Effect of Organic Fertilizer on Growth and Yield Components in Rice (*Oryza sativa* L.)

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Abstract

In order to study the effect of organic fertilizer on growth and yield components in rice, an experiment was carried out in 2008 and 2009, in randomized block design based on 4 replications. The chicken manure, cow manure and paddy rice were mixed together in 1:1:0.5 ratio to from organic fertilizer. The treatments of organic fertilizer were given in 5 levels (0.5, 1.0, 1.5, 2.0 and 2.5 ton/ha). At one level organic fertilizer 1.5 ton/ha was mixed with inorganic fertilizers (N-50, P-25, K-25 kg / ha) and recommended dose of inorganic fertilizer-NPK (N=100, P=50, K=50 kg/ha) was used as check. The plants without treatments were served as control. Grain yield and its components were significantly increased in all the treatments over control. The maximum grain yield in 2008 (4335.88 kg/ha) was noted in plants treated with 2 ton/ha organic fertilizer and it was (4662.71 kg/ha) for 2009 for plant treated with combination of chemical fertilizer + 1.5 ton/ha organic fertilizer. An increase in the grain yield at the abovementioned treatments was may be due to the increase of 1000-seed weight, panicle number, number of fertile tiller, flag leaf length, number of spikelet, panicle length and decrease number of hollow spikelet per panicle.

Keywords: Organic fertilizer, Rice, Grain yield

1. Introduction

In the past few decades, chemical fertilizers have widely spread throughout the world focusing that the soil is inert medium for plant roots, rather than as a living biosphere in which the crop is only one of hundreds or thousands of interacting species. However, it is now realized that in fields under intensive monoculture which receive heavy applications of chemical fertilizers alone, there is a slow decline in productivity. This decline occurs even in irrigated paddy fields (FFTC, 1998).

Applications of nitrogen fertilizers are responsible for emissions of green house gases like nitrous oxide (N_2O) and ammonia (NH_3). Besides supplying nitrogen, ammonia can also increase soil acidity. Excessive nitrogen fertilizer applications lead to pest problems by increasing the birth rate, longevity and overall fitness of certain pests (Jhan 2004, Jhan *et al*. 2005).

Experience in tropical Asian countries generally shows that organic farming alone does not supply enough nutrients, and organic fertilizers need to be supplemented by a basal dressing of chemical fertilizer.

However, over a longer period of time, applications of organic materials such as livestock manure and crop residues have been found to bring about a gradual improvement in soil productivity and crop performance. A study carried out on five crops in Japan showed that applications of organic matter enhance root growth and nutrient uptake, resulting in higher yields (FFTC, 1998).

Another benefit from the increased use of organic materials is that it can help to solve pollution problems caused by agro-industrial wastes. However, the soil must not be seen as a dumping ground for organic wastes. If too much nitrogen fertilizer is applied, whether in the form of organic matter or chemical fertilizer, some of the excess nitrogen is converted to nitrates, which are harmful to human health (Preap *et al.* 2002). Improper use of organic fertilizers can cause nitrates to accumulate in groundwater, and also in crops if they are taken up by the plant roots.

In the light of these problems, it was planned to study the effect of organic fertilizer based on cow manure, poultry manure and paddy rice on growth and yield components in rice.

2. Materials and methods

This experiment was carried out at Baykola Research Center, Neka, Mazandaran, Iran in 2008 and 2009. The research plot was located in 36°, 60□ N and 53°, 13□ E and 4 meters above of sea level. There were total eight treatments including control. The treatments were arranged in randomized complete block design based on four replications. Organic fertilizer was used at five levels: 0.5, 1.0, 1.5, 2.0 and 2.5 ton/ha, chemical fertilizers (N=100, P=50, K=50 kg/ha) at one level and mixture of organic and chemical fertilizers (N-50, P-25, K-25 + organic fertilizer 1.5 ton/ha) at one level. The plants without treatments were served as control. Nitrogen in the form of urea was given in tree doses at the time transplanting, at tillering and flowering stage.

Hand weeding was done after 3 weeks of transplantation and regular disease control measures recommend for rice were followed to avoid any disease incidence. Plants were irrigated with regular intervals.

At the time of harvesting eight hills were selected from each plot for counting total number of tillers and total number of fertile tillers per hill. Total eight samples were cut from ground level from each plot for measuring the plant height, flag leaf length and panicle length and panicle number. Plants were cut from one square meter area from the centre of each plot for measuring panicle number, grain yield, weight of 1000-seeds and biological yield. Ten panicles were randomly selected from each plot for counting total number of spikelet per panicle and total number of hollow spikelet per panicle.

3. Results

The results depicted in Table (1) showed that plant height, total number of tiller per hill, flag leaf length and dry matter were significantly increased in all the treatments over control.

Maximum plant height in 2008 was noted in plants treated with 2 ton/ha organic fertilizer (132.22cm), it was followed by organic fertilizer+ NPK (131.38 cm) and NPK alone (130.47 cm) and minimum of that was for 0.5 ton/ha organic fertilizer (126.56 cm), whereas control plants showed 122.44 cm as an average plant height but in 2009 the maximum plant height was observed in application of organic fertilizer+ NPK (139.44 cm), it was followed by 2 ton/ha organic fertilizer (139.31 cm), then NPK (138.06 cm) and minimum of that was for 0.5 ton/ha organic fertilizer (134.31 cm), whereas control plants showed (128.94 cm) as an average plant height.

Highest total number of tillers were observed in plots treated with 2 ton/ha organic fertilizer (11.19), it was followed by organic fertilizer+ NPK (11.03) and NPK alone (10.66) and minimum of that was for 0.5 ton/ha organic fertilizer (9.75) against untreated control (9.63). On the other hand in 2009 it was seen that majority of total number of tillers per hill was observed in organic fertilizer + NPK (13.01), after that it was in plants treated with organic fertilizer 2 ton/ha (12.87) and chemical fertilizer (12.47) also the minimum of total number of tillers per hill was in plot treated through 0.5 ton/ha organic fertilizer (11.19), simultaneously in control total number of tillers was (10.94).

The flag leaf length in control plant was (28.17 cm), while maximum flag leaf length was noted in plants treated with 2.0 ton/ha organic fertilizer (29.48 cm). The plants treated with chemical fertilizer in combination with organic fertilizer exhibited 29.28 cm flag leaf length and was followed by chemical fertilizer treated plants (29.27 cm). Even so in 2009 the best flag leaf length was exhibited by chemical fertilizer in combination with organic fertilizer (29.97 cm), followed by organic fertilizer 2 ton/ha (29.83 cm) and chemical fertilizer (29.66 cm), also the minimum flag leaf length was as result of 0.5 ton/ha organic fertilizer (28.71 cm), while in control flag leaf length was 28.46 cm.

Data cornering to dry matter accumulation clearly indicate that more dry matter accumulation significantly increased in all the treatments and more dry matter accumulation (51.35 g) was observed in plants grown in plots treated 2.0 ton/ha organic fertilizer, however, in 2009 it was noted for organic fertilizer + NPK (54.20 g) and followed by organic fertilizer 2 ton/ha (53.94 g) and organic fertilizer 2.5 ton/ha (53.41 g). The least quantity dry matter accumulation was seen in plots treated in 0.5 ton/ha organic fertilizer (49.78 g), while in control it was 46.56 g.

The results given in Table (2) showed that number of fertile tillers per hill, panicle number per square meter and panicle length significantly increased in all the treatments over control.

Maximum number of fertile tillers were observed in plots treated with 2 ton/ha organic fertilizer (10.53), it was followed by 2.5 ton/ha organic fertilizer (10.51) and organic fertilizer in combination with NPK (10.48), chemical fertilizers alone (10.28) and minimum of that was for 0.5 ton/ha organic fertilizer (9.50) against untreated control (9.47). On the other hand in 2009 it was seen that maximum total number of tillers per hill was noted in organic fertilizer + NPK (10.63), after that it was in plants treated by organic fertilizer 2 ton/ha (10.59) and chemical fertilizer (10.44), also the minimum of total number of tillers per hill was in plot treated through 0.5 ton/ha organic fertilizer (9.72), simultaneously in control total number of tillers was 9.49.

Maximum number of panicles per square meter area was noted in plants treated with 2 ton/ha organic fertilizer (329.58), it was followed by organic fertilizer in combination with NPK (326.27) and 2.5 ton/ha organic fertilizer (324.81) and minimum of that was for 0.5 ton/ha organic fertilizer (310.57), whereas control plants showed 306.17 as an average panicle number in said unit area, but in 2009 the utmost panicles per square meter area was noticed for organic fertilizer 1.5 ton/ha + NPK (343.28), afterward plot treated by organic fertilizer 2 ton/ha (341.04) then plot treated with organic fertilizer 2.5 ton/ha (335.69), and the minimum amount of panicles per square meter area was for 0.5 ton/ha organic fertilizer (327.63), although control plants showed 308.50 panicles.

Panicle length in control plant was (22.22 cm), while maximum panicle length was noted in plants treated with 2.0 ton/ha organic fertilizer (22.89 cm). The plants treated with chemical fertilizer in combination with organic fertilizer exhibited 22.82 cm panicle length and was followed by chemical fertilizer treated plants (22.73 cm), Even so in 2009 the more panicle length was observed in plot treated with chemical fertilizer in combination with organic fertilizer 1.5 ton (25.50 cm), followed by organic fertilizer 2.0 ton/ha (25.45 cm) and plot treated with chemical fertilizer (25.34 cm). Minimum panicle length was shown by organic fertilizer 0.5 ton/ha (24.95 cm), whereas in control the panicle length was 24.56 cm.

The data depicted in Table (3) reveal that number of spikelet per panicle increased in all the treatments and number of hollow spikelet per panicle significantly decreased over control.

Maximum number of spikelets per panicle was observed in plants treated with 2 ton/ha organic fertilizer (90.98), it was followed by organic fertilizer+ NPK (89.82) and 1.5 ton/ha organic fertilizer (89.55) and minimum of that was for 0.5 ton/ha organic fertilizer (85.50), whereas control plants showed 80.18 as an average spikelet number per panicle. The chemical fertilizer (NPK) significantly increased number of spikelets per panicles, however the increase was only 8.29 percent over untreated control, whereas in 2.0 ton/ha organic fertilizer treatment it was 13.47 percent and chemical fertilizer in combination with organic fertilizer showed 12.02 percent increase over untreated plants. In 2009 maximum number of spikelet per panicle (99.40) was exhibited by chemical fertilizer in combination with organic fertilizer, and the next was for organic fertilizer 2.0 ton/ha (98.64) and plot treated with 2.5 ton/ha organic fertilizer (97.35), the minimum number was seen in plot treated with 0.5 ton/ha organic fertilizer (92.72), whereas in control the number of spikelet per panicle was 86.34.

The data concerning to hollow spikelets clearly indicate that number of hollow spikelets per panicle significantly decreased in all the treatments except chemical fertilizer treated plants as against untreated plants. Maximum number of hollow spiklets per panicle (8.15) was observed in plants treated with chemical fertilizer (NPK). Rest all the treatments decreased number of hollow spikelets and maximum decrease (11.46 %) was noted in plants treated with organic fertilizer in combination with chemical fertilizers (NPK) and it was followed by in 2 ton/ha organic fertilizer (5.48 %) and 1.5 ton/ha organic fertilizer (3.82 %) and minimum of that was for 0.5 ton/ha organic fertilizer (0.38%). However, in 2009 the maximum number of hollow spikelets per panicle was found in plants treated with chemical fertilizer (9.54), after that plots treated by organic fertilizer 0.5 ton/ha (8.94), then plots treated with organic fertilizer 1.0 ton/ha (8.80). Lowest number of hollow spikeletes (7.90) was exhibited by organic fertilizer 1.5 ton/ha + NPK, while in control the number of hollow spikeletes per panicle was 8.98.

The data presented in Table (4) reveal that 1000-seed weight, grain yield, and biological yield significantly increased in all the treatments over control.

Maximum 1000-seed weight was noted in plants treated with 2 ton/ha organic fertilizer (25.42 g), it was followed by organic fertilizer in combination with NPK (25.40 g) and 2.5 ton/ha organic fertilizer (25.06 g) and minimum of that was for 0.5 ton/ha organic fertilizer (23.38 g), whereas control plants showed 22.92 g as an average 1000-seed weight. The chemical fertilizer (NPK) significantly increased 1000-seed weight (25.02 g); however the increase was 9.18 percent over untreated control, whereas in 2.0 ton/ha organic fertilizer treatment it was 10.90 percent and chemical fertilizer in combination with organic fertilizer showed 10.84 percent increase

over untreated plants. On the other hand in 2009 maximum 1000-seed weight (27.16 g) was exhibited by chemical fertilizer in combination with organic fertilizer, afterward plot treated by organic fertilizer 2.0 ton/ha (27.12 g) and in plot treated through chemical fertilizer (27.06 g). Moreover the least 1000-seed weight was shown by organic fertilizer 0.5 ton/ha (25.02 g), whereas in control 1000-seed weight was 23.06 g.

Maximum grain yield was observed in plots treated with 2 ton/ha organic fertilizer (4335.88 kg/ha), it was followed by organic fertilizer in combination with NPK (4334.32 kg/ha), 2.5 ton/ha organic fertilizer (4332.56 kg/ha) and in chemical fertilizers it was 4256.37 kg/ha. Whereas, minimum grain yield (4001.92 kg/ha) was noted in the plot treated with 0.5 ton/ha organic fertilizer as against untreated control (3925.00 kg/ha). Even so in 2009 the more grain yield was noted for organic fertilizer+ NPK (4662.71 kg/ha), after that plot treated with organic fertilizer 2.0 ton/ha (4650.73 kg/ha), then plot treated with NPK (100:50:50) (4425.65 kg/ha), as well as the minimum amount of grain yield was identified in plot treated with 0.5 ton/ha organic fertilizer (4127.91 kg/ha), whereas control it was 3962.79 kg/ha.

Biological yield in control plant was 6434.61 kg/ha, while maximum biological yield was noted in plants treated with 2.0 ton/ha organic fertilizer (7863.00 kg/ha). The plants treated with chemical fertilizer showed 7805.51 kg/ha biological yield and was followed by chemical fertilizer in combination with organic fertilizer treated plants (7722.92 kg/ha). In 2009 the highest amount of biological yield was viewed through organic fertilizer+ NPK (8207.59 kg/ha), afterward plot treated by organic fertilizer 2 ton/ha (8175.00 kg/ha) and plot treated with chemical fertilizer (8027.61 kg/ha). Moreover the least amount of biological yield was seen with 0.5 ton/ha organic fertilizer (7162.50 kg/ha), while in control it was shown to be 6512.50 kg/ha.

The data related soil physical and chemical properties are given in table 5. The results clearly indicate that soil properties are improved due to application of organic fertilizer.

4. Discussions

Chemical fertilizer offers nutrients which are readily soluble in soil solution and thereby instantly available to plants. Nutrient availability from organic sources is due to microbial action and improved physical condition of soil (Sarker *et al*. 2004). The increase in plant height, number of tillers per hill, spikelet number per panicle, grain yield and 1000-grain weight in response to application of organic and chemical fertilizers is probably due to enhanced availability of nutrients. The variation in plant height due to nutrient sources was considered to be due to variation in the availability of major nutrients. Muhammad *et al*. (2008) observed similar results with application of organic manure and compost in rice. The available nutrients might have helped in enhancing leaf area, which thereby resulted in higher photo-assimilates and more dry matter accumulation. These results are supported by the findings of Swarup and Yaduvanshi, (2000) and Yadana *et al*. (2009). The increase in fresh weight has also been reported by Sarwar *et al*. (2008).

Tillering is an important trait for grain production and is thereby an important aspect in rice yield. Mirza et *al*. (2010) reported increase in number of tillers in rice plants due to influence of different fertilizer combinations. According to them more number of tillers per square meter might be due to the more availability of nitrogen, which plays a vital role in cell division. Organic sources offer more balanced nutrition to the plants, especially micro nutrients which positively affect number of tiller in plants (Miller, 2007).

In case of any plant, leaves are important organs which have an active role in photosynthesis. To achieve high yield maximization of leaf area is an important factor. In present investigation we found that organic fertilizer alone and in combination with chemical fertilizers significantly increased the flag leaf length over untreated control. Similar findings are reported by Mirza *et al*. (2010). The increase in leaf number as well as size due to enough nutrition can be explained in terms of possible increase in nutrient absorption capacity of plant as a result of better root development and increased translocation of carbohydrates from source to growing points (Singh and Agarwal, 2001). The yield components of rice crop *viz*., number of panicle per square meter, number of filled grains/panicle, unfilled grain percentage and 1000-grain weight showed significant differences due to treatments. Salem (2006) reported that application of FYM along with nitrogen fertilizer significantly increased number of panicles per square meter, panicle length, panicle weight, number of filled grains/panicle, 1000-grain weight and grain yield in rice.

The productivity of rice plant is greatly dependent on the number of productive tiller (tillers which bears panicle) rather than the total number of tillers. In present investigation maximum number of fertile tillers and spikelet per panicle were observed in the all the treated plants. From this study it was observed that excess application of inorganic fertilizers is not necessary to produce effective tillers if we can supplement it from organic manures, which also help in providing essential micronutrients to the plants (Miller, 2007; Rakshit *et al*., 2008). Mirza *et al*. (2010) also reported similar results in rice.

In present study we observed reduction in hollow spikelets in all the treated plants except chemical fertilizer treated plants. Similar observations were made by Luong and Heong (2005). They observed reduction in unfilled grain percentage, increase in grain weight of rice with application of organic manure. Bala *et al.* (2008) suggested application of Mo with organic matter to produce highest number of panicle / hill, spikelets / panicle and grains.

The increase in biological and grain yield could be due to the increase in yield attributes (plant height, number of productive tillers/hill, panicle weight and 1000-grain weight) consequently (Ebaid *et al*., 2007). A significant difference in 1000-grain weight of rice as affected by variation in fertilizer packages was also observed by Mirza *et al*. (2010). These results were supported by Channabasavanna and Biradar (2001). The increase in grain yield components can be due to the fact that available more water enhanced nutrient availability which improved nitrogen and other macro- and micro-elements absorption as well as enhancing the production and translocation of the dry matter content from source to sink. Ebaid *et al*. (2007). Similar results were reported by El- Weheishy and Abd El-Hafez (1997), Awad (2001) and El-Refaee *et al*. (2006).

From the above discussion it is clear that organic fertilizer have a significant influence on growth and productivity in rice. Organic ferthilizer can be a better supplement of inorganic fertilizer to produce better growth and yield. All the treatments showed significant influence on growth and productivity of rice. Form the present study it was observed that 1.5 ton/ha organic fertilizer along with 50 % recommended chemical fertilizer could give similar yield. However, among organic fertilizer treatments the 2.0 ton/ha itself produced the better grain yield compared to others organic fertilizer treatments. From the economic point of view farmers can use the combination of organic fertilizer and reduced rate of inorganic fertilizers to boost the yield of rice as well as to maintain and improve soil health.

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Table 1. Effect of organic fertilizer on plant height, total number of tillers per hill, flag leaf length and dry matter per hill in rice.

Treatments	Plant height (cm)				Total number of tillers per hill				Flag leaf length (cm)				Dry matter per hill (g)			
(Per hectare)	2008	PIOC	2009	PIOC	2008	PIOC	2009	PIOC	2008	PIOC	2009	PIOC	2008	PIOC	2009	PIOC
Control	122.44	0.00	128.94	0.00	9.63	0.00	10.94	0.00	28.17	0.00	28.46	0.00	46.05	0.00	46.56	0.00
NPK (100:50:50 kg)	130.47	6.56	138.06	7.07	10.66	10.73	12.47	13.99	29.27	3.89	29.66	4.21	49.17	6.78	52.19	12.09
Organic fertilizer 0.5 tones	126.56	3.37	134.31	4.17	9.75	1.30	11.19	2.28	28.28	0.39	28.71	0.87	48.24	4.76	49.78	6.92
Organic fertilizer 1.0 tones	128.75	5.15	136.75	6.06	10.13	5.19	11.91	8.91	28.59	1.50	28.91	1.57	50.13	8.87	52.63	13.04
Organic fertilizer 1.5 tones	129.91	6.10	137.25	6.44	10.29	6.88	12.26	12.05	29.23	3.77	29.56	3.86	50.46	9.59	53.31	14.50
Organic fertilizer 2.0 tones	132.22	7.99	139.31	8.04	11.19	16.22	12.87	17.65	29.48	4.66	29.83	4.82	51.35	11.52	53.94	15.85
Organic fertilizer 2.5 tones	129.91	6.10	137.44	6.59	10.34	7.47	12.34	12.85	28.88	2.50	29.42	3.37	49.84	8.24	53.41	14.71
Organic fertilizer 1.5 tones + NPK	131.38	7.30	139.44	8.14	11.03	14.61	13.01	18.91	29.28	3.94	29.97	5.31	50.69	10.07	54.20	16.41
CD 5%	1.36	_	1.50	_	0.28	_	0.37	_	0.28	_	0.45	_	0.90	_	1.05	_
CD 1%	1.96	_	2.17	_	0.40	_	0.54	_	0.41	_	0.65	_	1.30	_	1.52	_

Table 2. Effect of organic fertilizer on number of fertile tiller per hill, panicle number and panicle length in rice.

Treatments (Per hectare)	Number of fertile tiller per hill				Panicle number (M^2)				Panicle length (cm)			
	2008	PIOC	2009	PIOC	2008	PIOC	2009	PIOC	2008	PIOC	2009	PIOC
Control	9.47	0.00	9.49	0.00	306.17	0.00	308.50	0.00	22.22	0.00	24.56	0.00
NPK (100:50:50 kg)	10.28	8.58	10.44	10.04	320.00	4.52	334.88	8.55	22.73	2.32	25.34	3.19
Organic fertilizer 0.5 tones	9.50	0.33	9.72	2.46	310.57	1.44	327.63	6.20	22.41	0.84	24.95	1.60
Organic fertilizer 1.0 tones	9.59	1.32	9.96	4.97	311.77	1.83	329.13	6.69	22.59	1.69	25.23	2.73
Organic fertilizer 1.5 tones	9.85	4.02	10.28	8.39	312.10	1.94	330.56	7.15	22.69	2.11	25.31	3.06
Organic fertilizer 2.0 tones	10.53	11.22	10.59	11.61	329.58	7.65	341.04	10.55	22.89	3.02	25.45	3.62
Organic fertilizer 2.5 tones	10.51	11.02	10.55	11.18	324.81	6.09	335.69	8.81	22.55	1.48	25.31	3.06
Organic fertilizer 1.5 tones + NPK	10.48	10.62	10.63	12.02	326.27	6.57	343.28	11.27	22.82	2.72	25.50	3.83
CD 5%	0.25	-	0.21	-	3.21	-	3.79	-	0.10	-	0.16	-
CD 1%	0.36	-	0.31	-	4.64	-	5.48	-	0.15	-	0.23	-

Table 3. Effect of organic fertilizer on number of spikelets per panicle and hollow spikelets per panicle in rice.

Treatments (Per hectare)	Number of spikelets per panicle				Hollow spikelets per panicle			
	2008	PIOC	2009	PIOC	2008	PIOC	2009	PIOC
Control	80.18	0.00	86.34	0.00	7.85	0.00	8.98	0.00
NPK(100:50:50 kg)	86.83	8.29	94.82	9.82	8.15	3.82	9.54	6.32
Organic fertilizer 0.5 tones	85.50	6.64	92.72	7.38	7.82	-0.38	8.94	-0.39
Organic fertilizer 1.0 tones	88.93	10.91	96.03	11.22	7.73	-1.59	8.80	-1.95
Organic fertilizer 1.5 tones	89.55	11.69	96.91	12.24	7.55	-3.82	8.58	-4.43
Organic fertilizer 2.0 tones	90.98	13.47	98.64	14.24	7.42	-5.48	8.45	-5.82
Organic fertilizer 2.5 tones	89.18	11.23	97.35	12.75	7.65	-2.55	8.63	-3.90
Organic fertilizer 1.5 tones + NPK	89.82	12.02	99.40	15.12	6.95	-11.46	7.90	-11.98
CD 5%	1.93	-	2.11	-	0.41	-	0.32	-
CD 1%	2.78	-	3.05	-	0.59	-	0.46	-

Table 4. Effect of organic fertilizer on 1000-seed, grain yield and biological yield in rice.

Treatments (Per hectare)	1000-seed weight (g)				Grain Yield (Kg/ha)				Biological yield (Kg/ha)			
	2008	PIOC	2009	PIOC	2008	PIOC	2009	PIOC	2008	PIOC	2009	PIOC
Control	22.92	0.00	23.06	0.00	3925.00	0.00	3962.79	0.00	6434.61	0.00	6512.50	0.00
NPK (100:50:50 kg)	25.02	9.18	27.06	17.38	4256.37	8.44	4425.65	11.68	7805.51	21.31	8027.61	23.26
Organic fertilizer 0.5 tones	23.38	2.02	25.02	8.51	4001.92	1.96	4127.91	4.17	6519.04	1.31	7162.50	9.98
Organic fertilizer 1.0 tones	24.05	4.93	25.74	11.62	4089.82	4.20	4280.59	8.02	6625.41	2.97	7295.36	12.02
Organic fertilizer 1.5 tones	24.57	7.21	25.91	12.39	4185.48	6.64	4375.46	10.41	7165.57	11.36	7387.50	13.44
Organic fertilizer 2.0 tones	25.42	10.90	27.12	17.64	4335.88	10.47	4650.73	17.36	7863.00	22.20	8175.00	25.53
Organic fertilizer 2.5 tones	25.06	9.35	26.07	13.06	4332.56	10.38	4325.56	9.15	7465.48	16.02	7762.50	19.19
Organic fertilizer 1.5 tones + NPK	25.40	10.84	27.16	17.82	4334.32	10.43	4662.71	17.66	7722.92	20.02	8207.59	26.03
CD 5%	0.35	_	0.52	_	68.87	_	93.87	_	231.87	_	202.17	_
CD 1%	0.51	_	0.75	_	99.50	_	135.61	_	335.35	_	292.08	_

Table 5. Effect of organic fertilizer on soil parameters.

Soil Characters	Pre-planting		After crop harvest															
			Control (00)		Chemical (Kg/ha)		Organic (0.5 t/h)		Organic (1.0 t/h)		Organic (1.5t/h)		Organic (2.0 t/h)		Organic (2.5 t/h)		Chemical + organic	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
pH	7.66	6.92	7.53	7.23	7.49	7.25	7.34	7.26	7.54	7.37	7.48	7.31	7.44	7.29	7.45	7.27	7.40	7.35
E.C	1.19	1.10	1.03	1.05	1.14	1.13	1.41	1.47	2.02	1.95	1.98	1.89	1.54	1.55	1.30	1.29	1.11	1.14
Organic Carbon	1.23	1.25	1.32	1.33	1.36	1.37	1.38	1.39	1.41	1.42	1.43	1.45	1.46	1.48	1.48	1.49	1.44	1.48
Organic Matter	2.12	2.28	2.26	2.34	2.38	2.40	2.40	2.41	2.42	2.43	2.46	2.47	2.52	2.55	2.58	2.59	2.51	2.55
Nitrogen %	0.12	0.13	0.13	0.14	0.21	0.23	0.18	0.19	0.20	0.22	0.22	0.24	0.23	0.25	0.24	0.26	0.25	0.27
Phosphorous P.P.M	6.00	6.00	4.00	5.00	4.52	5.00	3.00	4.00	4.00	5.00	4.00	5.00	3.00	5.00	3.00	5.00	4.00	5.00
Potassium P.P.M	120.00	170.00	142.42	200.00	190.12	230.00	190.68	225.00	200.22	230.00	230.92	240.00	234.48	245.00	236.56	245.00	230.78	250.00
Sand	15.00	16.00	16.00	17.00	15.00	16.00	14.56	15.00	14.67	15.00	14.41	16.00	14.34	16.00	14.28	16.00	14.16	16.00
Silt	54.00	57.00	57.00	58.00	59.00	61.00	60.00	61.00	60.00	61.50	61.00	62.00	58.00	60.00	60.00	61.00	60.00	61.00
Clay	27.00	27.00	26.85	27.00	28.00	27.00	28.00	27.00	28.00	27.00	26.90	27.00	27.59	27.00	27.84	27.00	27.00	27.00
Soil texture	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L	Si.C.L