

Nutrient Absorption by *Spirodela Polyrrhiza*¹

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INTRODUCTION

The ability of macrophytes to obtain nutrients from their environment is essential to their growth. Hillman (1961) considered the roots of vascular hydrophytes to be merely for anchoring the plants with nutrient absorption to be facilitated through stems and leaves. But because the roots of vascular hydrophytes have an endodermis, Sculthorpe (1967) reasoned that some absorption of ions by the roots should occur. More than a decade later, Peter *et al.* (1979) confirmed that *Potamogeton crispus* L. and *P. pectinatus* L. did indeed absorb ions through their roots. It now seems reasonably clear that a number of submersed plants do absorb a significant amount of nutrients through their roots (Barko and Smart, 1979; Best and Mantai, 1978).

What has not been investigated, however, is whether the roots of a floating plant like giant duckweed (*Spirodela polyrrhiza* (L.) Schleid.) can absorb a significant amount of nutrients. Hillman (1961) stated that *S. polyrrhiza* can be grown without roots just as effectively as with roots. He also stated that the undersurface of fronds absorbs all nutrients required for plant growth, however, Sculthorpe steadfastly opposed the idea that *S. polyrrhiza* absorbs nutrients only through its fronds.

The objective of this experiment was to determine the role of roots for nutrient absorption by giant duckweed. It was tentatively assumed that neither removal of roots nor coating of roots with paraffin would affect nutrient absorption as measured by plant growth rates.

MATERIALS AND METHODS

Giant duckweed plants were collected from a eutrophic pond in Mohawk Park, Tulsa, Oklahoma. The plants were grown under identical conditions of light, temperature,

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and nutrient medium. The light source was two 40-watt Sylvania Gro-Lux fluorescent tubes lighted 24 hours per day. Temperature was maintained at 22.5 ± 1 C. Stern's Miracle-Gro commercial plant food medium (15-30-15 N-P-K plus microelement) was used in the first experiment. Stern's Miracle-Gro plant food, combined with Ortho plant food (5-10-5 N-P-K plus microelements), was used for the second experiment. The third experiment used a combination of Stern's Miracle-Gro plant food and Plant Marvel brand all purpose plant food (12-31-14 N-P-K plus microelements). The fourth and fifth experiments used only Plant Marvel brand all purpose plant food. The prepared medium was placed into aquaria, partitioned into sections such that it could circulate freely among sections.

An exact number of plants (50 or 100) were placed into each section. One section contained plants with excised roots. Another section contained plants with intact roots, but coated with paraffin. The remaining section contained plants with intact roots (control group). Similar experiments were conducted using only rooted and nonrooted plants.

An alga bloom and an unidentified aquatic herbivore became so abundant during the first experiment that the insecticide Sevin and an algicide were used to control these problem populations. The next two experiments were free from the small aquatic herbivore, but still had alga blooms. Barko (1980) pointed out that dense attachment of algae to submersed macrophytes can cause a decline of macrophyte growth. Because of the persistent alga blooms, the fifth experiment was conducted after first washing the plants with diluted Clorox.

Hillman (1961) determined that multiplication rate was the most accurate method for accurately measuring growth rates of giant duckweed plants. We determined multiplication rates by taking frond counts and determining the percent daily change of frond numbers in each colony according to Hillman's equation:

$$MR = \frac{Fd - Fo}{Fo (n)} \times 100, \text{ where: "MR" is multiplication rate}$$

"Fd" is the frond number on the last day of count

"Fo" is the frond number on the first day of count

"n" is the number of culture days

Furthermore, we assumed growth rate to parallel nutrient uptake (Hillman, 1961).

Two experiments had two replications each of rooted, non-rooted, and paraffin-coated plants; two experiments had four replications each of rooted and nonrooted plants; and one experiment had three replications each of rooted and nonrooted plants. Growth rates for each of the groups were compared with a one-way analysis of variance test to determine if significant differences existed among the treatments.

RESULTS AND DISCUSSION

The average daily growth rate achieved in this study was 15.2%, considerably lower than the 43% daily growth rate achieved in an experiment involving the culture of *S. polyrrhiza* by Perry and Byrne (1969). But Perry and Byrne's cultures were aseptic, unlike the cultures in this study. The alga blooms present in the first four experiments no doubt competed with the giant duckweed for available nutrients (Barko, 1980; Fitzgerald, 1969). Rinsing the plants with diluted Clorox in the fifth experiment suppressed algae growth, but also caused a decrease in the growth rate of the duckweed as compared to the growth rates in the other four experiments.

Table 1 presents the results of this study. The analysis of variance test was performed on each of the experiments based on the daily frond count increase. Only in the second experiment was there a significant difference in growth rates. And in this case, the plants with excised roots multiplied more rapidly than the rooted plants.

Therefore, based upon the data obtained from these experiments, and the hypothesis that plant growth rate is directly proportional to nutrient uptake, it may be concluded that roots played no important role in nutrient uptake by the giant duckweed plants used in these experiments. These results support the contention that roots have little or no role in nutrient absorption in this species.

ACKNOWLEDGMENT

We would like to acknowledge the interest in and support for this project by Drs. John Korstad and Edward Nelson of the Natural Science Department, Oral Roberts University.

TABLE 1. FROND COUNT INCREASES BY *Spirodela polyrrhiza* WHEN ROOTED, WITH ROOTS EXCISED, AND WITH ROOTS COATED WITH PARAFFIN.

Experiment No.	No. Plants Initially	No. of Culture Days	Replications	Root Treatment ¹			Statistical ² Significance
				Rooted	Excised	Coated	
1	100	8	4	62(7.7%)	64(8%)		NS
2	100	8	4	41(5.1%)	72(9%)		*
3	100	3	3	16(5.4%)	16(5.3%)		NS
4	50	6	2	88(29.3%)	86(28.8%)	88(29.3%)	NS
5	50	11	2	71(12.9%)	60(10.8%)	72(13.1%)	NS

¹Average frond count increases with percent daily multiplication rates in parentheses.

²NS = not significant at 0.05 level of probability.

* = significant at 0.05 level of probability (ANOVA).

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