BIOAVAILABILITY AND TOXICITY OF AGRICULTURAL CHEMICALS IN RUNOFF FROM MSEA SITES: POTENTIAL IMPACTS ON NON-TARGET AQUATIC ORGANISMS

AN AQUATIC HAZARD ASSESSMENT OF FOUR HERBICIDES USING SIX SPECIES OF ALGAE AND FIVE SPECIES OF AQUATIC MACROPHYTES

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I. Executive Summary

An aquatic hazard assessment for atrazine, metribuzin, alachlor, and metolachlor was conducted using five species of aquatic macrophytes (4-14 day static EC50) and six species of algae (96-h static EC50). Risk was calculated using a quotient method comparing the expected environmental concentration (EEC) to toxicity (EC50 growth response). Toxicity studies ranked metribuzin > atrazine > alachlor > metolachlor in decreasing order of toxicity. Macrophyte studies ranked Ceratophyllum > Naja > Lemna > Egeria > Myriophyllum in decreasing order of sensitivity and algal studies ranked Selenastrum > Chlorella > Chlamydmonas > Scenedesmus > Microcystis > Anabaena in decreasing order of sensitivity. The triazine (metribuzin and atrazine) herbicides were more toxic than the acetanilide (alachlor and metolachlor) herbicides. However, both classes were of similar ecological risk when differences in application rates were considered; adjustments for estimates of leachability would generally indicate a risk quotient of atrazine > metribuzin > alachlor > metolachlor. Highest ecological risk was calculated for edge-of-field habitats such as edge-of-field wetlands and ponds. Risk estimates generally decrease in fluvial habitats as watershed and stream size increases. Current human health advisory limits (HAL's) for atrazine (3 ug/L), alachlor (2 ug/L), and metolachlor (100 ug/L) should be protective of aquatic plant impacts in rivers used for drinking water; however, the HAL for metribuzin (200 ug/L) is not. None of the HAL values can be assumed to be protective of aquatic plants in edge-of field wetland habitats; thus, herbicide impacts on wetland aquatic plants should continue to be studied.

II. INTRODUCTION

Agricultural production pressures have resulted in an increasing reliance on use of herbicides and other agri-chemicals. Pervasive use of chemical pest control has resulted in numerous environmental concerns including 1) direct and indirect impacts on non-target fish, invertebrates, and birds; 2) development of chemical resistance in insect and weed pests; and 3) increased human exposure to contaminated ground and surface waters. Current agricultural strategies are shifting to use of environmentally sustainable practices such as slow-release chemical formulations, integrated pest management, alternative crops, and minimum tillage practices. However, the ultimate success of these practices on improvement of water quality are unknown.

The Management Systems Evaluation Area (MSEA) projects have been established as controlled agricultural studies to examine the success of using sustainable agricultural practices to decrease non-point source agricultural pollution. Cooperative, integrated studies are being conducted by the U.S. Dept. of Agriculture (USDA), U.S. Geological Survey (USGS), U.S. Environmental Protection Agency (USEPA), and the National Biological Survey (NBS; formerly of the USFWS) to determine the success of different tillage, cropping, and pest-control practices on agricultural productivity and off-site transport of sediments, nutrients, and pesticides. Traditional assessment of off-site transport of agricultural chemicals has consisted of measurement of chemical residues. However, it is difficult to determine the environmental significance of many agricultural chemicals in runoff based on residue chemistry. Analytical procedures for many pesticides are costly and are frequently not available via normal contract procedures. Also, it is difficult to estimate the bioavailability and hazard of measured concentrations to non-target species. Many new-generation insecticides are highly toxic to aquatic organisms such as invertebrates and fishes. Furthermore, many herbicides are toxic to aquatic macrophytes and algae. Menzel et al. (1984) have indicated that the macrophyte Ceratophyllum, formerly common in Iowa streams, has been largely eliminated in many areas. However, these losses have not been directly linked to herbicides to date, and thus the ultimate effects of herbicides on aquatic flora and fauna in receiving waters and adjacent wetlands are still being questioned.

The USEPA's Midwest Agricultural Surface/Subsurface Transport and Effects Research (MASTER) program is an integrated effort to combine the results of landscape modeling, mechanistic studies, toxicity testing, and in-situ community assessments to determine the ecological effects of agricultural practices in the Midwest. In 1992 the MASTER Program and the USFWS cooperated to conduct event-based toxicity tests of water samples derived from the Goodwater Creek, MO, and

Walnut Creek, IA, MSEA sites. Toxicity tests were conducted with two species of aquatic plants (an alga, Selenastrum capricornutum; and duckweed, Lemna minor), one species of fish (fathead minnow, Pimephales promelas), and one species of zooplankton (Ceriodaphnia dubia) (see Fairchild et al., 1993).

No samples were toxic to fathead minnows or zooplankton. The alga, S. capricornutum, was the most sensitive test species, and exhibited both stimulatory and inhibitory responses to stream water and edge-of-field samples. Results indicated that herbicide concentrations in the bioassay samples were low (generally less than 1 µg/L) due to the lack of rainfall during the early part of the growing season at both MSEA sites. However, these herbicide measures were not always reflective of maximum concentrations measured at the MSEA sites. For instance, atrazine and metolachlor concentrations reached 29 and 80 ug/L, respectively, in one tile sample immediately following one runoff event in 1992 at the Walnut Creek, IA, MSEA site (Soenksen and Schmitz, 1993). Thus, it is evident that it is difficult to anticipate rainfall events and to capture the most ecologically significant bioassay samples using an event-based sampling approach. The 1992 data also indicated that the Selenastrum studies may not be accurate due to problems with chelation or precipitation of essential micronutrients by constituents in natural surface water. Furthermore, existing herbicide/aquatic plant data is scattered across studies conducted under different conditions, and data on many ecologically important aquatic plant species is lacking. Lastly, data on the effects of some herbicides commonly used at MSEA sites (e.g. metolachlor and metribuzin) on aquatic plants are scant. Based on these needs, research at the Midwest Science Center in 1993-1994 was conducted to meet three specific objectives:

1. To determine acute threshold concentrations of four herbicides (atrazine, alachlor, metolachlor, and metribuzin) which inhibit production of phytoplankton and aquatic vascular plants,
2. To examine the effects of changes in water quality on the toxicity of atrazine to Selenastrum and Lemna sp.,
3. To investigate the ecological risk of four herbicides (atrazine, alachlor, metolachlor, and metribuzin) using structural and functional responses of multi-species microcosms. These data were compared to single-species plant data to determine the accuracy of standard lab tests in prediction of herbicide effects in simulated aquatic ecosystems, and
4. To conduct an aquatic hazard assessment for atrazine, alachlor, metolachlor, and metribuzin using the above data.

III. MATERIALS AND METHODS

Test chemicals:

Herbicides used in these studies included atrazine, metribuzin, alachlor, and metolachlor. Chemical and physical parameters of these chemicals are presented in Table 1. These chemicals were chosen because they are the primary chemicals of emphasis at the USDA/ARS MSEA sites. All chemicals used were technical grade. Plant toxicity is the primary concern with these chemicals, as they are relatively non-toxic to fish and invertebrates (Macek et al. 1976; Mayer and Ellersieck 1986); however, indirect effects on invertebrates have been shown with atrazine (Dewey 1986; Hamilton et al. 1988).

General test conditions, water quality, and sediment analysis:

Water quality analyses, including dissolved oxygen, pH, conductivity, alkalinity, total nitrogen, total phosphorus, ammonia, nitrate:nitrite, and soluble reactive phosphorus were determined using Standard Operating Procedures cited in Table 2. These SOP's have been developed based on standard methods or in accordance with the manufacturers instructions. Copies of individual SOP's are available on request.

All experiments were conducted under controlled conditions of temperature and lighting in an enclosed environmental chamber (Table 3). All plants were cultured under the same temperature and lighting conditions as the experiments.

Herbicide stock solutions were analyzed and confirmed by Hazelton Environmental Services, Madison, WI, using a modification of EPA Method 507, Revision 2.0, "Methods for Determination of Organic Compounds in Finished Drinking Water and Raw Source Water (1989). Samples were extracted in methylene chloride, concentrated in methyl tert-butyl ether (MTBE), and analyzed using capillary column GC with a nitrogen-phosphorus detector. Exposure concentrations are presented as nominal herbicide concentrations.

Sediments used in the macrophyte and microcosm studies were characterized for particle size, texture, pH, ammonium-N, nitrate-N, and organic matter content by the UMC Soils Lab located at Mumford Hall, University of Missouri, Columbia, MO. Total organic carbon measurements were performed at the Midwest Science Center. Results are presented in Table 4.

Determination of the effects of atrazine, metribuzin, alachlor, and metolachlor on algae and macrophytes:

All algae and macrophytes used in these studies were obtained from commercial sources with the exception of Myriophyllum, which was obtained from a culture pond located at the Midwest Science Center. Plants were maintained in culture conditions for a minimum of 2 weeks prior to use in the studies.

Algal and duckweed tests were conducted using modifications of the methods of ASTM (1992a) and Taraldsen and Norberg-King (1990). Algal studies were conducted in 15-ml tubes following a study which examined the difference between the tube and flask method. A series of 18 tubes (15 ml tubes; 5-ml ASTM media; 20,000 cells/ml) were compared to the standard flask method (125-ml Erlenmeyer flasks; 50 ml ASTM media; cell density 20,000 cells/ml). With each treatment a 50% dilution series of atrazine (3 reps per treatment; 6 concentrations) was examined using in-vivo fluorescence as the endpoint. This study was used to validate the use of the tube method for all remaining algal studies.

Macrophyte tests conducted using species other than duckweed (e.g. Najas, Egeria, Ceratophyllum, and Myriophyllum sp. were developed at the Midwest Science Center in a series of trials which investigated the effects of various aqueous nutrient sources, sediments, and aeration in a three-way analysis of variance (e.g. mixed effects statistical model; n=60 beakers; Snedecor and Cochran 1967). In these evaluations the growth of Egeria and Myriophyllum was tested in solutions of well water, well water spiked with nitrogen and phosphorus (well + N/P), 10% Hoagland's solution, and 10X ASTM medias. Three plants (10 cm length each) were placed in 800 ml of the nutrient media and incubated under 400 fc light (16:8 h light:dark) at 25° C for 14 days; each treatment was tested in triplicate, for total of n=24 beakers. A separate replicate series (n=3 replicates) contained 100 ml of pond sediment and was used to determine the effect of presence or absence of sediments (i.e., an additional 24 beakers). The effect of aeration was tested by replicating the 10% Hoagland's series (with and without sediments) and providing aeration (additional 12 beakers; slow bubbling via capillary glass tube). The effect of growth conditions was evaluated using length and weight gain at 7 and 14 d. Water quality characteristics (dissolved oxygen, conductivity, pH, and alkalinity) were analyzed at the beginning and end of each test as described in Table 2.

Final conditions selected for macrophyte toxicity tests (800 ml 1X ASTM; 100 ml pond sediment; no aeration) were selected based on the above studies and are summarized in Table 3.

Effects of water quality on the EC50 of atrazine:

Standard aquatic toxicity tests have been established for both Selenastrum capricornutum (e.g. ASTM 1992a) and the duckweed Lemna minor (e.g. Taraldsen and Norberg-King 1990). These standard tests are based on use of quantified, prepared media which insures the repeatability of the test procedure. However, published information for Selenastrum indicates that changes in water quality, such as addition of natural stream water, can alter the apparent sensitivity to herbicides (Turbak et al. 1986). In addition, data from past studies at the Midwest Science Center have indicated that nutrient stimulation is frequently a problem in plant testing of natural surface waters (Fairchild et al. 1993). These observations indicate that standard laboratory aquatic plant tests may not be accurate in predicting the effects of herbicides and other chemicals in natural surface waters.

We evaluated the effect of variation in water quality/water sources on the sensitivity (e.g. EC50) of the alga Selenastrum capricornutum and the duckweed Lemna minor to atrazine using the procedures summarized in Table 3. Six concentrations (n=3 reps) were tested using four water qualities (i.e. 72 units per plant species). Water qualities evaluated included the following: 1X ASTM; 10X ASTM (NEW) (i.e. 10X ASTM with nutrient enriched water; Taraldsen and Norberg-King 1990); stream water; and stream + 1X ASTM. Characteristics of these waters are presented in Table 5. Streamwater was obtained on January 10, 1994, from Goodwater Creek within the Missouri MSEA study area. Water quality characteristics (dissolved oxygen, conductivity, pH, and alkalinity) were analyzed at the beginning and end of each test in control samples using methods listed in Table 2.

Microcosm studies:

Microcosms have been successfully used to study the effects of herbicides (e.g. atrazine) on the structure and function of aquatic systems (Stay et al. 1985; Larsen et al. 1986). In this study generic, self-selected microcosms were used to determine the structural and functional responses of aquatic plant communities to herbicides (see Table 1 for chemical characteristics). These data were compared to single-species plant data to determine the accuracy of standard lab tests in prediction of herbicide effects in simulated aquatic ecosystems.

Microcosm studies were conducted in an enclosed environmental chamber at 25°C (Table 2). Methods, endpoints, and sampling schedules for this study are provided in Table 3. Lighting was maintained under a 16:8 h light:dark cycle (intensity 400 fc). Sediments were obtained from ponds at the MSC. Water used in the study was standard 1X ASTM reconstituted water (ASTM 1992a). A 2-cm sediment layer (100 ml wet volume) was placed in a 1-L Pyrex beaker and air-dried for 5 days to facilitate consolidation of the sediments and encourage plant germination. On day 0 the beakers were gently filled with 800 ml 1X ASTM algal media. We used Najas sp. as the macrophyte; plants were naturally germinated from seeds and plant fragments in the sediment. Following a 7-day equilibration period (i.e. days 0 to 7) microcosms were treated with serial dilutions of atrazine, metolachlor, alachlor, and metribuzin dissolved in acetone. Microcosms were monitored over a 21-d post-treatment period, or a total of 28 days. A total of 189 beakers (4 chemicals X 5 concentrations X 3 reps plus 3 controls for each of 3 sampling dates) were studied. Individual sets of microcosms were sacrificed on days 14, 21, and 28.

Herbicide concentrations were based on nominal estimates. Additional, back-spiked acetone was added to control and treatment beakers to provide equivalent levels in each beaker (i.e. 0.2 ml/beaker across all concentrations and treatments) and standardize biological oxygen demand. Individual containers were placed in a completely randomized design to discount variance due to side-lighting, temperature, or other factors.

Planktonic chlorophyll a, pH, dissolved oxygen, conductivity, ammonia, nitrate/nitrite, soluble reactive phosphorus, total nitrogen, and total phosphorus, and primary productivity were measured 24 h prior to break-down times (days 13, 20, and 27) using methods described in Table 6. Whole-system rates of gross photosynthesis, community respiration, and net primary production were measured at weekly intervals using diurnal oxygen fluctuations (i.e. dawn:dusk:dawn; 16:8 h light:dark schedule) according to McConnell (1962). Total available light was measured daily using a General Electric Type 214 Light Meter. Phytoplankton biomass was estimated by in-vitro measurement of chlorophyll a (following acetone extraction; APHA 1989) via algal fluorescence. Macrophyte production was determined as wet weight total biomass (gravimetric) and total number plants on days 14, 21, and 28.

At study termination (day 28) the sediments were homogenized using a spatula. A 5-ml volume of sediment was removed for analysis of total organic carbon. All plant material was removed from the subsample and added back to the original beaker. The 5-ml subsample was then dried (105°C) and frozen until analysis of total organic carbon using SOP B4.36; particle size was determined from the day 0 archived sediment sample. The remaining sediment (approximately 100 ml) was sieved to remove Najas plants for determination of wet weight. Sampling dates and endpoints are summarized in Table 6.

Statistical Analyses:

Estimates of EC50 values for algae were determined using inverse non-linear regression and the Statistical Analysis System^{tm} (SAS; Carey, NC). Macrophyte EC50 values were determined using the Trimmed Spearman Karber Technique (Stephan 1977) within the Toxstat^{tm} (U. of Wyoming, Laramie, WY) statistical package. All NOEC and LOEC values were determined using analysis of variance and Tukey's Multiple Range Test (Snedecor and Cochran 1967) in SAS. Relative ranking of test species and test chemicals were performed using the Proc Rank procedures in SAS. Raw data are provided in the Appendices.

IV. RESULTS

Development and validation of algal tube procedure:

Comparisons of the algal tube and standard flask procedures indicated that the tube procedure would provide similar estimates of algal growth rates and chemical sensitivity but at considerably less effort than the flask procedure (Table 7; Figure 1). There are three primary advantages of the tube procedure over the conventional flask procedure: 1) less space for incubation is required, 2) minimum sample volumes are needed, and 3) biomass (via fluorescence) can be read directly in the incubation tube without destructive sub-sampling.

Tests comparing relative biomass levels at 96 h indicated that algal growth was quite similar for Selenastrum, Chlamydomonas, and Scenedesmus sp.; the tube method produced lower biomass for Chlorella, Anabaena, and Microcystis sp. (Table 7). The coefficients of variation for the tube method ranged from 2-24% (average 7%), whereas the variation for the flask method ranged from 1-10% (average 5%). If the data for Microcystis are ignored, the tube method provides significantly better precision than the flask test.

Tests were also run comparing the relative response of Selenastrum to atrazine using both the tube and flask methods (Figure 1). Both procedures produced similar response curves and 96-h EC50 values: tube 96-h EC50 103 (95% C.I. of 89-117) ug/L; flask 96-h EC50 65 (95% C.I. of 61-69) ug/L. Thus, we elected to use the tube method for all remaining toxicity studies.

Development of procedures for macrophyte tests: Studies were also run to develop optimum conditions for conducting toxicity tests with macrophytes. Standard test procedures exist for species of duckweed (e.g. Taraldsen and Norberg-King 1990; ASTM 1992b); however, it was not clear if a similar approach would work with other species of vascular plants. For example, Lemna tests are conducted with relatively low biomass, and therefore nutrient limitation is not a problem. Further, Lemna grows at the air:water interface, which greatly reduces concerns over inorganic carbon availability, gaseous exchange, light penetration, nuisance algal growth, and sediment quality. These factors must be considered, however, in developing tests with submerged aquatic vascular plants.

Studies were run using two submerged macrophyte species (Myriophyllum and Egeria). The effects of various nutrient medias, presence and absence sediments, and the effects of aeration were evaluated. Results of these experiments are presented in Tables 8-11.

Statistical analysis of results revealed several significant interactions; therefore, one cannot unequivocally determine the effects of single factors such as presence/absence of sediment, presence/absence of aeration, or optimum nutrient media sources (Snedecor and Cochran, 1967). However, several consistent trends were observed.

The most consistent trend observed was that the presence of sediments consistently increased plant growth rates (Table 8); this was especially true of Myriophyllum sp. Sediments increased the growth of Myriophyllum two-fold in some cases compared to beakers without sediments; the relative benefits varied depending on aqueous nutrient sources (Table 8). Sediments did not increase growth of Egeria, but in no case was it deleterious to plant growth. The positive effects of sediments were probably due increased micronutrient levels and enhancement of nutrient uptake.

Several differences were also observed between the four aqueous nutrient sources tested. The same data from Table 8 is split into Tables 9 and 10 to allow visual comparison of aqueous nutrient sources in the presence and absence of sediments. Well water, Hoagland's 10%, and 10X ASTM produced similar growth levels for both plant species, and consistently out-performed the well+N/P treatment in both the absence (Table 9) and presence (Table 10) of sediments. This is surprising given the extremely low levels of nitrogen and phosphorus in the well water, and cannot be explained using the minimal data at hand. Of further significance was the observation that the weights of Egeria and Myriophyllum consistently decreased between days 7 and 14 even though the lengths increased; this was most pronounced in the beakers without sediments and was especially pronounced with Egeria.

Aeration had minimal benefits on plant growth (Table 11). Slight stimulation in growth was observed for both Egeria and Myriophyllum in the absence of sediments. However, when sediments were used the aeration actually decreased growth, and had much less stimulatory effects than the addition of sediments.

In summary, sediment addition produced greater beneficial effects on plant growth than either aqueous nutrient addition or aeration. Given these observations, we selected the test conditions in Table 3 for conducting toxicity tests with macrophytes. These procedures were used for all macrophyte species except for Lemna. For Lemna we used the published procedures of Taraldsen and Norberg-King (1990) which were also used in the 1992-93 studies.

Effects of atrazine, metribuzin, alachlor, and metolachlor on algae:

Studies were conducted using six species of algae and four herbicides. Results of these studies are presented in Tables 12-18 and Figures 2-7.

Several generalities were noted in the data. Green algae, including Selenastrum, Chlorella, Chlamydomonas, and Scenedesmus were more sensitive than the blue-greens (Microcystis and Anabaena) (Table 12). Anabaena was the least sensitive species; no herbicide EC50 could be obtained at concentrations less than 3000 ug/L for any of the four herbicides.

The triazine herbicides, including atrazine and metribuzin, were generally more toxic than the acetanilide herbicides alachlor and metribuzin. However, two notable exceptions were the response of Selenastrum and Chlorella to alachlor, which were two of the most sensitive responses measured in these studies (Table 12). Metolachlor was the least toxic of the herbicides when pooling all species of algae.

Effects of atrazine, metribuzin, alachlor, and metolachlor on macrophytes:

Studies were conducted using five species of aquatic macrophytes and four herbicides. Results of these studies are presented in Tables 19-24 and Figures 8-12.

Ceratophyllum was the most sensitive species of macrophyte, followed by Lemna and Naja (Table 19). Myriophyllum and Egeria sp. were generally the least sensitive macrophyte species, however both species were relatively sensitive to atrazine and metribuzin (Table 19).

Major response differences were observed between the triazine (atrazine and metribuzin) and acetanilide (alachlor and metolachlor) class of herbicides. The triazine chemicals, which are inhibitors of photosynthesis, produced a typical log-linear dose-response curve in which increasing exposures produced increasingly severe responses (Figures 8-12). However, the acetanilides, which generally inhibit lipid metabolism, produced a distinctly different response curve in many cases. For example, exposure of Lemna (Figures 8c and 8d) and Egeria (Figures 10c and 10d) produced a range of flat responses to alachlor and metolachlor which did not reflect a clear dose-response pattern.

Alachlor and metolachlor actually produced stimulatory responses in Myriophyllum (Figures 12c and 12d).

Relative sensitivity of algae and macrophytes to atrazine, metribuzin, alachlor, and metolachlor:

A ranked analysis of variance indicated that there were significant differences ($P<.0001$; 10 d.f.) between test species in terms of relative sensitivity, with Ceratophyllum > Selenastrum > Chlorella > Najas > Lemna > Egeria > Chlamydomonas > Myriophyllum > Scenedesmus > Microcystis > Anabaena (Table 25). Significant differences ($P<.0001$; 3 d.f.) were also noted in terms of herbicide toxicity (e.g. metribuzin > atrazine > alachlor > metolachlor).

Effect of water quality on the response of algae and macrophytes to atrazine:

Water quality had no overt effect on the response of Selenastrum and Lemna to atrazine (Figures 13 and 14; Table 26). The only major difference was the apparent 2-fold decreased sensitivity of Selenastrum to atrazine in stream water (i.e. no additions of media or nutrients) (Table 26; Figure 13). All other medias produced similar responses. Responses of Selenastrum to atrazine in Stream+ASTM (96-h EC50 107 ug/L) (e.g. conditions comparable to the 1993 field studies) were quite similar to responses to atrazine in standard ASTM media (126 ug/L) as indicated by the overlapping of 95% confidence intervals.

The duckweed Lemna produced similar dose-response curves in all medias (Figure 14), however, a precise EC50 value could not be calculated because >50% response occurred at the lowest concentration tested (i.e. 160 ug/L; Table 26).

Effects of atrazine, metribuzin, alachlor, and metolachlor in microcosms:

Microcosm studies were conducted with two major objectives: 1) to compare the results derived from single species tests, and 2) to compare the relative sensitivity of structural versus functional endpoints in the hazard assessment of herbicides.

The EC50 values calculated at equivalent exposure dates (day 14) were similar for atrazine, metribuzin, and metolachlor in both single species tests and microcosms; however, the relative response of alachlor was much lower in the microcosms than in the single species test (Table 27). Most notable, however, is the relative difference in EC50 values between days 14 and 21 post-exposure in the microcosms (Table 27; Fig. 15). Relative EC50 values on days 21 were higher for all chemicals except for metolachlor, which actually decreased (Table 27). This implies that either acclimation is occurring between days 14 and 21, or that chemical metabolism has decreased exposure over time. Published data on the fate of atrazine indicates that the half-life of atrazine exceeds 100 days in aquatic systems (Larsen et al. 1986; Spalding et al. 1994), which would indicate that acclimation is a more likely factor (e.g. Hersh and Crumpton 1988). Inherent differences in methodologies may also be factor in these comparisons. In the microcosms, the Najas population was 7-d old on the date of treatment to allow the establishment of a baseline of pre-treatment functional response; in the single species tests, treatments were implemented on day 0 (study initiation). An unequivocal explanation of the differences observed between the single species and microcosm results will require further study.

The second objective of the microcosm study was to compare the relative sensitivity of various assessment endpoints. The microcosm study indicated that atrazine and metribuzin had the most severe effects on macrophyte biomass and total primary productivity in aquatic microcosms (Tables 28 and 29; Figures 15-20). However, the severity of effects was dependent on both the particular endpoint as well as the chemical. Najas wet weight was the most sensitive endpoint for assessment of the 14-d EC50 for all four herbicides (atrazine, 26 ug/L; metribuzin, 18 ug/L; alachlor, <47 ug/L; and metolachlor, 335 ug/L) (Table 28). Average weight of individual Najas plants was slightly less sensitive in determining the EC50 for all chemicals. Community respiration and gross photosynthesis were sensitive indicators of stress for the triazine herbicides (atrazine and metribuzin), but not for the acetanilides (alachlor and metolachlor); this was expected, given the differential modes of action of the two herbicide classes. Number of total Najas plants, pH, and conductivity were insensitive parameters for assessment of the EC50.

An assessment of the LOEC's for the microcosm data revealed some interesting trends in the microcosm data. Firstly, the data was frequently quite variable, which precluded determining a LOEC for several chemicals and variables. For instance, although an EC50 was determined for the effects of atrazine on Najas wet weight (Table 28), there were no statistical treatment differences due to variability of the data (Table 29). This is normally not expected, but can occur because the EC50 is an interpolated point estimate while the LOEC is a statistical test for significant differences between treatments (Stephan 1977). Secondly, the data indicated that there were obvious differences between the relative precision of the various parameters. For instance, there were significant statistical effects due to atrazine and metribuzin for pH due to the relative precision and sensitivity of the measurement (Table 29); however, an EC50 value could not be determined because the response was not severe. Community respiration and gross photosynthesis were the most sensitive functional endpoints for determining the LOEC for all chemicals, even though an EC50 frequently could not be calculated (e.g. for alachlor and metolachlor). However, this difference again reflects the different dose-response relationships for the triazines and the acetanilides: the triazines caused an increasingly severe response with dose, whereas the acetanilides did not.

V. DISCUSSION

Toxicity assessment:

The eleven species of aquatic plants exhibited wide ranges of sensitivities to the four herbicides; in general, the triazines (atrazine and metribuzin) were more toxic than the acetanilides. A notable exception was the high toxicity of alachlor to Selenastrum, Chlorella, and Ceratophyllum. Both algae and macrophytes, as general plant classes, appeared equally sensitive to herbicides over the range of species and chemicals studied.

Our results were similar to those of others in indicating that Selenastrum is somewhat more sensitive than other species of algae and aquatic vascular plants to atrazine. Two papers (Larsen et al. 1986; Jones and Winchell 1984), using 24-h carbon uptake as an endpoint, determined that four species of algae and four aquatic macrophytes were sensitive to atrazine at concentrations ranging from 43 to 308 µg/L. Chlorella was the most resistant (308 ug/L) of these species; all other species response ranged from 43 (Selenastrum) to 104 (Myriophyllum and Ruppia) µg/L (Table 30).

Larsen et al. (1986) demonstrated that atrazine reduced carbon uptake in isolated natural phytoplankton communities at concentrations ranging from 24 to 131 µg/L (24 h EC50). Further, atrazine reduced carbon uptake and phytoplankton biomass at 101 and 82 µg/L (12 wk EC50) in in-situ plankton phytoplankton communities (Larsen et al. 1986). In similar experiments, deNoyelles et al. (1982) exposed experimental mesocosms to 20 and 500 µg/L atrazine and demonstrated that photosynthesis and algal biomass were reduced at both concentrations. Correll and Wu (1982) observed significant decreases in Vallisneria americana following a 47 d exposure to 12 µg/L atrazine in simulated microcosms. Similarly, Kemp et al. (1985) determined that atrazine reduced photosynthesis and biomass of Potamogeton perfoliatus (EC50 55 and 30 µg/L, respectively) and Myriophyllum spicatum (EC50 117 and 91 µg/L, respectively) in estuarine microcosms. Fairchild et al. (1994) observed that Naja sp. was replaced by Chara sp. in experimental ponds exposed to 50 ug/L atrazine; although species composition of macrophytes was changed, total biomass and system metabolism were unaffected. Carney (1983) measured reductions in macrophyte biomass in ponds exposed to 100 μg/L atrazine; both Potamogeton and Najas were sensitive, while Chara was less sensitive.

Selenastrum appears to be especially sensitive to the triazine, thiocarbamate, pyridine, triazinone, and acetanilide classes of herbicides (96-h EC50 range from 1 to 59 μg/L) (Table 31). Selenastrum is much less sensitive to benzonitrile, aliphatic, and phenoxy herbicides (Table 31) (St-Laurent et al. 1992; Turbak et al. 1986). Unfortunately, field data on the effects of herbicides other than triazines are lacking.

Selenastrum and the duckweed Lemna appear to be good surrogates for other aquatic plants in standard toxicity testing. Ceratophyllum was the most sensitive test species in these studies; however, Selenastrum and Lemna were of similar overall sensitivity, and offer considerable advantages over the other test species in terms of culture, ease of testing, and precision. The tube-testing procedure developed for algae greatly increased the cost-effectiveness and precision of algal testing compared to the traditional flask procedure. The air:surface-water niche of Lemna makes it particularly attractive as a standard macrophyte test species because problems with carbon limitation, nuisance algal growth, sediment:chemical partitioning, and sediment texture are avoided. However, Lemna may be limited in its usefulness for assessment of contaminated sediments; rooted macrophyte species may provide greater sensitivity and ecological realism some cases.

The microcosm studies provided similar rankings of chemical toxicity as did single species tests, i.e. metribuzin > atrazine > alachlor > metolachlor. However, time was a primary determinant of the relative EC50's of herbicides based on the endpoint of Najas biomass (Table 27). The EC50 values for atrazine and metribuzin were similar between the single species test and microcosm study on days 14 and 21 (based on Najas biomass). The microcosm study apparently was more sensitive than the single species study for alachlor and metolachlor (Table 27); however, these results are tentative due to the variability observed in the analysis of variance (see Table 29).

Structural and functional measurements provided similar levels of sensitivity in the microcosm study. For example, weight per Najas plant, community respiration, gross photosynthesis, and pH were all sensitive determinants of the LOEC level for atrazine, metribuzin, and alachlor (Table 29). None of these endpoints were useful as stress indicators for metolachlor because the effects were variable and not severe. Average weight of Naja plants, determined as a ratio by dividing the total plant biomass by number of Najas plants, was the most sensitive structural indicator from the microcosm study; total Najas wet weight and total number plants as individual measurements were not sensitive. The literature is replete with arguments over the relative sensitivity and ecological significance of structural versus functional endpoints (Cairns 1983; Kimball and Levin 1985; Stay et al. 1985; Schindler et al. 1985; Larsen et al. 1986; Pratt et al. 1988), but no clear consensus has been reached because differences in chemical mode of action, choice of measurement, and statistical precision can strongly shape results and interpretation. The results of our study continue to provide evidence that neither structural nor functional approaches are consistently most sensitive.

Exposure assessment:

Several approaches have been used to estimate potential exposures to pesticides, including measured environmental data and runoff models. Environmental data for atrazine is extensive; environmental concentrations of atrazine are reported to range from 0 to 2300 μg/L in runoff (Hall 1974; Triplett et al. 1978; Klaine et al. 1988), 0 to 88 μg/L in groundwater (Junk et al. 1980), and from 0 to 70 μg/L in aquatic ecosystems (Richard et al. 1975; Frank and Sirons 1979). Environmental data on metribuzin, alachlor, and metolachlor is less extensive, and exists primarily in two groups of data: 1) experimental plot and runoff data, and 2) stream data gathered for human drinking water risk assessments.

Experimental plot data has demonstrated that herbicide concentrations in edge-of-field samples can reach levels known to impact aquatic plants. Data has indicated that total annual herbicide losses in runoff usually average less than 1.0% of total chemical applied; however, extreme rainfall events immediately following chemical application can result in losses of up to 15% (Hall 1974; Wauchope 1978; Weber et al. 1980; Hall et al. 1991). Kadoum and Mock (1978) observed high average concentrations of atrazine (13 to 82 μg/L) and alachlor (38-188 ug/L) in irrigation tail-water pits adjacent to 65 ha grain fields; maximum concentrations reached 1074 μg/L atrazine in water. Wauchope (1978) reviewed the literature on edge-of-field concentrations of pesticides in runoff adjacent to small agricultural plots and found that levels greatly exceed those measured in stream-monitoring programs. For example, atrazine concentrations ranged from 37 to 4,700 μg/L across eleven small-plot studies; highest numbers occurred in situations of 40 m^2 plots of 14% slope following a storm event (Wauchope 1978). Baker et al. (1976) measured high concentrations of alachlor (75 to 198 μg/L) adjacent to 33 m^2 plots following a severe storm. Although these concentrations represent extremes in potential herbicide exposures, they indicate that herbicide concentrations in wetlands and aquatic habitats adjacent to agricultural fields can likely exceed levels known to cause impacts on aquatic plant species composition and primary productivity.

Stream monitoring data indicates that herbicide levels are generally much lower than those measured directly in field runoff. Richards and Baker (1993) recently published data concerning the environmental concentrations of herbicides in 7 rivers of the Lake Erie-Ohio Region (Table 32). Maximum measured concentrations of these herbicides exceed levels which can adversely impact more sensitive plant species (e.g. Ceratophyllum and Selenastrum). However, these maximum measured values are extremes in terms of potential chronic exposures; an examination of 95th and 50th percentiles and time-weighted means (TWM's) indicates that these maximum concentrations usually only occur as pulses over a few days (Richards and Baker 1993) (Table 32). Thurman (1991 and 1992) evaluated herbicide levels in rivers and streams in the Midwest in 1989 and 1990 and determined that highest levels of herbicides occurred immediately post-planting during spring flushes; maximum values of atrazine, metribuzin, alachlor, and metolachlor were 108, 8, 51, and 40 ug/L, respectively, while median values were 3.8, 0.1, 1.0, and 1.3 ug/L, respectively.

Relatively little environmental data exists for herbicides in small streams or wetlands. However, Richards and Baker (1993) determined that concentrations of herbicides increase inversely with size of the watershed, which indicates that maximum herbicide levels would probably occur in edge-of-field habitats and relatively small (<500 km^2) watersheds. A general lack of data in small watersheds has prompted researchers to develop general fate models to estimate potential pesticide exposures. This approach appears to be more useful for herbicides than insecticides, because herbicides are relatively water soluble and are usually transported primarily in the aqueous phase (Baker et al. 1976; Richards et al. 1973). Environment Canada uses a relatively straightforward approach to estimating exposure in prairie wetlands and other aquatic habitats by assuming that worst-case exposures could result from 100% direct over-spray or drift (Peterson et al. 1994); others have used similar approaches in estimating potential exposure resulting from 1-10% runoff of applied chemical (Urban and Cook, 1986; Sheehan et al. 1987). Actual factors vary considerably depending on topography, chemical characteristics, application rates, and rainfall patterns. However, these figures can provide useful estimates for providing estimates of water-body exposure. In Table 33, we provide estimates of water-body exposure for atrazine, metribuzin, alachlor, and metolachlor given each of these scenarios.

Hazard assessment:

Hazard assessments of pesticides are usually conducted by comparing the toxicity of a chemical to expected environmental exposure concentrations (Urban and Cook, 1986). We have used this approach to calculate the relative risk of atrazine, metribuzin, alachlor, and metolachlor to aquatic plants based on the toxicity and exposure data derived from Table 33. Relative risk was calculated by dividing the median, low, and high plant response (toxicity) values by expected environmental exposures. Results are presented in Table 34. Exposure assessments in runoff were based on an assumption of a 1 ha wetland receiving runoff from a 10:1 watershed:wetland ratio (Urban and Cook 1986) with a wetland depth of 15 cm (Peterson et al. 1994); worst-case exposures were calculated based on a direct over-spray of a wetland (i.e. 100% deposition) of 15 cm depth (Peterson et al. 1994).

Results indicate that primary concern occurs in areas receiving direct over-spray or excessive runoff (10% of application) which may include ephemeral wetlands and farmed wetlands that exist in agricultural fields as temporary, seasonally-flooded habitats; similar exposures can occur in pothole areas interspersed with farmed land in the Prairie Pothole region of North America (Sheehan et al. 1987) (Table 34). The spatial and volume assumptions of these calculations results in equivalent exposure and hazard predicitions for both direct overspray and 10% runoff. In these worst-case scenarios, the median risk value for the four herbicides ranges from 6.9 (highest median risk; atrazine) to 1.4 (lowest median risk; metolachlor). Conservative estimates, using risk values for the most sensitive species, range from 183 (alachlor) to 8.1 (metribuzin).

Risk estimates based on the 1% runoff, simulating potential exposures in streams, rivers, and permanent wetlands provides risk estimates generally <1.0 based on the median plant response value. The most conservative approach, using the most sensitive species response, provided a risk coefficient of 18.3 (alachlor; Selenastrum sp.) to 0.8 (metribuzin; Ceratophyllum sp.). Therefore, 1% runoff scenario, based on the species and endpoints of these studies data, generally indicate that a threshold for adverse aquatic plant impacts are approached in many cases for herbicides in streams and permanent wetlands. Further, the data in Table 33 indicate that atrazine, alachlor, and metolachlor represent risks in terms of human health related to drinking water. It is also evident that the HAL is protective on most cases of plant impacts for atrazine, alachlor, and metolachlor, but is not protective for aquatic plant impacts from metribuzin.

Peterson et al. (1994) performed a risk assessment for 23 pesticides using one species of macrophyte (Lemna), 4 species of green algae, and 6 species of cyanobacteria; hazard was assessed by testing each species using the expected environmental concentration resulting from direct overspray of a 15-m deep wetland. Their results found that atrazine and metribuzin (as well as other triazines) were of high ecological risk, which was similar to our findings. However, metolachlor was assigned a relatively low risk, and alachlor was not tested. Our results assigned a much higher risk for metolachlor, which is primarily due to the differences in species tested in our studies. We used only two species of cyanobacteria for testing, which were relatively insensitive to herbicides; however, Peterson et al. (1994) used cyanobacteria as 6 of 10 total test species, and placed little emphasis on submerged macrophytes which are more sensitive. Further comparisons between these two studies are difficult because actual EC50 numbers were not generated by Peterson et al. (1994).

Several qualifications must be used with the above hazard assessments. First, the approach is based on relatively crude assumptions, and are not statistically-derived probabilities. Although this could be done, it would require a much more extensive database than is currently available. Second, the hazard assessment is based on data derived from relatively standard test designs and endpoints, which can overestimate or underestimate potential plant response depending on the intensity and duration of exposure. And lastly, these exposure estimates can vary greatly depending on local topography, distance of receiving waters from chemical sources, rainfall scenarios, and numerous other factors.

Chemical characteristics are also not taken into account. For example, K_{oc} values for metribuzin (41), atrazine (160), alachlor (190), and metolachlor (200) indicate that metribuzin and atrazine are more leachable than the acetanilides, and thus have a relatively higher potential for surface water contamination; conversely, alachlor and metolachlor are more sorptive, and would be less likely to be found in surface waters (Table 1). Although relatively little data exists for these chemicals in edge-of-field wetlands, Hall et. al. (1991) indicated that metolachlor was approximately 2-fold less mobile than atrazine in runoff from experimental plots. Furthermore, both metolachlor ($T^1/_2$=75 d) and alachlor ($T^1/_2$=21 d) have shorter half-lives in aquatic environments than atrazine ($T^1/_2$=193 d) (Table 33; Spalding et al. 1994), which will decrease the duration of exposures. More refined hazard assessment models may be capable of considering such chemical characteristics in hazard evaluations for runoff; however, we have not used them in this hazard assessment.

VI. CONCLUSIONS AND RECOMMENDATIONS

Toxicity studies ranked metribuzin > atrazine > alachlor > metolachlor in decreasing order of toxicity. Macrophyte studies ranked Naja > Lemna > Ceratophyllum > Vallisneria > Egeria > Myriophyllum in decreasing order of sensitivity and algal studies ranked Chlorella > Selenastrum > Scenedesmus > Chlamydomonas > Microcystis > Anabaena in decreasing order of sensitivity. The triazine herbicides (metribuzin and atrazine) were more toxic than the acetanilides (alachlor and metolachlor). However, the four herbicides are generally of equivalent ecological risk given the difference in application rates and runoff assumptions; adjustments for solubility and leachability would generally indicate a risk quotient of atrazine > metribuzin > alachlor > metolachlor. Highest ecological risk was calculated for edge-of-field habitats such as edge-of-field wetlands and ponds which may be impacted due to direct over-spray or drift. Risk estimates generally decrease in fluvial habitats as watershed and stream size increases. Current human health advisory limits (HAL's) for atrazine (3 ug/L), alachlor (2 ug/L), and metolachlor (100 ug/L) should be protective of aquatic plant impacts in rivers used for drinking water; however, the HAL for metribuzin (200 ug/L) is not. None of the HAL values can be assumed to be protective of aquatic plants in edge-of field wetland habitats; thus, herbicide impacts on wetlands should continue to be studied.

Conclusions drawn from this study must be considered tentative given the relatively small amount of available exposure data. Likewise, this hazard assessment is based only on single species laboratory data; more research should be performed to relate single species responses to plant community responses in field situations. For instance, laboratory studies with atrazine have demonstrated short-term cellular effects at concentrations of 1 μg/L; yet, acclimation and species substitution in natural environments can mitigate algal community impacts at concentrations as high as 50 μg/L (deNoylles et al. 1982; Larsen et al. 1986; Hersh and Crumption 1989). Thus, although aquatic plant communities are sensitive to atrazine, it appears that aquatic plant communities can exhibit functional redundancy in cases where sensitive species are replaced by resistant species capable of maintaining system function. Similar species replacement has been demonstrated in natural algal communities exposed to experimental acidification (Schindler et al. 1985) and to metals (Crossey and LaPoint 1988). Others have argued that the concept of "functional redundancy" does not exist, and that such accounts are primarily due to experimental bias or lack of statistical power (Pratt and Rosenberger 1993). Species replacement in itself could be ecologically significant if the displaced species (e.g. Naja) is needed for food, shelter, or nesting habitat of other species (Engle 1985;

Carpenter and Lodge 1986). The ultimate effects of herbicides in wetlands will be a function of the intensity and duration of exposure, as well as potential mitigating factors such as functional redundancy of aquatic plant communities. These studies have not been conducted with herbicides, which constitutes a major remaining data gap.

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Table 32. Comparison of application rates, drinking water maximum consumption limits, plant response values, and potential environmental herbicide exposures (ug/L) for four herbicides.
Table 33. Hazard assessment for algae and aquatic macrophytes based on quotient of toxicity and potential exposure.

Table 1. Summary of chemical properties and physical/chemical behavior of selected herbicides.

Property	**Herbicide**			
	Atrazine	**Alachlor**	**Metolachlor**	**Metribuzin**
Chemical Family[1]	triazine	acetanilide	acetamide	triazinone
Use[1]	pre/post-emergent annual and perennial grass/broad-leaf control	pre/post-emergent annual grass and broad-leaf control	pre-emergent annual grass and broad-leaf control	post-emergent grass and broadleaf control
Production[2] (#/yr X 10^3)	64236	55187	49713	4822
Mode of Action[3]	inhibits photosynthesis and other enzyme processes	inhibits protein synthesis and root elongation; cell membrane alteration	inhibits nucleic acid metabolism in hypocotyl and shoot	inhibits photosynthesis
Water Solubility (mg/L at 20-25°C)[4]	33 mg/L	242 mg/L	530 mg/L	1,220 mg/L
K_{oc}[4] (soil sorptive index)	160	190	200	41
Surface Loss Potential[4]	large	medium	medium	medium
Leaching Potential[4]	small	medium	medium	large
Water $T_{1/2}$[5]	193	21	75	n/a
Soil $T_{1/2}$[4]	60 days	14 days	20 days	30 days

[1] Farm Chemicals Handbook. 1992. Meister Publishing Co., Willoughby, OH.

[2] From Gianessi and Puffer (1991).

[3] Herbicide Handbook of the Weed Science Society of America. 1989. 6th Ed. Champaign, IL.

[4] Wauchope, R.D., Interim Pesticide Properties Data Base, Version 1.0, USDA/ARS.

[5] From Spalding et al. (1994); data for metribuzin not given (n/a).

Table 2. Summary of methods for use in analysis of water quality.

PARAMETER	SOP #
pH	B4.41
alkalinity	B4.16
turbidity	B4.42
dissolved oxygen	B4.18
conductivity	B5.237
TOC	B4.46
DOC	B5.21
SRP	B5.19
NH_3	B5.19
NO_2NO_3	B5.20
fluorescence	B4.40

Table 3. Experimental conditions for selected for algae and vascular plant testing in 1993-1994.

Condition	Test		
	Algae[1]	Duckweed	Vascular Plants
Temperature (°C)	25	25	25
Light source	fluorescent	fluorescent	fluorescent
Light intensity (fc)	400	400	400
Photoperiod	6:8	16:8	16:8
Test chamber	10-ml tube	50-ml beaker	1000-ml beaker
Water volume (mL)	5	25	750
Organisms stocked (#)	20,000 cells/mL	12 fronds	varies; usually 3 shoots
Replicates	3	3	3
Media	ASTM	10X ASTM (NEW)[2]	1X ASTM with sediment layer
Test duration	96h	4 d	14 d
Water renewal	no	no	no
Endpoint	population growth	frond count	length increase; weight increase

[1] modified from ASTM (1992a).

[2] From Taraldsen and Norberg-King (1990).

Table 4. Physical and chemical characteristics of sediment used in macrophyte and microcosm studies.[1]

Sample #	Particle Size			Texture	Organic[2] Carbon (%)	Organic Matter (%)	pH	NH_4-N (ppm)	NO_3-N (ppm)
	% sand	% silt	% clay						
1	16	54	30	silty-clay loam	5.5	9.8	7.1	6.1	35.3
2	20	50	30	silty-clay loam	6.6	9.6	7.3	8.0	36.9

[1] Analyzed by Soil Testing Services Laboratory, University of Missouri, Columbia, MO.

[2] Analyzed at Midwest Science Center.

Table 5. Characteristics of waters used to examine response of Selenastrum and Lemna to atrazinunder variations in water quality.

Water Quality Source	pH	Alk (mg/L)	Cond (uM/cm)	Turbidity (NTU's)	SRP (ug/L)	NH_3 (ug/L)	NO_2NO_3 (ug/L)	DOC (mg/L)
ASTM	6.1	10	134	0.5	140	0	4750	0
10X ASTM (NEW)	7.0	80	913	3.0	2490	248	26200	13.8
Stream	7.3	200	752	0.1	40	0	1750	5.0
Stream + ASTM[1]	7.4	212	827	0.6	190	4	6650	5.5

[1] Most comparable to water quality conditions experienced in 1992 field-sample testing.

Table 6. Parameters, frequency of measurement, and methodology used for water quality measures used in 1993 microcosm study.

Parameter	Frequency	Method; SOP Number
alkalinity	day 0 and 28	titration; SOP B4.16
temperature	daily (air)	thermometer
conductivity	days 6, 13, 20, 27	YSI Model 35; SOP B4.15
pH	days 6, 13, 20, 27	Orion; SOP B4.41
oxygen	day 6, 13, 20, and 27 (diurnal[1])	YSI Model 54; SOP B4.46
TN	days 6, 13, 20, 27	Technicon; SOP B5.18
NH_3	days 6, 13, 20, 27	Technicon; SOP B5.19
NO_2NO_3	days 6, 13, 20, 27	Technicon; SOP B5.20
TP	days 6, 13, 20, 27	Technicon; SOP B5.18
PO_4	days 6, 13, 20, 27	Technicon; SOP B5.19
sediment TOC	day 28	Coulometrics; SOP B4.36
macrophytes species composition	days 14, 21, 28	taxonomic
macrophyte biomass	days 14, 21, 28	gravimetric
Algae	day 28	chlorophyll; SOP B.40
system metabolism	weekly	diurnal oxygen; McConnell (1962)
light intensity	daily	General Electric Type 214 Meter

Table 7. Comparison of algal biomass (measured as fluorescence units) at 96 h using tube and flask method. Numbers represent mean ± 1. S.D. at 96 hours; coefficient of variation (%) is in parentheses. All medias were 1X ASTM.

Algal Species	**Tube**	**Flask**
Selenastrum	9,274 ± 268 (3)	10,977 ± 134 (1)
Clamydomonas	13,438 ± 354 (3)	13,154 ± 1277 (10)
Scenedesmus	1,071 ± 31 (3)	901 ± 59 (6)
Chlorella	5,533 ± 94 (2)	7,000 ± 0 (0)
Anabaena	395 ± 24 (6)	522 ± 36 (7)
Microcystis	588 ± 141 (24)	916 ± 48 (5)

Table 8. Comparison of plant growth response to 4 growth medias with and without sediments.

Genus	Media Type	Sediment	7-d weight (g)	14-d weight (g)		7-d length (cm)	14-d length (cm)
Egeria							
	well	yes	0.96 ± 0.14	0.80 ± 0.18		5.5 ± 0.8	5.6 ± 1.1
	well	no	0.90 ± 0.19	0.59 ± 0.26		5.3 ± 0.4	5.3 ± 0.6
	well + N/P	yes	0.78 ± 0.11	0.56 ± 0.15		5.3 ± 0.2	5.2 ± 0.2
	well + N/P	no	0.63 ± 0.14	0.37 ± 0.12		5.2 ± 0.2	5.4 ± 0.5
	Hoagland's 10%	yes	0.95 ± 0.25	0.63 ± 0.33		5.3 ± 0.3	5.2 ± 0.4
	Hoagland's 10%	no	0.88 ± 0.09	0.61 ± 0.28		5.1 ± 0.2	5.0 ± 0.1
	10X ASTM	yes	1.06 ± 0.07	0.81 ± 0.08		5.4 ± 0.4	5.9 ± 0.9
	10X ASTM	no	0.84 ± 0.23	0.66 ± 0.15		5.4 ± 0.4	5.4 ± 0.9
Myriophyllum	well	yes	2.53 ± 0.36	2.61 ± 0.18		12.4 ± 1.0	18.4 ± 2.0
	well	no	1.56 ± 0.21	1.52 ± 0.22		7.8 ± 1.0	7.2 ± 0.9
	well + N/P	yes	1.56 ± 0.49	0.55 ± 0.29		7.8 ± 0.5	8.5 ± 0.6
	well + N/P	no	0.80 ± 0.22	0.43 ± 0.13		7.1 ± 0.7	6.7 ± 0.6
	Hoagland's 10%	yes	2.20 ± 0.18	2.23 ± 0.11		11.2 ± 1.2	14.5 ± 1.9
	Hoagland's 10%	no	1.40 ± 0.30	1.27 ± 0.12		6.2 ± 0.3	6.3 ± 0.4
	10X ASTM	yes	2.15 ± 0.14	2.04 ± 0.22		10.6 ± 1.6	14.1 ± 2.6
	10X ASTM	no	1.35 ± 0.23	1.21 ± 0.19		6.4 ± 0.3	6.6 ± 0.3

Table 9. Effects of various aqueous nutrient sources on plant growth in beakers in the absence of sediment. Numbers represent mean ± 1 S.D. of n=3 replicates.

Genus	media type	7-d weight (g)	14-d weight (g)		7-d length (cm)	14-d length (cm)
<u>Egeria</u>						
	well	0.89 ± 0.19	0.60 ± 0.26		5.3 ± 0.4	5.3 ± 0.6
	well + N/P	0.63 ± 0.14	0.37 ± 0.12		5.2 ± 0.2	5.4 ± 0.5
	Hoagland's 10%	0.88 ± 0.09	0.61 ± 0.29		5.1 ± 0.2	5.0 ± 0.1
	10X ASTM	0.84 ± 0.23	0.66 ± 0.15		5.2 ± 0.4	5.3 ± 0.9
<u>Myriophyllum</u>						
	well	1.55 ± 0.20	1.52 ± 0.22		7.2 ± 0.8	7.8 ± 1.0
	well + N/P	0.80 ± 0.22	0.43 ± 0.13		6.7 ± 0.6	7.2 ± 0.7
	Hoagland's 10%	1.40 ± 0.30	1.27 ± 0.12		6.2 ± 0.3	6.3 ± 0.4
	10X ASTM	1.35 ± 0.23	1.21 ± 0.19		6.4 ± 0.3	6.5 ± 0.3

[1] Notes:- no container was aerated or had sediment.

Table 10. Effects of aqueous nutrient source on plant growth in beakers with sediment. Numbers represent mean ± 1 S.D. of n=3 replicates.

Genus	media type	7-d weight (g)	14-d weight (g)		7-d length (cm)	14-d length (cm)
Egeria						
	well	0.96 ± 0.14	0.80 ± 0.18		5.5 ± 0.8	5.6 ± 1.1
	well + N/P	0.78 ± 0.11	0.56 ± 0.15		5.3 ± 0.2	5.2 ± 0.2
	Hoagland's 10%	0.95 ± 0.25	0.63 ± 0.33		5.3 ± 0.3	5.2 ± 0.4
	10X ASTM	1.06 ± 0.07	0.81 ± 0.08		5.4 ± 0.4	5.9 ± 0.9
Myriophyllum						
	well	2.53 ± 0.36	2.61 ± 0.18		12.4 ± 1.0	18.4 ± 2.0
	well + N/P	1.56 ± 0.49	0.55 ± 0.29		7.8 ± 0.5	8.5 ± 0.6
	Hoagland's 10%	2.20 ± 0.18	2.23 ± 0.11		11.2 ± 1.2	14.5 ± 1.9
	10X ASTM	2.15 ± 0.14	2.04 ± 0.22		10.6 ± 1.6	14.1 ± 2.6

[1] Notes:- container were not aerated.

Table 11. Effect of aeration on macrophyte plant growth in 10% Hoagland's Media.

		7-d weight (g)		**14-d weight (g)**			**7-d length (cm)**		**14-d length (cm)**	
Genus	**sediments**	**no air**	**air**	**no air**	**air**		**no air**	**air**	**no air**	**air**
Egeria	yes	0.95 ± 0.25	0.88 ± 0.17	0.63 ± 0.33	0.68 ± 0.31		5.3 ± 0.3	5.0 ± 0	5.2 ± 0.4	5.0 ± 0
	no	0.88 ± 0.09	0.90 ± 0.29	0.61 ± 0.28	0.74 ± 0.42		5.1 ± 0.2	5.4 ± 0.7	5.0 ± 0.1	5.4 ± 0.9
Myriophyllum	yes	2.20 ± 0.18	2.03 ± 0.21	2.23 ± 0.11	1.86 ± 0.29		11.2 ± 1.2	10.4 ± 1.3	14.5 ± 1.9	13.2 ± 1.8
	no	1.40 ± 0.30	1.67 ± 0.20	1.27 ± 0.12	1.49 ± 0.40		6.2 ± 0.3	6.6 ± 0.7	6.3 ± 0.4	7.2 ± 0.7

Table 12. 96-h EC50's[1] (ug/L) of 4 herbicides with algae.

Herbicide	Selenastrum	Anabaena	Chlorella	Scenedesmus	Microcystis	Chlamydomonas
atrazine	117 (96-138)	>3000	92 (75-109)	169 (134-204)	90[2]	176 (145-207)
metribuzin	43 (35-50)	>3000	31 (22-39)	152 (126-179)	100[2]	23[2]
alachlor	10[2]	>3000	26 (16-35)	1328 (986-1669)	>3000	460 (388-532)
metolachlor	84 (72-95)	>3000	203 (160-246)	>3000	>3000	1138 (987-1290)

[1] Calculated using linear-logistic regression (with hormesis).

[2] EC50 less than lowest concentration tested, thus value is estimated rather than calculated.

Table 13. 96-h LC50, NOEC, and LOEC of Selenastrum response to 4 herbicides. All concentrations are in ug/L. EC50 represents calculated value ± 95% C.I.

Herbicide	96-h EC50	NOEC	LOEC
atrazine	117 (96-138)	75	150
metribuzin	43 (35-50)	19	38
alachlor	10[1]	<19	19
metolachlor	84 (72-95)	38	75

[1] Significant response occurred at lowest concentration; EC50 could not be calculated.

Table 14. 96-h EC50, NOEC, and LOEC for Scenedesmus. All concentrations are in ug/L. EC50 represents calculated value ± 95% C.I.

Herbicide	96-h EC50	NOEC	LOEC
atrazine	169 (134-204	38	75
metribuzin	152 (126-179)	38	75
alachlor	>3000	<188	<188
metolachlor	>3000	>3000	>3000

Table 15. 96-h EC50, NOEC, and LOEC for Chlorella. All concentrations are in ug/L. EC50 represents calculated value ± 95% C.I.

Herbicide	96-h EC50	NOEC	LOEC
atrazine	92 (75-109)	38	75
metribuzin	31 (22-39)	<19	<19
alachlor	26 (16-35)	<19	<19
metolachlor	203 (160-246)	75	150

Table 16. 96-h EC50, NOEC, and LOEC for Anabaena. All concentrations are in ug/L. EC50 represents calculated value ± 95% C.I.

Herbicide	**96-h EC50**	**NOEC**	**LOEC**
atrazine	>3000	>3000	>3000
metribuzin	>3000	375	750
alachlor	>3000	>3000	>3000
metolachlor	>3000	>3000	>3000

Table 17. 96-h EC50, NOEC, and LOEC for Microcystis. All concentrations are in ug/L. EC50 represents calculated value ± 95% C.I.

Herbicide	**96-h EC50**	**NOEC**	**LOEC**
atrazine	90[1]	<188	<188
metribuzin	100 (44-156)	<188	<188
alachlor	>3000	<188	<188
metolachlor	>3000	750	1500

[1] EC50 less than lowest concentration tested, therefore estimated rather than calculated value.

Table 18. 96-h EC50, NOEC, and LOEC for Clamydomonas. All concentrations are in ug/L. EC50 represents calculated value ± 95% C.I.

Herbicide	**96-h EC50**	**NOEC**	**LOEC**
atrazine	176 (145-207)	75	150
metribuzin	23 (18-29)	<38	<38
alachlor	460 (388-532)	150	300
metolachlor	1138 (987-1290)	188	375

Table 19. EC50's[1] (ug/L) of 4 herbicides with macrophytes.

Herbicide	Lemna	Myriophyllum	Egeria	Ceratophyllum	Najas
atrazine	92 (80-104)	132 (122-143)	<38	22 (20-23)	24 (20-28)
metribuzin	36 (31-41)	<38	21 (20-23)	14 (13-16)	19 (16-23)
alachlor	482 (332-632)	>3000	>3000	85 (72-98)	584 (452-717)
metolachlor	360 (373-398)	>3000	2355 (218-2593)	70 (62-78)	242 (164-321)

[1] Calculated using Trimmed Spearman-Karber Method; 14d test duration with exception of Lemna (96-h).

Table 20. 96-h EC50[1], NOEC, and LOEC for Lemna. All concentrations are in ug/L. EC50 represents calculated value ± 95% C.I.

Herbicide	96-h EC50	NOEC	LOEC
atrazine	92 (80-104)	75	150
metribuzin	36 (332-632)	<19	<19
alachlor	432 (332-398)	<187	<187
metolachlor	360 (373-398)	187	375

[1] Calculated using Trimmed Spearman-Karber Method.

Table 21. 14-d EC50[1], NOEC, and LOEC for Najas. All concentrations are in ug/L. EC50 represents calculated value ± 95% C.I.

Herbicide	96-h EC50	NOEC	LOEC
atrazine	24 (20-28)	>750	>750
metribuzin	19 (16-23)	19	38
alachlor	584 (452-717)	>750	>750
metolachlor	242 (164-321)	>750	>750

[1] Calculated using Trimmed Spearman-Karber Method.

Table 22. 14-d EC50[1], NOEC, and LOEC for Egeria. All concentrations are in ug/L. EC50 represents calculated value ± 95% C.I.

Herbicide	**96-h EC50**	**NOEC**	**LOEC**
atrazine	<38	150	300
metribuzin	21 (20-23)	19	38
alachlor	>3000	>3000	>3000
metolachlor	2355 (2118-2593)	>3000	>3000

[1] Calculated using Trimmed Spearman-Karber Method.

Table 23. 14-d EC50[1], NOEC, and LOEC for Ceratophyllum. All concentrations are in ug/L. EC50 represents calculated value ± 95% C.I.

Herbicide	**96-h EC50**	**NOEC**	**LOEC**
atrazine	22 (20-23)	19	38
metribuzin	14 (13-16)	<10	<10
alachlor	85 (72-98)	94	188
metolachlor	70 (62-78)	47	94

[1] Calculated using Trimmed Spearman-Karber Method.

Table 24. 14-d EC50[1], NOEC, and LOEC for Myriophyllum. All concentrations are in ug/L. EC50 represents calculated value ± 95% C.I.

Herbicide	**96-h EC50**	**NOEC**	**LOEC**
atrazine	132 (122-143)	300	600
metribuzin	<38	300	600
alachlor	>3000	>3000	>3000
metolachlor	>3000	>3000	>3000

[1] Calculated using Trimmed Spearman-Karber Method.

Table 25. Two-way ranked values of toxicity[1] of 4 herbicides with eleven species of aquatic plants. Note: potential ranks range from 1 to 44 with ties calculated as means of tied ranks.

	Overall Herbicide Toxicity Rank[1]				
Species	**Metribuzin**	**Atrazine**	**Alachlor**	**Metolachlor**	**Mean Species Rank**
Ceratophyllum	2	5	16	14	**9**
Selenastrum	13	20	1	15	**12**
Chlorella	9	18	8	26	**15**
Najas	3	7	31	27	**17**
Lemna	10	18	30	28	**21**
Egeria	4	12	37	34	**22**
Chlamydomonas	6	24	29	32	**23**
Myriophyllum	12	21	40	40	**28**
Scenedesmus	22	23	33	40	**30**
Microcystis	19	25	40	40	**31**
Anabaena	40	40	40	40	**40**
Mean Herbicide Rank	**13**	**19**	**28**	**30**	

[1] Calculated using the Statistical Analysis System (SAS) Rank Procedure.

Table 26. Effects of water quality on response of Selenastrum and Lemna to atrazine (ug/L).

Water Quality Source	Selenastrum 96-h EC50[1]	Lemna 96-h EC50
ASTM[2]	126 (114-139)	< 160[3]
10X ASTM (NEW)[4]	138 (126-150)	< 160
Stream	277 (253-304)	< 160
Stream + ASTM[5]	107 (97-119)	< 160

[1] Calculated using Trimmed Spearman-Karber Method.

[2] Standard procedure from ASTM (1992a).

[3] Lowest concentration tested; EC50 could not be accurately calculated.

[4] Procedure of Taraldsen and Norberg-King (1990).

[5] Comparable to water quality conditions in 1992 field sample testing.

Table 27. Comparison of EC50 (ug/L)[1] values of four herbicides based on Najas wet weight in single species tests compared to the microcosm study.

Herbicide	Single species test day 14	Microcosm test day 14-d exposure	Microcosm test 21-d exposure[2]
atrazine	24 (20-28)	26 (24-28)	75
metribuzin	19 (16-23)	18 (13-23)	30
alachlor	584 (452-717)	<47	140
metolachlor	242 (164-321)	335 (288-383)	100

[1] Determined using the Trimmed Spearman-Karber method.

[2] Estimated pending further analysis.

Table 28. Comparison of various endpoints in estimation of EC50 (ug/L)[1] of four herbicides (14 days post-treatment) on Naja-dominated microcosms.

Herbicide	Najas wet weight	# Najas plants	weight per Najas plant	Community respiration	Gross photosynthesis	pH	conductivity
atrazine	26 (24-28)	>150	47 (39-55)	89 (73-105)	88 (67-109)	>150	>150
metribuzin	18 (13-23)	>150	24 (15-34)	47 (37-56)	49 (41-57)	>150	>150
alachlor	<47	57 (0-122)	213 (166-261)	>750	>750	>750	>750
metolachlor	335 (288-383)	>750	437 (342-533)	>750	>750	>750	>750

[1] Determined using the Trimmed Spearman-Karber method.

Table 29. Comparison of Lowest Observable Effect Concentrations (LOEC's)[1] for various endpoints in Najas-dominated microcosms (14-days post-treatment) exposed to four herbicides.

Herbicide	Najas wet weight	# Najas plants	weight per Najas plant	Community respiration	Gross photosynthesis	pH	conductivity
atrazine	>150	>150	38	38	38	19	>150
metribuzin	38	>150	9	38	9	75	>150
alachlor	>750	>750	188	188	>750	>750	>750
metolachlor	>750	>750	>750	>750	>750	>750	>750

[1] Determined using a one-way analysis of variance followed by Tukey's Multiple Range Test.

Table 30. Atrazine effects on 24-h carbon uptake in plants.

GROUP	Species	EC50 (µg/L)
Algae[1]		
	Selenastrum	43
	Chlamydomonas	67
	Scenedesmus	48
	Chlorella	308
Vascular Plants[2]		
	Potamogeton	77
	Myriophyllum	104
	Zanichellia	91
	Ruppia	104

[1] from Larsen et al. (1986).

[2] from Jones and Winchell (1984).

Table 31. Growth response of Selenastrum to herbicides (μg/L)[1].

Herbicide	Class	96-h LC50
simazine[2]	triazine	1
triallate[2]	thiocarbamate	11
cyanazine	triazine	18
hexazinone	triazine	24
diquat	pyridine	34
metribuzin[3]	triazinone	36
alachlor[3]	acetanilide	36
metolachlor	acetanilide	55
atrazine[2]	triazine	59
bromoxynil	benzonitrile	3,000
glyphosate	aliphatic acid	14,000
picloram	picolinic acid	22,000
2,4-D	phenoxy	89,000

[1] from St-Laurent et al. (1992).
[2] from Turbak et al. (1986)
[3] this study.

Table 32. Comparison of maximum, 95th and 50th time-weighted percentiles, and time-weighted mean (TWM) for four herbicides in 7 Lake Erie tributaries over 8-yr period from 1983-1991.

Chemical	Maximum	95th percentile	50th percentile	TWM
atrazine	7-69	1-11	≤ 0.7	≤ 2.0
metribuzin	1-25	≤ 2.0	≤ 0.1	≤ 0.3
alachlor	1-65	0-4	≤ 0.1	≤ 0.9
metolachlor	5-97	1-9	≤ 0.4	≤ 2.0

[1] from Richards and Baker (1993).

Table 33. Comparison of application rates, drinking water maximum consumption limits, plant response values, and potential environmental herbicide exposures (ug/L) for four herbicides.

						Calculated Exposures		
Chemical	**Application Rate[1] (kg/ha)**	**Surface Loss Potential[2]**	**Aqueous half-life (T½)[3]**	**MCL[4]**	**Plant response range[5]**	**1%[6] runoff**	**10%[6] runoff**	**100%[7] direct overspray**
atrazine	0.96	small	193	3	92 (22-3000)	64	638	638
metribuzin	0.17	large	n/a	200	36 (14-3000)	11	113	113
alachlor	2.70	medium	21	2	584 (10-3000)	183	1834	1834
metolachlor	2.40	medium	75	100	1138 (70-3000)	163	1628	1628

[1] Data from USDA (1994) for application in corn in Iowa; note that application rates will vary by crops and region.

[2] From Wauchope (1988).

[3] From Spalding et al. (1994); data for metribuzin not given (n/a).

[4] From Richards and Baker (1993).

[5] From this study; values represent median species response, with most sensitive and least sensitive plant species response in parenthesis.

[6] Final concentration in wetland, assuming 10:1 watershed:wetland ratio (from Urban and Cook 1986) and average of 15 cm depth (from Petersen et al. 1994).

[7] Final concentration assuming direct over-spray of wetland resulting in 100% deposition (from Petersen et al. 1994) assuming wetland of 15 cm depth.

Table 34. Hazard assessment for algae and aquatic macrophytes based on quotient of toxicity and potential exposure.

	Risk Range		
Herbicide	**1% assumption e.g. streams**	**10% assumption e.g. edge-of-field**	**50% assumption e.g. direct over-spray**
atrazine	0.7 (2.9 - 0)	6.9 (29.0 - 0.2)	6.9 (29.0 - 0.2)
metribuzin	0.3 (0.8 - 0.0)	3.1 (8.1 - 0.0)	3.1 (8.1 - 0.0)
alachlor	0.3 (18.3 - 0.0)	3.1 (183.4 - 0.6)	3.1 (183.4 - 0.6)
metolachlor	0.1 (2.3 - 0.0)	1.4 (23.2 - 0.5)	1.4 (23.2 - 0.5)

[1] Risk calculated as expected environmental exposure divided by plant response range. A value < 1 indicates exposure lower than EC50; a value > 1 indicates exposure exceeds EC50. Values are expressed as species risk of median plant species response, with most sensitive and least sensitive species risk in parenthesis. All values were obtained from toxicity values and expected environmental values from Table 32.

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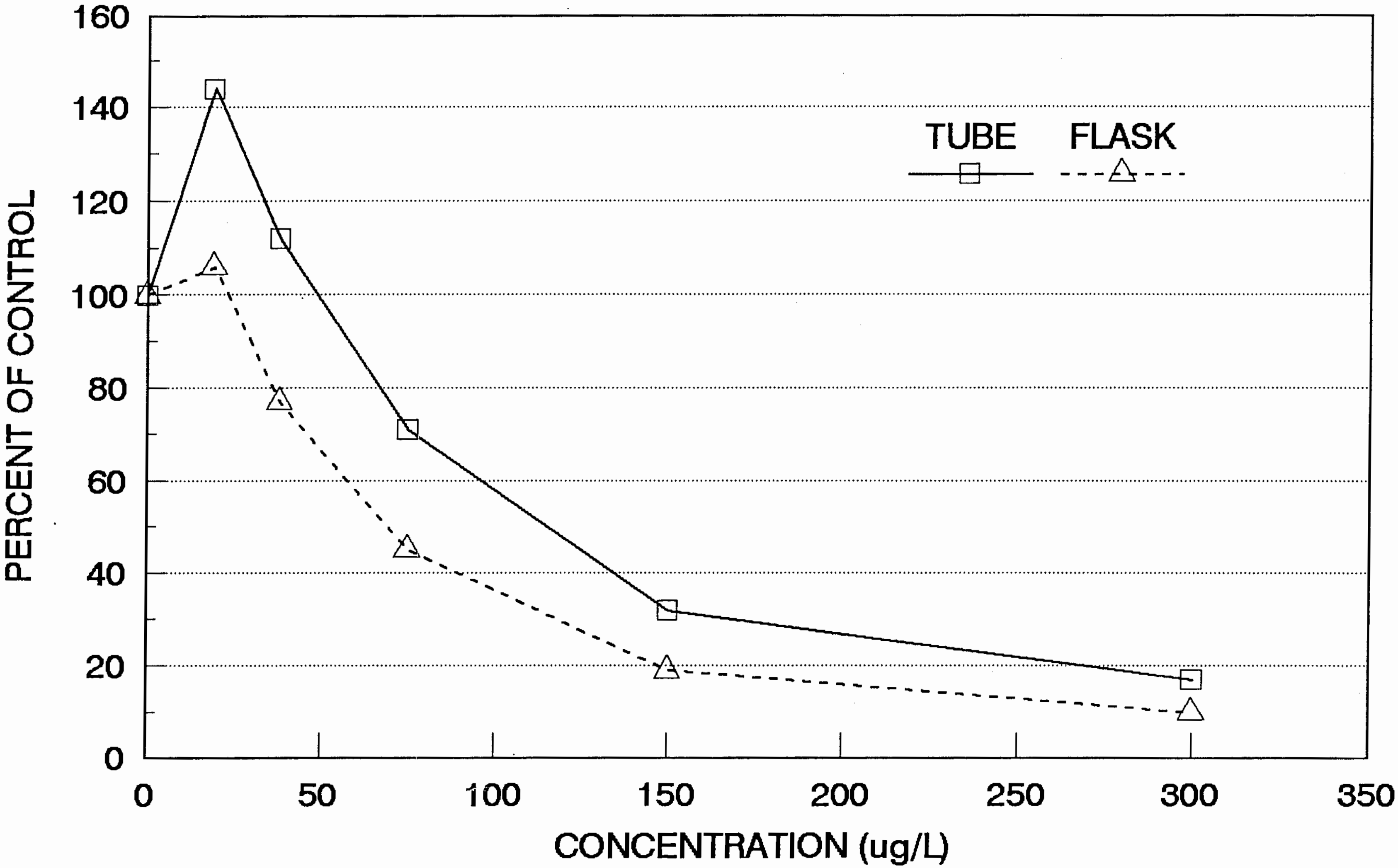
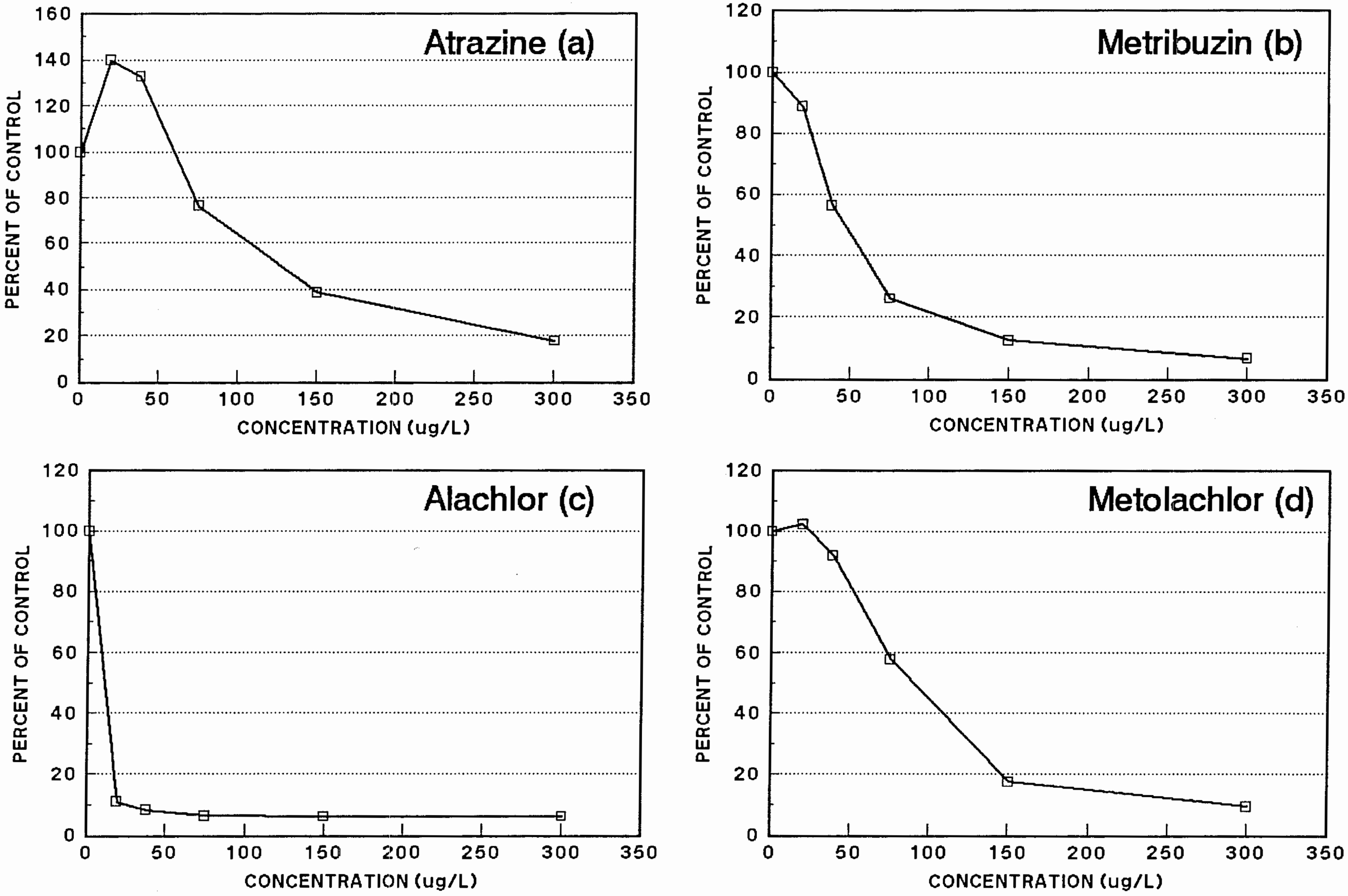


Fig. 1. Response of Selenastrum to atrazine using tube and flask methods.



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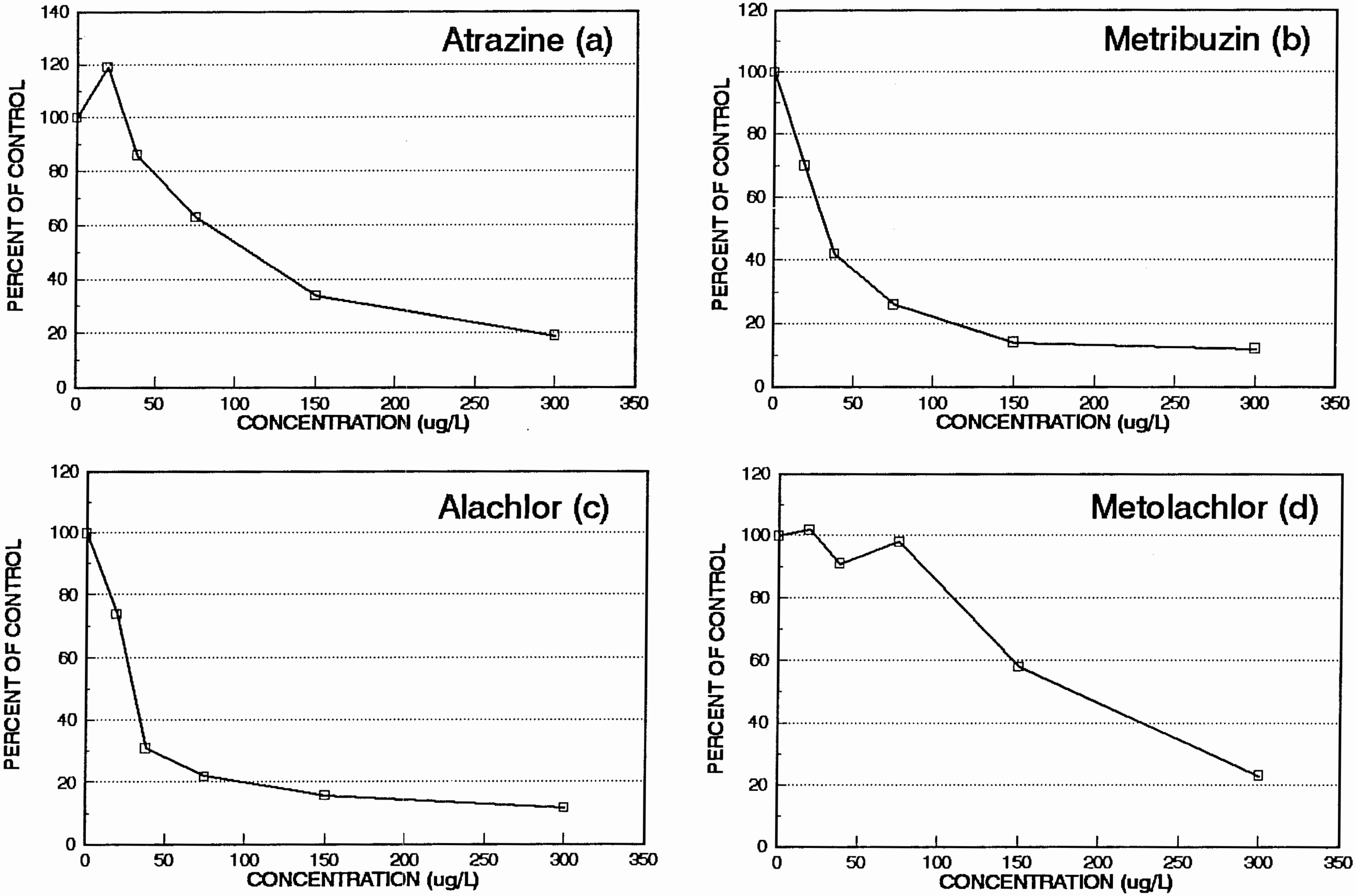

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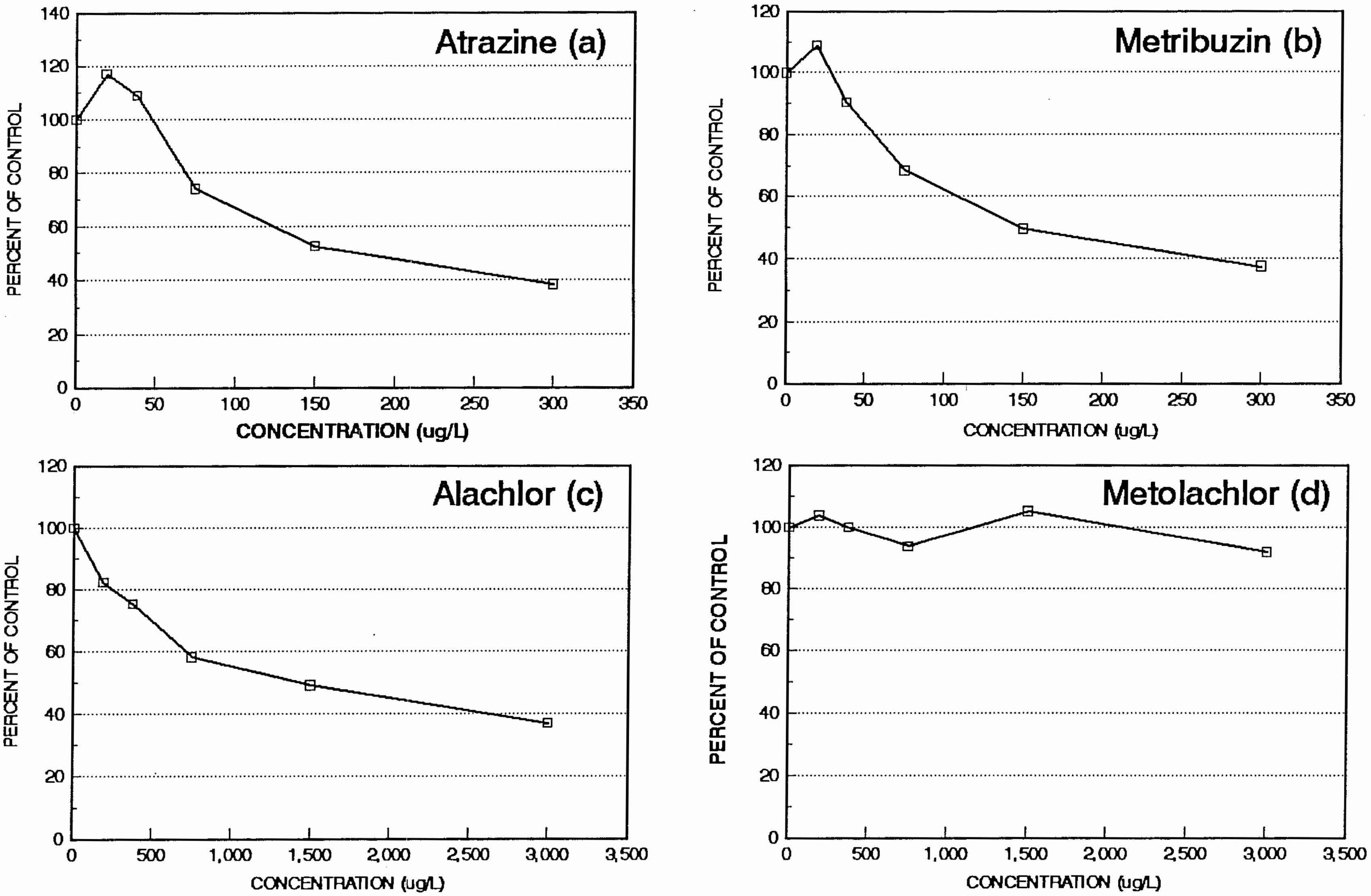

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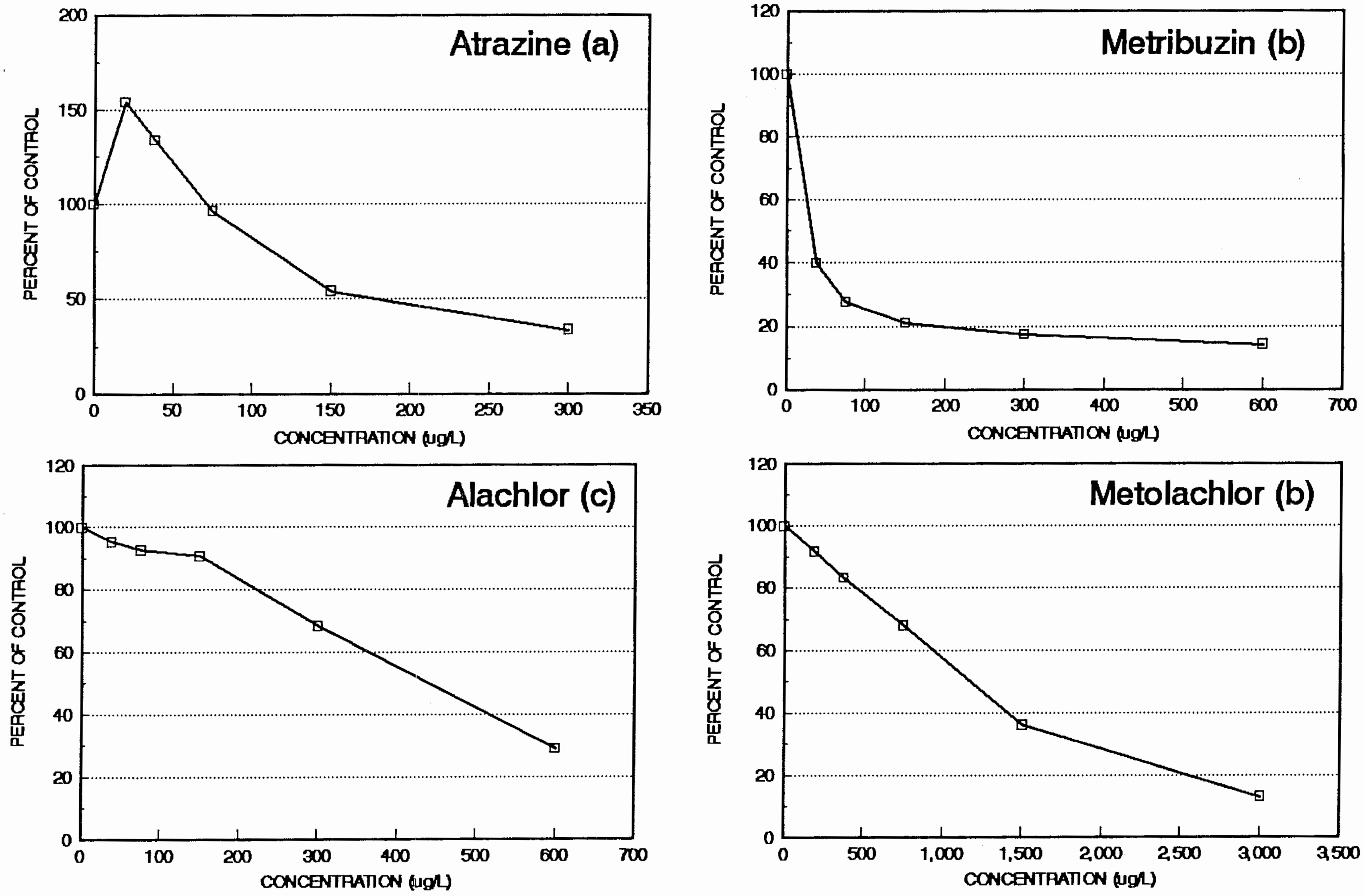

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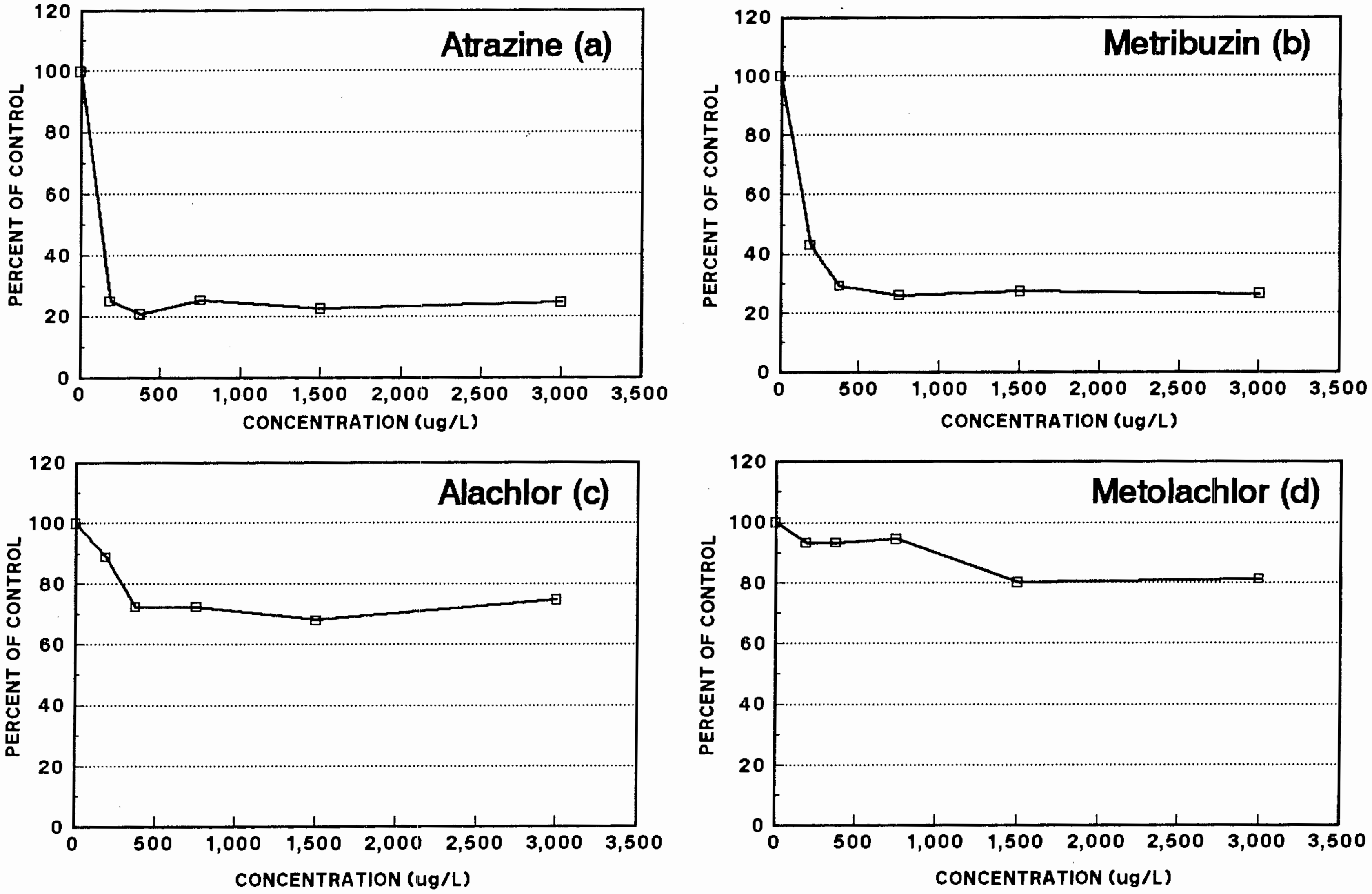
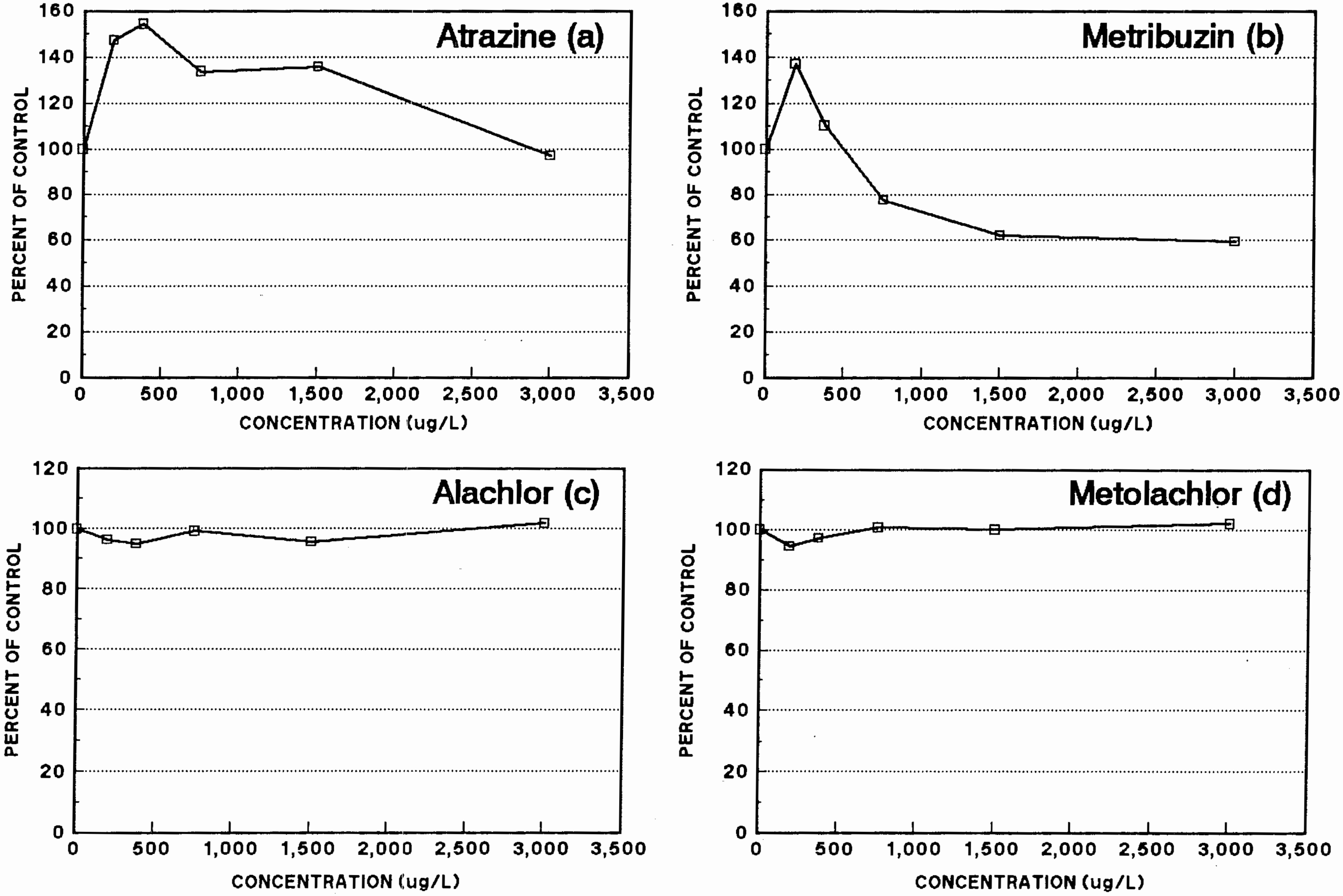


Fig. 6. 96-h response of *Microcystis* to four herbicides.



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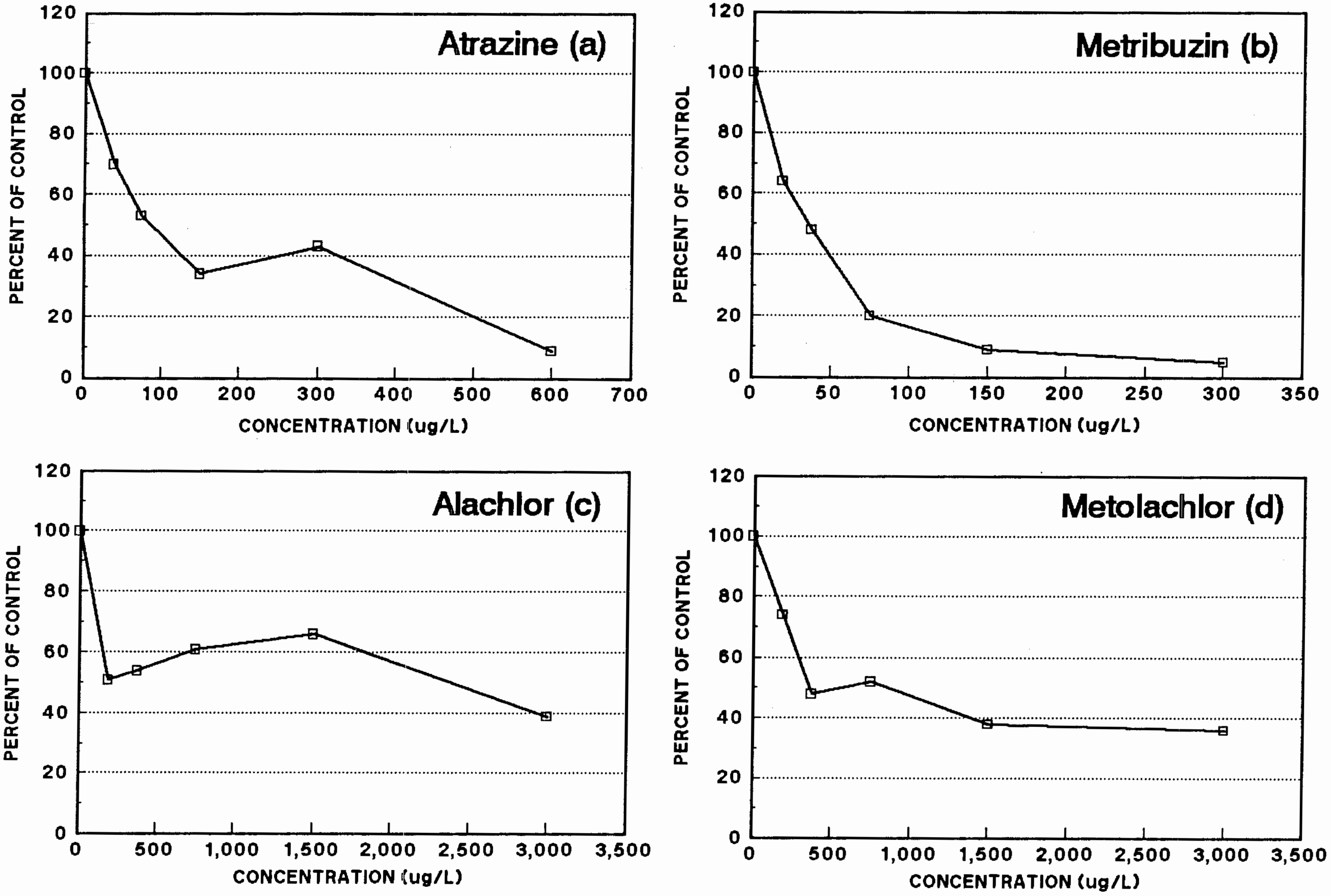

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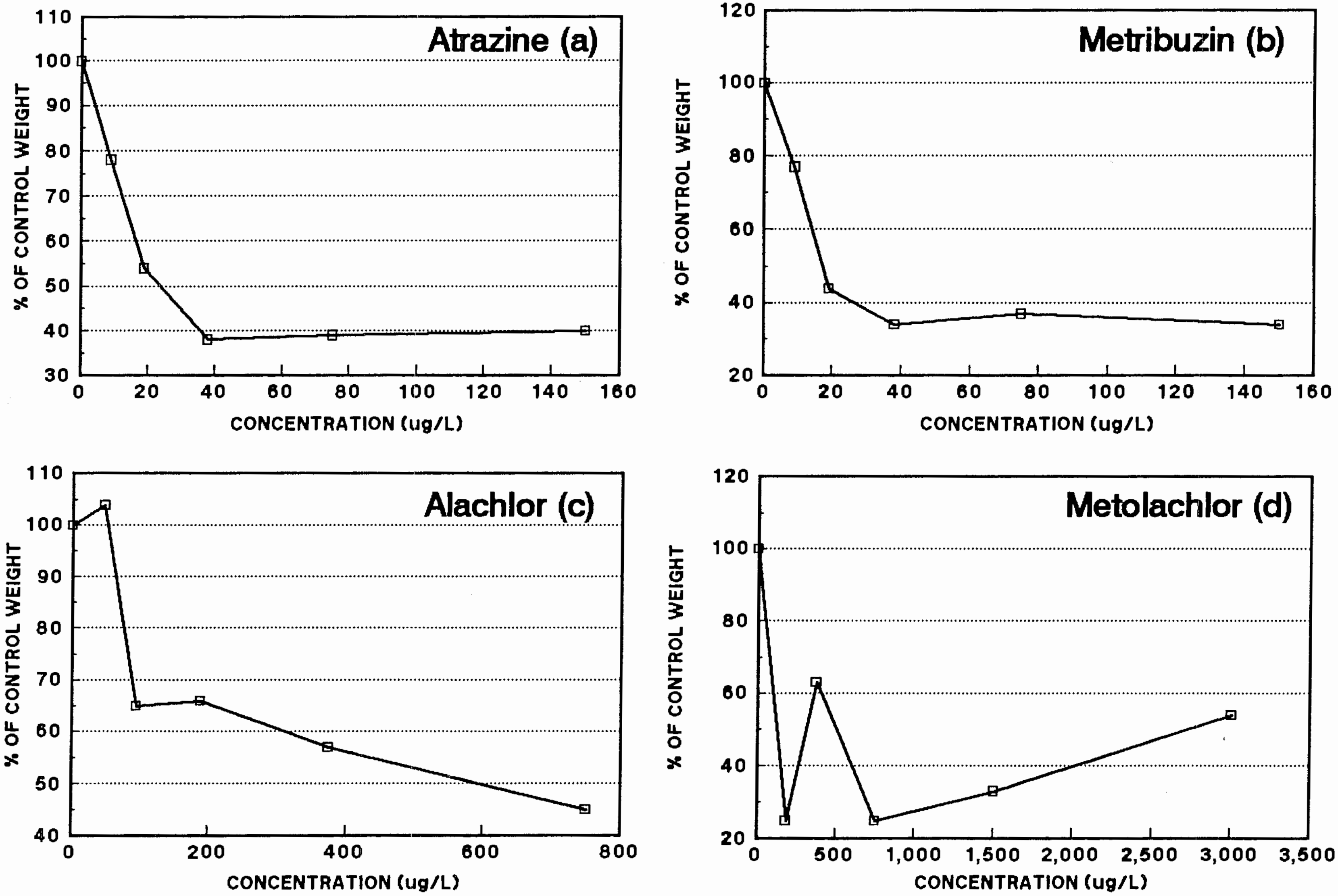
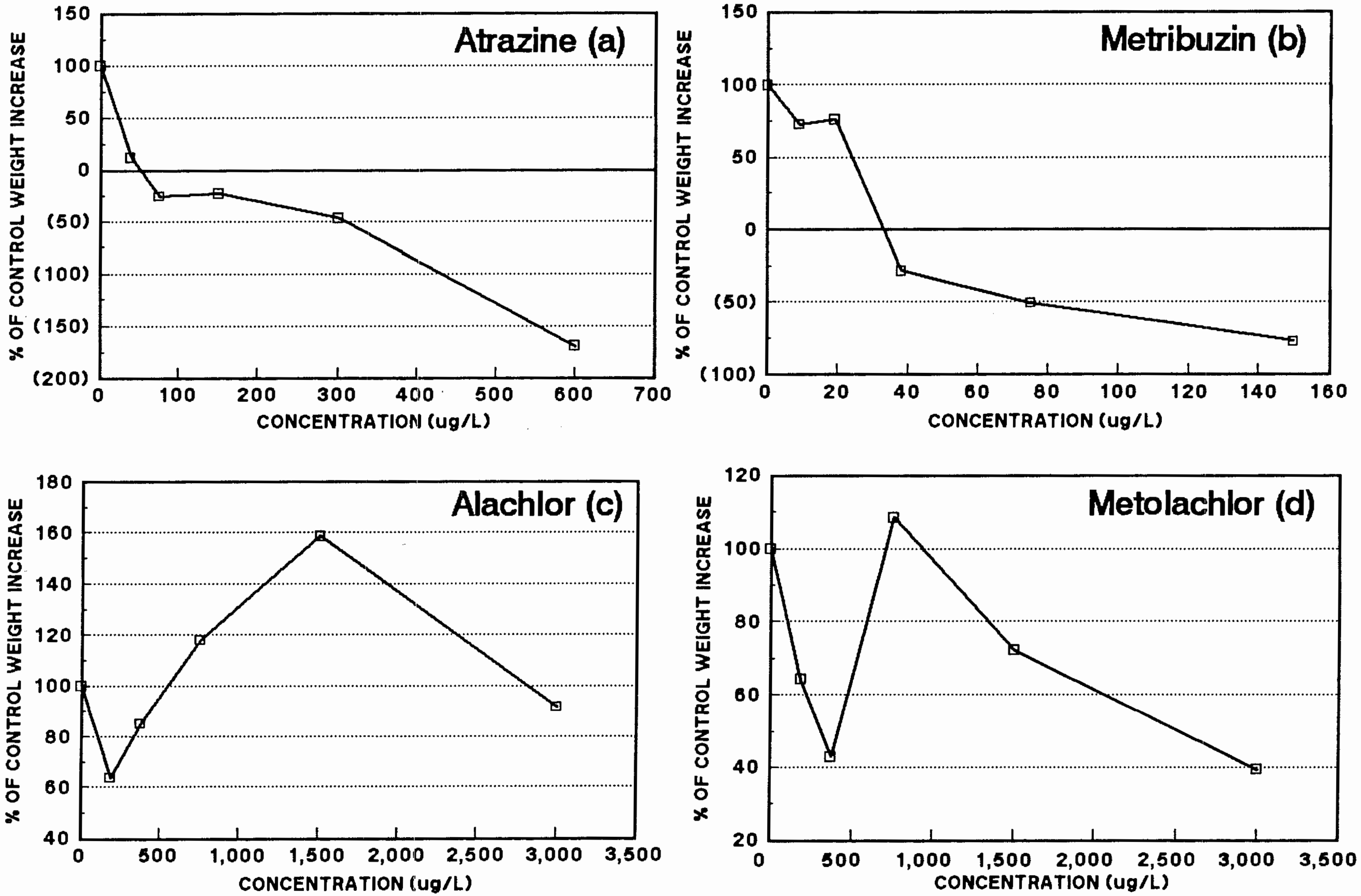


Fig. 9. 14 day response of Najas to four herbicides.



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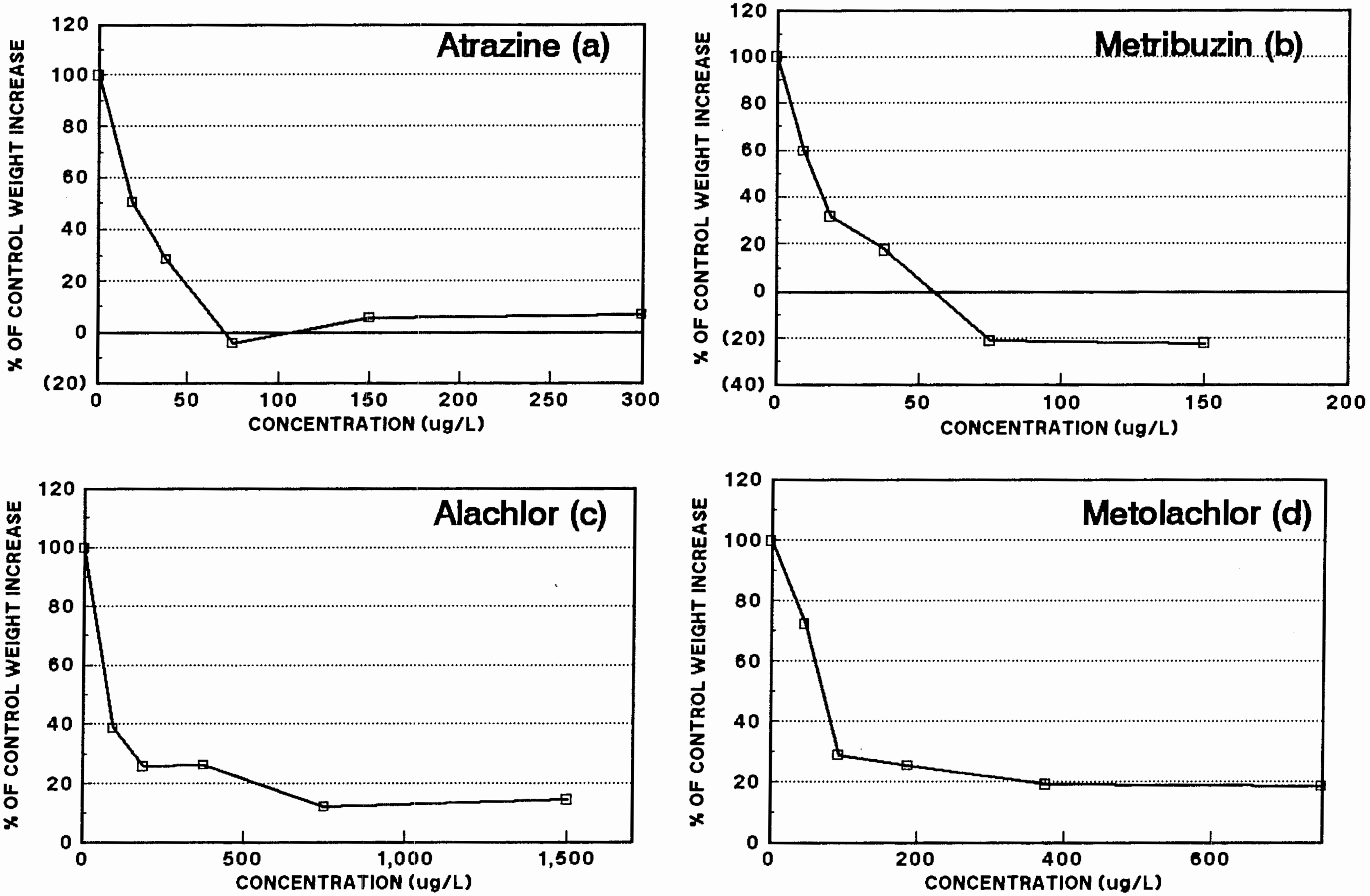

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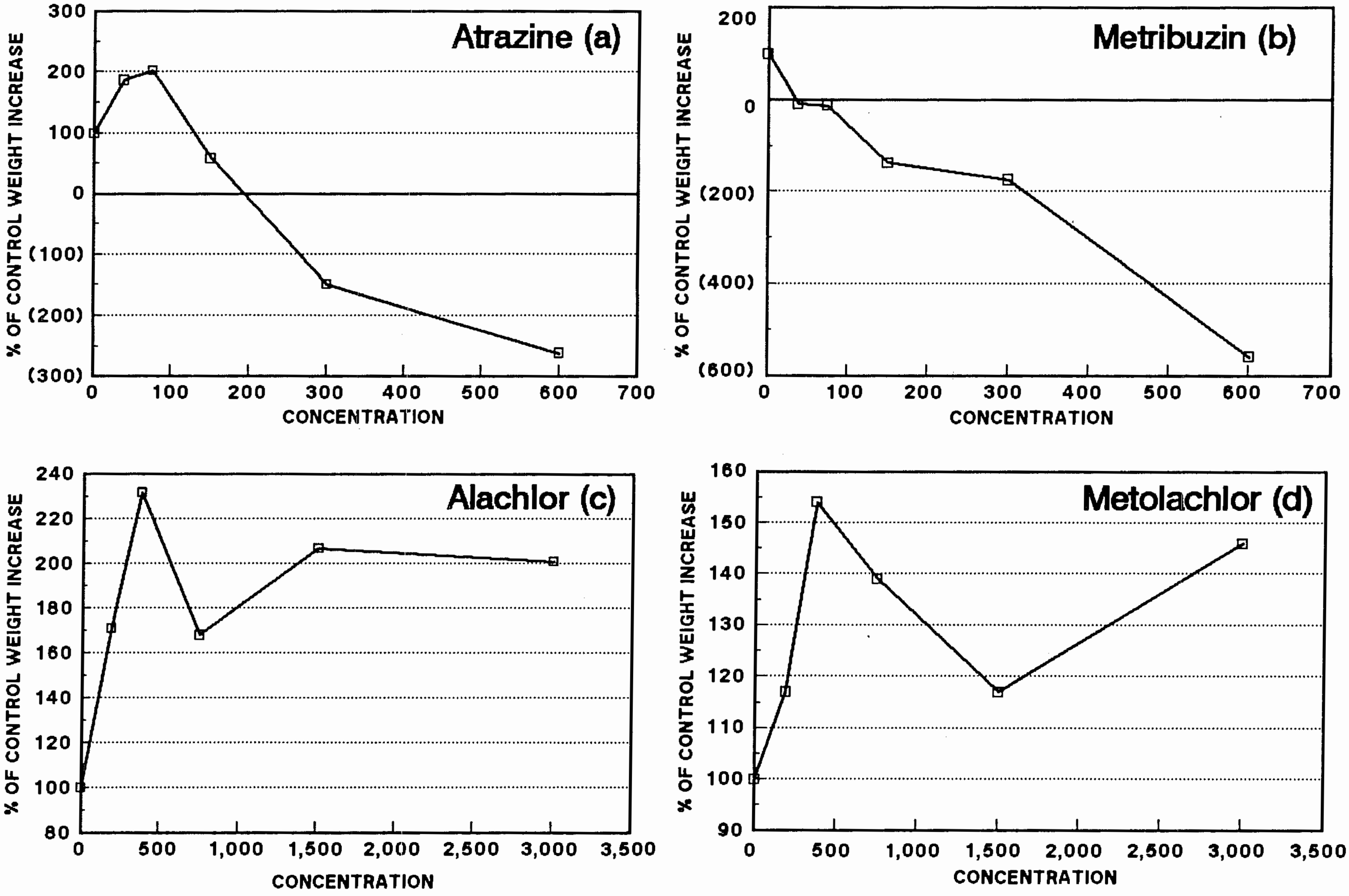

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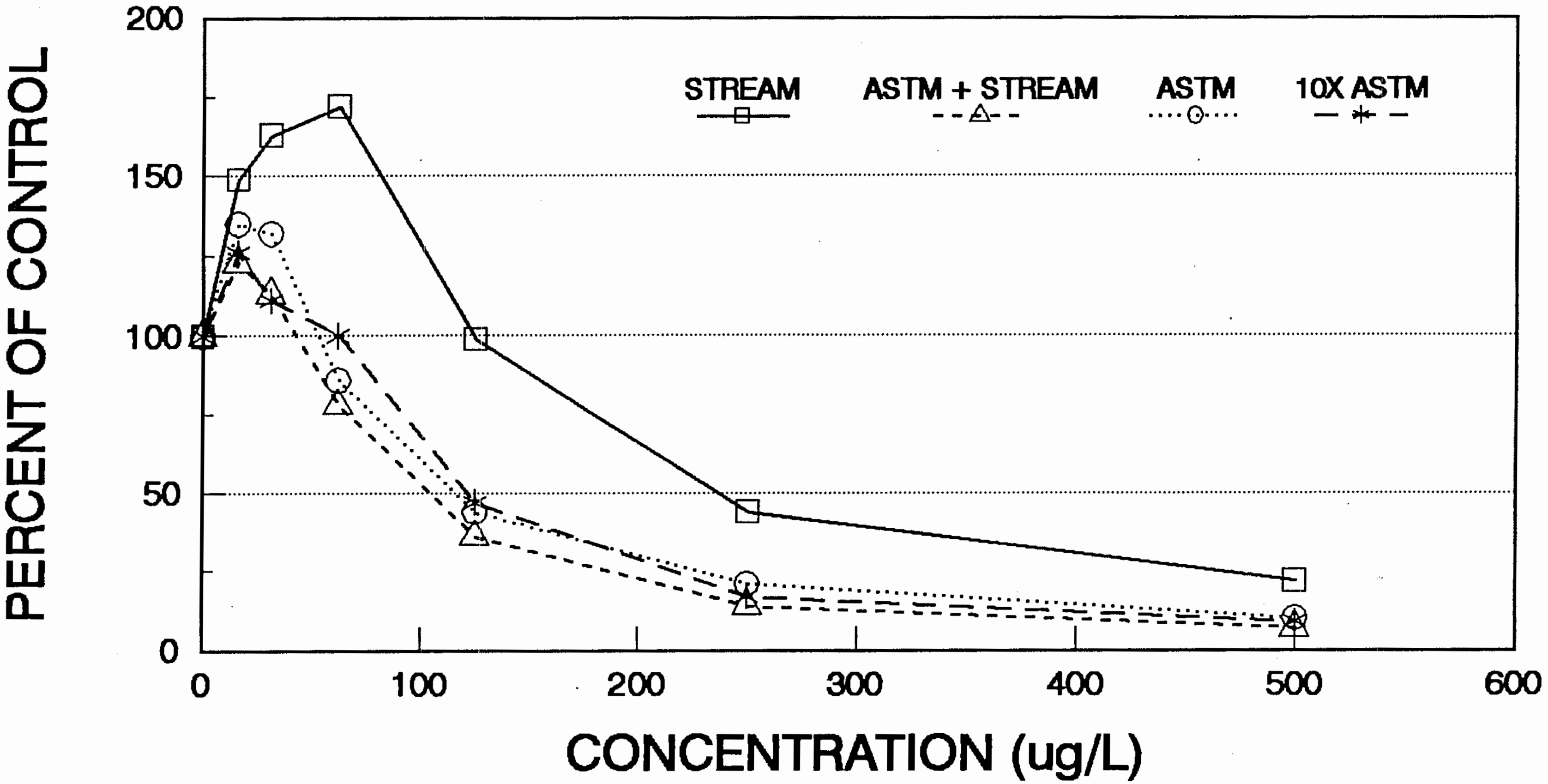


Fig. 13. Response of <u>Selenastrum</u> to atrazine under variation in water quality.

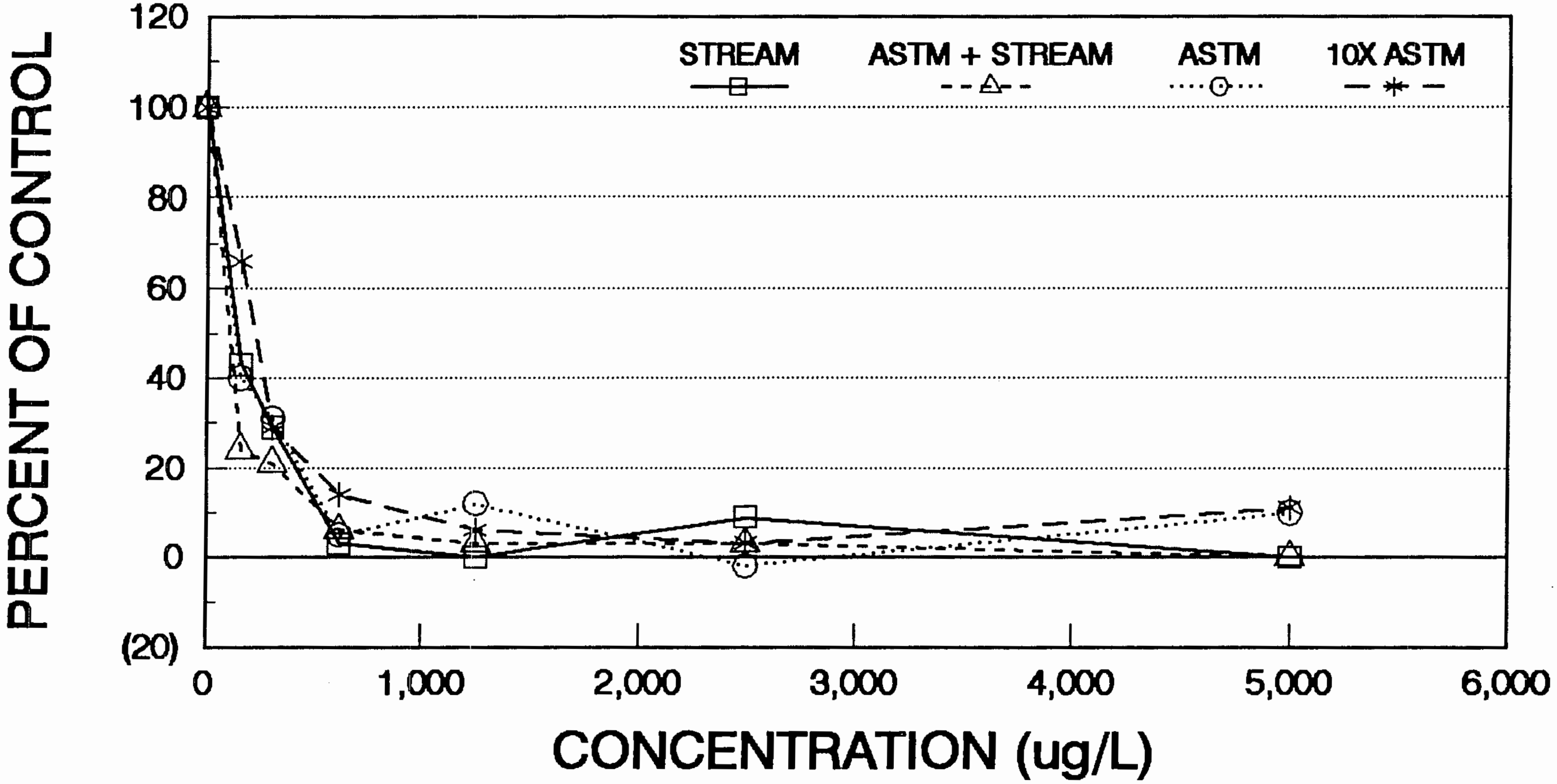


Fig. 14. Response of Lemna to atrazine under variation in water quality.

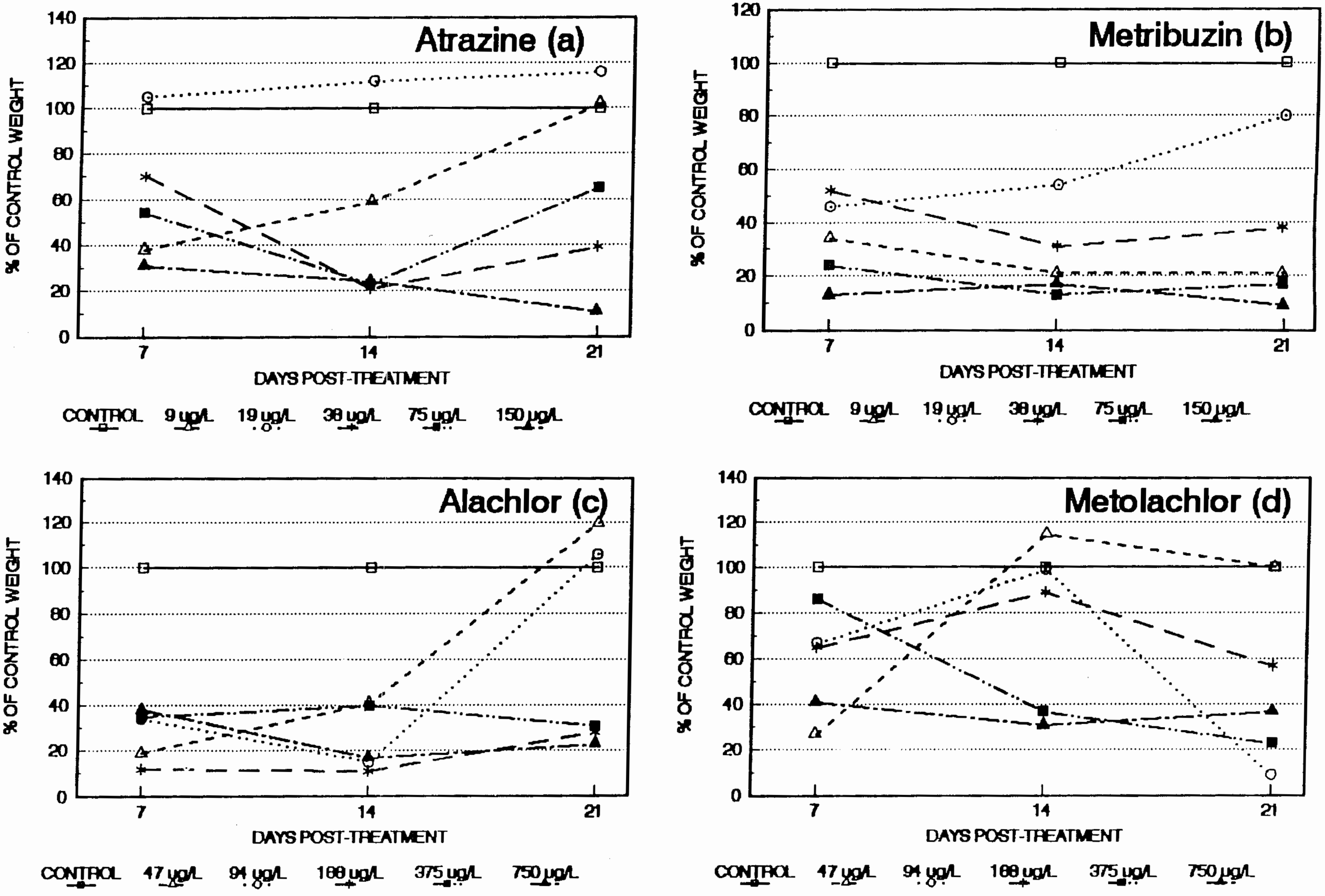


Fig. 15. Changes in wet weight of Najas over time in microcosms

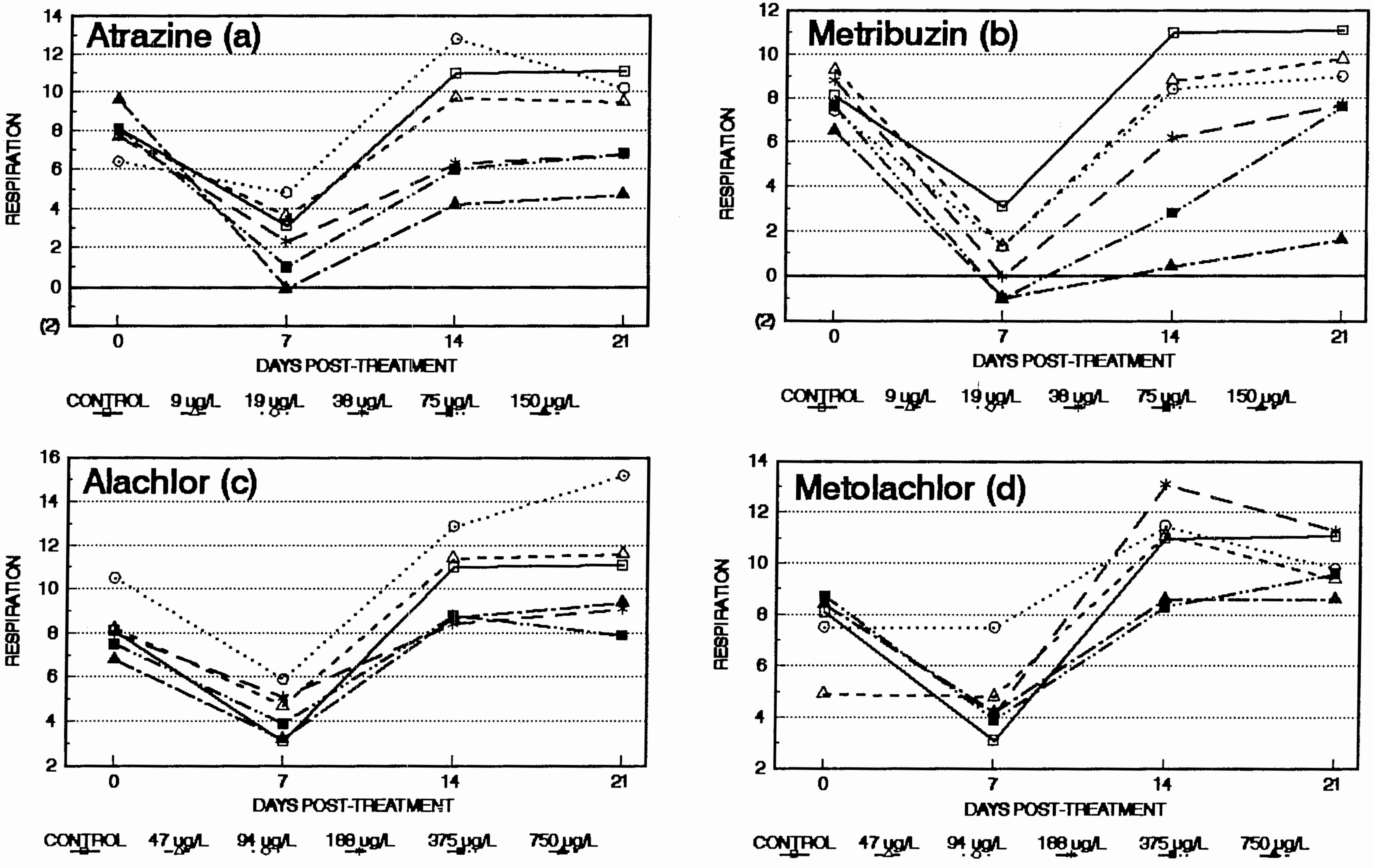
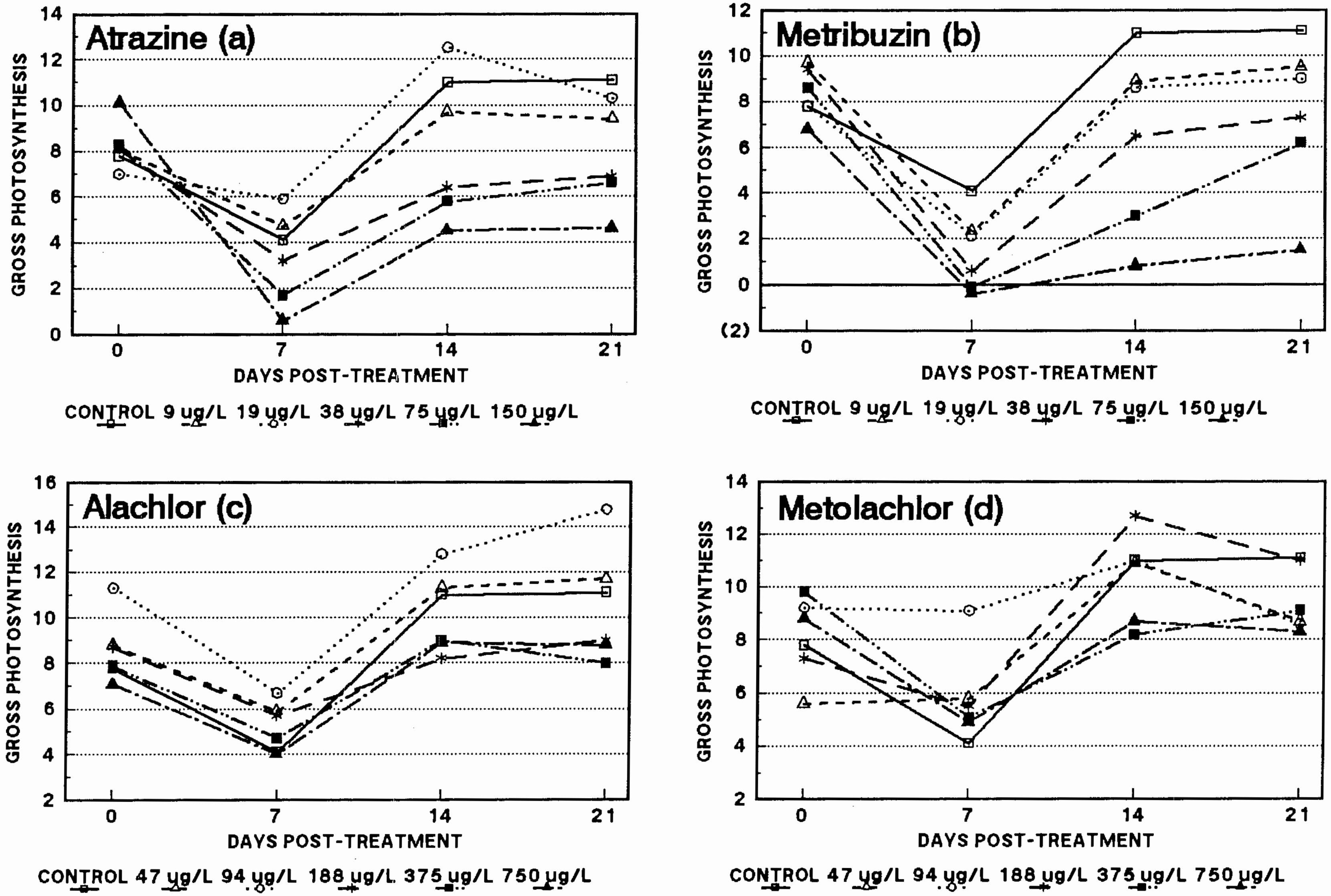


Fig. 16. Changes in community respiration over time of microcosms exposed to four herbicides.



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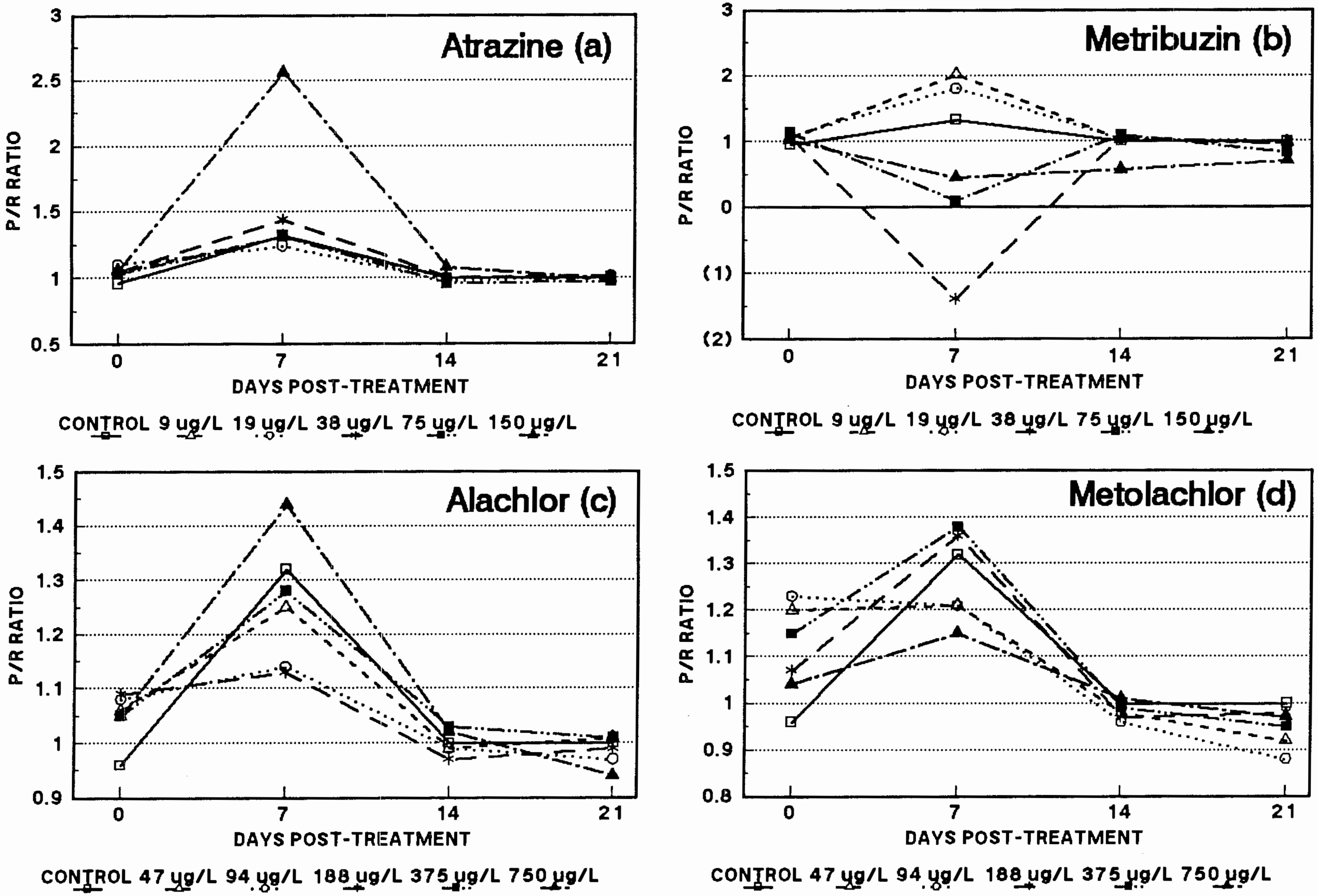

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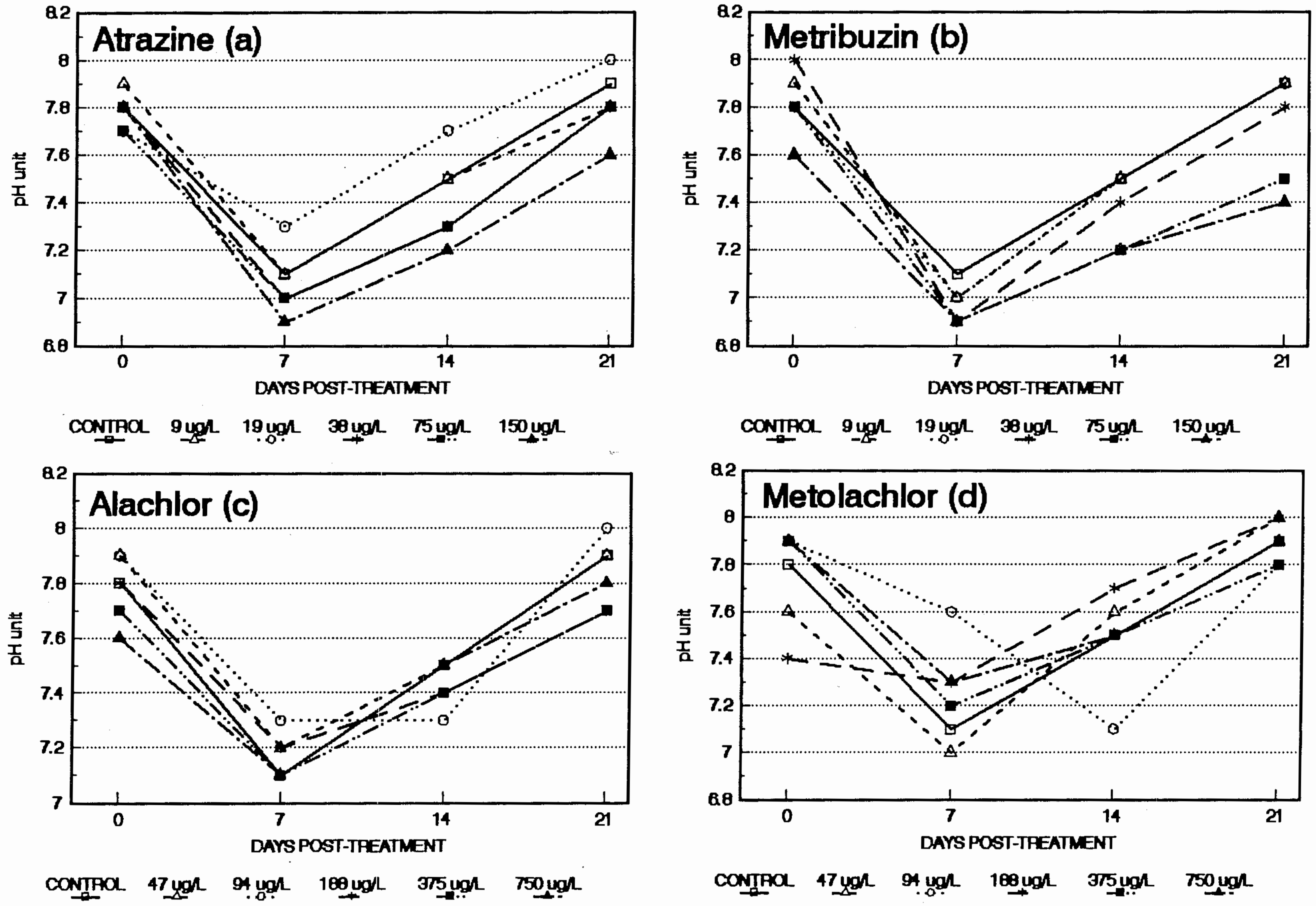

Fig. 19. Changes in pH over time in microcosms exposed to four herbicides.

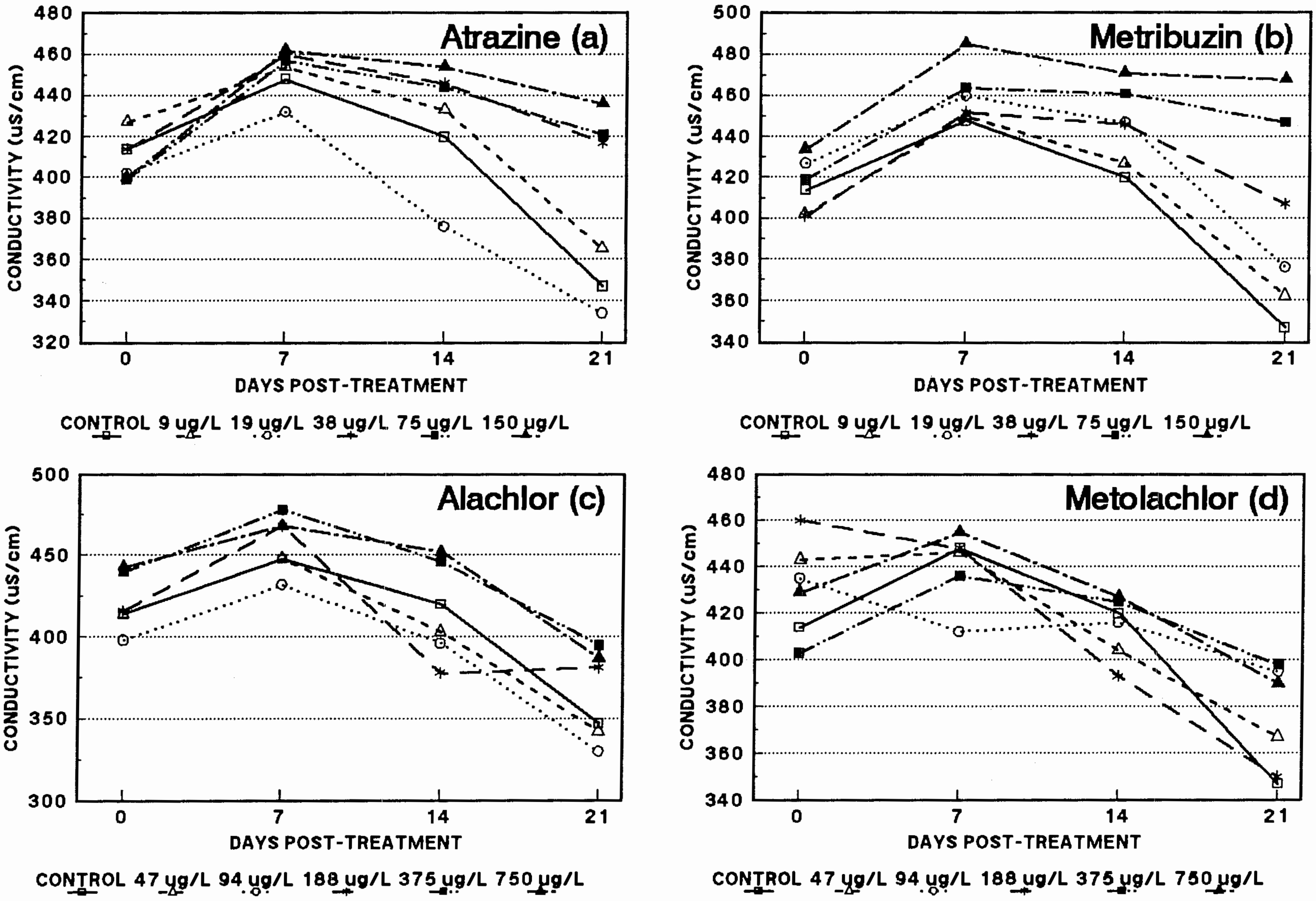

Fig. 20. Changes in conductivity over time in microcosms exposed to four herbicides.

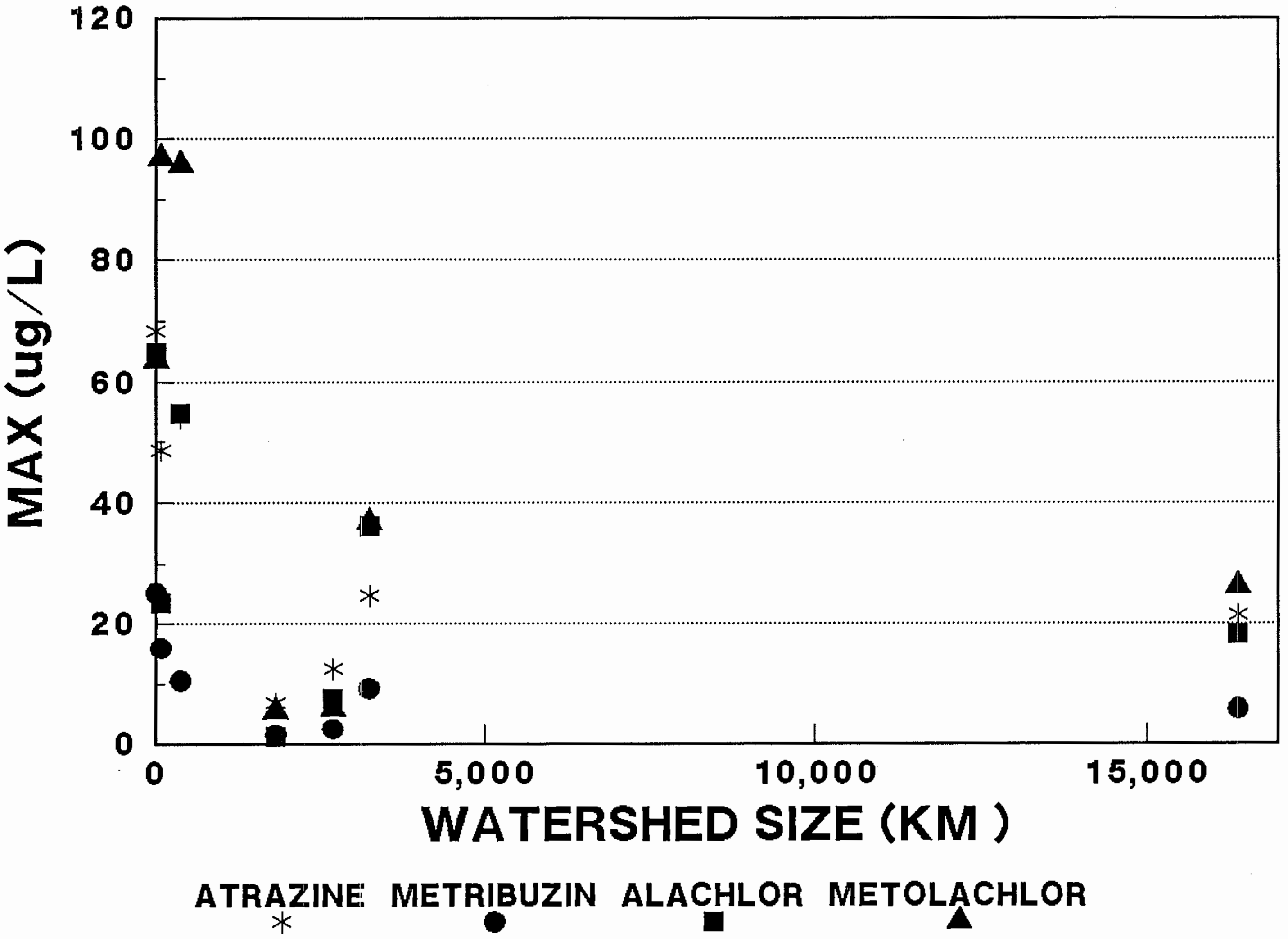

Fig. 21. Relationship of watershed size to maximum measured concentrations of four herbicides in Lake Erie tributary rivers. (from Richards and Baker, 1993).

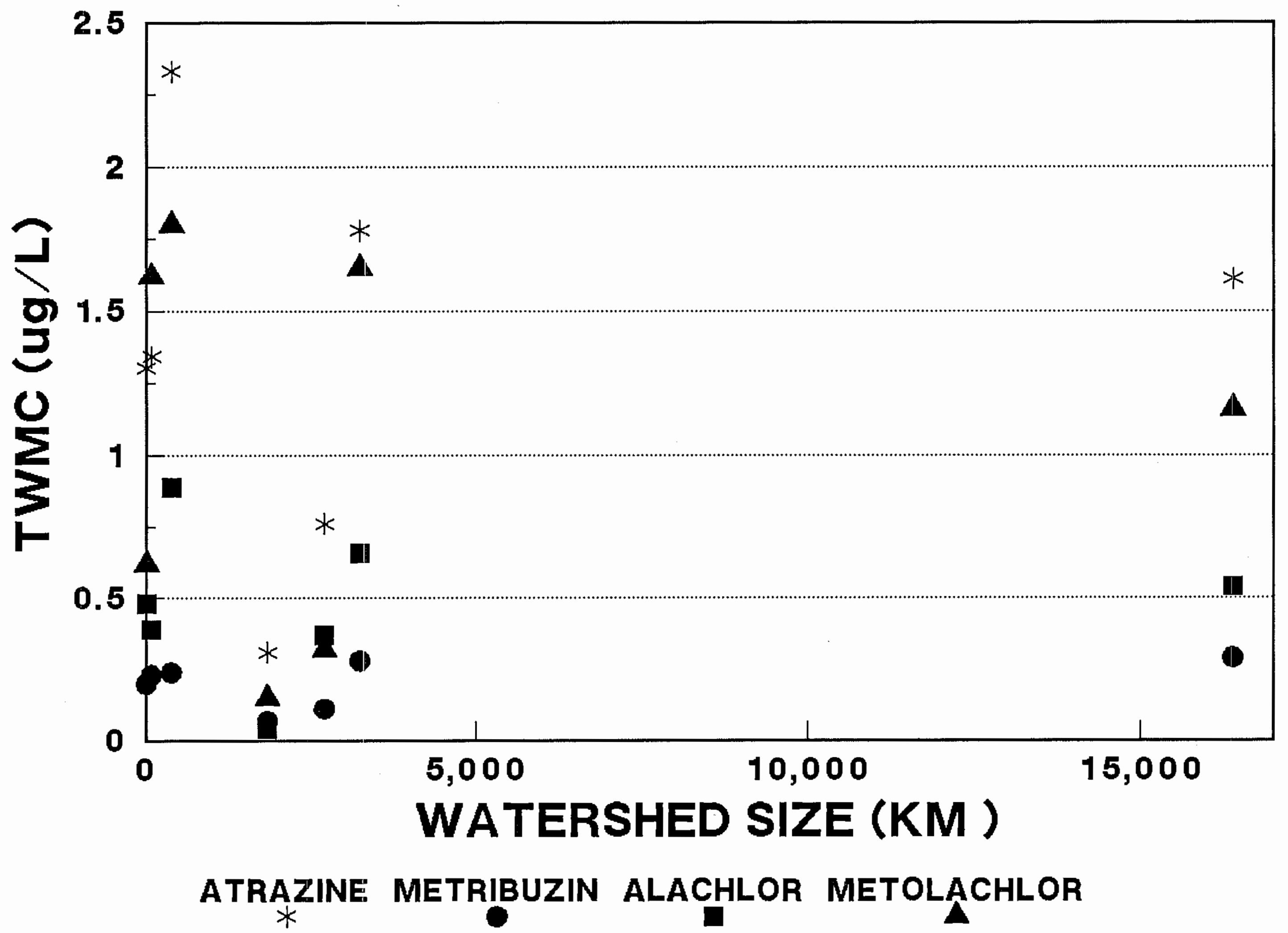

Fig. 22. Relationship of watershed size to Time-weighted mean concentrations of four herbicides in Lake Erie tributary rivers. (from Richards and Baker, 1993).

XI. APPENDICES

APPENDIX I: TEST TUBE VS FLASK VALIDATION DATA
24 HRS

DATE	RANDOM NUMBER CODE	CHEM NAME	DIL	REP	MULT	SENS	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
1-25-94	82	AT	300	1	100	2.84	4.4	1249.6	1183	184	174
1-25-94	30	AT	300	2	100	2.84	3.9	1107.6		163	
1-25-94	68	AT	300	3	100	2.84	4.2	1192.8		175	
1-25-94	62	AT	150	1	100	2.84	4.1	1164.4	1145	171	168
1-25-94	24	AT	150	2	100	2.84	4.2	1192.8		175	
1-25-94	44	AT	150	3	100	2.84	3.8	1079.2		158	
1-25-94	59	AT	75	1	100	2.84	4.4	1249.6	1036	184	152
1-25-94	33	AT	75	2	100	2.84	3.5	994		146	
1-25-94	3	AT	75	3	100	0.9	9.6	864		127	
1-25-94	74	AT	38	1	100	2.84	5.8	1647.2	1316	242	193
1-25-94	64	AT	38	2	100	2.84	4.7	1334.8		196	
1-25-94	38	AT	38	3	100	2.84	3.4	965.6		142	
1-25-94	18	AT	19	1	100	0.9	9.5	855	881	126	129
1-25-94	11	AT	19	2	100	2.84	3.1	880.4		129	
1-25-94	47	AT	19	3	100	2.84	3.2	908.8		133	
1-25-94	8	AT	0	1	100	0.9	6.4	576	681	85	100
1-25-94	23	AT	0	2	100	2.84	3.2	908.8		133	
1-25-94	40	AT	0	3	100	0.9	6.2	558		82	
1-25-94	.	AT-2	300	1	100	2.84	3.9	1107.6	1070	115	111
1-25-94	.	AT-2	300	2	100	2.84	3.8	1079.2		112	
1-25-94	.	AT-2	300	3	100	2.84	3.6	1022.4		106	
1-25-94	.	AT-2	150	1	100	2.84	4	1136	1136	118	118
1-25-94	.	AT-2	150	2	100	2.84	4	1136		118	
1-25-94	.	AT-2	150	3	100	2.84	4	1136		118	
1-25-94	.	AT-2	75	1	100	2.84	4.2	1192.8	1202	124	125
1-25-94	.	AT-2	75	2	100	2.84	4.4	1249.6		129	
1-25-94	.	AT-2	75	3	100	2.84	4.1	1164.4		121	
1-25-94	.	AT-2	38	1	100	2.84	4.2	1192.8	1259	124	130
1-25-94	.	AT-2	38	2	100	2.84	4.5	1278		132	
1-25-94	.	AT-2	38	3	100	2.84	4.6	1306.4		135	
1-25-94	.	AT-2	19	1	100	2.84	4.5	1278	1250	132	129
1-25-94	.	AT-2	19	2	100	2.84	4.2	1192.8		124	
1-25-94	.	AT-2	19	3	100	2.84	4.5	1278		132	
1-25-94	.	AT-2	0	1	100	2.84	3.5	994	966	103	100
1-25-94	.	AT-2	0	2	100	2.84	3.3	937.2		97	
1-25-94	.	AT-2	0	3	100	2.84	3.4	965.6		100	

APPENDIX I: TEST TUBE VS FLASK VALIDATION DATA
48 HRS

DATE	RANDOM NUMBER CODE	CHEM NAME	DIL	REP	MULT	SENS	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
1-26-94	82	AT	300	1	100	2.84	5.8	1647.2	1619	48	47
1-26-94	30	AT	300	2	100	2.84	5.7	1618.8		47	
1-26-94	68	AT	300	3	100	2.84	5.6	1590.4		46	
1-26-94	62	AT	150	1	100	2.84	7.8	2215.2	2102	65	61
1-26-94	24	AT	150	2	100	2.84	7.6	2158.4		63	
1-26-94	44	AT	150	3	100	2.84	6.8	1931.2		56	
1-26-94	59	AT	75	1	100	9.25	3.4	3145	2954	92	86
1-26-94	33	AT	75	2	100	9.25	3.6	3330		97	
1-26-94	3	AT	75	3	100	2.84	8.4	2385.6		70	
1-26-94	74	AT	38	1	100	9.25	3.8	3515	3916	103	114
1-26-94	64	AT	38	2	100	9.25	4.9	4532.5		132	
1-26-94	38	AT	38	3	100	9.25	4	3700		108	
1-26-94	18	AT	19	1	100	9.25	4.4	4070	3823	119	112
1-26-94	11	AT	19	2	100	9.25	3.8	3515		103	
1-26-94	47	AT	19	3	100	9.25	4.2	3885		114	
1-26-94	8	AT	0	1	100	9.25	3.4	3145	3423	92	100
1-26-94	23	AT	0	2	100	9.25	4	3700		108	
1-26-94	40	AT	0	3	100	9.25	3.7	3422.5		100	
1-26-94	.	AT-2	300	1	100	2.84	3.9	1107.6	1108	34	34
1-26-94	.	AT-2	300	2	100	2.84	4	1136		35	
1-26-94	.	AT-2	300	3	100	2.84	3.8	1079.2		33	
1-26-94	.	AT-2	150	1	100	2.84	5.1	1448.4	1458	45	45
1-26-94	.	AT-2	150	2	100	2.84	5.2	1476.8		46	
1-26-94	.	AT-2	150	3	100	2.84	5.1	1448.4		45	
1-26-94	.	AT-2	75	1	100	2.84	7.8	2215.2	2206	68	68
1-26-94	.	AT-2	75	2	100	2.84	7.9	2243.6		69	
1-26-94	.	AT-2	75	3	100	2.84	7.6	2158.4		67	
1-26-94	.	AT-2	38	1	100	2.84	9.2	2612.8	2875	81	89
1-26-94	.	AT-2	38	2	100	9.25	3.3	3052.5		94	
1-26-94	.	AT-2	38	3	100	9.25	3.2	2960		91	
1-26-94	.	AT-2	19	1	100	9.25	3.3	3052.5	3207	94	99
1-26-94	.	AT-2	19	2	100	9.25	3.4	3145		97	
1-26-94	.	AT-2	19	3	100	9.25	3.7	3422.5		106	
1-26-94	.	AT-2	0	1	100	9.25	3.6	3330	3238	103	100
1-26-94	.	AT-2	0	2	100	9.25	3.6	3330		103	
1-26-94	.	AT-2	0	3	100	9.25	3.3	3052.5		94	

APPENDIX I: TEST TUBE VS FLASK VALIDATION DATA
72 HRS

DATE	RANDOM NUMBER CODE	CHEM NAME	DIL	REP	MULT	SENS	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
1-27-94	82	AT	300	1	100	2.84	7	1988	2035	23	24
1-27-94	30	AT	300	2	100	2.84	7.9	2243.6		26	
1-27-94	68	AT	300	3	100	2.84	6.6	1874.4		22	
1-27-94	62	AT	150	1	100	9.25	3.7	3422.5	3268	40	38
1-27-94	24	AT	150	2	100	9.25	3.2	2960		35	
1-27-94	44	AT	150	3	100	9.25	3.7	3422.5		40	
1-27-94	59	AT	75	1	100	9.25	6.4	5920	6074	70	71
1-27-94	33	AT	75	2	100	9.25	7.4	6845		80	
1-27-94	3	AT	75	3	100	9.25	5.9	5457.5		64	
1-27-94	74	AT	38	1	100	9.25	8.6	7955	8715	93	102
1-27-94	64	AT	38	2	100	29.34	3.1	9095.4		107	
1-27-94	38	AT	38	3	100	29.34	3.1	9095.4		107	
1-27-94	18	AT	19	1	100	29.34	3.5	10269	10367	121	122
1-27-94	11	AT	19	2	100	29.34	3.4	9975.6		117	
1-27-94	47	AT	19	3	100	29.34	3.7	10855.8		128	
1-27-94	8	AT	0	1	100	9.25	8.7	8047.5	8510	95	100
1-27-94	23	AT	0	2	100	9.25	10	9250		109	
1-27-94	40	AT	0	3	100	9.25	8.9	8232.5		97	
1-27-94	.	AT-2	300	1	100	2.84	5.6	1590.4	1562	18	17
1-27-94	.	AT-2	300	2	100	2.84	5.6	1590.4		18	
1-27-94	.	AT-2	300	3	100	2.84	5.3	1505.2		17	
1-27-94	.	AT-2	150	1	100	2.84	8.5	2414	2348	27	26
1-27-94	.	AT-2	150	2	100	2.84	8.3	2357.2		26	
1-27-94	.	AT-2	150	3	100	2.84	8	2272		25	
1-27-94	.	AT-2	75	1	100	9.25	5.4	4995	4903	56	54
1-27-94	.	AT-2	75	2	100	9.25	5.5	5087.5		57	
1-27-94	.	AT-2	75	3	100	9.25	5	4625		51	
1-27-94	.	AT-2	38	1	100	9.25	7.5	6937.5	7215	77	80
1-27-94	.	AT-2	38	2	100	9.25	8	7400		82	
1-27-94	.	AT-2	38	3	100	9.25	7.9	7307.5		81	
1-27-94	.	AT-2	19	1	100	29.34	3.2	9388.8	9291	104	103
1-27-94	.	AT-2	19	2	100	29.34	3.1	9095.4		101	
1-27-94	.	AT-2	19	3	100	29.34	3.2	9388.8		104	
1-27-94	.	AT-2	0	1	100	29.34	3.1	8802	8998	98	100
1-27-94	.	AT-2	0	2	100	29.34	3	9095.4		101	
1-27-94	.	AT-2	0	3	100	29.34	3.1	9095.4		101	

APPENDIX I: TEST TUBE VS FLASK VALIDATION DATA
96 HRS

DATE	RANDOM NUMBER CODE	CHEM NAME	DIL	REP	MULT	SENS	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
1-28-94	82	AT	300	1	100	2.84	8.1	2300.4	2263	18	17
1-28-94	30	AT	300	2	100	2.84	8.4	2385.6		18	
1-28-94	68	AT	300	3	100	2.84	7.4	2101.6		16	
1-28-94	62	AT	150	1	100	9.25	4.6	4255	4132	33	32
1-28-94	24	AT	150	2	100	9.25	4	3700		28	
1-28-94	44	AT	150	3	100	9.25	4.8	4440		34	
1-28-94	59	AT	75	1	100	29.34	3	8802	9225	68	71
1-28-94	33	AT	75	2	100	29.34	3.5	10269		79	
1-28-94	3	AT	75	3	100	9.25	9.3	8602.5		66	
1-28-94	74	AT	38	1	100	29.34	4.4	12909.6	14572	99	112
1-28-94	64	AT	38	2	100	29.34	5.1	14963.4		115	
1-28-94	38	AT	38	3	100	29.34	5.4	15843.6		122	
1-28-94	18	AT	19	1	100	29.34	6.8	19951.2	18778	153	144
1-28-94	11	AT	19	2	100	29.34	6.2	18190.8		140	
1-28-94	47	AT	19	3	100	29.34	6.2	18190.8		140	
1-28-94	8	AT	0	1	100	29.34	4.4	12909.6	13007	99	100
1-28-94	23	AT	0	2	100	29.34	4.5	13203		102	
1-28-94	40	AT	0	3	100	29.34	4.4	12909.6		99	
1-28-94	.	AT-2	300	1	100	2.84	5.8	1647.2	1704	10	10
1-28-94	.	AT-2	300	2	100	2.84	6.3	1789.2		11	
1-28-94	.	AT-2	300	3	100	2.84	5.9	1675.6		10	
1-28-94	.	AT-2	150	1	100	9.25	3.5	3237.5	3145	19	19
1-28-94	.	AT-2	150	2	100	9.25	3.4	3145		19	
1-28-94	.	AT-2	150	3	100	9.25	3.3	3052.5		18	
1-28-94	.	AT-2	75	1	100	9.25	8.3	7677.5	7647	46	45
1-28-94	.	AT-2	75	2	100	9.25	8.5	7862.5		47	
1-28-94	.	AT-2	75	3	100	9.25	8	7400		44	
1-28-94	.	AT-2	38	1	100	29.34	4.2	12322.8	12910	73	77
1-28-94	.	AT-2	38	2	100	29.34	4.6	13496.4		80	
1-28-94	.	AT-2	38	3	100	29.34	4.4	12909.6		77	
1-28-94	.	AT-2	19	1	100	29.34	5.8	17017.2	17897	101	106
1-28-94	.	AT-2	19	2	100	29.34	6.1	17897.4		106	
1-28-94	.	AT-2	19	3	100	29.34	6.4	18777.6		112	
1-28-94	.	AT-2	0	1	100	29.34	5.8	17017.2	16822	101	100
1-28-94	.	AT-2	0	2	100	29.34	5.7	16723.8		99	
1-28-94	.	AT-2	0	3	100	29.34	5.7	16723.8		99	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
24 HRS ON CHLORELLA

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
03/01/94	52	CONTROL	0	1	100	0.9	7.3	657	753	87	100
03/01/94	54	CONTROL	0	2	100	0.9	8.8	792		105	
03/01/94	16	CONTROL	0	3	100	0.9	9	810		108	
03/01/94	27	AL	19	1	100	0.9	8.4	756	759	100	101
03/01/94	17	AL	19	2	100	0.9	8.7	783		104	
03/01/94	50	AL	19	3	100	0.9	8.2	738		98	
03/01/94	43	AL	38	1	100	0.9	7.4	666	651	88	86
03/01/94	35	AL	38	2	100	0.9	7.4	666		88	
03/01/94	34	AL	38	3	100	0.9	6.9	621		82	
03/01/94	22	AL	75	1	100	0.9	7.5	675	573	90	76
03/01/94	2	AL	75	2	100	0.9	6.2	558		74	
03/01/94	41	AL	75	3	100	0.9	5.4	486		65	
03/01/94	28	AL	150	1	100	0.9	5.2	468	519	62	69
03/01/94	59	AL	150	2	100	0.9	6.1	549		73	
03/01/94	40	AL	150	3	100	0.9	6	540		72	
03/01/94	19	AL	300	1	100	0.9	5.7	513	522	68	69
03/01/94	61	AL	300	2	100	0.9	5.9	531		71	
03/01/94	55	AL	300	3	100	0.9	5.8	522		69	
03/01/94	46	AT	19	1	100	2.84	4.7	1334.8	1344	177	179
03/01/94	12	AT	19	2	100	2.84	4.9	1391.6		185	
03/01/94	44	AT	19	3	100	2.84	4.6	1306.4		173	
03/01/94	20	AT	38	1	100	2.84	5.1	1448.4	1382	192	184
03/01/94	36	AT	38	2	100	2.84	4.9	1391.6		185	
03/01/94	9	AT	38	3	100	2.84	4.6	1306.4		173	
03/01/94	32	AT	75	1	100	2.84	4	1136	1325	151	176
03/01/94	29	AT	75	2	100	2.84	4.4	1249.6		166	
03/01/94	26	AT	75	3	100	2.84	5.6	1590.4		211	
03/01/94	10	AT	150	1	100	2.84	4.9	1391.6	1382	185	184
03/01/94	45	AT	150	2	100	2.84	4.5	1278		170	
03/01/94	56	AT	150	3	100	2.84	5.2	1476.8		196	
03/01/94	11	AT	300	1	100	2.84	4.6	1306.4	1363	173	181
03/01/94	30	AT	300	2	100	2.84	4.9	1391.6		185	
03/01/94	37	AT	300	3	100	2.84	4.9	1391.6		185	
03/01/94	38	MB	19	1	100	2.84	5.1	1448.4	1344	192	179
03/01/94	33	MB	19	2	100	2.84	5	1420		189	
03/01/94	4	MB	19	3	100	2.84	4.1	1164.4		155	
03/01/94	8	MB	38	1	100	2.84	4.6	1306.4	1363	173	181
03/01/94	31	MB	38	2	100	2.84	4.8	1363.2		181	
03/01/94	14	MB	38	3	100	2.84	5	1420		189	
03/01/94	42	MB	75	1	100	2.84	4.7	1334.8	1297	177	172
03/01/94	49	MB	75	2	100	2.84	4.4	1249.6		166	
03/01/94	53	MB	75	3	100	2.84	4.6	1306.4		173	
03/01/94	39	MB	150	1	100	2.84	4.7	1334.8	1373	177	182
03/01/94	7	MB	150	2	100	2.84	4.6	1306.4		173	
03/01/94	25	MB	150	3	100	2.84	5.2	1476.8		196	
03/01/94	24	MB	300	1	100	2.84	4.5	1278	1145	170	152
03/01/94	3	MB	300	2	100	2.84	3.7	1050.8		140	
03/01/94	6	MB	300	3	100	2.84	3.9	1107.6		147	
03/01/94	21	ML	19	1	100	2.84	3	852	827	113	110
03/01/94	48	ML	19	2	100	0.9	8.6	774		103	
03/01/94	56	ML	19	3	100	0.9	9.5	855		114	
03/01/94	1	ML	38	1	100	0.9	7.4	666	771	88	102
03/01/94	51	ML	38	2	100	0.9	9.1	819		109	
03/01/94	15	ML	38	3	100	0.9	9.2	828		110	
03/01/94	60	ML	75	1	100	2.84	3.7	1050.8	881	140	117
03/01/94	23	ML	75	2	100	0.9	9.3	837		111	
03/01/94	63	ML	75	3	100	0.9	8.4	756		100	
03/01/94	5	ML	150	1	100	0.9	8.1	729	1329	97	176
03/01/94	57	ML	150	2	100	2.84	9	2556		339	
03/01/94	47	ML	150	3	100	0.9	7.8	702		93	
03/01/94	18	ML	300	1	100	0.9	8.6	774	762	103	101
03/01/94	13	ML	300	2	100	0.9	8.4	756		100	
03/01/94	62	ML	300	3	100	0.9	8.4	756		100	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA

48 HRS ON CHLORELLA

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
03/02/94	52	CONTROL	0	1	100	2.84	9.4	2669.6	2480	108	100
03/02/94	54	CONTROL	0	2	100	2.84	9.1	2584.4		104	
03/02/94	16	CONTROL	0	3	100	2.84	7.7	2186.8		88	
03/02/94	27	AL	19	1	100	2.84	8.4	2385.6	2253	96	91
03/02/94	17	AL	19	2	100	2.84	6.8	1931.2		78	
03/02/94	50	AL	19	3	100	2.84	8.6	2442.4		98	
03/02/94	43	AL	38	1	100	2.84	5.6	1590.4	1553	64	63
03/02/94	35	AL	38	2	100	2.84	5.8	1647.2		66	
03/02/94	34	AL	38	3	100	2.84	5	1420		57	
03/02/94	22	AL	75	1	100	2.84	3.4	965.6	892	39	36
03/02/94	2	AL	75	2	100	0.9	8.9	801		32	
03/02/94	41	AL	75	3	100	2.84	3.2	908.8		37	
03/02/94	28	AL	150	1	100	2.84	3.2	908.8	804	37	32
03/02/94	59	AL	150	2	100	0.9	9.2	828		33	
03/02/94	40	AL	150	3	100	0.9	7.5	675		27	
03/02/94	19	AL	300	1	100	0.9	6.8	612	765	25	31
03/02/94	61	AL	300	2	100	2.84	3.2	908.8		37	
03/02/94	55	AL	300	3	100	0.9	8.6	774		31	
03/02/94	46	AT	19	1	100	9.25	3.4	3145	3193	127	129
03/02/94	12	AT	19	2	100	2.84	8	2272		92	
03/02/94	44	AT	19	3	100	9.25	4.5	4162.5		168	
03/02/94	20	AT	38	1	100	2.84	7.8	2215.2	2158	89	87
03/02/94	36	AT	38	2	100	2.84	8	2272		92	
03/02/94	9	AT	38	3	100	2.84	7	1988		80	
03/02/94	32	AT	75	1	100	2.84	6	1704	1647	69	66
03/02/94	29	AT	75	2	100	2.84	5.8	1647.2		66	
03/02/94	26	AT	75	3	100	2.84	5.6	1590.4		64	
03/02/94	10	AT	150	1	100	2.84	3.1	880.4	1439	35	58
03/02/94	45	AT	150	2	100	2.84	4.9	1391.6		56	
03/02/94	58	AT	150	3	100	2.84	7.2	2044.8		82	
03/02/94	11	AT	300	1	100	2.84	3.2	908.8	1231	37	50
03/02/94	30	AT	300	2	100	2.84	5.2	1476.8		60	
03/02/94	37	AT	300	3	100	2.84	4.6	1306.4		53	
03/02/94	38	MB	19	1	100	2.84	5.9	1675.6	1562	68	63
03/02/94	33	MB	19	2	100	2.84	6.2	1760.8		71	
03/02/94	4	MB	19	3	100	2.84	4.4	1249.6		50	
03/02/94	8	MB	38	1	100	2.84	5.4	1533.6	1439	62	58
03/02/94	31	MB	38	2	100	2.84	5.4	1533.6		62	
03/02/94	14	MB	38	3	100	2.84	4.4	1249.6		50	
03/02/94	42	MB	75	1	100	2.84	5	1420	1145	57	46
03/02/94	49	MB	75	2	100	2.84	3.7	1050.8		42	
03/02/94	53	MB	75	3	100	2.84	3.4	965.6		39	
03/02/94	39	MB	150	1	100	0.9	8	720	738	29	30
03/02/94	7	MB	150	2	100	0.9	7.8	702		28	
03/02/94	25	MB	150	3	100	0.9	8.8	792		32	
03/02/94	24	MB	300	1	100	2.84	3.8	1079.2	816	44	33
03/02/94	3	MB	300	2	100	0.9	6.2	558		22	
03/02/94	6	MB	300	3	100	0.9	9	810		33	
03/02/94	21	ML	19	1	100	2.84	8.8	2499.2	2646	101	107
03/02/94	48	ML	19	2	100	2.84	9.7	2754.8		111	
03/02/94	56	ML	19	3	100	9.25	2.9	2682.5		108	
03/02/94	1	ML	38	1	100	2.84	7.2	2044.8	2433	82	98
03/02/94	51	ML	38	2	100	2.84	9	2556		103	
03/02/94	15	ML	38	3	100	2.84	9.5	2698		109	
03/02/94	60	ML	75	1	100	9.25	3.6	3330	2795	134	113
03/02/94	23	ML	75	2	100	2.84	9.2	2612.8		105	
03/02/94	63	ML	75	3	100	2.84	8.6	2442.4		98	
03/02/94	5	ML	150	1	100	2.84	7.5	2130	2054	86	83
03/02/94	57	ML	150	2	100	2.84	7.2	2044.8		82	
03/02/94	47	ML	150	3	100	2.84	7	1988		80	
03/02/94	18	ML	300	1	100	2.84	4	1136	1193	46	48
03/02/94	13	ML	300	2	100	2.84	3.8	1079.2		44	
03/02/94	62	ML	300	3	100	2.84	4.8	1363.2		55	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
72 HRS ON CHLORELLA

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
03/03/94	52	CONTROL	0	1	100	9.25	3.9	3607.5	3916	92	100
03/03/94	54	CONTROL	0	2	100	9.25	4.6	4255		109	
03/03/94	18	CONTROL	0	3	100	9.25	4.2	3885		99	
03/03/94	27	AL	19	1	100	9.25	2.8	2590	2806	66	72
03/03/94	17	AL	19	2	100	9.25	3.1	2867.5		73	
03/03/94	50	AL	19	3	100	9.25	3.2	2960		76	
03/03/94	43	AL	38	1	100	0.9	9.4	846	1115	22	28
03/03/94	35	AL	38	2	100	2.84	4.6	1306.4		33	
03/03/94	34	AL	38	3	100	2.84	4.2	1192.8		30	
03/03/94	22	AL	75	1	100	2.84	3.5	994	913	25	23
03/03/94	2	AL	75	2	100	2.84	3.2	908.8		23	
03/03/94	41	AL	75	3	100	0.9	9.3	837		21	
03/03/94	28	AL	150	1	100	2.84	3.4	965.6	802	25	20
03/03/94	59	AL	150	2	100	0.9	9.4	846		22	
03/03/94	40	AL	150	3	100	0.9	6.6	594		15	
03/03/94	19	AL	300	1	100	0.9	7.5	675	663	17	17
03/03/94	61	AL	300	2	100	0.9	8.2	738		19	
03/03/94	55	AL	300	3	100	0.9	6.4	576		15	
03/03/94	46	AT	19	1	100	9.25	4.7	4347.5	4317	111	110
03/03/94	12	AT	19	2	100	9.25	4.5	4162.5		106	
03/03/94	44	AT	19	3	100	9.25	4.8	4440		113	
03/03/94	20	AT	38	1	100	9.25	3.2	2960	2806	76	72
03/03/94	36	AT	38	2	100	9.25	2.9	2682.5		69	
03/03/94	9	AT	38	3	100	9.25	3	2775		71	
03/03/94	32	AT	75	1	100	2.84	6.2	1760.8	1857	45	47
03/03/94	29	AT	75	2	100	2.84	5.6	1590.4		41	
03/03/94	26	AT	75	3	100	9.25	2.4	2220		57	
03/03/94	10	AT	150	1	100	2.84	4.6	1306.4	1212	33	31
03/03/94	45	AT	150	2	100	2.84	3.6	1022.4		26	
03/03/94	58	AT	150	3	100	2.84	4.6	1306.4		33	
03/03/94	11	AT	300	1	100	2.84	3.2	908.8	918	23	23
03/03/94	30	AT	300	2	100	2.84	3.3	937.2		24	
03/03/94	37	AT	300	3	100	2.84	3.2	908.8		23	
03/03/94	38	MB	19	1	100	9.25	2.5	2312.5	2141	59	55
03/03/94	33	MB	19	2	100	9.25	2.6	2405		61	
03/03/94	4	MB	19	3	100	2.84	6	1704		44	
03/03/94	8	MB	38	1	100	2.84	5	1420	1553	36	40
03/03/94	31	MB	38	2	100	2.84	4.8	1363.2		35	
03/03/94	14	MB	38	3	100	2.84	6.6	1874.4		48	
03/03/94	42	MB	75	1	100	2.84	3	852	843	22	22
03/03/94	49	MB	75	2	100	0.9	7.9	711		18	
03/03/94	53	MB	75	3	100	2.84	3.4	965.6		25	
03/03/94	39	MB	150	1	100	0.9	6.7	603	618	15	16
03/03/94	7	MB	150	2	100	0.9	7.9	711		18	
03/03/94	25	MB	150	3	100	0.9	6	540		14	
03/03/94	24	MB	300	1	100	0.9	9.3	837	654	21	17
03/03/94	3	MB	300	2	100	0.9	5.6	504		13	
03/03/94	6	MB	300	3	100	0.9	6.9	621		16	
03/03/94	21	ML	19	1	100	9.25	4.2	3885	3793	99	97
03/03/94	48	ML	19	2	100	9.25	3.8	3515		90	
03/03/94	56	ML	19	3	100	9.25	4.3	3977.5		102	
03/03/94	1	ML	38	1	100	9.25	3.2	2960	3515	76	90
03/03/94	51	ML	38	2	100	9.25	3.6	3330		85	
03/03/94	15	ML	38	3	100	9.25	4.6	4255		109	
03/03/94	60	ML	75	1	100	9.25	5	4625	4317	118	110
03/03/94	23	ML	75	2	100	9.25	5.2	4810		123	
03/03/94	63	ML	75	3	100	9.25	3.8	3515		90	
03/03/94	5	ML	150	1	100	2.84	5.9	1675.6	1827	43	47
03/03/94	57	ML	150	2	100	2.84	7	1988		51	
03/03/94	47	ML	150	3	100	2.84	6.4	1817.6		46	
03/03/94	16	ML	300	1	100	2.84	3.9	1107.6	1032	28	26
03/03/94	13	ML	300	2	100	2.84	3.4	965.6		25	
03/03/94	62	ML	300	3	100	2.84	3.6	1022.4		26	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
96 HRS ON CHLORELLA

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
03/04/94	52	CONTROL	0	1	100	29.34	3	8802	9682	91	100
03/04/94	54	CONTROL	0	2	100	29.34	3.8	11149.2		115	
03/04/94	16	CONTROL	0	3	100	29.34	3.1	9095.4		94	
03/04/94	27	AL	19	1	100	29.34	2.2	6454.8	7147	67	74
03/04/94	17	AL	19	2	100	9.25	7.4	6845		71	
03/04/94	50	AL	19	3	100	9.25	8.8	8140		84	
03/04/94	43	AL	38	1	100	9.25	3	2775	2991	29	31
03/04/94	35	AL	38	2	100	9.25	3.8	3515		36	
03/04/94	34	AL	38	3	100	9.25	2.9	2682.5		28	
03/04/94	22	AL	75	1	100	2.84	7	1988	2111	21	22
03/04/94	2	AL	75	2	100	2.84	6.9	1959.6		20	
03/04/94	41	AL	75	3	100	2.84	8.4	2385.6		25	
03/04/94	28	AL	150	1	100	2.84	5.2	1476.8	1571	15	16
03/04/94	59	AL	150	2	100	2.84	5.6	1590.4		16	
03/04/94	40	AL	150	3	100	2.84	5.8	1647.2		17	
03/04/94	19	AL	300	1	100	2.84	3.4	965.6	1136	10	12
03/04/94	61	AL	300	2	100	2.84	4.4	1249.6		13	
03/04/94	55	AL	300	3	100	2.84	4.2	1192.8		12	
03/04/94	46	AT	19	1	100	29.34	4.1	12029.4	11540	124	119
03/04/94	12	AT	19	2	100	29.34	3.9	11442.6		118	
03/04/94	44	AT	19	3	100	29.34	3.8	11149.2		115	
03/04/94	20	AT	38	1	100	29.34	2.8	8215.2	8293	85	86
03/04/94	36	AT	38	2	100	9.25	8.5	7862.5		81	
03/04/94	9	AT	38	3	100	29.34	3	8802		91	
03/04/94	32	AT	75	1	100	9.25	6.6	6105	6134	63	63
03/04/94	29	AT	75	2	100	9.25	6	5550		57	
03/04/94	26	AT	75	3	100	29.34	2.3	6748.2		70	
03/04/94	10	AT	150	1	100	9.25	3.4	3145	3268	32	34
03/04/94	45	AT	150	2	100	9.25	3.9	3607.5		37	
03/04/94	58	AT	150	3	100	9.25	3.3	3052.5		32	
03/04/94	11	AT	300	1	100	2.84	6.6	1874.4	1808	19	19
03/04/94	30	AT	300	2	100	2.84	6.2	1760.8		18	
03/04/94	37	AT	300	3	100	2.84	6.3	1789.2		18	
03/04/94	38	MB	19	1	100	29.34	2.2	6454.8	6746	67	70
03/04/94	33	MB	19	2	100	9.25	7.9	7307.5		75	
03/04/94	4	MB	19	3	100	9.25	7	6475		67	
03/04/94	6	MB	38	1	100	9.25	4.1	3792.5	4101	39	42
03/04/94	31	MB	38	2	100	9.25	4.4	4070		42	
03/04/94	14	MB	38	3	100	9.25	4.8	4440		46	
03/04/94	42	MB	75	1	100	9.25	2.9	2682.5	2498	28	26
03/04/94	49	MB	75	2	100	9.25	3	2775		29	
03/04/94	53	MB	75	3	100	9.25	2.2	2035		21	
03/04/94	39	MB	150	1	100	2.84	4.2	1192.8	1316	12	14
03/04/94	7	MB	150	2	100	2.84	4.8	1363.2		14	
03/04/94	25	MB	150	3	100	2.84	4.9	1391.6		14	
03/04/94	24	MB	300	1	100	2.84	4.8	1363.2	1138	14	12
03/04/94	3	MB	300	2	100	2.84	4.4	1249.6		13	
03/04/94	8	MB	300	3	100	0.9	8.9	801		8	
03/04/94	21	ML	19	1	100	29.34	3.1	9095.4	9878	94	102
03/04/94	48	ML	19	2	100	29.34	3.4	9975.6		103	
03/04/94	56	ML	19	3	100	29.34	3.6	10562.4		109	
03/04/94	1	ML	38	1	100	29.34	2.6	7628.4	8802	79	91
03/04/94	51	ML	38	2	100	29.34	3	8802		91	
03/04/94	15	ML	38	3	100	29.34	3.4	9975.6		103	
03/04/94	60	ML	75	1	100	29.34	3.3	9682.2	9487	100	98
03/04/94	23	ML	75	2	100	29.34	3.6	10562.4		109	
03/04/94	63	ML	75	3	100	29.34	2.8	8215.2		85	
03/04/94	5	ML	150	1	100	9.25	4.8	4440	5612	46	58
03/04/94	57	ML	150	2	100	9.25	6.8	6290		65	
03/04/94	47	ML	150	3	100	9.25	6.6	6105		63	
03/04/94	18	ML	300	1	100	9.25	2.4	2220	2218	23	23
03/04/94	13	ML	300	2	100	9.25	2.4	2220		23	
03/04/94	62	ML	300	3	100	2.84	7.8	2215.2		23	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
24 HRS ON CHLAM

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/08/94	55	C	0	1	100	2.84	6.6	1874.4	1817.6	103.1	100.0
03/08/94	12	C	0	2	100	2.84	6.4	1817.6		100.0	
03/08/94	96	C	0	3	100	2.84	6.2	1760.8		96.9	
03/08/94	80	AL	38	1	100	2.84	5.4	1533.6	1618.8	84.4	89.1
03/08/94	41	AL	38	2	100	2.84	5.9	1675.6		92.2	
03/08/94	95	AL	38	3	100	2.84	5.8	1647.2		90.6	
03/08/94	115	AL	75	1	100	2.84	5.8	1647.2	1647.2	90.6	90.6
03/08/94	51	AL	75	2	100	2.84	6	1704.0		93.8	
03/08/94	61	AL	75	3	100	2.84	5.6	1590.4		87.5	
03/08/94	93	AL	150	1	100	2.84	5.9	1675.6	1675.6	92.2	92.2
03/08/94	94	AL	150	2	100	2.84	5.9	1675.6		92.2	
03/08/94	20	AL	150	3	100	2.84	5.9	1675.6		92.2	
03/08/94	127	AL	300	1	100	2.84	5.8	1647.2	1741.9	90.6	95.8
03/08/94	48	AL	300	2	100	2.84	6.2	1760.8		96.9	
03/08/94	22	AL	300	3	100	2.84	6.4	1817.6		100.0	
03/08/94	1	AL	600	1	100	2.84	5.8	1647.2	1666.1	90.6	91.7
03/08/94	121	AL	600	2	100	2.84	5.7	1618.8		89.1	
03/08/94	31	AL	600	3	100	2.84	6.1	1732.4		95.3	
03/08/94	16	AT	19	1	100	9.25	3.4	3145.0	2896.5	173.0	159.4
03/08/94	100	AT	19	2	100	9.25	3.2	2960.0		162.9	
03/08/94	84	AT	19	3	100	2.84	9.1	2584.4		142.2	
03/08/94	63	AT	38	1	100	9.25	3.6	3330.0	3330.0	183.2	183.2
03/08/94	56	AT	38	2	100	9.25	3.4	3145.0		173.0	
03/08/94	109	AT	38	3	100	9.25	3.8	3515.0		193.4	
03/08/94	90	AT	75	1	100	9.25	3.6	3330.0	3607.5	183.2	198.5
03/08/94	91	AT	75	2	100	9.25	4.1	3792.5		208.7	
03/08/94	92	AT	75	3	100	9.25	4	3700.0		203.6	
03/08/94	98	AT	150	1	100	9.25	3.8	3515.0	3607.5	193.4	198.5
03/08/94	111	AT	150	2	100	9.25	4	3700.0		203.6	
03/08/94	108	AT	150	3	100	9.25	3.9	3607.5		198.5	
03/08/94	118	AT	300	1	100	9.25	3.6	3330.0	3453.3	183.2	190.0
03/08/94	42	AT	300	2	100	9.25	3.8	3515.0		193.4	
03/08/94	69	AT	300	3	100	9.25	3.8	3515.0		193.4	
03/08/94	65	MB	38	1	100	9.25	4.2	3885.0	3792.5	213.7	208.7
03/08/94	116	MB	38	2	100	9.25	4.1	3792.5		208.7	
03/08/94	107	MB	38	3	100	9.25	4	3700.0		203.6	
03/08/94	36	MB	75	1	100	9.25	3.6	3330.0	3330.0	183.2	183.2
03/08/94	62	MB	75	2	100	9.25	3.6	3330.0		183.2	
03/08/94	50	MB	75	3	100	9.25	3.6	3330.0		183.2	
03/08/94	64	MB	150	1	100	9.25	3.6	3330.0	3422.5	183.2	188.3
03/08/94	15	MB	150	2	100	9.25	3.8	3515.0		193.4	
03/08/94	101	MB	150	3	100	9.25	3.7	3422.5		188.3	
03/08/94	5	MB	300	1	100	9.25	3.4	3145.0	3083.3	173.0	169.6
03/08/94	57	MB	300	2	100	9.25	3.3	3052.5		167.9	
03/08/94	52	MB	300	3	100	9.25	3.3	3052.5		167.9	
03/08/94	112	MB	600	1	100	9.25	3.2	2960.0	3052.5	162.9	167.9
03/08/94	117	MB	600	2	100	9.25	3.4	3145.0		173.0	
03/08/94	113	MB	600	3	100	9.25	3.3	3052.5		167.9	
03/08/94	79	ML	188	1	100	2.84	6	1704.0	1779.7	93.8	97.9
03/08/94	75	ML	188	2	100	2.84	6.4	1817.6		100.0	
03/08/94	26	ML	188	3	100	2.84	6.4	1817.6		100.0	
03/08/94	2	ML	375	1	100	2.84	6	1704.0	1656.7	93.8	91.1
03/08/94	45	ML	375	2	100	2.84	5.7	1618.8		89.1	
03/08/94	28	ML	375	3	100	2.84	5.8	1647.2		90.6	
03/08/94	70	ML	750	1	100	2.84	5.8	1647.2	1656.7	90.6	91.1
03/08/94	71	ML	750	2	100	2.84	5.7	1618.8		89.1	
03/08/94	13	ML	750	3	100	2.84	6	1704.0		93.8	
03/08/94	10	ML	1500	1	100	2.84	5.5	1562.0	1599.9	85.9	88.0
03/08/94	61	ML	1500	2	100	2.84	5.2	1476.8		81.3	
03/08/94	66	ML	1500	3	100	2.84	6.2	1760.8		96.9	
03/08/94	76	ML	3000	1	100	2.84	5.3	1505.2	1637.7	82.8	90.1
03/08/94	35	ML	3000	2	100	2.84	6	1704.0		93.8	
03/08/94	32	ML	3000	3	100	2.84	6	1704.0		93.8	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA

48 HRS ON CHLAM

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/09/94	55	C	0	1	100	9.25	6	5550.0	5426.7	102.3	100.0
03/09/94	12	C	0	2	100	9.25	6	5550.0		102.3	
03/09/94	96	C	0	3	100	9.25	5.6	5180.0		95.5	
03/09/94	80	AL	38	1	100	9.25	4.8	4440.0	4563.3	81.8	84.1
03/09/94	41	AL	38	2	100	9.25	5.2	4810.0		88.6	
03/09/94	95	AL	38	3	100	9.25	4.8	4440.0		81.8	
03/09/94	115	AL	75	1	100	9.25	4.4	4070.0	4285.8	75.0	79.0
03/09/94	51	AL	75	2	100	9.25	4.5	4162.5		76.7	
03/09/94	81	AL	75	3	100	9.25	5	4625.0		85.2	
03/09/94	93	AL	150	1	100	9.25	4	3700.0	3823.3	68.2	70.5
03/09/94	94	AL	150	2	100	9.25	4.2	3885.0		71.6	
03/09/94	20	AL	150	3	100	9.25	4.2	3885.0		71.6	
03/09/94	127	AL	300	1	100	9.25	3.6	3330.0	3453.3	61.4	63.6
03/09/94	48	AL	300	2	100	9.25	3.8	3515.0		64.8	
03/09/94	22	AL	300	3	100	9.25	3.8	3515.0		64.8	
03/09/94	1	AL	600	1	100	9.25	2.7	2497.5	2651.7	46.0	48.9
03/09/94	121	AL	600	2	100	9.25	3.1	2867.5		52.8	
03/09/94	31	AL	600	3	100	9.25	2.8	2590.0		47.7	
03/09/94	16	AT	19	1	100	9.25	8.4	7770.0	7307.5	143.2	134.7
03/09/94	100	AT	19	2	100	9.25	7.7	7122.5		131.3	
03/09/94	84	AT	19	3	100	9.25	7.6	7030.0		129.5	
03/09/94	83	AT	38	1	100	9.25	7.2	6660.0	6382.5	122.7	117.6
03/09/94	56	AT	38	2	100	9.25	6.8	6290.0		115.9	
03/09/94	109	AT	38	3	100	9.25	6.7	6197.5		114.2	
03/09/94	90	AT	75	1	100	9.25	5.4	4995.0	5241.7	92.0	96.6
03/09/94	91	AT	75	2	100	9.25	5.9	5457.5		100.6	
03/09/94	92	AT	75	3	100	9.25	5.7	5272.5		97.2	
03/09/94	98	AT	150	1	100	9.25	4.4	4070.0	4070.0	75.0	75.0
03/09/94	111	AT	150	2	100	9.25	4.5	4162.5		76.7	
03/09/94	108	AT	150	3	100	9.25	4.3	3977.5		73.3	
03/09/94	118	AT	300	1	100	9.25	3.3	3052.5	3422.5	56.3	63.1
03/09/94	42	AT	300	2	100	9.25	4	3700.0		68.2	
03/09/94	89	AT	300	3	100	9.25	3.8	3515.0		64.8	
03/09/94	85	MB	38	1	100	9.25	4.3	3977.5	3669.2	73.3	67.6
03/09/94	116	MB	38	2	100	9.25	3.6	3330.0		61.4	
03/09/94	107	MB	38	3	100	9.25	4	3700.0		68.2	
03/09/94	38	MB	75	1	100	9.25	3.4	3145.0	3052.5	58.0	56.3
03/09/94	82	MB	75	2	100	9.25	3.2	2960.0		54.5	
03/09/94	50	MB	75	3	100	9.25	3.3	3052.5		56.3	
03/09/94	64	MB	150	1	100	9.25	3.1	2867.5	3114.2	52.8	57.4
03/09/94	15	MB	150	2	100	9.25	3.6	3330.0		61.4	
03/09/94	101	MB	150	3	100	9.25	3.4	3145.0		58.0	
03/09/94	5	MB	300	1	100	2.84	9.2	2612.8	2597.6	48.1	47.9
03/09/94	57	MB	300	2	100	9.25	2.8	2590.0		47.7	
03/09/94	52	MB	300	3	100	9.25	2.8	2590.0		47.7	
03/09/94	112	MB	600	1	100	9.25	2.4	2220.0	2312.5	40.9	42.6
03/09/94	117	MB	600	2	100	9.25	2.5	2312.5		42.6	
03/09/94	113	MB	600	3	100	9.25	2.6	2405.0		44.3	
03/09/94	79	ML	188	1	100	9.25	4.7	4347.5	4655.8	80.1	85.8
03/09/94	75	ML	188	2	100	9.25	5	4625.0		85.2	
03/09/94	26	ML	188	3	100	9.25	5.4	4995.0		92.0	
03/09/94	2	ML	375	1	100	9.25	4.4	4070.0	4039.2	75.0	74.4
03/09/94	45	ML	375	2	100	9.25	4.5	4162.5		76.7	
03/09/94	28	ML	375	3	100	9.25	4.2	3885.0		71.6	
03/09/94	70	ML	750	1	100	9.25	3.9	3607.5	3484.2	66.5	64.2
03/09/94	71	ML	750	2	100	9.25	3.6	3330.0		61.4	
03/09/94	13	ML	750	3	100	9.25	3.8	3515.0		64.8	
03/09/94	10	ML	1500	1	100	9.25	2.8	2590.0	2867.5	47.7	52.8
03/09/94	61	ML	1500	2	100	9.25	3.2	2960.0		54.5	
03/09/94	68	ML	1500	3	100	9.25	3.3	3052.5		56.3	
03/09/94	76	ML	3000	1	100	9.25	2.5	2312.5	2405.0	42.6	44.3
03/09/94	35	ML	3000	2	100	9.25	2.7	2497.5		46.0	
03/09/94	32	ML	3000	3	100	9.25	2.6	2405.0		44.3	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
72 HRS ON CHLAM

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/10/94	55	CONTROL	0	1	100	29.34	2.9	8508.6	8108.7	104.9	100.0
03/10/94	12	CONTROL	0	2	100	9.25	8.3	7677.5		94.7	
03/10/94	96	CONTROL	0	3	100	9.25	8.8	8140.0		100.4	
03/10/94	80	AL	38	1	100	9.25	7.4	6845.0	7523.3	84.4	92.8
03/10/94	41	AL	38	2	100	9.25	8.6	7955.0		98.1	
03/10/94	95	AL	38	3	100	9.25	8.4	7770.0		95.8	
03/10/94	115	AL	75	1	100	9.25	6.8	6290.0	6475.0	77.6	79.9
03/10/94	51	AL	75	2	100	9.25	7.4	6845.0		84.4	
03/10/94	61	AL	75	3	100	9.25	6.8	6290.0		77.6	
03/10/94	93	AL	150	1	100	9.25	6.6	6105.0	6105.0	75.3	75.3
03/10/94	94	AL	150	2	100	9.25	7.1	6567.5		81.0	
03/10/94	20	AL	150	3	100	9.25	6.1	5642.5		69.6	
03/10/94	127	AL	300	1	100	9.25	5	4625.0	4655.8	57.0	57.4
03/10/94	48	AL	300	2	100	9.25	5.6	5180.0		63.9	
03/10/94	22	AL	300	3	100	9.25	4.5	4162.5		51.3	
03/10/94	1	AL	600	1	100	2.84	6.2	1760.8	2044.8	21.7	25.2
03/10/94	121	AL	600	2	100	2.84	7.8	2215.2		27.3	
03/10/94	31	AL	600	3	100	2.84	7.6	2158.4		26.6	
03/10/94	18	AT	19	1	100	29.34	3.8	11149.2	11051.4	137.5	136.3
03/10/94	100	AT	19	2	100	29.34	3.7	10855.8		133.9	
03/10/94	84	AT	19	3	100	29.34	3.8	11149.2		137.5	
03/10/94	83	AT	38	1	100	29.34	3.5	10269.0	9877.8	126.6	121.8
03/10/94	56	AT	38	2	100	29.34	3.4	9975.6		123.0	
03/10/94	109	AT	38	3	100	29.34	3.2	9388.8		115.8	
03/10/94	90	AT	75	1	100	9.25	7.6	7030.0	7307.5	86.7	90.1
03/10/94	91	AT	75	2	100	9.25	8	7400.0		91.3	
03/10/94	92	AT	75	3	100	9.25	8.1	7492.5		92.4	
03/10/94	98	AT	150	1	100	9.25	4.9	4532.5	4378.3	55.9	54.0
03/10/94	111	AT	150	2	100	9.25	4.8	4440.0		54.8	
03/10/94	106	AT	150	3	100	9.25	4.5	4162.5		51.3	
03/10/94	116	AT	300	1	100	9.25	3.3	3052.5	3268.3	37.6	40.3
03/10/94	42	AT	300	2	100	9.25	3.6	3330.0		41.1	
03/10/94	89	AT	300	3	100	9.25	3.7	3422.5		42.2	
03/10/94	65	MB	38	1	100	9.25	4.6	4255.0	3761.7	52.5	46.4
03/10/94	118	MB	38	2	100	9.25	3.8	3515.0		43.3	
03/10/94	107	MB	38	3	100	9.25	3.8	3515.0		43.3	
03/10/94	36	MB	75	1	100	9.25	3.2	2960.0	3083.3	36.5	38.0
03/10/94	82	MB	75	2	100	9.25	3.5	3237.5		39.9	
03/10/94	50	MB	75	3	100	9.25	3.3	3052.5		37.6	
03/10/94	64	MB	150	1	100	9.25	3	2775.0	2690.1	34.2	33.2
03/10/94	15	MB	150	2	100	9.25	2.9	2682.5		33.1	
03/10/94	101	MB	150	3	100	2.84	9.2	2612.8		32.2	
03/10/94	5	MB	300	1	100	2.84	8	2272.0	1772.7	28.0	21.9
03/10/94	57	MB	300	2	100	2.84	8	2272.0		28.0	
03/10/94	52	MB	300	3	100	0.9	8.6	774.0		9.5	
03/10/94	112	MB	600	1	100	2.84	6.3	1789.2	1846.0	22.1	22.8
03/10/94	117	MB	600	2	100	2.84	6.6	1874.4		23.1	
03/10/94	113	MB	600	3	100	2.84	6.6	1874.4		23.1	
03/10/94	79	ML	188	1	100	9.25	7.4	6845.0	6629.2	84.4	81.8
03/10/94	75	ML	188	2	100	9.25	7.9	7307.5		90.1	
03/10/94	26	ML	188	3	100	9.25	6.2	5735.0		70.7	
03/10/94	2	ML	375	1	100	9.25	5.7	5272.5	5673.3	65.0	70.0
03/10/94	45	ML	375	2	100	9.25	6.8	6290.0		77.6	
03/10/94	28	ML	375	3	100	9.25	5.9	5457.5		67.3	
03/10/94	70	ML	750	1	100	9.25	4.9	4532.5	4594.2	55.9	56.7
03/10/94	71	ML	750	2	100	9.25	4.9	4532.5		55.9	
03/10/94	13	ML	750	3	100	9.25	5.1	4717.5		58.2	
03/10/94	10	ML	1500	1	100	9.25	2.6	2405.0	2744.2	29.7	33.8
03/10/94	81	ML	1500	2	100	9.25	3.2	2960.0		36.5	
03/10/94	68	ML	1500	3	100	9.25	3.1	2867.5		35.4	
03/10/94	76	ML	3000	1	100	2.84	4.3	1221.2	936.1	15.1	11.5
03/10/94	35	ML	3000	2	100	2.84	2.8	795.2		9.8	
03/10/94	32	ML	3000	3	100	0.9	8.8	792.0		9.8	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
96 HRS ON CHLAM

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/11/94	55	CONTROL	0	1	100	29.34	3.8	11149.2	10660.2	104.6	100.0
03/11/94	12	CONTROL	0	2	100	29.34	3.8	11149.2		104.6	
03/11/94	96	CONTROL	0	3	100	29.34	3.3	9682.2		90.8	
03/11/94	80	AL	38	1	100	29.34	3.2	9388.8	10171.2	88.1	95.4
03/11/94	41	AL	38	2	100	29.34	3.7	10855.8		101.8	
03/11/94	95	AL	38	3	100	29.34	3.5	10269.0		96.3	
03/11/94	115	AL	75	1	100	29.34	3	8802.0	9877.8	82.6	92.7
03/11/94	51	AL	75	2	100	29.34	3.9	11442.6		107.3	
03/11/94	81	AL	75	3	100	29.34	3.2	9388.8		88.1	
03/11/94	93	AL	150	1	100	29.34	3.2	9388.8	9682.2	88.1	90.8
03/11/94	94	AL	150	2	100	29.34	3.6	10562.4		99.1	
03/11/94	20	AL	150	3	100	29.34	3.1	9095.4		85.3	
03/11/94	127	AL	300	1	100	9.25	7	6475.0	7307.5	60.7	68.5
03/11/94	48	AL	300	2	100	9.25	8.5	7862.5		73.8	
03/11/94	22	AL	300	3	100	9.25	8.2	7585.0		71.2	
03/11/94	1	AL	600	1	100	9.25	3.2	2960.0	3114.2	27.8	29.2
03/11/94	121	AL	600	2	100	9.25	3.4	3145.0		29.5	
03/11/94	31	AL	600	3	100	9.25	3.5	3237.5		30.4	
03/11/94	18	AT	19	1	100	29.34	6.1	17897.4	16430.4	167.9	154.1
03/11/94	100	AT	19	2	100	29.34	5.3	15550.2		145.9	
03/11/94	84	AT	19	3	100	29.34	5.4	15843.6		148.6	
03/11/94	63	AT	38	1	100	29.34	5.1	14963.4	14278.8	140.4	133.9
03/11/94	56	AT	38	2	100	29.34	4.9	14376.6		134.9	
03/11/94	109	AT	38	3	100	29.34	4.6	13496.4		126.6	
03/11/94	90	AT	75	1	100	29.34	3.4	9975.6	10269.0	93.6	96.3
03/11/94	91	AT	75	2	100	29.34	3.7	10855.8		101.8	
03/11/94	92	AT	75	3	100	29.34	3.4	9975.6		93.6	
03/11/94	98	AT	150	1	100	9.25	6.3	5827.5	5765.8	54.7	54.1
03/11/94	111	AT	150	2	100	9.25	6.2	5735.0		53.8	
03/11/94	108	AT	150	3	100	9.25	6.2	5735.0		53.8	
03/11/94	118	AT	300	1	100	9.25	3.6	3330.0	3607.5	31.2	33.8
03/11/94	42	AT	300	2	100	9.25	4.3	3977.5		37.3	
03/11/94	89	AT	300	3	100	9.25	3.8	3515.0		33.0	
03/11/94	85	MB	38	1	100	9.25	4.8	4440.0	4255.0	41.7	39.9
03/11/94	116	MB	38	2	100	9.25	4.4	4070.0		38.2	
03/11/94	107	MB	38	3	100	9.25	4.6	4255.0		39.9	
03/11/94	38	MB	75	1	100	9.25	3.5	3237.5	2960.0	30.4	27.8
03/11/94	62	MB	75	2	100	9.25	3	2775.0		26.0	
03/11/94	50	MB	75	3	100	9.25	3.1	2867.5		26.9	
03/11/94	64	MB	150	1	100	2.84	7.9	2243.6	2262.5	21.0	21.2
03/11/94	15	MB	150	2	100	2.84	8.4	2385.6		22.4	
03/11/94	101	MB	150	3	100	2.84	7.6	2158.4		20.2	
03/11/94	5	MB	300	1	100	2.84	6.7	1902.8	1864.9	17.8	17.5
03/11/94	57	MB	300	2	100	2.84	6.6	1874.4		17.6	
03/11/94	52	MB	300	3	100	2.84	6.4	1817.6		17.1	
03/11/94	112	MB	600	1	100	2.84	5.3	1505.2	1533.6	14.1	14.4
03/11/94	117	MB	600	2	100	2.84	5.4	1533.6		14.4	
03/11/94	113	MB	600	3	100	2.84	5.5	1562.0		14.7	
03/11/94	79	ML	188	1	100	29.34	3.2	9388.8	9780.0	88.1	91.7
03/11/94	75	ML	188	2	100	29.34	3.5	10269.0		96.3	
03/11/94	26	ML	188	3	100	29.34	3.3	9682.2		90.8	
03/11/94	2	ML	375	1	100	9.25	8.8	8140.0	8874.7	76.4	83.3
03/11/94	45	ML	375	2	100	29.34	3.1	9095.4		85.3	
03/11/94	28	ML	375	3	100	29.34	3.2	9388.8		88.1	
03/11/94	70	ML	750	1	100	9.25	7.9	7307.5	7245.8	68.5	68.0
03/11/94	71	ML	750	2	100	9.25	7.2	6660.0		62.5	
03/11/94	13	ML	750	3	100	9.25	8.4	7770.0		72.9	
03/11/94	10	ML	1500	1	100	9.25	4	3700.0	3854.2	34.7	36.2
03/11/94	61	ML	1500	2	100	9.25	4.2	3885.0		36.4	
03/11/94	68	ML	1500	3	100	9.25	4.3	3977.5		37.3	
03/11/94	76	ML	3000	1	100	2.84	5.6	1590.4	1391.6	14.9	13.1
03/11/94	35	ML	3000	2	100	2.84	4.6	1306.4		12.3	
03/11/94	32	ML	3000	3	100	2.84	4.5	1278.0		12.0	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
24 HRS ON SELENASTRUM

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/22/94	11	CONTROL	0	1	100	2.84	3.6	1022.4	984.5	103.8	100.0
03/22/94	3	CONTROL	0	2	100	2.84	3.2	908.8		92.3	
03/22/94	31	CONTROL	0	3	100	2.84	3.6	1022.4		103.8	
03/22/94	54	AL	19	1	100	2.84	2.7	766.8	776.3	77.9	78.8
03/22/94	86	AL	19	2	100	2.84	2.7	766.8		77.9	
03/22/94	64	AL	19	3	100	2.84	2.8	795.2		80.8	
03/22/94	63	AL	38	1	100	2.84	2.4	681.6	681.6	69.2	69.2
03/22/94	87	AL	38	2	100	2.84	2.5	710.0		72.1	
03/22/94	112	AL	38	3	100	2.84	2.3	653.2		66.3	
03/22/94	27	AL	75	1	100	2.84	2.4	681.6	681.6	69.2	69.2
03/22/94	23	AL	75	2	100	2.84	2.4	681.6		69.2	
03/22/94	106	AL	75	3	100	2.84	2.4	681.6		69.2	
03/22/94	30	AL	150	1	100	2.84	2.4	681.6	662.7	69.2	67.3
03/22/94	36	AL	150	2	100	2.84	2.3	653.2		66.3	
03/22/94	101	AL	150	3	100	2.84	2.3	653.2		66.3	
03/22/94	55	AL	300	1	100	2.84	2.3	653.2	681.6	66.3	69.2
03/22/94	121	AL	300	2	100	2.84	2.5	710.0		72.1	
03/22/94	35	AL	300	3	100	2.84	2.4	681.6		69.2	
03/22/94	124	AT	19	1	100	2.84	5.3	1505.2	1448.4	152.9	147.1
03/22/94	84	AT	19	2	100	2.84	5	1420.0		144.2	
03/22/94	100	AT	19	3	100	2.84	5	1420.0		144.2	
03/22/94	59	AT	38	1	100	2.84	5.6	1590.4	1628.3	161.5	165.4
03/22/94	120	AT	38	2	100	2.84	5.9	1675.6		170.2	
03/22/94	107	AT	38	3	100	2.84	5.7	1618.8		164.4	
03/22/94	114	AT	75	1	100	2.84	6	1704.0	1628.3	173.1	165.4
03/22/94	52	AT	75	2	100	2.84	5.7	1618.8		164.4	
03/22/94	74	AT	75	3	100	2.84	5.5	1562.0		158.7	
03/22/94	80	AT	150	1	100	2.84	5.2	1476.8	1495.7	150.0	151.9
03/22/94	85	AT	150	2	100	2.84	5.2	1476.8		150.0	
03/22/94	96	AT	150	3	100	2.84	5.4	1533.6		155.8	
03/22/94	88	AT	300	1	100	2.84	4.8	1363.2	1438.9	138.5	146.2
03/22/94	118	AT	300	2	100	2.84	5	1420.0		144.2	
03/22/94	66	AT	300	3	100	2.84	5.4	1533.6		155.8	
03/22/94	33	MB	19	1	100	2.84	5.2	1476.8	1637.7	150.0	166.3
03/22/94	109	MB	19	2	100	2.84	5.9	1675.6		170.2	
03/22/94	42	MB	19	3	100	2.84	6.2	1760.8		178.8	
03/22/94	56	MB	38	1	100	2.84	6	1704.0	1704.0	173.1	173.1
03/22/94	17	MB	38	2	100	2.84	5.8	1647.2		167.3	
03/22/94	76	MB	38	3	100	2.84	6.2	1760.8		178.8	
03/22/94	43	MB	75	1	100	2.84	5.6	1590.4	1628.3	161.5	165.4
03/22/94	102	MB	75	2	100	2.84	5.9	1675.6		170.2	
03/22/94	8	MB	75	3	100	2.84	5.7	1618.8		164.4	
03/22/94	48	MB	150	1	100	2.84	5.3	1505.2	1495.7	152.9	151.9
03/22/94	40	MB	150	2	100	2.84	5.3	1505.2		152.9	
03/22/94	9	MB	150	3	100	2.84	5.2	1476.8		150.0	
03/22/94	34	MB	300	1	100	2.84	4.4	1249.6	1249.6	126.9	126.9
03/22/94	32	MB	300	2	100	2.84	4.4	1249.6		126.9	
03/22/94	111	MB	300	3	100	2.84	4.4	1249.6		126.9	
03/22/94	14	ML	19	1	100	2.84	3.8	1079.2	1145.5	109.6	116.3
03/22/94	94	ML	19	2	100	2.84	4.3	1221.2		124.0	
03/22/94	97	ML	19	3	100	2.84	4	1136.0		115.4	
03/22/94	70	ML	38	1	100	2.84	3.9	1107.6	1145.5	112.5	116.3
03/22/94	90	ML	38	2	100	2.84	4	1136.0		115.4	
03/22/94	115	ML	38	3	100	2.84	4.2	1192.8		121.2	
03/22/94	82	ML	75	1	100	2.84	3.6	1022.4	1079.2	103.8	109.6
03/22/94	58	ML	75	2	100	2.84	3.8	1079.2		109.6	
03/22/94	116	ML	75	3	100	2.84	4	1136.0		115.4	
03/22/94	51	ML	150	1	100	2.84	3.3	937.2	927.7	95.2	94.2
03/22/94	77	ML	150	2	100	2.84	3.1	880.4		89.4	
03/22/94	49	ML	150	3	100	2.84	3.4	965.6		98.1	
03/22/94	81	ML	300	1	100	2.84	2.4	681.6	681.6	69.2	69.2
03/22/94	108	ML	300	2	100	2.84	2.5	710.0		72.1	
03/22/94	73	ML	300	3	100	2.84	2.3	653.2		66.3	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
48 HRS ON SELENASTRUM

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/23/94	11	CONTROL	0	1	100	9.25	3.6	3330.0	3175.8	104.9	100.0
03/23/94	3	CONTROL	0	2	100	9.25	3.3	3052.5		96.1	
03/23/94	31	CONTROL	0	3	100	9.25	3.4	3145.0		99.0	
03/23/94	54	AL	19	1	100	2.84	4.6	1306.4	1249.6	41.1	39.3
03/23/94	86	AL	19	2	100	2.84	4.2	1192.8		37.6	
03/23/94	84	AL	19	3	100	2.84	4.4	1249.6		39.3	
03/23/94	63	AL	38	1	100	2.84	3.7	1050.8	946.7	33.1	29.8
03/23/94	67	AL	38	2	100	2.84	2.9	823.6		25.9	
03/23/94	112	AL	38	3	100	2.84	3.4	965.6		30.4	
03/23/94	27	AL	75	1	100	2.84	3.4	965.6	956.1	30.4	30.1
03/23/94	23	AL	75	2	100	2.84	3.4	965.6		30.4	
03/23/94	108	AL	75	3	100	2.84	3.3	937.2		29.5	
03/23/94	30	AL	150	1	100	2.84	3.3	937.2	908.8	29.5	28.6
03/23/94	38	AL	150	2	100	2.84	3.1	880.4		27.7	
03/23/94	101	AL	150	3	100	2.84	3.2	908.8		28.6	
03/23/94	55	AL	300	1	100	2.84	2.9	823.6	842.5	25.9	26.5
03/23/94	121	AL	300	2	100	2.84	2.9	823.6		25.9	
03/23/94	35	AL	300	3	100	2.84	3.1	880.4		27.7	
03/23/94	124	AT	19	1	100	9.25	5	4625.0	4347.5	145.6	136.9
03/23/94	64	AT	19	2	100	9.25	4.6	4255.0		134.0	
03/23/94	100	AT	19	3	100	9.25	4.5	4162.5		131.1	
03/23/94	59	AT	38	1	100	9.25	4	3700.0	4039.2	116.5	127.2
03/23/94	120	AT	38	2	100	9.25	4.5	4162.5		131.1	
03/23/94	107	AT	38	3	100	9.25	4.6	4255.0		134.0	
03/23/94	114	AT	75	1	100	9.25	3.6	3330.0	3175.8	104.9	100.0
03/23/94	52	AT	75	2	100	9.25	3.4	3145.0		99.0	
03/23/94	74	AT	75	3	100	9.25	3.3	3052.5		96.1	
03/23/94	80	AT	150	1	100	2.84	7.7	2186.8	2243.6	68.9	70.6
03/23/94	85	AT	150	2	100	2.84	7.8	2215.2		69.8	
03/23/94	96	AT	150	3	100	2.84	8.2	2328.8		73.3	
03/23/94	88	AT	300	1	100	2.84	5.6	1590.4	1580.9	50.1	49.8
03/23/94	118	AT	300	2	100	2.84	5.6	1590.4		50.1	
03/23/94	66	AT	300	3	100	2.84	5.5	1562.0		49.2	
03/23/94	33	MB	19	1	100	9.25	3.4	3145.0	3484.2	99.0	109.7
03/23/94	109	MB	19	2	100	9.25	3.7	3422.5		107.8	
03/23/94	42	MB	19	3	100	9.25	4.2	3885.0		122.3	
03/23/94	56	MB	38	1	100	2.84	9.6	2726.4	2842.1	85.8	89.5
03/23/94	17	MB	38	2	100	2.84	10	2840.0		89.4	
03/23/94	76	MB	38	3	100	9.25	3.2	2960.0		93.2	
03/23/94	43	MB	75	1	100	2.84	7	1988.0	2082.7	62.6	65.6
03/23/94	102	MB	75	2	100	2.84	7.6	2158.4		68.0	
03/23/94	8	MB	75	3	100	2.84	7.4	2101.6		66.2	
03/23/94	48	MB	150	1	100	2.84	5.4	1533.6	1524.1	48.3	48.0
03/23/94	40	MB	150	2	100	2.84	5.3	1505.2		47.4	
03/23/94	9	MB	150	3	100	2.84	5.4	1533.6		48.3	
03/23/94	34	MB	300	1	100	2.84	3.3	937.2	956.1	29.5	30.1
03/23/94	32	MB	300	2	100	2.84	3.6	1022.4		32.2	
03/23/94	111	MB	300	3	100	2.84	3.2	908.8		28.6	
03/23/94	14	ML	19	1	100	9.25	3.6	3330.0	3484.2	104.9	109.7
03/23/94	94	ML	19	2	100	9.25	3.8	3515.0		110.7	
03/23/94	97	ML	19	3	100	9.25	3.9	3607.5		113.6	
03/23/94	70	ML	38	1	100	9.25	3.4	3145.0	3268.3	99.0	102.9
03/23/94	90	ML	38	2	100	9.25	3.5	3237.5		101.9	
03/23/94	115	ML	38	3	100	9.25	3.7	3422.5		107.8	
03/23/94	82	ML	75	1	100	2.84	8.8	2499.2	2652.2	78.7	83.5
03/23/94	58	ML	75	2	100	9.25	2.9	2682.5		84.5	
03/23/94	116	ML	75	3	100	9.25	3	2775.0		87.4	
03/23/94	51	ML	150	1	100	2.84	6.4	1817.6	1836.5	57.2	57.8
03/23/94	77	ML	150	2	100	2.84	5.8	1647.2		51.9	
03/23/94	49	ML	150	3	100	2.84	7.2	2044.8		64.4	
03/23/94	81	ML	300	1	100	2.84	3.8	1079.2	1060.3	34.0	33.4
03/23/94	106	ML	300	2	100	2.84	3.7	1050.8		33.1	
03/23/94	73	ML	300	3	100	2.84	3.7	1050.8		33.1	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
72 HRS ON SELENASTRUM

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/24/94	11 C		0	1	100	9.25	7.7	7122.5	6721.7	106.0	100.0
03/24/94	3 C		0	2	100	9.25	6.7	6197.5		92.2	
03/24/94	31 C		0	3	100	9.25	7.4	6845.0		101.8	
03/24/94	54 AL		19	1	100	2.84	4.9	1391.6	1401.1	20.7	20.8
03/24/94	86 AL		19	2	100	2.84	5	1391.6		20.7	
03/24/94	84 AL		19	3	100	2.84	4.8	1420.0		21.1	
03/24/94	83 AL		38	1	100	2.84	3.8	1363.2	1173.9	20.3	17.5
03/24/94	87 AL		38	2	100	2.84	3.8	1079.2		16.1	
03/24/94	112 AL		38	3	100	2.84	3.9	1079.2		16.1	
03/24/94	27 AL		75	1	100	2.84	3.4	1107.6	1012.9	16.5	15.1
03/24/94	23 AL		75	2	100	2.84	3.4	965.6		14.4	
03/24/94	108 AL		75	3	100	2.84	3.4	965.6		14.4	
03/24/94	30 AL		150	1	100	2.84	3.4	965.6	946.7	14.4	14.1
03/24/94	38 AL		150	2	100	2.84	3.2	965.6		14.4	
03/24/94	101 AL		150	3	100	2.84	2.9	908.8		13.5	
03/24/94	55 AL		300	1	100	2.84	3.1	880.4	908.8	13.1	13.5
03/24/94	121 AL		300	2	100	2.84	3.4	880.4		13.1	
03/24/94	35 AL		300	3	100	2.84	3.2	965.6		14.4	
03/24/94	124 AT		19	1	100	29.34	3.4	9975.6	9877.8	148.4	147.0
03/24/94	64 AT		19	2	100	29.34	3.2	9388.8		139.7	
03/24/94	100 AT		19	3	100	29.34	3.5	10269.0		152.8	
03/24/94	59 AT		38	1	100	9.25	9.6	8880.0	9116.6	132.1	135.6
03/24/94	120 AT		38	2	100	9.25	9.5	8787.5		130.7	
03/24/94	107 AT		38	3	100	29.34	3.3	9682.2		144.0	
03/24/94	114 AT		75	1	100	9.25	6.1	5642.5	6135.8	83.9	91.3
03/24/94	52 AT		75	2	100	9.25	6.8	6290.0		93.6	
03/24/94	74 AT		75	3	100	9.25	7	6475.0		96.3	
03/24/94	80 AT		150	1	100	9.25	3.7	3422.5	3545.8	50.9	52.8
03/24/94	85 AT		150	2	100	9.25	4	3700.0		55.0	
03/24/94	96 AT		150	3	100	9.25	3.8	3515.0		52.3	
03/24/94	88 AT		300	1	100	2.84	6.6	1874.4	1902.8	27.9	28.3
03/24/94	118 AT		300	2	100	2.84	6.8	1931.2		28.7	
03/24/94	66 AT		300	3	100	2.84	6.7	1902.8		28.3	
03/24/94	33 MB		19	1	100	9.25	6.5	6012.5	7122.5	89.4	106.0
03/24/94	109 MB		19	2	100	9.25	8	7400.0		110.1	
03/24/94	42 MB		19	3	100	9.25	8.6	7955.0		118.3	
03/24/94	56 MB		38	1	100	9.25	5.1	4717.5	4902.5	70.2	72.9
03/24/94	17 MB		38	2	100	9.25	5.2	4810.0		71.6	
03/24/94	76 MB		38	3	100	9.25	5.6	5180.0		77.1	
03/24/94	43 MB		75	1	100	9.25	2.8	2590.0	2588.1	38.5	38.5
03/24/94	102 MB		75	2	100	2.84	9.1	2584.4		38.4	
03/24/94	8 MB		75	3	100	9.25	2.8	2590.0		38.5	
03/24/94	48 MB		150	1	100	2.84	5.2	1476.8	1476.8	22.0	22.0
03/24/94	40 MB		150	2	100	2.84	5.2	1476.8		22.0	
03/24/94	9 MB		150	3	100	2.84	5.2	1476.8		22.0	
03/24/94	34 MB		300	1	100	2.84	2.6	738.4	776.3	11.0	11.5
03/24/94	32 MB		300	2	100	2.84	2.8	795.2		11.8	
03/24/94	111 MB		300	3	100	2.84	2.8	795.2		11.8	
03/24/94	14 ML		19	1	100	9.25	8.2	7585.0	7893.3	112.8	117.4
03/24/94	94 ML		19	2	100	9.25	8.2	7585.0		112.8	
03/24/94	97 ML		19	3	100	9.25	9.2	8510.0		126.6	
03/24/94	70 ML		38	1	100	9.25	8	7400.0	7430.8	110.1	110.6
03/24/94	90 ML		38	2	100	9.25	7.8	7215.0		107.3	
03/24/94	115 ML		38	3	100	9.25	8.3	7677.5		114.2	
03/24/94	82 ML		75	1	100	9.25	4.8	4440.0	4779.2	66.1	71.1
03/24/94	58 ML		75	2	100	9.25	5.4	4995.0		74.3	
03/24/94	116 ML		75	3	100	9.25	5.3	4902.5		72.9	
03/24/94	51 ML		150	1	100	9.25	2.6	2405.0	2367.7	35.8	35.2
03/24/94	77 ML		150	2	100	9.25	2.5	2312.5		34.4	
03/24/94	49 ML		150	3	100	2.84	8.4	2385.6		35.5	
03/24/94	61 ML		300	1	100	2.84	3.9	1107.6	1136.0	16.5	16.9
03/24/94	106 ML		300	2	100	2.84	4.3	1221.2		18.2	
03/24/94	73 ML		300	3	100	2.84	3.8	1079.2		16.1	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
96 HRS ON SELENASTRUM

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/25/94	11	AL	0	1	100	29.34	4.5	13203.0	12225.0	108.0	100.0
03/25/94	3	AL	0	2	100	29.34	3.4	9975.6		81.6	
03/25/94	31	AL	0	3	100	29.34	4.6	13496.4		110.4	
03/25/94	54	AL	19	1	100	2.84	5.4	1533.6	1353.7	12.5	11.1
03/25/94	86	AL	19	2	100	2.84	4.5	1278.0		10.5	
03/25/94	84	AL	19	3	100	2.84	4.4	1249.6		10.2	
03/25/94	63	AL	38	1	100	2.84	3.5	994.0	1031.9	8.1	8.4
03/25/94	67	AL	38	2	100	2.84	4	1136.0		9.3	
03/25/94	112	AL	38	3	100	2.84	3.4	965.6		7.9	
03/25/94	27	AL	75	1	100	2.84	2.8	795.2	795.2	6.5	6.5
03/25/94	23	AL	75	2	100	2.84	2.6	738.4		6.0	
03/25/94	108	AL	75	3	100	2.84	3	852.0		7.0	
03/25/94	30	AL	150	1	100	2.84	2.7	766.8	776.3	6.3	6.3
03/25/94	38	AL	150	2	100	2.84	2.7	766.8		6.3	
03/25/94	101	AL	150	3	100	2.84	2.8	795.2		6.5	
03/25/94	55	AL	300	1	100	2.84	2.8	795.2	766.8	6.5	6.3
03/25/94	121	AL	300	2	100	2.84	2.5	710.0		5.8	
03/25/94	35	AL	300	3	100	2.84	2.8	795.2		6.5	
03/25/94	11	AT	0	1	100	29.34	4.5	13203.0	12225.0	108.0	100.0
03/25/94	3	AT	0	2	100	29.34	3.4	9975.6		81.6	
03/25/94	31	AT	0	3	100	29.34	4.6	13496.4		110.4	
03/25/94	124	AT	19	1	100	29.34	5.5	16137.0	17115.0	132.0	140.0
03/25/94	64	AT	19	2	100	29.34	5.4	15843.6		129.6	
03/25/94	100	AT	19	3	100	29.34	6.6	19364.4		158.4	
03/25/94	59	AT	38	1	100	29.34	5.7	16723.8	16234.8	136.8	132.8
03/25/94	120	AT	38	2	100	29.34	5.1	14963.4		122.4	
03/25/94	107	AT	38	3	100	29.34	5.8	17017.2		139.2	
03/25/94	114	AT	75	1	100	9.25	9.7	8972.5	9347.8	73.4	76.5
03/25/94	52	AT	75	2	100	29.34	3.3	9682.2		79.2	
03/25/94	74	AT	75	3	100	29.34	3.2	9388.8		76.8	
03/25/94	80	AT	150	1	100	9.25	5.2	4810.0	4748.3	39.3	38.8
03/25/94	85	AT	150	2	100	9.25	5	4625.0		37.8	
03/25/94	96	AT	150	3	100	9.25	5.2	4810.0		39.3	
03/25/94	88	AT	300	1	100	9.25	2.4	2220.0	2189.2	18.2	17.9
03/25/94	116	AT	300	2	100	9.25	2.2	2035.0		16.6	
03/25/94	66	AT	300	3	100	9.25	2.5	2312.5		18.9	
03/25/94	11	MB	0	1	100	29.34	4.5	13203.0	12225.0	108.0	100.0
03/25/94	3	MB	0	2	100	29.34	3.4	9975.6		81.6	
03/25/94	31	MB	0	3	100	29.34	4.6	13496.4		110.4	
03/25/94	33	MB	19	1	100	29.34	3.4	9975.6	10855.8	81.6	88.8
03/25/94	109	MB	19	2	100	29.34	4	11736.0		96.0	
03/25/94	42	MB	19	3	100	29.34	4.2	12322.8		100.8	
03/25/94	56	MB	38	1	100	29.34	2.3	6748.2	6905.2	55.2	56.5
03/25/94	17	MB	38	2	100	9.25	7.5	6937.5		56.7	
03/25/94	76	MB	38	3	100	9.25	7.6	7030.0		57.5	
03/25/94	43	MB	75	1	100	9.25	3.5	3237.5	3206.7	26.5	26.2
03/25/94	102	MB	75	2	100	9.25	3.4	3145.0		25.7	
03/25/94	6	MB	75	3	100	9.25	3.5	3237.5		26.5	
03/25/94	46	MB	150	1	100	2.84	5.6	1590.4	1552.5	13.0	12.7
03/25/94	40	MB	150	2	100	2.84	5.6	1590.4		13.0	
03/25/94	9	MB	150	3	100	2.84	5.2	1476.8		12.1	
03/25/94	34	MB	300	1	100	2.84	2.8	795.2	833.1	6.5	6.8
03/25/94	32	MB	300	2	100	2.84	3	852.0		7.0	
03/25/94	111	MB	300	3	100	2.84	3	852.0		7.0	
03/25/94	11	ML	0	1	100	29.34	4.5	13203.0	12225.0	108.0	100.0
03/25/94	3	ML	0	2	100	29.34	3.4	9975.6		81.6	
03/25/94	31	ML	0	3	100	29.34	4.6	13496.4		110.4	
03/25/94	14	ML	19	1	100	29.34	4.3	12616.2	12518.4	103.2	102.4
03/25/94	94	ML	19	2	100	29.34	4.1	12029.4		98.4	
03/25/94	97	ML	19	3	100	29.34	4.4	12909.6		105.6	
03/25/94	70	ML	38	1	100	29.34	3.9	11442.6	11247.0	93.6	92.0
03/25/94	90	ML	38	2	100	29.34	3.8	11149.2		91.2	
03/25/94	115	ML	38	3	100	29.34	3.8	11149.2		91.2	
03/25/94	62	ML	75	1	100	29.34	2.2	6454.8	7078.2	52.8	57.9
03/25/94	58	ML	75	2	100	9.25	9	8325.0		68.1	
03/25/94	116	ML	75	3	100	29.34	2.2	6454.8		52.8	
03/25/94	51	ML	150	1	100	9.25	2.1	1942.5	2158.3	15.9	17.7
03/25/94	77	ML	150	2	100	9.25	2.4	2220.0		18.2	
03/25/94	49	ML	150	3	100	9.25	2.5	2312.5		18.9	
03/25/94	81	ML	300	1	100	2.84	4	1136.0	1164.4	9.3	9.5
03/25/94	106	ML	300	2	100	2.84	4.6	1306.4		10.7	
03/25/94	73	ML	300	3	100	2.84	3.7	1050.8		8.6	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
24 HRS ON SCENEDESMUS

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/22/94	71	AL	0	4	100	2.84	3.1	880.4	899.3	97.9	100.0
03/22/94	103	AL	0	5	100	2.84	3.4	965.6		107.4	
03/22/94	6	AL	0	6	100	2.84	3	852.0		94.7	
03/22/94	53	AL	188	4	100	2.84	3.2	908.8	899.3	101.1	100.0
03/22/94	93	AL	188	5	100	2.84	3.1	880.4		97.9	
03/22/94	123	AL	188	6	100	2.84	3.2	908.8		101.1	
03/22/94	72	AL	375	4	100	2.84	3	852.0	870.9	94.7	96.8
03/22/94	41	AL	375	5	100	2.84	3.2	908.8		101.1	
03/22/94	44	AL	375	6	100	2.84	3	852.0		94.7	
03/22/94	57	AL	750	4	100	2.84	3.1	880.4	899.3	97.9	100.0
03/22/94	62	AL	750	5	100	2.84	3.2	908.8		101.1	
03/22/94	104	AL	750	6	100	2.84	3.2	908.8		101.1	
03/22/94	36	AL	1500	4	100	2.84	3	852.0	833.1	94.7	92.6
03/22/94	79	AL	1500	5	100	2.84	2.8	795.2		88.4	
03/22/94	105	AL	1500	6	100	2.84	3	852.0		94.7	
03/22/94	125	AL	3000	4	100	2.84	2.7	766.8	804.7	85.3	89.5
03/22/94	39	AL	3000	5	100	2.84	2.9	823.6		91.6	
03/22/94	96	AL	3000	6	100	2.84	2.9	823.6		91.6	
03/22/94	71	AT	0	4	100	2.84	3.1	880.4	899.3	97.9	100.0
03/22/94	103	AT	0	5	100	2.84	3.4	965.6		107.4	
03/22/94	6	AT	0	6	100	2.84	3	852.0		94.7	
03/22/94	89	AT	19	4	100	2.84	5.1	1448.4	1476.8	161.1	164.2
03/22/94	65	AT	19	5	100	2.84	5.3	1505.2		167.4	
03/22/94	12	AT	19	6	100	2.84	5.2	1476.8		164.2	
03/22/94	22	AT	38	4	100	2.84	6.5	1846.0	1789.2	205.3	198.9
03/22/94	69	AT	38	5	100	2.84	6	1704.0		189.5	
03/22/94	45	AT	38	6	100	2.84	6.4	1817.6		202.1	
03/22/94	7	AT	75	4	100	2.84	5.6	1590.4	1732.4	176.8	192.6
03/22/94	117	AT	75	5	100	2.84	6.7	1902.8		211.6	
03/22/94	18	AT	75	6	100	2.84	6	1704.0		189.5	
03/22/94	25	AT	150	4	100	2.84	6	1704.0	1647.2	189.5	183.2
03/22/94	20	AT	150	5	100	2.84	6	1704.0		189.5	
03/22/94	60	AT	150	6	100	2.84	5.4	1533.6		170.5	
03/22/94	4	AT	300	4	100	2.84	4.8	1363.2	1533.6	151.6	170.5
03/22/94	75	AT	300	5	100	2.84	6	1704.0		189.5	
03/22/94	91	AT	300	6	100	2.84	5.4	1533.6		170.5	
03/22/94	71	MB	0	4	100	2.84	3.1	880.4	899.3	97.9	100.0
03/22/94	103	MB	0	5	100	2.84	3.4	965.6		107.4	
03/22/94	6	MB	0	6	100	2.84	3	852.0		94.7	
03/22/94	95	MB	19	4	100	2.84	6.2	1760.8	1685.1	195.8	187.4
03/22/94	46	MB	19	5	100	2.84	5.9	1675.6		186.3	
03/22/94	78	MB	19	6	100	2.84	5.7	1618.8		180.0	
03/22/94	28	MB	38	4	100	2.84	6.8	1931.2	2044.8	214.7	227.4
03/22/94	50	MB	38	5	100	2.84	7.4	2101.6		233.7	
03/22/94	110	MB	38	6	100	2.84	7.4	2101.6		233.7	
03/22/94	2	MB	75	4	100	2.84	6.2	1760.8	1921.7	195.8	213.7
03/22/94	87	MB	75	5	100	2.84	7.1	2016.4		224.2	
03/22/94	16	MB	75	6	100	2.84	7	1988.0		221.1	
03/22/94	99	MB	150	4	100	2.84	6.5	1846.0	1931.2	205.3	214.7
03/22/94	119	MB	150	5	100	2.84	6.9	1959.6		217.9	
03/22/94	122	MB	150	6	100	2.84	7	1988.0		221.1	
03/22/94	5	MB	300	4	100	2.84	5.2	1476.8	1637.7	164.2	182.1
03/22/94	83	MB	300	5	100	2.84	6.1	1732.4		192.6	
03/22/94	26	MB	300	6	100	2.84	6	1704.0		189.5	
03/22/94	71	ML	0	4	100	2.84	3.1	880.4	899.3	97.9	100.0
03/22/94	103	ML	0	5	100	2.84	3.4	965.6		107.4	
03/22/94	6	ML	0	6	100	2.84	3	852.0		94.7	
03/22/94	37	ML	188	4	100	2.84	3.6	1022.4	965.6	113.7	107.4
03/22/94	19	ML	188	5	100	2.84	3.3	937.2		104.2	
03/22/94	24	ML	188	6	100	2.84	3.3	937.2		104.2	
03/22/94	29	ML	375	4	100	2.84	3.3	937.2	880.4	104.2	97.9
03/22/94	47	ML	375	5	100	2.84	3	852.0		94.7	
03/22/94	1	ML	375	6	100	2.84	3	852.0		94.7	
03/22/94	126	ML	750	4	100	2.84	3.2	908.8	946.7	101.1	105.3
03/22/94	92	ML	750	5	100	2.84	3.1	880.4		97.9	
03/22/94	61	ML	750	6	100	2.84	3.7	1050.8		116.8	
03/22/94	10	ML	1500	4	100	2.84	3.3	937.2	994.0	104.2	110.5
03/22/94	15	ML	1500	5	100	2.84	3.4	965.6		107.4	
03/22/94	21	ML	1500	6	100	2.84	3.8	1079.2		120.0	
03/22/94	13	ML	3000	4	100	2.84	3.2	908.8	956.1	101.1	106.3
03/22/94	113	ML	3000	5	100	2.84	3.3	937.2		104.2	
03/22/94	68	ML	3000	6	100	2.84	3.6	1022.4		113.7	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
48 HRS ON SCENEDESMUS

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/23/94	71	AL	0	4	100	2.84	5.6	1590.4	1741.9	91.3	100.0
03/23/94	103	AL	0	5	100	2.84	6	1704.0		97.8	
03/23/94	6	AL	0	6	100	2.84	6.8	1931.2		110.9	
03/23/94	53	AL	188	4	100	2.84	6.2	1760.8	1722.9	101.1	98.9
03/23/94	93	AL	188	5	100	2.84	6.2	1760.8		101.1	
03/23/94	123	AL	188	6	100	2.84	5.8	1647.2		94.6	
03/23/94	72	AL	375	4	100	2.84	5.4	1533.6	1685.1	88.0	96.7
03/23/94	41	AL	375	5	100	2.84	6	1704.0		97.8	
03/23/94	44	AL	375	6	100	2.84	6.4	1817.6		104.3	
03/23/94	57	AL	750	4	100	2.84	5.2	1476.8	1524.1	84.8	87.5
03/23/94	62	AL	750	5	100	2.84	5.3	1505.2		86.4	
03/23/94	104	AL	750	6	100	2.84	5.6	1590.4		91.3	
03/23/94	36	AL	1500	4	100	2.84	4.7	1334.8	1391.6	76.6	79.9
03/23/94	79	AL	1500	5	100	2.84	5.2	1476.8		84.8	
03/23/94	105	AL	1500	6	100	2.84	4.8	1363.2		78.3	
03/23/94	125	AL	3000	4	100	2.84	4.4	1249.6	1382.1	71.7	79.3
03/23/94	39	AL	3000	5	100	2.84	5.2	1476.8		84.8	
03/23/94	98	AL	3000	6	100	2.84	5	1420.0		81.5	
03/23/94	71	AT	0	4	100	2.84	5.6	1590.4	1741.9	91.3	100.0
03/23/94	103	AT	0	5	100	2.84	6	1704.0		97.8	
03/23/94	6	AT	0	6	100	2.84	6.8	1931.2		110.9	
03/23/94	89	AT	19	4	100	2.84	7.8	2215.2	2505.9	127.2	143.9
03/23/94	65	AT	19	5	100	9.25	3	2775.0		159.3	
03/23/94	12	AT	19	6	100	2.84	8.9	2527.6		145.1	
03/23/94	22	AT	38	4	100	2.84	10	2840.0	2669.6	163.0	153.3
03/23/94	69	AT	38	5	100	2.84	8.8	2499.2		143.5	
03/23/94	45	AT	38	6	100	2.84	9.4	2669.6		153.3	
03/23/94	7	AT	75	4	100	2.84	8.1	2300.4	2281.5	132.1	131.0
03/23/94	117	AT	75	5	100	2.84	8	2272.0		130.4	
03/23/94	18	AT	75	6	100	2.84	8	2272.0		130.4	
03/23/94	25	AT	150	4	100	2.84	5.9	1675.6	1789.2	96.2	102.7
03/23/94	20	AT	150	5	100	2.84	7.2	2044.8		117.4	
03/23/94	60	AT	150	6	100	2.84	5.8	1647.2		94.6	
03/23/94	4	AT	300	4	100	2.84	6	1704.0	1637.7	97.8	94.0
03/23/94	75	AT	300	5	100	2.84	6.1	1732.4		99.5	
03/23/94	91	AT	300	6	100	2.84	5.2	1476.8		84.8	
03/23/94	71	MB	0	4	100	2.84	5.6	1590.4	1741.9	91.3	100.0
03/23/94	103	MB	0	5	100	2.84	6	1704.0		97.8	
03/23/94	6	MB	0	6	100	2.84	6.8	1931.2		110.9	
03/23/94	95	MB	19	4	100	2.84	8.2	2328.8	2423.5	133.7	139.1
03/23/94	46	MB	19	5	100	2.84	8.8	2499.2		143.5	
03/23/94	78	MB	19	6	100	2.84	8.6	2442.4		140.2	
03/23/94	28	MB	38	4	100	2.84	8.8	2499.2	2626.6	143.5	150.8
03/23/94	50	MB	38	5	100	2.84	9.5	2698.0		154.9	
03/23/94	110	MB	38	6	100	9.25	2.9	2682.5		154.0	
03/23/94	2	MB	75	4	100	2.84	7.8	2215.2	2328.8	127.2	133.7
03/23/94	87	MB	75	5	100	2.84	8.3	2357.2		135.3	
03/23/94	16	MB	75	6	100	2.84	8.5	2414.0		138.6	
03/23/94	99	MB	150	4	100	2.84	6.6	1874.4	2044.8	107.6	117.4
03/23/94	119	MB	150	5	100	2.84	7.2	2044.8		117.4	
03/23/94	122	MB	150	6	100	2.84	7.8	2215.2		127.2	
03/23/94	5	MB	300	4	100	2.84	5.8	1647.2	1694.5	94.6	97.3
03/23/94	83	MB	300	5	100	2.84	5.6	1590.4		91.3	
03/23/94	26	MB	300	6	100	2.84	6.5	1846.0		106.0	
03/23/94	71	ML	0	4	100	2.84	5.6	1590.4	1741.9	91.3	100.0
03/23/94	103	ML	0	5	100	2.84	6	1704.0		97.8	
03/23/94	6	ML	0	6	100	2.84	6.8	1931.2		110.9	
03/23/94	37	ML	188	4	100	2.84	6.8	1931.2	1959.6	110.9	112.5
03/23/94	19	ML	188	5	100	2.84	7.5	2130.0		122.3	
03/23/94	24	ML	188	6	100	2.84	6.4	1817.6		104.3	
03/23/94	29	ML	375	4	100	2.84	7	1988.0	2016.4	114.1	115.8
03/23/94	47	ML	375	5	100	2.84	7.3	2073.2		119.0	
03/23/94	1	ML	375	6	100	2.84	7	1988.0		114.1	
03/23/94	126	ML	750	4	100	2.84	6.2	1760.8	1864.9	101.1	107.1
03/23/94	92	ML	750	5	100	2.84	6.9	1959.6		112.5	
03/23/94	61	ML	750	6	100	2.84	6.6	1874.4		107.6	
03/23/94	10	ML	1500	4	100	2.84	7	1988.0	2092.1	114.1	120.1
03/23/94	15	ML	1500	5	100	2.84	6.9	1959.6		112.5	
03/23/94	21	ML	1500	6	100	2.84	8.2	2328.8		133.7	
03/23/94	13	ML	3000	4	100	2.84	7.5	2130.0	1883.9	122.3	108.2
03/23/94	113	ML	3000	5	100	2.84	6	1704.0		97.8	
03/23/94	68	ML	3000	6	100	2.84	6.4	1817.6		104.3	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
72 HRS ON SCENEDESMUS

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/24/94	71	AL	0	4	100	9.25	3.4	3145.0	3175.6	99.0	100.0
03/24/94	103	AL	0	5	100	9.25	3.4	3145.0		99.0	
03/24/94	6	AL	0	6	100	9.25	3.5	3237.5		101.9	
03/24/94	53	AL	188	4	100	9.25	2.9	2682.5	2651.7	84.5	83.5
03/24/94	93	AL	188	5	100	9.25	2.8	2682.5		84.5	
03/24/94	123	AL	188	6	100	9.25	3.3	2590.0		81.6	
03/24/94	72	AL	375	4	100	2.84	8.4	2385.6	4365.4	75.1	137.5
03/24/94	41	AL	375	5	100	2.84	9	2385.6		75.1	
03/24/94	44	AL	375	6	100	9.25	2.7	8325.0		262.1	
03/24/94	57	AL	750	4	100	2.84	7.6	766.6	3318.4	24.1	104.5
03/24/94	62	AL	750	5	100	2.84	7.6	2158.4		68.0	
03/24/94	104	AL	750	6	100	9.25	2.4	7030.0		221.4	
03/24/94	36	AL	1500	4	100	2.84	6.7	681.6	1560.9	21.5	49.6
03/24/94	79	AL	1500	5	100	2.84	7.6	1902.8		59.9	
03/24/94	105	AL	1500	6	100	2.84	6.6	2158.4		68.0	
03/24/94	125	AL	3000	4	100	2.84	5.6	1590.4	1628.3	50.1	51.3
03/24/94	39	AL	3000	5	100	2.84	6	1704.0		53.7	
03/24/94	98	AL	3000	6	100	2.84	5.6	1590.4		50.1	
03/24/94	71	AT	0	4	100	9.25	3.4	3145.0	3175.6	99.0	100.0
03/24/94	103	AT	0	5	100	9.25	3.4	3145.0		99.0	
03/24/94	6	AT	0	6	100	9.25	3.5	3237.5		101.9	
03/24/94	89	AT	19	4	100	9.25	4.4	4070.0	4039.2	128.2	127.2
03/24/94	65	AT	19	5	100	9.25	4.4	4070.0		128.2	
03/24/94	12	AT	19	6	100	9.25	4.3	3977.5		125.2	
03/24/94	22	AT	38	4	100	9.25	4	3700.0	3700.0	116.5	116.5
03/24/94	69	AT	38	5	100	9.25	3.8	3515.0		110.7	
03/24/94	45	AT	38	6	100	9.25	4.2	3885.0		122.3	
03/24/94	7	AT	75	4	100	9.25	2.9	2682.5	2929.2	84.5	92.2
03/24/94	117	AT	75	5	100	9.25	3.4	3145.0		99.0	
03/24/94	18	AT	75	6	100	9.25	3.2	2960.0		93.2	
03/24/94	25	AT	150	4	100	2.84	7.5	2130.0	2287.9	67.1	72.0
03/24/94	20	AT	150	5	100	9.25	2.6	2405.0		75.7	
03/24/94	60	AT	150	6	100	2.84	8.2	2328.8		73.3	
03/24/94	4	AT	300	4	100	2.84	5.8	1647.2	1741.9	51.9	54.6
03/24/94	75	AT	300	5	100	2.84	6.4	1817.6		57.2	
03/24/94	91	AT	300	6	100	2.84	6.2	1760.8		55.4	
03/24/94	71	MB	0	4	100	9.25	3.4	3145.0	3175.6	99.0	100.0
03/24/94	103	MB	0	5	100	9.25	3.4	3145.0		99.0	
03/24/94	6	MB	0	6	100	9.25	3.5	3237.5		101.9	
03/24/94	95	MB	19	4	100	9.25	4	3700.0	3885.0	116.5	122.3
03/24/94	46	MB	19	5	100	9.25	4.2	3885.0		122.3	
03/24/94	78	MB	19	6	100	9.25	4.4	4070.0		128.2	
03/24/94	28	MB	38	4	100	9.25	3.8	3515.0	3761.7	110.7	118.4
03/24/94	50	MB	38	5	100	9.25	4.2	3885.0		122.3	
03/24/94	110	MB	38	6	100	9.25	4.2	3885.0		122.3	
03/24/94	2	MB	75	4	100	9.25	2.8	2590.0	2775.0	81.6	87.4
03/24/94	87	MB	75	5	100	9.25	3.3	3052.5		96.1	
03/24/94	16	MB	75	6	100	9.25	2.9	2682.5		84.5	
03/24/94	99	MB	150	4	100	2.84	7.6	2158.4	2338.3	68.0	73.6
03/24/94	119	MB	150	5	100	2.84	8.3	2357.2		74.2	
03/24/94	122	MB	150	6	100	2.84	8.8	2499.2		78.7	
03/24/94	5	MB	300	4	100	2.84	5.1	1448.4	1732.4	45.6	54.5
03/24/94	83	MB	300	5	100	2.84	6.4	1817.6		57.2	
03/24/94	26	MB	300	6	100	2.84	6.8	1931.2		60.8	
03/24/94	71	ML	0	4	100	9.25	3.4	3145.0	3175.6	99.0	100.0
03/24/94	103	ML	0	5	100	9.25	3.4	3145.0		99.0	
03/24/94	6	ML	0	6	100	9.25	3.5	3237.5		101.9	
03/24/94	37	ML	188	4	100	9.25	3.6	3330.0	3175.6	104.9	100.0
03/24/94	19	ML	188	5	100	9.25	3.4	3145.0		99.0	
03/24/94	24	ML	188	6	100	9.25	3.3	3052.5		96.1	
03/24/94	29	ML	375	4	100	9.25	3	2775.0	3021.7	87.4	95.1
03/24/94	47	ML	375	5	100	9.25	3.8	3515.0		110.7	
03/24/94	1	ML	375	6	100	9.25	3	2775.0		87.4	
03/24/94	126	ML	750	4	100	9.25	3.4	3145.0	3237.5	99.0	101.9
03/24/94	92	ML	750	5	100	9.25	3.6	3330.0		104.9	
03/24/94	61	ML	750	6	100	9.25	3.5	3237.5		101.9	
03/24/94	10	ML	1500	4	100	9.25	3.4	3145.0	3237.5	99.0	101.9
03/24/94	15	ML	1500	5	100	9.25	3.3	3052.5		96.1	
03/24/94	21	ML	1500	6	100	9.25	3.8	3515.0		110.7	
03/24/94	13	ML	3000	4	100	9.25	3.4	3145.0	3052.5	99.0	96.1
03/24/94	113	ML	3000	5	100	9.25	3.3	3052.5		96.1	
03/24/94	68	ML	3000	6	100	9.25	3.2	2960.0		93.2	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
96 HRS ON SCENEDESMUS

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/25/94	71	AL	0	4	100	9.25	5.2	4810.0	4871.7	98.7	100.0
03/25/94	103	AL	0	5	100	9.25	4.9	4532.5		93.0	
03/25/94	6	AL	0	6	100	9.25	5.7	5272.5		108.2	
03/25/94	53	AL	188	4	100	9.25	4.2	3885.0	4008.3	79.7	82.3
03/25/94	93	AL	188	5	100	9.25	4.6	4255.0		87.3	
03/25/94	123	AL	188	6	100	9.25	4.2	3885.0		79.7	
03/25/94	72	AL	375	4	100	9.25	4.2	3885.0	3669.2	79.7	75.3
03/25/94	41	AL	375	5	100	9.25	3.7	3422.5		70.3	
03/25/94	44	AL	375	6	100	9.25	4	3700.0		75.9	
03/25/94	57	AL	750	4	100	9.25	2.9	2682.5	2836.7	55.1	58.2
03/25/94	62	AL	750	5	100	9.25	3.1	2867.5		58.9	
03/25/94	104	AL	750	6	100	9.25	3.2	2960.0		60.8	
03/25/94	36	AL	1500	4	100	2.84	8	2272.0	2391.5	46.6	49.1
03/25/94	79	AL	1500	5	100	9.25	2.6	2405.0		49.4	
03/25/94	105	AL	1500	6	100	9.25	2.7	2497.5		51.3	
03/25/94	125	AL	3000	4	100	2.84	6.3	1789.2	1798.7	36.7	36.9
03/25/94	39	AL	3000	5	100	2.84	6.4	1817.6		37.3	
03/25/94	98	AL	3000	6	100	2.84	6.3	1789.2		36.7	
03/25/94	71	AT	0	4	100	9.25	5.2	4810.0	4871.7	98.7	100.0
03/25/94	103	AT	0	5	100	9.25	4.9	4532.5		93.0	
03/25/94	6	AT	0	6	100	9.25	5.7	5272.5		108.2	
03/25/94	89	AT	19	4	100	9.25	6	5550.0	5704.2	113.9	117.1
03/25/94	65	AT	19	5	100	9.25	5.8	5365.0		110.1	
03/25/94	12	AT	19	6	100	9.25	6.7	6197.5		127.2	
03/25/94	22	AT	38	4	100	9.25	6	5550.0	5303.3	113.9	108.9
03/25/94	69	AT	38	5	100	9.25	5.6	5180.0		106.3	
03/25/94	45	AT	38	6	100	9.25	5.6	5180.0		106.3	
03/25/94	7	AT	75	4	100	9.25	4	3700.0	3607.5	75.9	74.1
03/25/94	117	AT	75	5	100	9.25	3.9	3607.5		74.1	
03/25/94	18	AT	75	6	100	9.25	3.8	3515.0		72.2	
03/25/94	25	AT	150	4	100	9.25	2.8	2590.0	2559.2	53.2	52.5
03/25/94	20	AT	150	5	100	9.25	2.8	2590.0		53.2	
03/25/94	60	AT	150	6	100	9.25	2.7	2497.5		51.3	
03/25/94	4	AT	300	4	100	2.84	6.4	1817.6	1870.0	37.3	38.4
03/25/94	75	AT	300	5	100	9.25	2	1850.0		38.0	
03/25/94	91	AT	300	6	100	9.25	2.1	1942.5		39.9	
03/25/94	71	MB	0	4	100	9.25	5.2	4810.0	4871.7	98.7	100.0
03/25/94	103	MB	0	5	100	9.25	4.9	4532.5		93.0	
03/25/94	6	MB	0	6	100	9.25	5.7	5272.5		108.2	
03/25/94	95	MB	19	4	100	9.25	5.6	5180.0	5303.3	106.3	108.9
03/25/94	46	MB	19	5	100	9.25	5.6	5180.0		106.3	
03/25/94	78	MB	19	6	100	9.25	6	5550.0		113.9	
03/25/94	28	MB	38	4	100	9.25	4.7	4347.5	4409.2	89.2	90.5
03/25/94	50	MB	38	5	100	9.25	5	4625.0		94.9	
03/25/94	110	MB	38	6	100	9.25	4.6	4255.0		87.3	
03/25/94	2	MB	75	4	100	9.25	3.6	3330.0	3330.0	68.4	68.4
03/25/94	87	MB	75	5	100	9.25	3.6	3330.0		68.4	
03/25/94	16	MB	75	6	100	9.25	3.6	3330.0		68.4	
03/25/94	99	MB	150	4	100	9.25	2.5	2312.5	2418.0	47.5	49.6
03/25/94	119	MB	150	5	100	2.84	8.5	2414.0		49.6	
03/25/94	122	MB	150	6	100	2.84	8.9	2527.6		51.9	
03/25/94	5	MB	300	4	100	2.84	6.3	1789.2	1823.8	36.7	37.4
03/25/94	83	MB	300	5	100	2.84	5.8	1647.2		33.8	
03/25/94	26	MB	300	6	100	9.25	2.2	2035.0		41.8	
03/25/94	71	ML	0	4	100	9.25	5.2	4810.0	4871.7	98.7	100.0
03/25/94	103	ML	0	5	100	9.25	4.9	4532.5		93.0	
03/25/94	6	ML	0	6	100	9.25	5.7	5272.5		108.2	
03/25/94	37	ML	188	4	100	9.25	5.6	5180.0	5056.7	106.3	103.8
03/25/94	19	ML	188	5	100	9.25	5.5	5087.5		104.4	
03/25/94	24	ML	188	6	100	9.25	5.3	4902.5		100.6	
03/25/94	29	ML	375	4	100	9.25	4.8	4440.0	4871.7	91.1	100.0
03/25/94	47	ML	375	5	100	9.25	6	5550.0		113.9	
03/25/94	1	ML	375	6	100	9.25	5	4625.0		94.9	
03/25/94	126	ML	750	4	100	9.25	4.5	4162.5	4563.3	85.4	93.7
03/25/94	92	ML	750	5	100	9.25	4.9	4532.5		93.0	
03/25/94	61	ML	750	6	100	9.25	5.4	4995.0		102.5	
03/25/94	10	ML	1500	4	100	9.25	5.4	4995.0	5118.3	102.5	105.1
03/25/94	15	ML	1500	5	100	9.25	5.2	4810.0		98.7	
03/25/94	21	ML	1500	6	100	9.25	6	5550.0		113.9	
03/25/94	13	ML	3000	4	100	9.25	5.2	4810.0	4470.8	98.7	91.8
03/25/94	113	ML	3000	5	100	9.25	4.8	4440.0		91.1	
03/25/94	68	ML	3000	6	100	9.25	4.5	4162.5		85.4	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
24 HRS ANABAENA

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/29/94	2	AL	0	1	100	0.9	5	450.0	471.0	95.5	100.0
03/29/94	38	AL	0	2	100	0.9	5.6	504.0		107.0	
03/29/94	113	AL	0	3	100	0.9	5.1	459.0		97.5	
03/29/94	61	AL	188	1	100	0.9	5	450.0	444.0	95.5	94.3
03/29/94	51	AL	188	2	100	0.9	4.5	405.0		86.0	
03/29/94	55	AL	188	3	100	0.9	5.3	477.0		101.3	
03/29/94	90	AL	375	1	100	0.9	4.5	405.0	450.0	86.0	95.5
03/29/94	24	AL	375	2	100	0.9	5.4	486.0		103.2	
03/29/94	94	AL	375	3	100	0.9	5.1	459.0		97.5	
03/29/94	69	AL	750	1	100	0.9	5.2	468.0	456.0	99.4	96.8
03/29/94	123	AL	750	2	100	0.9	5.2	468.0		99.4	
03/29/94	52	AL	750	3	100	0.9	4.8	432.0		91.7	
03/29/94	117	AL	1500	1	100	0.9	6	540.0	465.0	114.6	98.7
03/29/94	32	AL	1500	2	100	0.9	5.1	459.0		97.5	
03/29/94	104	AL	1500	3	100	0.9	4.4	396.0		84.1	
03/29/94	74	AL	3000	1	100	0.9	3.3	297.0	438.0	63.1	93.0
03/29/94	107	AL	3000	2	100	0.9	6.1	549.0		116.6	
03/29/94	17	AL	3000	3	100	0.9	5.2	468.0		99.4	
03/29/94	2	AT	0	1	100	0.9	5	450.0	471.0	95.5	100.0
03/29/94	38	AT	0	2	100	0.9	5.6	504.0		107.0	
03/29/94	113	AT	0	3	100	0.9	5.1	459.0		97.5	
03/29/94	105	AT	188	1	100	0.9	7.6	684.0	663.0	145.2	140.8
03/29/94	26	AT	188	2	100	0.9	7.7	693.0		147.1	
03/29/94	11	AT	188	3	100	0.9	6.8	612.0		129.9	
03/29/94	102	AT	375	1	100	0.9	7.6	684.0	684.0	145.2	145.2
03/29/94	100	AT	375	2	100	0.9	8.8	792.0		168.2	
03/29/94	6	AT	375	3	100	0.9	6.4	576.0		122.3	
03/29/94	86	AT	750	1	100	0.9	9.4	846.0	759.0	179.6	161.1
03/29/94	45	AT	750	2	100	0.9	7.4	666.0		141.4	
03/29/94	116	AT	750	3	100	0.9	8.5	765.0		162.4	
03/29/94	70	AT	1500	1	100	0.9	9.2	828.0	744.0	175.8	158.0
03/29/94	79	AT	1500	2	100	0.9	6.6	594.0		126.1	
03/29/94	92	AT	1500	3	100	0.9	9	810.0		172.0	
03/29/94	96	AT	3000	1	100	0.9	9	810.0	750.0	172.0	159.2
03/29/94	15	AT	3000	2	100	0.9	7.6	684.0		145.2	
03/29/94	85	AT	3000	3	100	0.9	8.4	756.0		160.5	
03/29/94	2	MB	0	1	100	0.9	5	450.0	471.0	95.5	100.0
03/29/94	38	MB	0	2	100	0.9	5.6	504.0		107.0	
03/29/94	113	MB	0	3	100	0.9	5.1	459.0		97.5	
03/29/94	59	MB	188	1	100	2.84	3.3	937.2	873.4	199.0	185.4
03/29/94	47	MB	188	2	100	0.9	9.2	828.0		175.8	
03/29/94	41	MB	188	3	100	0.9	9.5	855.0		181.5	
03/29/94	49	MB	375	1	100	0.9	9	810.0	866.4	172.0	183.9
03/29/94	80	MB	375	2	100	2.84	3	852.0		180.9	
03/29/94	67	MB	375	3	100	2.84	3.3	937.2		199.0	
03/29/94	111	MB	750	1	100	0.9	8	720.0	780.0	152.9	165.6
03/29/94	31	MB	750	2	100	0.9	9.4	846.0		179.6	
03/29/94	88	MB	750	3	100	0.9	8.6	774.0		164.3	
03/29/94	26	MB	1500	1	100	0.9	9.4	846.0	819.0	179.6	173.9
03/29/94	8	MB	1500	2	100	0.9	8.1	729.0		154.8	
03/29/94	83	MB	1500	3	100	0.9	9.8	882.0		187.3	
03/29/94	93	MB	3000	1	100	0.9	10	900.0	886.8	191.1	188.3
03/29/94	77	MB	3000	2	100	0.9	8.2	738.0		156.7	
03/29/94	42	MB	3000	3	100	2.84	3.6	1022.4		217.1	
03/29/94	2	MT	0	1	100	0.9	5	450.0	471.0	95.5	100.0
03/29/94	38	MT	0	2	100	0.9	5.6	504.0		107.0	
03/29/94	113	MT	0	3	100	0.9	5.1	459.0		97.5	
03/29/94	58	MT	188	1	100	0.9	5.3	477.0	444.0	101.3	94.3
03/29/94	35	MT	188	2	100	0.9	4.6	414.0		87.9	
03/29/94	14	MT	188	3	100	0.9	4.9	441.0		93.6	
03/29/94	30	MT	375	1	100	0.9	4.6	414.0	426.0	87.9	90.4
03/29/94	124	MT	375	2	100	0.9	5	450.0		95.5	
03/29/94	91	MT	375	3	100	0.9	4.6	414.0		87.9	
03/29/94	19	MT	750	1	100	0.9	5.6	504.0	507.0	107.0	107.6
03/29/94	87	MT	750	2	100	0.9	5.8	522.0		110.8	
03/29/94	120	MT	750	3	100	0.9	5.5	495.0		105.1	
03/29/94	75	MT	1500	1	100	0.9	5.1	459.0	438.0	97.5	93.0
03/29/94	68	MT	1500	2	100	0.9	4.3	387.0		82.2	
03/29/94	63	MT	1500	3	100	0.9	5.2	468.0		99.4	
03/29/94	1	MT	3000	1	100	0.9	6	540.0	456.0	114.6	96.8
03/29/94	4	MT	3000	2	100	0.9	4.6	414.0		87.9	
03/29/94	71	MT	3000	3	100	0.9	4.6	414.0		87.9	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
48 HRS ANABAENA

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/30/94	2	AL	0	1	100	2.84	2.4	681.6	672.1	101.4	100.0
03/30/94	38	AL	0	2	100	2.84	2.2	624.8		93.0	
03/30/94	113	AL	0	3	100	2.84	2.5	710.0		105.6	
03/30/94	61	AL	188	1	100	2.84	2.4	681.6	624.8	101.4	93.0
03/30/94	51	AL	188	2	100	2.84	2.2	624.8		93.0	
03/30/94	55	AL	188	3	100	2.84	2	568.0		84.5	
03/30/94	90	AL	375	1	100	2.84	2	568.0	577.5	84.5	85.9
03/30/94	24	AL	375	2	100	2.84	2	568.0		84.5	
03/30/94	94	AL	375	3	100	2.84	2.1	596.4		88.7	
03/30/94	69	AL	750	1	100	2.84	2.2	624.8	643.7	93.0	95.8
03/30/94	123	AL	750	2	100	2.84	2.2	624.8		93.0	
03/30/94	52	AL	750	3	100	2.84	2.4	681.6		101.4	
03/30/94	117	AL	1500	1	100	2.84	2.2	624.8	596.4	93.0	88.7
03/30/94	32	AL	1500	2	100	2.84	2.1	596.4		68.7	
03/30/94	104	AL	1500	3	100	2.84	2	568.0		84.5	
03/30/94	74	AL	3000	1	100	2.84	2	568.0	627.0	84.5	93.3
03/30/94	107	AL	3000	2	100	2.84	2.5	710.0		105.6	
03/30/94	17	AL	3000	3	100	0.9	6.7	603.0		89.7	
03/30/94	2	AT	0	1	100	2.84	2.4	681.6	672.1	101.4	100.0
03/30/94	38	AT	0	2	100	2.84	2.2	624.8		93.0	
03/30/94	113	AT	0	3	100	2.84	2.5	710.0		105.6	
03/30/94	105	AT	188	1	100	2.84	3.5	994.0	984.5	147.9	146.5
03/30/94	28	AT	188	2	100	2.84	3.4	965.6		143.7	
03/30/94	11	AT	188	3	100	2.84	3.5	994.0		147.9	
03/30/94	102	AT	375	1	100	2.84	3	852.0	899.3	126.8	133.8
03/30/94	100	AT	375	2	100	2.84	3.2	908.8		135.2	
03/30/94	6	AT	375	3	100	2.84	3.3	937.2		139.4	
03/30/94	86	AT	750	1	100	2.84	3.1	880.4	927.7	131.0	138.0
03/30/94	45	AT	750	2	100	2.84	3.5	994.0		147.9	
03/30/94	116	AT	750	3	100	2.84	3.2	908.8		135.2	
03/30/94	70	AT	1500	1	100	2.84	3.6	1022.4	946.7	152.1	140.8
03/30/94	79	AT	1500	2	100	2.84	2.8	795.2		118.3	
03/30/94	92	AT	1500	3	100	2.84	3.6	1022.4		152.1	
03/30/94	96	AT	3000	1	100	2.84	3.3	937.2	814.1	139.4	121.1
03/30/94	15	AT	3000	2	100	2.84	2.4	681.6		101.4	
03/30/94	85	AT	3000	3	100	2.84	2.9	823.6		122.5	
03/30/94	2	MB	0	1	100	2.84	2.4	681.6	672.1	101.4	100.0
03/30/94	38	MB	0	2	100	2.84	2.2	624.8		93.0	
03/30/94	113	MB	0	3	100	2.84	2.5	710.0		105.6	
03/30/94	59	MB	188	1	100	2.84	4.2	1192.8	1154.9	177.5	171.8
03/30/94	47	MB	188	2	100	2.84	4.4	1249.6		185.9	
03/30/94	41	MB	188	3	100	2.84	3.6	1022.4		152.1	
03/30/94	49	MB	375	1	100	2.84	3.4	965.6	994.0	143.7	147.9
03/30/94	80	MB	375	2	100	2.84	3.4	965.6		143.7	
03/30/94	67	MB	375	3	100	2.84	3.7	1050.8		156.3	
03/30/94	111	MB	750	1	100	2.84	2.6	738.4	833.1	109.9	123.9
03/30/94	31	MB	750	2	100	2.84	3.3	937.2		139.4	
03/30/94	88	MB	750	3	100	2.84	2.9	823.6		122.5	
03/30/94	26	MB	1500	1	100	2.84	2.8	795.2	813.1	118.3	121.0
03/30/94	8	MB	1500	2	100	0.9	8.8	792.0		117.8	
03/30/94	83	MB	1500	3	100	2.84	3	852.0		126.8	
03/30/94	93	MB	3000	1	100	2.84	2.8	795.2	795.2	118.3	118.3
03/30/94	77	MB	3000	2	100	2.84	2.8	795.2		118.3	
03/30/94	42	MB	3000	3	100	2.84	2.8	795.2		118.3	
03/30/94	2	MT	0	1	100	2.84	2.4	681.6	672.1	101.4	100.0
03/30/94	38	MT	0	2	100	2.84	2.2	624.8		93.0	
03/30/94	113	MT	0	3	100	2.84	2.5	710.0		105.6	
03/30/94	56	MT	188	1	100	2.84	2.2	624.8	605.9	93.0	90.1
03/30/94	35	MT	188	2	100	2.84	2	568.0		84.5	
03/30/94	14	MT	188	3	100	2.84	2.2	624.8		93.0	
03/30/94	30	MT	375	1	100	2.84	2	568.0	596.4	84.5	88.7
03/30/94	124	MT	375	2	100	2.84	2.1	596.4		88.7	
03/30/94	91	MT	375	3	100	2.84	2.2	624.8		93.0	
03/30/94	19	MT	750	1	100	2.84	2.1	596.4	653.2	88.7	97.2
03/30/94	87	MT	750	2	100	2.84	2.4	681.6		101.4	
03/30/94	120	MT	750	3	100	2.84	2.4	681.6		101.4	
03/30/94	75	MT	1500	1	100	2.84	2.1	596.4	634.3	68.7	94.4
03/30/94	68	MT	1500	2	100	2.84	2.2	624.8		93.0	
03/30/94	63	MT	1500	3	100	2.84	2.4	681.6		101.4	
03/30/94	1	MT	3000	1	100	0.9	7.2	648.0	649.3	96.4	96.6
03/30/94	4	MT	3000	2	100	0.9	7.5	675.0		100.4	
03/30/94	71	MT	3000	3	100	2.84	2.2	624.8		93.0	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
72 HRS ANABAENA

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/31/94	2	AL	0	1	100	2.84	3.6	1022.4	1031.9	99.1	100.0
03/31/94	38	AL	0	2	100	2.84	3.6	1022.4		99.1	
03/31/94	113	AL	0	3	100	2.84	3.7	1050.8		101.8	
03/31/94	61	AL	188	1	100	2.84	3.4	965.6	927.7	93.6	89.9
03/31/94	51	AL	188	2	100	2.84	3.2	908.8		88.1	
03/31/94	55	AL	188	3	100	2.84	3.2	908.8		88.1	
03/31/94	90	AL	375	1	100	2.84	3.2	908.8	927.7	88.1	89.9
03/31/94	24	AL	375	2	100	2.84	3.4	908.8		88.1	
03/31/94	94	AL	375	3	100	2.84	3.3	965.6		93.6	
03/31/94	69	AL	750	1	100	2.84	3.3	937.2	975.1	90.8	94.5
03/31/94	123	AL	750	2	100	2.84	3.7	937.2		90.8	
03/31/94	52	AL	750	3	100	2.84	3.1	1050.8		101.8	
03/31/94	117	AL	1500	1	100	2.84	3.4	880.4	918.3	85.3	89.0
03/31/94	32	AL	1500	2	100	2.84	3.2	965.6		93.6	
03/31/94	104	AL	1500	3	100	2.84	3	908.8		88.1	
03/31/94	74	AL	3000	1	100	2.84	3.4	852.0	937.2	82.6	90.8
03/31/94	107	AL	3000	2	100	2.84	3.5	965.6		93.6	
03/31/94	17	AL	3000	3	100	2.84	2.6	994.0		96.3	
03/31/94	2	AT	0	1	100	2.84	3.6	1022.4	1031.9	99.1	100.0
03/31/94	38	AT	0	2	100	2.84	3.6	1022.4		99.1	
03/31/94	113	AT	0	3	100	2.84	3.7	1050.8		101.8	
03/31/94	105	AT	188	1	100	2.84	5.7	1760.8	1590.4	170.6	154.1
03/31/94	28	AT	188	2	100	2.84	4.9	1618.8		156.9	
03/31/94	11	AT	188	3	100	2.84	5.2	1391.6		134.9	
03/31/94	102	AT	375	1	100	2.84	5	1420.0	1476.8	137.6	143.1
03/31/94	100	AT	375	2	100	2.84	5.2	1476.8		143.1	
03/31/94	6	AT	375	3	100	2.84	5.4	1533.6		148.6	
03/31/94	86	AT	750	1	100	2.84	4.8	1363.2	1382.1	132.1	133.9
03/31/94	45	AT	750	2	100	2.84	4.4	1249.6		121.1	
03/31/94	116	AT	750	3	100	2.84	5.4	1533.6		148.6	
03/31/94	70	AT	1500	1	100	2.84	4.9	1391.6	1391.6	134.9	134.9
03/31/94	79	AT	1500	2	100	2.84	4.4	1249.6		121.1	
03/31/94	92	AT	1500	3	100	2.84	5.4	1533.6		148.6	
03/31/94	98	AT	3000	1	100	2.84	4	1136.0	1145.5	110.1	111.0
03/31/94	15	AT	3000	2	100	2.84	4.1	1164.4		112.8	
03/31/94	85	AT	3000	3	100	2.84	4	1136.0		110.1	
03/31/94	2	MB	0	1	100	2.84	3.6	1022.4	1031.9	99.1	100.0
03/31/94	38	MB	0	2	100	2.84	3.6	1022.4		99.1	
03/31/94	113	MB	0	3	100	2.84	3.7	1050.8		101.8	
03/31/94	59	MB	188	1	100	2.84	5.2	1476.8	1391.6	143.1	134.9
03/31/94	47	MB	188	2	100	2.84	4.9	1391.6		134.9	
03/31/94	41	MB	188	3	100	2.84	4.6	1306.4		126.6	
03/31/94	49	MB	375	1	100	2.84	4.6	1306.4	1249.6	126.6	121.1
03/31/94	80	MB	375	2	100	2.84	4.6	1306.4		126.6	
03/31/94	67	MB	375	3	100	2.84	4	1136.0		110.1	
03/31/94	111	MB	750	1	100	2.84	3.1	880.4	927.7	85.3	89.9
03/31/94	31	MB	750	2	100	2.84	3.4	965.6		93.6	
03/31/94	88	MB	750	3	100	2.84	3.3	937.2		90.8	
03/31/94	26	MB	1500	1	100	2.84	3	852.0	823.6	82.6	79.8
03/31/94	6	MB	1500	2	100	2.84	2.6	738.4		71.6	
03/31/94	63	MB	1500	3	100	2.84	3.1	880.4		85.3	
03/31/94	93	MB	3000	1	100	2.84	3	852.0	804.7	82.6	78.0
03/31/94	77	MB	3000	2	100	2.84	2.7	766.8		74.3	
03/31/94	42	MB	3000	3	100	2.84	2.6	795.2		77.1	
03/31/94	2	MT	0	1	100	2.84	3.6	1022.4	1031.9	99.1	100.0
03/31/94	38	MT	0	2	100	2.84	3.6	1022.4		99.1	
03/31/94	113	MT	0	3	100	2.84	3.7	1050.8		101.8	
03/31/94	58	MT	188	1	100	2.84	3.2	908.8	918.3	88.1	89.0
03/31/94	35	MT	188	2	100	2.84	3.3	937.2		90.8	
03/31/94	14	MT	188	3	100	2.84	3.2	908.8		88.1	
03/31/94	30	MT	375	1	100	2.84	3.1	880.4	956.1	85.3	92.7
03/31/94	124	MT	375	2	100	2.84	3.5	994.0		96.3	
03/31/94	91	MT	375	3	100	2.84	3.5	994.0		96.3	
03/31/94	19	MT	750	1	100	2.84	3.3	937.2	1012.9	90.8	98.2
03/31/94	87	MT	750	2	100	2.84	3.6	1022.4		99.1	
03/31/94	120	MT	750	3	100	2.84	3.6	1079.2		104.6	
03/31/94	75	MT	1500	1	100	2.84	3.6	1022.4	975.1	99.1	94.5
03/31/94	68	MT	1500	2	100	2.84	3.3	937.2		90.8	
03/31/94	63	MT	1500	3	100	2.84	3.4	965.6		93.6	
03/31/94	1	MT	3000	1	100	2.84	3	852.0	927.7	82.6	89.9
03/31/94	4	MT	3000	2	100	2.84	3.5	994.0		96.3	
03/31/94	71	MT	3000	3	100	2.84	3.3	937.2		90.8	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
96 HRS ANABAENA

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
04/01/94	2	AL	0	1	100	2.84	5.1	1448.4	1372.7	105.5	100.0
04/01/94	38	AL	0	2	100	2.84	4.8	1363.2		99.3	
04/01/94	113	AL	0	3	100	2.84	4.6	1306.4		95.2	
04/01/94	61	AL	188	1	100	2.84	4.9	1391.6	1325.3	101.4	96.6
04/01/94	51	AL	188	2	100	2.84	4.7	1334.8		97.2	
04/01/94	55	AL	188	3	100	2.84	4.4	1249.6		91.0	
04/01/94	90	AL	375	1	100	2.84	4.6	1306.4	1306.4	95.2	95.2
04/01/94	24	AL	375	2	100	2.84	4.6	1306.4		95.2	
04/01/94	94	AL	375	3	100	2.84	4.6	1306.4		95.2	
04/01/94	69	AL	750	1	100	2.84	4.6	1306.4	1363.2	95.2	99.3
04/01/94	123	AL	750	2	100	2.84	5.2	1476.8		107.6	
04/01/94	52	AL	750	3	100	2.84	4.6	1306.4		95.2	
04/01/94	117	AL	1500	1	100	2.84	4.8	1363.2	1315.9	99.3	95.9
04/01/94	32	AL	1500	2	100	2.84	4.6	1306.4		95.2	
04/01/94	104	AL	1500	3	100	2.84	4.5	1278.0		93.1	
04/01/94	74	AL	3000	1	100	2.84	4.8	1363.2	1401.1	99.3	102.1
04/01/94	107	AL	3000	2	100	2.84	5.6	1590.4		115.9	
04/01/94	17	AL	3000	3	100	2.84	4.4	1249.6		91.0	
04/01/94	2	AT	0	1	100	2.84	5.1	1448.4	1372.7	105.5	100.0
04/01/94	38	AT	0	2	100	2.84	4.8	1363.2		99.3	
04/01/94	113	AT	0	3	100	2.84	4.6	1306.4		95.2	
04/01/94	105	AT	188	1	100	2.84	7.2	2044.8	2025.9	149.0	147.6
04/01/94	28	AT	188	2	100	2.84	6.8	1931.2		140.7	
04/01/94	11	AT	188	3	100	2.84	7.4	2101.6		153.1	
04/01/94	102	AT	375	1	100	2.84	7.2	2044.8	2120.5	149.0	154.5
04/01/94	100	AT	375	2	100	2.84	7.6	2158.4		157.2	
04/01/94	6	AT	375	3	100	2.84	7.6	2158.4		157.2	
04/01/94	86	AT	750	1	100	2.84	6.6	1874.4	1836.5	136.6	133.8
04/01/94	45	AT	750	2	100	2.84	6.1	1732.4		126.2	
04/01/94	116	AT	750	3	100	2.84	6.7	1902.8		138.6	
04/01/94	70	AT	1500	1	100	2.84	6.8	1931.2	1864.9	140.7	135.9
04/01/94	79	AT	1500	2	100	2.84	6.4	1817.6		132.4	
04/01/94	92	AT	1500	3	100	2.84	6.5	1846.0		134.5	
04/01/94	96	AT	3000	1	100	2.84	4.8	1363.2	1334.8	99.3	97.2
04/01/94	15	AT	3000	2	100	2.84	4.4	1249.6		91.0	
04/01/94	85	AT	3000	3	100	2.84	4.9	1391.6		101.4	
04/01/94	2	MB	0	1	100	2.84	5.1	1448.4	1372.7	105.5	100.0
04/01/94	38	MB	0	2	100	2.84	4.8	1363.2		99.3	
04/01/94	113	MB	0	3	100	2.84	4.6	1306.4		95.2	
04/01/94	59	MB	188	1	100	2.84	7	1988.0	1883.9	144.8	137.2
04/01/94	47	MB	188	2	100	2.84	6.3	1789.2		130.3	
04/01/94	41	MB	188	3	100	2.84	6.6	1874.4		136.6	
04/01/94	49	MB	375	1	100	2.84	4.9	1391.6	1514.7	101.4	110.3
04/01/94	80	MB	375	2	100	2.84	5.5	1562.0		113.8	
04/01/94	67	MB	375	3	100	2.84	5.6	1590.4		115.9	
04/01/94	111	MB	750	1	100	2.84	3.4	965.6	1065.0	70.3	77.6
04/01/94	31	MB	750	2	100	2.84	4.1	1164.4		84.8	
04/01/94	88	MB	750	3	100	2.84	3.6	1022.4		74.5	
04/01/94	26	MB	1500	1	100	2.84	3	852.0	852.0	62.1	62.1
04/01/94	8	MB	1500	2	100	2.84	3	852.0		62.1	
04/01/94	83	MB	1500	3	100	2.84	3	852.0		62.1	
04/01/94	93	MB	3000	1	100	2.84	2.8	795.2	814.1	57.9	59.3
04/01/94	77	MB	3000	2	100	2.84	2.9	823.6		60.0	
04/01/94	42	MB	3000	3	100	2.84	2.9	823.6		60.0	
04/01/94	2	MT	0	1	100	2.84	5.1	1448.4	1372.7	105.5	100.0
04/01/94	38	MT	0	2	100	2.84	4.8	1363.2		99.3	
04/01/94	113	MT	0	3	100	2.84	4.6	1306.4		95.2	
04/01/94	58	MT	188	1	100	2.84	4.7	1334.8	1296.9	97.2	94.5
04/01/94	35	MT	188	2	100	2.84	4.6	1306.4		95.2	
04/01/94	14	MT	188	3	100	2.84	4.4	1249.6		91.0	
04/01/94	30	MT	375	1	100	2.84	4.4	1249.6	1334.8	91.0	97.2
04/01/94	124	MT	375	2	100	2.84	4.8	1363.2		99.3	
04/01/94	91	MT	375	3	100	2.84	4.9	1391.6		101.4	
04/01/94	19	MT	750	1	100	2.84	4.8	1363.2	1382.1	99.3	100.7
04/01/94	87	MT	750	2	100	2.84	4.7	1334.8		97.2	
04/01/94	120	MT	750	3	100	2.84	5.1	1448.4		105.5	
04/01/94	75	MT	1500	1	100	2.84	4.8	1363.2	1372.7	99.3	100.0
04/01/94	68	MT	1500	2	100	2.84	4.8	1363.2		99.3	
04/01/94	63	MT	1500	3	100	2.84	4.9	1391.6		101.4	
04/01/94	1	MT	3000	1	100	2.84	4.8	1363.2	1401.1	99.3	102.1
04/01/94	4	MT	3000	2	100	2.84	4.9	1391.6		101.4	
04/01/94	71	MT	3000	3	100	2.84	5.1	1448.4		105.5	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
24 HRS MICROCYSTIS

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/29/94	95	AL	0	4	100	0.9	2.1	189.0	186.0	101.6	100.0
03/29/94	34	AL	0	5	100	0.9	2.1	189.0		101.6	
03/29/94	10	AL	0	6	100	0.9	2	180.0		96.8	
03/29/94	43	AL	188	4	100	0.9	2.1	189.0	195.0	101.6	104.8
03/29/94	3	AL	188	5	100	0.9	2.2	198.0		106.5	
03/29/94	25	AL	188	6	100	0.9	2.2	198.0		106.5	
03/29/94	109	AL	375	4	100	0.9	2.2	198.0	195.0	106.5	104.8
03/29/94	39	AL	375	5	100	0.9	2.1	189.0		101.6	
03/29/94	106	AL	375	6	100	0.9	2.2	198.0		106.5	
03/29/94	112	AL	750	4	100	0.9	2.1	189.0	189.0	101.6	101.6
03/29/94	89	AL	750	5	100	0.9	2.2	198.0		106.5	
03/29/94	125	AL	750	6	100	0.9	2	180.0		96.8	
03/29/94	60	AL	1500	4	100	0.9	2	180.0	192.0	96.8	103.2
03/29/94	16	AL	1500	5	100	0.9	2.2	198.0		106.5	
03/29/94	23	AL	1500	6	100	0.9	2.2	198.0		106.5	
03/29/94	62	AL	3000	4	100	0.9	2.1	189.0	195.0	101.6	104.8
03/29/94	114	AL	3000	5	100	0.9	2.2	198.0		106.5	
03/29/94	57	AL	3000	6	100	0.9	2.2	198.0		106.5	
03/29/94	95	AT	0	4	100	0.9	2.1	189.0	186.0	101.6	100.0
03/29/94	34	AT	0	5	100	0.9	2.1	189.0		101.6	
03/29/94	10	AT	0	6	100	0.9	2	180.0		96.8	
03/29/94	106	AT	188	4	100	0.9	3.7	333.0	330.0	179.0	177.4
03/29/94	21	AT	188	5	100	0.9	3.6	324.0		174.2	
03/29/94	12	AT	188	6	100	0.9	3.7	333.0		179.0	
03/29/94	99	AT	375	4	100	0.9	3.6	324.0	318.0	174.2	171.0
03/29/94	37	AT	375	5	100	0.9	3.6	324.0		174.2	
03/29/94	122	AT	375	6	100	0.9	3.4	306.0		164.5	
03/29/94	65	AT	750	4	100	0.9	3.3	297.0	294.0	159.7	158.1
03/29/94	76	AT	750	5	100	0.9	3.4	306.0		164.5	
03/29/94	119	AT	750	6	100	0.9	3.1	279.0		150.0	
03/29/94	118	AT	1500	4	100	0.9	3.1	279.0	288.0	150.0	154.8
03/29/94	46	AT	1500	5	100	0.9	3.4	306.0		164.5	
03/29/94	9	AT	1500	6	100	0.9	3.1	279.0		150.0	
03/29/94	103	AT	3000	4	100	0.9	3.1	279.0	282.0	150.0	151.6
03/29/94	20	AT	3000	5	100	0.9	3.2	288.0		154.8	
03/29/94	50	AT	3000	6	100	0.9	3.1	279.0		150.0	
03/29/94	95	MB	0	4	100	0.9	2.1	189.0	186.0	101.6	100.0
03/29/94	34	MB	0	5	100	0.9	2.1	189.0		101.6	
03/29/94	10	MB	0	6	100	0.9	2	180.0		96.8	
03/29/94	40	MB	188	4	100	0.9	4.4	396.0	384.0	212.9	206.5
03/29/94	13	MB	188	5	100	0.9	4.2	378.0		203.2	
03/29/94	115	MB	188	6	100	0.9	4.2	378.0		203.2	
03/29/94	16	MB	375	4	100	0.9	3.9	351.0	348.0	188.7	187.1
03/29/94	110	MB	375	5	100	0.9	3.9	351.0		188.7	
03/29/94	54	MB	375	6	100	0.9	3.8	342.0		183.9	
03/29/94	22	MB	750	4	100	0.9	3.7	333.0	327.0	179.0	175.8
03/29/94	101	MB	750	5	100	0.9	3.6	324.0		174.2	
03/29/94	7	MB	750	6	100	0.9	3.6	324.0		174.2	
03/29/94	53	MB	1500	4	100	0.9	3.3	297.0	300.0	159.7	161.3
03/29/94	29	MB	1500	5	100	0.9	3.4	306.0		164.5	
03/29/94	56	MB	1500	6	100	0.9	3.3	297.0		159.7	
03/29/94	33	MB	3000	4	100	0.9	3.1	279.0	276.0	150.0	148.4
03/29/94	97	MB	3000	5	100	0.9	3	270.0		145.2	
03/29/94	61	MB	3000	6	100	0.9	3.1	279.0		150.0	
03/29/94	95	MT	0	4	100	0.9	2.1	189.0	186.0	101.6	100.0
03/29/94	34	MT	0	5	100	0.9	2.1	189.0		101.6	
03/29/94	10	MT	0	6	100	0.9	2	180.0		96.8	
03/29/94	44	MT	188	4	100	0.9	2.2	198.0	195.0	106.5	104.8
03/29/94	82	MT	188	5	100	0.9	2.3	207.0		111.3	
03/29/94	78	MT	188	6	100	0.9	2	180.0		96.8	
03/29/94	5	MT	375	4	100	0.9	2.1	189.0	189.0	101.6	101.6
03/29/94	66	MT	375	5	100	0.9	2.1	189.0		101.6	
03/29/94	84	MT	375	6	100	0.9	2.1	189.0		101.6	
03/29/94	64	MT	750	4	100	0.9	2.2	198.0	198.0	106.5	106.5
03/29/94	73	MT	750	5	100	0.9	2.2	198.0		106.5	
03/29/94	27	MT	750	6	100	0.9	2.2	198.0		106.5	
03/29/94	126	MT	1500	4	100	0.9	2.1	189.0	195.0	101.6	104.8
03/29/94	96	MT	1500	5	100	0.9	2.3	207.0		111.3	
03/29/94	121	MT	1500	6	100	0.9	2.1	189.0		101.6	
03/29/94	48	MT	3000	4	100	0.9	2.2	198.0	201.0	106.5	108.1
03/29/94	72	MT	3000	5	100	0.9	2.2	198.0		106.5	
03/29/94	36	MT	3000	6	100	0.9	2.3	207.0		111.3	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
48 HRS MICROCYSTIS

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/30/94	95	AL	0	4	100	0.9	3.4	306.0	312.0	98.1	100.0
03/30/94	34	AL	0	5	100	0.9	3.6	324.0		103.8	
03/30/94	10	AL	0	6	100	0.9	3.4	306.0		98.1	
03/30/94	43	AL	188	4	100	0.9	3.4	306.0	306.0	98.1	98.1
03/30/94	3	AL	188	5	100	0.9	3.4	306.0		98.1	
03/30/94	25	AL	188	6	100	0.9	3.4	306.0		98.1	
03/30/94	109	AL	375	4	100	0.9	3.4	306.0	318.0	98.1	101.9
03/30/94	39	AL	375	5	100	0.9	3.6	324.0		103.8	
03/30/94	108	AL	375	6	100	0.9	3.6	324.0		103.8	
03/30/94	112	AL	750	4	100	0.9	3.6	324.0	324.0	103.8	103.8
03/30/94	69	AL	750	5	100	0.9	3.6	324.0		103.8	
03/30/94	125	AL	750	6	100	0.9	3.6	324.0		103.8	
03/30/94	60	AL	1500	4	100	0.9	3.4	306.0	306.0	98.1	98.1
03/30/94	16	AL	1500	5	100	0.9	3.4	306.0		98.1	
03/30/94	23	AL	1500	6	100	0.9	3.4	306.0		98.1	
03/30/94	62	AL	3000	4	100	0.9	3.4	306.0	312.0	98.1	100.0
03/30/94	114	AL	3000	5	100	0.9	3.4	306.0		98.1	
03/30/94	57	AL	3000	6	100	0.9	3.6	324.0		103.8	
03/30/94	95	AT	0	4	100	0.9	3.4	306.0	312.0	98.1	100.0
03/30/94	34	AT	0	5	100	0.9	3.6	324.0		103.8	
03/30/94	10	AT	0	6	100	0.9	3.4	306.0		98.1	
03/30/94	106	AT	188	4	100	0.9	4.2	378.0	372.0	121.2	119.2
03/30/94	21	AT	188	5	100	0.9	4	360.0		115.4	
03/30/94	12	AT	188	6	100	0.9	4.2	378.0		121.2	
03/30/94	99	AT	375	4	100	0.9	3.7	333.0	327.0	106.7	104.8
03/30/94	37	AT	375	5	100	0.9	3.6	324.0		103.8	
03/30/94	122	AT	375	6	100	0.9	3.6	324.0		103.8	
03/30/94	65	AT	750	4	100	0.9	3.2	288.0	297.0	92.3	95.2
03/30/94	76	AT	750	5	100	0.9	3.4	306.0		98.1	
03/30/94	119	AT	750	6	100	0.9	3.3	297.0		95.2	
03/30/94	116	AT	1500	4	100	0.9	3.2	288.0	282.0	92.3	90.4
03/30/94	46	AT	1500	5	100	0.9	3.2	288.0		92.3	
03/30/94	9	AT	1500	6	100	0.9	3	270.0		86.5	
03/30/94	103	AT	3000	4	100	0.9	3	270.0	267.0	86.5	85.6
03/30/94	20	AT	3000	5	100	0.9	3.1	279.0		89.4	
03/30/94	50	AT	3000	6	100	0.9	2.8	252.0		80.8	
03/30/94	95	MB	0	4	100	0.9	3.4	306.0	312.0	98.1	100.0
03/30/94	34	MB	0	5	100	0.9	3.6	324.0		103.8	
03/30/94	10	MB	0	6	100	0.9	3.4	306.0		98.1	
03/30/94	40	MB	188	4	100	0.9	4.9	441.0	447.0	141.3	143.3
03/30/94	13	MB	188	5	100	0.9	4.8	432.0		138.5	
03/30/94	115	MB	188	6	100	0.9	5.2	468.0		150.0	
03/30/94	18	MB	375	4	100	0.9	4.1	369.0	372.0	118.3	119.2
03/30/94	110	MB	375	5	100	0.9	4.2	378.0		121.2	
03/30/94	54	MB	375	6	100	0.9	4.1	369.0		118.3	
03/30/94	22	MB	750	4	100	0.9	3.6	324.0	324.0	103.8	103.8
03/30/94	101	MB	750	5	100	0.9	3.6	324.0		103.8	
03/30/94	7	MB	750	6	100	0.9	3.6	324.0		103.8	
03/30/94	53	MB	1500	4	100	0.9	3.2	288.0	300.0	92.3	96.2
03/30/94	29	MB	1500	5	100	0.9	3.4	306.0		98.1	
03/30/94	56	MB	1500	6	100	0.9	3.4	306.0		98.1	
03/30/94	33	MB	3000	4	100	0.9	3.3	297.0	282.0	95.2	90.4
03/30/94	97	MB	3000	5	100	0.9	2.9	261.0		83.7	
03/30/94	81	MB	3000	6	100	0.9	3.2	288.0		92.3	
03/30/94	95	MT	0	4	100	0.9	3.4	306.0	312.0	98.1	100.0
03/30/94	34	MT	0	5	100	0.9	3.6	324.0		103.8	
03/30/94	10	MT	0	6	100	0.9	3.4	306.0		98.1	
03/30/94	44	MT	188	4	100	0.9	3.6	324.0	315.0	103.8	101.0
03/30/94	82	MT	188	5	100	0.9	3.4	306.0		98.1	
03/30/94	78	MT	188	6	100	0.9	3.5	315.0		101.0	
03/30/94	5	MT	375	4	100	0.9	3.7	333.0	318.0	106.7	101.9
03/30/94	66	MT	375	5	100	0.9	3.4	306.0		98.1	
03/30/94	64	MT	375	6	100	0.9	3.5	315.0		101.0	
03/30/94	64	MT	750	4	100	0.9	3.8	342.0	339.0	109.6	108.7
03/30/94	73	MT	750	5	100	0.9	4	360.0		115.4	
03/30/94	27	MT	750	6	100	0.9	3.5	315.0		101.0	
03/30/94	126	MT	1500	4	100	0.9	3.8	342.0	330.0	109.6	105.8
03/30/94	96	MT	1500	5	100	0.9	3.8	342.0		109.6	
03/30/94	121	MT	1500	6	100	0.9	3.4	306.0		98.1	
03/30/94	48	MT	3000	4	100	0.9	3.6	324.0	324.0	103.8	103.8
03/30/94	72	MT	3000	5	100	0.9	3.6	324.0		103.8	
03/30/94	36	MT	3000	6	100	0.9	3.6	324.0		103.8	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
72 HRS MICROCYSTIS

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
03/31/94	95	AL	0	4	100	0.9	6.2	558.0	564.0	101.6	102.7
03/31/94	34	AL	0	5	100	0.9	6.2	558.0		101.6	
03/31/94	10	AL	0	6	100	0.9	6.4	576.0		104.9	
03/31/94	43	AL	188	4	100	0.9	6.2	558.0	549.0	101.6	100.0
03/31/94	3	AL	188	5	100	0.9	6.1	549.0		100.0	
03/31/94	25	AL	188	6	100	0.9	6	540.0		98.4	
03/31/94	109	AL	375	4	100	0.9	5.8	252.0	429.0	45.9	78.1
03/31/94	39	AL	375	5	100	0.9	5.7	522.0		95.1	
03/31/94	106	AL	375	6	100	0.9	6.2	513.0		93.4	
03/31/94	112	AL	750	4	100	0.9	6	468.0	522.0	85.2	95.1
03/31/94	89	AL	750	5	100	0.9	6.2	540.0		98.4	
03/31/94	125	AL	750	6	100	0.9	5.6	558.0		101.6	
03/31/94	60	AL	1500	4	100	0.9	5.8	504.0	507.0	91.8	92.3
03/31/94	16	AL	1500	5	100	0.9	5.5	522.0		95.1	
03/31/94	23	AL	1500	6	100	0.9	5.7	495.0		90.2	
03/31/94	62	AL	3000	4	100	0.9	5.9	513.0	522.0	93.4	95.1
03/31/94	114	AL	3000	5	100	0.9	5.8	531.0		96.7	
03/31/94	57	AL	3000	6	100	0.9	5.9	522.0		95.1	
03/31/94	95	AT	0	4	100	0.9	6.2	558.0	564.0	101.6	102.7
03/31/94	34	AT	0	5	100	0.9	6.2	558.0		101.6	
03/31/94	10	AT	0	6	100	0.9	6.4	576.0		104.9	
03/31/94	106	AT	188	4	100	0.9	4	360.0	351.0	65.6	63.9
03/31/94	21	AT	188	5	100	0.9	4	360.0		65.6	
03/31/94	12	AT	188	6	100	0.9	3.7	333.0		60.7	
03/31/94	99	AT	375	4	100	0.9	3.4	306.0	318.0	55.7	57.9
03/31/94	37	AT	375	5	100	0.9	3.6	324.0		59.0	
03/31/94	122	AT	375	6	100	0.9	3.6	324.0		59.0	
03/31/94	65	AT	750	4	100	0.9	3.2	288.0	297.0	52.5	54.1
03/31/94	76	AT	750	5	100	0.9	3.2	288.0		52.5	
03/31/94	119	AT	750	6	100	0.9	3.5	315.0		57.4	
03/31/94	118	AT	1500	4	100	0.9	3.2	288.0	273.0	52.5	49.7
03/31/94	46	AT	1500	5	100	0.9	2.9	261.0		47.5	
03/31/94	9	AT	1500	6	100	0.9	3	270.0		49.2	
03/31/94	103	AT	3000	4	100	0.9	3.4	306.0	282.0	55.7	51.4
03/31/94	20	AT	3000	5	100	0.9	3.1	279.0		50.8	
03/31/94	50	AT	3000	6	100	0.9	2.9	261.0		47.5	
03/31/94	95	MB	0	4	100	0.9	6.2	558.0	564.0	101.6	102.7
03/31/94	34	MB	0	5	100	0.9	6.2	558.0		101.6	
03/31/94	10	MB	0	6	100	0.9	6.4	576.0		104.9	
03/31/94	40	MB	188	4	100	0.9	5.5	495.0	471.0	90.2	85.8
03/31/94	13	MB	188	5	100	0.9	4.6	414.0		75.4	
03/31/94	115	MB	188	6	100	0.9	5.6	504.0		91.8	
03/31/94	18	MB	375	4	100	0.9	4.1	369.0	387.0	67.2	70.5
03/31/94	110	MB	375	5	100	0.9	4.4	396.0		72.1	
03/31/94	54	MB	375	6	100	0.9	4.4	396.0		72.1	
03/31/94	22	MB	750	4	100	0.9	3.4	306.0	300.0	55.7	54.6
03/31/94	101	MB	750	5	100	0.9	3.4	306.0		55.7	
03/31/94	7	MB	750	6	100	0.9	3.2	288.0		52.5	
03/31/94	53	MB	1500	4	100	0.9	3.2	288.0	303.0	52.5	55.2
03/31/94	29	MB	1500	5	100	0.9	3.4	306.0		55.7	
03/31/94	56	MB	1500	6	100	0.9	3.5	315.0		57.4	
03/31/94	33	MB	3000	4	100	0.9	3.3	297.0	303.0	54.1	55.2
03/31/94	97	MB	3000	5	100	0.9	3.4	306.0		55.7	
03/31/94	61	MB	3000	6	100	0.9	3.4	306.0		55.7	
03/31/94	95	MT	0	4	100	0.9	6.2	558.0	564.0	101.6	102.7
03/31/94	34	MT	0	5	100	0.9	6.2	558.0		101.6	
03/31/94	10	MT	0	6	100	0.9	6.4	576.0		104.9	
03/31/94	44	MT	188	4	100	0.9	6.5	585.0	585.0	106.6	106.6
03/31/94	82	MT	188	5	100	0.9	6.6	594.0		108.2	
03/31/94	78	MT	188	6	100	0.9	6.4	576.0		104.9	
03/31/94	5	MT	375	4	100	0.9	6.4	576.0	576.0	104.9	104.9
03/31/94	66	MT	375	5	100	0.9	6.5	585.0		106.6	
03/31/94	84	MT	375	6	100	0.9	6.3	567.0		103.3	
03/31/94	64	MT	750	4	100	0.9	6.6	594.0	576.0	108.2	104.9
03/31/94	73	MT	750	5	100	0.9	6.4	576.0		104.9	
03/31/94	27	MT	750	6	100	0.9	6.2	558.0		101.6	
03/31/94	126	MT	1500	4	100	0.9	6.6	594.0	576.0	108.2	104.9
03/31/94	96	MT	1500	5	100	0.9	6.6	594.0		108.2	
03/31/94	121	MT	1500	6	100	0.9	6	540.0		98.4	
03/31/94	46	MT	3000	4	100	0.9	6.2	558.0	573.0	101.6	104.4
03/31/94	72	MT	3000	5	100	0.9	6.4	576.0		104.9	
03/31/94	36	MT	3000	6	100	0.9	6.5	585.0		106.6	

APPENDIX II: EFFECTS OF HERBICIDES ON ALGAE DATA
96 HRS MICROCYSTIS

DATE	Random Number Code	Chemical Name	Dilution	Rep	MULT.	SENS.	SCALE	UNIT	AVG UNIT	PERCET OF CONTROL	AVG % OF CONTROL
04/01/94	95	AL	0	4	100	2.84	2.9	823.6	861.5	95.6	100.0
04/01/94	34	AL	0	5	100	2.84	3.2	908.8		105.5	
04/01/94	10	AL	0	6	100	2.84	3	852.0		98.9	
04/01/94	43	AL	188	4	100	2.84	2.6	738.4	766.8	85.7	89.0
04/01/94	3	AL	188	5	100	2.84	2.7	766.8		89.0	
04/01/94	25	AL	188	6	100	2.84	2.8	795.2		92.3	
04/01/94	109	AL	375	4	100	2.84	2.2	624.8	624.8	72.5	72.5
04/01/94	39	AL	375	5	100	2.84	2.2	624.8		72.5	
04/01/94	108	AL	375	6	100	2.84	2.2	624.8		72.5	
04/01/94	112	AL	750	4	100	2.84	2.1	596.4	624.8	69.2	72.5
04/01/94	89	AL	750	5	100	2.84	2.3	653.2		75.8	
04/01/94	125	AL	750	6	100	2.84	2.2	624.8		72.5	
04/01/94	60	AL	1500	4	100	2.84	2.2	624.8	586.9	72.5	68.1
04/01/94	16	AL	1500	5	100	2.84	2	568.0		65.9	
04/01/94	23	AL	1500	6	100	2.84	2	568.0		65.9	
04/01/94	62	AL	3000	4	100	2.84	2.4	681.6	643.7	79.1	74.7
04/01/94	114	AL	3000	5	100	2.84	2.1	596.4		69.2	
04/01/94	57	AL	3000	6	100	2.84	2.3	653.2		75.8	
04/01/94	95	AT	0	4	100	2.84	2.9	823.6	861.5	95.6	100.0
04/01/94	34	AT	0	5	100	2.84	3.2	908.8		105.5	
04/01/94	10	AT	0	6	100	2.84	3	852.0		98.9	
04/01/94	106	AT	188	4	100	0.9	2.2	198.0	216.0	23.0	25.1
04/01/94	21	AT	188	5	100	0.9	2.4	216.0		25.1	
04/01/94	12	AT	188	6	100	0.9	2.6	234.0		27.2	
04/01/94	99	AT	375	4	100	0.9	1.8	162.0	180.0	18.8	20.9
04/01/94	37	AT	375	5	100	0.9	2.2	198.0		23.0	
04/01/94	122	AT	375	6	100	0.9	2	180.0		20.9	
04/01/94	65	AT	750	4	100	0.9	2.4	216.0	219.0	25.1	25.4
04/01/94	76	AT	750	5	100	0.9	2.4	216.0		25.1	
04/01/94	119	AT	750	6	100	0.9	2.5	225.0		26.1	
04/01/94	118	AT	1500	4	100	0.9	2.1	189.0	195.0	21.9	22.8
04/01/94	46	AT	1500	5	100	0.9	2.2	198.0		23.0	
04/01/94	9	AT	1500	6	100	0.9	2.2	198.0		23.0	
04/01/94	103	AT	3000	4	100	0.9	2.5	225.0	213.0	26.1	24.7
04/01/94	20	AT	3000	5	100	0.9	2.4	216.0		25.1	
04/01/94	50	AT	3000	6	100	0.9	2.2	198.0		23.0	
04/01/94	95	MB	0	4	100	2.84	2.9	823.6	861.5	95.6	100.0
04/01/94	34	MB	0	5	100	2.84	3.2	908.8		105.5	
04/01/94	10	MB	0	6	100	2.84	3	852.0		98.9	
04/01/94	40	MB	188	4	100	0.9	4.7	423.0	372.0	49.1	43.2
04/01/94	13	MB	188	5	100	0.9	3.9	351.0		40.7	
04/01/94	115	MB	188	6	100	0.9	3.8	342.0		39.7	
04/01/94	18	MB	375	4	100	0.9	2.8	252.0	252.0	29.3	29.3
04/01/94	110	MB	375	5	100	0.9	2.6	234.0		27.2	
04/01/94	54	MB	375	6	100	0.9	3	270.0		31.3	
04/01/94	22	MB	750	4	100	0.9	2.6	234.0	225.0	27.2	26.1
04/01/94	101	MB	750	5	100	0.9	2.2	198.0		23.0	
04/01/94	7	MB	750	6	100	0.9	2.7	243.0		28.2	
04/01/94	53	MB	1500	4	100	0.9	2.6	234.0	237.0	27.2	27.5
04/01/94	29	MB	1500	5	100	0.9	2.4	216.0		25.1	
04/01/94	56	MB	1500	6	100	0.9	2.9	261.0		30.3	
04/01/94	33	MB	3000	4	100	0.9	2.4	216.0	228.0	25.1	26.5
04/01/94	97	MB	3000	5	100	0.9	2.6	234.0		27.2	
04/01/94	81	MB	3000	6	100	0.9	2.6	234.0		27.2	
04/01/94	95	MT	0	4	100	2.84	2.9	823.6	861.5	95.6	100.0
04/01/94	34	MT	0	5	100	2.84	3.2	908.8		105.5	
04/01/94	10	MT	0	6	100	2.84	3	852.0		98.9	
04/01/94	44	MT	188	4	100	2.84	2.8	795.2	804.7	92.3	93.4
04/01/94	82	MT	188	5	100	2.84	2.9	823.6		95.6	
04/01/94	78	MT	188	6	100	2.84	2.8	795.2		92.3	
04/01/94	5	MT	375	4	100	2.84	2.9	823.6	804.7	95.6	93.4
04/01/94	66	MT	375	5	100	2.84	2.8	795.2		92.3	
04/01/94	84	MT	375	6	100	2.84	2.8	795.2		92.3	
04/01/94	64	MT	750	4	100	2.84	3	852.0	814.1	98.9	94.5
04/01/94	73	MT	750	5	100	2.84	2.6	738.4		85.7	
04/01/94	27	MT	750	6	100	2.84	3	852.0		98.9	
04/01/94	126	MT	1500	4	100	2.84	2.4	681.6	691.1	79.1	80.2
04/01/94	96	MT	1500	5	100	2.84	2.6	738.4		85.7	
04/01/94	121	MT	1500	6	100	2.84	2.3	653.2		75.8	
04/01/94	48	MT	3000	4	100	2.84	2.4	681.6	700.5	79.1	81.3
04/01/94	72	MT	3000	5	100	2.84	2.4	681.6		79.1	
04/01/94	36	MT	3000	6	100	2.84	2.6	738.4		85.7	

APPENDIX III: EFFECTS OF HERBICIDES ON MACROPHYTES
96 HRS WITH LEMNA

DATE	RANDOM NUMBER	CHEM	DOSE	REP	FROND NUMBER	FROND GROWTH	AVG FROND GROWTH	PERCENT CONTROL GROWTH	AVG % CON GROWTH
01/28/94		AL	0	1	26	14	14	102	100
01/28/94		AL	0	2	24	12		88	
01/28/94		AL	0	3	27	15		110	
01/28/94		AL	187	1	18	6	7	44	51
01/28/94		AL	187	2	18	6		44	
01/28/94		AL	187	3	21	9		66	
01/28/94		AL	375	1	22	10	7	73	54
01/28/94		AL	375	2	18	6		44	
01/28/94		AL	375	3	18	6		44	
01/28/94		AL	750	1	22	10	8	73	61
01/28/94		AL	750	2	20	8		59	
01/28/94		AL	750	3	19	7		51	
01/28/94		AL	1500	1	24	12	9	88	66
01/28/94		AL	1500	2	19	7		51	
01/28/94		AL	1500	3	20	8		59	
01/28/94		AL	3000	1	16	4	5	29	39
01/28/94		AL	3000	2	16	4		29	
01/28/94		AL	3000	3	20	8		59	
01/28/94		AT	0	1	34	22	16	140	100
01/28/94		AT	0	2	26	14		89	
01/28/94		AT	0	3	23	11		70	
01/28/94		AT	38	1	25	13	11	83	70
01/28/94		AT	38	2	25	13		83	
01/28/94		AT	38	3	19	7		45	
01/28/94		AT	75	1	22	10	8	64	53
01/28/94		AT	75	2	19	7		45	
01/28/94		AT	75	3	20	8		51	
01/28/94		AT	150	1	15	3	5	19	34
01/28/94		AT	150	2	17	5		32	
01/28/94		AT	150	3	20	8		51	
01/28/94		AT	300	1	16	4	7	26	43
01/28/94		AT	300	2	18	6		38	
01/28/94		AT	300	3	22	10		64	
01/28/94		AT	600	1	12	0	1	0	9
01/28/94		AT	600	2	14	2		13	
01/28/94		AT	600	3	14	2		13	
01/28/94		MB	0	1	24	12	15	82	100
01/28/94		MB	0	2	29	17		116	
01/28/94		MB	0	3	27	15		102	
01/28/94		MB	19	1	18	6	9	41	64
01/28/94		MB	19	2	23	11		75	
01/28/94		MB	19	3	23	11		75	
01/28/94		MB	38	1	18	6	7	41	48
01/28/94		MB	38	2	21	9		61	
01/28/94		MB	38	3	18	6		41	
01/28/94		MB	75	1	13	1	3	7	20
01/28/94		MB	75	2	15	3		20	
01/28/94		MB	75	3	17	5		34	
01/28/94		MB	150	1	14	2	1	14	9
01/28/94		MB	150	2	13	1		7	
01/28/94		MB	150	3	13	1		7	
01/28/94		MB	300	1	13	1	1	7	5
01/28/94		MB	300	2	12	0		0	
01/28/94		MB	300	3	13	1		7	
01/28/94		ML	0	1	29	17	17	102	100
01/28/94		ML	0	2	29	17		102	
01/28/94		ML	0	3	28	16		96	
01/28/94		ML	187	1	29	17	12	102	74
01/28/94		ML	187	2	20	8		48	
01/28/94		ML	187	3	24	12		72	
01/28/94		ML	375	1	20	8	8	48	48
01/28/94		ML	375	2	18	6		36	
01/28/94		ML	375	3	22	10		60	
01/28/94		ML	750	1	21	9	9	54	52
01/28/94		ML	.750	2	21	9		54	
01/28/94		ML	750	3	20	8		48	
01/28/94		ML	1500	1	21	9	6	54	38
01/28/94		ML	1500	2	16	4		24	
01/28/94		ML	1500	3	18	6		36	
01/28/94		ML	3000	1	20	8	6	48	36
01/28/94		ML	3000	2	17	5		30	
01/28/94		ML	3000	3	17	5		30	

APPENDIX III: EFFECTS OF HERBICIDES ON MACROPHYTES
DAY 14 WITH NAJAS

Date	Beaker #	Chemical	Chemical Conc.	Rep.	Weight (gm)	Average Weight (gm)	% Of Control For Weight	Mean % Of Control For Weight	# Of Recruits	Average # Of Recruits	% Of Control For # Of Recruits	Mean % Of Control For # Of Recruits	Weight Per Recruit (mg)	Average Weight Per Recruit (mg)	% Of Control For Weight Per Recruit	Mean % Of Control For Weight Per Recruit
04\22\94	9	AL	47	1	0.009	0.1861	5.006489894	104	7	44	16.8	106	1.3	3.4	30.96209391	82.6
04\22\94	64	AL	47	2	0.2828		157.315036		54		129.6		5.2		126.1978459	
04\22\94	66	AL	47	3	0.2666		148.3033562		71		170.4		3.8		90.48322951	
04\22\94	38	AL	94	1	0.2292	0.1172	127.4966093	65	57	38	136.8	87	4.0	2.8	96.89604575	68.7
04\22\94	42	AL	94	2	0.0366		20.35972557		22		52.8		1.7		40.06695182	
04\22\94	19	AL	94	3	0.0859		47.78416466		30		72		2.9		68.99827062	
04\22\94	18	AL	188	1	0.1788	0.1182	99.4622659	66	61	44	146.4	105	2.9	2.7	70.63240207	63.9
04\22\94	11	AL	188	2	0.0885		49.23048396		35		84		2.5		60.93145136	
04\22\94	40	AL	188	3	0.0872		48.50732431		35		84		2.5		60.03641309	
04\22\94	22	AL	375	1	0.1144	0.1019	63.63804932	57	58	50	139.2	120	2.0	2.1	47.5296164	49.5
04\22\94	29	AL	375	2	0.0957		53.23567588		42		100.8		2.3		54.90715532	
04\22\94	59	AL	375	3	0.0955		53.12442055		50		120		1.9		46.02562173	
04\22\94	6	AL	750	1	0.068	0.0818	37.82681253	45	45	49	108	117	1.5	1.7	36.41352272	40.7
04\22\94	24	AL	750	2	0.0837		46.56035602		43		103.2		1.9		46.90544915	
04\22\94	45	AL	750	3	0.0936		52.0674949		58		139.2		1.6		38.8678696	
04\22\94	3	AT	9	1	0.0661	0.1404	36.76988689	78	34	40	81.6	97	1.9	3.4	46.84776095	81.4
04\22\94	10	AT	9	2	0.17		94.58703134		45		108		3.8		91.0338068	
04\22\94	39	AT	9	3	0.1851		102.9668066		42		100.8		4.4		106.199733	
04\22\94	16	AT	19	1	0.1641	0.0963	91.28499907	54	51	32	122.4	77	3.2	2.9	77.53623371	70.5
04\22\94	34	AT	19	2	0.0679		37.77118487		22		52.8		3.1		74.37267291	
04\22\94	31	AT	19	3	0.057		31.70776933		23		55.2		2.5		59.71910855	
04\22\94	51	AT	38	1	0.0568	0.0675	31.596514	38	20	24	48	58	2.8	2.8	68.43600299	66.5
04\22\94	21	AT	38	2	0.091		50.6211756		32		76.8		2.8		68.52636743	
04\22\94	28	AT	38	3	0.0546		30.37270536		21		50.4		2.6		62.6526768	
04\22\94	47	AT	75	1	0.065	0.0695	36.15796257	39	33	34	79.2	82	2.0	1.6	47.4641506	39.4
04\22\94	13	AT	75	2	0.0068		3.782681253		11		26.4		0.6		14.89644111	
04\22\94	44	AT	75	3	0.1367		76.04301673		59		141.6		2.3		55.8319504	
04\22\94	61	AT	150	1	0.0494	0.0714	27.48006675	40	27	35	64.8	85	1.8	2.0	44.08892212	49.1
04\22\94	55	AT	150	2	0.075		41.72074912		31		74.4		2.4		58.29963906	
04\22\94	1	AT	150	3	0.0897		49.89801595		48		115.2		1.9		45.03161288	
04\22\94	35	Con W/Ace	0	1	0.2851	0.1700	158.5944743	95	52	39	124.8	93	5.5	4.1	132.1174462	98.9
04\22\94	7	Con W/Ace	0	2	0.1676		93.23196737		46		110.4		3.6		87.79756661	
04\22\94	62	Con W/Ace	0	3	0.0574		31.93027999		18		43.2		3.2		76.8432428	
04\22\94	49	CON W/O ACE	0	1	0.3061	0.1798	170.2762841	100	64	42	153.6	100	4.8	4.1	115.2523136	100.0
04\22\94	26	CON W/O ACE	0	2	0.1109		61.69108103		28		67.2		4.0		95.44206152	
04\22\94	14	CON W/O ACE	0	3	0.1223		68.0326349		33		79.2		3.7		89.3056249	
04\22\94	37	MB	9	1	0.1174	0.1379	65.30687929	77	38	42	91.2	101	3.1	3.2	74.4476163	77.4
04\22\94	25	MB	9	2	0.2015		112.089746		49		117.6		4.1		99.09352259	
04\22\94	5	MB	9	3	0.0948		52.73502689		39		93.6		2.4		58.57469379	
04\22\94	20	MB	19	1	0.0781	0.0783	43.44520675	44	34	32	81.6	76	2.3	2.5	55.35264948	60.0
04\22\94	46	MB	19	2	0.0798		44.39087706		33		79.2		2.4		58.27137259	
04\22\94	58	MB	19	3	0.0771		42.88893009		28		67.2		2.8		66.35331779	
04\22\94	2	MB	38	1	0.0143	0.0618	7.954758165	34	15	31	36	75	1.0	1.7	22.97264889	41.2
04\22\94	63	MB	38	2	0.1193		66.36380493		50		120		2.4		57.49588139	
04\22\94	43	MB	38	3	0.0519		28.87075839		29		69.6		1.8		43.12565026	
04\22\94	56	MB	75	1	0.0861	0.0673	47.89541999	37	44	35	105.6	85	2.0	1.8	47.15380808	43.3
04\22\94	8	MB	75	2	0.0257		14.29631003		20		48		1.3		30.96488164	
04\22\94	15	MB	75	3	0.09		50.06489894		42		100.8		2.1		51.63682316	
04\22\94	32	MB	150	1	0.0481	0.0603	26.7569071	34	32	34	76.8	82	1.5	1.8	36.22107993	42.7
04\22\94	30	MB	150	2	0.0738		41.05321713		34		81.6		2.2		52.30506442	
04\22\94	54	MB	150	3	0.0589		32.76469497		36		86.4		1.6		39.42567074	
04\22\94	53	MT	188	1	0.0632	0.0453	35.15668459	25	26	19	62.4	45	2.4	2.4	58.57469379	58.9
04\22\94	52	MT	188	2	0.0281		15.631374		11		26.4		2.6		61.55735224	
04\22\94	17	MT	188	3	0.0447		24.86556648		19		45.6		2.4		56.6917964	
04\22\94	4	MT	375	1	0.0874	0.1129	48.61857964	63	46	49	110.4	117	1.9	2.3	45.78464969	55.4
04\22\94	33	MT	375	2	0.1665		92.62006304		51		122.4		3.3		78.67021685	
04\22\94	36	MT	375	3	0.0848		47.17226034		49		117.6		1.7		41.70288196	
04\22\94	12	MT	750	1	0.0357	0.0457	19.85907658	25	24	26	57.6	62	1.5	1.9	35.84458143	46.3
04\22\94	50	MT	750	2	0.0227		12.62748007		9		21.6		2.5		60.77845336	
04\22\94	65	MT	750	3	0.0787		43.77897274		45		108		1.7		42.14329762	
04\22\94	41	MT	1500	1	0.0691	0.0586	38.43871686	33	33	33	79.2	79	2.1	1.8	50.45604316	42.7
04\22\94	48	MT	1500	2	0.0475		26.42314111		30		72		1.6		38.15387491	
04\22\94	27	MT	1500	3	0.0591		32.87595031		36		86.4		1.6		39.55954396	
04\22\94	57	MT	3000	1	0.1072	0.0964	59.63285741	54	50	53	120	127	2.1	1.8	51.66436282	44.1
04\22\94	23	MT	3000	2	0.0927		51.56684591		56		134.4		1.7		39.88944591	
04\22\94	60	MT	3000	3	0.0893		49.67550526		53		127.2		1.7		40.60146196	

APPENDIX III: EFFECTS OF HERBICIDES ON MACROPHYTES

DAY 0 WITH ELODEA

Date	Beaker #	Chemical	Chemical Conc.	Rep.	Length (cm) Rep 1	Length (cm) Rep 2	Length (cm) Rep 3	Weight (gm)	Avg Length (cm)	Mean Avg Length (cm)	% Length Increase	Mean % Length Increase	% Of Control For % Length Increase	Mean % Of Control For % Length Increase	% Weight Increase	Mean % Weight Increase	Total Root Blotted Weight 3 Plants (gm)	Total Weight 3 Plants + Roots (gm)	% Of Control For % Weight Increase	Mean % Of Control For % Weight Increase
03\30\94	46	AL	188	1	15	15	15	5.1771	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	6	AL	188	2	15	15	15	6.1339	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	58	AL	188	3	15	15	15	5.2154	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	20	AL	375	1	15	15	15	6.0412	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	53	AL	375	2	15	15	15	6.7025	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	33	AL	375	3	15	15	15	4.821	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	26	AL	750	1	15	15	15	6.033	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	41	AL	750	2	15	15	15	6.0948	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	9	AL	750	3	15	15	15	6.894	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	37	AL	1500	1	15	15	15	5.1567	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	19	AL	1500	2	15	15	15	4.3834	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	61	AL	1500	3	15	15	15	6.9248	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	1	AL	3000	1	15	15	15	7.1844	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	65	AL	3000	2	15	15	15	6.6662	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	43	AL	3000	3	15	15	15	3.738	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	51	AT	38	1	15	15	15	7.148	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	2	AT	38	2	15	15	15	3.3701	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	55	AT	38	3	15	15	15	5.5001	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	10	AT	75	1	15	15	15	6.0282	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	31	AT	75	2	15	15	15	5.4771	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	27	AT	75	3	15	15	15	6.4772	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	48	AT	150	1	15	15	15	4.9409	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	18	AT	150	2	15	15	15	4.9292	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	42	AT	150	3	15	15	15	4.9915	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	63	AT	300	1	15	15	15	6.0605	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	8	AT	300	2	15	15	15	5.9368	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	16	AT	300	3	15	15	15	5.398	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	22	AT	600	1	15	15	15	6.9022	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	35	AT	600	2	15	15	15	7.18	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	57	AT	600	3	15	15	15	6.2001	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	39	Con W/Ace	0	1	15	15	15	4.8204	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	14	Con W/Ace	0	2	15	15	15	5.5835	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	59	Con W/Ace	0	3	15	15	15	6.8662	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	64	CON W/O ACE	0	1	15	15	15	5.5542	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	5	CON W/O ACE	0	2	15	15	15	5.6722	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	38	CON W/O ACE	0	3	15	15	15	6.6238	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	29	MB	9	1	15	15	15	6.6112	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	50	MB	9	2	15	15	15	5.653	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	47	MB	9	3	15	15	15	4.9025	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	24	MB	19	1	15	15	15	5.4165	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	34	MB	19	2	15	15	15	5.8863	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	30	MB	19	3	15	15	15	6.8871	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	52	MB	38	1	15	15	15	4.9759	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	11	MB	38	2	15	15	15	6.4231	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	45	MB	38	3	15	15	15	5.7741	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	13	MB	75	1	15	15	15	5.9565	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	23	MB	75	2	15	15	15	6.5433	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	56	MB	75	3	15	15	15	4.8801	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	60	MB	150	1	15	15	15	5.0001	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	62	MB	150	2	15	15	15	5.6831	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	4	MB	150	3	15	15	15	5.0605	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	49	MT	188	1	15	15	15	4.6001	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	3	MT	188	2	15	15	15	6.076	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	25	MT	188	3	15	15	15	6.5751	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	36	MT	375	1	15	15	15	7.0904	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	17	MT	375	2	15	15	15	6.8834	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	21	MT	375	3	15	15	15	5.7773	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	40	MT	750	1	15	15	15	4.3103	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	7	MT	750	2	15	15	15	6.5915	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	54	MT	750	3	15	15	15	6.7212	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	28	MT	1500	1	15	15	15	5.4411	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	44	MT	1500	2	15	15	15	6.69	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	12	MT	1500	3	15	15	15	6.8822	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	66	MT	3000	1	15	15	15	6.284	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	32	MT	3000	2	15	15	15	5.787	.	.	.	.	.	.	.	.	.	.	.	.
03\30\94	15	MT	3000	3	15	15	15	5.78	.	.	.	.	.	.	.	.	.	.	.	.

APPENDIX III: EFFECTS OF HERBICIDES ON MACROPHYTES
DAY 7 WITH ELODEA

Date	Beaker #	Chemical	Chemical Conc.	Rep.	Length (cm) Rep 1	Length (cm) Rep 2	Length (cm) Rep 3	Weight (gm)	Avg Length (cm)	Mean Avg Length (cm)	% Length Increase	Mean % Length Increase	% Of Control For % Length Increase	Mean % Of Control For % Length Increase	% Weight Increase	Mean % Weight Increase	Total Root Blotted Weight 3 Plants (gm)	Total Weight 3 Plants + Roots (gm)	% Of Control For % Weight Increase	Mean % Of Control For % Weight Increase
04\06\94	46	AL	188	1	15	17.5	17.3	5.4811	16.6	16.1	10.66667	7	182.2785	125	6	5.8	.	.	53.51695	52.9
04\06\94	8	AL	188	2	17	15	15.3	6.7061	15.8		5.111111		87.34177		9		.	.	85.02207	
04\06\94	56	AL	188	3	17.2	15.5	15.1	5.3301	15.9		6.222222		106.3291		2		.	.	20.04455	
04\06\94	20	AL	375	1	15	15	15	6.2459	15.0	15.7	0	5	0	78	3	8.6	.	.	30.86269	78.6
04\06\94	53	AL	375	2	15	15.3	15.1	7.6615	15.1		0.888889		15.18987		14		.	.	130.4074	
04\06\94	33	AL	375	3	18	17.4	15.4	5.2181	16.9		12.88889		220.2532		8		.	.	75.07292	
04\06\94	26	AL	750	1	15	15.5	15.3	6.9821	15.3	15.5	1.777778	3	30.37975	57	16	10.7	.	.	143.3835	97.3
04\06\94	41	AL	750	2	15.5	16	16.7	6.9665	16.1		7.111111		121.519		14		.	.	130.6542	
04\06\94	9	AL	750	3	15.4	15.1	15	7.0281	15.2		1.111111		18.98734		2		.	.	17.72875	
04\06\94	37	AL	1500	1	15.5	18.4	15.1	6.1634	16.3	16.0	8.888889	7	151.8987	116	20	15.3	.	.	177.9298	139.6
04\06\94	19	AL	1500	2	15.4	17.2	16.4	5.0168	16.3		8.888889		151.8987		14		.	.	132.0748	
04\06\94	61	AL	1500	3	15.5	15.2	15.5	7.7515	15.4		2.666667		45.56962		12		.	.	108.8081	
04\06\94	1	AL	3000	1	15.5	15.6	15.6	6.0508	15.6	15.9	3.777778	6	64.55696	97	12	10.7	.	.	109.8675	97.5
04\06\94	65	AL	3000	2	15	15	15	7.3214	15.0		0		0		10		.	.	89.73122	
04\06\94	43	AL	3000	3	15.3	18.5	17.2	4.1162	17.0		13.33333		227.8481		10		.	.	92.94873	
04\06\94	51	AT	38	1	15.5	15.5	15	7.3517	15.3	16.0	2.222222	7	37.97468	119	3	1.8	.	.	26.23565	16.2
04\06\94	2	AT	38	2	15	17.2	17.5	3.3421	16.6		10.44444		178.481		−1		.	.	−7.57244	
04\06\94	55	AT	38	3	15.5	17.2	16	5.6808	16.2		8.222222		140.5063		3		.	.	29.91074	
04\06\94	10	AT	75	1	15.5	15	15	5.8367	15.2	16.0	1.111111	7	18.98734	111	−3	0.8	.	.	−28.9535	7.6
04\06\94	31	AT	75	2	16.9	15.4	19.2	5.5718	17.2		14.44444		246.8354		2		.	.	15.75868	
04\06\94	27	AT	75	3	15.8	15	16	6.7323	15.6		4		68.35443		4		.	.	35.8956	
04\06\94	48	AT	150	1	16.5	15	15	4.9428	15.5	15.6	3.333333	4	56.96203	70	0	1.7	.	.	0.313591	15.2
04\06\94	18	AT	150	2	16	15.5	15.2	5.1751	15.6		3.777778		64.55696		5		.	.	45.46766	
04\06\94	42	AT	150	3	15	15.5	16.8	4.9912	15.8		5.111111		87.34177		−0		.	.	−0.05478	
04\06\94	63	AT	300	1	15.4	15.5	15.5	5.686	15.5	15.6	3.111111	4	53.16456	73	−6	−1.4	.	.	−56.3202	−12.5
04\06\94	6	AT	300	2	15.5	15.5	15.8	5.963	15.6		4		68.35443		1		.	.	7.12362	
04\06\94	16	AT	300	3	17	15.2	15.4	5.4662	15.9		5.777778		98.73418		1		.	.	11.66839	
04\06\94	22	AT	600	1	15	15	15	6.4841	15.0	15.1	0	1	0	13	−6	−4.7	.	.	−55.2094	−42.7
04\06\94	35	AT	600	2	15.5	16	14.5	6.7863	15.3		2.222222		37.97468		−5		.	.	−50.1156	
04\06\94	57	AT	600	3	15	15	15	6.0444	15.0		0		0		−3		.	.	−22.8681	
04\06\94	39	Con W/Ace	0	1	18	15.5	18.3	5.8641	17.3	16.1	15.11111	7	258.2278	128	22	16.2	.	.	201.1206	147.7
04\06\94	14	Con W/Ace	0	2	17.5	15	15	6.2801	15.8		5.555556		94.93671		12		.	.	110.445	
04\06\94	59	Con W/Ace	0	3	15.5	15	15.3	7.857	15.3		1.777778		30.37975		14		.	.	131.5195	
04\06\94	64	CON W/O ACE	0	1	19.3	15.2	16	6.1801	16.8	15.9	12.22222	6	208.8608	100	11	11.0	.	.	102.7079	100.0
04\06\94	5	CON W/O ACE	0	2	15	15	17.4	6.4233	15.8		5.333333		91.13924		13		.	.	120.6887	
04\06\94	38	CON W/O ACE	0	3	15	15	15	7.1803	15.0		0		0		8		.	.	76.60333	
04\06\94	29	MB	9	1	15	16	15.5	6.8351	15.5	15.8	3.333333	5	56.96203	87	3	4.6	.	.	30.86699	42.2
04\06\94	50	MB	9	2	15	15	15.2	5.9631	15.1		0.444444		7.594937		5		.	.	49.99693	
04\06\94	47	MB	9	3	15.1	18.1	17	5.1482	16.7		11.55556		197.4684		5		.	.	45.67811	
04\06\94	24	MB	19	1	15.8	15.1	16.1	5.6471	15.7	15.9	4.444444	6	75.94937	101	4	11.1	.	.	38.80262	100.9
04\06\94	34	MB	19	2	19.1	15.6	15.5	7.0041	16.7		11.55556		197.4684		19		.	.	173.0781	
04\06\94	30	MB	19	3	15.1	15.3	15.4	7.5732	15.3		1.777778		30.37975		10		.	.	90.79701	
04\06\94	52	MB	38	1	17.1	15.1	15.1	5.0273	15.8	15.7	5.111111	5	87.34177	78	1	−0.4	.	.	9.41482	−3.4
04\06\94	11	MB	38	2	15.1	15.4	15	6.2757	15.2		1.111111		18.98734		−2		.	.	−20.9157	
04\06\94	45	MB	38	3	15.5	17.6	15.3	5.7831	16.1		7.555556		129.1139		0		.	.	1.420823	
04\06\94	13	MB	75	1	16.1	15	15	5.7068	15.4	15.4	2.444444	3	41.77215	48	−4	−2.8	.	.	−38.3605	−25.3
04\06\94	23	MB	75	2	15	15.4	15.3	6.2764	15.2		1.555556		26.58228		−4		.	.	−37.1768	
04\06\94	58	MB	75	3	15.7	15.3	16	4.6776	15.7		4.444444		75.94937		−0		.	.	−0.42956	
04\06\94	60	MB	150	1	15	15.5	15.1	4.725	15.2	15.8	1.333333	5	22.78481	90	−6	−4.1	.	.	−50.1456	−37.8
04\06\94	62	MB	150	2	15.6	16.1	16.8	5.7361	16.2		7.777778		132.9114		1		.	.	8.820596	
04\06\94	4	MB	150	3	16	15	17	4.66	16.0		6.666667		113.9241		−8		.	.	−72.1323	
04\06\94	49	MT	188	1	15	17.5	18.5	4.6738	17.0	16.3	13.33333	8	227.8481	144	6	6.3	.	.	54.18693	57.5
04\06\94	3	MT	188	2	19	15.6	15.5	6.1675	16.7		11.33333		193.6709		2		.	.	16.72544	
04\06\94	25	MT	188	3	15.3	15	15	7.3074	15.1		0.666667		11.39241		11		.	.	101.5098	
04\06\94	36	MT	375	1	15.1	15.5	15.5	7.2041	15.4	15.3	2.444444	2	41.77215	30	2	6.8	.	.	14.61538	62.4
04\06\94	17	MT	375	2	15.1	15	15.3	7.522	15.1		0.888889		15.18987		9		.	.	84.55639	
04\06\94	21	MT	375	3	15.3	15.2	15.4	6.3345	15.3		2		34.17722		10		.	.	87.90361	
04\06\94	40	MT	750	1	15.5	15	16.5	4.3216	15.7	15.5	4.444444	3	75.94937	56	0	8.8	.	.	2.369414	79.8
04\06\94	7	MT	750	2	15.5	15.5	15.6	7.4813	15.5		3.555556		60.75949		13		.	.	120.2695	
04\06\94	54	MT	750	3	15.3	15.3	15.2	7.5625	15.3		1.777778		30.37975		13		.	.	116.7961	
04\06\94	28	MT	1500	1	15	15	16	6.2005	15.3	15.4	2.222222	3	37.97468	48	14	11.8	.	.	127.2051	107.8
04\06\94	44	MT	1500	2	15.5	15.5	15	7.3743	15.3		2.222222		37.97468		10		.	.	93.22684	
04\06\94	12	MT	1500	3	15	15.3	16.5	7.66	15.6		4		68.35443		11		.	.	103.0057	
04\06\94	66	MT	3000	1	15.1	15.2	15.2	6.461	15.2	15.3	1.111111	2	18.98734	32	3	7.9	.	.	28.66388	72.1
04\06\94	32	MT	3000	2	16.1	15.1	15.2	6.6665	15.5		3.111111		53.16456		16		.	.	142.4742	
04\06\94	15	MT	3000	3	15	15.5	15.1	6.067	15.2		1.333333		22.78481		5		.	.	45.25584	

APPENDIX III: EFFECTS OF HERBICIDES ON MACROPHYTES
DAY 14 WITH ELODEA

Date	Beaker #	Chemical	Chemical Conc.	Rep.	Length (cm) Rep 1	Length (cm) Rep 2	Length (cm) Rep 3	Weight (gm)	Avg Length (cm)	Mean Avg Length (cm)	% Length Increase	Mean % Length Increase	% Of Control For % Length Increase	Mean % Of Control For % Length Increase	% Weight Increase	Mean % Weight Increase	Total Root Blotted Weight 3 Plants (gm)	Total Weight 3 Plants + Roots (gm)	% Of Control For % Weight Increase	Mean % Of Control For % Weight Increase
04\13\94	46	AL	188	1	18	20.1	21.2	5.5425	19.8	19.3	31.77778	29	90.88983	83	11	8.0	0.225	5.7675	90.74342	63.9
04\13\94	8	AL	188	2	18.5	19.2	19.8	6.7489	19.2		27.77778		79.44915		12		0.0967	6.8456	92.32421	
04\13\94	56	AL	188	3	18.2	20	19	5.1215	19.1		27.11111		77.54237		1		0.1512	5.2727	6.742232	
04\13\94	20	AL	375	1	19.7	21.3	15	6.285	18.7	19.8	24.44444	32	69.91525	92	5	10.7	0.067	6.352	40.93673	85.4
04\13\94	53	AL	375	2	20.8	20.4	21.2	7.4198	20.8		38.66667		110.5932		14		0.2277	7.6475	112.189	
04\13\94	33	AL	375	3	19.7	20.8	19.5	5.3042	20.0		33.33333		95.33898		13		0.1407	5.4449	102.9753	
04\13\94	26	AL	750	1	20.2	22.4	23.6	7.1315	22.1	21.0	47.11111	40	134.7458	114	22	14.9	0.2027	7.3342	171.8193	116.2
04\13\94	41	AL	750	2	23	18	23	7.1235	21.3		42.22222		120.7627		19		0.1581	7.2816	154.9435	
04\13\94	9	AL	750	3	20.3	18.5	19.7	6.9757	19.5		30		85.80508		4		0.1617	7.1374	28.09342	
04\13\94	37	AL	1500	1	20	21.6	23.5	6.405	21.7	20.2	44.66667	35	127.7542	99	28	20.0	0.0915	6.4965	208.7395	159.0
04\13\94	19	AL	1500	2	17.4	20.5	19.3	4.9701	19.1		27.11111		77.54237		14		0.0475	5.0176	115.1252	
04\13\94	61	AL	1500	3	20.7	23.5	15.3	6.1219	19.8		32.22222		92.16102		19		0.1528	6.2747	155.1135	
04\13\94	1	AL	3000	1	23.5	18	20.5	6.1608	20.7	19.9	37.77778	33	108.0508	94	15	11.5	0.1333	6.2941	122.9052	91.6
04\13\94	65	AL	3000	2	19.5	17.8	21.6	7.0334	19.6		30.88889		88.34746		7		0.0876	7.121	54.41473	
04\13\94	43	AL	3000	3	18.5	20.5	19.5	4.1711	19.5		30		85.80508		12		0.0276	4.1987	98.06957	
04\13\94	51	AT	38	1	21.1	18.2	19.5	7.2578	19.6	18.8	30.66667	25	87.71186	72	3	1.5	0.103	7.3608	23.89583	12.1
04\13\94	2	AT	38	2	18.7	18.2	19.7	3.2315	18.9		25.77778		73.72881		−3		0.0387	3.2702	−23.5873	
04\13\94	55	AT	38	3	17.5	18	18	5.5558	17.8		18.88889		54.02542		5		0.1923	5.7481	35.87868	
04\13\94	10	AT	75	1	17.9	18.7	18.1	5.4348	18.2	18.4	21.55556	23	61.65254	65	−9	−3.2	0.0411	5.4759	−72.9026	−25.4
04\13\94	31	AT	75	2	15.5	20.5	17.5	5.1776	17.8		18.88889		54.02542		−3		0.1445	5.3221	−22.5183	
04\13\94	27	AT	75	3	17	17.6	23.1	6.4783	19.2		28.22222		80.72034		2		0.1554	6.6337	19.22571	
04\13\94	48	AT	150	1	17.1	19.2	18.8	4.7775	18.4	17.6	22.44444	17	64.19492	49	−2	−2.9	0.0803	4.8578	−13.3829	−22.9
04\13\94	16	AT	150	2	17.5	16.3	17.8	4.8514	17.2		14.66667		41.94915		−1		0.0266	4.878	−6.26511	
04\13\94	42	AT	150	3	17.5	17	16.9	4.654	17.1		14.22222		40.67797		−6		0.0432	4.6972	−46.9153	
04\13\94	63	AT	300	1	19	16.9	15.5	5.5746	17.1	18.1	14.22222	21	40.67797	59	−7	−5.9	0.0336	5.6082	−59.3845	−48.7
04\13\94	6	AT	300	2	19	20.5	18.2	5.5426	19.2		28.22222		80.72034		−6		0.0627	5.6053	−44.4057	
04\13\94	16	AT	300	3	17.6	17	19.2	5.0887	17.9		19.55556		55.9322		−5		0.0603	5.149	−36.4234	
04\13\94	22	AT	600	1	12.6	13	10	3.9871	11.9	15.2	−20.8889	2	−59.7458	4	−42	−21.3	0	3.9871	−336.063	−169.2
04\13\94	35	AT	600	2	14.2	18.5	17.2	6.3021	16.6		10.88889		31.14407		−12		0	6.3021	−95.3408	
04\13\94	57	AT	600	3	17.9	16	17.7	5.6053	17.2		14.66667		41.94915		−10		0	5.6053	−76.3357	
04\13\94	39	Con W/Ace	0	1	19	20.6	23.5	5.9487	21.0	20.7	40.22222	38	115.0424	108	28	20.6	0.2031	6.1518	219.7763	165.6
04\13\94	14	Con W/Ace	0	2	19.1	23.8	19.7	6.3453	20.9		39.11111		111.8644		17		0.1875	6.5328	135.2856	
04\13\94	59	Con W/Ace	0	3	20.2	20	20.1	7.8015	20.1		34		97.24576		16		0.2866	8.0881	141.6037	
04\13\94	64	CON W/O ACE	0	1	23.1	22	18.3	6.3357	21.1	20.2	40.88889	35	116.9492	100	18	12.6	0.1945	6.5302	139.8246	100.0
04\13\94	5	CON W/O ACE	0	2	18.5	18.8	20.7	6.1402	19.3		28.88889		82.62712		11		0.1623	6.3025	88.42012	
04\13\94	36	CON W/O ACE	0	3	19.7	18.6	22.5	7.016	20.3		35.11111		100.4237		9		0.2049	7.2209	71.75526	
04\13\94	29	MB	9	1	21.2	19.9	18.7	6.8144	19.9	19.8	32.88889	32	94.0678	92	6	9.1	0.1832	6.9976	46.50634	72.7
04\13\94	50	MB	9	2	16	20	19.6	5.8808	18.5		23.55556		67.37288		7		0.1534	6.0342	53.65735	
04\13\94	47	MB	9	3	19.9	24.7	18.5	5.383	21.0		40.22222		115.0424		15		0.2468	5.6298	118.046	
04\13\94	24	MB	19	1	22.5	17.5	17.2	5.6531	19.1	20.7	27.11111	36	77.54237	109	6	9.5	0.11	5.7631	50.81727	75.9
04\13\94	34	MB	19	2	24	20.2	20.5	6.6951	21.6		43.77778		125.2119		16		0.1183	6.8134	125.3255	
04\13\94	30	MB	19	3	19.7	21.8	23	7.2141	21.5		43.33333		123.9407		6		0.1192	7.3333	51.55236	
04\13\94	52	MB	38	1	17.2	18	18.6	4.772	17.9	17.9	19.55556	19	55.9322	55	−4	−3.6	0.0129	4.7849	−30.5434	−28.4
04\13\94	11	MB	38	2	16.8	17.7	19.2	5.9576	17.9		19.33333		55.29661		−6		0.0749	6.0325	−48.3886	
04\13\94	45	MB	38	3	17.2	17.2	19	5.6805	17.8		18.66667		53.38983		−1		0.0475	5.728	−6.3529	
04\13\94	13	MB	75	1	18.8	18.3	14.5	5.415	17.2	17.7	14.66667	16	41.94915	51	−9	−6.3	0.02	5.435	−89.6656	−50.5
04\13\94	23	MB	75	2	18.7	18.7	16.1	5.9679	17.8		18.88889		54.02542		−6		0.0472	6.0151	−64.2328	
04\13\94	56	MB	75	3	18	19.8	16	4.7242	17.9		19.55556		55.9322		−2		0.0484	4.7726	−17.5281	
04\13\94	60	MB	150	1	16.4	15.6	16	4.5277	16.0	16.9	6.666667	13	19.0678	37	−9	−9.7	0.0183	4.546	−72.265	−76.9
04\13\94	62	MB	150	2	17.6	18.8	17.2	5.2441	17.9		19.11111		54.66102		−6		0.0121	5.2562	−59.7716	
04\13\94	4	MB	150	3	18.4	17	15.5	4.4112	17.0		13.11111		37.5		−12		0.0223	4.4335	−98.5892	
04\13\94	49	MT	188	1	20	19	18.3	4.8931	19.1	20.1	27.33333	34	78.17797	98	6	6.1	0.0594	4.9525	80.95705	64.4
04\13\94	3	MT	188	2	20	21.3	20	6.27	20.4		36.22222		103.6017		4		0.0493	6.3193	31.86249	
04\13\94	25	MT	188	3	17.2	26	19.5	7.2447	20.9		39.33333		112.5		13		0.1605	7.4052	100.4577	
04\13\94	38	MT	375	1	22.2	19.5	19.7	7.2841	20.5	19.6	36.44444	31	104.2373	89	4	5.4	0.091	7.3751	31.95009	43.0
04\13\94	17	MT	375	2	18.5	20.4	21.5	6.9862	20.1		34.22222		97.88136		2		0.0537	7.0399	16.09117	
04\13\94	21	MT	375	3	18.9	17.6	18.5	6.328	18.3		22.22222		63.55932		10		0.0217	6.3497	78.83699	
04\13\94	40	MT	750	1	17	18.3	18.5	4.5197	17.9	18.8	19.55556	25	55.9322	73	6	13.7	0.0311	4.5508	44.39795	108.6
04\13\94	7	MT	750	2	20.9	19.4	18.9	7.6828	19.7		31.55556		90.25424		17		0.0383	7.7211	136.3628	
04\13\94	54	MT	750	3	19.2	19.2	17.9	7.8846	18.8		25.11111		71.82203		18		0.0627	7.9473	145.1558	
04\13\94	28	MT	1500	1	17.7	18.3	18	6.0218	18.0	18.2	20	21	57.20339	61	11	9.1	0	6.0218	84.8928	72.2
04\13\94	44	MT	1500	2	19.1	18.9	19.5	7.5911	19.2		27.77778		79.44915		13		0	7.5911	107.1772	
04\13\94	12	MT	1500	3	17.2	18.7	16.3	7.095	17.4		16		45.76271		3		0	7.095	24.60366	
04\13\94	66	MT	3000	1	17	17.4	17.5	6.4767	17.3	17.3	15.33333	15	43.85593	44	3	5.0	0	6.4767	27.01911	39.5
04\13\94	32	MT	3000	2	18.8	17.1	18	6.2178	18.0		19.77778		56.5678		8		0	6.2178	62.17225	
04\13\94	15	MT	3000	3	18.5	16	15.4	5.9939	16.6		10.88889		31.14407		4		0	5.9939	29.44681	

APPENDIX III: EFFECTS OF HERBICIDES ON MACROPHYTES
DAY 0 WITH CERATOPHYLLUM

Date	Beaker #	Chemical	Chemical Conc.	Rep.	Length (cm)	Weight (gm)	% Length Increase	Mean % Length Increase	% Weight Increase	Mean % Weight Increase	% Of Control For % Length Increase	Mean % Of Control For % Length Increase	% Of Control For % Weight Increase	Mean % Of Control For % Weight Increase
03\09\94	12	AL	94	1	12	2.0153	.	.	.	.	.	.	.	.
03\09\94	27	AL	94	2	12	1.1343	.	.	.	.	.	.	.	.
03\09\94	21	AL	94	3	12	1.3767	.	.	.	.	.	.	.	.
03\09\94	7	AL	188	1	12	0.7679	.	.	.	.	.	.	.	.
03\09\94	64	AL	188	2	12	1.1296	.	.	.	.	.	.	.	.
03\09\94	50	AL	188	3	12	1.0935	.	.	.	.	.	.	.	.
03\09\94	53	AL	375	1	12	1.1553	.	.	.	.	.	.	.	.
03\09\94	20	AL	375	2	12	2.9627	.	.	.	.	.	.	.	.
03\09\94	17	AL	375	3	12	1.8583	.	.	.	.	.	.	.	.
03\09\94	37	AL	750	1	12	0.9783	.	.	.	.	.	.	.	.
03\09\94	23	AL	750	2	12	1.9039	.	.	.	.	.	.	.	.
03\09\94	55	AL	750	3	12	1.4365	.	.	.	.	.	.	.	.
03\09\94	33	AL	1500	1	12	1.2421	.	.	.	.	.	.	.	.
03\09\94	16	AL	1500	2	12	1.908	.	.	.	.	.	.	.	.
03\09\94	58	AL	1500	3	12	1.167	.	.	.	.	.	.	.	.
03\09\94	15	AT	19	1	12	1.2091	.	.	.	.	.	.	.	.
03\09\94	46	AT	19	2	12	0.9367	.	.	.	.	.	.	.	.
03\09\94	42	AT	19	3	12	1.2318	.	.	.	.	.	.	.	.
03\09\94	47	AT	38	1	12	1.96	.	.	.	.	.	.	.	.
03\09\94	6	AT	38	2	12	1.7774	.	.	.	.	.	.	.	.
03\09\94	39	AT	38	3	12	1.069	.	.	.	.	.	.	.	.
03\09\94	45	AT	75	1	12	2.6487	.	.	.	.	.	.	.	.
03\09\94	29	AT	75	2	12	1.0616	.	.	.	.	.	.	.	.
03\09\94	30	AT	75	3	12	2.4203	.	.	.	.	.	.	.	.
03\09\94	49	AT	150	1	12	1.3624	.	.	.	.	.	.	.	.
03\09\94	25	AT	150	2	12	1.3221	.	.	.	.	.	.	.	.
03\09\94	65	AT	150	3	12	1.4825	.	.	.	.	.	.	.	.
03\09\94	5	AT	300	1	12	1.166	.	.	.	.	.	.	.	.
03\09\94	18	AT	300	2	12	1.516	.	.	.	.	.	.	.	.
03\09\94	61	AT	300	3	12	0.8762	.	.	.	.	.	.	.	.
03\09\94	11	CON NO ACE	0	1	12	1.5763	.	.	.	.	.	.	.	.
03\09\94	62	CON NO ACE	0	2	12	1.2017	.	.	.	.	.	.	.	.
03\09\94	35	CON NO ACE	0	3	12	1.7301	.	.	.	.	.	.	.	.
03\09\94	41	CON W/ACE	0	1	12	1.3097	.	.	.	.	.	.	.	.
03\09\94	3	CON W/ACE	0	2	12	1.7458	.	.	.	.	.	.	.	.
03\09\94	40	CON W/ACE	0	3	12	1.6217	.	.	.	.	.	.	.	.
03\09\94	28	MB	9.5	1	12	0.9515	.	.	.	.	.	.	.	.
03\09\94	38	MB	9.5	2	12	1.6866	.	.	.	.	.	.	.	.
03\09\94	66	MB	9.5	3	12	0.7733	.	.	.	.	.	.	.	.
03\09\94	56	MB	19	1	12	1.1737	.	.	.	.	.	.	.	.
03\09\94	52	MB	19	2	12	1.0948	.	.	.	.	.	.	.	.
03\09\94	10	MB	19	3	12	1.2936	.	.	.	.	.	.	.	.
03\09\94	19	MB	38	1	12	1.3373	.	.	.	.	.	.	.	.
03\09\94	34	MB	38	2	12	1.4379	.	.	.	.	.	.	.	.
03\09\94	4	MB	38	3	12	1.262	.	.	.	.	.	.	.	.
03\09\94	14	MB	75	1	12	0.948	.	.	.	.	.	.	.	.
03\09\94	51	MB	75	2	12	0.698	.	.	.	.	.	.	.	.
03\09\94	1	MB	75	3	12	0.8641	.	.	.	.	.	.	.	.
03\09\94	26	MB	150	1	12	0.9527	.	.	.	.	.	.	.	.
03\09\94	24	MB	150	2	12	1.6325	.	.	.	.	.	.	.	.
03\09\94	60	MB	150	3	12	0.8977	.	.	.	.	.	.	.	.
03\09\94	57	MT	47	1	12	0.9635	.	.	.	.	.	.	.	.
03\09\94	2	MT	47	2	12	1.0279	.	.	.	.	.	.	.	.
03\09\94	9	MT	47	3	12	1.8731	.	.	.	.	.	.	.	.
03\09\94	22	MT	94	1	12	1.964	.	.	.	.	.	.	.	.
03\09\94	43	MT	94	2	12	1.2473	.	.	.	.	.	.	.	.
03\09\94	54	MT	94	3	12	1.5774	.	.	.	.	.	.	.	.
03\09\94	31	MT	188	1	12	1.4027	.	.	.	.	.	.	.	.
03\09\94	32	MT	188	2	12	0.9126	.	.	.	.	.	.	.	.
03\09\94	13	MT	188	3	12	0.7127	.	.	.	.	.	.	.	.
03\09\94	63	MT	375	1	12	1.2017	.	.	.	.	.	.	.	.
03\09\94	44	MT	375	2	12	1.2891	.	.	.	.	.	.	.	.
03\09\94	36	MT	375	3	12	0.7683	.	.	.	.	.	.	.	.
03\09\94	59	MT	750	1	12	1.9184	.	.	.	.	.	.	.	.
03\09\94	8	MT	750	2	12	1.2553	.	.	.	.	.	.	.	.
03\09\94	48	MT	750	3	12	0.7712	.	.	.	.	.	.	.	.

APPENDIX III: EFFECTS OF HERBICIDES ON MACROPHYTES
DAY 7 WITH CERATOPHYLLUM

Date	Beaker #	Chemical	Chemical Conc.	Rep.	Length (cm)	Weight (gm)	% Length Increase	Mean % Length Increase	% Weight Increase	Mean % Weight Increase	% Of Control For % Length Increase	Mean % Of Control For % Length Increase	% Of Control For % Weight Increase	Mean % Of Control For % Weight Increase
03\16\94	12	AL	94	1	14.9	2.079	24.2	24.4	3.2	4.8	68.503937008	69.3	13.000034235	19.6
03\16\94	27	AL	94	2	14.6	1.218	21.7		7.4		61.417322835		30.348853867	
03\16\94	21	AL	94	3	15.3	1.4302	27.5		3.7		77.952755906		15.363219022	
03\16\94	7	AL	188	1	12.1	0.838	0.8	6.1	9.1	12.4	2.3622047244	17.3	37.545519595	51.0
03\16\94	64	AL	188	2	12.1	1.2164	0.8		7.9		2.3622047244		32.332035772	
03\16\94	50	AL	188	3	14	1.3147	16.7		20.2		47.244094488		83.197658511	
03\16\94	53	AL	375	1	14.7	1.4372	22.5	20.8	24.4	12.9	63.779527559	59.1	100.35639936	53.0
03\16\94	20	AL	375	2	15.4	3.1586	28.3		5.9		80.31496063		24.254966308	
03\16\94	17	AL	375	3	13.4	2.0133	11.7		8.3		33.070866142		34.305254047	
03\16\94	37	AL	750	1	15.6	1.1261	30.0	28.6	15.1	12.2	85.039370079	81.1	62.136551828	50.3
03\16\94	23	AL	750	2	15.7	2.138	30.8		12.3		87.401574803		50.57105902	
03\16\94	55	AL	750	3	15	1.5694	25.0		9.3		70.866141732		38.050828662	
03\16\94	33	AL	1500	1	17	1.4727	41.7	30.8	18.6	11.8	118.11023622	87.4	76.356763125	48.7
03\16\94	16	AL	1500	2	15.4	2.031	28.3		6.4		80.31496063		26.51377153	
03\16\94	56	AL	1500	3	14.7	1.2896	22.5		10.5		63.779527559		43.208021731	
03\16\94	15	AT	19	1	15.6	1.208	30.0	21.4	−0.3	9.6	85.039370079	60.6	−1.054494311	39.5
03\16\94	46	AT	19	2	13.7	1.0367	14.2		10.7		40.157480315		43.908059932	
03\16\94	42	AT	19	3	14.4	1.4588	20.0		18.4		56.692913386		75.793231861	
03\16\94	47	AT	38	1	12	1.9652	0.0	21.1	0.3	4.8	0	59.8	1.0911680543	19.8
03\16\94	8	AT	38	2	16.1	1.72	34.2		−3.2		96.850393701		−13.28224495	
03\16\94	39	AT	38	3	15.5	1.2782	29.2		17.4		82.677165354		71.455888031	
03\16\94	45	AT	75	1	13.6	2.3081	13.3	15.3	−12.9	−1.7	37.795275591	43.3	−52.88793868	−7.1
03\16\94	29	AT	75	2	13.7	1.1182	14.2		3.4		40.157480315		13.917434157	
03\16\94	30	AT	75	3	14.2	2.524	18.3		4.3		51.968503937		17.621964587	
03\16\94	49	AT	150	1	14	1.4091	16.7	16.7	3.4	0.2	47.244094488	47.2	14.097964027	0.7
03\16\94	25	AT	150	2	14.5	1.3268	20.8		0.3		59.05511811		1.3998869891	
03\16\94	65	AT	150	3	13.5	1.4348	12.5		−3.2		35.433070866		−13.26879433	
03\16\94	5	AT	300	1	14.1	1.078	17.5	11.9	−7.5	4.1	49.606299213	33.9	−31.04051301	16.8
03\16\94	18	AT	300	2	13.5	1.5481	12.5		2.1		35.433070866		8.7086452481	
03\16\94	61	AT	300	3	12.7	1.0336	5.8		17.7		16.535433071		72.778374304	
03\16\94	11	CON NO ACE	0	1	15.4	2.0031	28.3	35.3	26.9	24.3	80.31496063	100.0	110.69798614	100.0
03\16\94	62	CON NO ACE	0	2	17	1.5847	41.7		31.9		118.11023622		131.08333477	
03\16\94	35	CON NO ACE	0	3	16.3	1.975	35.8		14.2		101.57480315		58.218679082	
03\16\94	41	CON W/ACE	0	1	16.2	1.6078	35.0	44.4	22.8	39.9	99.212598425	126.0	93.612731389	164.0
03\16\94	3	CON W/ACE	0	2	18.3	2.7101	52.5		55.2		148.81889764		227.17589881	
03\16\94	40	CON W/ACE	0	3	17.5	2.2967	45.8		41.6		129.92125984		171.18985524	
03\16\94	28	MB	9.5	1	13.9	1.3149	15.8	16.7	38.2	18.5	44.881889764	47.2	157.08000228	76.1
03\16\94	38	MB	9.5	2	14.9	1.8239	24.2		8.1		68.503937008		33.461369193	
03\16\94	66	MB	9.5	3	13.2	0.8441	10.0		9.2		28.346456693		37.655638504	
03\16\94	56	MB	19	1	14.7	1.2812	22.5	11.9	9.2	4.3	63.779527559	33.9	37.670044065	17.7
03\16\94	52	MB	19	2	13.2	1.0527	10.0		−3.8		28.346456693		−15.81583318	
03\16\94	10	MB	19	3	12.4	1.3916	3.3		7.6		9.4488188976		31.158090711	
03\16\94	19	MB	38	1	13.8	1.4884	15.0	12.5	11.3	9.0	42.519685039	35.4	46.470825608	36.9
03\16\94	34	MB	38	2	13	1.552	8.3		7.9		23.622047244		32.636361069	
03\16\94	4	MB	38	3	13.7	1.3594	14.2		7.7		40.157480315		31.742736977	
03\16\94	14	MB	75	1	12	0.8745	0.0	3.6	−7.8	−6.1	0	10.2	−31.8877422	−24.9
03\16\94	51	MB	75	2	13.1	0.669	9.2		−4.2		25.984251969		−17.08784688	
03\16\94	1	MB	75	3	12.2	0.81	1.7		−6.3		4.7244094488		−25.75004715	
03\16\94	26	MB	150	1	13.3	0.8906	10.8	6.4	−6.5	−9.4	30.708661417	18.1	−26.80897462	−38.9
03\16\94	24	MB	150	2	13	1.4935	8.3		−8.5		23.622047244		−35.01921276	
03\16\94	60	MB	150	3	12	0.7782	0.0		−13.3		0		−54.74966279	
03\16\94	57	MT	47	1	11.7	1.0546	−2.5	10.0	9.5	17.2	−7.086614173	28.3	38.887625575	70.8
03\16\94	2	MT	47	2	12.4	1.377	3.3		34.0		9.4488188976		139.6830835	
03\16\94	9	MT	47	3	15.5	2.024	29.2		8.1		82.677165354		33.133937177	
03\16\94	22	MT	94	1	15.4	2.0916	28.3	23.3	6.5	7.3	80.31496063	66.1	26.72107706	30.2
03\16\94	43	MT	94	2	14.7	1.2805	22.5		2.7		63.779527559		10.947423774	
03\16\94	54	MT	94	3	14.3	1.7801	19.2		12.9		54.330708661		52.851422486	
03\16\94	31	MT	188	1	14	1.5531	16.7	11.9	10.7	13.0	47.244094488	33.9	44.098905202	53.3
03\16\94	32	MT	188	2	14.3	0.997	19.2		9.2		54.330708661		37.938593712	
03\16\94	13	MT	188	3	12	0.6478	0.0		19.0		0		77.963864637	
03\16\94	63	MT	375	1	13.5	1.368	12.5	8.1	13.8	12.1	35.433070866	22.8	56.918863115	49.8
03\16\94	44	MT	375	2	11.7	1.3824	−2.5		7.2		−7.086614173		29.767324642	
03\16\94	36	MT	375	3	13.7	0.8857	14.2		15.3		40.157480315		62.846635446	
03\16\94	59	MT	750	1	14.7	2.3034	22.5	20.8	20.1	14.9	63.779527559	59.1	82.54035498	61.5
03\16\94	6	MT	750	2	14.8	1.3278	23.3		5.8		66.141732283		23.753917638	
03\16\94	48	MT	750	3	14	0.9178	16.7		19.0		47.244094488		78.076228135	

APPENDIX III: EFFECTS OF HERBICIDES ON MACROPHYTES
DAY 14 WITH CERATOPHYLLUM

Date	Beaker #	Chemical	Chemical Conc.	Rep.	Length (cm)	Weight (gm)	% Length Increase	Mean % Length Increase	% Weight Increase	Mean % Weight Increase	% Of Control For % Length Increase	Mean % Of Control For % Length Increase	% Of Control For % Weight Increase	Mean % Of Control For % Weight Increase
03\23\94	12	AL	94	1	16.6	2.424	38.3	43.1	20.3	26.3	52.47148289	58.9	29.850047029	38.8
03\23\94	27	AL	94	2	16.1	1.4647	34.2		29.1		46.768060837		42.673821299	
03\23\94	21	AL	94	3	18.8	1.7871	58.7		29.6		77.566539924		43.600959307	
03\23\94	7	AL	188	1	13.5	1.0719	12.5	10.3	39.6	17.6	17.11026616	14.1	58.270534651	25.9
03\23\94	64	AL	188	2	11.2	1.031	−6.7		−8.7		−9.125475285		−12.84790504	
03\23\94	50	AL	188	3	15	1.334	25.0		22.0		34.220532319		32.372510486	
03\23\94	53	AL	375	1	16.3	1.4029	35.8	41.1	21.4	17.9	49.049429658	58.3	31.54539384	26.4
03\23\94	20	AL	375	2	18	3.2926	50.0		10.4		66.441064639		15.292978885	
03\23\94	17	AL	375	3	16.5	2.265	37.5		21.9		51.330798479		32.213538487	
03\23\94	37	AL	750	1	16.4	1.0736	36.7	34.7	9.7	8.3	50.190114068	47.5	14.338407997	12.2
03\23\94	23	AL	750	2	16.1	1.9677	34.2		3.4		46.768060837		4.9323811771	
03\23\94	55	AL	750	3	16	1.6049	33.3		11.7		45.627376426		17.255062779	
03\23\94	33	AL	1500	1	17.5	1.3471	45.6	33.3	8.5	9.8	62.737642586	45.6	12.442648257	14.5
03\23\94	18	AL	1500	2	15.5	2.0908	29.2		9.8		39.923954373		14.101909002	
03\23\94	58	AL	1500	3	15	1.3011	25.0		11.5		34.220532319		16.913676068	
03\23\94	15	AT	19	1	19.9	1.4761	65.8	45.8	22.1	34.3	90.114068441	62.7	32.503425041	50.4
03\23\94	46	AT	19	2	15.3	1.2621	27.5		34.7		37.642585551		51.132510387	
03\23\94	42	AT	19	3	17.3	1.7982	44.2		46.0		60.456273764		67.68043351	
03\23\94	47	AT	38	1	14	2.261	16.7	45.6	15.4	19.6	22.813688213	62.4	22.604271299	28.8
03\23\94	8	AT	38	2	21.1	2.0755	75.8		16.6		103.80228137		24.686350285	
03\23\94	39	AT	38	3	17.3	1.3785	44.2		26.8		60.456273764		39.129182556	
03\23\94	45	AT	75	1	16.5	2.41	37.5	30.0	−9.0	−2.9	51.330798479	41.1	−13.26477031	−4.3
03\23\94	29	AT	75	2	15.5	1.0779	29.2		−0.3		39.923954373		−0.503516153	
03\23\94	30	AT	75	3	14.8	2.434	23.3		0.6		31.939163498		0.8331658357	
03\23\94	49	AT	150	1	17.2	1.4541	43.3	38.9	6.7	3.6	59.315589354	53.2	9.9070588719	5.6
03\23\94	25	AT	150	2	17.2	1.4458	43.3		9.4		59.315589354		13.771634287	
03\23\94	65	AT	150	3	15.6	1.4146	30.0		−4.6		41.064638783		−6.741478583	
03\23\94	5	AT	300	1	15.1	1.102	25.8	23.1	−5.5	4.7	35.36121673	31.6	−6.079072583	6.9
03\23\94	18	AT	300	2	15.6	1.563	30.0		3.1		41.064638783		4.5632970838	
03\23\94	61	AT	300	3	13.6	1.0226	13.3		16.4		16.25095057		24.202144375	
03\23\94	11	CON NO ACE	0	1	16.9	2.2924	40.8	73.1	45.2	67.9	55.893536122	100.0	66.596217564	100.0
03\23\94	62	CON NO ACE	0	2	22.2	2.409	85.0		100.5		116.34980989		147.67652158	
03\23\94	35	CON NO ACE	0	3	23.2	2.7354	93.3		58.1		127.75665399		85.527260858	
03\23\94	41	CON W/ACE	0	1	19	2.0105	58.3	58.6	53.5	59.1	79.847908745	80.2	76.759391578	87.0
03\23\94	3	CON W/ACE	0	2	20	2.9646	66.7		71.0		91.254752852		104.44478322	
03\23\94	40	CON W/ACE	0	3	18.1	2.4773	50.6		52.8		69.581749049		77.656952963	
03\23\94	28	MB	9.5	1	16.1	1.3928	34.2	35.6	46.4	40.7	46.768060837	46.7	68.266120296	59.8
03\23\94	38	MB	9.5	2	16.6	2.0705	38.3		22.6		52.47148289		33.503165582	
03\23\94	66	MB	9.5	3	16.1	1.1617	34.2		52.8		46.768060837		77.735216082	
03\23\94	56	MB	19	1	17.6	1.5706	46.7	27.2	33.8	21.6	63.878326996	37.3	49.77417624	31.7
03\23\94	52	MB	19	2	13.7	1.166	14.2		8.3		19.391634981		12.261402144	
03\23\94	10	MB	19	3	14.5	1.5652	20.8		22.5		28.517110266		33.179329059	
03\23\94	19	MB	38	1	15.5	1.5527	29.2	24.7	16.1	12.0	39.923954373	33.6	23.706110417	17.7
03\23\94	34	MB	38	2	14	1.4706	16.7		2.3		22.813688213		3.3676078207	
03\23\94	4	MB	38	3	15.4	1.484	28.3		17.6		38.783269962		25.892463396	
03\23\94	14	MB	75	1	12.8	0.7906	6.7	13.9	−16.6	−14.3	9.1254752852	19.0	−24.43860669	−21.0
03\23\94	51	MB	75	2	14.5	0.6091	20.6		−12.7		28.517110266		−16.74676888	
03\23\94	1	MB	75	3	13.7	0.746	14.2		−13.4		19.391634981		−19.77644845	
03\23\94	26	MB	150	1	12.7	0.868	5.8	5.3	−6.9	−14.9	7.9847908745	7.2	−13.06601254	−22.0
03\23\94	24	MB	150	2	13.7	1.39	14.2		−14.9		19.391634981		−21.86445416	
03\23\94	60	MB	150	3	11.5	0.7089	−4.2		−21.0		−5.703422053		−30.95642865	
03\23\94	57	MT	47	1	12.2	1.3664	1.7	16.1	41.6	49.2	2.2613688213	22.1	61.549656746	72.4
03\23\94	2	MT	47	2	13.6	1.7086	13.3		66.2		16.25095057		97.473143315	
03\23\94	9	MT	47	3	16	2.6142	33.3		39.6		45.627376426		58.236569669	
03\23\94	22	MT	94	1	18.4	2.4024	53.3	41.7	22.3	19.7	73.003802281	57.0	32.85558081	29.0
03\23\94	43	MT	94	2	17.1	1.4691	42.5		17.6		58.174904943		26.174036659	
03\23\94	54	MT	94	3	15.5	1.8776	29.2		19.0		39.923954373		28.030973364	
03\23\94	31	MT	188	1	14.5	1.615	20.8	16.1	15.1	17.4	28.517110266	22.1	22.277440072	25.6
03\23\94	32	MT	188	2	15	1.073	25.0		17.8		34.220532319		25.832531475	
03\23\94	13	MT	188	3	12.3	0.8513	2.5		19.4		3.4220532319		28.624410956	
03\23\94	63	MT	375	1	13.7	1.4444	14.2	15.3	20.2	13.1	19.391634981	20.9	29.727166107	19.2
03\23\94	44	MT	375	2	13.2	1.307	10.0		1.4		13.688212928		2.043836188	
03\23\94	36	MT	375	3	14.8	0.9035	21.7		17.6		29.657794677		25.901561415	
03\23\94	59	MT	750	1	16	2.2711	33.3	29.4	18.4	12.7	45.627376426	40.3	27.061158238	16.7
03\23\94	6	MT	750	2	18	1.3511	33.3		7.6		45.627376426		11.233059703	
03\23\94	48	MT	750	3	14.8	0.8641	21.7		12.0		29.657794677		17.730616327	

APPENDIX III: EFFECTS OF HERBICIDES ON MACROPHYTES
DAY 0 WITH MYRIOPHYLLUM

Date	Beaker #	Chemical	Chemical Conc.	Rep.	Length (cm) Rep 1	Length (cm) Rep 2	Length (cm) Rep 3	Total 3 Plants Weight (gm)	Avg Length (cm)	Mean Avg Length (cm)	% Length Increase	Mean % Length Increase	% of Control for % Length Increase	Mean % of Control for % Length Increase	% Weight Increase	Mean % Weight Increase	Total Root Blotted Weight 3 plants (gm)	Total Weight 3 plants + Roots (gm)	% Of Control For % Weight Increase	Mean % Of Control For % Weight Increase
03\18\94	13	AL	188	1	13	13	13	3.3571	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	56	AL	188	2	13	13	13	3.113	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	55	AL	188	3	13	13	13	4.967	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	37	AL	375	1	13	13	13	2.9301	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	48	AL	375	2	13	13	13	4.0401	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	66	AL	375	3	13	13	13	2.7168	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	24	AL	750	1	13	13	13	4.4201	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	16	AL	750	2	13	13	13	4.211	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	9	AL	750	3	13	13	13	3.3522	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	27	AL	1500	1	13	13	13	4.121	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	6	AL	1500	2	13	13	13	3.0121	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	50	AL	1500	3	13	13	13	3.781	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	43	AL	3000	1	13	13	13	3.3861	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	57	AL	3000	2	13	13	13	3.1772	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	19	AL	3000	3	13	13	13	3.9444	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	34	AT	38	1	13	13	13	2.6004	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	44	AT	38	2	13	13	13	3.077	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	1	AT	38	3	13	13	13	3.0641	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	45	AT	75	1	13	13	13	3.0464	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	10	AT	75	2	13	13	13	2.8719	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	15	AT	75	3	13	13	13	4.1221	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	8	AT	150	1	13	13	13	3.262	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	32	AT	150	2	13	13	13	3.854	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	25	AT	150	3	13	13	13	4.414	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	61	AT	300	1	13	13	13	3.5583	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	60	AT	300	2	13	13	13	3.0391	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	42	AT	300	3	13	13	13	2.7555	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	31	AT	600	1	13	13	13	2.8123	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	28	AT	600	2	13	13	13	3.746	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	17	AT	600	3	13	13	13	3.341	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	65	CONC.NO ACE	0	1	13	13	13	3.3301	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	38	CONC.NO ACE	0	2	13	13	13	4.5473	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	41	CONC.NO ACE	0	3	13	13	13	3.2004	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	30	CONC.W/ACE	0	1	13	13	13	3.137	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	12	CONC.W/ACE	0	2	13	13	13	3.7667	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	64	CONC.W/ACE	0	3	13	13	13	3.617	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	7	MB	38	1	13	13	13	4.0978	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	23	MB	38	2	13	13	13	4.172	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	11	MB	38	3	13	13	13	4.0507	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	52	MB	75	1	13	13	13	2.6271	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	46	MB	75	2	13	13	13	3.9153	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	59	MB	75	3	13	13	13	3.1951	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	18	MB	150	1	13	13	13	3.302	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	2	MB	150	2	13	13	13	3.3401	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	49	MB	150	3	13	13	13	3.1341	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	29	MB	300	1	13	13	13	3.204	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	53	MB	300	2	13	13	13	3.861	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	14	MB	300	3	13	13	13	3.1609	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	36	MB	600	1	13	13	13	2.8823	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	5	MB	600	2	13	13	13	3.254	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	54	MB	600	3	13	13	13	2.6421	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	47	MT	188	1	13	13	13	3.9044	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	35	MT	188	2	13	13	13	3.3018	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	51	MT	188	3	13	13	13	3.4875	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	39	MT	375	1	13	13	13	3.2918	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	22	MT	375	2	13	13	13	3.845	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	33	MT	375	3	13	13	13	3.857	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	26	MT	750	1	13	13	13	4.23	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	20	MT	750	2	13	13	13	2.9007	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	4	MT	750	3	13	13	13	4.1101	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	63	MT	1500	1	13	13	13	3.607	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	62	MT	1500	2	13	13	13	2.6613	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	58	MT	1500	3	13	13	13	3.475	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	3	MT	3000	1	13	13	13	3.475	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	40	MT	3000	2	13	13	13	3.1144	.	.	.	.	.	.	.	.	.	.	.	.
03\18\94	21	MT	3000	3	13	13	13	4.068	.	.	.	.	.	.	.	.	.	.	.	.

To Farley FROM PAM
Email with programs is on its way

Instructions for using the SAS nonlinear regression program for calculation EC50 with and without hormesis.

○ Make a subdirectory on your hard disk--e.g. md \ec50

○ Copy files the file from the EC50 floppy to the subdirectory you create
e.g. copy b:*.* c:\ec50

○ If you use a different drive of subdirectory for the program files and the data file, use a text editor to edit the EC50.SAS program and change the drive and subdirectory location in the %LET statement and the %INCLUDE statement.

○ Start SAS

○ At the program editor prompt, include the EC50.SAS program.
e.g. INCLUDE 'C:\EC50\EC50.SAS

○ Press F7 to zoom the program editor window.

○ Change the TITLE statement and the data file name in the %LET statement.

○ The plot of the data and the regression lines defaults to the screen. If you want it on the printer, change the DEVICE= in the GOPTIONS statement from EGA to HPLJS2.

○ Press ~~F10~~ F8 to submit.

○ To save the output, press F5 to get to the output window.
To send the output to the printer, enter FILE 'PRN:' on the command line.
To save the output to a file, enter FILE '*datasetname*' on the command line (replace *datasetname* with the path and name of the file--OUT is the suggested file extension).

○ To save the log, press F5 to get to the log window
To send the log to the printer, enter FILE 'PRN:' on the command line.
To save the log to a file, enter FILE '*datasetname*' on the command line (replace *datasetname* with the path and name of the file--LOG is the suggested file extension).

Instructions for using the SAS nonlinear regression program for calculation EC50M with and without hormesis. EC50M will run the analysis for more than one chemical in the data file.

- The data file must be DOSE space RESPONSE space CHEMCODE. The EC50NLIN.SAS program will work with both EC50.SAS and EC50M.SAS.

- Copy files the EC50M.SAS file from the EC50 floppy to the subdirectory you create
  e.g. copy b:*.* c:\ec50

- If you use a different drive of subdirectory for the program files and the data file, use a text editor to edit the EC50M.SAS program and change the drive and subdirectory location in the %LET statement and the %INCLUDE statement.

- Start SAS

- At the program editor prompt, include the EC50M.SAS program.
  e.g. INCLUDE 'C:\EC50\EC50M.SAS

- Press F7 to zoom the program editor window.

- Change the TITLE statement (leave out the chemical's name) and the data file name in the %LET statement.

- Go to the bottom of the SAS program (press the <HOME> key and enter DOWN MAX). In the %EC50 statement enter between the parentheses, the chemical code, a comma, the chemical name, a comma, the dose to use for zero in plotting (not zero), a comma, and the maximum dose. The chemical code matches the chemical code in the data file and the chemical name will be displayed in the second title. You can have as many %EC50 statements as you have chemicals in the data file.

- The plot of the data and the regression lines defaults to the screen. If you want it on the printer, change the DEVICE= in the GOPTIONS statement from EGA to HPLJS2.

- Press F10 to submit.

- To save the output, press F5 to get to the output window.
  - To send the output to the printer, enter FILE 'PRN:' on the command line.
  - To save the output to a file, enter FILE '*datasetname*' on the command line (replace *datasetname* with the path and name of the file--OUT is the suggested file extension).

- To save the log, press F5 to get to the log window
  - To send the log to the printer, enter FILE 'PRN:' on the command line.
  - To save the log to a file, enter FILE '*datasetname*' on the command line (replace *datasetname* with the path and name of the file--LOG is the suggested file extension).

```
*EC50NLIN.SAS  -- THE NONLINEAR REGRESSION PROGRAM TO CALCULATE
   EC50 WITH AND WITHOUT HORMESIS;

DATA HORM;
  INFILE &DATASET FIRSTOBS=2;
   INPUT DOS RESP CHEM;

 %IF &K=1 %THEN %DO;
    WHERE CHEM="&CHEMCODE";
      %END;
   IF DOS>0.001 THEN LDOS=LOG(DOS);
   ELSE LDOS=LOG(0.001);

       *THE FIRST PART OF THE FILE FINDS INITIAL ESTIMATES;

    *CALCULATION OF MEAN FOR CONTROL;

  PROC PRINT DATA=HORM;
    TITLE3 'RAW DATA';

  PROC MEANS NWAY DATA=HORM;
    VAR RESP;
    CLASS DOS;
    OUTPUT OUT=HORMMN MEAN=RESPMN;

  DATA CONTRMN;
    SET HORMMN;
    IF DOS=0;
    K=RESPMN;

  DATA HORMCOMB;
       *K=MEAN OF CONTROL;
    SET HORM ;
    IF _N_=1 THEN SET CONTRMN;
    LOGITR=LOG(RESP/(K-RESP));


  CALL SYMPUT('INIK',K);
      *INITIAL ESTIMATE FOR K;

  *PROC PRINT DATA=HORMCOMB;

  PROC REG DATA=HORMCOMB OUTEST=ESTLIN;
       *LINEAR REGRESSION TO FIND;
    MODEL LOGITR=LDOS;
       *INITIAL ESTIMATE FOR B AND X0;
  RUN;

  DATA _NULL_;
    SET ESTLIN;

  CALL SYMPUT('INIB', -LDOS);
  CALL SYMPUT('INIX0', EXP(-INTERCEP/LDOS));
  %LET INIF=0;
     *NOW THE INITIAL ESTIMATES ARE KNOWN,
        NONLINEAR REGRESSION CAN BE PERFORMED;

 TITLE3 'MODEL 5 - LINEAR LOGISTIC WITH HORMESIS (ALL DATA)';
  PROC NLIN DATA=HORM;
   PARMS K=&INIK X0=&INIX0 B=&INIB F=&INIF;
     *INITIAL ESTIMATES;
     *SPECIFICATION OF DERIVATIVES;
    IF DOS>0.0001 THEN DO;
        XX0B=(DOS/X0)**B;
        FX0=2*F*X0+1;
        DENOM=1+FX0 * XX0B;
        Y=K*(1+F*DOS)/DENOM;
      DER.K=Y/K;
      DER.B=-Y/DENOM * FX0 * LOG(DOS/X0) * XX0B;
      DER.X0=Y/DENOM * XX0B * (-2*F + FX0 * B/X0);
      DER.F=K*DOS/DENOM-Y/DENOM *2*X0*XX0B;
     END;
    ELSE DO;
      *DERIVATIVES FOR CONTROL NEED SPECIAL CARE;
        DENOM=1;
        Y=K;
      DER.K=1;
      DER.B=0;
      DER.F=0;
      DER.X0=0;
     END;
   MODEL RESP=Y;
   OUTPUT OUT=MODEL5 P=PRE5;
```

```
RUN;

    TITLE3 'MODEL 1 - STANDARD LOGISTIC (ALL DATA)';
  PROC NLIN DATA=HORM;
   PARMS K=&INIK X0=&INIX0 B=&INIB ;
     *INITIAL ESTIMATES;
     *SPECIFICATION OF DERIVATIVES;
    IF DOS>0.0001 THEN DO;
        XX0B=(DOS/X0)**B;
        DENOM=1+ XX0B;
        Y=K/DENOM;
      DER.K=Y/K;
      DER.B=-Y/DENOM * LOG(DOS/X0) * XX0B;
      DER.X0=Y/DENOM * XX0B * B/X0;
     END;
    ELSE DO;
      *DERIVATIVES FOR CONTROL NEED SPECIAL CARE;
        DENOM=1;
        Y=K;
      DER.K=1;
      DER.B=0;
      DER.X0=0;
     END;
   MODEL RESP=Y;
   OUTPUT OUT=MODEL1 P=PRE1;
      *FIT OF THE MODEL;
   RUN;


DATA ALL; MERGE HORM MODEL5 MODEL1 ;

PROC PRINT DATA=ALL;
  VAR DOS RESP PRE1  PRE5;
  TITLE3 'LIST OF DATA AND PREDICTED VALUES';

DATA  ALL;  SET ALL;
  IF DOS=0 THEN DOS=.001;

RUN;
```

```
    M.SAS NLIN PROGRAM FOR EC50 FOR MORE THAN ONE CHEMICAL;
    ; EC50NLIN.SAS--CHECK THE DRIVE AND SUBDIRECTORY IN THE
    %INCLUDE STATEMENT THAT RETRIEVES EC50NLIN.SAS;

*DATA IN THE DATA SET SHOULD START ON LINE 2;
*IT SHOULD BE DOSE SPACE RESPONSE SPACE CHEM;

*INSERT THE TITLE BETWEEN THE SINGLE QUOTATION MARKS
    IN THE TITLE STATEMENT WITHOUT THE CHEMICAL NAME;
*****************;
TITLE1 'INSERT TITLE HERE';
*****************;

%GLOBAL DATASET ;
%GLOBAL K;
%LET K=1;

*INSERT COMPLETE DATA SET NAME IN THE %LET
     STATEMENT BETWEEN THE SINGLE QUOTATION MARKS;

%LET DATASET='C:\EC50\TEST2.DAT' /*DATA SET NAME HERE- BETWEEN THE QUOTES*/;

/*
EXAMPLE
%LET DATASET='D:\PAM\JIMF\TEST.DAT';
*/

%MACRO EC50(CHEMCODE,CHEMNAME,MIN,MAX);
TITLE2 "&CHEMNAME";
OPTIONS ERRORS=2;
%INCLUDE 'C:\EC50\EC50NLIN.SAS';

*MODEL 5 CALCULATES ESTIMATES WITH HORMESIS;
*K IS THE INITIAL RESPONSE (DOSE=0);
*X0 IS THE EC50;
*F IS THE HOMESIS;
*B IS THE SLOPE;

*IN PLOTTING, IF DOSE=0 THEN DOSE=.001;

%GLOBAL ORDE;
RUN;
DATA BUILD;
  M=LOG10(&MI N);N=LOG10(&MAX);
  CM=INT(LOG10(&MIN)) ;CN=INT(LOG10(&MAX));
   IF M=CM THEN MM=M; ELSE MM=CM-1;
   IF N=CN THEN NN=N ;ELSE NN=CN+1;
   FORMAT ORD ORD2 $CHAR30. D $CHAR10.;
     ORD= '                              ';
        DO I= MM TO NN BY 1;
          K=10**I; D=K;
            ORD2=LEFT(TRIM(ORD)) ¦¦  ' '¦¦ LEFT(TRIM(D));
            ORD=ORD2;
            END;
              CALL SYMPUT('ORDE',ORD2);
              RUN;
              %GLOBAL ORDE;

GOPTIONS DEVICE=EGA ROTATE=LANDSCAPE FTEXT=SWISSB;

SYMBOL1 I=NONE V=STAR COLOR=YELLOW;
SYMBOL2 I=SPLINE V='5' COLOR=GREEN LINE=1;
SYMBOL3 I=SPLINE V='1' COLOR=BLUE LINE=2;
AXIS1 LABEL=(J=CENTER 'CONCENTRATION (LOG10 SCALE)')
     LOGBASE=10 LOGSTYLE=EXPAND
    ORDER=&ORDE;
AXIS2 LABEL=(ANGLE=90 J=CENTER 'RESPONSE');
RUN;

PROC GPLOT DATA=ALL;
 PLOT RESP*DOS=1 PRE5*DOS=2 PRE1*DOS=3 /
   OVERLAY HAXIS=AXIS1 VAXIS=AXIS2;
  TITLE3 'PLOT OF ORIGINAL DATA WITH MODEL 1 AND MODEL 5 PREDICTIONS';

RUN;
%MEND EC50;
/* %EC50 IS THE MACRO THAT WILL RUN THE ANALYSIS
   PUT THE CHEMICAL'S CODE THAT IS IN THE DATA SET,
   THE CHEMICALS NAME THAT IS USED IN THE TITLE, THE MINIMUM DOSE (NOT ZERO)
   AND THE MAXIMUM DOSE */
/*YOU CAN RUN AS MANY OF THESE AS YOU HAVE CHEMICALS IN
```

```
  THE DATA SET*/

/* FOR EXAMPLE
     %EC50(AT,ATRAZINE,.001,1000);
*/

%EC50(AT,ATRAZINE,.001,1000);



RUN;
```

```
*EC50.SAS NLIN PROGRAM FOR EC50;
*CALLS EC50NLIN.SAS--CHECK THE DRIVE AND SUBDIRECTORY IN THE
    %INCLUDE STATEMENT THAT RETRIEVES EC50NLIN.SAS;

*DATA IN THE DATA SET SHOULD START ON LINE 2;
*IT SHOULD BE DOSE THEN RESPONSE WITH A SPACE IN BETWEEN;

*INSERT THE TITLE BETWEEN THE SINGLE QUOTATION MARKS
    IN THE TITLE STATEMENT ;
*****************;
TITLE1 'insert title here';
*****************;

%GLOBAL DATASET ;
%GLOBAL K;
%LET K=0;

*INSERT COMPLETE DATA SET NAME IN THE %LET
     STATEMENT BETWEEN THE SINGLE QUOTATION MARKS;

%LET DATASET='C:\EC50\TEST2.DAT' /*data set name here- between the quotes*/;

/*
EXAMPLE
%LET DATASET='D:\PAM\JIMF\TEST.DAT';
*/

OPTIONS ERRORS=2;
%INCLUDE 'C:\EC50\EC50NLIN.SAS';

*MODEL 5 CALCULATES ESTIMATES WITH HORMESIS;
*K IS THE INITIAL RESPONSE (DOSE=0);
*X0 IS THE EC50;
*F IS THE HOMESIS;
*B IS THE SLOPE;

*IN PLOTTING, IF DOSE=0 THEN DOSE=.001;

GOPTIONS DEVICE=EGA ROTATE=LANDSCAPE FTEXT=SWISSB;

SYMBOL1 I=NONE V=STAR COLOR=YELLOW;
SYMBOL2 I=SPLINE V='5' COLOR=GREEN LINE=1;
SYMBOL3 I=SPLINE V='1' COLOR=BLUE LINE=2;
AXIS1 LABEL=(J=CENTER 'Concentration (log10 scale)')
     LOGBASE=10
    ORDER=(.001 .01 .1 1 10 100 1000);
AXIS2 LABEL=(ANGLE=90 J=CENTER 'RESPONSE');
RUN;

PROC GPLOT DATA=ALL;
 PLOT RESP*DOS=1 PRE5*DOS=2 PRE1*DOS=3 /
   OVERLAY HAXIS=AXIS1 VAXIS=AXIS2;
  TITLE3 'PLOT OF ORIGINAL DATA WITH MODEL 1 AND MODEL 5 PREDICTIONS';

RUN;
```

APPENDIX III: EFFECTS OF HERBICIDES ON MACROPHYTES
DAY 7 WITH MYRIOPHYLLUM

Date	Beaker #	Chemical	Chemical Conc.	Rep.	Length (cm) Rep 1	Length (cm) Rep 2	Length (cm) Rep 3	Total 3 Plants Weight (gm)	Avg Length (cm)	Mean Avg Length (cm)	% Length Increase	Mean % Length Increase	% of Control for % Length Increase	Mean % of Control for % Length Increase	% Weight Increase	Mean % Weight Increase	Total Root Blotted Weight 3 plants (gm)	Total Weight 3 plants + Roots (gm)	% Of Control For % Weight Increase	Mean % Of Control For % Weight Increase
03\25\94	13	AL	188	1	15.1	16	15.4	3.6725	15.5	15.5	19.231	18.889	136.3636	134	9	13	.	.	81.84002	85
03\25\94	56	AL	188	2	14.5	14.8	15.6	3.5228	15.0		15.128		107.2727		13	.	.	.	86.60701	
03\25\94	55	AL	188	3	14.5	16.7	16.5	5.76	15.9		22.308		158.1818		16	.	.	.	105.0875	
03\25\94	37	AL	375	1	14.1	14.5	16.6	3.208	15.1	15.4	15.897	16.462	112.7273	131	9	14	.	.	62.42784	95
03\25\94	48	AL	375	2	15	15.1	16.6	4.4845	15.6		19.744		140		11	.	.	.	72.4026	
03\25\94	66	AL	375	3	15	15.7	16	3.337	15.6		19.744		140		23	.	.	.	150.3205	
03\25\94	24	AL	750	1	15.4	15.9	16.5	4.644	15.9	15.9	22.564	22.393	160	159	10	13	.	.	63.12531	85
03\25\94	18	AL	750	2	15.1	15	17	4.4853	15.7		20.769		147.2727		7	.	.	.	42.87565	
03\25\94	9	AL	750	3	17	15.6	15.5	4.11	16.1		23.846		169.0909		23	.	.	.	148.7979	
03\25\94	27	AL	1500	1	16	16.1	16.1	4.8401	16.1	15.2	23.590	16.667	167.2727	116	17	16	.	.	114.8574	121
03\25\94	6	AL	1500	2	14	14.5	15	3.646	14.5		11.538		81.81818		21	.	.	.	138.5235	
03\25\94	50	AL	1500	3	14.7	15.6	14.5	4.3912	14.9		14.872		105.4545		17	.	.	.	110.2928	
03\25\94	43	AL	3000	1	15.3	15.2	14.6	3.9558	15.1	14.9	16.154	14.786	114.5455	105	17	15	.	.	110.7047	100
03\25\94	57	AL	3000	2	14.9	14	15	3.6542	14.6		12.564		89.09091		15	.	.	.	96.82027	
03\25\94	19	AL	3000	3	15.3	14.9	14.9	4.4863	15.0		15.641		110.9091		14	.	.	.	90.42956	
03\25\94	34	AT	38	1	14.5	14.9	14.5	2.9346	14.6	14.5	12.564	11.197	89.09091	79	13	13	.	.	84.59379	67
03\25\94	44	AT	38	2	14.5	13.5	15	3.5603	14.3		10.256		72.72727		16	.	.	.	103.3659	
03\25\94	1	AT	38	3	14.7	13.6	14.7	3.425	14.4		10.769		76.36364		11	.	.	.	72.75633	
03\25\94	45	AT	75	1	14.7	15.5	15.1	3.6961	15.1	15.1	16.154	15.812	114.5455	112	21	11	.	.	140.3777	74
03\25\94	10	AT	75	2	14.5	14.5	15.4	3.0422	14.6		13.846		98.18182		8	.	.	.	39.03171	
03\25\94	15	AT	75	3	15.3	15.2	15.3	4.36	15.3		17.436		123.6364		6	.	.	.	41.18177	
03\25\94	8	AT	150	1	15.9	15	14.7	3.621	15.2	15.4	16.923	18.376	120	130	11	9	.	.	72.44071	59
03\25\94	32	AT	150	2	15	15	16	4.2849	15.3		17.949		127.2727		11	.	.	.	73.59308	
03\25\94	25	AT	150	3	15.4	16	15.5	4.6301	15.6		20.256		143.6364		5	.	.	.	32.22513	
03\25\94	61	AT	300	1	14.9	15.1	14.6	3.7021	14.9	14.9	14.359	14.615	101.8182	104	4	3	.	.	26.40602	23
03\25\94	60	AT	300	2	14.5	14.6	15.1	3.0267	14.7		13.333		94.54545		−0	.	.	.	−2.25248	
03\25\94	42	AT	300	3	15.5	15.1	14.7	2.9367	15.1		16.154		114.5455		7	.	.	.	44.00089	
03\25\94	31	AT	600	1	13.4	14.2	15.5	2.8155	14.4	14.6	10.513	14.103	74.54545	100	0	1	.	.	0.748963	6
03\25\94	26	AT	600	2	15.1	15	15	3.9462	15.0		15.641		110.9091		5	.	.	.	34.80778	
03\25\94	17	AT	600	3	15.5	15.5	14.3	3.2505	15.1		16.154		114.5455		−3	.	.	.	−17.8297	
03\25\94	65	CONC.NO ACE	0	1	14.4	13.9	16	3.7316	14.8	14.8	13.590	14.103	96.36364	100	12	15	.	.	79.35979	100
03\25\94	36	CONC.NO ACE	0	2	15.5	14.3	14.5	5.285	14.6		13.590		96.36364		16	.	.	.	108.7821	
03\25\94	41	CONC.NO ACE	0	3	15	15.4	14.5	3.754	15.0		15.128		107.2727		17	.	.	.	113.8581	
03\25\94	30	CONC.W/ACE	0	1	15.8	17.1	16.5	4.1662	16.5	16.5	28.667	27.009	169.0909	182	33	28	.	.	215.9521	183
03\25\94	12	CONC.W/ACE	0	2	16.2	17	17.3	4.6966	16.8		29.487		209.0909		25	.	.	.	162.323	
03\25\94	64	CONC.W/ACE	0	3	16.2	16.2	16.3	4.801	16.2		24.872		176.3636		26	.	.	.	169.6857	
03\25\94	7	MB	38	1	16.3	15.5	16.4	4.6507	16.1	15.6	23.590	21.538	167.2727	153	13	11	.	.	88.64773	75
03\25\94	23	MB	38	2	16	15.6	16.7	4.8223	16.1		23.846		169.0909		16	.	.	.	102.5967	
03\25\94	11	MB	38	3	15.5	15.2	15	4.2628	15.2		17.179		121.8182		5	.	.	.	34.46536	
03\25\94	52	MB	75	1	15.1	14.5	14.6	2.8665	14.7	15.1	13.333	15.897	94.54545	113	9	6	.	.	59.96164	40
03\25\94	46	MB	75	2	15.2	15	16.7	3.9501	15.6		20.256		143.6364		1	.	.	.	5.850412	
03\25\94	59	MB	75	3	14.5	15	15	3.4617	14.8		14.103		100		6	.	.	.	54.9222	
03\25\94	16	MB	150	1	14.3	15	13.4	3.3028	14.2	14.5	9.487	11.453	67.27273	61	0	1	.	.	0.159472	7
03\25\94	2	MB	150	2	15.2	14.5	15.3	3.3375	15.0		15.385		109.0909		−0	.	.	.	−0.51237	
03\25\94	49	MB	150	3	13.7	14.5	14.5	3.2408	14.2		9.487		67.27273		3	.	.	.	22.36706	
03\25\94	29	MB	300	1	14	14.3	14.5	3.275	14.3	14.3	9.744	10.342	69.09091	73	2	1	.	.	14.58608	4
03\25\94	53	MB	300	2	14.5	15.5	14.1	3.97	14.7		13.077		92.72727		3	.	.	.	18.58228	
03\25\94	14	MB	300	3	13.5	14.5	14.2	3.062	14.1		8.205		58.18182		−3	.	.	.	−20.5948	
03\25\94	36	MB	600	1	15.4	13.5	15.1	2.9945	14.7	14.4	12.821	10.855	90.90909	77	4	−1	.	.	25.62276	−6
03\25\94	5	MB	600	2	12.1	14.7	15.2	2.9968	14.0		7.692		54.54545		−6	.	.	.	−52.0671	
03\25\94	54	MB	600	3	14.5	14.5	14.7	2.6735	14.6		12.051		85.45455		1	.	.	.	7.822827	
03\25\94	47	MT	188	1	14.5	15	15	4.1061	14.8	14.9	14.103	14.701	100	104	5	9	.	.	34.34068	57
03\25\94	35	MT	188	2	13.1	15	14.3	3.416	14.1		8.718		61.81818		3	.	.	.	22.76604	
03\25\94	51	MT	188	3	14.5	16.6	16	4.0645	15.8		21.282		150.9091		17	.	.	.	112.6762	
03\25\94	39	MT	375	1	14.7	15	15.6	3.627	15.2	15.0	16.667	15.385	118.1818	109	10	8	.	.	67.02592	53
03\25\94	22	MT	375	2	15.5	13.5	15	4.075	14.7		12.821		90.90909		6	.	.	.	39.37347	
03\25\94	33	MT	375	3	14.7	15	15.6	4.1733	15.2		16.667		118.1818		6	.	.	.	53.97862	
03\25\94	26	MT	750	1	15.5	15.5	15.9	4.8124	15.6	15.1	20.256	16.410	143.6364	116	9	9	.	.	59.50449	82
03\25\94	20	MT	750	2	15.1	14.5	14.7	3.284	14.8		13.590		96.36364		13	.	.	.	86.97776	
03\25\94	4	MT	750	3	15.5	15.5	14	4.3565	15.0		15.385		109.0909		6	.	.	.	39.46031	
03\25\94	63	MT	1500	1	15	14.2	14.6	4.1937	14.6	14.2	12.308	9.060	87.27273	64	16	13	.	.	107.0637	63
03\25\94	62	MT	1500	2	14.5	13.7	13.3	3.0361	13.8		8.410		45.45455		14	.	.	.	93.19428	
03\25\94	56	MT	1500	3	13.5	14.3	14.5	3.727	14.1		8.462		60		7	.	.	.	47.73291	
03\25\94	3	MT	3000	1	14.6	14.9	15.1	3.7215	14.9	14.6	14.359	13.590	101.8182	96	7	12	.	.	48.69112	77
03\25\94	40	MT	3000	2	14.3	14.6	15	3.8163	14.6		12.564		89.09091		16	.	.	.	108.4982	
03\25\94	21	MT	3000	3	14.5	14.9	15	4.5428	14.6		13.846		98.18182		12		.	.	78.79254	

APPENDIX III: EFFECTS OF HERBICIDES ON MACROPHYTES
DAY 14 WITH MYRIOPHYLLUM

Date	Beaker #	Chemical	Chemical Conc.	Rep.	Length (cm) Rep 1	Length (cm) Rep 2	Length (cm) Rep 3	Total 3 Plants Weight (gm)	Avg Length (cm)	Mean Avg Length (cm)	% Length Increase	Mean % Length Increase	% of Control for % Length Increase	Mean % of Control for % Length Increase	% Weight Increase	Mean % Weight Increase	Total Root Blotted Weight 3 plants (gm)	Total Weight 3 plants + Roots (gm)	% Of Control For % Weight Increase	Mean % Of Control For % Weight Increase
04\01\94	13	AL	188	1	16.7	17.2	18	3.6041	17.3	17.5	33.077	34.444	122.8571	128	11	13	0.1122	3.7163	137.5614	171
04\01\94	56	AL	188	2	16.9	16	18.9	3.4855	17.3		32.821		121.9048		16		0.1287	3.6142	208.9933	
04\01\94	55	AL	188	3	19	19.4	15.2	5.3733	17.9		37.436		139.0476		13		0.2419	5.6152	167.7797	
04\01\94	37	AL	375	1	16.7	16.7	20.3	3.365	17.9	18.1	37.692	38.889	140	144	20	18	0.1628	3.5278	262.2559	232
04\01\94	48	AL	375	2	18.3	17.8	20.3	4.4887	18.8		44.615		165.7143		15		0.1718	4.6605	197.4259	
04\01\94	66	AL	375	3	18.2	15	19.2	3.1184	17.5		34.359		127.619		18		0.0985	3.2169	236.7714	
04\01\94	24	AL	750	1	18.7	19.5	20.8	4.8381	19.7	19.4	51.282	49.402	190.4762	183	12	13	0.1285	4.9666	158.958	168
04\01\94	16	AL	750	2	18.1	21.5	19.1	4.8027	19.6		50.513		187.619		19		0.1992	5.0019	241.4667	
04\01\94	9	AL	750	3	20.5	18.1	18.5	3.545	19.0		46.410		172.381		8		0.081	3.626	105.0093	
04\01\94	27	AL	1500	1	20.6	18.8	20.6	4.5921	20.0	18.6	53.846	42.821	200	159	13	16	0.0797	4.6718	171.8366	207
04\01\94	6	AL	1500	2	17.4	17.3	18.4	3.6966	17.7		36.154		134.2857		24		0.0452	3.7418	311.4579	
04\01\94	50	AL	1500	3	18.7	18.2	17.1	4.1391	18.0		38.462		142.8571		11		0.0282	4.1673	138.869	
04\01\94	43	AL	3000	1	19.3	17.7	19.3	4.229	18.8	18.7	44.359	43.761	164.7619	163	25	16	0.0028	4.2318	321.0248	201
04\01\94	57	AL	3000	2	16.5	18.7	19.4	3.4172	18.2		40.000		148.5714		9		0.0383	3.4555	112.6142	
04\01\94	19	AL	3000	3	19.3	18.5	19.5	4.4618	19.1		46.923		174.2857		13		0	4.4618	168.5784	
04\01\94	34	AT	38	1	16.2	16.5	16	2.9058	16.2	15.9	24.872	21.966	92.38095	82	16	15	0.115	3.0208	207.6013	187
04\01\94	44	AT	38	2	16.3	16.6	15.5	3.1588	16.1		24.103		89.52381		11		0.243	3.4018	135.7103	
04\01\94	1	AT	38	3	16.2	15.4	14	3.5166	15.2		16.923		62.85714		17		0.0865	3.6031	216.3532	
04\01\94	45	AT	75	1	18	17.3	18	3.6051	17.8	17.5	36.667	34.872	136.1905	130	28	16	0.2897	3.8948	358.0454	203
04\01\94	10	AT	75	2	18.3	17.2	18.2	3.1737	17.2		32.564		120.9524		18		0.2085	3.3822	228.4445	
04\01\94	15	AT	75	3	17.5	16.5	18.8	3.9522	17.6		35.385		131.4286		2		0.245	4.1972	23.42318	
04\01\94	8	AT	150	1	17.5	19.4	18.2	3.6003	18.4	17.4	41.282	34.103	153.3333	127	16	5	0.1821	3.7824	205.1057	58
04\01\94	32	AT	150	2	15.9	16.2	17.1	3.5758	16.4		26.154		97.14286		−3		0.1506	3.7264	−42.5681	
04\01\94	25	AT	150	3	18	16.9	17.7	4.2504	17.5		34.872		129.5238		1		0.2034	4.4538	11.59245	
04\01\94	61	AT	300	1	15.7	15.5	16	3.2625	15.7	15.4	21.026	18.120	78.09524	67	−6	−12	0.0965	3.359	−72.3504	−149
04\01\94	60	AT	300	2	15.2	14	12.2	2.0371	13.8		6.154		22.85714		−32		0.0365	2.0736	−408.443	
04\01\94	42	AT	300	3	16.8	15.9	16.9	2.7359	16.5		27.179		100.9524		3		0.0931	2.829	34.29346	
04\01\94	31	AT	600	1	16.2	16	0	1.677	10.7	14.3	−17.436	10.000	−64.7619	37	−40	−20	0	1.677	−519.007	−262
04\01\94	28	AT	600	2	15.9	16.3	16.1	3.3333	16.1		23.846		88.57143		−10		0.0298	3.3631	−132.03	
04\01\94	17	AT	600	3	16.5	16.4	15.3	2.9571	16.1		23.590		87.61905		−10		0.0348	2.9919	−134.336	
04\01\94	65	CONC.NO ACE	0	1	15	17.7	15.6	3.5112	16.1	16.5	23.846	26.923	88.57143	100	11	8	0.1872	3.6984	142.1899	100
04\01\94	38	CONC.NO ACE	0	2	16.6	15.5	17.5	4.1657	16.5		27.179		100.9524		−4		0.213	4.3787	−47.6682	
04\01\94	41	CONC.NO ACE	0	3	16.2	17.8	16.6	3.468	16.9		29.744		110.4762		16		0.2439	3.7119	205.4762	
04\01\94	30	CONC.W/ACE	0	1	18.6	17	18.1	2.9743	18.6	19.1	42.821	47.265	159.0476	176	1	13	0.2092	3.1835	19.06737	166
04\01\94	12	CONC.W/ACE	0	2	21.8	19.5	19.6	3.5906	20.3		56.154		208.5714		6		0.3908	3.9814	73.28168	
04\01\94	64	CONC.W/ACE	0	3	18.5	19	18.2	4.6601	18.6		42.821		159.0476		31		0.3573	5.0174	404.3228	
04\01\94	7	MB	38	1	16.7	19.1	19	4.2503	18.3	17.4	40.513	34.103	150.4762	127	11	−1	0.302	4.5523	142.6856	−10
04\01\94	23	MB	38	2	17.5	17.6	18.2	3.3959	17.8		36.667		136.1905		−9		0.4139	3.8098	−111.617	
04\01\94	11	MB	38	3	16	16.6	16.2	3.6336	16.3		25.128		93.33333		−5		0.2272	3.8608	−60.2725	
04\01\94	52	MB	75	1	15.2	16.7	15.4	2.4751	15.8	16.2	21.282	24.957	79.04762	93	−1	−1	0.1232	2.5983	−14.0942	−13
04\01\94	46	MB	75	2	16	16	17.9	3.5644	16.6		27.949		103.8095		−4		0.2111	3.7755	−45.9057	
04\01\94	59	MB	75	3	16.5	15.8	16.7	3.0765	16.3		25.641		95.2381		2		0.1722	3.2487	21.56775	
04\01\94	18	MB	150	1	13.5	12	15	2.5277	13.5	15.2	3.846	17.009	14.28571	63	−23	−11	0	2.5277	−301.479	−138
04\01\94	2	MB	150	2	17.4	16	17	2.9851	16.8		29.231		108.5714		−9		0.0519	3.037	−118.668	
04\01\94	49	MB	150	3	14.5	16	15.5	3.0911	15.3		17.949		66.66667		0		0.0503	3.1414	2.99457	
04\01\94	29	MB	300	1	15.9	14	15.6	2.7241	15.2	15.3	16.667	17.521	61.90476	65	−15	−14	0.0146	2.7387	−186.709	−175
04\01\94	53	MB	300	2	15	15.3	16.6	3.4411	15.6		20.256		75.2381		−10		0.0166	3.4577	−134.293	
04\01\94	14	MB	300	3	15.3	15.3	14.5	2.643	15.0		15.641		58.09524		−16		0.0133	2.6563	−205.239	
04\01\94	36	MB	600	1	11.1	16.3	12.5	2.3101	13.3	7.5	2.308	−41.966	8.571429	−156	−20	−44	0	2.3101	−255.231	−559
04\01\94	5	MB	600	2	0	15.9	12.1	1.6065	9.3		−28.205		−104.762		−51		0	1.6065	−650.927	
04\01\94	54	MB	600	3	0	0	0	1.056	0.0		−100.000		−371.429		−60		0	1.056	−771.602	
04\01\94	47	MT	188	1	14.9	17	16.8	4.3071	16.2	17.0	24.872	30.684	92.38095	114	11	9	0.0232	4.3303	140.2419	117
04\01\94	35	MT	188	2	16.3	17.5	14.6	3.5153	16.1		24.103		89.52381		9		0.0806	3.5959	114.5167	
04\01\94	51	MT	188	3	20.5	18.6	16.7	3.7203	18.6		43.077		160		8		0.0299	3.7502	96.84346	
04\01\94	39	MT	375	1	16.5	17.2	19	3.6025	17.6	17.4	35.128	33.761	130.4762	125	9	12	0	3.6025	121.3479	154
04\01\94	22	MT	375	2	18.1	18.2	14.9	4.1615	17.1		31.282		116.1905		8		0	4.1615	105.8263	
04\01\94	33	MT	375	3	17.2	18.2	17.2	4.5494	17.5		34.872		129.5238		18		0.0113	4.5607	234.5645	
04\01\94	26	MT	750	1	17.2	18.4	17.1	4.7851	17.6	17.0	35.128	30.598	130.4762	114	13	11	0	4.7851	168.7156	139
04\01\94	20	MT	750	2	17.2	16.5	16.4	3.2638	16.7		28.462		105.7143		13		0	3.2638	160.8454	
04\01\94	4	MT	750	3	16.1	16.2	17.7	4.392	16.7		28.205		104.7619		7		0	4.392	88.17939	
04\01\94	63	MT	1500	1	15.3	16.5	16	4.1068	15.9	15.4	22.564	18.547	83.80952	69	14	9	0	4.1068	178.7869	117
04\01\94	62	MT	1500	2	14.5	14	15.8	2.9186	14.8		13.590		50.47619		10		0	2.9186	124.7829	
04\01\94	58	MT	1500	3	16.5	16.3	13.8	3.6037	15.5		19.487		72.38095		4		0	3.6037	47.61548	
04\01\94	3	MT	3000	1	15	15.3	14.7	3.8005	15.0	15.3	15.385	17.521	57.14286	65	9	11	0	3.8005	120.4261	146
04\01\94	40	MT	3000	2	15.4	15.3	15.1	3.6373	15.3		17.436		64.7619		17		0	3.6373	215.8583	
04\01\94	21	MT	3000	3	15.3	15.4	16	4.3942	15.6		19.744		73.33333		8		0	4.3942	103.0826	

APPENDIX IV: EFFECTS OF WATER QUALITY ON TOXICITY OF ATRAZINE TO ALGAE
24 HRS WITH SELENASTRUM

DATE	RANDOM NUMBER SYSTEM	WATER QUALITY TYPE	CHEMICAL DOSE	REP	MULT	SENS	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
1/11/94	39	S	500	1	100	2.84	4	1136	1155	113	115
1/11/94	6	S	500	2	100	2.84	4.2	1192.8		119	
1/11/94	15	S	500	3	100	2.84	4	1136		113	
1/11/94	14	S	250	1	100	2.84	4.3	1221.2	1145	122	114
1/11/94	36	S	250	2	100	2.84	3.8	1079.2		108	
1/11/94	27	S	250	3	100	2.84	4	1136		113	
1/11/94	2	S	125	1	100	2.84	4.4	1249.6	1231	125	123
1/11/94	5	S	125	2	100	2.84	4.2	1192.8		119	
1/11/94	41	S	125	3	100	2.84	4.4	1249.6		125	
1/11/94	3	S	62	1	100	2.84	4.5	1278	1316	127	131
1/11/94	75	S	62	2	100	2.84	4.5	1278		127	
1/11/94	88	S	62	3	100	2.84	4.9	1391.6		139	
1/11/94	9	S	31	1	100	2.84	4.4	1249.6	1250	125	125
1/11/94	60	S	31	2	100	2.84	4.6	1306.4		130	
1/11/94	12	S	31	3	100	2.84	4.2	1192.8		119	
1/11/94	67	S	16	1	100	2.84	4.6	1306.4	1250	130	125
1/11/94	18	S	16	2	100	2.84	4.6	1306.4		130	
1/11/94	71	S	16	3	100	2.84	4	1136		113	
1/11/94	34	S	0	1	100	2.84	3.9	1107.6	1003	110	100
1/11/94	82	S	0	2	100	2.84	3.5	994		99	
1/11/94	73	S	0	3	100	2.84	3.2	908.8		91	
1/11/94	8	A+S	500	1	100	2.84	3.4	965.6	1003	74	77
1/11/94	65	A+S	500	2	100	2.84	4	1136		87	
1/11/94	80	A+S	500	3	100	2.84	3.2	908.8		70	
1/11/94	83	A+S	250	1	100	2.84	3.9	1107.6	1145	85	88
1/11/94	74	A+S	250	2	100	2.84	4.1	1164.4		89	
1/11/94	86	A+S	250	3	100	2.84	4.1	1164.4		89	
1/11/94	26	A+S	125	1	100	2.84	4	1136	1259	87	96
1/11/94	28	A+S	125	2	100	2.84	4.7	1334.8		102	
1/11/94	19	A+S	125	3	100	2.84	4.6	1306.4		100	
1/11/94	63	A+S	62	1	100	2.84	5	1420	1325	109	101
1/11/94	1	A+S	62	2	100	2.84	4.2	1192.8		91	
1/11/94	85	A+S	62	3	100	2.84	4.8	1363.2		104	
1/11/94	31	A+S	31	1	100	2.84	4.4	1249.6	1240	96	95
1/11/94	78	A+S	31	2	100	2.84	4.4	1249.6		96	
1/11/94	76	A+S	31	3	100	2.84	4.3	1221.2		93	
1/11/94	35	A+S	16	1	100	2.84	4.6	1306.4	1250	100	96
1/11/94	90	A+S	16	2	100	2.84	4.1	1164.4		89	
1/11/94	23	A+S	16	3	100	2.84	4.5	1278		98	
1/11/94	52	A+S	0	1	100	2.84	6.4	1817.6	1306	139	100
1/11/94	20	A+S	0	2	100	2.84	3.6	1022.4		78	
1/11/94	32	A+S	0	3	100	2.84	3.8	1079.2		83	
1/11/94	16	A	500	1	100	2.84	4	1136	1164	118	121
1/11/94	50	A	500	2	100	2.84	4.2	1192.8		124	
1/11/94	57	A	500	3	100	2.84	4.1	1164.4		121	
1/11/94	48	A	250	1	100	2.84	4.9	1391.6	1325	144	137
1/11/94	56	A	250	2	100	2.84	5	1420		147	
1/11/94	68	A	250	3	100	2.84	4.1	1164.4		121	
1/11/94	58	A	125	1	100	2.84	4.3	1221.2	1269	126	131
1/11/94	54	A	125	2	100	2.84	4.8	1363.2		141	
1/11/94	13	A	125	3	100	2.84	4.3	1221.2		126	
1/11/94	43	A	62	1	100	2.84	4.9	1391.6	1325	144	137
1/11/94	84	A	62	2	100	2.84	4.7	1334.8		138	
1/11/94	77	A	62	3	100	2.84	4.4	1249.6		129	
1/11/94	29	A	31	1	100	2.84	4.2	1192.8	1250	124	129
1/11/94	7	A	31	2	100	2.84	4.4	1249.6		129	
1/11/94	84	A	31	3	100	2.84	4.6	1306.4		135	
1/11/94	81	A	16	1	100	2.84	4.4	1249.6	1231	129	127
1/11/94	25	A	16	2	100	2.84	4.2	1192.8		124	
1/11/94	10	A	16	3	100	2.84	4.4	1249.6		129	
1/11/94	61	A	0	1	100	2.84	3.7	1050.8	966	109	100
1/11/94	53	A	0	2	100	2.84	3.1	880.4		91	
1/11/94	86	A	0	3	100	2.84	3.4	965.6		100	
1/11/94	59	A	0–72	1	100	2.84	3.7	1050.8	1041	109	108
1/11/94	37	A	0–72	2	100	2.84	3.6	1022.4		106	
1/11/94	47	A	0–72	3	100	2.84	3.7	1050.8		109	
1/11/94	22	A	0–48	1	100	2.84	3.7	1050.8	1022	109	106
1/11/94	69	A	0–48	2	100	2.84	3.7	1050.8		109	
1/11/94	92	A	0–48	3	100	2.84	3.4	965.6		100	

APPENDIX IV: EFFECTS OF WATER QUALITY ON TOXICITY OF ATRAZINE TO ALGAE WITH SELENASTRUM

DATE	RANDOM NUMBER SYSTEM	WATER QUALITY TYPE	CHEMICAL DOSE	REP	MULT	SENS	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
1/11/94	44	A	0–24	1	100	2.84	3.8	1079.2	1003	112	104
1/11/94	40	A	0–24	2	100	2.84	3.4	965.6		100	
1/11/94	46	A	0–24	3	100	2.84	3.4	965.6		100	
1/11/94	70	10X	500	1	100	2.84	4.7	1334.8	1325	104	104
1/11/94	72	10X	500	2	100	2.84	4.6	1306.4		102	
1/11/94	93	10X	500	3	100	2.84	4.7	1334.8		104	
1/11/94	21	10X	250	1	100	2.84	4.9	1391.6	1354	109	106
1/11/94	79	10X	250	2	100	2.84	4.7	1334.8		104	
1/11/94	17	10X	250	3	100	2.84	4.7	1334.8		104	
1/11/94	4	10X	125	1	100	2.84	5	1420	1429	111	112
1/11/94	42	10X	125	2	100	2.84	5.1	1448.4		113	
1/11/94	24	10X	125	3	100	2.84	5	1420		111	
1/11/94	11	10X	62	1	100	2.84	5.2	1476.8	1515	116	119
1/11/94	38	10X	62	2	100	2.84	5.4	1533.6		120	
1/11/94	30	10X	62	3	100	2.84	5.4	1533.6		120	
1/11/94	55	10X	31	1	100	2.84	5.2	1476.8	1496	116	117
1/11/94	49	10X	31	2	100	2.84	5.2	1476.8		116	
1/11/94	87	10X	31	3	100	2.84	5.4	1533.6		120	
1/11/94	45	10X	16	1	100	2.84	6.2	1760.8	1581	138	124
1/11/94	89	10X	16	2	100	2.84	5	1420		111	
1/11/94	33	10X	16	3	100	2.84	5.5	1562		122	
1/11/94	62	10X	0	1	100	2.84	4.9	1391.6	1278	109	100
1/11/94	51	10X	0	2	100	2.84	4.4	1249.6		98	
1/11/94	91	10X	0	3	100	2.84	4.2	1192.8		93	
1/12/94	39	S	500	1	100	2.84	4.6	1306.4	1316	32	32
1/12/94	6	S	500	2	100	2.84	4.7	1334.8		32	
1/12/94	15	S	500	3	100	2.84	4.6	1306.4		32	
1/12/94	14	S	250	1	100	9.25	2	1850	1788	45	43
1/12/94	36	S	250	2	100	9.25	1.9	1757.5		43	
1/12/94	27	S	250	3	100	9.25	1.9	1757.5		43	
1/12/94	2	S	125	1	100	2.84	7.6	2158.4	2340	52	57
1/12/94	5	S	125	2	100	2.84	8	2272		55	
1/12/94	41	S	125	3	100	9.25	2.8	2590		63	
1/12/94	3	S	62	1	100	9.25	4	3700	3669	90	89
1/12/94	75	S	62	2	100	9.25	3.8	3515		85	
1/12/94	88	S	62	3	100	9.25	4.1	3792.5		92	
1/12/94	9	S	31	1	100	9.25	4.6	4255	4317	103	104
1/12/94	60	S	31	2	100	9.25	4.9	4532.5		110	
1/12/94	12	S	31	3	100	9.25	4.5	4162.5		101	
1/12/94	67	S	16	1	100	9.25	5.5	5087.5	4841	123	117
1/12/94	18	S	16	2	100	9.25	5.4	4995		121	
1/12/94	71	S	16	3	100	9.25	4.8	4440		107	
1/12/94	34	S	0	1	100	9.25	4.6	4255	4132	103	100
1/12/94	82	S	0	2	100	9.25	4.8	4440		107	
1/12/94	73	S	0	3	100	9.25	4	3700		90	
1/12/94	8	A+S	500	1	100	2.84	3.9	1107.6	1202	23	25
1/12/94	65	A+S	500	2	100	2.84	4.8	1363.2		29	
1/12/94	80	A+S	500	3	100	2.84	4	1136		24	
1/12/94	83	A+S	250	1	100	2.84	5.7	1618.8	1619	34	34
1/12/94	74	A+S	250	2	100	2.84	5.4	1533.6		32	
1/12/94	86	A+S	250	3	100	2.84	6	1704		36	
1/12/94	26	A+S	125	1	100	9.25	2.2	2035	2313	43	49
1/12/94	28	A+S	125	2	100	9.25	2.6	2405		51	
1/12/94	19	A+S	125	3	100	9.25	2.7	2497.5		53	
1/12/94	63	A+S	62	1	100	9.25	3.8	3515	3276	74	69
1/12/94	1	A+S	62	2	100	2.84	9.2	2612.8		55	
1/12/94	85	A+S	62	3	100	9.25	4	3700		78	
1/12/94	31	A+S	31	1	100	9.25	5	4625	4132	97	87
1/12/94	78	A+S	31	2	100	9.25	4.6	4255		90	
1/12/94	76	A+S	31	3	100	9.25	3.8	3515		74	
1/12/94	35	A+S	16	1	100	9.25	5.8	5365	5088	113	107
1/12/94	90	A+S	16	2	100	9.25	5	4625		97	
1/12/94	23	A+S	16	3	100	9.25	5.7	5272.5		111	
1/12/94	52	A+S	0	1	100	9.25	5.6	5180	4748	109	100
1/12/94	20	A+S	0	2	100	9.25	4.8	4440		94	
1/12/94	32	A+S	0	3	100	9.25	5	4625		97	

APPENDIX IV: EFFECTS OF WATER QUALITY ON TOXICITY OF ATRAZINE TO ALGAE WITH SELENASTRUM

DATE	RANDOM NUMBER SYSTEM	WATER QUALITY TYPE	CHEMICAL DOSE	REP	MULT	SENS	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
1/12/94	16	A	500	1	100	2.84	4.7	1334.8	1269	40	38
1/12/94	50	A	500	2	100	2.84	4.6	1306.4		39	
1/12/94	57	A	500	3	100	2.84	4.1	1164.4		35	
1/12/94	48	A	250	1	100	9.25	1.8	1665	1634	50	49
1/12/94	56	A	250	2	100	2.84	5.6	1590.4		47	
1/12/94	68	A	250	3	100	2.84	5.8	1647.2		49	
1/12/94	58	A	125	1	100	2.84	7.8	2215.2	2249	66	67
1/12/94	54	A	125	2	100	9.25	2.4	2220		66	
1/12/94	13	A	125	3	100	9.25	2.5	2312.5		69	
1/12/94	43	A	62	1	100	9.25	3.6	3330	3145	99	94
1/12/94	64	A	62	2	100	9.25	3.4	3145		94	
1/12/94	77	A	62	3	100	9.25	3.2	2960		88	
1/12/94	29	A	31	1	100	9.25	3.6	3330	3546	99	106
1/12/94	7	A	31	2	100	9.25	3.9	3607.5		107	
1/12/94	84	A	31	3	100	9.25	4	3700		110	
1/12/94	81	A	16	1	100	9.25	4.5	4162.5	3854	124	115
1/12/94	25	A	16	2	100	9.25	4	3700		110	
1/12/94	10	A	16	3	100	9.25	4	3700		110	
1/12/94	61	A	0	1	100	9.25	3.9	3607.5	3361	107	100
1/12/94	53	A	0	2	100	9.25	3.2	2960		88	
1/12/94	66	A	0	3	100	9.25	3.8	3515		105	
1/12/94	59	A	0–72	1	100	9.25	3.8	3515	3546	105	106
1/12/94	37	A	0–72	2	100	9.25	3.7	3422.5		102	
1/12/94	47	A	0–72	3	100	9.25	4	3700		110	
1/12/94	22	A	0–48	1	100	9.25	3.8	3515	3577	105	106
1/12/94	69	A	0–48	2	100	9.25	4	3700		110	
1/12/94	92	A	0–48	3	100	9.25	3.8	3515		105	
1/12/94	44	A	0–24	1	.	.	.	0	0	0	0
1/12/94	40	A	0–24	2	.	.	.	0		0	
1/12/94	46	A	0–24	3	.	.	.	0		0	
1/12/94	70	10X	500	1	100	2.84	5.2	1476.8	1439	40	39
1/12/94	72	10X	500	2	100	2.84	4.8	1363.2		37	
1/12/94	93	10X	500	3	100	2.84	5.2	1476.8		40	
1/12/94	21	10X	250	1	100	9.25	1.9	1757.5	1817	48	50
1/12/94	79	10X	250	2	100	2.84	6.4	1817.6		50	
1/12/94	17	10X	250	3	100	2.84	6.6	1874.4		51	
1/12/94	4	10X	125	1	100	9.25	2.4	2220	2498	61	68
1/12/94	42	10X	125	2	100	9.25	3	2775		76	
1/12/94	24	10X	125	3	100	9.25	2.7	2497.5		68	
1/12/94	11	10X	62	1	100	9.25	3.3	3052.5	3361	83	92
1/12/94	38	10X	62	2	100	9.25	3.6	3330		91	
1/12/94	30	10X	62	3	100	9.25	4	3700		101	
1/12/94	55	10X	31	1	100	9.25	4.2	3885	4132	106	113
1/12/94	49	10X	31	2	100	9.25	4.2	3885		106	
1/12/94	87	10X	31	3	100	9.25	5	4625		126	
1/12/94	45	10X	16	1	100	9.25	5.2	4810	4810	131	131
1/12/94	89	10X	16	2	100	9.25	4.9	4532.5		124	
1/12/94	33	10X	16	3	100	9.25	5.5	5087.5		139	
1/12/94	62	10X	0	1	100	9.25	4.1	3792.5	3669	103	100
1/12/94	51	10X	0	2	100	9.25	3.8	3515		96	
1/12/94	91	10X	0	3	100	9.25	4	3700		101	
1/13/94	39	S	500	1	100	2.84	5.4	1533.6	1543	20	20
1/13/94	8	S	500	2	100	2.84	5.6	1590.4		20	
1/13/94	15	S	500	3	100	2.84	5.3	1505.2		19	
1/13/94	14	S	250	1	100	9.25	3.4	3145	2559	40	33
1/13/94	36	S	250	2	100	9.25	2.5	2312.5		30	
1/13/94	27	S	250	3	100	9.25	2.4	2220		26	
1/13/94	2	S	125	1	100	9.25	4.4	4070	4255	52	54
1/13/94	5	S	125	2	100	9.25	4.8	4440		57	
1/13/94	41	S	125	3	100	9.25	4.6	4255		54	
1/13/94	3	S	62	1	100	9.25	8.6	7955	7444	102	95
1/13/94	75	S	62	2	100	29.34	2.2	6454.8		82	
1/13/94	88	S	62	3	100	29.34	2.7	7921.8		101	
1/13/94	9	S	31	1	100	29.34	3.4	9975.6	9876	127	126
1/13/94	60	S	31	2	100	29.34	3.1	9095.4		116	
1/13/94	12	S	31	3	100	29.34	3.6	10562.4		135	
1/13/94	67	S	16	1	100	29.34	3.1	9095.4	9584	116	122
1/13/94	18	S	16	2	100	29.34	3.6	10562.4		135	
1/13/94	71	S	16	3	100	29.34	3.1	9095.4		116	

APPENDIX IV: EFFECTS OF WATER QUALITY ON TOXICITY OF ATRAZINE TO ALGAE WITH SELENASTRUM

DATE	RANDOM NUMBER SYSTEM	WATER QUALITY TYPE	CHEMICAL DOSE	REP	MULT	SENS	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
1/13/94	34	S	0	1	100	29.34	2.8	8215.2	7830	105	100
1/13/94	82	S	0	2	100	9.25	8.9	8232.5		105	
1/13/94	73	S	0	3	100	29.34	2.4	7041.6		90	
1/13/94	8	A+S	500	1	100	2.84	4.4	1249.6	1269	10	10
1/13/94	65	A+S	500	2	100	2.84	5	1420		11	
1/13/94	80	A+S	500	3	100	2.84	4	1136		9	
1/13/94	83	A+S	250	1	100	9.25	2	1850	1973	14	15
1/13/94	74	A+S	250	2	100	9.25	2.2	2035		16	
1/13/94	86	A+S	250	3	100	9.25	2.2	2035		16	
1/13/94	26	A+S	125	1	100	9.25	4.4	4070	4255	32	33
1/13/94	28	A+S	125	2	100	9.25	4.6	4255		33	
1/13/94	19	A+S	125	3	100	9.25	4.8	4440		35	
1/13/94	63	A+S	62	1	100	9.25	8.6	7955	8000	62	62
1/13/94	1	A+S	62	2	100	29.34	2.6	7628.4		60	
1/13/94	85	A+S	62	3	100	9.25	9.1	8417.5		66	
1/13/94	31	A+S	31	1	100	29.34	4.2	12322.8	11834	96	92
1/13/94	78	A+S	31	2	100	29.34	4.2	12322.8		96	
1/13/94	76	A+S	31	3	100	29.34	3.7	10855.8		85	
1/13/94	35	A+S	16	1	100	29.34	5.2	15256.8	14083	119	110
1/13/94	90	A+S	16	2	100	29.34	4.4	12909.6		101	
1/13/94	23	A+S	16	3	100	29.34	4.8	14083.2		110	
1/13/94	52	A+S	0	1	100	29.34	4.3	12616.2	12812	98	100
1/13/94	20	A+S	0	2	100	29.34	4.6	13496.4		105	
1/13/94	32	A+S	0	3	100	29.34	4.2	12322.8		96	
1/13/94	16	A	500	1	100	2.84	4.8	1363.2	1259	19	18
1/13/94	50	A	500	2	100	2.84	4.3	1221.2		17	
1/13/94	57	A	500	3	100	2.84	4.2	1192.8		17	
1/13/94	48	A	250	1	100	2.84	8	2272	2052	32	29
1/13/94	56	A	250	2	100	9.25	2	1850		26	
1/13/94	68	A	250	3	100	9.25	2.2	2035		29	
1/13/94	58	A	125	1	100	9.25	3.8	3515	3854	49	54
1/13/94	54	A	125	2	100	9.25	4.1	3792.5		53	
1/13/94	13	A	125	3	100	9.25	4.6	4255		60	
1/13/94	43	A	62	1	100	9.25	7	6475	6013	91	85
1/13/94	64	A	62	2	100	9.25	6.3	5827.5		82	
1/13/94	77	A	62	3	100	9.25	6.2	5735		81	
1/13/94	29	A	31	1	100	9.25	7.9	7307.5	8402	103	118
1/13/94	7	A	31	2	100	29.34	3	8802		124	
1/13/94	84	A	31	3	100	29.34	3.1	9095.4		128	
1/13/94	81	A	16	1	100	29.34	3.6	10562.4	9976	149	140
1/13/94	25	A	16	2	100	29.34	3.4	9975.6		140	
1/13/94	10	A	16	3	100	29.34	3.2	9388.8		132	
1/13/94	61	A	0	1	100	29.34	2.4	7041.6	7110	99	100
1/13/94	53	A	0	2	100	9.25	7.2	6660		94	
1/13/94	66	A	0	3	100	29.34	2.6	7628.4		107	
1/13/94	59	A	0–72	1	100	9.25	8	7400	7918	104	111
1/13/94	37	A	0–72	2	100	9.25	8.8	8140		114	
1/13/94	47	A	0–72	3	100	29.34	2.8	8215.2		116	
1/13/94	22	A	0–48	1	.	.	.	0	0	0	0
1/13/94	69	A	0–48	2	.	.	.	0		0	
1/13/94	92	A	0–48	3	.	.	.	0		0	
1/13/94	44	A	0–24	1	.	.	.	0	0	0	0
1/13/94	40	A	0–24	2	.	.	.	0		0	
1/13/94	48	A	0–24	3	.	.	.	0		0	
1/13/94	70	10X	500	1	100	2.84	4.3	1221.2	1278	15	16
1/13/94	72	10X	500	2	100	2.84	4.2	1192.8		15	
1/13/94	93	10X	500	3	100	2.84	5	1420		18	
1/13/94	21	10X	250	1	100	9.25	2.4	2220	2103	28	27
1/13/94	79	10X	250	2	100	2.84	6.4	1817.6		23	
1/13/94	17	10X	250	3	100	2.84	8	2272		29	
1/13/94	4	10X	125	1	100	9.25	4	3700	3947	47	50
1/13/94	42	10X	125	2	100	9.25	4.6	4255		54	
1/13/94	24	10X	125	3	100	9.25	4.2	3885		49	
1/13/94	11	10X	62	1	100	29.34	2.7	7921.8	8257	100	104
1/13/94	38	10X	62	2	100	29.34	3	8802		111	
1/13/94	30	10X	62	3	100	9.25	8.7	8047.5		102	
1/13/94	55	10X	31	1	100	29.34	2.8	8215.2	9193	104	116
1/13/94	49	10X	31	2	100	29.34	3	8802		111	
1/13/94	87	10X	31	3	100	29.34	3.6	10562.4		133	

APPENDIX IV: EFFECTS OF WATER QUALITY ON TOXICITY OF ATRAZINE TO ALGAE WITH SELENASTRUM

DATE	RANDOM NUMBER SYSTEM	WATER QUALITY TYPE	CHEMICAL DOSE	REP	MULT	SENS	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
1/13/94	45	10X	16	1	100	29.34	3.7	10855.8	10367	137	131
1/13/94	89	10X	16	2	100	29.34	3.4	9975.6		126	
1/13/94	33	10X	16	3	100	29.34	3.5	10269		130	
1/13/94	62	10X	0	1	100	29.34	2.8	8215.2	7922	104	100
1/13/94	51	10X	0	2	100	29.34	2.4	7041.6		89	
1/13/94	91	10X	0	3	100	29.34	2.9	8508.6		107	
1/14/94	39	S	500	1	100	2.84	6	1704	1647	23	22
1/14/94	6	S	500	2	100	2.84	5.5	1562		21	
1/14/94	15	S	500	3	100	2.84	5.9	1675.6		23	
1/14/94	14	S	250	1	100	9.25	3.6	3330	3207	45	44
1/14/94	36	S	250	2	100	9.25	3.4	3145		43	
1/14/94	27	S	250	3	100	9.25	3.4	3145		43	
1/14/94	2	S	125	1	100	9.25	6.5	6012.5	7240	82	99
1/14/94	5	S	125	2	100	9.25	8.1	7492.5		102	
1/14/94	41	S	125	3	100	29.34	2.8	8215.2		112	
1/14/94	3	S	62	1	100	29.34	4.4	12909.6	12616	176	172
1/14/94	75	S	62	2	100	29.34	4.3	12616.2		172	
1/14/94	88	S	62	3	100	29.34	4.2	12322.8		168	
1/14/94	9	S	31	1	100	29.34	4	11736	11932	160	163
1/14/94	60	S	31	2	100	29.34	4	11736		160	
1/14/94	12	S	31	3	100	29.34	4.2	12322.8		168	
1/14/94	67	S	16	1	100	29.34	3.8	11149.2	10954	152	149
1/14/94	16	S	16	2	100	29.34	3.4	9975.6		136	
1/14/94	71	S	16	3	100	29.34	4	11736		160	
1/14/94	34	S	0	1	100	29.34	2.6	7628.4	7335	104	100
1/14/94	82	S	0	2	100	29.34	2.5	7335		100	
1/14/94	73	S	0	3	100	29.34	2.4	7041.6		96	
1/14/94	6	A+S	500	1	100	2.84	4.6	1306.4	1448	7	7
1/14/94	65	A+S	500	2	100	2.84	6.6	1874.4		10	
1/14/94	80	A+S	500	3	100	2.84	4.1	1164.4		6	
1/14/94	83	A+S	250	1	100	9.25	2.6	2405	2683	12	14
1/14/94	74	A+S	250	2	100	9.25	3.2	2960		15	
1/14/94	86	A+S	250	3	100	9.25	2.9	2682.5		14	
1/14/94	26	A+S	125	1	100	29.34	2.5	7335	7069	38	36
1/14/94	28	A+S	125	2	100	9.25	7.7	7122.5		37	
1/14/94	19	A+S	125	3	100	29.34	2.3	6748.2		35	
1/14/94	63	A+S	62	1	100	29.34	5.6	16430.4	15159	84	78
1/14/94	1	A+S	62	2	100	29.34	4.6	13496.4		69	
1/14/94	85	A+S	62	3	100	29.34	5.3	15550.2		80	
1/14/94	31	A+S	31	1	100	29.34	8.3	24352.2	21907	125	113
1/14/94	76	A+S	31	2	100	29.34	7.3	21418.2		110	
1/14/94	76	A+S	31	3	100	29.34	6.8	19951.2		103	
1/14/94	35	A+S	16	1	100	29.34	8.3	24352.2	23863	125	123
1/14/94	90	A+S	16	2	100	29.34	8.3	24352.2		125	
1/14/94	23	A+S	16	3	100	29.34	7.8	22885.2		118	
1/14/94	52	A+S	0	1	100	29.34	6.4	18777.6	19462	96	100
1/14/94	20	A+S	0	2	100	29.34	6.4	18777.6		96	
1/14/94	32	A+S	0	3	100	29.34	7.1	20831.4		107	
1/14/94	16	A	500	1	100	2.84	4.6	1306.4	1297	10	10
1/14/94	50	A	500	2	100	2.84	4.5	1278		10	
1/14/94	57	A	500	3	100	2.84	4.6	1306.4		10	
1/14/94	48	A	250	1	100	9.25	2.8	2590	2683	20	21
1/14/94	56	A	250	2	100	9.25	2.8	2590		20	
1/14/94	68	A	250	3	100	9.25	3.1	2867.5		22	
1/14/94	58	A	125	1	100	29.34	2.2	6454.8	5697	50	44
1/14/94	54	A	125	2	100	9.25	5.6	5180		40	
1/14/94	13	A	125	3	100	9.25	5.9	5457.5		42	
1/14/94	43	A	62	1	100	29.34	4	11736	11149	91	86
1/14/94	84	A	62	2	100	29.34	4	11736		91	
1/14/94	77	A	62	3	100	29.34	3.4	9975.6		77	
1/14/94	29	A	31	1	100	29.34	5.4	15843.6	17017	123	132
1/14/94	7	A	31	2	100	29.34	5.7	16723.8		130	
1/14/94	84	A	31	3	100	29.34	6.3	18484.2		143	
1/14/94	81	A	16	1	100	29.34	6	17604	17408	136	135
1/14/94	25	A	16	2	100	29.34	6	17604		136	
1/14/94	10	A	16	3	100	29.34	5.8	17017.2		132	
1/14/94	61	A	0	1	100	29.34	4.9	14376.6	12910	111	100
1/14/94	53	A	0	2	100	29.34	3.6	10562.4		82	
1/14/94	66	A	0	3	100	29.34	4.7	13789.8		107	

APPENDIX IV: EFFECTS OF WATER QUALITY ON TOXICITY OF ATRAZINE TO ALGAE WITH SELENASTRUM

DATE	RANDOM NUMBER SYSTEM	WATER QUALITY TYPE	CHEMICAL DOSE	REP	MULT	SENS	SCALE	UNIT	AVG UNIT	% OF CONTROL	AVG % OF CONTROL
1/14/94	59	A	0–72	1	.	.	.	0	0	0	0
1/14/94	37	A	0–72	2	.	.	.	0		0	
1/14/94	47	A	0–72	3	.	.	.	0		0	
1/14/94	22	A	0–48	1	.	.	.	0	0	0	0
1/14/94	69	A	0–48	2	.	.	.	0		0	
1/14/94	92	A	0–48	3	.	.	.	0		0	
1/14/94	44	A	0–24	1	.	.	.	0	0	0	0
1/14/94	40	A	0–24	2	.	.	.	0		0	
1/14/94	46	A	0–24	3	.	.	.	0		0	
1/14/94	70	10X	500	1	100	2.84	5.8	1647.2	1344	11	9
1/14/94	72	10X	500	2	100	2.84	4	1136		7	
1/14/94	93	10X	500	3	100	2.84	4.4	1249.6		8	
1/14/94	21	10X	250	1	100	9.25	2.9	2682.5	2559	17	17
1/14/94	79	10X	250	2	100	9.25	2.6	2405		16	
1/14/94	17	10X	250	3	100	9.25	2.8	2590		17	
1/14/94	4	10X	125	1	100	29.34	2.1	6161.4	7237	40	47
1/14/94	42	10X	125	2	100	29.34	2.7	7921.8		52	
1/14/94	24	10X	125	3	100	29.34	2.6	7628.4		50	
1/14/94	11	10X	62	1	100	29.34	4.9	14376.6	15355	94	100
1/14/94	38	10X	62	2	100	29.34	5.4	15843.6		103	
1/14/94	30	10X	62	3	100	29.34	5.4	15843.6		103	
1/14/94	55	10X	31	1	100	29.34	5.9	17310.6	17115	113	111
1/14/94	49	10X	31	2	100	29.34	5.4	15843.6		103	
1/14/94	87	10X	31	3	100	29.34	6.2	18190.8		118	
1/14/94	45	10X	16	1	100	29.34	7	20538	19364	134	126
1/14/94	89	10X	16	2	100	29.34	6	17604		115	
1/14/94	33	10X	16	3	100	29.34	6.8	19951.2		130	
1/14/94	62	10X	0	1	100	29.34	5.6	16430.4	15355	107	100
1/14/94	51	10X	0	2	100	29.34	4.4	12909.6		84	
1/14/94	91	10X	0	3	100	29.34	5.7	16723.8		109	
1/14/94	83	A+S	250	1	100	9.25	2.6	2405	2683	12	14
1/14/94	74	A+S	250	2	100	9.25	3.2	2960		15	
1/14/94	86	A+S	250	3	100	9.25	2.9	2682.5		14	
1/14/94	26	A+S	125	1	100	29.34	2.5	7335	7069	38	36
1/14/94	28	A+S	125	2	100	9.25	7.7	7122.5		37	
1/14/94	19	A+S	125	3	100	29.34	2.3	6748.2		35	
1/14/94	63	A+S	62	1	100	29.34	5.6	16430.4	15159	84	78
1/14/94	1	A+S	62	2	100	29.34	4.6	13496.4		69	
1/14/94	85	A+S	62	3	100	29.34	5.3	15550.2		80	
1/14/94	31	A+S	31	1	100	29.34	8.3	24352.2	21907	125	113
1/14/94	76	A+S	31	2	100	29.34	7.3	21418.2		110	
1/14/94	78	A+S	31	3	100	29.34	6.8	19951.2		103	
1/14/94	35	A+S	16	1	100	29.34	8.3	24352.2	23863	125	123
1/14/94	90	A+S	16	2	100	29.34	8.3	24352.2		125	
1/14/94	23	A+S	16	3	100	29.34	7.8	22885.2		118	
1/14/94	52	A+S	0	1	100	29.34	6.4	18777.6	19462	96	100
1/14/94	20	A+S	0	2	100	29.34	6.4	18777.6		96	
1/14/94	32	A+S	0	3	100	29.34	7.1	20831.4		107	
1/14/94	16	A	500	1	100	2.84	4.6	1306.4	1297	10	10
1/14/94	50	A	500	2	100	2.84	4.5	1278		10	
1/14/94	57	A	500	3	100	2.84	4.6	1306.4		10	
1/14/94	48	A	250	1	100	9.25	2.8	2590	2683	20	21
1/14/94	56	A	250	2	100	9.25	2.8	2590		20	
1/14/94	68	A	250	3	100	9.25	3.1	2867.5		22	
1/14/94	58	A	125	1	100	29.34	2.2	6454.8	5697	50	44
1/14/94	54	A	125	2	100	9.25	5.6	5180		40	
1/14/94	13	A	125	3	100	9.25	5.9	5457.5		42	
1/14/94	43	A	62	1	100	29.34	4	11736	11149	91	86
1/14/94	64	A	62	2	100	29.34	4	11736		91	
1/14/94	77	A	62	3	100	29.34	3.4	9975.6		77	
1/14/94	29	A	31	1	100	29.34	5.4	15843.6	17017	123	132
1/14/94	7	A	31	2	100	29.34	5.7	16723.8		130	
1/14/94	84	A	31	3	100	29.34	6.3	18484.2		143	
1/14/94	81	A	16	1	100	29.34	6	17604	17408	136	135
1/14/94	25	A	16	2	100	29.34	6	17604		136	
1/14/94	10	A	16	3	100	29.34	5.8	17017.2		132	
1/14/94	81	A	0	1	100	29.34	4.9	14376.6	12910	111	100
1/14/94	53	A	0	2	100	29.34	3.6	10562.4		82	
1/14/94	66	A	0	3	100	29.34	4.7	13789.8		107	

APPENDIX V: EFFECTS OF WATER QUALITY ON TOXICITY OF ATRAZINE TO LEMNA
96 HRS

DATE	SOLUTION TYPE	DILUTION FACTOR	REP	FROND #	FROND GROWTH	AVG FROND GROWTH	% OF CONTROL	AVG % OF CONTROL
1/14/94	10X	5000	1	12	0	1	0	11
1/14/94	10X	5000	2	15	3		25.71428571	
1/14/94	10X	5000	3	13	1		8.571428571	
1/14/94	10X	2500	1	12	0	0	0	3
1/14/94	10X	2500	2	12	0		0	
1/14/94	10X	2500	3	13	1		8.571428571	
1/14/94	10X	1250	1	13	1	1	8.571428571	6
1/14/94	10X	1250	2	12	0		0	
1/14/94	10X	1250	3	13	1		8.571428571	
1/14/94	10X	620	1	13	1	2	8.571428571	14
1/14/94	10X	620	2	13	1		8.571428571	
1/14/94	10X	620	3	15	3		25.71428571	
1/14/94	10X	310	1	14	2	3	17.14285714	29
1/14/94	10X	310	2	15	3		25.71428571	
1/14/94	10X	310	3	17	5		42.85714286	
1/14/94	10X	160	1	21	9	8	77.14285714	66
1/14/94	10X	160	2	20	8		68.57142857	
1/14/94	10X	160	3	18	6		51.42857143	
1/14/94	10X	0	1	22	10	12	85.71428571	100
1/14/94	10X	0	2	22	10		85.71428571	
1/14/94	10X	0	3	27	15		128.5714286	
1/14/94	A	5000	1	14	2	1	14.28571429	10
1/14/94	A	5000	2	14	2		14.28571429	
1/14/94	A	5000	3	12	0		0	
1/14/94	A	2500	1	12	0	-0	0	-2
1/14/94	A	2500	2	10	-2		-14.2857143	
1/14/94	A	2500	3	13	1		7.142857143	
1/14/94	A	1250	1	15	3	2	21.42857143	12
1/14/94	A	1250	2	14	2		14.28571429	
1/14/94	A	1250	3	12	0		0	
1/14/94	A	620	1	14	2	1	14.28571429	5
1/14/94	A	620	2	12	0		0	
1/14/94	A	620	3	12	0		0	
1/14/94	A	310	1	20	8	4	57.14285714	31
1/14/94	A	310	2	15	3		21.42857143	
1/14/94	A	310	3	14	2		14.28571429	
1/14/94	A	160	1	20	8	6	57.14285714	40
1/14/94	A	160	2	15	3		21.42857143	
1/14/94	A	160	3	18	6		42.85714286	
1/14/94	A	0	1	23	11	14	78.57142857	100
1/14/94	A	0	2	25	13		92.85714286	
1/14/94	A	0	3	30	18		128.5714286	

APPENDIX V: EFFECTS OF WATER QUALITY ON TOXICITY OF ATRAZINE TO LEMNA
96 HRS

DATE	SOLUTION TYPE	DILUTION FACTOR	REP	FROND #	FROND GROWTH	AVG FROND GROWTH	% OF CONTROL	AVG % OF CONTROL
1/14/94	A+S	5000	1	12	0	0	0	0
1/14/94	A+S	5000	2	12	0		0	
1/14/94	A+S	5000	3	12	0		0	
1/14/94	A+S	2500	1	12	0	0	0	3
1/14/94	A+S	2500	2	13	1		9.090909091	
1/14/94	A+S	2500	3	12	0		0	
1/14/94	A+S	1250	1	13	1	0	9.090909091	3
1/14/94	A+S	1250	2	12	0		0	
1/14/94	A+S	1250	3	12	0		0	
1/14/94	A+S	620	1	12	0	1	0	6
1/14/94	A+S	620	2	13	1		9.090909091	
1/14/94	A+S	620	3	13	1		9.090909091	
1/14/94	A+S	310	1	13	1	2	9.090909091	21
1/14/94	A+S	310	2	15	3		27.27272727	
1/14/94	A+S	310	3	15	3		27.27272727	
1/14/94	A+S	160	1	14	2	3	18.18181818	24
1/14/94	A+S	160	2	17	5		45.45454545	
1/14/94	A+S	160	3	13	1		9.090909091	
1/14/94	A+S	0	1	21	9	11	81.81818182	100
1/14/94	A+S	0	2	24	12		109.0909091	
1/14/94	A+S	0	3	24	12		109.0909091	
1/14/94	S	5000	1	12	0	0	0	0
1/14/94	S	5000	2	12	0		0	
1/14/94	S	5000	3	12	0		0	
1/14/94	S	2500	1	15	3	1	25.71428571	9
1/14/94	S	2500	2	12	0		0	
1/14/94	S	2500	3	12	0		0	
1/14/94	S	1250	1	12	0	0	0	0
1/14/94	S	1250	2	12	0		0	
1/14/94	S	1250	3	12	0		0	
1/14/94	S	620	1	12	0	0	0	3
1/14/94	S	620	2	13	1		8.571428571	
1/14/94	S	620	3	12	0		0	
1/14/94	S	310	1	16	4	3	34.28571429	29
1/14/94	S	310	2	14	2		17.14285714	
1/14/94	S	310	3	16	4		34.28571429	
1/14/94	S	160	1	18	6	5	51.42857143	43
1/14/94	S	160	2	15	3		25.71428571	
1/14/94	S	160	3	18	6		51.42857143	
1/14/94	S	0	1	24	12	12	102.8571429	100
1/14/94	S	0	2	24	12		102.8571429	
1/14/94	S	0	3	23	11		94.28571429	

APPENDIX VI: EFFECTS OF HERBICIDES ON MICROCOSM
DAY 7 AFTER TREATMENT

Date	Beaker #	Chemical	Chemical Conc.	Rep.	Weight (gm)	Average Weight (gm)	% Of Control For Weight	Mean % Of Control For Weight	# Of Recruits	Average # Of Recruits	% Of Control For # Of Recruits	Mean % Of Control For # Of Recruits	Weight Per Recruit (gm)	Average Weight Per Recruit (gm)	% Of Control For Weight Per Recruit	Mean % Of Control For Weight Per Recruit
05\18\94	35	AL	47	1	0.0449	0.0556	15.31552018	19	14	17	25	30	0.0032	0.0034	60.97184733	65
05\18\94	5	AL	47	2	0.0219		7.470153496		6		10.71428571		0.0037		69.39112246	
05\18\94	29	AL	47	3	0.1006		34.31495168		30		53.57142857		0.0034		83.75111342	
05\18\94	61	AL	94	1	0.0417	0.0984	14.2239909	34	14	33	25	60	0.0030	0.0030	56.626415	57
05\18\94	66	AL	94	2	0.1305		44.51392837		46		85.71428571		0.0027		51.6868806	
05\18\94	33	AL	94	3	0.123		41.95565662		38		67.85714286		0.0032		61.53646765	
05\18\94	15	AL	188	1	0.0072	0.0343	2.455940675	12	6	13	14.28571429	24	0.0009	0.0022	17.11013979	43
05\18\94	58	AL	188	2	0.0328		11.1881751		14		25		0.0023		44.54068135	
05\18\94	59	AL	188	3	0.063		21.48948266		16		32.14285714		0.0035		66.5394325	
05\18\94	40	AL	375	1	0.0633	0.1015	21.59181353	35	30	37	53.57142857	66	0.0021	0.0026	40.11377216	50
05\18\94	11	AL	375	2	0.1799		61.3644116		58		103.5714286		0.0031		58.96770397	
05\18\94	49	AL	375	3	0.0614		20.94371802		23		41.07142857		0.0027		50.75181559	
05\18\94	56	AL	750	1	0.0674	0.1064	22.99033542	36	24	33	42.85714286	60	0.0028	0.0031	53.38997322	59
05\18\94	64	AL	750	2	0.0894		30.4945992		32		57.14285714		0.0028		53.11272558	
05\18\94	18	AL	750	3	0.1623		55.36100057		44		78.57142857		0.0037		70.12564667	
05\18\94	32	AT	9	1	0.0484	0.1114	16.50938033	38	16	37	32.14285714	67	0.0027	0.0030	51.11918306	57
05\18\94	3	AT	9	2	0.1506		51.43831723		40		71.42857143		0.0038		71.67247443	
05\18\94	16	AT	9	3	0.1349		46.01478113		54		96.42857143		0.0025		47.49296002	
05\18\94	36	AT	19	1	0.2241	0.3071	76.44115975	105	51	56	91.07142857	101	0.0044	0.0054	83.5377413	102
05\18\94	48	AT	19	2	0.299		101.9697669		54		96.42857143		0.0055		105.2660863	
05\18\94	50	AT	19	3	0.3963		135.6612848		64		114.2857143		0.0062		118.3154284	
05\18\94	13	AT	38	1	0.2779	0.2064	94.79249574	70	61	48	108.9285714	66	0.0046	0.0043	88.61034326	61
05\18\94	19	AT	38	2	0.1942		66.24216306		50		89.28571429		0.0039		73.83975881	
05\18\94	44	AT	38	3	0.147		50.14212621		34		60.71428571		0.0043		82.19576956	
05\18\94	57	AT	75	1	0.0712	0.1572	24.28652644	54	29	49	51.78571429	88	0.0025	0.0031	48.67593689	58
05\18\94	41	AT	75	2	0.1677		57.20295623		52		92.85714286		0.0032		61.31133423	
05\18\94	30	AT	75	3	0.2326		79.34053439		67		119.6428571		0.0035		66.00030703	
05\18\94	25	AT	150	1	0.1215	0.0916	41.44400227	31	52	42	92.85714286	74	0.0023	0.0023	44.42055521	43
06\18\94	39	AT	150	2	0.0656		29.19840819		47		83.92857143		0.0018		34.6247746	
05\18\94	52	AT	150	3	0.0677		23.09266629		26		46.42857143		0.0026		49.50241297	
05\18\94	7	CONT WO/ACE	0	1	0.0778	0.1353	26.53780557	46	19	32	33.92857143	57	0.0041	0.0042	77.84613306	80
05\18\94	27	CONT WO/ACE	0	2	0.2051		69.96020466		39		69.64285714		0.0053		99.97976268	
05\18\94	31	CONT WO/ACE	0	3	0.1229		41.92154633		37		66.07142857		0.0033		83.14823362	
05\18\94	46	CONT W/ACE	0	1	0.344	0.2932	117.3393974	100	50	56	89.28571429	100	0.0069	0.0053	130.797513	100
05\18\94	14	CONT W/ACE	0	2	0.1928		65.764639		52		92.85714286		0.0037		70.48792629	
05\18\94	20	CONT W/ACE	0	3	0.3427		116.8959636		66		117.8571429		0.0052		98.71456068	
05\18\94	54	Mb	9	1	0.1615	0.0985	55.08811825	34	39	29	69.64285714	52	0.0041	0.0030	78.72614175	58
05\18\94	10	Mb	9	2	0.1193		40.6935759		41		73.21428571		0.0029		55.31814841	
05\18\94	23	Mb	9	3	0.0146		4.980102331		7		12.5		0.0021		39.65206998	
05\18\94	63	Mb	19	1	0.1646	0.1354	56.21375782	46	55	43	98.21428571	76	0.0030	0.0032	56.96466741	61
05\18\94	1	Mb	19	2	0.1112		37.93064241		38		67.85714286		0.0029		55.63296913	
05\18\94	51	Mb	19	3	0.1301		44.37746721		35		62.5		0.0037		70.66759321	
05\18\94	4	Mb	38	1	0.1617	0.1521	55.15633883	52	55	51	98.21428571	90	0.0029	0.0030	55.8931233	57
05\18\94	37	Mb	38	2	0.1321		45.05969301		49		87.5		0.0027		51.25282235	
05\18\94	21	Mb	38	3	0.1625		55.42922115		48		85.71428571		0.0034		64.36105822	
05\18\94	65	Mb	75	1	0.1517	0.0716	51.74530964	24	62	31	110.7142857	56	0.0024	0.0021	46.51627608	40
05\18\94	45	Mb	75	2	0.0522		17.80557135		26		46.42857143		0.0020		38.16677337	
05\18\94	8	Mb	75	3	0.011		3.752131693		6		10.71428571		0.0018		34.85398845	
05\18\94	42	Mb	150	1	0.0651	0.0372	22.20579875	13	31	18	55.35714286	32	0.0021	0.0022	39.9236595	41
05\18\94	60	Mb	150	2	0.0124		4.229675952		5		8.928571429		0.0025		47.14794074	
05\18\94	62	Mb	150	3	0.0341		11.63160887		16		32.14285714		0.0019		38.01578807	
05\18\94	26	MT	47	1	0.0585	0.0783	19.95451961	27	17	22	30.35714286	40	0.0034	0.0032	65.42112271	61
05\18\94	24	MT	47	2	0.0262		6.936895964		12		21.42857143		0.0022		41.5079317	
05\18\94	38	MT	47	3	0.1501		51.1995452		38		67.85714286		0.0040		75.09450239	
05\18\94	43	MT	94	1	0.1417	0.1957	48.33428084	67	36	46	64.28571429	83	0.0039	0.0042	74.83045702	80
05\18\94	34	MT	94	2	0.2002		68.28880045		46		82.14285714		0.0044		82.7403378	
05\18\94	2	MT	94	3	0.2453		83.67254122		57		101.7857143		0.0043		81.81515184	
05\18\94	17	MT	188	1	0.2632	0.1914	89.77828312	65	40	37	71.42857143	65	0.0066	0.0049	125.0941331	93
05\18\94	28	MT	188	2	0.0523		17.83968164		16		28.57142857		0.0033		62.14307714	
05\18\94	22	MT	188	3	0.2586		88.20920978		54		96.42857143		0.0048		91.04284256	
05\18\94	12	MT	375	1	0.2222	0.2520	75.79308424	88	55	57	98.21428571	102	0.0040	0.0044	76.80551837	84
05\18\94	47	MT	375	2	0.2923		99.70437749		65		116.0714286		0.0045		85.49220272	
05\18\94	55	MT	375	3	0.2416		82.41046049		52		92.85714286		0.0046		88.32926863	
05\18\94	53	MT	750	1	0.2383	0.1196	81.28482092	41	67	34	119.6428571	61	0.0036	0.0032	67.61768343	61
05\18\94	6	MT	750	2	0.0108		3.683911313		4		7.142857143		0.0027		51.33041936	
05\18\94	9	MT	750	3	0.1097		37.41896606		32		57.14285714		0.0034		65.17299772	

APPENDIX VI: EFFECTS OF HERBICIDES ON MICROCOSM
DAY 14 AFTER TREATMENT

Date	Beaker #	Chemical	Chemical Conc.	Rep.	Weight (gm)	Average Weight (gm)	% Of Control For Weight	Mean % Of Control For Weight	# Of Recruits	Average # Of Recruits	% Of Control For # Of Recruits	Mean % Of Control For # Of Recruits	Weight Per Recruit (gm)	Average Weight Per Recruit (gm)	% Of Control For Weight Per Recruit	Mean % Of Control For Weight Per Recruit
05\25\94	35	AL	47	1	0.0018	0.1876	0.393643388	41	2	22	4.511278195	50	0.0009	0.0059	8.81440819	58
05\25\94	5	AL	47	2	0.3727		81.50605044		39		87.96992481		0.0096		93.59344537	
05\25\94	29	AL	47	3	0.1884		41.2013413		26		58.64661654		0.0072		70.96728645	
05\25\94	61	AL	94	1	0.0687	0.0708	15.02405598	15	12	13	27.06766917	29	0.0057	0.0063	56.06942988	62
05\25\94	66	AL	94	2	0.025		5.467269281		3		6.766917293		0.0083		81.61489065	
05\25\94	33	AL	94	3	0.1188		25.98046362		24		54.13533835		0.0050		48.47924504	
05\25\94	15	AL	188	1	0.0257	0.0505	5.620352821	11	9	13	20.30075188	29	0.0029	0.0037	27.96670253	37
05\25\94	58	AL	188	2	0.0293		6.407639598		7		15.78947368		0.0042		40.99399365	
05\25\94	59	AL	188	3	0.0965		21.10365943		23		51.87969925		0.0042		41.0913232	
05\25\94	40	AL	375	1	0.4541	0.1814	99.30747922	40	67	30	151.1278195	68	0.0068	0.0040	66.37848688	40
05\25\94	11	AL	375	2	0.0889		19.44160956		22		49.62406015		0.0040		39.57580243	
05\25\94	49	AL	375	3	0.0013		0.284298003		1		2.255639098		0.0013		12.73192294	
05\25\94	56	AL	750	1	0.0831	0.0777	18.17320309	17	29	28	65.41353383	63	0.0029	0.0028	28.06426516	27
05\25\94	64	AL	750	2	0.0621		13.58069689		23		51.87969925		0.0027		26.44322457	
05\25\94	18	AL	750	3	0.0879		19.22291879		32		72.18045113		0.0027		26.90230833	
05\25\94	32	AT	9	1	0.5566	0.2705	121.7232833	59	59	32	133.0827068	73	0.0094	0.0075	92.39358943	73
05\25\94	3	AT	9	2	0.0796		17.40778539		15		33.83458647		0.0053		51.97236236	
05\25\94	16	AT	9	3	0.1752		38.31462312		23		51.87969925		0.0076		74.603107	
05\25\94	36	AT	19	1	0.331	0.5102	72.38664528	112	42	47	94.73684211	107	0.0079	0.0108	77.18436801	106
05\25\94	48	AT	19	2	0.5505		120.3892696		40		90.22556391		0.0138		134.7869919	
05\25\94	50	AT	19	3	0.649		141.9303105		60		135.3383459		0.0108		105.9361281	
05\25\94	13	AT	38	1	0.108	0.0973	23.61860329	21	24	23	54.13533835	51	0.0045	0.0036	44.07204095	36
05\25\94	19	AT	38	2	0.1711		37.41799096		37		83.45864662		0.0046		45.28964689	
05\25\94	44	AT	38	3	0.0127		2.777372795		7		15.78947368		0.0018		17.76872762	
05\25\94	57	AT	75	1	0.0435	0.1039	9.513048549	23	16	27	36.09022556	60	0.0027	0.0036	26.62685807	35
05\25\94	41	AT	75	2	0.1917		41.92302085		38		85.71428571		0.0050		49.40707749	
05\25\94	30	AT	75	3	0.0766		16.75171306		26		58.64661654		0.0029		28.85400288	
05\25\94	25	AT	150	1	0.024	0.1107	5.24857851	24	13	38	29.32330827	86	0.0018	0.0026	18.08083731	26
05\25\94	39	AT	150	2	0.1854		40.54526899		53		119.5488722		0.0035		34.25977523	
05\25\94	52	AT	150	3	0.1228		26.85522671		48		108.2706767		0.0026		25.05577143	
05\25\94	7	CONT WO/ACE	0	1	0.0009	0.1942	0.196821694	42	2	18	4.511278195	41	0.0005	0.0053	4.407204095	52
05\25\94	27	CONT WO/ACE	0	2	0.5631		123.1447733		46		103.7593985		0.0122		119.8887259	
05\25\94	31	CONT WO/ACE	0	3	0.0187		4.089517422		6		13.53383459		0.0031		30.5239691	
05\25\94	46	CONT W/ACE	0	1	0.6175	0.4573	135.0415512	100	59	44	133.0827068	100	0.0105	0.0102	102.5027694	100
05\25\94	14	CONT W/ACE	0	2	0.2612		57.12202945		27		60.90225564		0.0097		94.74581972	
05\25\94	20	CONT W/ACE	0	3	0.4931		107.8364193		47		106.0150376		0.0105		102.7514108	
05\25\94	54	Mb	9	1	0.0907	0.0954	19.83525295	21	22	23	49.62406015	53	0.0041	0.0042	40.37711226	41
05\25\94	10	Mb	9	2	0.08		17.4952617		17		38.34586466		0.0047		46.08840684	
05\25\94	23	Mb	9	3	0.1156		25.28065316		31		69.92481203		0.0037		36.5213472	
05\25\94	63	Mb	19	1	0.3677	0.2485	80.41259659	54	60	44	135.3383459	98	0.0061	0.0054	60.01959058	52
05\25\94	1	Mb	19	2	0.069		15.08966322		16		36.09022556		0.0043		42.23570591	
05\25\94	51	Mb	19	3	0.3088		67.53171016		55		124.0601504		0.0056		54.9876616	
05\25\94	4	Mb	38	1	0.2233	0.1415	48.83364922	31	59	50	133.0827068	112	0.0038	0.0029	37.06699339	29
05\25\94	37	Mb	38	2	0.0688		15.04592506		23		51.87969925		0.0030		29.29619727	
05\25\94	21	Mb	38	3	0.1324		28.95465811		67		151.1278195		0.0020		19.35369226	
05\25\94	65	Mb	75	1	0.0958	0.0580	20.95057589	13	35	21	78.94736842	47	0.0027	0.0027	26.8069938	26
05\25\94	45	Mb	75	2	0.0138		3.017932643		6		13.53383459		0.0023		22.52570982	
05\25\94	8	Mb	75	3	0.0644		14.08368567		22		49.62406015		0.0029		28.66908522	
05\25\94	42	Mb	150	1	0.1193	0.0786	26.08980901	17	53	36	119.5488722	80	0.0023	0.0016	22.0452599	16
05\25\94	60	Mb	150	2	0.116		25.36812946		53		119.5488722		0.0022		21.43545607	
05\25\94	62	Mb	150	3	0.0005		0.109345386		1		2.255639098		0.0005		4.896893439	
05\25\94	26	MT	47	1	0.0592	0.5262	12.94649366	115	16	50	36.09022556	112	0.0037	0.0088	36.23701145	87
05\25\94	24	MT	47	2	0.7243		158.3977256		66		148.8721805		0.0110		107.4793914	
05\25\94	38	MT	47	3	0.7952		173.9029013		67		151.1278195		0.0119		116.2390944	
05\25\94	43	MT	94	1	0.6358	0.4536	139.0435924	99	62	48	139.8496241	108	0.0103	0.0087	100.4337048	85
05\25\94	34	MT	94	2	0.1351		29.5451232		25		56.39097744		0.0054		52.92562429	
05\25\94	2	MT	94	3	0.59		129.027555		57		128.5714286		0.0104		101.3742852	
05\25\94	17	MT	188	1	0.3207	0.4050	70.13413034	89	43	41	96.9924812	92	0.0075	0.0097	73.04342911	95
05\25\94	28	MT	188	2	0.6486		141.8428342		51		115.037594		0.0127		124.5539249	
05\25\94	22	MT	188	3	0.2458		53.75419157		28		63.15789474		0.0088		85.97545768	
05\25\94	12	MT	375	1	0.2973	0.1700	65.01676629	37	50	32	112.7819549	73	0.0059	0.0050	58.23385677	49
05\25\94	47	MT	375	2	0.0717		15.6801283		17		38.34586466		0.0042		41.30673642	
05\25\94	55	MT	375	3	0.1411		30.85726782		30		67.66917293		0.0047		46.06344428	
05\25\94	53	MT	750	1	0.3927	0.1429	85.87966587	31	76	30	171.4285714	68	0.0052	0.0040	50.60552772	39
05\25\94	6	MT	750	2	0.0318		6.954366526		13		29.32330827		0.0024		23.95710944	
05\25\94	9	MT	750	3	0.0043		0.940370316		1		2.255639098		0.0043		42.11326357	

APPENDIX VI: EFFECTS OF HERBICIDES ON MICROCOSM
DAY 21 AFTER TREATMENT

Date	Beaker #	Chemical	Chemical Conc.	Rep.	Weight (gm)	Average Weight (gm)	% Of Control For Weight	Mean % Of Control For Weight	# Of Recruits	Average # Of Recruits	% Of Control For # Of Recruits	Mean % Of Control For # Of Recruits	Weight Per Recruit (gm)	Average Weight Per Recruit (gm)	% Of Control For Weight Per Recruit	Mean % Of Control For Weight Per Recruit
06\01\94	35	AL	47	1	0.7523	0.8287	109.2453652	120	51	57	122.4	136	0.0148	0.0151	79.93067506	82
06\01\94	5	AL	47	2	0.8318		120.7899705		45		108		0.0165		100.1613303	
06\01\94	29	AL	47	3	0.9021		130.9985963		74		177.6		0.0122		66.0566652	
06\01\94	61	AL	94	1	0.7228	0.7307	104.961516	106	46	51	110.4	122	0.0157	0.0147	85.14398921	80
06\01\94	66	AL	94	2	0.6859		99.60307856		60		144		0.0114		61.94456884	
06\01\94	33	AL	94	3	0.7833		113.7470352		46		110.4		0.0170		92.2707343	
06\01\94	15	AL	188	1	0.4865	0.1914	70.64717557	28	51	20	122.4	49	0.0095	0.0074	51.68997837	40
06\01\94	58	AL	188	2	0.0047		0.682511254		2		4.8		0.0024		12.7339032	
06\01\94	59	AL	188	3	0.0829		12.0383368		8		19.2		0.0104		56.15109444	
06\01\94	40	AL	375	1	0.2932	0.2124	42.57708505	31	42	26	100.8	62	0.0070	0.0072	37.8275625	39
06\01\94	11	AL	375	2	0.0255		3.702966592		7		16.8		0.0036		19.73948521	
06\01\94	49	AL	375	3	0.3185		46.25102861		29		69.6		0.0110		59.51207879	
06\01\94	56	AL	750	1	0.2983	0.1601	43.31768237	23	57	35	136.8	84	0.0052	0.0042	28.35777025	23
06\01\94	64	AL	750	2	0.12		17.42581926		31		74.4		0.0039		20.97554405	
06\01\94	18	AL	750	3	0.0619		8.988818433		17		40.8		0.0036		19.73037818	
06\01\94	32	AT	9	1	0.0967	0.7030	14.04230602	102	7	41	16.8	96	0.0138	0.0162	74.85522429	88
06\01\94	3	AT	9	2	0.9115		132.3636188		58		139.2		0.0157		85.15739375	
06\01\94	16	AT	9	3	1.1008		159.8526486		58		139.2		0.0190		102.8428514	
06\01\94	36	AT	19	1	0.7056	0.8005	102.4638172	116	59	55	141.6	132	0.0120	0.0151	64.80376559	82
06\01\94	48	AT	19	2	0.8851		128.5299385		44		105.6		0.0201		109.0017188	
06\01\94	50	AT	19	3	0.8107		117.7259306		62		148.8		0.0131		70.85363965	
06\01\94	13	AT	38	1	0.0929	0.2692	13.49048641	39	13	26	31.2	63	0.0071	0.0093	38.72273674	50
06\01\94	19	AT	38	2	0.1946		28.25887023		22		52.8		0.0088		47.93070721	
06\01\94	44	AT	38	3	0.5201		75.52640496		44		105.6		0.0118		64.0512888	
06\01\94	57	AT	75	1	0.3782	0.4456	54.92037369	65	44	45	105.6	108	0.0086	0.0097	46.57603666	53
06\01\94	41	AT	75	2	0.6231		90.48356648		50		120		0.0125		67.52761774	
06\01\94	30	AT	75	3	0.3355		48.71968634		41		98.4		0.0082		44.34068006	
06\01\94	25	AT	150	1	0.0155	0.0755	2.250834987	11	8	23	19.2	54	0.0019	0.0027	10.49869879	15
06\01\94	39	AT	150	2	0.1764		25.61595431		45		108		0.0039		21.24123428	
06\01\94	52	AT	150	3	0.0345		5.009923036		15		36		0.0023		12.46296909	
06\01\94	7	CONT WO/ACE	0	1	0.9777	0.6009	141.9788624	87	94	47	225.6	113	0.0104	0.0152	56.36005957	82
06\01\94	27	CONT WO/ACE	0	2	0.3621		52.5824096		20		48		0.0181		98.10524147	
06\01\94	31	CONT WO/ACE	0	3	0.463		67.23461929		27		64.8		0.0171		92.92036536	
06\01\94	46	CONT W/ACE	0	1	0.5009	0.6886	72.73827388	100	58	42	139.2	100	0.0086	0.0185	46.7968607	100
06\01\94	14	CONT W/ACE	0	2	0.7814		113.4711264		34		81.6		0.0230		124.5340671	
06\01\94	20	CONT W/ACE	0	3	0.7836		113.7905997		33		79.2		0.0237		128.6690722	
06\01\94	54	Mb	9	1	0.0691	0.1451	10.03436759	21	6	10	14.4	24	0.0115	0.0118	62.40515682	64
06\01\94	10	Mb	9	2	0.3349		48.63255724		19		45.6		0.0176		95.51140386	
06\01\94	23	Mb	9	3	0.0314		4.559756039		5		12		0.0063		34.0293243	
06\01\94	63	Mb	19	1	0.4671	0.5499	67.83000145	80	51	52	122.4	126	0.0092	0.0118	49.82875415	64
06\01\94	1	Mb	19	2	0.6123		88.91524275		74		177.6		0.0083		44.83593404	
06\01\94	51	Mb	19	3	0.5704		82.83072753		32		76.8		0.0178		96.58801045	
06\01\94	4	Mb	38	1	0.2546	0.2603	36.97177965	38	48	44	115.2	106	0.0053	0.0058	28.74159357	31
06\01\94	37	Mb	38	2	0.349		50.680091		48		115.2		0.0073		39.39833526	
06\01\94	21	Mb	38	3	0.1773		25.74664795		37		88.8		0.0048		25.96573936	
06\01\94	65	Mb	75	1	0.0685	0.1185	9.947238492	17	16	32	38.4	76	0.0043	0.0037	23.19873323	20
06\01\94	45	Mb	75	2	0.2115		30.71300644		54		129.6		0.0039		21.223172	
06\01\94	8	Mb	75	3	0.0754		10.9492231		25		60		0.0030		16.34274556	
06\01\94	42	Mb	150	1	0.0975	0.0600	14.15847815	9	38	28	91.2	66	0.0026	0.0021	13.90319778	11
06\01\94	60	Mb	150	2	0.0387		5.61982671		20		48		0.0019		10.48515006	
06\01\94	62	Mb	150	3	0.0437		6.345902512		25		60		0.0017		9.471856509	
06\01\94	26	MT	47	1	1.088	0.6888	157.9940946	100	53	37	127.2	88	0.0205	0.0173	111.2363443	94
06\01\94	24	MT	47	2	0.1354		19.66213273		10		24		0.0135		73.36895717	
06\01\94	38	MT	47	3	0.8431		122.4309016		47		112.8		0.0179		97.20193562	
06\01\94	43	MT	94	1	0.0483	0.0618	7.01389225	9	14	10	33.6	24	0.0035	0.0070	18.69445364	38
06\01\94	34	MT	94	2	0.0584		8.480565371		6		14.4		0.0097		52.74184021	
06\01\94	2	MT	94	3	0.0788		11.44295464		10		24		0.0079		42.69921584	
06\01\94	17	MT	188	1	0.079	0.3929	11.47199788	57	10	25	24	61	0.0079	0.0106	42.80758949	58
06\01\94	28	MT	188	2	0.0526		7.638317744		15		36		0.0035		19.00151229	
06\01\94	22	MT	188	3	1.0472		152.069316		51		122.4		0.0205		111.2636081	
06\01\94	12	MT	375	1	0.1241	0.1589	18.02120141	23	19	24	45.6	58	0.0065	0.0064	35.39255067	35
06\01\94	47	MT	375	2	0.0184		2.671958953		3		7.2		0.0061		33.23458424	
06\01\94	55	MT	375	3	0.3342		48.53090663		51		122.4		0.0066		35.5063058	
06\01\94	53	MT	750	1	0.308	0.2569	44.72626942	37	45	44	108	105	0.0068	0.0058	37.08786937	32
06\01\94	6	MT	750	2	0.3235		46.97710441		59		141.6		0.0055		29.7109101	
06\01\94	9	MT	750	3	0.1391		20.19942882		27		64.8		0.0052		27.916248	

APPENDIX VII: EFFECTS OF HERBICIDES IN MICROCOSMS ON WATER QUALITY
DAY OF TREATMENT

Date	Beaker #	Chemical	Chemical Conc.	Rep.	MONDAY EVENING O2 (MG/L)	MONDAY MORNING O2 (MG/L)	TUESDAY EVENING O2 (MG/L)	pH	Cond (uS/cm)	Commun RESPIR	Gross Photo	P/R Ratio	Mean Commun RESPIR	Mean Gross Photo	Mean P/R Ratio	Mean pH	Mean Cond (uS/cm)	Mean MONDAY EVENING O2 (MG/L)	Mean MONDAY MORNING O2 (MG/L)	Mean TUESDAY EVENING O2 (MG/L)
05\10\94	35	AL	47	1	11.8	8.5	12.8	7.97	390	9.9	10.9	1.10	8.2	8.8	1.06	7.9	414	10.9	8.2	11.5
05\10\94	5	AL	47	2	10.9	8.1	11.8	8	440	8.4	9.1	1.08								
05\10\94	29	AL	47	3	10	7.9	10.0	7.69	413	6.3	6.3	1.00								
05\10\94	61	AL	94	1	11.9	8.8	13.0	7.93	385	9.9	11	1.11	10.5	11.3	1.08	7.9	398	12.1	8.8	12.9
05\10\94	66	AL	94	2	12.1	8.7	12.8	7.86	403	10.2	10.7	1.05								
05\10\94	33	AL	94	3	12.4	8.8	13.2	7.9	397	11.4	12.2	1.07								
05\10\94	15	AL	188	1	10.4	7.9	10.7	7.89	430	7.5	7.8	1.04	8	8.7	1.09	7.8	418	11.3	8.8	12.0
05\10\94	56	AL	188	2	12.4	9.5	13.9	7.9	399	8.7	10.2	1.17								
05\10\94	59	AL	188	3	11.1	8.5	11.5	7.87	418	7.8	8.2	1.05								
05\10\94	40	AL	375	1	12	8.8	12.8	7.83	409	10.2	11	1.08	7.5	7.9	1.05	7.7	440	10.3	7.8	10.7
05\10\94	11	AL	375	2	9.8	7.2	10.0	7.86	455	7.2	7.8	1.08								
05\10\94	49	AL	375	3	9.3	7.6	9.4	7.47	456	5.1	5.2	1.02								
05\10\94	58	AL	750	1	8	6.9	8.2	7.31	469	3.3	3.5	1.06	6.8	7.1	1.05	7.8	443	9.9	7.8	10.2
05\10\94	64	AL	750	2	9.8	7.8	9.8	7.55	462	6.6	6.6	1.00								
05\10\94	18	AL	750	3	11.8	8.3	12.8	8.04	398	10.5	11.3	1.08								
05\10\94	32	AT	9	1	12	8.3	12.7	7.98	381	11.1	11.8	1.06	7.7	8.1	1.05	7.9	427	10.3	7.8	10.8
05\10\94	3	AT	9	2	11.3	8	11.8	8.09	429	9.9	10.4	1.05								
05\10\94	16	AT	9	3	7.7	7	7.8	7.53	471	2.1	2.2	1.05								
05\10\94	36	AT	19	1	11.2	8.7	12.4	7.93	375	7.5	8.7	1.16	6.4	7.0	1.10	7.7	402	9.9	7.7	10.5
05\10\94	48	AT	19	2	10.7	7.8	11.1	7.75	403	8.7	9.1	1.05								
05\10\94	50	AT	19	3	7.7	6.7	8.0	7.36	428	3	3.3	1.10								
05\10\94	13	AT	38	1	11	8.2	11.8	8.01	402	8.4	9	1.07	7.7	8.1	1.05	7.8	414	10.5	7.9	10.9
05\10\94	19	AT	38	2	9.4	7.1	9.8	7.72	448	6.9	7.1	1.03								
05\10\94	44	AT	38	3	11.1	8.5	11.8	7.77	392	7.8	8.3	1.06								
05\10\94	57	AT	75	1	8.1	6.7	8.2	7.37	441	4.2	4.3	1.02	8.1	8.3	1.03	7.7	399	10.7	8.0	10.9
05\10\94	41	AT	75	2	12.1	8.5	12.1	7.83	378	10.8	10.8	1.00								
05\10\94	30	AT	75	3	11.9	8.8	12.4	7.86	379	9.3	9.8	1.05								
05\10\94	25	AT	150	1	11.4	8.2	12.0	7.86	417	9.6	10.2	1.06	9.6	10.1	1.08	7.6	400	11.2	8.0	11.7
05\10\94	39	AT	150	2	11.8	7.8	12.4	7.86	379	12	12.8	1.05								
05\10\94	52	AT	150	3	10.4	8	10.8	7.71	404	7.2	7.8	1.06								
05\10\94	7	CONT WO/ACE	0	1	8.3	6.6	8.4	7.78	465	5.1	5.2	1.02	6.7	6.9	1.02	7.7	433	9.5	7.3	9.7
05\10\94	27	CONT WO/ACE	0	2	11.2	8	11.8	7.86	392	9.8	10.2	1.06								
05\10\94	31	CONT WO/ACE	0	3	9	7.2	8.9	7.55	442	5.4	5.3	0.98								
05\10\94	46	CONT W/ACE	0	1	11.9	8.3	12.8	7.92	378	10.8	11.5	1.06	8.1	7.8	0.96	7.8	414	10.3	7.6	9.9
05\10\94	14	CONT W/ACE	0	2	7.9	8.5	7.8	7.55	450	4.2	4.1	0.98								
05\10\94	20	CONT W/ACE	0	3	11	7.9	9.4	7.87	415	9.3	7.7	0.83								
05\10\94	54	Mb	9	1	12.8	8.8	13.3	7.98	377	11.4	12.1	1.06	9.3	9.7	1.05	7.9	402	11.5	8.4	11.9
05\10\94	10	Mb	9	2	10.9	7.9	10.8	7.92	429	9	8.9	0.99								
05\10\94	23	Mb	9	3	10.9	8.4	11.8	7.92	400	7.5	8.2	1.09								
05\10\94	63	Mb	19	1	7.9	8.9	8.4	7.35	486	3	3.5	1.17	7.4	7.8	1.06	7.8	427	10.4	7.9	10.7
05\10\94	1	Mb	19	2	11.4	8	11.8	8.13	418	10.2	10.4	1.02								
05\10\94	51	Mb	19	3	11.8	8.8	12.2	7.81	379	9	9.4	1.04								
05\10\94	4	Mb	38	1	11.3	8.2	12.0	8.1	429	9.3	10	1.08	8.8	9.4	1.07	8.0	401	11.5	8.5	12.1
05\10\94	37	Mb	38	2	11.3	8.8	12.0	7.84	391	8.1	8.8	1.09								
05\10\94	21	Mb	38	3	11.8	8.8	12.2	7.98	383	9	9.4	1.04								
05\10\94	65	Mb	75	1	10.9	8.2	12.0	7.73	422	8.1	9.2	1.14	7.6	8.6	1.13	7.8	419	10.5	8.0	11.5
05\10\94	45	Mb	75	2	10.4	7.9	11.0	7.87	418	7.5	8.1	1.08								
05\10\94	8	Mb	75	3	10.3	7.9	11.8	8.03	418	7.2	8.5	1.18								
05\10\94	42	Mb	150	1	8.7	7.3	8.8	7.49	434	4.2	4.3	1.02	6.5	6.8	1.02	7.6	434	9.7	7.6	10.0
05\10\94	60	Mb	150	2	11.7	8.4	12.8	7.79	408	9.9	11	1.11								
05\10\94	62	Mb	150	3	8.8	7	8.4	7.42	459	5.4	5	0.93								
05\10\94	26	MT	47	1	10.4	7.7	11.2	7.74	442	8.1	8.9	1.10	4.9	5.8	1.20	7.6	443	9.1	7.4	9.8
05\10\94	24	MT	47	2	7.4	8.8	8.0	7.45	464	1.8	2.4	1.33								
05\10\94	38	MT	47	3	9.4	7.8	10.2	7.65	424	4.8	5.8	1.17								
05\10\94	43	MT	94	1	11.8	9	13.1	7.86	407	8.4	9.7	1.15	7.5	9.2	1.23	7.9	435	10.9	8.4	12.6
05\10\94	34	MT	94	2	10.7	8.5	12.8	7.75	435	6.6	8.7	1.32								
05\10\94	2	MT	94	3	10.2	7.7	11.8	8.01	463	7.5	9.1	1.21								
05\10\94	17	MT	188	1	6.2	5.7	6.8	7.32	505	1.5	2.1	1.40	8.4	7.3	1.07	7.4	460	9.3	6.5	8.2
05\10\94	28	MT	188	2	11	5.5	8.2	7.14	443	16.5	11.7	0.71								
05\10\94	22	MT	188	3	10.8	8.4	11.8	7.86	431	7.2	8	1.11								
05\10\94	12	MT	375	1	10.4	8.3	12.2	8.05	421	6.3	8.1	1.29	8.7	9.8	1.15	7.9	403	11.4	8.5	12.5
05\10\94	47	MT	375	2	11.9	8.8	12.8	7.86	397	9.9	10.6	1.07								
05\10\94	55	MT	375	3	12	8.7	12.8	7.9	392	9.9	10.7	1.08								
05\10\94	53	MT	750	1	11.4	7.8	12.2	7.83	400	10.8	11.6	1.07	8.4	8.8	1.04	7.9	429	10.2	7.4	10.7
05\10\94	6	MT	750	2	10.8	7.8	11.2	8.05	428	8.4	9	1.07								
05\10\94	9	MT	750	3	8.7	6.7	8.8	7.73	460	6	5.9	0.98								

APPENDIX VII: EFFECTS OF HERBICIDES IN MICROCOSMS ON WATER QUALITY
DAY 7 AFTER TREATMENT

Date	Beaker #	Chemical	Chemical Conc.	Rep.	MONDAY EVENING O2 (MG/L)	MONDAY MORNING O2 (MG/L)	TUESDAY EVENING O2 (MG/L)	pH	Cond (uS/cm)	Commun RESPIR	Gross Photo	P/R Ratio	Mean Commun RESPIR	Mean Gross Photo	Mean P/R Ratio	Mean pH	Mean Cond (uS/cm)	Mean MONDAY EVENING O2 (MG/L)	Mean MONDAY MORNING O2 (MG/L)	Mean TUESDAY EVENING O2 (MG/L)
05\17\94	35	AL	47	1	6.9	5.4	8.5	7.32	424	4.5	6.1	1.36	4.7	5.9	1.25	7.2	448	6.6	5.0	7.8
05\17\94	5	AL	47	2	6.7	5.1	7.5	7.15	468	4.8	5.6	1.17								
05\17\94	29	AL	47	3	6.2	4.6	7.3	7.14	451	4.8	5.9	1.23								
05\17\94	61	AL	94	1	7.2	5.5	8.1	7.28	428	5.1	6	1.18	5.9	6.7	1.14	7.3	432	7.6	5.7	8.4
05\17\94	66	AL	94	2	7.8	5.6	8.3	7.26	437	6.6	7.1	1.08								
05\17\94	33	AL	94	3	7.9	5.9	8.9	7.34	431	6	7	1.17								
05\17\94	15	AL	188	1	6.4	5	7.1	7.09	477	4.2	4.9	1.17	5.1	5.7	1.13	7.2	468	7.2	5.5	7.9
05\17\94	58	AL	188	2	8.3	6.2	9	7.26	454	6.3	7	1.11								
05\17\94	59	AL	188	3	7	5.4	7.5	7.11	474	4.8	5.3	1.10								
05\17\94	40	AL	375	1	7.5	5.5	8.6	7.27	437	6	7.1	1.18	3.9	4.7	1.28	7.1	478	6.2	4.9	7.0
05\17\94	11	AL	375	2	4.7	4.3	5.3	6.87	493	1.2	1.8	1.50								
05\17\94	49	AL	375	3	6.4	4.9	7.1	7.09	504	4.5	5.2	1.16								
05\17\94	56	AL	750	1	6.9	5.4	7.5	7.15	487	4.5	5.1	1.13	3.2	4.0	1.44	7.1	468	6.2	5.2	7.0
05\17\94	64	AL	750	2	6.7	5.4	7.1	7.1	487	3.9	4.3	1.10								
05\17\94	16	AL	750	3	5.1	4.7	6.4	6.99	430	1.2	2.5	2.08								
05\17\94	32	AT	9	1	6.2	5	7.4	7.12	409	3.6	4.8	1.33	3.6	4.7	1.31	7.1	454	6.2	5.0	7.3
05\17\94	3	AT	9	2	6.4	4.9	7.3	7.12	470	4.5	5.4	1.20								
05\17\94	18	AT	9	3	6.1	5.2	7.2	7.09	484	2.7	3.8	1.41								
05\17\94	36	AT	19	1	6.4	4.9	8.1	7.31	411	4.5	6.2	1.38	4.8	5.9	1.24	7.3	432	7.1	5.5	8.2
05\17\94	48	AT	19	2	7.5	5.7	8.4	7.29	440	5.4	6.3	1.17								
05\17\94	50	AT	19	3	7.3	5.8	8.1	7.25	445	4.5	5.3	1.18								
05\17\94	13	AT	38	1	5.2	4.3	6.1	6.95	456	2.7	3.6	1.33	2.3	3.2	1.44	7.0	460	5.2	4.4	6.1
05\17\94	19	AT	38	2	5.3	4.4	6	6.98	495	2.7	3.4	1.26								
05\17\94	44	AT	38	3	5	4.5	6.1	6.97	430	1.5	2.6	1.73								
05\17\94	57	AT	75	1	4.7	4.3	5.3	6.91	497	1.2	1.8	1.50	1	1.7	1.31	7.0	457	4.7	4.4	5.4
05\17\94	41	AT	75	2	4.9	4.3	5.1	6.96	442	1.8	2	1.11								
05\17\94	30	AT	75	3	4.5	4.5	5.7	6.98	433	0	1.2	.								
05\17\94	25	AT	150	1	4.3	4.2	5.2	6.88	478	0.3	1.2	4.00	−0.1	0.6	2.56	6.9	462	4.5	4.5	5.2
05\17\94	39	AT	150	2	4.7	4.6	5.4	6.93	448	0.3	1	3.33								
05\17\94	52	AT	150	3	4.4	4.7	5	6.87	460	−0.9	−0.3	0.33								
05\17\94	7	CONT WO/ACE	0	1	8.2	6.2	8.5	7.42	480	6	6.3	1.05	5.7	6.3	1.11	7.3	463	7.6	5.7	8.2
05\17\94	27	CONT WO/ACE	0	2	7.6	5.2	8.4	7.36	436	7.2	8	1.11								
05\17\94	31	CONT WO/ACE	0	3	7	5.7	7.7	7.21	472	3.9	4.6	1.18								
05\17\94	46	CONT W/ACE	0	1	5.8	4.7	6.9	7.09	412	3.3	4.4	1.33	3.1	4.1	1.32	7.1	448	5.9	4.9	6.9
05\17\94	14	CONT W/ACE	0	2	5.8	4.8	6.8	7.07	482	3	4	1.33								
05\17\94	20	CONT W/ACE	0	3	6.1	5.1	7	7.09	450	3	3.9	1.30								
05\17\94	54	Mb	9	1	5.4	4.7	6.4	7.02	420	2.1	3.1	1.48	1.3	2.3	2.02	7.0	450	5.1	4.6	6.1
05\17\94	10	Mb	9	2	5	4.6	5.9	6.95	487	1.2	2.1	1.75								
05\17\94	23	Mb	9	3	4.8	4.6	5.9	6.96	443	0.6	1.7	2.83								
05\17\94	63	Mb	19	1	5.8	5.1	6.4	7.05	496	2.1	2.7	1.29	1.3	2.1	1.80	7.0	460	5.5	5.0	6.3
05\17\94	1	Mb	19	2	5.2	4.9	6.4	7.04	450	0.9	2.1	2.33								
05\17\94	51	Mb	19	3	5.4	5.1	6.1	7.05	435	0.9	1.6	1.78								
05\17\94	4	Mb	38	1	3.9	4	5	6.86	469	−0.3	0.8	−2.67	−0.4	0.6	−1.39	6.9	452	4.1	4.2	5.1
05\17\94	21	Mb	38	3	4.4	4.7	5.4	6.94	446	−0.9	0.1	−0.11								
05\17\94	37	Mb	38	2	3.9	3.9	4.9	6.86	440	0	1	.								
05\17\94	65	Mb	75	1	4.4	4.7	5.3	6.94	481	−0.9	8.7E−19	−0.00	−1	−0.1	0.09	6.9	464	3.9	4.3	4.8
05\17\94	45	Mb	75	2	3.5	3.7	4.1	6.83	463	−0.6	−2.2E−19	0.00								
05\17\94	8	Mb	75	3	3.9	4.4	5	6.88	449	−1.5	−0.4	0.27								
05\17\94	42	Mb	150	1	3.9	4.2	4.4	6.84	483	−0.9	−0.4	0.44	−1	−0.4	0.45	6.9	485	4.0	4.3	4.6
05\17\94	60	Mb	150	2	3.8	4.2	4.7	6.88	471	−1.2	−0.3	0.25								
05\17\94	62	Mb	150	3	4.3	4.6	4.6	6.89	501	−0.9	−0.6	0.67								
05\17\94	26	MT	47	1	6.9	5.4	8.3	7.31	467	4.5	5.9	1.31	4.8	5.8	1.21	7.0	446	7.2	5.6	8.2
05\17\94	24	MT	47	2	7.9	6.1	8.7	6.37	434	5.4	6.2	1.15								
05\17\94	38	MT	47	3	6.8	5.3	7.6	7.25	437	4.5	5.3	1.18								
05\17\94	43	MT	94	1	7.8	5.8	9.2	7.39	434	6	7.4	1.23	7.5	9.1	1.21	7.6	412	9.5	7.0	11.1
05\17\94	34	MT	94	2	10.6	7.8	13.2	7.76	378	8.4	11	1.31								
05\17\94	2	MT	94	3	10	7.3	10.8	7.5	424	8.1	8.9	1.10								
05\17\94	17	MT	188	1	8.2	6.1	9.8	7.48	475	6.3	7.9	1.25	4.1	5.5	1.36	7.3	448	7.0	5.6	8.3
05\17\94	28	MT	188	2	6.8	5.7	8.1	7.3	399	3.3	4.6	1.39								
05\17\94	22	MT	188	3	5.9	5	7.1	7.19	470	2.7	3.9	1.44								
05\17\94	12	MT	375	1	5.7	4.9	6.9	7.09	470	2.4	3.6	1.50	3.9	5.1	1.38	7.2	436	6.4	5.1	7.6
05\17\94	47	MT	375	2	5.4	4.6	6.5	7.12	437	2.4	3.5	1.46								
05\17\94	55	MT	375	3	8.2	5.9	9.4	7.52	401	6.9	8.1	1.17								
05\17\94	53	MT	750	1	7.7	5.8	8.7	7.42	404	5.7	6.7	1.18	4.2	4.9	1.15	7.3	455	7.0	5.6	7.7
05\17\94	6	MT	750	2	6.8	5.6	7.4	7.24	466	3.6	4.2	1.17								
05\17\94	9	MT	750	3	6.5	5.4	6.9	7.18	495	3.3	3.7	1.12								

APPENDIX VII: EFFECTS OF HERBICIDES IN MICROCOSMS ON WATER QUALITY
DAY 14 AFTER TREATMENT

Date	Beaker #	Chemical	Chemical Conc.	Rep.	MONDAY EVENING O2 (MG/L)	MONDAY MORNING O2 (MG/L)	TUESDAY EVENING O2 (MG/L)	pH	Cond (uS/cm)	Commun RESPIR	Gross Photo	P/R Ratio	Mean Commun RESPIR	Mean Gross Photo	Mean P/R Ratio	Mean pH	Mean Cond (uS/cm)	Mean MONDAY EVENING O2 (MG/L)	Mean MONDAY MORNING O2 (MG/L)	Mean TUESDAY EVENING O2 (MG/L)
05\24\94	35	AL	47	1	10.5	6.1	10.3	7.59	378	13.2	13	0.98	11.4	11.3	0.99	7.5	403	9.8	5.8	9.5
05\24\94	5	AL	47	2	8.8	5.8	8.8	7.39	429	9.8	9.4	0.98								
05\24\94	29	AL	47	3	9.8	5.8	9.8	7.53	402	11.4	11.4	1.00								
05\24\94	61	AL	94	1	10.8	6.4	10.9	7.63	374	13.2	13.3	1.01	12.9	12.8	0.99	7.3	398	10.5	6.2	10.5
05\24\94	66	AL	94	2	10	5.9	9.9	7.54	411	12.3	12.2	0.99								
05\24\94	33	AL	94	3	10.8	6.4	10.8	6.85	404	13.2	13	0.98								
05\24\94	15	AL	188	1	8.4	5.8	8.2	7.38	426	8.4	8.2	0.98	8.4	8.2	0.97	7.4	376	8.8	5.8	8.3
05\24\94	58	AL	188	2	9	6.1	8.4	7.42	406	8.7	8.1	0.93								
05\24\94	59	AL	188	3	8.3	5.8	8.4	7.39	301	8.1	8.2	1.01								
05\24\94	40	AL	375	1	9.3	5.8	9.3	7.44	414	10.5	10.5	1.00	8.8	9.0	1.03	7.4	446	8.3	5.4	8.5
05\24\94	11	AL	375	2	7	4.8	7.3	7.24	466	6.8	6.9	1.05								
05\24\94	49	AL	375	3	8.8	5.5	9	7.42	458	9.3	9.7	1.04								
05\24\94	56	AL	750	1	9.2	5.9	9.4	7.53	454	9.9	10.1	1.02	8.7	8.9	1.02	7.5	452	8.5	5.8	8.7
05\24\94	64	AL	750	2	8.3	5.5	8.8	7.44	479	8.4	8.7	1.04								
05\24\94	18	AL	750	3	8	5.4	8.1	7.39	422	7.8	7.9	1.01								
05\24\94	32	AT	9	1	9	6	9.1	7.48	415	9	9.1	1.01	9.7	9.7	1.00	7.5	433	9.0	5.8	9.0
05\24\94	3	AT	9	2	8.4	5.2	8.5	7.41	433	9.8	9.7	1.01								
05\24\94	16	AT	9	3	9.8	6.1	9.5	7.56	451	10.5	10.4	0.99								
05\24\94	36	AT	19	1	10.7	6.7	10.4	7.73	371	12	11.7	0.98	12.6	12.5	0.98	7.7	376	10.7	6.5	10.5
05\24\94	48	AT	19	2	10.8	6.2	10.8	7.68	373	13.8	13.8	0.99								
05\24\94	50	AT	19	3	10.7	6.5	10.4	7.7	385	12.8	12.3	0.98								
05\24\94	13	AT	38	1	7.2	5.1	7.1	7.27	432	6.3	6.2	0.98	6.3	6.4	1.01	7.3	446	7.4	5.3	7.4
05\24\94	19	AT	38	2	7.5	5.2	7.7	7.35	477	6.9	7.1	1.03								
05\24\94	44	AT	38	3	7.4	5.5	7.5	7.35	428	5.7	5.8	1.02								
05\24\94	57	AT	75	1	6.9	5	6.1	7.32	460	5.7	4.9	0.86	6	5.8	0.98	7.3	444	6.9	4.9	6.7
05\24\94	41	AT	75	2	7	4.8	7.3	7.31	434	6.8	6.9	1.05								
05\24\94	30	AT	75	3	6.8	4.9	6.7	7.25	437	5.7	5.6	0.98								
05\24\94	25	AT	150	1	6.6	5	6.9	7.23	471	4.8	5.1	1.06	4.2	4.5	1.06	7.2	454	6.1	4.7	6.4
05\24\94	39	AT	150	2	5.9	4.7	6.1	7.14	451	3.8	3.8	1.06								
05\24\94	52	AT	150	3	5.7	4.3	6.2	7.12	440	4.2	4.7	1.12								
05\24\94	7	CONT WO/ACE	0	1	9.8	5.7	9.2	7.85	444	11.7	11.3	0.97	10.8	10.5	0.97	7.8	435	9.1	5.5	8.7
05\24\94	27	CONT WO/ACE	0	2	8.9	5.2	8.5	7.47	417	11.1	10.7	0.96								
05\24\94	31	CONT WO/ACE	0	3	8.7	5.5	8.5	7.44	444	9.8	9.4	0.96								
05\24\94	46	CONT W/ACE	0	1	8.5	4.8	8.9	7.38	400	11.1	11.5	1.04	11	11.0	1.00	7.5	420	9.1	5.4	9.1
05\24\94	14	CONT W/ACE	0	2	9.1	5.8	9.1	7.48	455	10.5	10.5	1.00								
05\24\94	20	CONT W/ACE	0	3	9.7	5.9	9.4	7.5	405	11.4	11.1	0.97								
05\24\94	54	Mb	9	1	10.2	6.5	10	7.8	387	11.1	10.9	0.98	8.8	8.9	1.02	7.5	427	9.0	6.1	9.1
05\24\94	10	Mb	9	2	8.5	5.8	8.9	7.44	458	8.1	8.5	1.05								
05\24\94	23	Mb	9	3	8.3	5.9	8.4	7.45	436	7.2	7.3	1.01								
05\24\94	63	Mb	19	1	8.5	5.7	8.7	7.52	471	8.4	8.6	1.02	8.4	8.6	1.03	7.5	447	8.8	5.8	8.8
05\24\94	1	Mb	19	2	8.5	5.9	8.7	7.54	443	7.8	8	1.03								
05\24\94	51	Mb	19	3	8.8	5.8	9.1	7.52	427	9	9.3	1.03								
05\24\94	4	Mb	38	1	6.8	5.2	7.1	7.28	468	4.2	4.7	1.12	6.2	6.5	1.06	7.4	446	7.7	5.6	6.0
05\24\94	37	Mb	38	2	8.3	5.8	6.4	7.47	431	7.5	7.6	1.01								
05\24\94	21	Mb	38	3	8.2	5.9	8.5	7.48	439	6.9	7.2	1.04								
05\24\94	65	Mb	75	1	6.7	5.4	7.1	7.28	469	3.9	4.3	1.10	2.8	3.0	1.09	7.2	461	6.2	5.3	6.4
05\24\94	45	Mb	75	2	5.2	4.8	5.4	7.09	474	1.2	1.4	1.17								
05\24\94	6	Mb	75	3	6.8	5.7	6.8	7.26	439	3.3	3.3	1.00								
05\24\94	42	Mb	150	1	4.8	5.1	5.4	7.09	469	−0.9	−0.3	0.33	0.4	0.6	0.57	7.2	471	5.3	5.2	5.8
05\24\94	60	Mb	150	2	6.4	5.4	6.5	7.27	465	3	3.1	1.03								
05\24\94	62	Mb	150	3	4.8	5.1	5.4	7.12	460	−0.9	−0.3	0.33								
05\24\94	26	MT	47	1	10.2	5.8	10.2	7.68	398	13.2	13.2	1.00	11.1	10.9	0.98	7.6	404	9.6	5.9	9.4
05\24\94	24	MT	47	2	9.2	5.9	8.7	7.55	423	9.9	9.4	0.95								
05\24\94	38	MT	47	3	9.4	6	9.4	7.64	394	10.2	10.2	1.00								
05\24\94	43	MT	94	1	10.2	6.3	9.9	7.62	424	11.7	11.4	0.97	11.5	11.0	0.98	7.1	416	10.9	7.0	10.4
05\24\94	34	MT	94	2	12.4	7.9	12	8.02	413	13.5	13.1	0.97								
05\24\94	2	MT	94	3	10	6.9	9.3	7.56	410	9.3	8.8	0.92								
05\24\94	17	MT	188	1	13.3	7.7	12.8	7.85	366	16.8	16.3	0.97	13.1	12.7	0.97	7.7	393	11.1	6.7	10.8
05\24\94	28	MT	188	2	10.3	6.7	9.5	7.87	383	10.8	10	0.93								
05\24\94	22	MT	188	3	9.8	5.7	9.8	7.8	430	11.7	11.7	1.00								
05\24\94	12	MT	375	1	8.1	5.7	8	7.44	463	7.2	7.1	0.99	8.3	8.2	0.99	7.5	425	8.3	5.5	8.2
05\24\94	47	MT	375	2	8.2	5.8	8.2	7.48	424	7.8	7.8	1.00								
05\24\94	55	MT	375	3	8.8	5.3	8.3	7.51	388	9.9	9.6	0.97								
05\24\94	53	MT	750	1	9.8	6	9.8	7.62	387	10.8	10.8	1.00	8.8	8.7	1.01	7.5	427	8.4	5.5	8.5
05\24\94	6	MT	750	2	7.2	5.1	7.4	7.37	443	6.3	6.5	1.03								
05\24\94	9	MT	750	3	8.4	5.5	8.5	7.53	450	8.7	8.8	1.01								

APPENDIX VII: EFFECTS OF HERBICIDES IN MICROCOSMS ON WATER QUALITY
DAY 21 AFTER TREATMENT

Date	Beaker #	Chemical	Chemical Conc.	Rep.	MONDAY EVENING O2 (MG/L)	MONDAY MORNING O2 (MG/L)	TUESDAY EVENING O2 (MG/L)	pH	Cond (uS/cm)	Commun RESPIR	Gross Photo	P/R Ratio	Mean Commun RESPIR	Mean Gross Photo	Mean P/R Ratio	Mean pH	Mean Cond (uS/cm)	Mean MONDAY EVENING O2 (MG/L)	Mean MONDAY MORNING O2 (MG/L)	Mean TUESDAY EVENING O2 (MG/L)
05\31\94	35	AL	47	1	13.2	8.8	13.4	8	315	13.2	13.4	1.02	11.6	11.7	1.01	7.9	342	12.2	8.3	12.3
05\31\94	5	AL	47	2	12.2	8	12.2	7.79	353	12.6	12.6	1.00								
05\31\94	29	AL	47	3	11.2	8.2	11.4	7.83	358	9	9.2	1.02								
05\31\94	61	AL	94	1	15	8.8	14	8.07	312	18.6	17.8	0.95	15.2	14.8	0.97	8.0	330	13.6	8.6	13.2
05\31\94	66	AL	94	2	13	8.5	12.8	7.93	332	13.5	13.3	0.99								
05\31\94	33	AL	94	3	12.9	8.4	12.8	7.92	347	13.5	13.4	0.99								
05\31\94	15	AL	188	1	10.4	7.8	10.4	7.69	385	7.8	7.8	1.00	9.1	9.0	0.99	7.7	381	10.9	7.8	10.8
05\31\94	58	AL	188	2	10.2	7.4	10	7.59	386	8.4	8.2	0.98								
05\31\94	59	AL	188	3	12	8.3	12	7.73	371	11.1	11.1	1.00								
05\31\94	40	AL	375	1	11	8.1	11.4	7.75	355	8.7	9.1	1.05	7.9	8.0	1.01	7.7	395	10.5	7.9	10.6
05\31\94	11	AL	375	2	10.2	7.6	9.9	7.68	431	7.8	7.5	0.96								
05\31\94	49	AL	375	3	10.4	8	10.6	7.77	398	7.2	7.4	1.03								
05\31\94	56	AL	750	1	11	8.2	10.9	7.85	378	8.4	8.3	0.99	9.4	8.8	0.94	7.8	387	11.2	8.1	10.6
05\31\94	64	AL	750	2	10.8	8.2	10.4	7.79	419	7.8	7.4	0.95								
05\31\94	18	AL	750	3	11.8	7.8	10.4	7.74	363	12	10.6	0.88								
05\31\94	32	AT	9	1	11.4	8.3	11.2	7.75	355	9.3	9.1	0.98	9.5	9.4	0.99	7.8	365	11.3	8.1	11.2
05\31\94	3	AT	9	2	11	7.8	11.2	7.82	366	9.6	9.8	1.02								
05\31\94	16	AT	9	3	11.4	8.2	11.1	7.87	374	9.6	9.3	0.97								
05\31\94	36	AT	19	1	12	8.8	12	7.97	320	10.2	10.2	1.00	10.2	10.3	1.01	8.0	334	12.0	8.6	12.2
05\31\94	48	AT	19	2	12.5	8.6	12.8	8.1	329	11.1	11.2	1.01								
05\31\94	50	AT	19	3	11.6	8.5	11.9	8.03	352	9.3	9.6	1.03								
05\31\94	13	AT	38	1	9.4	7.4	9.8	7.84	420	6	6.2	1.03	6.8	6.9	1.02	7.8	417	9.9	7.7	10.1
05\31\94	19	AT	38	2	11	8.2	11	7.87	424	8.4	8.4	1.00								
05\31\94	44	AT	38	3	9.4	7.4	9.6	7.75	406	6	6.2	1.03								
05\31\94	57	AT	75	1	10.4	8	10.2	7.86	424	7.2	7	0.97	6.8	6.6	0.97	7.8	421	9.6	7.3	9.4
05\31\94	41	AT	75	2	9.6	7	9.1	7.76	412	7.8	7.3	0.94								
05\31\94	30	AT	75	3	8.8	7	8.8	7.85	427	5.4	5.4	1.00								
05\31\94	25	AT	150	1	9.4	7.6	9.5	7.69	440	5.4	5.5	1.02	4.7	4.6	0.99	7.6	436	6.5	6.9	8.4
05\31\94	39	AT	150	2	6.2	6.4	7.9	7.57	441	5.4	5.1	0.94								
05\31\94	52	AT	150	3	7.9	6.6	7.9	7.53	426	3.3	3.3	1.00								
05\31\94	7	CONT WO/ACE	0	1	11	7.9	11.1	7.84	404	9.3	9.4	1.01	8.9	8.9	1.00	7.8	376	11.1	8.2	11.1
05\31\94	27	CONT WO/ACE	0	2	11.4	8.2	11.4	7.78	352	9.6	9.6	1.00								
05\31\94	31	CONT WO/ACE	0	3	11	8.4	10.9	7.74	371	7.8	7.7	0.99								
05\31\94	46	CONT W/ACE	0	1	14.6	9.9	14.6	8.1	306	14.1	14.1	1.00	11.1	11.1	1.00	7.9	347	12.5	8.8	12.5
05\31\94	14	CONT W/ACE	0	2	11	8.2	11.2	7.79	382	8.4	8.6	1.02								
05\31\94	20	CONT W/ACE	0	3	12	8.4	11.8	7.86	353	10.8	10.6	0.98								
05\31\94	54	Mb	9	1	11.9	8.4	11.4	7.86	332	10.5	10	0.95	9.8	9.5	0.97	7.9	362	11.6	8.3	11.3
05\31\94	10	Mb	9	2	11.8	8.3	11.3	7.89	373	10.5	10	0.95								
05\31\94	23	Mb	9	3	11	8.2	11.1	7.82	382	8.4	8.5	1.01								
05\31\94	63	Mb	19	1	11.8	8.4	11.7	7.97	401	10.2	10.1	0.99	9	9.0	1.00	7.9	376	11.2	8.2	11.2
05\31\94	1	Mb	19	2	10.4	7.9	10.8	7.84	368	7.5	7.7	1.03								
05\31\94	51	Mb	19	3	11.4	8.3	11.2	7.87	358	9.3	9.1	0.98								
05\31\94	4	Mb	38	1	9.3	7.4	9.2	7.74	442	5.7	5.6	0.98	7.7	7.3	0.95	7.8	407	10.3	7.8	9.9
05\31\94	37	Mb	38	2	10.9	8.1	10.4	7.81	383	8.4	7.9	0.94								
05\31\94	21	Mb	38	3	10.8	7.8	10.2	7.79	397	9	8.4	0.93								
05\31\94	65	Mb	75	1	9.9	7.8	9.8	7.74	439	6.9	6.8	0.98	7.6	6.2	0.83	7.5	447	9.1	6.6	7.7
05\31\94	45	Mb	75	2	6.5	5.7	6	7.36	460	2.4	1.9	0.79								
05\31\94	8	Mb	75	3	10.9	6.4	7.4	7.51	443	13.5	10	0.74								
05\31\94	60	Mb	150	2	8.5	7	8.5	7.63	452	4.5	4.5	1.00	1.6	1.5	0.7	7.4	468	6.5	6.0	6.4
05\31\94	62	Mb	150	3	5.6	5.5	5.4	7.27	487	0.3	0.1	0.33								
05\31\94	42	Mb	150	1	5.4	5.4	5.4	7.24	466	0	0									
05\31\94	26	MT	47	1	12	8	11.5	8.13	341	12	11.5	0.96	9.4	8.7	0.92	8.0	367	10.8	7.7	10.1
05\31\94	24	MT	47	2	9.3	6.8	8.2	7.71	402	7.5	6.4	0.85								
05\31\94	38	MT	47	3	11.2	8.3	10.7	8.03	358	8.7	8.2	0.94								
05\31\94	43	MT	94	1	10.9	7.5	10.4	7.8	378	10.2	9.7	0.95	9.8	8.6	0.88	7.8	395	10.5	7.2	9.3
05\31\94	34	MT	94	2	11	7.4	9	7.91	414	10.8	8.8	0.81								
05\31\94	2	MT	94	3	9.8	6.6	8.5	7.72	394	8.4	7.3	0.87								
05\31\94	17	MT	188	1	15	9.4	14	8.26	299	16.8	15.8	0.94	11.3	11.0	0.96	8.0	350	11.9	8.2	11.6
05\31\94	28	MT	188	2	9.4	7.2	9.6	7.8	383	6.6	6.8	1.03								
05\31\94	22	MT	188	3	11.4	7.9	11.2	8.04	368	10.5	10.3	0.98								
05\31\94	12	MT	375	1	10	7.4	9.6	7.74	425	7.8	7.4	0.95	9.6	9.1	0.95	7.8	398	10.6	7.4	10.1
05\31\94	47	MT	375	2	11.5	7.6	11	7.9	377	11.7	11.2	0.96								
05\31\94	55	MT	375	3	10.2	7.1	9.6	7.84	392	9.3	8.7	0.94								
05\31\94	53	MT	750	1	11.8	8	11.4	7.95	347	10.8	10.6	0.98	8.6	8.3	0.97	7.9	390	10.5	7.7	10.3
05\31\94	6	MT	750	2	9.2	7	9.1	7.73	412	6.6	6.5	0.98								
05\31\94	9	MT	750	3	10.6	8	10.3	7.99	410	8.4	7.9	0.94								