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Study on Percent Recovery of Nitrogen in Incubation with Five BGA (Blue-green algae) Species at Four Temperature and Three Moisture Conditions

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Introduction

The paddy field ecosystem provides an environment favorable for the growth of BGA (blue-green algae) with respect to their requirement for light, water, high temperature and nutrient availability that frequently produce luxuriant growths in rice field. This may account for the maximum abundance of BGA in paddy soils under as widely different climatic conditions, as found in India (Mitra, 1951) and the Ukraine (Prikthod'kova, 1971). Nutrients fixed by the algae are released either through exudation or through microbial decomposition after the cells die. Laboratory experiments have frequently shown that the BGA liberate large portions of their assimilated nitrogen (Roger *et al.*, 1987) but no information is available on the exudation of fixed nitrogen by BGA under field condition but it is clear that only part of it is available to rice. Obviously the quantity of nutrients release to the growing crop will vary with different seasons of the year under various moisture and temperature condition.

Materials and Methods

An experiment has been performed to evaluate how much of nitrogen would be recovered due to the effect of four different temperatures and three different moisture conditions from five specific BGA species. The soil for the present experiment is non-calcareous brown flood plain soil highly adapted to rice cultivation. The soil has a pH (in water) of 5.43, and 13.0 % clay, 30.3 % silt and 56.7 % sand (sandy loam),organic carbon 0.60 % (O.M. 1.04 %), total nitrogen 0.09 % and cation ion exchange capacity 48.3 meq kg^{-1}. Pure culture of five species of BGA viz. *Anabaena variabilis, Anabaena cylindrica, Nostoc muscorum, Anabaena doliolum and Plectonema boryanum* were procured from the Department of Biological Science, Dundee University, U.K. 20 g dried (oven dry basis) soil sample was mixed intimately with ground 50 mg BGA species. Each of the five BGA materials was placed in a 250-ml conical flask in duplicate. Approximate 10 ml deionised water was added slowly from a burette to bring them to 50% water-holding capacity. To make the soil as waterlogged condition 100 ml deionised water was added to another set of conical flasks. For 1 % moisture content soil, standard air-dried soil (1.01 % moisture content) sample was used. The flasks were then closed

firmly with rubber bung. The incubation was carried out under four different temperatures, viz, 20^{O}, 30^{O}, 40^{O} and 50^{O} C. Duplicate controls for each temperature were prepared, containing no soil. For the estimation of mineral-N at the end of each incubation period , 10 g soil samples was shaken with 50 ml 2M KCl and filtered, 10 ml portion of the aliquots from the filtrate were distilled for NH_4-N and NO_3-N determination (Bremner, 1965).

Results and Discussion

The results of % recovery of mineral-N is presented in the Table I are the means of duplicates net values, i.e. the soil control value has been subtracted from those obtained for soil plus BGA.

Table. I. Percent recovery of nitrogen as mineral-N after 48 days of incubation in five BGA species at four temperatures with 1% and 50% moistures and 32 days under waterlogged condition at three temperatures in three BGA species.

BGA species	Temperature		Moisture level	
	oC	50%	1%	Waterlogged
A. variabilies	20	62.6	6.74	17.50
	30	63.7	25	22.70
	40	100.0	28.62	30.50
	50	83.4	24.3	
A. cylindrica	20	60.9	22.5	
	30	53.3	16.2	18.90
	40	56.6	25.3	17.20
	50	58.4	26.9	29.16
N. muscorum	20	64.2	32.1	
	30	85.8	31.3	23.90
	40	74.3	23	32.0
	50	96.9	38.7	41.3
A. doliolum	20	42.4	16.9	-
	30	62.7	23.4	-
	40	43.7	13.5	-
	50	96.1	32.3	-
P. boryanum	20	53.7	20.9	-
	30	71.4	45.4	-
	40	61.6	40	-
	50	64.3	35.7	-
		0.48 r=5%	0.401 r=10%	0.880 r=1%

% Recovery of nitrogen as mineral-N after 48 days of incubation in five BGA species at 4 temperatures with 1 % and 50 % moisture and 32 days for waterlogged incubation at 3 temperatures is presented in Table I. From the table it can be said that at 1 % moisture level showed lower % of mineral-N recover with all five species than other two moisture conditions (Fig. 1a). Only at higher temperatures showed recovery of some significant

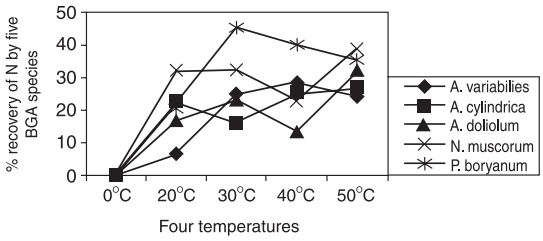

Fig. 1a. % recovery of N at 1% moisture

amount of nitrogen particularly with *P. boryanum* (45.4 %) at 30^{O} C and 40 % at 40^{O} C. *N. muscorum* showed highest amount of N at 50^{O} C (38.7 and *A. doliolum* at 50^{O} C (32.3 %). Marumoto *et al.* (1977) explained that the rate of decomposition during air-drying treatment and nitrogen was mineralized from the soil during the incubation period was a little. In case of *A. variabilies* and *A. cylindrica* higher amounts was noticed at 400 (28.62 %) and 50^{O} C (26.9 %) respectively. Under 50 % moisture condition (Table I) all the five BGA species showed the highest amount of N-recovery from their biomass than other two moisture conditions (Fig. 1b). Among all species *A. variabilies* showed the highest amount of recovery at 40^{O} C (100 %) and lowest at 20^{O} C (62.6 %). On the other

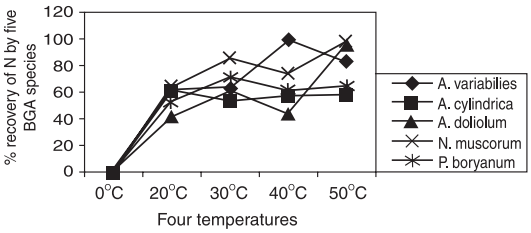

Fig. 1b. % recovery of N at 50 % moisture

hand, *A. cylindrica, A. doliolum, N. muscorum*, and *P. boryanum* at 50^{O} C were 58.41 %, 96.1, 96.9, and 64.3 % respectively. The lowest amount of N was recovered with, *A. doliolum* at 20^{O} C (42.4 %). Moisture must be adequate for decomposition to proceed. A moisture level (80-90 %) reduce microbial activities not as a result of water but rather indirectly, by hindering the movement of air and thus reducing O_2 supply. A medium moisture (50-70 %) is favorable for to filamentous fungi and to aerobic cellulose-decomposing bacteria (Schnitzer and Khan, 1978). Temperature profoundly influences the ammonia release in submerged soil. Mitsui (1960) reported a virtual doubling of ammonia accumulation when temperature of the anaerobic incubation was raised from 26^{O} to 40^{O} C. According to Chowdury and Cornfield (1978) N-mineralization and nitrification increased with temperature up to 40^{O} C and mineralized N accumulated entirely as nitrate.

In waterlogged condition from the table1 due to shortage of *Anabaena doliolum* and *Plectonema boryanum* materials out of five species three species were used in this condition. It can be revealed that all three BGA

species were found to release higher amount of mineral-N (1c) with *A. variabilies* (30.5 %), *A. cylindrica* (29.16 %) and *N. muscorum* (41.33 %) only at 40^{O} C. Tusneem (1971) found that the mineralization rate of organic-N of added residues were initially greater under waterlogged than under optimum moisture condition. Therefore, there was a gradual decline in NH_4 accumulation under waterlogged in contrast with a rapid increase in inorganic N under optimum condition (Fig. 1c).

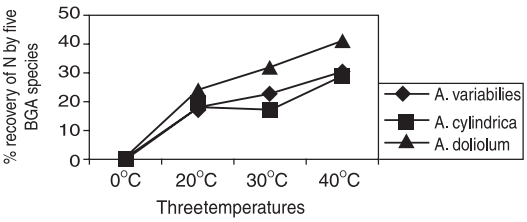

Fig. 1c. % recovery of N under waterlogged condition

From coefficient of correlation study it was found that the relationship between all five BGA species at 20^{O} to 50^{O} C temperatures under three moisture conditions mineral-N showed strong correlationship under waterlogged condition than that of 50 % and 1 % moisture conditions. The significant value was obtained at 1 % level (r = 0.880) under waterlogged condition (Table. Ia). On the contrary, at 1 % and 50 % moisture conditions showed positive correlationship significant at 10 % (r = 0.40) and 5 % (r = 0.480) respectively.

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