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Short Communication

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The Effect of Amount on Release of NH_4 and NO_3-N in the Soil at two Harvests of Nitrogen through five BGA Species and N-fertilizers in Rice Growing Plant

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Abstract

Among all treatments pots without growing rice plants containing *N. muscorum* showed the highest amount of mineral-N and *P. boryanum* was the lowest. On the contrary, treatments with rice plants containing all BGA species the amounts of NH_4-N and NO_3-N remaining were more or less equal to the fertilizers treatments. Among BGA species and fertilizers the highest amount of NH_4-N and NO_3-N were found at the 90 mg N pot^{-1} with urea and ammonium sulphate and *A. doliolum* gave the highest amount in comparison to other four species.

Key words: Mineral-N, Nitrification, Denitrificatoin, Bluegreen algae, Rice yield.

Introduction

Watanabe (1960) presented a method for improving the fertility of paddy yield by use of nitrogen fixing blue-green algae "as a green manure". It is resemble inferred that algal nitrogen source whether it is fixed from the atmosphere or by decomposition of algal bodies after its conversion by the activity of soil bacteria into inorganic forms such as ammonia and nitrate (Paros 1988). Most of the total nitrogen in soil is in organic forms in which are not easily available to plant, soil organic matter represents the reserves of this plant nutrient and accounts for more than a 95% of nitrogen in soil. Except for a small portion of soluble amino acids directly available to plants, all other compounds are only utilization on decomposition to inorganic forms NH_4^+ and NO_3^- (Parsons 1975). Nitrogen is the key elements to increase yield of rice. The rice plant its nitrogen from applied nitrogen fertilizer, from the ammonia produced in the reduces zone upon decomposition of organic matter, from nitrates produced in the surface oxidized layer of the soil and from biological nitrogen fixation (Yoshide and Ancajas 1971) So, an attempt has been made to evaluate the amounts of release of NH_4-N and NO_3-N (mg pot^{-1}) in the soils at two harvests from five rates of two N-fertilizer and five BGA species.

Materials and Methods

The soil for the present experiment is highly productive known as Insch soil obtained from Murrials farm in aberdeenshire of Scotland UK. Chemically, the soil had pH 5.96, organic carbon 7.95%, total nitrogen 0.28 %, cation exchange capacity 11.5 meq 100^{-1} and sandy loam as texture. The rice variety 'MRI' (variety no.1R22) of Malaysian agricultural development Institute was collected from school of agriculture, Aberdeen University, UK. was selected as indicator plant because of its high and stable yield that has poor eating quality but excellent plant type.

After viability test (98.3% germination was recorded), the 25 days old seedlings were transplanted to pots. The experiment was laid out in a split plot design. The experimental plots were divided into two blocks representing two replications. Each block was sub-divided into sub-blocks. Each sub-block was again divided into 21 unit plots upon which the treatment was superimposed randomly. The total number of unit plots (pots) was 84. There were three sources of nitrogen, namely urea (U), ammonium sulfate (As) and blue green algae (BGA) each at five rates. For the BGA each species was considered to be a rate.

Rate	Fertilizers (Mg N pot^{-1})	BGA	
1	30mg	*Anabaena*	*variabilies*
2	60mg	"	*cylindrica*
3	90mg	"	*doliolum*
4	120mg	*Nostoe*	*muscorum*
5	150mg	*Plectonema*	*boryanum*

Two types of control were prepared provided in this design. One control receiving no nitrogen (0) and the second control was inoculated with five species of BGA in each sub block with out growing rice plants. Thus there were 21 treatments and combinations. 84 plastic 21x17 cm round pots were numbered consecutively. Each pot was about 4-litre capacity and the drainage holes were closed with thick sticky tape. The pots were washed carefully and dried before use. 1800g air-dry soil was placed into each pot with capillary matting (Fyba mat) at the bottom. The air dry soil was mixed with 20 ml of KH_2PO_4 solution in a Kenwood mixer for the basic fertilizer dose of p and K .The moist soil were transferred to the pots with light and even packing and 1500 ml of water were added to each pot. This forms a 2-cm depth of standing water over the soil surface. The pots were kept at constant temperature covering with polythene sheet. The pots were transformed after 5 days to the glass house and appropriate quantities of N fertilizer added and mixed. In case of BGA pots each inoculate was applied as a liquid suspension. Four days after transplanting, when the seedlings become fully established, the depth of standing water was raised to 4.5 cm and maintained through out the growing period. In the present study the temperature was optimum (25-30^{O}C) upto 56 days and then dropped in month November. In that month and especially on cloudy clays fluorescent lights were used to supply adequate light. The pots were weeded by hand from time to time when necessary the rice plants started tillaring within 2 weeks after transplanting. Six weeks after transplanting, pots numbering 1-21 from block I and 43-63 from block II and twelve weeks after transplanting (harvest) from each pot 10g moist soil were taken and extracted with 2M KCL solution for NH_4-N and NO_3-N determination and another 10g samples was removed for determination of water content. The method of Bremner (1965) 5 was followed to extract and determination for NH_4-N and NO_3-N of the pot soils.

Results and Discusion

The results of chemical analyses of all five BGA species are presented in Table.I (a). The results of NH_4-N and NO_3-N in the soil after each of two harvests are shown in the Table. I(b).

NH_4-N:

The pot treatments containing five BGA species without growing rice plants produced the highest amount of both NH4-N and NO_3-N at the time of both harvests in comparisons to all other treatments. NH4-N and NO_3-N left in the residue soil weregreater at the second harvest than after the first. The important role of BGA has already been focused in the production of rice and in rice growing ecosystem. In the above treatments the amount of total mineral left after

Table I. (a). Chemical composition of Blue - green algae species (expressed in percent)

Species name	Nitrogen	Phosphorus	Potassium	Calcium	Magnesium	Organic carbon	C:N
Anabaena variabilies	6.5	0.37	1.42	0.86	0.79	38.16	5.87
Anabaena cylindrica	7.5	1.62	2.20	1.95	1.89	46.19	6.15
Anabaena doliolum	7.08	0.37	1.93	1.34	1.26	43.18	6.09
Nostoc muscorum	8.05	1.29	2.54	1.82	1.71	38.56	4.79
Plectonema boryanum	5.36	0.42	1.40	1.98	1.94	36.18	6.09

Table I. (b). Amounts of NH_4-N and NO_3-N (mg pot^{-1}) in the pots at each harvest.

Treatment		NH_4-N		NO_3-N		Total mineral-N	
Fertilizer	Rate (% or mg N pot -1)	Harvest 1	Harvest 2	Harvest 1	Harvest 2	Harvest 1	Harves 2
BGA control(without growing rice plant and without N-fertilizers	*A.variabilies (6.5%)*	15.5	43.2	16.8	42.4	32.3	85.0
	A.cylindrica (7.5%)	17.8	31.0	19.8	35.0	37.6	66.0
	A.doliolum (7.08%)	20.1	34.3	37.7	41.1	57.8	72.4
	N.muscorum (8.05%)	23.2	46.1	29.2	48.7	52.4	94.8
	P.boryanum (5.36%)	20.3	29.9	28.2	32.4	48.5	62.3
Coefficient	of correlation	**0.311**	**0.491**	**0.069**	**0.677**	**0.139**	**0.234**
Control	0	5.7	*	9.2	13.0	14.9	13.0
BGA	*A.variabilies (6.5%)*	13.5	5.2	14.5	27.6	28.0	32.8
	A.cylindrica (7.5%)	12.4	5.8	24.3	31.9	36.7	37.7
	A.doliolum (7.08)	21.1	14.8	26.2	31.5	47.3	46.3
	N.muscorum (8.05)	12.4	11.7	21.3	23.7	33.7	35.4
	P.boryanum (5.36)	17.9	13.5	20.6	20.6	38.5	34.1
Coefficient	of correlation	**-0.456**	**-0.173**	**0.352**	**0.473**	**-0.028**	**0.289**
Urea	30	8.9	6.6	15.4	27.8	24.3	34.4
	60	10.9	8.3	28.2	29.0	39.1	37.3
	90	27.4	13.3	24.7	28.3	52.1	41.6
	120	13.5	12.4	19.9	28.5	33.4	40.9
	150	20.6	7.4	31.9	26.5	52.5	33.9
Coefficient	of correlation	**0.538**	**0.296**	**0.600**	**-0.51**	**0.658**	**0.115**
NH_4-SO_4	30	11.6	4.6	13.6	32.1	25.2	36.7
	60	15.5	8.3	17.1	31.9	32.6	40.2
	90	16.8	14.5	22.2	33.8	39.0	48.3
	120	16.9	15.4	21.9	27.5	38.8	42.9
	150	15.8	7.9	18.1	22.7	33.9	30.6
		0.715	**0.468**	**0.609**	**-0.814**	**0.661**	**0.226**

* Only trace amounts of NH_4-N were detected.

second harvest by five BGA species was in the following order:

N. muscorum> A. variabilies> A. doliolum> A. cylindrica> P. boryanum.

In the treatments containing all five BGA species with growing rice plants the amounts of NH_4- N and NO_3-N remaining was more or less equal to the treatments receiving fertilizers. NH_4-N left in the soil was greater at the first harvest than at the second in all three sources. The highest amount of NH_4-N was found in the pots for those BGA species was in the order:

A.doliolum> P. boryanum> A. variabilies> A. cylindrica> N. muscorum. Among BGA species and two fertilizers the highest amount of NH_4-N was obtained at rate 90 mg N pot^{-1} with urea.

NO_3-N:

NO_3-N left in the soil was generally higher than NH_4-N at both harvests in all 21 treatment pots with the higher value at the second harvest. The highest amount was recorded in pots receiving 90-mg ammonium sulfate. There were no apparent differences in the amount of NO_3-N left in the pot after first harvest except pots receiving 60-mg urea-N. When urea or ammonical-N fertilizers are applied to the floodwater of a rice crop, fertilizers use efficiency is often reduced because there are substantial losses of NH_3 by volatilization (Bowmer and Muirhead 1987). As pH rise the potential loss increases exponentially due to the increasing dominance of volatile NH_3 gas in equilibrium with NH_4^+. It is postulated that the daytime pH rise is caused mainly by photosynthesis of algae and cyanobacteria, and addition of a suitable photosynthetic inhibitors concurrently with fertilizer, should suppress the pH rise, thus conserving N in the from of the non-volatile NH_4^+ (Bowmer and Muirhead, 1987).

Conclusion

The relationship between amounts of NH_4-N and NO_3-N at two harvests and different rate of two fertilizers and five BGA species showed positive correlation but insignificantly (Table.Ib) reason may be due to the release of mineral-N were not occurred with the rate of fertilizer and with respect to time.

References

Bremner, J.M., (1965). Inorganic forms of nitrogen in "Methods of Soil analysis" (C.A.Black, Ed), Agronomy No 9, Chapter 84 (Part 2) pp.1179-237. *Amer.Soc. Agron,* Madison, Wisconsin.

Bowmer, K.H. Muirhead, W.A. (1987). Inhibitions of algal photosynthesis to control pH and reduce ammonia volatilization from rice flood water. *Fertilizer Research* (1987) 13 (1), 12-29 [En. 34 ref., 6 fig., 4 tab] CSIRO Centre for Irrig. and Freshwater Res., P.M.B. Griffith 2680, Australia.

Paros, M., (1988). Can super blue- green algae save the world? *Nutr. Forum* **5 (3):** 17-19.

Parsons J.W., (1975). *Availability and Immobiliza-tion of soil nitrogen*. Welsh

Soil Discussion Group Report Number **16:** 1-8.

Yoshida, S. Ancajas, P.R. (1971). Nitrogen fixation by bacteria in the root zone of rice. *Soil Sci. Amer. Proc.* **35:** 156-157.

Watanabe, A. (1960). Proceedings of the Symposium on Algology. Indian Council of Agricultural Research, New Delhi. 162-166.

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