Effects of Red-light Intensity on the Growth of Waterstargrass, Coontail, and Duckweed[1]

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Abstract. The minimum red-light (> 590 mμ) intensities from fluorescent tubes at which growth or maintenance of original fresh weight were obtained at 20 C in a growth chamber for 28 days were 11–20 foot-candles for waterstargrass (*Heteranthera dubia* [Jacq.] Mac M.) and 12–45 foot-candles for coontail (*Ceratophyllum demersum* L.). Duckweed (*Lemna minor* L.) frond number increased significantly at 45 foot-candles red light, and the fresh weight probably increased at 45 foot-candles. The intensites of 11–45 foot-candles constituted 1.0–3.8 percent of the red portion of full sunlight.

INTRODUCTION

MINIMUM light intensities sufficient for growth of several submersed hydrophytes grown under a visible spectrum have been reported by Blackburn, *et al.*, (1), and Wilkinson (3, 4). Blackburn, *et al.*, (1), found 10 foot-candles to be insufficient for prolonged growth of waterstargrass (*Heteranthera dubia* [Jacq.] Mac. M.), but reported slight growth at 68 foot-candles. They found that higher light intensities within a range of 125–591 foot-candles progressively increased the growth of waterstargrass. Blackburn, *et al.*, also studied the effects of black, blue, green, and red lights on the elongation of waterstargrass and reported 125 foot-candles red illumination to be sufficient for prolonged growth which was nearly as great as that produced by daylight at 395 foot-candles. Growth did not occur under blue light at 145 foot-candles and was much less under green light at 225 foot-candles than under red light at 125 foot-candles.

Because red light apparently is the most critical component of daylight in the growth of waterstargrass and red light is filtered out by water more than is blue light or other shorter wavelengths, as reported by Hutchinson (2), the study reported here was undertaken to determine the minimum red-light intensity at which waterstargrass, coontail (*Ceratophyllum demersum* L.), and duckweed (*Lemna minor* L.) would grow.

METHODS AND MATERIALS

Procedures utilized were those of Wilkinson (4), which included a walk-in refrigerator containing three light chambers isolated with double curtains and illuminated with fluorescent lamps. Temperatures were maintained at 20 C and red filters were wrapped around the fluorescent tubes. The red filters were 10-mil, dyed, unplasticized polyvinylchloride plastic. The transmission characteristics shown in Figure 1 were obtained by placing the plastic in the chamber of a Klett-Summerson photoelectric colorimeter and taking a reading of the light intensity transmitted through the plastic within the spectra ranges passed by the Corning glass filters. Similarly, the percentage of full sunlight passed by the plastic was obtained by measuring the sunlight reaching the cells of a Weston Sunlight Illumination Meter, Model 756, with and without the plastic filter. Bright sunlight on a clear day (December 26, 1961, 1:15 P.M.) measured 9050 foot-candles and filtered red light measured 1200 foot-candles. Red-light intensities at the water surface were also determined by the same instrument. The experiment was repeated eight times. The statistical procedures followed those described by Wilkinson (4).

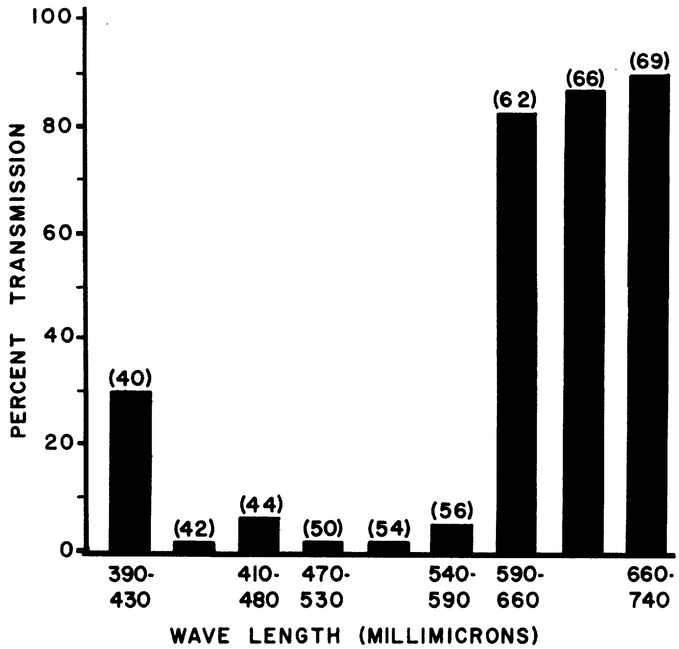

Figure 1. Transmission of light through red, unplasticized, polyvinylchloride plastic. Abscissa shows the range of transmission passed by the Corning glass filters. Numbers in parentheses are the Corning glass filter recognition numbers.

RESULTS AND DISCUSSION

The minimum red-light intensity sufficient for maintenance of fresh weight placed in the aquaria or growth of waterstargrass in 28 days was shown to between 11 and 20 foot-candles (Table 1). Wilkinson (4) reported the minimum total light intensity for maintenance of fresh weight to be between 2 and 3 percent of full sunlight (FS), which is equivalent to 200–300 foot-candles white light. Since these filters passed 1200 foot-candles

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Table 1. Average terminal fresh weight of waterstargrass, coontail, and duckweed, and number of duckweed fronds harvested after 28 days at 20 C under the red-light intensities indicated. Fresh weights have been adjusted by an analysis of covariance to correct for variation in fresh weight initially placed in the aquaria.

Red-light intensity ft-c	Fresh weight			Duckweed number of fronds
	Water-stargrass[a] grams	Coontail grams	Duckweed mg	
8		0.42 b	0.22 a	13.0 b
11	0.21 c			
12		0.45 b	0.25 a	14.5 b
20	0.27 b			
45		0.53 a	0.38 a	23.1 a
121	0.43 a			
Originally placed in aquaria	0.24	0.50	0.20	10.0

[a]Values in a column followed by the same letter are not significantly different at the 5 percent level.

red light out of 9050 foot-candles of sunlight, waterstargrass survived on less than 1.7 percent of the red light available.

Fresh weight of coontail grown at 45 foot-candles red light was significantly greater than fresh weight of coontail grown at 12 foot-candles red light, but the fresh weight of the sections originally added to the aquaria was intermediate. Therefore, the red-light intensity sufficient for maintenance of fresh weight placed into the aquaria or growth of coontail was between 12 and 45 foot-candles and indicates a natural red-light requirement of 1.0–3.8 percent of that in full sunlight.

The fresh-weight data for duckweed were so variable that significant differences between harvested fresh weights were not obtained. However, the fresh weight of duckweed increased from 0.20 mg per aquarium to 0.22, 0.25, and 0.38 per mg per aquarium in 8, 12, and 45 foot-candles red light, respectively. The differences between frond numbers harvested from aquaria under 45 and 12 foot-candles red light were significant.

The minimum red-light intensities at which growth occurs were found to be lower than minimum intensities of full sunlight reported by Wilkinson (3). It appears that control of these submersed hydrophytes and duckweed by shading might be very difficult in the field.

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Persistence of Diphenamid in Tobacco Field Soils[1]

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Abstract. After 10 months, diphenamid residues were found throughout the 0–9 inch soil depth. In silt loam soils under climatic conditions prevailing in and around the bluegrass region of Kentucky, diphenamid residues in soils may be present at phytotoxic levels in the plow layer 10–11 months after application at rates required for weed control in tobacco.

Introduction

Three field experiments on chemical weed-control in Burley tobacco were conducted at different locations in Kentucky in 1962. Growth of the barley cover crop seeded after tobacco harvest on two of the fields was retarded on plots which received *N,N*-dimethyl-2,2-diphenylacetamide (diphenamid). A cover crop was not seeded on the third field. Damage to cover crops was also reported by farmers in the state who used diphenamid for weed control in their tobacco fields. Diphenamid gave good weed control without causing damage to tobacco plants, and it is being marketed as a tobacco herbicide. It is doubtful if any herbicide that prevents establishment of a small grain cover crop after tobacco and persists in the soil very long would be desirable for use on tobacco in Kentucky. This paper reports results of studies on diphenamid residues persisting in the experimental plots at the two locations where cover crops were seeded. The amount of herbicide residues were determined by bioassay in the greenhouse.

Reports of studies on diphenamid residues in the soil were not found in the literature. However, some work has been reported on a related compound, 2-chloro-*N,N*-diallylacetamide (CDAA). Injury to small grain planted the year after application of 6 lb/A of CDAA was noted by Splittstoesser and Derscheid (2). Factors such

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