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MAXIMIZING THE RETURN OF FERTILIZATION AND ITS EFFECT ON YIELD, NUTRIENTS UPTAKE AND N- USE EFFECIENCY FOR RICE

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ABSTRACT

Two field trials were conducted at El-Serw Agricultural Research Station, Dammietta governorate through summer season 2006 and 2007, to study the effect of organic matter as compost (20 $m^3.fed^{-1}$), N-biofertilization (cyanobacteria *Azospirillum*, *Bacillus* inoculations and mix with previous inoculations) and mineral nitrogen applications (20, 40 and 60 kg-N.fed^{-1}) on rice grain and straw yield, N, P and K uptake and nitrogen use efficiency for rice crop (*Oryza sativa*), variety Giza 178. The results showed that rice grain and straw yield and N, P and K-uptake in grain and straw increasing with use of nitrogen fertilizer rates up to 60 kg N / fed, while decreasing values of nitrogen use efficiency for rice crop. As well as the results showed that blue-green algae, a mixture of bio-fertilizers, *Azospirillum*, and *Bacillus* inoculations, respectively gave the highest values of the previous parameters except the NUE, where the order of values was upward with the order of the previous inoculations. Also, the results showed that the use of organic matter as a compost gave the highest values of the previous parameters and lowest values of NUE for rice crop. Organic matter + Blue green algae inoculation + 60 kg N.fed-1 gave high rice grain and straw yield and nutrients uptake and gave the lowest N-use efficiency. Also, applying organic matter + BGA or mix or *Azospirillum* inoculation could produce economic rice grain yield when it combined with third dose of the recommend mineral nitrogen (20 kg-N.fed^{-1}), and in the same time, this treatment gave high nitrogen use efficiency, and thus save on mineral nitrogen fertilization, which may lose when applying the full recommended dose, and conserve environment by reducing pollution hazards.

Keywords: Rice, cyanobacteria, *Bacillus*, *Azospirillum*, compost, organic matter, uptake, nitrogen use efficiency.

INTRODUCTION

Plants show dramatic response to nitrogen amendments, since nitrogen is a major building block of amino acids and proteins, (Wilkinson 2000). Grain and straw yield and nitrogen, phosphorus and potassium uptake of paddy increased with increasing doses of nitrogen (Manjappa 2004; Walker, *et al.,* 2008 and Artacho, *et al.*, 2009). On the other hand, greater nitrogen use efficiency could be realized with less N application (Yanni 1991 and Stalin, *et al.,* 2002).

Bio-fertilizers assume special significance particularly because they are eco-friendly and because of their alternative chemical fertilizers are expensive (Kannaiyan 2003 and Choudhury and Kennedy 2004). Cyanobacteria may increase yields by providing the crop with N, possibly by producing growth-promoting substances and improving P availability and soil properties (Roger, *et al.,* 1980; Abd El-Fattah *et al*., 1999 and Mosaad 2005). Also, Azospirilla are free-living rhizobacteria that are able to promote plant growth and increase yields in many crops of agronomic importance

(Bloemberg and Lugtenberg 2001 and Dobbelaere *et al*. 2001). Applying N-biofertilization along with a low input of mineral N was useful for increasing N-use efficiency for rice (Ali, *et al*., 1995; Ali, *et al.*, 1998 and Yanni and Abd El-Fattah 1999).

Compost proved greatly helpful in increasing the yield of rice crop and N-P-K-uptake (Jeyabal and Kuppuswamy 2001 and Satyanarayana *et al.*, 2002).

The aim of this investigation is study the combined effect of using Organic Matter as compost, mineral nitrogen and biological nitrogen fixation (BNF) on rice grain and straw yield, nutrients uptake, nitrogen use efficiency for rice crop.

MATERIALS AND METHDOS

Two field trials were conducted at El-Serw Agricultural Research Station, Damietta Governorate during the two summer seasons of 2006 and 2007. Split Split Plot design with four replications was conducted to study the effect of using organic matter as compost treatments (the main plots) (Without organic matter and organic matter at a level of $20m^3.fed^{-1}$ of mature compost rice straw and farmyard manure), the various N_2-biofertilizers (control without inoculation, cyanobacteria, *Azospirillum*, *Bacillus* inoculations and Mix from previous inoculations) (the sub plots) and mineral nitrogen fertilizer levels (the sub subplots) (20, 40 and 60 kg N/fed) on rice growth, nutrients uptake and grain quality.

Disturbed soil samples were taken from the experimental site before conducting the experiment from 0-30, 30-60 and 60-90 cm depth. Soil samples were air-dried and ground to pass through 2 mm sieve. The different determinations of soil chemical and physical properties were carried out as follows:

1- Particle size distribution of the composite sample was determined according to the international method (Piper 1950).
2- Cations, anions and total soluble salts were estimated in the 1:5 soil water extract as described by (Jackson 1967).
3- pH values were measured in the soil water suspensions (1:2.5).
4- Organic matter was determined by using Walkley & Black method as described by (Jackson 1967).
5- Total nitrogen was determined by using the micro kjeldhal procedure as described by (Jackson 1967).
6- Available phosphorus was extracted by sodium bicarbonate and then determined colorimetrically according to (Olsen and Dean 1965).
7- Available potassium was extracted by ammonium acetate then measured by flame photometer as described by (Jackson 1967).

Soil physical and chemical properties of the experimental soil are presented in Tables (1-2).

Table (1): Physical and chemical properties of the soil samples taken from the experimental field before rice cultivation in 2006 growing season.

Depth, cm	Particle size distribution					O.M %	$CaCO_3$ %	C.E.C (meq /100g soil)	pH of soil susp-end (1:2.5)	EC dS/m at 25 °C
	Coarse sand %	Fine sand %	Silt %	Clay %	Texture					
0-30	1.45	10.34	22.2 8	65.93	Clayey	0.89	1.34	44.3	8.2	2.43
30-60	2.10	15.20	25.25	57.45	Clayey	0.65	2.22	40.5	8.1	2.54
60-90	2.75	35.30	22.1	39.85	S.C.L*	0.49	2.45	39.5	8.3	3.14

Depth, cm	Cations and anions in the soil extract (1:5), meq/100 g soil								Total N %	Avail-able P ppm	Avail-able K ppm
	Cations				Anions						
	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}			
0-30	3.12	2.79	11.40	0.28	---	1.70	12.21	3.68	0.033	7.94	479
30-60	2.49	3.13	13.72	0.29	---	1.65	13.62	4.36	0.030	6.17	463
60-90	2.81	3.24	14.82	0.34	---	2.42	14.46	4.33	0.023	4.69	414

*** S = Silt. C = Clay. L = Loam. O.M= Organic matter**

Table (2): Physical and chemical properties of the soil samples taken from the experimental field before rice cultivation in 2007 growing season.

Depth, cm	Particle size distribution					O.M %	$CaCO_3$ %	C.E.C (meq /100g soil)	pH of soil susp-end (1:2.5)	EC dS/m at 25 °C
	Coarse sand %	Fine sand %	Silt %	Clay %	Texture					
0-30	1.09	11.23	21.67	66.01	Clayey	0.75	1.41	44.1	8.0	2.32
30-60	1.70	16.03	24.64	57.63	Clayey	0.52	2.28	39.7	7.9	2.36
60-90	2.63	33.94	22.15	41.28	S.C.L*	0.43	2.57	38.9	8.1	2..94

Depth, cm	Cations and anions in the soil extract (1:5), meq/100 g soil								Total N %	Avail-able P ppm	Avail-able K ppm
	Cations				Anions						
	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}			
0-30	2.95	2.81	11.21	0.27	---	1.59	12.02	3.63	0.031	8.01	4.83
30-60	2.24	3.21	12.99	0.29	---	1.51	13.43	3.79	0.028	6.21	4.71
60-90	2.79	3.29	14.21	0.32	---	1.97	13.95	4.69	0.021	4.76	422

*** S = Silt. C = Clay. L = Loam. O.M= Organic matter**

Mature compost (rice straw and farmyard manure) ($20m^3.fed^{-1}$) were added to the soil and mixed with the upper layer after transplanting.

Table (3): Analysis of compost at 2006 and 2007 seasons.

Season	pH	EC dS/m at 25 °C	O.C. %	Total N %	Total P %	C/N
2006	7.53	2.89	29.82	1.56	0.27	19.12
2007	7.57	2.91	30.06	1.61	0.24	18.67

Nitrogen fertilizer in the form of ammonium sulphate (20% N) at the tested rate was added, 1/3 of the dose was added on dry soil before rice transplanting, 1/3 of the dose was added at maximum tillering stage and the remainder was added 2 weeks later. Uniform application of superphosphate (15% P_2O_5) at the rate of 100 Kg/fed was done as basal of each plot before rice transplanting.

The blue-green alga (Cyanobacteria) was provided from soil Microbiology Department at Soil, Water and Environmental Institute, ARC, Giza. Algalization treatment were inoculated 5 days after transplanting using dry mixed culture (800 gm/fed) containing *Anabaena Oryza*, *Nostoc muscrum* and *Tolypothrix tenuis*, (El-Kholy 1997).

N_2-fixing bacteria (*Azospirillum spp*, *Bacillus sp.* and Mix inoculation) were provided from the Soil, Water and Environmental Institute, ARC, Giza. Bacterial inoculation in nursery bed was performed using seed coating technique. Maximum care was taken to avoid cross-contamination in the field after transplanting. Bacterial inoculation was repeated again in both nursery bed after seed sowing in the nursery bed and after transplanting by using liquid culture (10^9 cells.ml^{-1} of bacteria) as soil application technique at rate of 5 L.fed^{-1}. Liquid inoculant was added 3 times during the growth period up to the flowering stage.

After the rice harvest, grain and straw yield, N-P-K-uptake in grains and straw and nitrogen use efficiency were recorded.

Nitrogen Use Efficiency:

Physiological N use efficiency (Singh *et al.,* 1998), also called N utilization efficiency (Sowers *et al.,* 1994 and, Fiez *et al.,* 1995) or N use efficiency for grain production (Borrell *et al.,* 1998) is equal to grain yield per unit total N uptake.

Physiological N use efficiency was calculated as follows:

Physiological N use efficiency = Grain Yield (kg.fed^{-1}) / Total aboveground plant (grain + straw) N uptake (kg.fed^{-1}).

The statistical analysis was carried out according to (Snedecor and Cochran 1989) to compare the treatments values.

RESULTS AND DISCUSSION

Rice grain and straw yield ton.fed^{-1}:

Table 4 pointed out that adding nitrogen fertilizer significantly affected on rice grain and straw yield (t.fed-1) by increasing nitrogen rate up to 60 kg N/fed. Data in Table 4 showed that the order of nitrogen biofertilization inoculations for their influence on rice grain and straw yield was as follows: blue green algae (cyanobacteria) > Mix from (BGA + *Azospirillum* sp. and *Bacillus* sp. Inoculations) > *Azospirillum* sp. Inoculation > *Bacillus* sp. inoculation. Also, there was significant increase in rice grain and straw yield by using organic matter treatments at both seasons 2006-2007, data in Table 4 showed that the highest result of rice grain and straw yield was obtained with organic matter treatment.

Data in Table 4 show the interaction effect between nitrogen application rates, N-biofertilization Inoculations and organic matter treatments. This interaction effect on rice grain yield was significantly at 5% level at both 2006 and 2007 seasons. The highest values were obtained with (60 kg-N.fed^{-1} + cyanobacteria+ organic matter) (4.22, 4.36 t.fed^{-1}), (60 kg-N.fed^{-1} + mixture inoculation + organic matter) (4.14, 4.27 t.fed^{-1}), (60 kg-N.fed^{-1} + *Azospirillum* inoculation+organic matter) (4.05, 4.17 t.fed^{-1}) and (60 kg-N.fed^{-1}+ *Bacillus* inoculation+organic matter) (3.93, 4.03 t.fed^{-1}). At the same time, no significant differences between $O_0I_0N_{60}$ and the following treatments [($O_1I_1N_{20}$), ($O_1I_4N_{20}$) ($O_1I_2N_{20}$) at both seasons] and [($O_1I_3N_{20}$) at 2007 season only]. Thus, it can be concluded that utilizing 20 m^3.fed^{-1} compost + some N-biofertilizer inoculations like cyanobacteria *Azospirillum*, and mix with previous inoculations in rice cultivation beside third recommended mineral nitrogen fertilizer can save about 40 kg-N.fed^{-1} of its total nitrogen requirements which is very important from the economical point of view. In addition, the use of mix with some N-biofertilizations and organic matter conserves the environment by reducing pollution hazards caused by leaching nitrate in the drainage water and through volatilization of NH_3 gas from $(NH_4)_2SO_4$ and $CO(NH_2)_2$ fertilizers and also, nitrogen oxides evolved during denitrification processes. (Jeyabal and Kuppuswamy 2001 and Yogananda and Reddy 2004) reported similar results.

Table (4): Grain and straw yield (ton.fed^{-1}) for rice plant as affected by interaction effect between nitrogen application rates and different inoculations with N-biofertilization with Organic matter treatments in 2006 and 2007 seasons.

Treatment		Grain yield ton.fed^{-1}				Straw yield ton.fed^{-1}			
		2006		2007		2006		2007	
		O_0	O_1	O_0	O_1	O_0	O_1	O_0	O_1
I_0	N_{20}	2.78	3.07	2.85	3.14	2.87	3.55	2.97	3.67
	N_{40}	3.21	3.53	3.29	3.61	3.80	3.82	3.97	3.95
	N_{60}	3.48	3.89	3.56	3.98	3.85	4.04	3.98	4.18
I_1	N_{20}	3.16	3.56	3.27	3.68	3.63	4.14	3.79	4.32
	N_{40}	3.49	3.99	3.61	4.12	4.12	4.34	4.30	4.53
	N_{60}	3.65	4.22	3.77	4.36	4.52	4.63	4.72	4.83
I_2	N_{20}	3.04	3.40	3.13	3.50	3.11	3.87	3.24	4.03
	N_{40}	3.31	3.87	3.41	3.99	3.93	4.25	4.09	4.42
	N_{60}	3.55	4.05	3.66	4.17	4.39	4.41	4.57	4.59
I_3	N_{20}	2.96	3.35	3.04	3.44	3.05	3.70	3.16	3.84
	N_{40}	3.28	3.77	3.37	3.87	3.75	4.12	3.89	4.27
	N_{60}	3.51	3.93	3.60	4.03	4.11	4.26	4.26	4.42
I_4	N_{20}	3.09	3.47	319	3.58	3.55	3.85	3.70	4.01
	N_{40}	3.34	3.95	3.45	4.07	3.97	4.28	4.13	4.46
	N_{60}	3.59	4.14	3.70	4.27	4.33	4.46	4.51	4.65
F. test		*		*		*		*	
LSD 5%		0.089		0.310		0.100		0.367	
LSD 1%		0.119		0.412		0.133		0.488	

***Significant at 5% level.**
**** Significant at 1% level.**
O_0= Control treatment. **I_0 = Control treatment.**
I_1 = Cyanobacteria treatment.
O_1 = Organic Mater "Compost". **I_2 = *Bacillus* treatment.**
I_3 = *Azospirillum* treatment.
I_4= Mixture from Cyanobacteria, *Bacillus* and *Azospirillum* inoculations

Data in Table 4 showed the interaction effect between nitrogen application rates, N-biofertilization Inoculations and organic matter treatments. This interaction effect on rice straw yield was significant at 5% level both 2006 and 2007 seasons. The highest values were obtained with (60 kg-N.fed^{-1} + cyanobacteria+ organic matter) (4.63 – 4.83 t.fed^{-1}) then (60 kg-N.fed^{-1} + cyanobacteria + No organic matter) (4.52 – 4.72 t.fed^{-1}) then (60 kg-N.fed^{-1} + mixture inoculation +organic matter) (4.46 – 4.65 t.fed^{-1}) then (60 kg-N.fed^{-1}+ *Azospirillum* inoculation+ organic matter) (4.41 – 4.59 t.fed^{-1}).

Nitrogen uptake in rice grain and straw kg-N.fed^{-1}

Data in Table 5 showed that there was significant increment in nitrogen uptake in both grains and straw at both 2006 and 2007 seasons by increasing nitrogen fertilizer rates up to 60 kg N/fed. Also, there was significant increment in N-uptake in rice grain and straw at both 2006 and 2007 seasons, by using the inoculations, the highest mean value of N-uptake in grains and straw at 2006 and 2007 seasons was recorded when cyanobacteria inoculant was applied followed by mix inoculation then *Azospirillum* then *Bacillus*. In addition, there was significant increment in N-uptake in rice grains and straw by applying organic matter as compost at both seasons 2006 and 2007.

Table (5): N-Uptake kg-N.fed^{-1} and N-Use Efficiency kg-grain.kg-N-uptake^{-1} for rice Grain and Straw as affected by interaction effect between nitrogen application rates and different inoculations with N-biofertilization with Organic matter treatments in 2006 and 2007 seasons.

Treatment		N-Uptake kg-N.fed^{-1}						N-Use Efficiency kg-grain.kg-N-uptake^{-1}			
		Grain				Straw					
		2006		2007		2007		2006		2007	
		O_0	O_1	O_0	O_1	O_0	O_1	O_0	O_1	O_0	O_1
I_0	N_{20}	29.69	35.37	30.89	36.64	13.78	15.26	59.52	56.69	64.48	60.95
	N_{40}	37.49	45.82	39.02	47.51	20.82	22.77	50.84	47.77	55.63	51.77
	N_{60}	45.76	51.39	47.46	53.33	26.46	29.74	44.45	44.32	48.75	48.32
I_1	N_{20}	35.99	44.00	37.80	46.04	16.50	18.98	56.47	53.11	61.01	57.12
	N_{40}	45.75	55.82	48.01	58.34	23.26	26.52	47.29	45.29	51.33	49.03
	N_{60}	51.32	63.55	53.76	66.45	28.72	33.27	42.43	40.62	46.35	44.17
I_2	N_{20}	33.71	40.63	35.21	42.35	15.33	17.24	57.76	54.97	62.64	59.20
	N_{40}	41.01	51.55	42.86	53.79	21.72	25.36	48.85	46.76	53.44	50.84
	N_{60}	47.43	55.16	49.56	57.55	27.58	31.52	43.68	43.14	48.06	47.24
I_3	N_{20}	32.23	39.56	33.59	41.14	14.76	16.78	58.88	55.77	63.68	59.96
	N_{40}	39.75	49.95	41.45	51.94	21.43	24.53	49.83	47.14	54.33	51.12
	N_{60}	46.51	52.70	48.35	54.77	26.91	30.35	44.27	43.79	48.52	47.85
I_4	N_{20}	34.70	41.92	36.33	43.82	15.82	17.96	57.13	54.30	61.89	58.54
	N_{40}	42.35	53.68	44.37	56.04	22.09	26.12	48.14	46.10	52.57	50.03
	N_{60}	48.18	60.73	50.39	63.41	28.07	32.37	43.54	41.37	47.78	44.99
F. test		**		**		**		**		**	
LSD 5%		1.284		1.562		0.327		0.276		0.688	
LSD 1%		1.707		2.077		0.435		0.367		0.915	

***Significant at 5% level.**
**** Significant at 1% level.**
O_0= Control treatment. **I_0 = Control treatment.**
I_1 = Cyanobacteria treatment.
O_1 = Organic Mater "Compost". **I_2 = *Bacillus* treatment.**
I_3 = *Azospirillum* treatment.
I_4= Mixture from Cyanobacteria, *Bacillus* and *Azospirillum* inoculations

Table 5 showed that interaction effect between Nitrogen application, N-biofertlizaton inoculations and organic matter treatments were significant on N-Uptake in rice grain at both 2006 and 2007 seasons but it was significantly for rice straw at 2007 season only. The highest values of N-uptake for rice grains were obtained with $N_{60}I_1O_1$ followed by $N_{60}I_4O_1$, $N_{40}I_1O_1$, $N_{60}I_2O_1$ and $N_{60}I_3O_1$, but for rice straw the highest values were obtained with $N_{60}I_1O_1$ followed by $N_{60}I_4O_1$, $N_{60}I_2O_1$ and $N_{60}I_3O_1$.This effect of organic matter and N-biofertilizer inoculations on nitrogen uptake could be attributed to release of nitrogen element from organic matter through and after this decomposing and to the high efficiency of these inoculations on fixing atmospheric nitrogen and/or to produce some biological active substance, e.g., gibberellins and cytokine.

Nitrogen Use Efficiency for Rice crop:

Data in Table 5 showed that there was significant decreased in NUE at both 2006 and 2007 seasons by increasing nitrogen fertilizer rates up to 60 kg-N.fed-1. Also, there was significant increment in NUE by applying N-biofertilizer inoculations at both seasons 2006 and 2007, the highest value of NUE was obtained with control treatment followed by *Bacillus* inoculation then *Azospirillum* inoculation then Mix inoculation then cyanobacteria inoculation. In addition, there was significant increment in NUE by applying organic matter as compost at both seasons 2006 and 2007, the highest value of NUE was obtained without of organic matter treatment then organic matter treatment. Table 5 showed that interaction effect between nitrogen application, N-biofertlizaton inoculations and organic matter treatments was significant on NUE at both 2006 and 2007 seasons. Data in table 5 showed that the highest values of NUE were obtained with $N_{20}I_0O_0$ followed by $N_{20}I_3O_0$, $N_{20}I_2O_0$ and $N_{20}I_4O_0$.

Because of the high potential for losses, N use efficiency in rice tends to be low in comparison with other major crops (Keeney and Sahrawat 1986). Reduction of N losses would increase both soil and fertilizer N use efficiency and reduce environmental costs associated with denitrification and leaching of NO_3 (George, *et al.,* 1993). Similar results were obtained by (Yanni 1991 and Stalin, *et al.*, 2002).

Phosphorus and potassium uptake in rice grain and straw kg-P-K.fed^{-1}:

Data in Table 6 showed that there was significant increment in P and K uptake in both grains and straw at both 2006 and 2007 seasons by increasing nitrogen fertilizer rates up to 60 kg N/fed. Also, there was significant increment in P and K-uptake in rice grain and straw at both 2006 and 2007 seasons, by using the N-biofertilizations, the highest mean value of P and K-uptake in grains and straw at 2006 and 2007 seasons was with cyanobacteria inoculant followed by Mix inoculation then *Azospirillum* then *Bacillus*. In addition, there was significant increment in P and K-uptake in rice grains and straw by applying organic matter as compost at both seasons 2006 and 2007.

Data presented in Table 6 showed that interaction effect between nitrogen application, N-biofertlizaton inoculations and organic matter treatments, it was significantly at 5 % level on P-uptake for rice grain and straw at 2006 season only, and significantly for rice straw at 2007 season.

Data in Table 6 showed that the highest values of P-uptake for rice grains were obtained with $N_{60}I_1O_1$ then $N_{60}I_4O_1$ then $N_{60}I_2O_1$ then $N_{60}I_3O_1$, but for rice straw the highest values were obtained with $N_{60}I_1O_1$ then $N_{60}I_4O_1$ then $N_{60}I_2O_1$ then $N_{60}I_3O_1$.

The previous table showed that interaction effect between nitrogen application, N-biofertlizaton inoculations and organic matter treatments on K-uptake was significantly at 5% level in rice straw 2006 season only. The highest values of K-uptake were obtained with $N_{60}I_1O_1$ then $N_{60}I_4O_1$ then $N_{60}I_2O_1$ then $N_{60}I_3O_1$.

This effect of organic matter and N-biofertilizer inoculations on nutrients uptake could be attributed to release of nutrients element from organic matter through and after this decomposing and to the high efficiency of these inoculations on fixing atmospheric nitrogen and/or to produce some biological active substance, e.g., gibberellins and cytokine.

Table (6): P-Uptake kg-P.fed^{-1} and K-Uptake kg-K.fed^{-1} for rice Grain and Straw as affected by interaction effect between nitrogen application rates and different inoculations with N-biofertilization with Organic matter treatments in 2006 and 2007 seasons.

Treatment		P-Uptake kg-P.fed^{-1}						K-Uptake kg-K.fed^{-1}	
		Grain		Straw				Straw	
		2006		2006		2007		2006	
		O_0	O_1	O_0	O_1	O_0	O_1	O_0	O_1
I_0	N_{20}	5.07	5.81	0.50	0.71	0.56	0.79	30.61	34.23
	N_{40}	6.85	7.74	0.84	1.09	0.95	1.26	38.94	43.70
	N_{60}	9.58	11.02	1.43	1.83	1.65	2.16	45.48	51.27
I_1	N_{20}	6.29	7.41	0.89	1.25	1.00	1.36	35.71	40.66
	N_{40}	7.96	9.58	1.36	1.84	1.59	2.03	43.31	50.15
	N_{60}	10.34	12.59	2.23	2.91	2.59	3.28	48.40	56.51
I_2	N_{20}	5.78	6.77	0.70	0.95	0.78	1.04	33.90	38.39
	N_{40}	7.29	8.83	1.06	1.51	1.21	1.67	40.65	48.18
	N_{60}	10.05	11.75	1.81	2.27	2.09	2.56	46.79	53.74
I_3	N_{20}	5.54	6.50	0.65	0.87	0.73	0.96	32.92	37.72
	N_{40}	7.06	8.41	0.95	1.28	1.08	1.46	40.05	46.86
	N_{60}	9.76	11.28	1.58	2.04	1.83	2.37	46.05	52.07
I_4	N_{20}	6.03	7.05	0.77	1.08	0.87	1.19	34.70	39.42
	N_{40}	7.49	9.29	1.14	1.66	1.37	1.88	41.52	49.34
	N_{60}	10.31	12.14	2.05	2.53	2.36	2.61	47.42	55.15
F. test		*		*		**		*	
LSD 5%		0.221		0.070		0.081		0.811	
LSD 1%		0.294		0.094		0.107		1.079	

***Significant at 5% level.**
**** Significant at 1% level.**
O_0= Control treatment. **I_0 = Control treatment.**
I_1 = Cyanobacteria treatment.
O_1 = Organic Mater "Compost". **I_2 = *Bacillus* treatment.**
I_3 = *Azospirillum* treatment.
I_4= Mixture from Cyanobacteria, *Bacillus* and *Azospirillum* inoculations

Conclusion

It could be concluded that applying N-biofertilizers and organic matter could produce high rice grain yield when it combined with third dose of the recommend mineral nitrogen (20 kg-N.fed^{-1}). Also applying biofertilization and organic matter with third or two third dose of recommend nitrogen can reduce of losing mineral nitrogen by leaching of NO_3 therefore, increasing N use efficiency.

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ترشـيد التسـميد وأثـره علـى محصـول وامتصـاص العناصـر وكفـاءة اسـتخدام النيتروجين للأرز

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أجريت تجربتان حقليتان فى محطة البحوث الزراعية بالسرو بمحافظة دمياط خلال الموسمين الصيفيين لعامي 2006,2007 لدارسة تأثير كل من التسميد العضوي فى صورة كمبوست بمعدل 20 م3/الفدان , التسميد الحيوي النيتروجينى (طحالب خضراء مزرقة, لقاح الأزوسبيريلم, لقاح الباسيلوس ومخلوط من اللقاحات السابقة) وثلاث معدلات من التسميد النيتروجينى (20 ، 40 و60كجم نتروجين /فدان) على محصول الأرز من الحبوب والقش, امتصاص كل من النيتروجين والفسفور والبوتاسيوم فى الحبوب والقش وفاعلية استخدام النيتروجين لمحصول الأرز صنف جيزة 178. أوضحت النتائج أن قيم كل من محصول الأرز من الحبوب والقش وإمتصاص النيتروجين واللفوسفور والبوتاسيوم فى الحبوب والقش تزيد مع استخدام معدلات التسميد النيتروجينى حتى 60 كجم نيتروجين /فدان, بينما تنقص قيم فاعلية استخدام النيتروجين لمحصول الأرز. كذلك أوضحت النتائج أن الطحالب الخضراء المزرقة ثم مخلوط الأسمدة الحيوية ثم لقاح الأزوسبيريلم ثم الباسيلوس على التوالى أعطت أعلى القيم من المدلولات السابقة ماعدا فاعلية استخدام النيتروجين لمحصول الأرز حيث أن ترتيب القيم كان تصاعديا مع ترتيب اللقاحات السابقة. أيضا أوضحت النتائج أن استخدام التسميد العضوى فى صورة كومبوست أعطى أعلى قيم المدلولات السابقة وأقل قيم استخدام النيتروجين لمحصول الأرز. كما أوضحت النتائج أنه باستخدام التسميد العضوي مع الطحالب الخضراء المزرقة مع 60 كجم نيتروجين/فدان أعطت أعلى القيم لمحصول الحبوب والقش وكذلك امتصاص عناصر النيتروجين والفسفور والبوتاسيوم للحبوب والقش بينما أعطت أقل قيم كفاءة استخدام النيتروجين لمحصول الأرز. أوضحت النتائج أيضا أنه باستخدام التسميد العضوي مع التسميد الحيوي بالطحالب الخضراء المزرقة أو الأزوسبيريلم أو مخلوط اللقاحات مع ثلث معدل التسميد النيتروجينى المعدني الموصى به (20 كجم نيتروجين /فدان) أعطت محصول إقتصادى و كفاءة استخدام للنيتروجين عالية وبالتالي توفيرا في التسميد النيتروجينى المعدني الذي قد يفقد عند استخدام المعدلات الموصى بها كاملة وبالتالي المحافظة على البيئة عن طريق الحد من مخاطر التلوث.

قام بتحكيم البحث

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