

POPULATION DNA DISTRIBUTION, CELLULAR DNA CONTENT, AND THE DIEL DNA CELL CYCLE OF CULTURED KARLODINIUM SPP. (DINOPHYCEAE)

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Seven strains of *Karlodinium veneficum* and one strain of *Karlodinium cf. armiger* were examined for DNA content by flow cytometric analysis of cells stained with the DNA fluorophore SYBR Green. Each strain exhibited distinct 1C, intermediate, and 2C DNA subpopulations indicative of respective eukaryotic cell cycle phases G1, S, and G2M. The measured 1C DNA content of *K. veneficum* was estimated using rainbow trout erythrocyte nuclei as an internal standard, and varied from 7.8 ± 0.65 pg cell⁻¹ (mean \pm 1 SD) in a strain from Norway (CCMP415) to 14.7 ± 1.5 pg cell⁻¹ in a strain from Spain (CSIC-1). The five tested strains from the U.S. (Maryland and South Carolina) did not differ significantly in measured 1C DNA content (11.2 ± 0.6 pg cell⁻¹). The estimated 1C DNA content of *K. armiger* (GC-3) was 32.9 ± 2.4 pg cell⁻¹, a significantly higher amount than was found in *K. veneficum*. It was unknown whether chromosome number also varied with DNA content.

K. veneficum strains from Norway (CCMP415) and South Carolina (CCMP2282) were examined for cell cycle progression over 48 h. Both had a similar diel periodicity of DNA synthesis (S) and cell division (G2M) that were phased with the 12:12 (h) light:dark photoperiod (Fig. 1). Cells with 1C DNA (G1) entered S phase late in the light period, and the maximum proportion of cells in S phase (15-22%) occurred near the light/dark transition. The G2M maximum (10-13%) occurred near the middle of the dark period, and the majority of G2M cells completed cell division by the end of the dark period. The duration of S + G2M was about 12 h.

Cells with two longitudinal flagella, a feature generally attributed to dinoflagellate planozygotes, were consistently observed in *Karlodinium spp.* cultures. Thus, some cells with 2C DNA may have formed by gamete fusion rather than DNA synthesis. Cells with 4C DNA, as would be expected in a conventional meiotic cycle, were not detected in appreciable numbers (< 0.3%). If persistent sexuality occurred, the observed lack of 4C DNA cells could have implications for the meiotic process in *Karlodinium spp.* Alternatively, *Karlodinium* vegetative cells may develop two longitudinal flagella prior to asexual division, as was originally reported for this dinoflagellate more than 40 years ago [1,2]. This possibility requires further study.

1. Ballantine D. 1956. J. Mar. Biol. Ass. U.K. 35:467-474.
2. Leadbeater B. & Dodge J.D. 1967. Archiv fur Mikrobiol. 57:239-254.

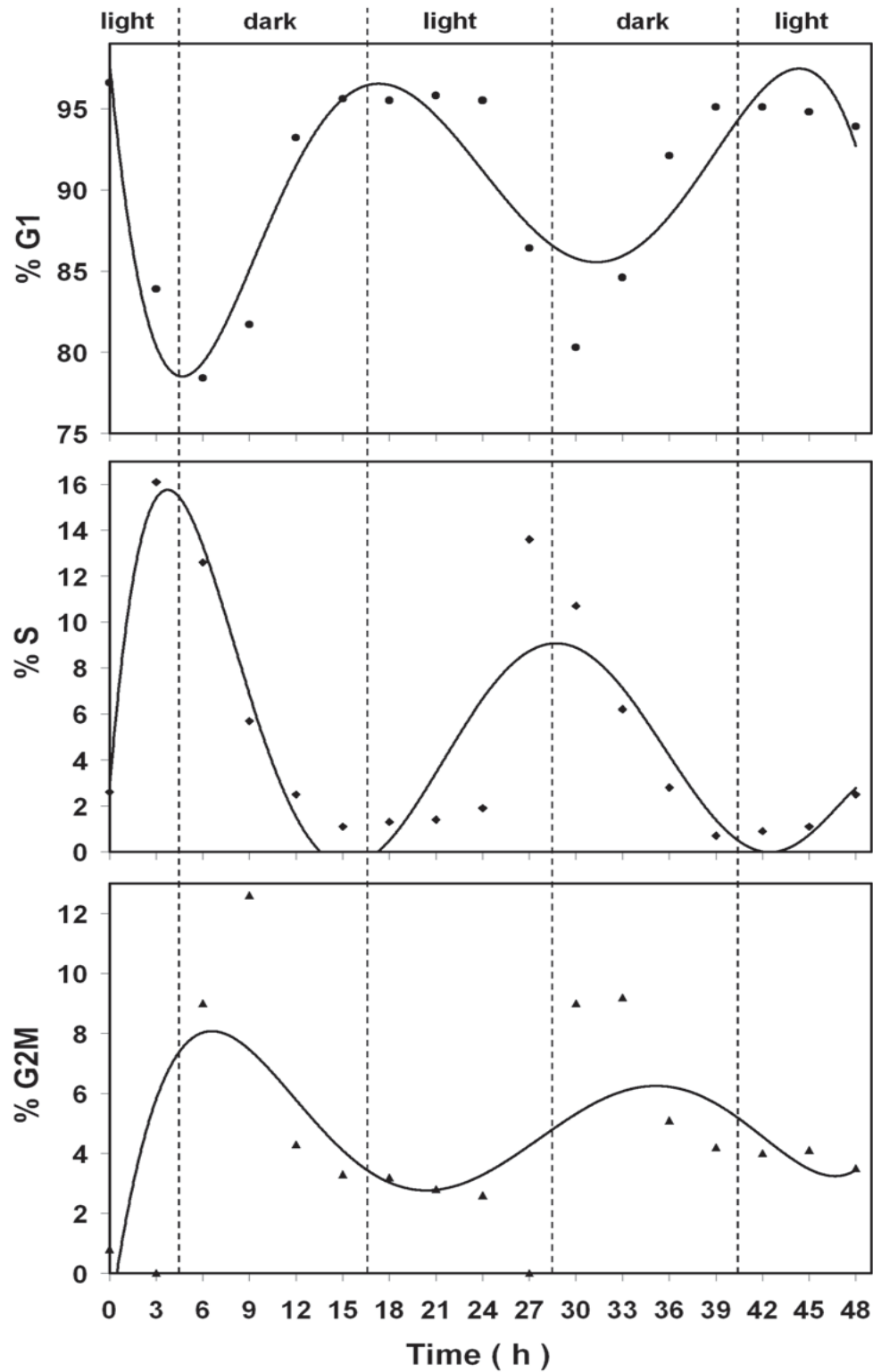


Fig. 1. *K. veneficum* (CCMP415) cell cycle phase fractions G1, S, and G2M over 48 h. Curves are 5th degree polynomials fitted to the phase fraction data.