Unicellular mucilaginous blue-green algae (BGA): impressive blooms but deceptive biofertilizers

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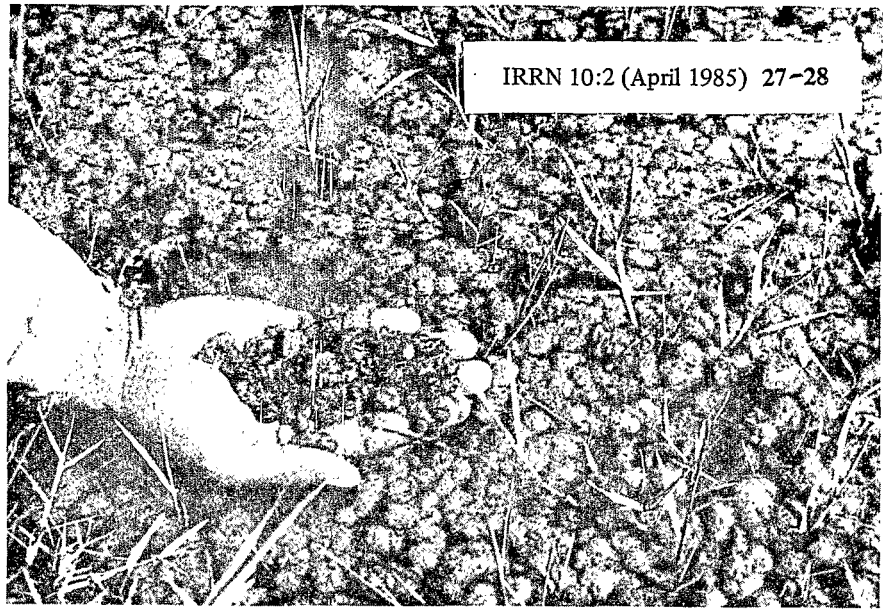
Certain mucilaginous N_2-fixing BGA develop impressive blooms in rice fields. Because of their high water and ash content, however, their N contribution may be low. The figure shows a bloom that has been observed annually since 1980 in no-N plots of the IRRI farm in dry season. It comprises *Aphanothece* as dominant genus and *Nostoc* and *Gloeotrichia* as associated genera. Highest fresh weight biomass recorded was 58 t/ha, but 98.6% water and 54% ash contents limited N content to 13 kg/ha.

In 1984 dry season, we studied the effects of such a bloom on rice yield. The experiment was in a Latin square of 16- 4- × 4-m plots, with control and BGA treatments. After 2 plowings and harrowings, IR60 was transplanted at 20- × 20-cm spacing. A basal application of 30 kg P/ha, 30 kg K/ha, and 0.5 kg ai furadan/ha was made in all the plots at transplanting. Two days later, half of the plots were inoculated with 20 g/m^2 of a dry algal inoculum collected from the same plots in May 1983. At the time of application, the inoculum contained 2.2×10^6 colony-forming units of N_2-fixing BGA per g dry weight. The dominant strains in the inoculum were *Aphanothece* sp. (2×10^6/g), *Nostoc* (1.3×10^5/g), and *Calothrix* sp. (4×10^4/g).



BGA bloom comprising *Aphanothece, Nostoc,* and *Gloeotrichia* genera.

Twenty-eight days after inoculation (30 days after transplanting [DT]), floating colonies were harvested and fresh weight, dry weight, and N content determined. The same BGA developed in inoculated and noninoculated plots, *Aphanothece* sp. being dominant. BGA harvested from control plots and inoculated plots were combined and redistributed evenly in the BGA-treated plots after these were drained. The following day (31 DT), the algal material was incorporated with a rotary weeder. Thirty days later (60 DT) the procedure was repeated. At maturity, grain and straw yield and grain protein content were measured.

Thirty days after transplanting, the biomass of mucilaginous BGA in inoculated plots was about twice that in the control (see table). *Aphanothece* was dominant in all plots, giving the BGA biomass a high water content (99.4%). Fresh weight biomasses of 18.7 and 33.0 t/ha produced only 1.5 and 2.6 kg N/ha.

Incorporating mucilaginous BGA in the surface soil negatively affected further development of BGA, as shown at 60 DT by a BGA biomass about 10 times lower in treated plots than in the control. At this time *Nostoc* sp. and *Aphanothece* sp. dominated.

BGA biomass produced in the plots, BGA biomass incorporated in treated plots, and rice yield.[a]

			Produced in control (A)	Produced in BGA-treated (B)	Level of signficance of the difference (A − B)	Incorporated in BGA-treated plots (A + B)
BGA biomass	30 DT	fw (t/ha)	18.7	33.0	10%	51.7
		dw (kg/ha)	74.8	132.0	10%	206.8
		N (kg/ha)	1.5	2.64	10%	4.8
	60 DT	fw (t/ha)	7.5	0.6	1%	8.1
		dw (kg/ha)	75.2	6.2	1%	81.5
		N (kg/ha)	1.72	0.14	1%	1.86
	30 DT	fw (26.2)	26.2	33.6	ns	59.8
	+	dw (kg/ha)	149.9	138.2	ns	288.1
	60 DT	N (kg/ha)	3.22	2.78	ns	6.0
Rice yield	Grain	t/ha	3.24 ± 0.29	3.31 ± 0.20	ns	
	straw	t/ha	2.41 ± 0.21	2.38 ± 0.14	ns	
	protein	% dw	1.45 ± 0.06	1.41 ± 0.06	ns	

[a]Each value is the average of eight replications. fw = fresh weight, dw = dry weight.

Productivity in the control, in terms of dry weight and N, was similar during the 1st and 2d months of growth. Total productivity (sum of biomasses harvested at 30 and 60 DT) was similar in control and BGA-treated plots, the higher productivity in treated plots during the 1st month of growth being balanced by lower productivity during the 2d. From 60 DT to harvest, biomass of mucilaginous BGA was very low.

Total BGA biomass incorporated in treated plots was equivalent to 60 t fresh weight/ha (52 t at 30 DT and 8 at 60 DT), corresponding to only 6 kg N (4.14 at 30 DT and 1.86 at 60 DT). Previous experiments had shown that about 20-30% of the N of incorporated BGA is available to the plant. This suggests that in the present experiment about 2 kg N was available to the plant, which was not enough to significantly increase the yield in treated plots.

Correlation between the different variables measured in the 8 replications of the control and BGA-treated plots were significant only for grain and straw yield. The absence of correlation between BGA biomass produced in control plots and rice yield indicates that N and growth-promoting substances exudated by the algae, if any, did not affect rice growth. □