri District is 26º C and the lowest temperature is 23º C. In 2014, Kebon Agung village has a rice field area of 104 ha with productivity of 8.7 ton/ha [5]. Kebon Agung village has an abundant water source every year, because the location of rice fields in this village is irrigated water originating from Tegal Dam. Thus, water sources available throughout the year can be used to produce rice throughout the season. Rice fields used are rice fields that have been ten years using organic farming system with rice-rice-rice pattern. The dominant rice varieties planted by the farmers are mentiksusu and mentikwangi with 2:1 legowo planting system. Organic pesticide used is fermentation from gadung and galangal.

3.2. Initial soil properties

The soil in Kebon Agung village, Imogiri is Inceptisol. The initial soil properties analyzed included soil chemical and physical properties. The results of inceptisol soil analysis prior to treatment were as follows:

Table 1. Initial soil chemical and physical properties

No.	Parameters	Unit	Value	Level
1	Actual pH	-	6.74	Neutral
2	Potential pH	-	5.9	-
3	Organic-C	%	1.98	Low
4	Organic Matter	%	3.41	
5	CEC	$Cmol^{(+)}\ kg^{-1}$	19.17	Low
6	Total-N	%	0.255	Medium
7	Available-N:			
	NH_4^+	mg/kg	6.67	
	NO_3^-	mg/kg	7.29	
8	Available-P	Ppm	56.47	Very High
9	Available-K	$Cmol^{(+)}\ kg^{-1}$	0.43	Medium
10	Texture:			Loam
	Sand	%	47.05	
	Silt	%	31.89	
	Clay	%	21.06	

3.3. Organic fertilizers properties

Organic fertilizer applied in this research is cow manure and neem compost. Table 2 shows the chemical properties of cow manure and neem compost.

Table 2. Chemical properties of cow manure and neem compost

No.	Parameters	Unit	Cow manure	Neem Compost
1	pH	-	8.07	4.8
2	EC	dSm^{-1}	0.85	0.37
3	Organic-C	%	16.42	54.14
4	C/N ratio	%	23.13	22.46
5	Total-N	%	0.71*	2.41*
6	P	%	0.23	0.13
7	K	%	1.08	1.00

The organic fertilizer used in this research is cow manure and neem compost. The results of the analysis of both fertilizers showed the pH value 4–8 so it has met minimum technical standards of organic fertilizer. The EC value of cow manure is 0.85 dSm^{-1} whereas the neem compost is 0.37dSm^{-1}. The level of C-organic cow manure is 16.42% while the neem compost is 54.14%. The C-organic content of both fertilizers has met the Permentan standard (C-organic minimum ≥12%). The C/N ratio for both fertilizers has met the standard (C/N ratio of 15–25%). Total N of cow manure amounted to 0.71% and neem compost of 2.41%, therefore the total N of fertilizer not yet fulfill minimum standard of total N following Permentan which is 4%. Elements P and K have met minimum standards less than 6%.

In general, nutrient content in organic fertilizer is relatively low and a little slow is available. Composted organic fertilizers can provide nutrients in a faster time than in fresh form, because during the composting process there has been a decomposition process performed by several kinds of microbes, both in aerobic and anaerobic conditions. The use of organic fertilizer can increase the productivity of plants and the reduction of the use of chemical fertilizers, both on paddy field and upland. There is a positive interaction on the use of organic fertilizers and chemical fertilizers in an integrated manner. Wise use of chemical fertilizers is expected to have a better impact in the future. Not only on the condition of the land and the better harvest, but also on environmental sustainability [6].

3.4. Effects of treatment towards soil chemical properties actual- pH and potential-pH

These results indicate that the application of cow manure and neem compost in various doses have no significant effect on soil pH.

Table 3. Effect of treatment on soil actual pH and potential pH

Treatments	Actual-pH		Potential-pH	
	Vegetative	Generative	Vegetative	Generative
Cow Manure 7 tons/ha (A1B1)	6.73 a	6.79 a	5.78 a	5.83 a
Cow Manure 15 tons/ha (A1B2)	6.62 a	6.72 a	5.66 a	5.69 a
Neem Compost 7 tons/ha (A2B1)	6.56 a	6.75 a	5.84 a	5.74 a
Neem Compost 15 tons/ha (A2B2)	6.66 a	6.83 a	5.74 a	5.71 a
Cow Manure + Neem Compost 7 tons/ha (A3B1)	6.67 a	6.69 a	5.72 a	5.68 a
Cow Manure + Neem Compost 15 tons/ha (A3B2)	6.60 a	6.69 a	5.71 a	5.67 a
Control (A4B3)	6.65 a	6.63 a	5.72 a	5.65 a

Based on the results of analysis of variance, the treatment of cow manure and neem compost did not give significant effect to the pH value. The highest actual pH value was found in the treatment of 7.5 ton/ha of cow manure (A1B1) in the maximum vegetative phase at 6.73, while in the generative phase the highest actual pH was found in 15 ton/ha neem compost (A2B2) at 6.83. The lowest actual pH value was found in 7.5 ton/ha neem compost (A2B1) in maximum vegetative phase at 6.56, while in the generative phase the lowest actual pH was in the control treatment (A4B3) at 6.63.

The highest potential pH value at the maximum vegetative phase was found in 7.5 ton/ha of neem compost (A2B1) at 5.84, and the lowest value was in 15 ton/ha of cow manure (A1B2) at 5.66. In the generative phase the highest potential pH value was found in 7.5 tons/ha of cow manure (A1B1) at 5.83 and the lowest value was in the control treatment (A4B3) at 5.65. Potential pH has smaller value than actual pH due to the amount of H^+ present in the larger solution. According to [7] the potential pH value tends to be more constant than the actual pH value because the amount of H^+ contained in the solution is larger, thus reducing the fluctuation effect.

3.5. Soil organic matter

Organic matter is a part of the soil decomposed from crop residues or animal feces because it is influenced by biological, chemical and physical factors. The value of organic material obtained is the result from the conversion of C-organic soil.

Table 4. Effect of treatments on soil organicmatter

Treatments	Organic Matter (%)	
	Vegetative	Generative
Cow Manure 7 tons/ha (A1B1)	3.36 b	3.15 a
Cow Manure 15 tons/ha (A1B2)	3.25 b	3.73 a
Neem Compost 7 tons/ha (A2B1)	3.81 a	3.55 a
Neem Compost 15 tons/ha (A2B2)	3.39 b	3.45 a
Cow Manure + Neem Compost 7 tons/ha (A3B1)	3.31 b	3.25 a
Cow Manure + Neem Compost 15 tons/ha (A3B2)	3.26 b	3.18 a
Control (A4B3)	3.48 ab	3.47 a

From the table above, in the maximum vegetative phase the addition of cow manure and neem compost from various doses has an effect to the soil organic matter. The highest value of vegetative phase is from 7.5 ton/ha of neem compost (A2B1) at 3.81%. The lowest value of organic matter in the treatment of 15 tons/ha cow manure (A1B2) at 3.25%. In the generative phase, the application of cow manure and neem compost do not give significant effect on organic matter. The highest value of organic matter is in the treatment of 15 tons/ha cow manure (A1B2) at 3.73%. While, the lowest organic matter is in 7.5 tons/ha cow manure (A1B1) at 3.15%.

3.6. Cation exchange capacity

The result of the analysis of variance, Table 5 shows that the treatment of different types and doses of fertilizer did not affect the value of soil CEC in the vegetative phase, but significant effect in the generative phase.

Table 5. Effect of treatment on Cation Exchange Capacity (CEC) of soil

Treatments	CEC ($Cmol^{(+)}$ kg^{-1})	
	Vegetative	Generative
Cow Manure 7 tons/ha (A1B1)	24.12 a	23.29 ab
Cow Manure 15 tons/ha (A1B2)	23.06 a	24.51 a
Neem Compost 7 tons/ha (A2B1)	23.36 a	24.46 a
Neem Compost 15 tons/ha (A2B2)	24.21 a	23.01 ab
Cow Manure + Neem Compost 7 tons/ha (A3B1)	22.42 a	20.98 a
Cow Manure + Neem Compost 15 tons/ha (A3B2)	23.17 a	22.61 ab
Control (A4B3)	23.31 a	23.08 ab

In the vegetative phase, the highest CEC value was found in the addition of 15 tons/ha of neem compost (A2B2) at 24.21 $Cmol^{(+)}$ kg^{-1} and the lowest value was found in the combination treatment of cow manure and compost neem with 7.5 ton/ha (A3B1) at 22.42 $Cmol^{(+)}$ kg^{-1}. In the generative phase, the highest CEC value was found in 15 tons/ha of cow manure at 24.51$Cmol^{(+)}$ kg^{-1}, while the lowest CEC value was found in the combination treatment of cow manure and compost neem with 7.5 tons/ha (A3B1) at 20.98$Cmol^{(+)}$ kg^{-1}.

According to [8], the composting effect on the formation of basic cations due to the mineralization of the compost. Another factor that affects the cation exchange capacity in tropical soils is the pH. The high rate of decomposition causes organic matter to be utilized by soil microorganisms as source of energy and carbon, thus the CEC value after generative phase is decreasing from the value of vegetative phase.

3.7. Soil total nitrogen

The result of the analysis of variance, Table 6 shows that the treatment of different type and dose influences the soil total N in the vegetative phasebut did not give effect to soil total N in the generative phase.

Table 6. Effect of treatment on soil total N

Treatments	TN (%)	
	Vegetative	Generative
Cow Manure 7 tons/ha (A1B1)	0.302 b	0.242 a
Cow Manure 15 tons/ha (A1B2)	0.315 ab	0.246 a
Neem Compost 7 tons/ha (A2B1)	0.325 ab	0.163 a
Neem Compost 15 tons/ha (A2B2)	0.335 a	0.228 a
Cow Manure + Neem Compost 7 tons/ha (A3B1)	0.318 ab	0.206 a
Cow Manure + Neem Compost 15 tons/ha (A3B2)	0.323 ab	0.236 a
Control (A4B3)	0.318 ab	0.223 a

The highest soil total N in the maximum vegetative phase was foundin neem compost with 15 ton/ha (A2B2) at 0.335%. While the lowest total N value was found in cow manure with 7.5 tons/ha (A1B1) at 0.302%. The effect of the apparent difference in treatment was shown in A2B2 to A1B1. In the generative phase the highest total N value of soil in cow manure with 15 tons/ha (A1B2) at 0.246%. The lowest total N value of the soil was found inneem compost with 7.5 ton/ha (A2B1) at 0.163%.

This low nitrogen content can be caused by the amount of nitrogen lost by volatilization or leaching of nitrogen. One way to increase the total N content of the soil is by organic fertilization. From the experiment [9, 10] can be concluded that with the use of organic fertilizer on rice plant can produce higher content of organic and nitrogen than the use of chemical fertilizers. Organic fertilizers will release complete nutrients such as N, P and K during the mineralization process.

3.8. Soil available nitrogen

Based on the results of analysis of variance, Table 7 shows that the treatment of cow manure and neem compost at various doses gave significant effect towards the value of available N (ammonium and nitrate) both in the vegetative phase and in the generative phase.

Table 7. Effect of treatment on soil available Nitrogen (mg/kg)

Treatments	Vegetative		Generative	
	Ammonium	Nitrate	Ammonium	Nitrate
Cow Manure 7 tons/ha (A1B1)	2.56 cd	1.35 Abc	1.60 ab	1.44 ab
Cow Manure 15 tons/ha (A1B2)	2.93 bc	1.46 Abc	1.76 b	1.10 b
Neem Compost 7 tons/ha (A2B1)	3.09 abc	1.32 Abc	2.80 a	2.78 a
Neem Compost 15 tons/ha (A2B2)	2.29 d	1.14 C	1.07 b	0.54 b
Cow Manure + Neem Compost 7 tons/ha (A3B1)	3.58 a	1.21 Bc	1.11 b	1.61 ab
Cow Manure + Neem Compost 15 tons/ha (A3B2)	2.60 cd	2.17 Ab	1.37 ab	1.27 b
Control (A4B3)	3.23 ab	2.25 A	1.81 ab	1.67 ab

Soil available Nitrogen is consisting of ammonium and nitrate at the maximum vegetative phase, the highest ammonium content was found in combination treatment of cow manure and neem compost with 7.5 ton/ha (A3B1) at 3.58 mg/kg. The lowest ammonium value was found in the neem compost with 15 ton/ha (A2B2) of 2.29 mg/kg. The highest nitrate content wasfound in control treatment (A4B3) at 2.25 mg/kg. In the generative phase the effect of the significant difference of treatment was shown in ammonium A2B1 to A1B2, A2B2 and A3B1. In the generative phase the highest ammonium value was found in the neem compost with7.5 ton/ha (A2B1) at 2.80 mg/kg, while the lowest ammonium value is at the neem compost with 15 ton/ha (A2B2) at 07 mg/kg. The highest nitrate value was found in the neem compost with 7.5 tons/ha (A2B1) at 2.78 mg/kg, and the lowest nitrate was found in the neem compost with 15 tons/ha (A2B2) at 0.54 mg/kg. Similarly, ammonium in the generative phase. There was a significant effect ofnitratein A2B1 to A1B2, A2B2 and A3B2.

3.9. Soil available phosphorous

The results of the analysis of variance, Table 8 shows that the treatment of cow manure and neem compost various doses did not give effect to the P available soil in the maximum vegetative phase or in the generative phase.

Table 8. Effect of treatment of different types and doses of fertilizer to soil available phosphorus

Treatments	Available-P (ppm)	
	Vegetative	Generative
Cow Manure 7 tons/ha (A1B1)	63.75 a	61.21 a
Cow Manure 15 tons/ha (A1B2)	62.36 a	70.30 a
Neem Compost 7 tons/ha (A2B1)	65.03 a	59.34 a
Neem Compost 15 tons/ha (A2B2)	70.17 a	56.14 a
Cow Manure + Neem Compost 7 tons/ha (A3B1)	66.59 a	52.61 a
Cow Manure + Neem Compost 15 tons/ha (A3B2)	62.22 a	56.44 a
Control (A4B3)	61.62 a	64.12 a

Phosphorus is the second nutrient after N which is needed by plants. The availability of phosphorus in the soil greatly affects the productivity of the plant. Phosphorus levels in the soil come from the soil itself or from fertilization.

The highest available P in the maximum vegetative phase was found at in theneem compost with15 ton/ha (A2B2) at 70.17 ppm, while for the lowest available Pwas found in the control treatment (A4B3) at 61.62 ppm. In the generative phase, it has no further significant test results, but the highest available P was found in the cow manure with 15 tons / ha (A1B2) at 70.30 ppm, while the lowest available P was found inthe combination of cow manure and neem compost with 7.5 tons/ha (A3B1) at 52.61 ppm. It is seen that fertilizer treatment greatly affects the available P. In the vegetative phase the maximum treatment without fertilizer or control has a low available P when compared with other treatments. This is due to competition between rice plant and microorganisms due to the addition of large amounts of organic matter to the flooded soil [11].

Organic fertilizers can provide additional elements of P that can be used by plants. According to [12]it can also produce humificated materials that increase the availability of phosphorus from minerals because it makes the P-humic more easily absorbed plants.

3.10. Soil available potassium

The results of the analysis of variance, Table 9 shows that the treatment of cow manure and neem compost various doses have an effect on available K ground either in the maximum vegetative phase or in the generative phase.

Table 9. Effect of treatment of species difference and dose of fertilizer to soil available potassium

Treatments	Available-K ($Cmol^{(+)}$ kg^{-1})	
	Vegetative	Generative
Cow Manure 7 tons/ha (A1B1)	0.57 Ab	0.54 ab
Cow Manure 15 tons/ha (A1B2)	0.79 A	0.74 a
Neem Compost 7 tons/ha (A2B1)	0.47 B	0.48 ab
Neem Compost 15 tons/ha (A2B2)	0.50 B	0.27 b
Cow Manure + Neem Compost 7 tons/ha (A3B1)	0.41 B	0.39 ab
Cow Manure + Neem Compost 15 tons/ha (A3B2)	0.46 B	0.36 ab
Control (A4B3)	0.46 B	0.54 ab

The highest available K at the maximum vegetative phase was found in the cow manure with 15 ton/ha (A1B2) at 0.79 $Cmol^{(+)}$ kg^{-1}, while for the lowest available K was found in the combination cow manure and neem compost with 7.5 ton/ha (A3B1) at 0.41 $Cmol^{(+)}$ kg^{-1}. Treatment A1B2 has significant difference compare to other treatments.

In the generative phase, having further test results are significant difference, the highest available Kwas found in the cow manure with 15 ton/ha (A1B2) at 0.74$Cmol^{(+)}$ kg^{-1}. ppm, whereas the lowest available K was found in the neem compost with 15 ton/ha (A2B2) at 0.27 $Cmol^{(+)}$ kg^{-1}. Treatment of A1B2 was significant different from the A2B2 treatment.

Most of the available K in the media are encountered in interchangeable form. Potassium in the media solution is more easily absorbed by plants and more easily lost to leaching [13]. But of all treatments above the content of K is available moderate and there are some high.

3.11. Effect of treatments towards biological properties soil respiration

The results of the analysis of variance, Table 10 shows that the treatment of cow manure and neem compost in various dose has no significant effect on the soil respiration, both at the maximum vegetative and in the generative phase.

Table 10. Effect of treatment of species difference and fertilizer dose on soil respiration

Treatments	Respiration (mg CO_2/gram soil/day)	
	Vegetative	Generatif
Cow Manure 7 tons/ha (A1B1)	0.051 A	0.055 a
Cow Manure 15 tons/ha (A1B2)	0.051 A	0.056 a
Neem Compost 7 tons/ha (A2B1)	0.058 A	0.053 a
Neem Compost 15 tons/ha (A2B2)	0.052 A	0.059 a
Cow Manure + Neem Compost 7 tons/ha (A3B1)	0.050 a	0.056 a
Cow Manure + Neem Compost 15 tons/ha (A3B2)	0.052 a	0.053 a
Control (A4B3)	0.047 a	0.061 a

Note: The numbers followed by the same letters in the column show no significant difference between treatmentat level 5%

The highest soil respiration in the maximum vegetative phase was found in neem compost with 7.5 tons/ha (A2B1) at 0.058 mg CO_2/gram of soil/day, while the lowest was found in control treatment (A4B3) or without treatment at 0.047 mg CO_2/grams of soil/day. In the highest generative phase of soil respiration was found in control treatment (A4B3) at 0.061 mg CO_2/gram of soil/day, while the lowest was found in neem compost with 7.5 ton/ha (A2B1) and the cow manure and neem compost with 15 ton/ha (A3B2) at 0.053 mg CO_2/gram of soil/day.

Paddy field conditions in the vegetative phase and generative phase showed a tendency of increased soil respiration due to treatment. This is because the addition of organic matter into the soil can increase the number and activity of microorganisms, so the measured value of CO_2 becomes higher.

3.12. Effect pf treatments towards plant nutrients uptake nitrogen uptake and nitrogen content in plant tissue

Based on the results of analysis of variance is known that the whole treatment of cow manure and neem compost various dosesmight not give effect to N plant tissue and N uptake in rice plants.

Table 11. Effect of treatment of species difference and fertilizer dose on total nitrogen content in plant tissue

Treatments	TN Tissue (%)	
	Shoot	Root
Cow Manure 7 tons/ha (A1B1)	2.07 a	1.06 a
Cow Manure 15 tons/ha (A1B2)	2.55 a	1.35 a
Neem Compost 7 tons/ha (A2B1)	2.21 a	1.07 a
Neem Compost 15 tons/ha (A2B2)	2.58 a	1.37 a
Cow Manure + Neem Compost 7 tons/ha (A3B1)	2.28 a	0.90 a
Cow Manure + Neem Compost 15 tons/ha (A3B2)	1.73 a	0.95 a
Control (A4B3)	2.35 a	1.03 A

Note: The numbers followed by the same letters in the column show no significant difference between treatmentat level 5%

It can be seen that the nutrient content in the soil with the application of cow manure and neem compost is still low so that the nutrients absorbed by plants is also low which ultimately has no effect on N plant tissue and N plant uptake. The nitrogen content in plant tissue is affected by the absorption of nitrate and ammonium ions by plants. This is made possible by the slow movement of nitrogen especially in the form of NH^{4+} in the soil solution. The average nitrogen content in plant tissue is 2–4% dry weight [14]. At both the shoot and the root of the highest N tissue content was found in the neem compost with 15 tons/ha (A2B2) at 2.58% and 1.37%.

Table 12. Effect of treatment of species difference and fertilizer dose to rice plant nitrogen uptake

Treatments	N Uptake (mg/plant)			
	Shoot		Root	
Cow Manure 7 tons/ha (A1B1)	63.98	A	10.25	a
Cow Manure 15 tons/ha (A1B2)	63.37	A	8.43	a
Neem Compost 7 tons/ha (A2B1)	71.05	A	21.73	a
Neem Compost 15 tons/ha (A2B2)	67.82	A	9.72	a
Cow Manure + Neem Compost 7 tons/ha (A3B1)	63.52	A	8.86	a
Cow Manure + Neem Compost 15 tons/ha (A3B2)	66.78	A	10.90	a
Control (A4B3)	71.72	A	9.49	A

Note: The numbers followed by the same letters in the column show no significant difference between treatmentat level 5%

According to Table 12 that the addition of organic fertilizer can increase the absorption of N. The highest N uptake in the shoot was achieved in control (A4B3) or without treatment at 71.72mg/plant. This is because of the organic rice field itself has been used almost ten years organically so it is very fertile and affect the absorption of N shoot rice plant. At the highest root of N uptake rice was found in the neem compost with 7.5 ton/ha (A2B1) that is equal to 21.73 mg/plant, while the lowest N absorption at treatment of cow manure with 15 ton/ha (A1B2) at 8.43 mg/plant. The addition of manure can increase the total N of soil, so the needs of the plants can be fulfilled. Manure is an organic fertilizer made from cattle manure. When animal feed contains many elements of nitrogen then the resulting nutrient also contains many elements of N. With the increase of organic matter content in the soil will increase uptake N plants. Organic matter has a strong correlation with N plant uptake.

Organic fertilizer is able to provide higher N nutrients than inorganic fertilizers. In addition, with high concentrations make fertilizer to be more quickly available to plants [15]. According to [16], the increase in N uptake is expected to increase the efficiency of N by plants. In the practice of nitrogen fertilization absorbed by plants only ranged between 22–65% and the average efficiency of nitrogen uptake on irrigated land can only reach 45% [17].

3.13. Phosporous uptake and P content in plant tissue

Seen in table 13 the results showed that the treatment of cow manure and neem compost various doses have an effect on P total tissue in the shoot and plant roots.

Table 13. Effect of treatment of species difference and dosege of fertilizer on phosphorus levels in plant tissue

Treatments	P Tissue (%)			
	Shoot		Root	
Cow Manure 7 tons/ha (A1B1)	0.078	b	0.101	ab
Cow Manure 15 tons/ha (A1B2)	0.086	ab	0.110	a
Neem Compost 7 tons/ha (A2B1)	0.080	b	0.071	b
Neem Compost 15 tons/ha (A2B2)	0.087	ab	0.093	ab
Cow Manure + Neem Compost 7 tons/ha (A3B1)	0.076	b	0.073	b
Cow Manure + Neem Compost 15 tons/ha (A3B2)	0.110	a	0.081	ab
Control (A4B3)	0.090	ab	0.085	Ab

Note: The numbers followed by the same letters in the column show no significant difference between treatmentat level 5%

In the shoot section, the highest total P content of the tissue was found in the treatment of cow manure and neem compost with 15 tons/ha (A3B2) at 0.11%, while the lowest total P content of the tissue in cow manure and neem compost with 7.5 tons/ha (A3B1) at 0.076%. The highest total P value of tissue in the root part was found in the treatment of cow manure with 15 ton/ha (A1B2) that is equal to 0.11% and the lowest total P value of tissue in neem compost treatment with 7.5 ton/ha (A2B1) at 0.07%. P levels in plants below levels of N and K, which is about 0.1 to 0.2% [16]. In the heading section of the significant difference treatment seen on A3B2 against A1B1, A2B1 and A3B1. At the root of the treatment the significant difference was seen A1B2 to the treatment of A2B1 and A3B1.

Table 14. Effect of treatment of species difference and dosege of fertilizer on rice phosphorus uptake

Treatments	P Uptake (mg/plant)	
	Shoot	Root
Cow Manure 7 tons/ha (A1B1)	2.38 ab	0.89 a
Cow Manure 15 tons/ha (A1B2)	2.15 b	0.67 a
Neem Compost 7 tons/ha (A2B1)	2.59 ab	1.36 a
Neem Compost 15 tons/ha (A2B2)	2.27 ab	0.65 a
Cow Manure + Neem Compost 7 tons/ha (A3B1)	2.08 b	0.78 a
Cow Manure + Neem Compost 15 tons/ha (A3B2)	3.03 a	0.96 a
Control (A4B3)	2.71 ab	0.78 A

Note: The numbers followed by the same letters in the column show no significant difference between treatmentat level 5%

Table 14 showed the value of phosphorus uptake of plant tissue. Nutrient uptake has a relationship with the dry weight of the plant. The greater the nutrient content and the dry weight of the plant, the greater the nutrient uptake.Statistically, the above results show that there is no significant difference between the absorption treatment of maximum plant vegetative phase P in the crown section, whereas in the root part there is no significant difference. The absorption value of P plant tissue has almost the same value of each treatment. The highest P uptake of plant tissue was found in the cow manure and neem compost with 15 ton/ha (A3B2) that is equal to 3.03 mg/plant, while the lowest absorption was found in cow manure and neem compost with 7.5 ton/ha (A3B1) at 2.08 mg/plant. At the root, the highest absorption value was found in the neem compost with 7.5 ton/ha (A2B1) at 1.36 mg/plant, and the lowest absorption value was found in the neem compost with 15 ton/ha (A2B2) at 0.65 mg/plant. Multiple dose of manure has an effect on P uptake of plant tissue in shoot and root.

3.14. Potassium content in plant tissue and potassium uptake

In table 15 showed that the treatment of cow manure and neem compost various doses did not affect the total K content of shoot and can significantly affect the root of the plant.

Table 15. Effect of treatment of different types and doses of fertilizer on potassium levels in tisue

Treatments	K tissue(%)	
	Shoot	Root
Cow Manure 7 tons/ha (A1B1)	3.07 a	1.91 ab
Cow Manure 15 tons/ha (A1B2)	3.17 a	2.08 ab
Neem Compost 7 tons/ha (A2B1)	3.09 a	1.42 b
Neem Compost 15 tons/ha (A2B2)	3.17 a	1.91 ab

Cow Manure + Neem Compost 7 tons/ha (A3B1)	2.93	a	1.83	ab
Cow Manure + Neem Compost 15 tons/ha (A3B2)	2.56	a	2.32	a
Control (A4B3)	3.03	a	1.67	Ab

Note: The numbers followed by the same letters in the column show no significant difference between treatmentat level 5%

In the shoot section, the highest total K content of the tissue was found in 15 tons / ha of cow manure (A1B2) and 15 tons/ha of neem compost (A2B2) at 3.17%, while the lowest total K content of the tissue was found in 15 ton/ha of cow manure and neem compost (A3B2) at 2.56%. In the root section, the highest total K content was found in 15 ton/ha of cow manure and neem compost (A3B2) at 2.32% and the lowest total K content was found in 7.5 ton/ha of neem compost (A2B1) at 1.42%. Treatment of A3B2 and A2B1 have significant difference.

To obtain a certain amount of K, manure is needed more because the K content in manure is lower than that of straw due to increased moisture content in manure [18]. Thus, the application of manure 7.5 tons/ha is almost equivalent to KCl 150 kg/ha.In order to manage Pottasium well, the K absorption pattern by the plant needs to be known. The absorption pattern of K by rice plants follows a vegetative growth pattern (dry weight biomass). Approximately 75% of K requirement in rice plant is taken before generative phase and the remaining 25% is absorbed before starting seed formation. In rice, most of the K elements are found in straw (leaves and stems) at 89% [19]. In rice, K absorption stops once the plant enters the seed formation phase.

Table 16. Effect of treatment of species different and dosage of fertilizer to rice potassium uptake

Treatments	K Uptake (mg/plant)			
	Shoot		Root	
Cow Manure 7 tons/ha (A1B1)	94.59	a	16.82	a
Cow Manure 15 tons/ha (A1B2)	77.17	a	13.33	a
Neem Compost 7 tons/ha (A2B1)	99.50	a	22.48	a
Neem Compost 15 tons/ha (A2B2)	82.38	a	12.68	a
Cow Manure + Neem Compost 7 tons/ha (A3B1)	81.26	a	18.24	a
Cow Manure + Neem Compost 15 tons/ha (A3B2)	97.01	a	25.30	a
Control (A4B3)	90.76	a	15.60	A

Note: The numbers followed by the same letters in the column show no significant difference between treatmentat level 5%

In table 16, the results of tissue uptake of K statistically show no significant difference between the treatments in the shoot and root of plant. In the shoot, the highest K absorption was found in the neem compost with 7.5 ton/ha (A2B1) at 99mg/plant, whereas the lowest K plant absorption was found in the cow manure with 15 ton/ha (A1B2) at 77.17 mg/plant. The highest value of K plant uptake in the root was found in the cow manure and neem compost with 15 ton/ha (A3B2) that is equal to 25.30 mg/plant and the lowest K plant absorption was found in neem compost with 15 ton/ha (A2B2) at 12.68 mg/plant.

The higher the availability of K in the soil, the higher K uptake by the plant. If the availability of K in the soil in large quantities, then the absorbed plants also become increasing. Intake of K nutrients by plants depends on the level of K nutrient availability in the soil, if the nutrient amount is high, nutrient uptake will also increase. In the flooding process of rice plants can also affect the absorption of K by plants, for example in the treatment that yields the highest K uptake. The process of moisture content in a reduction atmosphere encourages the release of K^+ to be exchanged into soluble form by

stimulating Fe^{3+} and Mn^{4+}, in which soluble K^{+} can reach the maximum value at the peak of soil reduction [20].

3.15. Effect of treatment towards characteristic growth of rice plant

The observations on the growth component of MentikSusu rice variety showed that the combination of fertilizer treatment can increase the rice growth component.

Table 17. Plant height and number of tiller paddy field nine week after planting

Treatments	Parameters			
	Height (cm)		Tillers	
Cow Manure 7 tons/ha	109.33	bc	24.89	ab
Cow Manure 15 tons/ha	118.11	ab	21.78	b
Neem Compost 7 tons/ha	118.56	ab	25.67	ab
Neem Compost 15 tons/ha	122.22	a	28.00	a
Cow Manure + Neem Compost 7 tons/ha	114.78	ab	24.67	ab
Cow Manure + Neem Compost 15 tons/ha	121.11	a	23.11	ab
Control	102.44	c	20.11	B

Note: The numbers followed by the same letters in the column show no significant difference between treatmentat level 5%

Table 17 shows that the difference of fertilizer showed significant difference in plant height and number of tillers. This shows the difference of nutrient content in soil absorbed by plants in fertilizer treatment and without fertilizer.

Treatments that gave the best plant height and number of tillers were found in the neem compost with 15 ton/ha (A2B2) with plant height 122.22 cm and number of tillers 28. This shows that A2B2 is the best treatment. In the neem compost give higher and better plant and the number of tillers, than the treatment of cow manure, because the nutrient content of neem compost is higher than that of cow manure. Neem compost contains 6% N, 1% P and 2% K [21].

3.16. Rice productivity

Based on the figure 1 rice productivity gives a significant difference between the treatment of fertilizer without treatment.

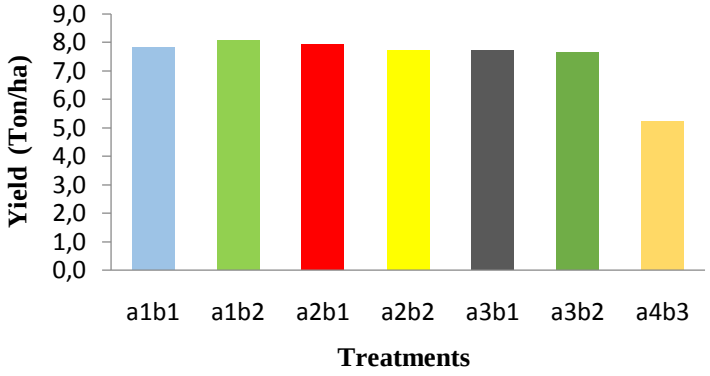

Figure 1. Productivity of Organic paddy field in Kebon Agung Village, Imogiri, Bantul.

Note
A1B1: Cow Manure 7 tons/ha
A1B2: Cow Manure 15 tons/ha
A2B1: Neem Compost 7 tons/ha
A2B2: Neem Compost 15 tons/ha
A3B1: Cow Manure + Neem Compost 7 tons/ha
A3B2: Cow Manure + Neem Compost 15 tons/ha
A4B3: Control

The highest rice productivity was found in the cow manure with 15 ton/ha (A1B2) dose and the lowest productivity in the treatment without fertilizer (A4B3). Allocation of organic fertilizer can increase production ranging from 1.49 to 1.65 ton/ha or 20–23% [22]. In accordance with the productivity of paddy, the treatment of cow manure with 15 ton/ha (A1B2) is the best treatment because it can produce the highest amount of production. Proper use of fertilizers may support plant growth [3]. However, there is no significant difference between fertilization treatments. This is because rice might not produce optimally because at the age of 14 week after planting rice has fallen. Topple can be caused by the high state of the plant, the rice grains start to fill up, and when the wind blows fast enough then the fragile rice will be easy to fall.

4. Conclusion

The treatment of different types of fertilizers and doses has significant effect on organic materials, soil CEC, soil total N, soil available N, soil available K, P uptake, plant height and number of tillers.Treatment of different types and doses of fertilizers based on the number of tillers and plant height showed that the neem compost with 15 ton/ha (A2B2) was the optimum dose on MentikSusu varieties rice in InceptisolImogiri.

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