

NOTES

Response of St. Augustinegrass to Fluridone in Irrigation Water¹

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INTRODUCTION

Research has shown that aquatic weeds, particularly hydrilla (*Hydrilla verticillata*, (L.F.) Royle), can be controlled with exposure of 8 to 12 weeks with concentrations of 10 to 15 ppb of fluridone (1-methyl-3-phenyl-5-[3-trifluoromethyl]phenyl]-4(1*H*)-pyridinone) (Haller et al. 1990 and Fox et al. 1994). Fluridone label recommendations restrict the use of the treated waters for irrigation of turf or newly seeded crops and seed beds for 30 days following the last application of the herbicide. The time of application plus the 30 day recommended use restriction can total 75 to 100 days of recommended water use restrictions if split applications are applied. The recommended use restrictions of fluridone were developed in the mid-1980's and were based on the maximum fluridone application rates of 2 to 4 kg ai/ha (ca 125 to 175 ppb) depending upon water depths (Sonar A.S. label dated 11/87).

More recent fluridone labels (Sonar A.S. label dated 1994 and AVAST label dated 2000) recommend lower application rates of fluridone and are based upon the concentration of the active ingredient in water. Concentrations of 60 to 90 ppb in ponds and use of 10 to 20 ppb for whole lake treatments are currently recommended. Despite these reduced application rates, the labels continue to suggest water use restrictions for irrigation for up to 30 days following fluridone applications.

Fluridone activity in soils is affected by soil organic matter and clay content. Loh et al. (1979) reported the K_a (absorption coefficient) of fluridone by 14 soil types was significantly correlated to the soil organic matter content and inversely related to the rates of fluridone necessary to reduce growth of *Sorghum vulgare* L. Weber et al. (1986) reported that fluridone adsorption was highly correlated ($r = 0.92$) with montmorillonite clay content in addition to the organic matter content of 18 soil types. They also reported that fluridone adsorption increased as soil pH decreased from 6.4 to 3.5. Flu-

ridone was not readily desorbed by water at the lower pH which suggests that the weakly basic herbicide was protonated and bound by cation exchange forces. Much of peninsular Florida is characterized by sandy top soils containing little clay or organic matter. Consequently, fluridone in treated water applied to Florida lawns would be readily available to actively growing turf. Homeowners typically irrigate their lawns most often in the dry season of March to June, prior to the beginning of summer convectional rains, the same time period when hydrilla is beginning active growth and management programs are begun. Therefore, the objective of this research was to determine the effects of 10 weeks of irrigation with fluridone containing water on a common Florida residential turfgrass.

METHODS AND MATERIALS

Sod Culture. St. Augustinegrass (*Stenotaphrum secundatum* (Walt.) Kuntze) variety "Floritam" sod grown on organic soil was purchased from a local vendor in Gainesville, FL and 15 cm circles were carefully cut from the sod and planted in commercially available nursery pots 15 cm in diameter by 13 cm deep filled to a 10 cm depth of an arredondo fine sand. The pots were placed in a greenhouse maintained at 22 ± 2 C with supplemental lighting providing long day conditions (16 hr light: 8 hr dark). After fertilization with 50 ml of 10 \times Hoaglands solution, the newly planted grass was allowed to grow for approximately 10 days at which time the sod was clipped and grown for approximately 10 more days, clipped and culled for uniformity.

The pots (five replicates) were irrigated on Tuesday and Thursdays with 0.8 cm of water containing 0, 2.5, 5, 10, 15, 30, 60, 120, and 240 ppb fluridone. In order to maintain an adequate water supply to the plants and attempt to simulate natural events, 2.5 cm of water containing no fluridone was added to the pots on each Sunday. Irrigation water was applied by slowly pouring the water from beakers over the pots, wetting the foliage, and taking care not to allow any overflow or runoff from the surface of the pots.

Stock solutions of technical grade fluridone (10 ppm) were made up with de-ionized water in clean, methanol rinsed glassware and stored in opaque poly bottles in a refrigerator. Appropriate amounts of stock solution were added to de-ionized water to be applied to each pot. Glassware was washed after each treatment in water and methanol to prevent contamination.

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The irrigation schedule described above was carried out for 10 weeks, and shoots were harvested at approximately weeks 4, 7, and 10 by clipping the pots to a height of 1.0 cm. The plant clippings were dried and weighed and the pots were fertilized with 50 ml of 10× Hoaglands nutrient solution at the time of each harvest.

Sand Culture. The sand culture study was conducted in exactly the same manner as described for the sod experiments except for initial establishment of the plants. Vegetative sprigs of St. Augustinegrass were obtained by thoroughly washing the organic soil from sod and planting sprigs into 15 cm diameter nursery pots similar to those used in the sod culture study. The nursery pots were filled with washed builders sand.

After sprigging the grass into the sand, the plants were fertilized as before and the grass was permitted to establish for 4 weeks before selecting for uniformity and assigning the treatments. Due to the low water holding capacity of the sand, dishes were placed under the pots to maintain soil moisture during establishment. These dishes were kept under the pots for the first 3 weeks of the treatment period at which time root growth in the pots increased the water holding capacity of the pots to the point where irrigation water was retained by the pots. Due to the low fertility of this soil, fertilizer (10× Hoaglands) was applied five times during the course of the sand culture study.

Following the 10 week greenhouse irrigation schedule with fluridone treated water, the plants were placed on a table outdoors, exposed to full sunlight and ambient conditions and watered (no fluridone) as needed to supplement rainfall. After several weeks of outdoor growth, the plants were evaluated to determine recovery from the previous fluridone irrigation phase.

The organic matter content of the potting media of both studies was determined by collecting samples from three replicate containers selected randomly from each study. Soil samples were collected from the surface, center and bottom 2.5 cm layers. The samples were dried at 80 C and sieved through a 20-mesh screen to separate roots from soil. Weighed soil samples were ashed at 550 C in a muffle furnace and reweighed to determine organic matter content of the soils.

Statistical analysis of the data was conducted by analysis of variance and treatment means were separated by Duncan's Multiple Range Test at the 5% confidence level.

RESULTS AND DISCUSSION

Dry weight of St. Augustinegrass grown in the greenhouse and irrigated with water containing fluridone are shown for in Figures 1A and 1B. The different shading on the bar graphs indicate individual harvests and the heights of the bars is the total or cumulative dry weight of the grass for the three clippings. Data from the subsequent 10-week grow out period showed that the 240 ppb (sod) survived, but the sand-sprigged grass treated at fluridone concentrations of 30 ppb and higher died (data not shown).

The effects of fluridone on the sod-cultured St. Augustinegrass (Figure 1A) was not evident during the first 3 to 4 weeks of the study. At the 10-week harvest, weight of grass

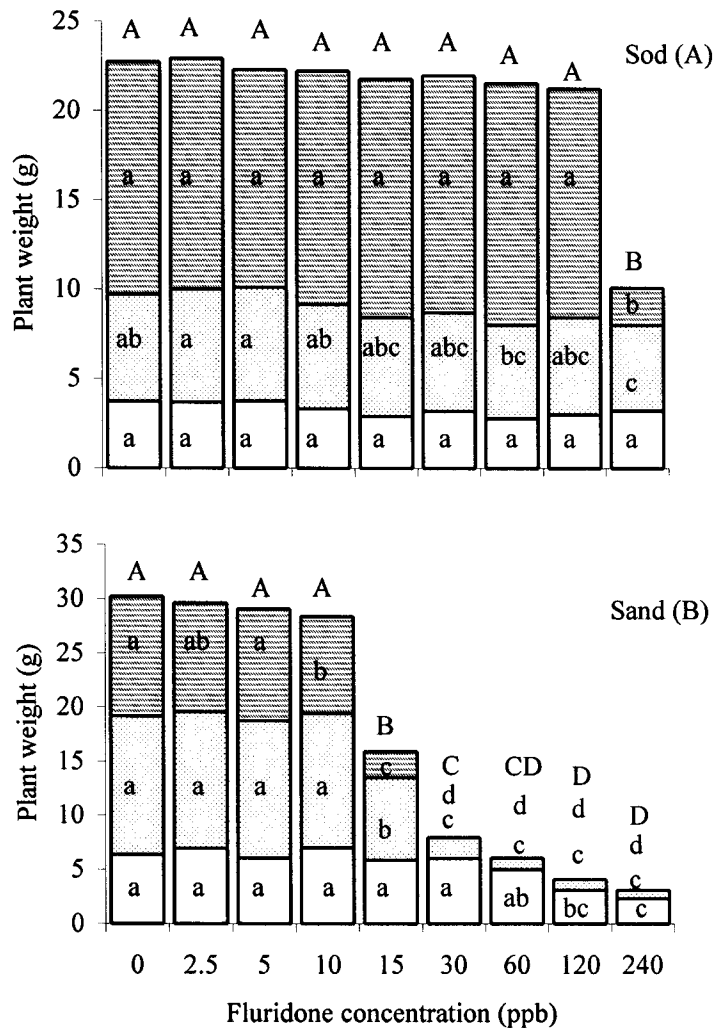


Figure 1. Interactive effects of fluridone treated irrigation water and soil type on the growth of St. Augustinegrass. Figure 1A (top) represents shoot biomass of grass clippings (gm dry wt/pot) harvested from sod grown St. Augustinegrass at 4 weeks (1st harvest) = open, 7 weeks (2nd harvest) = dots and 10 weeks (3rd harvest) = bars. The lower case letters are means comparisons (Duncan's) of each harvest and can be compared horizontally. The capital letters compare the cumulative means of the grass clippings over the 10-week herbicide treatment period. Figure 1B (bottom) same as above except grass was sprigged and grown in sand containing minimal (<1%) organic matter.

clippings at the 240 ppb irrigation rate was greatly reduced compared to the other treatments, but this treatment subsequently recovered after irrigation with fluridone treated water was discontinued. The organic matter content of the organic soil grown sod was $28 \pm 16\%$ and that of the underlying Arredondo fine sand was $1.5 \pm 0.2\%$.

St. Augustinegrass grown in sand culture containing only $0.6 \pm 0.3\%$ organic matter was much more susceptible to fluridone in the irrigation water (Figure 1B). Significant decreases in clipping weight occurred at the first harvest at 120 ppb, the second harvest at 15 ppb and at the final harvest, reduced growth was evident at 10 ppb. No vegetation was harvested at the final harvest at concentrations of 30 ppb or higher, as these plants were dead and did not recover dur-

ing a subsequent 10-week grow out period when irrigated with fluridone-free water. By the end of the 10-week herbicide irrigation period, all sand culture plants, except control plants, were exhibiting chlorosis and fluridone symptoms which ultimately disappeared during the subsequent grow out period.

Other fluridone irrigation studies have been conducted. West and Parka (1992) irrigated 26 crops in different geographical field locations with 123 ppb fluridone. These studies were done to collect residue data in field crops and did not evaluate any effects of fluridone on growth or production. In contrast, Kay et al. (1994) irrigated greenhouse grown tobacco (*Nicotiana tabacum* L.) and vegetable crop seedlings with several concentrations of fluridone to determine growth effects. Kay et al. noted that plants grown in sand culture were much more susceptible to fluridone in irrigation water compared to those grown in an organic potting soil (Metromix®). Two weeks following a single irrigation with fluridone containing water, tobacco grown in sand exhibited symptoms at 10 ppb compared to 100 ppb when plants were grown in potting soil. Two weeks of irrigation three times per week with fluridone treated water reduced growth of three vegetable crops at concentrations of 50 to 250 ppb, evidence that species have a wide range of susceptibilities to fluridone.

The presence of organic matter in the sod grown grass provided very significant protection from fluridone in irrigation water in this study. However, many Florida lawns are established on sand containing very little organic matter and despite lowered application rates of fluridone, these data indicate caution is warranted and it appears prudent to follow the suggested irrigation restrictions on the fluridone label. In addition, this study showed that St. Augustinegrass will likely recover if irrigation with fluridone treated water is stopped when fluridone symptoms first noted occur.

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