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Culture Density and Productivity of *Pistia stratiotes*[1]

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INTRODUCTION

Recent studies have demonstrated the relationship between stand density, productivity, and nutritive value of aquatic macrophytes (1, 2). Tucker (2) discussed these relationships and proposed that cultural practices should take into consideration the effects of plant density on both productivity and plant composition. Such data should establish the optimum conditions to produce the largest quantity of high quality plant material.

Water lettuce (*Pistia stratiotes* [L.]) has been found to be a productive aquatic plant with a higher crude protein and ash content and less fiber than waterhyacinth (*Eichhornia crassipes* (Mart.) Solms) (3). Data is available on the relationship between culture density and the composition of water lettuce (2). However, similar studies on the effect of culture density on productivity are lacking. The present study was undertaken to determine the optimum density for production of water lettuce.

METHODS AND MATERIALS

Research was conducted at the Harbor Branch Foundation aquaculture facility, near Fort Pierce, Florida. Plants were cultured in 0.3 m^2 plastic mesh cages, four of which were suspended in each of three 950 l cement tanks. Tanks were drained, washed, and refilled weekly with fresh nutrient solution. The composition (mg/l) of the nutrient solution was: NO_3-N, 14; PO_4-P, 3.1; K, 24; Ca, 8.0; Mg, 4.9; S, 6.4; Fe (EDTA chelated), 2.0; Mn, 0.75; Zn, 0.75; B, 0.02; Cu, 0.01; Mo, 0.009.

On October 24, 1979, water lettuce was obtained from preexisting cultures at the facility and stocked into each 0.3 m^2 cage at 40 g dry wt/m^2 (approximately 1 kg wet wt/m^2). Plants were weighed at weekly intervals and by November 20 the desired densities were established. Water lettuce was then maintained, in triplicate, at densities of 40, 100, 200, and 400 g dry wt/m^2. Cultures were maintained at these densities by removing the weekly growth at each weighing. Water lettuce was weighed by lifting and weighing on a spring scale. At each weighing, a sample of two or three plants was weighed, dried at 80 C for 48 hours and reweighed to provide a ratio of dry weight to wet weight. The final weighing was on August 3, 1980.

RESULTS AND DISCUSSION

Both average daily productivity and specific growth rate were highly density dependent (Figure 1). The highest average productivity occurred in cultures maintained at 200 g dry wt/m^2 (approximately 5 kg wet wt/m^2). Productivity decreased at higher and lower densities. Below the optimum density, incident solar radiation is inefficiently utilized and at excessively high densities self-shading occurs and net photosynthesis is reduced. This relationship of maximum productivity at intermediate densities has also been described for duckweed (*Lemna minor* [L.]) and water-

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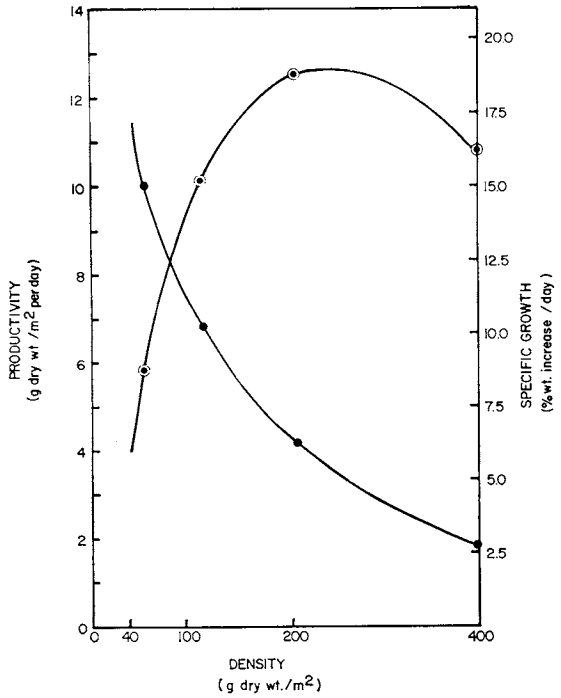

Figure 1. Average daily productivity (open circles) and average specific growth rate (closed circles) for water lettuce cultured at four different densities.

hyacinth (1). Optimum densities for the production of these three plants are approximately: duckweed, 20 g dry wt/m² (1); water lettuce, 200 g dry wt/m² (this study); and waterhyacinth, 1000 g dry wt/m² (1).

Specific growth rates declined as culture density increased. This relationship has been also observed for both duckweed and waterhyacinth (1). Although the "productivities" of plants are often compared using specific growth rates, the interspecific and intraspecific density dependence of this parameter makes such comparisons unreliable.

Culture density also effects the composition of water lettuce (2). When maintained at 100 to 200 g dry wt/m², water lettuce contains a higher percent crude protein and less fiber than plants cultured at 400 g dry wt/m². Since both productivity and nutritive value are decreased at high densities, cultures should be maintained at moderate densities for the greatest production of high quality biomass.

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