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# ALGAL BIOFERTILISERS FOR RICE IN JAMAICA

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## ABSTRACT

Two species of nitrogen-fixing blue-green algae (cyanobacteria) have been isolated from local freshwater sources and fields. These were *Anabaena variabilis* and *Nostoc sp*. Experiments were carried out to propagate these on a large scale under field conditions, suitable for the use of small farmers. Effects of these algae as a substitute/supplement to the commercial nitrogen fertiliser for the variety CICA 8 have been investigated under two soil types: maverley loam and clay loam. Blue-green algae alone without any added chemical fertiliser increased the rice yields between 15 and 25% over the control without any fertiliser. When used as a supplement along with fertilizer, the blue-greens still increased yields over their respective controls with fertiliser. Protein levels of the grains increased with the use of blue-greens similar to that of fertiliser. However, soluble carbohydrates did not show much differences.

Key words: Biofertiliser, Biological nitrogen fixation, Blue-green algae, Rice

## INTRODUCTION

Jamaica has a long history of rice cultivation. The interest in rice cultivation, however, declined in the fifties and sixties as imports were cheaper and consumption was not high. However, rice has become one of the important staple foods again. At the same time, imports have become very expensive. The country currently produces about 10% the total requirement. As a result, there is a renewed interest for rice cultivation, specially by the small farmers. Rice is a high nitrogen demanding crop, using anywhere between 50 - 100 kg nitrogen per ha. The cost and availability of chemical fertiliser has been one of the main constraints for rice cultivation in many developing countries. This problem has been solved to a large extent in Asian countries through the use of biological nitrogen fixation by blue-green algae, either in a free living state or in symbiotic association with the water fern *Azolla*. Very little, if any efforts have been made in the Caribbean or in the majority of the Latin American countries to develop algal biofertilisers for rice or any other crop. The present work reports the effects of indigenous free living blue-green algae as biofertilisers for rice in Jamaica.

## MATERIALS AND METHODS

Soil and water samples from various fields which are suitable for rice cultivation have been collected and crude cultures of algae have been established first. From these, two nitrogen fixing blue algae, viz. *Anabaena variabilis* and *Nostoc sp.*, have been isolated and pure cultures were established. These strains were later grown in large culture vessels and eventually they were grown in small aquarium tanks in the green house.

Field methods have been established for growing the blue-green algae on large scale. The basic methods were adopted from Venkatraman (1981) with modifications suitable for the local conditions and availability of the materials. Wooden trays lined with plastic sheet or half-drums were filled with good garden soil, to the height of 2" from the bottom. Potassium dihydrogen phosphate and potassium nitrate at the rate of 200 mg/Kg soil were incorporated into the soil along with a trace of ammonium molybdate. Carabofuran granules were also mixed with the soil at 20 mg/kg soil. Water was let in and allowed to stand for two days. The final water level was kept just one inch from the soil surface. Blue-green algae were introduced into these trays/half drums and were allowed to proliferate for two to three weeks. Within this time, a thick layer of algae grew and covered the surface of the containers. This was harvested in two ways. In the first method, the algal layer was scooped, and was sun dried before packing for future use. The amount of algae left behind served as inoculum for further algal growth. In the second method, the water was allowed to dry completely until the algae formed a crust on the soil surface. This algal crust was scraped and stored. This method delays the harvest but is more convenient.

Small scale experiments have been carried out using milk trays which hold 10 kg soil. Two soil types were used - maverley loam from Mona and clay loam from Caymanas estate. The rice variety CICA 8 has been used for our experiments. Seedlings were grown for 20 days and then were transplanted. Commercial fertiliser, ammonium sulphate, was used, where necessary for the treatment, at a rate of 100 kg N/ha. This was used as a split dose; the first dose was incorporated into the soil before transplanting. Blue-green algae were introduced 10 days after transplanting at a rate of 30 kg dry/ha. A second dose of algae at 10 kg/ha was introduced two months after the first introduction. Treatments included a control without any fertiliser added, with blue-green algae as sole fertiliser, half dose of the commercial fertiliser with and without blue-green algae; full dose of commercial fertiliser with and without blue-green algae.

RESULTS AND DISCUSSION

Results obtained using Mona soil are presented in Table 1. When blue-green algae were used as sole fertiliser, the rice yields increased by 14% over the control without any fertiliser. This was roughly equivalent to the yields obtained with half dose fertiliser. When blue-green algae were used along with half dose fertiliser, the yields increased by 29% over control and 15% over the yields obtained with half fertiliser only. The full dose fertiliser increased the yields by 40% but here also, the blue-greens, when used with full dose fertiliser, increased the yields by another 10%. Protein content of the rice grain increased significantly over the control when blue-green algae were used. These increases were similar to those obtained with the commercial fertiliser. However, total soluble carbohydrates did not show much difference.

Table 2 presents the results obtained with Caymanas soil. Here also, yields increased by 25% over control when blue-green algae were used as sole fertiliser. However, as supplement to full dose fertiliser, blue-greens did not have much effect. Protein content showed a significant increase with blue-greens over the controls while the soluble carbohydrate did not show much difference.

The results obtained in the present study are in agreement with several studies on the effect of algal biofertilisers on rice crop in other countries. In India, where algal biofertilisers are used extensively, yield increases between 7 and 27% by various authors on different varieties of rice (Agarwal, 1979; Goyal and Venkatraman, 1970, 1971; Mudholk et al., 1973; Venkataraman, 1972; Sharma and Gupta, 1983). In China, yields were observed to be higher between 18 - 24% (cf. Roger and Kulasooriya, 1981; Huang, 1978). Similarly, an increase of 18 - 24% was reported from Egypt (El-Fadl et al., 1967).

The present results clearly demonstrate the potential of blue-green algae as nitrogen fertiliser for rice in Jamaica. Further studies with field crops are underway.

Table 1: Effects of blue-green algae on CICA 8 when grown on Maverley loam soil from Mona.

| Treatment | Yield | Protein* content | Soluble carbo-* hydrate content |
|---|---|---|---|
| Control, no fertiliser | 100 | 100 | 100 |
| Blue-green algae | 114.2a | 137 | 118 |
| 1/2 dose fertiliser | 112.0a | 110 | 113 |
| 1/2 dose fertiliser + BGA | 129b | 136 | 109 |
| Full dose fertiliser | 141.5c | 138 | 110 |
| Full dose fertiliser + BGA | 151c | 153 | 114 |

* Control is taken as 100%

a,b,c, = yields with same letters are not significantly different at 5% level

Table 2: Effects of blue-green algae on CICA 8 when grown on Maverley loam soil from Mona.

| Treatment | Yield | Protein* content | Soluble carbo-* hydrate content |
|---|---|---|---|
| Control, no fertiliser | 100* | 100 | 100 |
| Blue-green algae | 125a | 118 | 109 |
| 1/2 dose fertiliser | 116b | 102 | 104 |
| 1/2 dose fertiliser + BGA | 128b | 159 | 113 |
| Full dose fertiliser | 139c | 225 | 113 |
| Full dose fertiliser + BGA | 145c | 260 | 118 |

* Control is taken as 100%
a,b,c, = yields with same letters are not significantly different at 5% level

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