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Study the Function of Blue-green Algae in Urban Garbage Compost of Iran

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Abstract: Blue-green algae as nitrogen fixers have been used in different countries for a long time and are well known as biofertilizer. According to the quality of urban garbage composts of Iran especially in Tehran, diazothrophic cyanobacteria were considered as compost supplier. Cyanobacteria species were collected from paddy fields of north provinces of Iran (Gillan, Mazandaran and Golestan). *Fischerella* sp. was the dominant species in each province and had the highest content of nitrogen. Different amounts of this cyanobacterium (0.1-1%) and also different ratio of moistures (80-240%) were added to compost. Results showed that using different amounts of algae had no significant effect on growth rate and nitrogen content. Otherwise moisture had significant effect on growth rate of *Fischerella* sp.

Key words: Cyanobacteria, compost, *Fischerella*, growth rate, moisture

INTRODUCTION

Algae especially nitrogen fixer cyanobacteria have been used in agriculture for many years. Cyanobacteria are morphologically the most diverse, complex and ancient prokaryotes. Heterocystous cyanobacteria are commonly used as biofertilizers and are included by Desikachary (1959) in the orders Nostocales and Stigonematales.

The atmosphere contains only about 350 ppm of CO_2 but it has about 78% nitrogen. In spite of this, plants can not use N_2 directly. Most plants require nitrogenous compounds such as nitrate or ammonium and these are usually supplied them as biofertilizer which are rather expensive and beyond the reach of poor and small farmers in developing countries. Otherwise they have a lot of environmental damages. Results demonstrated that the inoculation of rice fields with BGA may be equivalent to the addition of around 30-45 kg nitrogen per hectare annually. Algalization also increases the organic matter content of the soil thereby enhancing its fertility and protect the environments (Cresswell *et al*., 1989). Composting is the process by which organic substances are broken down by micro organisms (biological oxidation) and turned to sustainable material which is called humus or compost. Meanwhile it has no effect on plant growth and environment (Samavat, 2003). Results of compost analysis especially urban garbage compost showed that this substance is a rich source of micro nutrients but it isn't a good supplier for plants nutrient especially macro nutrients. Compost should be supplied (especially for elements like N, P, K) in order to have a rich and suitable substance for plants growth (Gaur and Singh, 1995).

MATERIALS AND METHODS

Samples were collected from paddy soils of north provinces of Iran (Gillan, Mazandaran and Golestan) in autumn 2004. Soil samples were cultured in lab (room culture) by Sardeshpande and Goyal (1981) method. After one month, algal colonies were formed on the surface of soil. Dominant species which had the most number of colonies were separated and cultured serially by Agar plate method (Kaushik, 1987). Species were identified by identification keys (Desikachary, 1959; Prescott, 1962; Tiffany and Britton, 1971). Growth medium was BG-110 ($NaNO_3$ 1.5 g, $K_2HPO_4.3H_2O$ 0.040 g, $MgSO_4$. 0.075 g, $CaCL_2$. $2H_2O$, 0.036 g, Citric acid 0.006 g, Ferrie ammonium citrate 0.006 g, EDTA 0.001 g, Na_2CO_3 0.020 g, Deionized water 1000 mL. Trace metal mix A5, (Richmond, 1986). Total nitrogen of dominant species analyzed by micro Kedjehdal method (APHA, 1985).

Tested compost was provided from Saleh-abad compost factory in Kahrizak Tehran and analyzed chemicaly. Different ratio of *Fischerella* sp. (0.005-0.01-0.02-0.03-0.04-0.05 gr 0.1-1%) were added to the compost. In each treatment we had different ratio of moistures (80-240%); 4-6 mL water/5 g compost (series 1) and 8-12 mL water/5 g compost (series 2). Growth rate was studied by moisture soil method with light microscope (Zeiss, 400X) for two months (Hawkes, 2001). Treatments (compost with different ratio of algae) were analyzed for their total nitrogen contents by acid digestion or Kedjehdal method (APHA, 1985).

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RESULTS AND DISCUSSION

According to the soil cultures of paddy fields, the dominant species were as follow: *Nostoc* sp., *Anabaena* sp., *Fischerella* sp. and *Calothrix* sp. Analysis of their total nitrogen contents showed that *Fischerella* sp. had the highest percentage of nitrogen in comparison with the other species (Table 1). So it is a good candidate for adding to compost.

According to this research *Fischerella* sp. is one of the dominant species of paddy fields that has high content of nitrogen. It should be considered that many factors such as physical, chemical and biological factors affected the growth and nitrogen fixation of cyanobacteria in soil and paddy fields (Ladha and Peoples, 1995). Therefore domination of species specifies to definite location and time and change year to year.

The chemical analysis of urban garbage compost of Saleh-abad, Tehran was shown in Table 2 and the growth rate of different amounts of *Fischerella* in compost in Table 3. These results indicates that using different amounts of algae had no significant effect on growth rate. The treated cyanobacteria had similar growth rate at the end of four week (one month) with a little difference in the beginning of their life cycle. For studding *Fischerella*'s viability in compost, growth rate studied for two months. Results showed that it was alive during this period but its growth rate became low and constant. It has concluded that this algae have its maximum physiologic activities; especially nitrogen fixation; in the first month, the best time for adding to compost. On the other hand by adding a few amounts of algae to the compost desirable result can be achieved.

Study the growth rate showed that *Fischerella* as well as other cyanobacteria like *Nostoc* have a monthly growth period (Baftehchi, 2000; Shokravi, 1988). Research showed that this is a normal growth rate for cyanobacteria (Stal, 1995; Fog, 1973)

Analysis of total nitrogen is the same with growth rate (Table 4). It means that different amount of algae in compost have the same percentage of total nitrogen and had no significant effect. Only by adding 0.01 g *Fischerella* to compost a little increase in total nitrogen were observed; by the way, in this treatment, growth rate and number of colonies were more than the others.

Moisture is an important factor for this alga. Because results revealed that it had significant effect on the growth rate of *Fischerella* sp. In low moisture (4-6 mL water/5 g compost or 80-120%), we had no growth but by doubling its rate (8-12 mL water/5 g compost or 160-240%) growth was seen. The latter moistures had no significant effects on growth rates. Moisture is an important factor for the growth of most cyanobacteria. In this way in the air-dried state some of them survive only for second whereas others can tolerate desiccation for thousands, perhaps millions of years. Otherwise for tolerance of desiccation a number of features that appear to be critical to the withstanding of a long-term water deficit must done (like *Nostoc commune*) (Potts, 1994). Meanwhile some of

Table 1: Percentage of total nitrogen of dominant algae in paddy fields of north of Iran

Algae	Total nitrogen (%)
Fischerella sp.	2.58
Calothrix sp.	1.59
Anabaena sp.	1.49
Nostoc sp.	1.48

Table 2: Chemical analysis of urban garbage compost of Saleh-Abad, Tehran (Fine Kind)

pH (In saturated extract)	EC ds/m	SP (%)	Fe (%)	Mn (%)	Zn (%)	Cu (%)	O.C (%)	P (%)	K (%)	N (%)	C/N
7.4	13.4	100	2.48	0.037	0.080	0.057	10.4	0.37	1.0	1.45	10.45/1.45

Table 3: Growth rate of the different ratio of *Fischerella* sp. In different moisture of compost

Alga (g)/moisture	(%)	1st	2nd	3rd	4th	6th	8th
0.005	240	0	232	301	238	323	230
	200	0	0	252	168	265	230
	160	0	0	223	0	345	300
0.01	240	236	351	300	365	350	290
	200	287	201	290	273	253	281
	160	0	0	232	140	160	186
0.02	240	0	0	187	286	280	200
	200	0	0	301	311	303	216
	160	0	226	213	290	206	188
0.03	240	207	268	264	356	293	260
	200	0	59	168	348	263	184
	160	0	173	235	246	260	198
0.04	4240	208	234	273	325	301	290
	200	0	215	247	361	231	180
	160	0	206	213	257	220	275
0.05	240	238	275	323	417	280	260
	200	188	217	253	331	297	198
	160	0	0	237	292	245	225

Note: Average number of filaments on the surface of plate were measured for 8 week

Table 4: Analysis of treated compost for total nitrogen

Compost + algae (g)/moisture	(%)	Total nitrogen (%)
Compost + 0.005	240	1.28
	200	1.46
	160	1.41
Compost + 0.01	240	1.19
	200	1.51
	160	1.49
Compost + 0.02	240	1.14
	200	1.43
	160	1.33
Compost + 0.03	240	1.24
	200	1.38
	160	1.33
Compost + 0.04	240	1.10
	200	1.38
	160	1.38
Compost + 0.05	240	1.24
	200	1.28
	160	1.56
Compost without algae	240	1.17
	200	1.38
	160	1.49

Note: 5 g compost with different ratio of algae and different moisture were analyzed for their total nitrogen by mikro Kedjehdal method

them like *Nostoc microscopicum* and *Rivularia natans* are water stress-tolerant species and remained for long period. There is a scope for selection of cyanobacterial species more tolerant to harsh conditions to prepare commercial inoculants for agronomic practice (Mahmoud *et al*., 1992). Results showed that *Fischerella* sp. is not a water stress-tolerant species and it should be considered for its culture both in laboratory and in the fields.

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