PHOTOFIXATION OF CARBON IN MICROCYSTIS — EFFECT OF LIGHT INTENSITY AND TEMPERATURE

B. P. NARASIMHARAO
CAS in Botany, Banaras Hindu University, Varanasi 221 005, India.
Present address: CAS in Botany, University of Madras, Madras 600 025, India.

MICROCYSTIS AERUGINOSA from ponds and temple tanks (PM) around Varanasi is isolated by repeated sub-culturing in different mineral media and is maintained in ASMT medium[1] at 25 ± 1° under 1000 lux (CM). After destroying the gas vacuoles by high pressure, dilute cell suspensions were prepared in fresh sterile growth medium for both *in vivo* and *in vitro* materials, Immediately after the addition of radioactive bicarbonate solution (0.125–2.5 μCi), the dilute homogeneous cell suspensions (5–10 ml), were exposed to light (850 lux or 25000 lux). After the experiment, the algal cell suspension was quickly filtered by suction through a filter paper disc. Radioactivity of the algal cells on paper disc was determined in a Beckman scintillation counter using bray's solution or toluene-based fluoroalloy (Beckman) as scintillator. Chlorophyll was estimated by the method of Talling and Driver[2].

Table 1 shows that carbon fixation in the alga from culture did not show any increase with change in the light intensity from 400 lux to 850 lux. In nature at 30°C, there was 33% increase in carbon fixation at 850 lux. This difference in carbon fixation between experimental and pond materials cannot be explained by enmasse effect[3] as the cell suspensions used in both the cases were very dilute. At the cell

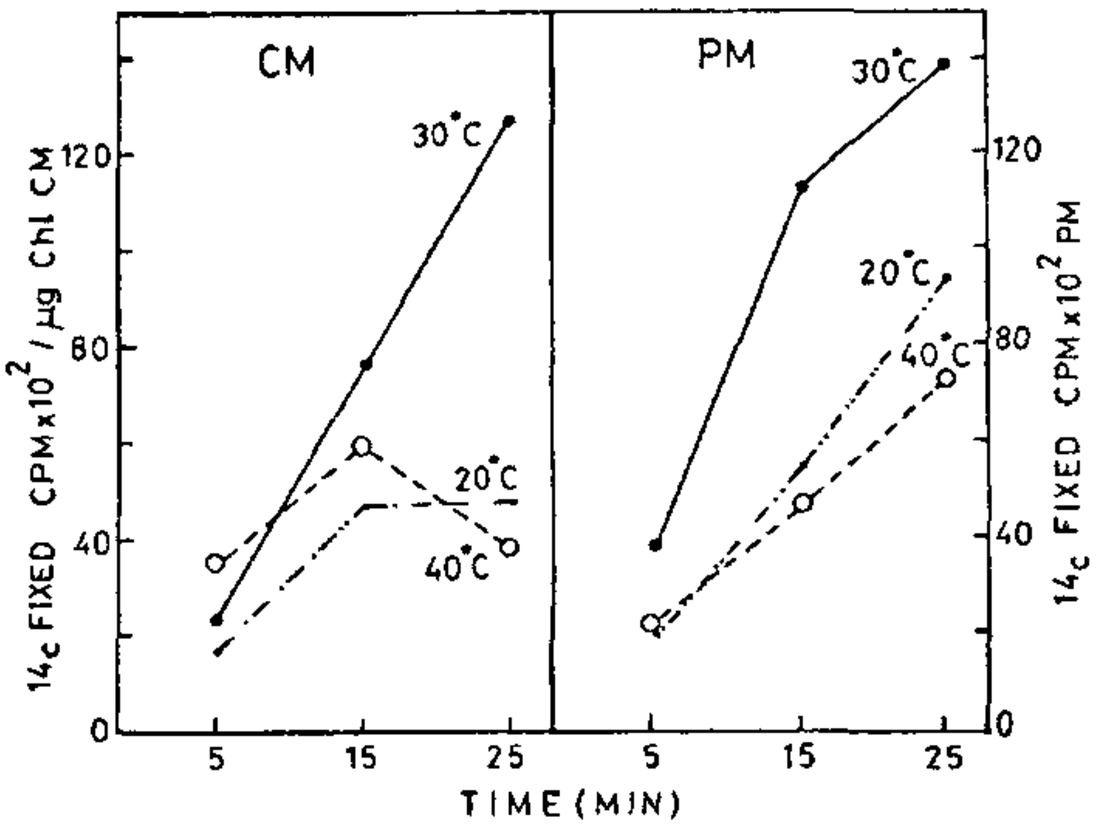

Figure 1. Effect of temperature on carbon fixation. CM, Culture material; PM, Pond material.

dilutions used, carbon fixation was saturated even at very low light intensity of 400 lux in the alga from culture but not in nature. At 40°C, 850 lux light intensity was inhibitory to carbon fixation in both CM and PM. The inhibition is however less in the latter. This may be due to the presence of more stable superoxide dismutase at high level in *M. aeruginosa* growing in ponds as shown by Eloff *et al*[4].

It is observed that the optimum temperature for carbon fixation for both culture and pond *Microcystis* strains is 30°C (figure 1). Culture material was more sensitive to temperature changes; carbon fixation being impaired upon long exposures (up to 25 min) at below or above the optimum temperature. Alga from nature have shown remarkable flexibility in its carbon fixation ability. Although carbon fixation is high at 30°C throughout the

Table 1 *Effect of light intensity on carbon fixation*

	Culture material			Pond material		
Temp.	400 lux	850 lux	± %	400 lux	850 lux	± %
20°C	451	535	16	334	275	21.5
30°C	1297	1267	− 2	1912	2875	33.5
40°C	3825	1855	− 106	3343	2530	− 32.0

Culture age: 43 days; Suspended in: ASMT (pH 7.5); Cell suspension: 5 ml (Chlorophyll content CM–1.27 μg/ml, PM–1.67 μg/ml); $NaH^{14}CO_3$: 25 μl (2.5 μCi); Exposure time: 5 min; Dark incubation: CM–17 h; PM–3 h. Figures in cpm/μg Chl; ± %: Per cent increase or decrease in carbon fixation under 850 lux.

Table 2 *Effect of temperature and exposure time on carbon fixation (culture material)*

	20°C		30°C		40°C	
Time (min)	Carbon fixed	± %	Carbon fixed	± %	Carbon fixed	± %
5	1793	–	2381	–	3506	–
15	4693	162	7722	224	6073	73
25	4740	1	12759	65	3910	− 55

Culture age: 24 days; Suspended in: ASMT (pH 7.5); Cell suspension: 10 ml (Chlorophyll content 2.4 μg ml) $NaH^{14}CO_3$: 25 μl (2.5 μCi); Light intensity: 850 lux. Carbon fixed in cpm/μg Chl; ± %: Per cent increase or decrease in carbon fixation.

Table 3 *Effect of temperature and exposure time on carbon fixation (pond material)*

	20°C		30°C		40°C	
Time (min)	Carbon fixed	± %	Carbon fixed	± %	Carbon fixed	± %
5	771	–	1459	–	829	–
15	2071	168	4271	193	1753	111
25	3531	71	5223	22	2777	59

Suspended in: ASMI (pH 7.5): Cell suspension: 5 ml (Chlorophyll content 1.33 μg ml), $NaH^{14}CO_3$: 25 μl (0.125 μCi): Light intensity: 25000 lux. Carbon fixed in cpm μg Chl: ± %: Per cent increase or decrease in carbon fixation

experiment, there is a linear increase with time period at 20°C as well as at 40°C (figure 1). With increase in time period in the alga from nature, the per cent increase or decrease in carbon fixation at the three temperatures was not highly variable in contrast to that observed for CM (tables 2 and 3).

The author is grateful to Prof. E. R. S. Talpasayi for encouragement and guidance.

12 November 1987; Revised 15 February 1988

1. Mclanchlan, J. and Gorham, P. R., *Can. J. Microbiol.*, 1961, **7**, 869.
2. Talling, J. F. and Driver, D., In: *Proceedings, conference of primary productivity measurement, marine and freshwater*, Hawaii, 1961, U.S. Atomic Energy Commn., TID-7633, 1962, p. 142.
3. Walsby, A. E., *Bacteriol. Rev.*, 1972, **36**, 1.
4. Eloff, J. N., Steinitz, Y. and Shilo, M., *Appl. Environ. Microbiol.*, 1976, **31**, 119.

BIOLOGICAL CONTROL OF WATER HYACINTH IN INDIA BY RELEASE OF THE EXOTIC WEEVIL *NEOCHETINA BRUCHI*

K. P. JAYANTH

Division of Entomology and Nematology, Indian Institute of Horticultural Research, Hessaraghatta Lake Post, Bangalore 560 089, India.

SINCE its introduction into India in the late 19th century water hyacinth has spread throughout the country, creating many problems in the management and utilization of freshwater resources[1]. *Neochetina bruchi* Hustache (Coleoptera: Curculionidae), of the South American origin, was introduced from USA in 1982 for biological control trials against this weed. Detailed host-specificity tests involving 76 plants belonging to 42 families under quarantine conditions confirmed the safety of this insect to cultivated crops in the country[2]. Field releases with *N. bruchi* were initiated in 1984 after obtaining permission of the Plant Protection Adviser to the Government of India.

A 20 ha tank at Agram in Bangalore, fully infested by water hyacinth (figure 1), was selected for conducting field trials with *N. bruchi*. Between February and July 1984 a total of 7 releases consisting of 1700 adults were made in this tank. Releases were confined to an area of about 1 ha and observations on establishment and dispersal were taken at intervals of two months. A summary of the observations on the number of leaves per plant, the petiole length and the adults per plant collected at intervals of 6 months is presented in table 1.

The first signs of establishment of *N. bruchi* in the Agram tank was noticed in September 1984 when freshly emerged adults could be collected from the release area. By March 1985 up to 5 adults were present per plant in about 1 ha area and the insect started dispersing to other parts of the tank. *N. bruchi* had migrated throughout the tank by September 1985.

Water hyacinth plants in the initial release area started turning brown in September 1985 and by March 1986 more than 90% of the plants in the tank were brown and collapse had also started. About 40% of the water hyacinth plants in the Agram tank collapsed by September 1986. Observations in March 1987 revealed that nearly 70% of the water surface in the tank was free of water hyacinth and by September 1987 about 90% control of water hyacinth was achieved (figure 2).

The remaining water hyacinth plants in the Agram tank are stunted with reduced vigour and hardly any flower production. When compared to 8–12 leaves per plant with petiole lengths ranging between 55 and 61 cm in 1984, only 5–8 leaves are now observed with petioles measuring only 25–37 cm. Although fresh plants are continuously being added from germinating seeds these are kept under check by *N. bruchi* present on older plants.

The present study proves that *N. bruchi* is an effective biological control agent of water hyacinth and has the potential to suppress this weed throughout the country. Biological control of water hyacinth by release of *N. bruchi* has also been reported from Argentina[3].