FIELD EVALUATIONS OF THE PHYTOTOXIC EFFECTS OF AROSURF® MSF ON SELECTED SPECIES OF AQUATIC VEGETATION

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The use of the monomolecular film Arosurf® MSF as a mosquito larvicide was first reported by Garrett and White (1977). Since then, the efficacy of this larvicide on many mosquito species has been demonstrated in a wide variety of aquatic habitats (Levy et al. 1981, 1982; Mulla et al. 1983, Takahashi et al. 1984).

Aquatic plants which occur in fresh and salt water habitats are an important source of nutrient recycling in the aquatic food chain (Odum and de la Cruz 1967, Odum et al. 1984). Quantitative studies have demonstrated the effects of oil (petroleum hydrocarbons) surface films used as mosquito larvicides on some vegetation types. Slavin et al. (1975) showed that 6 applications of oils at the rate of 20 gal/acre did affect the standing crop of *Spartina patens* Muhl. but not *S. alterniflora* Loisel, while lower application rates (5 gal/acre) had no affect on either vegetation. Bearden and Steelman (1971) indicated that Flit® MLO applied at the rate of 2 gal/acre did not affect rice yield, although formulations used previously had been detrimental to this crop.

Qualitative observations have not shown any adverse effects upon aquatic plants prevailing in larval mosquito habitats (Levy et al. 1981, 1982); however, no quantitative studies of the phytotoxicity of Arosurf MSF have been reported. Therefore, this paper reports the results of a quantitative study designed to assess the phytotoxicity of Arosurf MSF on 5 species of aquatic vegetation.

Phytotoxic effects of Arosurf MSF on 5 species of plants were studied in various aquatic habitats typical of those treated with larvicides for mosquito control. Effects on black mangrove [*Avicenna germinan* (Linn.)] and saltwort (*Batis maritima* Linn.) were studied in a supratidal marsh located on Sanibel Island, Lee County, Florida. Effects on cordgrass (*Spartina alterniflora* Loisel) and arrowhead (*Sagittaria* sp.) were studied in salt and freshwater marsh habitats, respectively, located on West Bay Point, Bay County, Florida. Effects on commercially grown rice (*Oryza sativa* Linn. var. mars) were studied on the M&K Ranch, Gulf County, Florida.

A single treatment of Arosurf MSF was applied at a rate of 0.94 ml AI/m^2 (1 gal/acre) to each treatment plot, based on the surface area of the plot. Arosurf MSF was volumetrically formulated at the ratio of 1:9 parts water and applied at a 10 gal/acre rate. Due to the insoluble nature of the technical material, Arosurf MSF was suspended in water with a household blender prior to field application and agitated by shaking during application. A hand sprayer operated at 1.4 kg/cm^2 (20 psi) and equipped with a Spraying Systems 8001 flat fan nozzle was used to apply the formulation at a calibrated delivery rate of 5.25 ml/sec with a swath width of 75 cm. All plants were treated from above except for black mangroves which were sprayed from the side due to their height.

The black mangrove study used a treatment and a control plot in close proximity with each containing a minimum of 5 small trees varying from 1 to 2 m in height. Five actively growing stems or branch tips were randomly selected on each of 5 trees for a total of 25 quantitative measurements in each plot. The number of new leaves on each stem were recorded as they appeared over a 4-wk period.

The saltwort and rice studies each employed two 3 m square plots, a control and a treatment in close proximity. Each plot was outlined using a 3 × 3 m floating frame constructed from 4 cm (1-½ in) diam. polyvinyl chloride (PVC) pipe. Five 30-cm square subplots were randomly selected within each plot for quantitative measurements of growth.

The saltwort plots were carpeted with a mat of vegetation up to 30 cm thick. Five stems were selected within each subplot for evaluation, and the number of new nodes that occurred on each stem were recorded for 4 wks posttreatment.

The rice plots were near the perimeter of a flooded 54 ha field. Water depth in the study area averaged 10 cm, and the height of the rice plants, 8 wks after germination, was ca 50 cm. Ten plants were selected at random within each subplot, and measurements used to evaluate the effects of treatment included plant growth in

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height and the number and weight of seeds produced at maturity. Plant height from the soil surface to the tip of the longest blade was recorded over a 3-wk period. Crop production was evaluated by measuring the number and weight of mature seeds from selected plants, as well as all plants within each subplot.

Water depth in the cordgrass study area was ca 8 cm, and the average plant height was 40 cm. The arrowhead study area had a water depth of ca 5 cm, and plants were ca 47 cm in height. Both study areas used 10 individual plots (5 treatments and 5 controls) randomly placed in each area. Plots were outlined with a (75 × 100 cm) floating frame constructed out of 4-cm PVC pipe. Short-term effects were evaluated by comparing the growth rates of the newest leaf occurring on selected control and treated plants. Leaf measurements from the base of the plant to the tip of the leaves were made at the time of treatment and at 3, 6 and 11 days posttreatment. Long-term effects were evaluated by comparing the increase in the number of leaves on designated plants within the plots over a 4-wk period.

All plant species tested were also visually evaluated for the effects of the Arosurf MSF application using a 0 to 100 rating system (Frans and Talbert 1977). This system rates plants by indicating no effect or plant injury at 0 to complete effect or plant destruction at 100.

The statistical analysis conducted on the data for all studies was an unmatched Student *t*-test to determine if there were any significant differences in growth rates between treatment and control plots.

The supratidal marsh in which the black mangrove and saltwort studies were conducted, contained no standing water at the time of treatment. The 2.5 cm of rain that occurred during the last posttreatment week did not create any standing water. Rainfall during the cordgrass and arrowhead studies was 1 cm, which occurred on the sixth day posttreatment of the short-term study. A total of 6.6 cm of rain fell during the long-term study (28 days). The water level in the cordgrass plot was influenced more by high tide periods than by precipitation, but the soil was always flooded. The water level in the arrowhead plots decreased slightly during the early posttreatment period but increased near the end following a 5-cm accumulation of rainfall.

The first major rainfall in the rice plots occurred 3 days posttreatment, and thunderstorms occurred almost daily during the study period. More than 42 cm of rain was recorded during the last 3 days of the study. Although water levels fluctuated, the rice was constantly flooded.

The measured growth that occurred in all species during the study period are shown in Table 1. When subjected to a *t*-test, the increase in growth for treated and untreated plots in all 5 species (black mangrove, saltwort, cordgrass, arrowhead and rice) was not significantly different. The visual method of rating treatment effects also indicated no difference between treated and control plots in the vegetations studied.

The evaluation of rice production at the time that the grower harvested the field is shown in Table 2. The treated plot had a significantly higher production of seeds and weight of seeds than did the control plot. Also, seed production per subplot was significantly higher in the treatment plot. This was attributed to a higher density of plants in the control plot resulting in smaller plants ($\bar{x}$ = 5 cm) than in the treated plot, and was doubtful it was an effect of the Arosuf MSF. There was no significant difference in the number of seed heads between plots.

These studies indicate that single applications of Arosurf MSF formulated in a 1:9 Arosurf to water mixture by volume did not significantly affect the species of aquatic vegetation under study.

Table 1. Posttreatment vegetation growth recorded after a single (0.94 ml AI/m^2) treatment of Arosurf® MSF applied as a 10 gal/acre water formulation.

Vegetation	Plot[1]	Mean increase in leaf length (cm)	New leaf addition/plot
Black mangrove	Treatment	–	28.0
	Control	–	33.0
Saltwort[2]	Treatment	–	20.0
	Control	–	20.0
Cordgrass	Treatment	13.5	24
	Control	13.0	24.4
Arrowhead	Treatment	15.4	20.8
	Control	17.1	20.2
Rice	Treatment	24.1	–
	Control	25.4	–

[1] Treatment and control growth for each species was not significantly different when subjected to a *t*-test (0.05 level).

[2] Additions recorded were nodes rather than leaves.

Table 2. Evaluation of rice seed production after a single (0.94 ml AI/m^2) treatment of Arosurf® MSF applied as a 10 gal/acre water formulation.

Observation	Plot	
	Control	Treatment
Mean wt (g) of seed/head	1.4	2.6[1]
Mean number of seeds/head	56.6	104.3[1]
Mean subplot seed production wt (g)	49.0	70.7[1]
Mean seed heads/subplot	39.4	36.0

[1] Significant difference between treatment and control at 0.05 level (*t*-test).

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