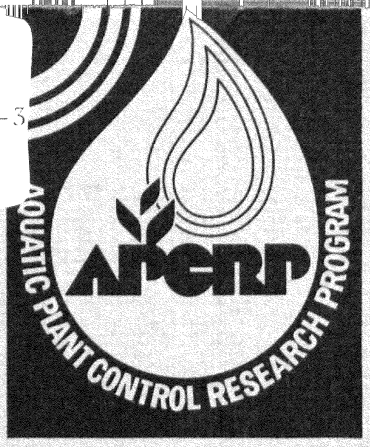

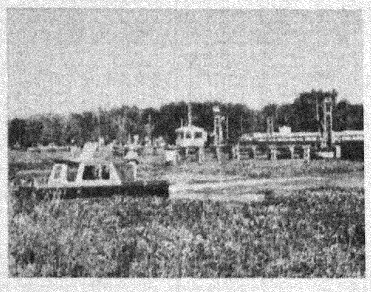

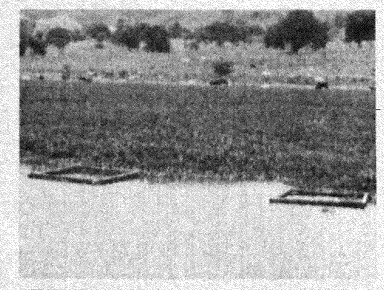

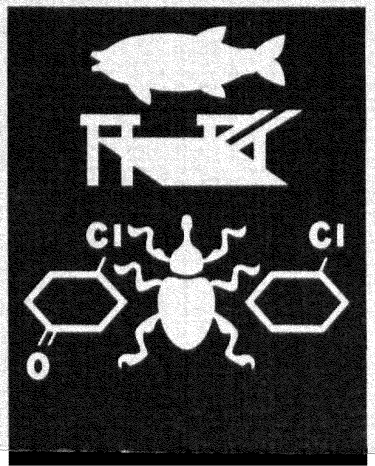

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EVALUATION OF CHEMICALS FOR AQUATIC PLANT CONTROL

By Kerry K. Steward

Aquatic Plant Management Laboratory
U. S. Department of Agriculture, SEA Federal Research
3205 S. W. 70th Avenue
Fort Lauderdale, Fla. 33314

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Annual Report for FY 1978

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The purpose of this project was to expand evaluation research on the use of chemicals for aquatic weed management in an attempt to discover new herbicides or growth regulators.

Several experimental formulations of fenac were screened for efficacy against waterhyacinth, hydrilla, and southern naiad. All ten were effective against waterhyacinth, four were effective against hydrilla, and three were effective against southern naiad. (Continued)

20. ABSTRACT (Continued).

The growth retardant EL-509 effectively inhibited hydrilla regrowth from clipped stems for 24 weeks in outside aquaria.

Combinations of fenac and organic copper complex more effectively controlled hydrilla in outside aquaria than either herbicide when used alone.

Hexazinone had controlled hydrilla in outside aquaria for nearly a year when the experiment was dismantled. No regrowth occurred from rootstocks nor from propagules since production of propagules had been prevented by treatments. Phytotoxic residues were detected by bioassays 8 months after treatments.

Field evaluation of hexazinone under Du Pont's experimental use permit produced control of hydrilla for over 12 months at 3.4-kg/ha treatment rate but for only 4 months at the 6.7-kg/ha rate.

A 2.0-mg/ℓ treatment of fenac to a 4.1-ha area within a 9.7-ha lake in Broward County, Florida, has controlled hydrilla throughout the lake for 10 months and has eliminated cattails in shallow areas and along the lake margin.

Both hexazinone and terbutryn controlled green alga Chara spp. in outside aquaria at concentrations of 0.2 mg/ℓ.

An experimental herbicide from Kalo Laboratories was effective in controlling waterhyacinth in greenhouse tests but ineffective against submersed weeds hydrilla, southern naiad, and Chara spp. in the laboratory.

Metribuzin and RH-2915 were not effective against torpedograss in field trials.

Preface

This report presents the results for FY 78 of an ongoing chemical screening program to evaluate chemical formulations to determine their potential as aquatic plant control herbicides. The program is being conducted for the Aquatic Plant Control Research Program (APCRP) by the U. S. Department of Agriculture (USDA), Science and Education Administration, Aquatic Plant Management Laboratory, Fort Lauderdale, Florida. Funds for this effort are provided by the Office, Chief of Engineers, U. S. Army, under appropriation number 96X3122, Construction General, and CWIS No. 31548 through the APCRP at the U. S. Army Engineer Waterways Experiment Station (WES).

The principal investigator for the work was Dr. Kerry K. Steward, USDA, who prepared this report.

The work was monitored at WES by Dr. Dana R. Sanders of the Aquatic Plant Research Branch (APRB), under the general supervision of Mr. W. G. Shockley, Chief of Mobility and Environmental Systems Laboratory, and Mr. B. O. Benn, Chief of the Environmental Systems Division, and under the direct supervision of Mr. J. L. Decell, Chief of the APRB, who is now manager of the APCRP, which is a part of the Environmental Laboratory of which Dr. John Harrison is Chief.

The Commanders and Directors of the WES during the conduct of the study and the preparation and publication of this report were COL John L. Cannon, CE, and COL Nelson P. Conover, CE. Technical Director was Mr. F. R. Brown.

Contents

EVALUATION OF CHEMICALS FOR AQUATIC PLANT CONTROL

Introduction

1. The future availability of adequate fresh water for agricultural and other uses is a major concern in Florida, the U. S. and abroad. Aquatic weeds are serious deterrents to the efficient conservation and utilization of this vital resource. Aquatic weeds cause severe problems to navigation in streams and inland waterways. Nuisance growths of aquatic weeds interfere with flow and utilization of water for irrigated agriculture.

2. Aquatic weeds infesting farm ponds restrict their use for stock watering, fish production, fire protection, and irrigation, for waterfowl and wildlife use, and for use as potable water. Recreational uses of water such as fishing, swimming and boating are also prevented or severely curtailed by these aquatic growths.

3. Management of aquatic weeds is primarily accomplished with herbicides; however, the number of these compounds available for use is decreasing. Only four herbicides are registered and widely used nationally for control of submersed aquatic weeds, and only two herbicides are widely used for control of ditchbank weeds. The use of 2,4-D, one of two herbicides widely used for waterhyacinth control, is restricted because of drift hazards to susceptible plants. Increasing cost of the other herbicide is effectively decreasing its use, with the consequence that problems are increasing in some areas.

4. There is a critical need to expand evaluation programs to discover and develop new environmentally safe herbicides and algacides for weed control in aquatic habitats.

Purpose

5. The purpose of this project is to expand evaluation research

on the use of chemicals for aquatic weed management. New herbicides or growth regulators need to be discovered for the selective removal or growth regulation of different species of aquatic plants.

6. With the assistance of Federal Regional Laboratories, Pioneer Laboratories, and the chemical industry, attempts are being made to discover new and more effective chemicals that have high phytotoxicity to aquatic plants but minimal adverse effect on nontarget aquatic organisms and the aquatic environment.

Procedures

7. GREENHOUSE EVALUATION TECHNIQUES FOR EMERGENT AND FLOATING TYPE AQUATIC PLANTS (e.g., alligator weed, torpedograss, waterhyacinth, duckweed). Plants to be treated are grown in polyethylene-lined, 12-liter capacity plastic containers. The plants are allowed to become established in a greenhouse for a period of approximately one to four weeks before being treated. Each replicated treatment is applied by placing the containers in a 929-sq-cm enclosure with an open top. The plants within this space are then uniformly sprayed with a small atomizer. The total spray volume is equivalent to 935 liters per hectare. Following application of the chemicals the plants are moved to a screenhouse where treatments are periodically evaluated for phytotoxicity.

8. LABORATORY EVALUATION TECHNIQUES FOR SUBMERSED TYPE AQUATIC PLANTS. Apical sections of submersed weeds are planted in sand-soil mix in small plastic pots and placed in 3.8- or 19-liter jars. Plants are then allowed to become established for approximately one week under controlled conditions of temperature (25 C) and light (25-40 μeinsteins. m^{-2}. sec^{-1}, from Gro-lux fluorescent tubes for 14 hours). The weeds are treated by injecting treatment solutions into the water with a hypodermic syringe. The treatments are then evaluated biweekly for phytotoxicity.

9. LABORATORY EVALUATION OF CHEMICALS FOR GROWTH INHIBITION OF HYDRILLA PROPAGULES. Vegetative propagules (tubers) of hydrilla are planted (five per 5-cm pot in sand-soil mix) in three pots per 3.8-liter jar filled with water. Chemical treatments are applied at the time of

planting. Effects on germination are recorded along with phytotoxic response of sprouted plants. Jar tests are conducted in a growth lab with controlled light and temperature.

10. EVALUATION TECHNIQUES IN OUTSIDE AQUARIA. Evaluations are conducted in aquaria of two sizes and types. One type consists of circular, vinyl plastic-lined containers manufactured for use as swimming or wading pools. The dimensions are 3.05 meters in diameter (7.3×10^{-4} ha) and they have a maximum depth of 74 cm. The volume for those dimensions would be 5400 liters. The pools normally are filled to a 53-cm depth, which results in a volume of 3867 liters.

11. The second type of aquaria are rectangular-shaped concrete boxes covered with two coats of white epoxy paint on the inside. The dimensions for these are 77 cm wide × 219 cm long (1.7×10^{-4} ha) and they range from 48 cm to 65 cm deep. The maximum capacity of these containers ranges from 815 to 1093 liters. The normal volume after soil has been added would be 500-825 liters.

12. When these aquaria are used for evaluation of submersed plants, apical cuttings of individual species are established by planting 15-cm cuttings into holes on 5.1-cm centers (428 stems per sq meter) punched into a 15-cm layer of sand-organic soil mix on the bottom of the aquaria. Water levels are then slowly raised in the aquaria and the plants are subjected to an intermittent water flow until treatments are applied. When aquaria are used for the evaluation of floating weed species, field-collected plants are established and allowed to completely cover the surface before treatment.

13. All chemical treatment rates are replicated a minimum of three times and are applied on an area basis (kg/ha) or on a volume basis (mg/liter). Phytotoxicity ratings are made at various times posttreatment and are made on a scale of 0-100 percent injury: 0 percent is no injury; 100 percent is complete elimination of live tissue.

Results and Discussion

Torpedograss (*Panicum repens* L)

14. Chemicals with proven efficacy against torpedograss were

evaluated in the greenhouse against plants which were cultured hydroponically to simulate growth as floating mats or plants which were rooted in soil in pots and partially submerged.

15. The efficacy of all treatments was reduced when they were applied to rooted plants (Table 1), indicating that rooted submerged plants may be more resistant to control. The addition of the adjuvant SA-77 did not alter the efficacy of selected treatments to rooted plants except for the 6.7-kg/ha glyphosate treatment.

16. Field evaluation of RH-2915 and Metribuzin revealed that neither compound was as effective as the reference herbicide glyphosate (Table 2).

Waterhyacinth (Eichhornia crassipes (Mart.) Solms)

17. All experimental formulations of fenac were effective in the greenhouse at the 1-kg/ha rate but not quite as effective as the reference 2,4-D which produced greater injury and faster response. The coded confidential compound from Kalo Laboratories Inc. was not as effective as fenac or 2,4-D (Table 3). The Kalo compound is currently under test in outside aquaria.

18. Hexazinone was the most effective herbicide evaluated in outside aquaria (Table 4). It was more effective than the reference 2,4-D and Elanco's EL-171 (Floridone). The growth retardant EL-509 was continuing to suppress growth at 23 weeks. Tests are currently in progress to evaluate integrated control of waterhyacinth utilizing EL-509 and the insect Neochetina.

Submersed weeds: Hydrilla (Hydrilla verticillata Royle) and southern naiad (Najas quadalupensis (Spreng.) Magnus).

19. LABORATORY EVALUATIONS. The experimental fenac granular formulation, which was used in Tigertail Lake field trials, was compared with the standard liquid formulation (Table 5). The efficacy of the granule was slightly less than the liquid. Plant response was also slower with the granule.

20. Combinations of diquat and iron were compared with diquat and copper for efficacy against hydrilla (Table 6). In the first series of tests no differences between the combinations were apparent.

Phytotoxicity to hydrilla appeared to be caused by diquat alone since additions of copper or iron did not increase phytotoxicity ratings. A second series was established in which lower diquat concentrations were tested. In this second series, additions of iron to 0.02 mg/l rates of diquat appeared to increase the efficacy of the treatment toward hydrilla (Table 7). The addition of copper decreased the injury rating. In this series, southern naiad was controlled at the lower diquat rate.

21. In a third series of tests, the response of hydrilla to combinations of diquat and iron was not different than to diquat alone (Table 8). As in the second series, the addition of copper appeared to reduce the efficacy of diquat.

22. In the third series, evaluation of the adjuvant properties of SA-77 was confounded by use of phytotoxic levels of the adjuvant, that is, all treatments containing SA-77 were controlled. Tests are under way to determine threshold concentrations of this compound.

23. Evaluations of ten experimental fenac formulations have identified several with efficacy toward hydrilla (77-A-591, 77-A-599, and AL-3589) and southern naiad (A-08563, A-70316, AL-3589, dry sodium salt and fenac plus dicamba) (Table 9).

24. A confidential compound from Kalo Laboratories Inc. was ineffective against hydrilla and southern naiad (Table 10).

25. Terbutryne was not effective in inhibiting sprouting of hydrilla tubers but exhibited moderate toxicity toward emerging shoots (Table 11).

26. EVALUATIONS IN OUTSIDE AQUARIA AGAINST HYDRILLA. Asulam was not effective 28 weeks after treatment except at the 5-mg/liter rate (Table 12). This rate would be environmentally and economically unfeasible, however.

27. EL-171 (Fluridone) was moderately effective 28 weeks after treatment. A 2.0-mg/liter rate had produced 82 percent control by this time (Table 13).

28. The growth retardant EL-509 was applied at a rate of 1 mg/liter to hydrilla stems which had been clipped at the soil surface. Regrowth from rootstocks and remaining stems was prevented for approximately

24 weeks (Table 14). Retreatment at this time at the same rate did not prevent further regrowth. Untreated clipped controls had reached the water surface in the aquaria approximately eight weeks after the initial treatments.

29. An apparent synergism toward hydrilla between combinations of fenac and copper was observed in earlier tests in the laboratory and also in preliminary tests in outside aquaria.

30. Attempts to confirm these findings were initiated in November 1977 by application of the herbicides alone or in combination to hydrilla cultured in outside aquaria. The experiment was arranged as a randomized complete block using three replications. Observations were made biweekly for thirty weeks at which time aquaria were drained and plants were harvested, dried, and weighed to obtain biomass estimates. The results of this experiment are contained in Table 15. The most efficacious treatment was the 2-mg/liter combination treatment, which produced nearly complete control very early in the experiments and maintained control throughout. This treatment achieved the greatest reduction in biomass. The 2 mg/liter fenac plus 1 mg/liter copper, and the 1 mg/liter fenac plus 2 mg/liter copper were next most efficacious in decreasing order. All treatments reduced plant biomass below that of controls by at least half, indicating that all treatments were effective to varying degrees.

31. Water from the treatment replicates with the lowest concentrations of fenac and copper was bioassayed for presence of phytotoxic residues 12 weeks after treatments. Only the treatment containing fenac prevented growth from germinated tubers (Table 16). The treatments containing copper alone had no effect on growth from tubers. A preliminary field experiment to evaluate this herbicide combination is being planned for the fall.

32. Hexazinone was applied to hydrilla in outside aquaria at 0.0-, 0.5- and 1.0-mg/liter rates. Plant samples were taken at 0, 12, 24, 48, and 96 hours and then at 8 and 16 days posttreatment to determine the time course of herbicide uptake. Efficacy data were collected monthly for 11 months and after this time aquaria were drained and biomass and propagule counts were obtained for each of three replicates.

33. The efficacy of these treatments is indicated in Table 17. The 1.0-mg/liter treatment rate produced a more rapid response than the lower 0.5-mg/liter rate, that is, an average of 95 percent control was achieved after three months at 1 mg/liter as opposed to five months for the lower rate.

34. Preliminary results of tissue analyses to estimate herbicide uptake (Table 18) indicate that uptake may have been complete after one day at the higher treatment rate and complete by four days at the lower rate. The differences in tissue levels between treatments would not seem to account for the differences in response rate between treatments.

35. The effects of herbicide treatments on propagule production and viability are presented in Table 19. Application of herbicide treatments to hydrilla two months after planting prevented production of propagules and of considerable biomass. A few tubers were produced within the 0.5-mg/liter treatments and these appeared to possess a reduced dormancy in comparison to controls.

36. Hydrilla cuttings established in pots were placed in treatment replicates eight months after treatments to bioassay for chemical residues. Phytotoxic residues were found in replicates of both treatment rates (Table 20). Persistence of hexazinone is one of the factors responsible for the long-term control observed in this experiment.

37. FIELD EVALUATIONS. Hexazinone was tested for efficacy against hydrilla infestations in the field under E. I. du Pont de Nemours and Company's experimental use permit 352-EUP-94.

38. Four ponds ranging in size from 0.45 to 0.85 ha and located in Lee and Charlotte Counties, Florida, were treated 16 June 1977 at rates of 0, 1.7, 3.4 or 6.7 kg/ha.

39. Samples of water, soil and plants and measurements of dissolved oxygen, pH and temperature were taken pretreatment and at various intervals after treatment up to 12 months. These data are to be used to support registration along with efficacy data.

40. The effects of treatments on hydrilla are listed in Table 21 and on dissolved oxygen and pH in Table 22.

41. On 15 June 1977, prior to treatment, a fish kill was observed

in the 3.4-kg/ha pond. Species involved were bluegill, shad and catfish. An area in the central part of the pond consisted of foul-smelling water, dead and dying hydrilla, and mats of bluegreen algae. The water in this area had a milky, haze-like appearance. Dissolved oxygen in this area of the pond was 0.0 ppmw. Numerous gulls and shore birds were congregated around this pond feeding on the dead fish.

42. On 21 June 1977, five days after treatment, the milky appearance of the water increased to most of the pond. However, the area of decomposition was still confined to the central 1/3 of the pond. No additional dead fish were observed and the bird life had gone. Five alligators were observed in the pond, presumably feeding on the remains of the dead fish.

43. The 6.7-kg/ha pond on 21 June 1977 was undergoing a fish kill involving the same species as for the 3.4-kg/ha pond. The milky haze was present throughout the pond although no signs of plant decomposition and bluegreen algae were evident. Some of the fish appeared to have been dead for one or two days while others appeared to have died more recently. Oxygen in this pond was 0.0 ppmw. The gulls and shore birds had moved into this pond and were actively feeding on the dead fish.

44. Plants in both the 1.7-kg/ha pond and the 3.4-kg/ha pond showed response to herbicidal activity after five days. In both ponds the surface hydrilla (a 1.5- to 5-cm layer) was defoliated, flaccid and yellowish in color. Below 5 cm in the 1.7-kg/ha pond, however, the hydrilla was still turgid and healthy looking. In the 3.4-kg/ha pond, however, the hydrilla was flaccid to a depth of about 15 cm. Below this level the plants appeared healthy. In the central area of the 3.4-kg/ha pond where the haze had been originally observed, the plants were in advanced stages of decomposition.

45. No apparent damage to the hydrilla was evident in the 6.7-kg/ha pond after five days posttreatment. The plants were still green and turgid and showed no leaf loss. The 1.7-kg/ha rate was ineffective, having only produced 1 percent injury 29 days after treatment. The theoretical herbicide concentration in water, based on area and depth measurement, was calculated to be 0.06 mg/liter.

46. The 3.4-kg/ha treatment was the most effective treatment, producing 80 percent control by two months. Good control in this pond was maintained for 12 months. The theoretical concentration in water of this treatment was 0.16 mg/liter.

47. The 6.7-kg/ha treatment produced nearly complete control of hydrilla two and three months after treatment but regrowth was rapid by four months and beyond. The calculated concentration of the herbicide in water of this treatment was 0.67 mg/liter. The analyses of the various samples for herbicide residues are not complete. These data may help to explain the brief period of control in the higher treatment rate.

48. The dissolved oxygen levels were depressed before the 1.7-kg/ha treatment was applied. The oxygen levels were further depressed by treatments and they remained depressed 29 days after treatments. The levels had returned to normal by six months, however.

49. The oxygen levels were also lower than desired in the 3.4-kg/ha treatment pond prior to treatment. These oxygen levels also appeared to be depressed by the treatments for 29 days or longer.

50. The 6.7-kg/ha treatment pond appeared to be affected less by the treatments. Oxygen levels were 0.0 ppmw five days after treatment but they had recovered by 14 days.

51. Oxygen levels in the control pond ranged from a high of 9.8 to a low of 2.7 mg/liter. Levels in the 14- and 29-day samples were below environmentally acceptable standards.

52. There was no apparent relationship between pH and chemical treatments. The changes appeared to coincide with changes occurring in the controls.

53. Assistance was provided November 1977 to Amchem Products, Inc. with their application of fenac, under experimental use permit 264-EUP-54, for control of hydrilla in 9.7-ha Tigertail Lake, Broward County, Florida.

54. On 2 November, a 2-mg/l rate of granular formulation of fenac was applied to a 4.1-ha area. Water samples for residue analysis were taken pretreatment, at two and four weeks posttreatment and at monthly

intervals. Analyses are being conducted by Amchem. The results of analyses to date show that whole lake residues were 0.52 mg/l at three months posttreatment. From these data a 4.5 fenac half-life in water was predicted. Control of hydrilla in the lake has gradually increased from 50 percent at two months to a current 99 percent which was attained between seven and eight months posttreatment (Table 23).

Musk grass (Chara spp.)

55. The confidential compound from Kalo Laboratories was not effective in laboratory tests (Table 10). Combinations of diquat and copper-triethanolamine produced injury to Chara spp. but toxicity was due to the copper not diquat (Table 7). Additions of the adjuvant SA-77 to combination treatments produced injury but was due to the adjuvant since the adjuvant by itself produced similar injury (Table 8). Additional evaluations of the adjuvant are in progress to determine lower concentration limits.

56. Evaluations in outside aquaria indicated that recommended rates of granular formulations of organic copper complexes were not as effective as terbutryn or hexazinone (Tables 24 and 25).

57. A list of the chemicals which were evaluated and their sources are included in Table 26.

Plans for FY 1979

58. Laboratory and greenhouse evaluations will be conducted on new compounds as they are received from industry and from other sources. Compounds that are scheduled to be evaluated at this time or are currently being evaluated are Norflurazon (Sandoz), Krenite (Du Pont) and two experimental formulations of 2,4-D (one from the University of Washington and one from Wright State University).

59. Compounds which show efficacy in laboratory or greenhouse tests will be taken into the secondary testing phase and evaluated in outside aquaria. The confidential compound from Kalo Laboratories is scheduled to be evaluated against waterhyacinth. The growth retardant EL-509 is being evaluated for control of waterhyacinth in combination

with Neochetina in an integrated approach.

60. Several compounds are scheduled to be field evaluated or are in the planning stages.

61. Scheduled tests are as follows: Evaluate hexazinone for efficacy against hydrilla and collect data on persistence in water and bottom soil. Data are to be used by Du Pont to support their petition to EPA for registration of hexazinone for use in aquatic weed control.

62. Evaluate the use of adjuvant SA-77 for increasing the efficacy of the herbicides dalapon, diuron, glyphosate and hexazinone against cattails.

63. Evaluate the use of fenac and copper combinations for efficacy against hydrilla and collect data on persistence of copper in water and bottom mud.

64. Evaluate various rates of diquat and copper applied as invert emulsions against hydrilla through a cooperative project with the Florida Department of Natural Resources.

65. Field trials which are being planned but are not scheduled are as follows: hexazinone and terbutryn should be evaluated for efficacy against musk grass (Chara spp.) and against other algae.

66. Several compounds have shown efficacy against waterhyacinth that is comparable or superior to 2,4-D. These compounds are hexazinone, metribuzin, M-3724 (Dow Chemical Company) and R-24191 (Stauffer Chemical Company).

TABLE NO. 1
1978 GREENHOUSE EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD TORPEDOGRASS

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha [1]	PERCENT CONTROL - WEEKS POSTTREATMENT 1 week	2 weeks	4 weeks	6 weeks	8 weeks
5/10/78	Dalapon [2]	DOW	16.8	1	2	10	13	16
			22.4	2	3	13	17	18
			33.6	6	12	73	83	83
	Diuron [2]	duPont	22.4	0	1	99	100	100
			44.8	0	3	100	100	100
			67.2	0	2	99	100	100
	Hexazinone [2]	duPont	2.2	0	2	94	100	100
			4.5	1	3	99	100	100
			6.7	1	3	99	100	100
	Glyphosate [2]	Monsanto	2.2	1	1	5	7	8
			4.5	2	3	45	63	70
			6.7	3	8	68	94	96
	Control			0	0	0	0	0

(Continued)

TABLE NO. 1 (cont'd)
1978 GREENHOUSE EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD TORPEDOGRASS

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha [1]	PERCENT CONTROL - WEEKS POSTTREATMENT 10 weeks	12 weeks	14 weeks	16 weeks
5/10/78	Dalapon [2]	DOW	16.8	16	16	17	18
			22.4	21	40	48	57
			33.6	86	87	85	83
	Diruon [2]	duPont	22.4	100	100	100	100
			44.8	100	100	100	100
			67.2	100	100	100	100
	Hexazinone [2]	duPont	2.2	100	100	100	100
			4.5	100	100	100	100
			6.7	100	100	100	100
	Glyphosate [2]	Monsanto	2.2	7	18	30	35
			4.5	73	71	71	68
			6.7	97	96	96	95
	Control			0	2	6	13

(Continued)

TABLE NO. 1 (cont'd)
1978 GREENHOUSE EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD TORPEDOGRASS

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha [1]	PERCENT CONTROL - WEEKS POSTTREATMENT 1 week	2 weeks	4 weeks	6 weeks	8 weeks
5/10/78	Dalapon [3]	DOW	16.8	18	28	28	28	28
			22.4	20	30	31	30	29
			33.6	25	30	32	32	32
	Diuron [3]	duPont	22.4	12	13	17	16	14
			44.8	12	12	13	16	16
			67.2	10	17	17	25	25
	Hexazinone [3]	duPont	2.2	5	7	7	10	15
			4.5	6	7	7	10	12
			6.7	6	6	8	11	12
	Glyphosate [3]	Monsanto	1.1	6	6	7	6	4
			2.2	9	16	18	19	15
			4.5	13	53	56	54	43
			6.7	17	60	65	72	70

(Continued)

TABLE NO. 1 (cont'd)
1978 GREENHOUSE EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD TORPEDOGRASS

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha [1]	PERCENT CONTROL - WEEKS POSTTREATMENT 10 weeks	12 weeks	14 weeks	16 weeks
5/10/78	Dalapon [3]	DOW	16.8	25	25	28	20
			22.4	28	27	27	23
			33.6	32	33	35	28
	Diuron [3]	duPont	22.4	13	23	35	45
			44.8	16	40	52	58
			67.2	25	42	70	77
	Hexazinone [3]	duPont	2.2	14	23	33	50
			4.5	13	33	28	58
			6.7	13	36	52	77
	Glyphosate [3]	Monsanto	1.1	4	4	5	6
			2.2	7	6	6	8
			4.5	38	33	22	17
			6.7	64	58	47	36

(Continued)

TABLE NO. 1 (cont'd)
1978 GREENHOUSE EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY
TOWARD TORPEDOGRASS

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha [1/]	PERCENT CONTROL - WEEKS POSTTREATMENT 1 week	2 weeks	4 weeks	6 weeks	8 weeks
5/10/78	Glyphosate [3/] + SA 77(1/ha)	Monsanto JLB Int. Chem.	1.1 + 9.4	6	6	9	10	3
			2.2 + 9.4	6	6	7	9	3
			4.5 + 9.4	15	45	48	52	45
			6.7 + 9.4	22	60	63	75	90
	Dalapon [3/]	DOW	6.7	6	6	8	12	12
			13.4	6	10	13	15	18
	Dalapon [3/] + SA 77(1/ha)	DOW JLB Int. Chem.	6.7 + 2.3	7	6	6	13	12
			13.4 + 2.3	9	10	10	18	18
			22.4 + 2.3	20	30	32	38	38

(Continued)

TABLE NO. 1 (cont'd)
1978 GREENHOUSE EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD TORPEDOGRASS

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha [1/]	PERCENT CONTROL - WEEKS POSTTREATMENT 10 weeks	12 weeks	14 weeks	16 weeks
5/10/78	Glyphosate [3/] + SA 77(1/ha)	Monsanto JLB Int. Chem.	1.1 + 9.4	3	3	6	5
			2.2 + 9.4	3	3	4	5
			4.5 + 9.4	43	30	23	18
			6.7 + 9.4	95	94	93	92
	Dalapon [3/]	DOW	6.7	8	17	17	19
			13.4	15	22	25	22
	Dalapon [3/] + SA 77(1/ha)	DOW JLB Int. Chem.	6.7 + 2.3	8	17	17	17
			13.4 + 2.3	12	17	19	19
			22.4 + 2.3	38	37	36	28

(Continued)

TABLE NO. 1 (cont'd)
1978 GREENHOUSE EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY
TOWARD TORPEDOGRASS

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha 1/	PERCENT CONTROL - WEEKS POSTTREATMENT 1 week	2 weeks	4 weeks	6 weeks	8 weeks
5/10/78	Control 3/			5	5	5	6	32
	Control 3/+ SA 77	JLB Int. Chem.	9.4	5	5	5	6	18
	Control 3/+ SA 77	JLB Int. Chem.	2.3	5	5	5	6	13

(Continued)

TABLE NO. 1 (concluded)
1978 GREENHOUSE EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD TORPEDOGRASS

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha [1]	PERCENT CONTROL - WEEKS POSTTREATMENT 10 weeks	12 weeks	14 weeks	16 weeks
5/10/78	Control [3]			20	20	23	20
	Control [3] + SA 77	JLB Int. Chem.	9.4	7	9	12	15
	Control [3] + SA 77	JLB Chem.		14	13	15	17

1/ SA 77 expressed in ℓ/ha.

2/ Cuttings rooted in water.

3/ Rhizome sections established in soil.

TABLE NO. 2
FIELD EVALUATIONS OF VARIOUS HERBICIDES FOR PHOTOTOXICITY
TOWARD TORPEDOGRASS

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha	PERCENT CONTROL - WEEKS POSTTREATMENT 2 wk	4 wk	2 mo	3 mo	4 mo	5 mo	6 mo	7 mo
6/22/77	Glyphosate	Monsanto	2.0	4	28	70	50	58	47	45	52
			4.0	17	53	67	57	63	50	43	57
			6.0	37	85	91	80	77	68	62	64
	RH 2915	Rohm & Haas	2.0	11	14	1	0	0			
			4.0	18	22	3	2	8			
			6.0	48	43	13	10	32			
	Metribuzin	Chemagro	2.0	1	2	0	0	8			
			4.0	1	5	3	3	10			
			6.0	5	8	1	0	0			
	Control			0	0	0	0	0	0	0	2

TABLE NO. 3
1978 GREENHOUSE EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD WATERHYACINTH

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha	PERCENT CONTROL - WEEKS POSTTREATMENT 1 week	2 weeks	4 weeks	6 weeks
3/29/78	Fenac liquid (sugarcane) (A 70316)	Amchem	1.0	10	37	95	100
			2.0	11	50	97	100
			4.0	14	57	99	100
			6.0	17	70	100	100
	Fenac plus (sugarcane) (A 08563)		1.0	4	35	95	100
			2.0	12	40	98	100
			4.0	15	75	100	100
			6.0	17	77	99	100
	Fenac Potassium/Sodium (77A-599)		1.0	10	21	96	100
			2.0	10	45	97	100
			4.0	9	48	99	100
			6.0	10	47	98	100

(Continued)

TABLE NO. 3 (cont'd)
1978 GREENHOUSE EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD WATERHYACINTH

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha	PERCENT CONTROL - WEEKS POSTTREATMENT 1 week	2 weeks	4 weeks	6 weeks
3/29/78	Fenac Potassium salt liquid (AL 3589)	Amchem	1.0	9	35	97	100
			2.0	11	45	99	100
			4.0	10	50	99	100
			6.0	11	52	100	100
	Control			0	0	2	5
3/30/78	Fenac + Dicamba (AL 3591) (66-67)		1.0 + 0.33	11	47	98	100
			2.0 + 0.66	15	52	99	100
			4.0 + 1.32	15	53	99	100
			6.0 + 1.98	19	68	100	100

(Continued)

TABLE NO. 3 (concluded)
1978 GREENHOUSE EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD WATERHYACINTH

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha	PERCENT CONTROL - WEEKS POSTTREATMENT 1 week	2 weeks	4 weeks	6 weeks
3/30/78	Fenac Dry sodium salt	Amchem	1.0	11	35	97	100
			2.0	11	37	97	100
			4.0	10	50	99	100
			6.0	15	70	100	100
	Control			0	0	1	5
4/14/78	Confidential	KALO	0.5	9	11	20	27
			1.0	22	43	70	75
			2.0	40	55	90	93
			4.0	52	77	99	100
	Control			0	0	3	4
Ref.	2,4-D		1.0	30	94	100	
			2.0	40	99	100	
			4.0	55	99	100	

TABLE NO. 4
1978 OUTSIDE AQUARIA EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD WATERHYACINTH

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha	PERCENT CONTROL - WEEKS POSTTREATMENT 1	2	4	6	8	10	12	14	16
4/3/78	EL-171	Elanco	2.0	1	2	3	4	9	9	9	7	4
			4.0	2	3	5	5	12	12	11	11	6
			6.0	2	3	5	7	13	13	11	11	7
	2,4-D	Amchem	2.0	22	80	90	98	98	98	99	98	89
			4.0	57	95	97	99	99	100	100	100	100
	EL-509	Elanco	2.2	3	3	5	15	15	15	15	15	15
	Control			1	2	2	3	4	4	3	3	3
6/15/78	Hexazinone	Du Pont	1.0	5	8	72	99					
			2.0	5	11	92	100					
			3.0	5	15	97	100					
			4.0	5	17	96	100					
	Control			1	1	2	3					

TABLE NO. 5

LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY
TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT											
				2			4			6			8		
				H	N	CR	H	N	CR	H	N	CR	H	N	CR
11/16/77	Fenac granule (prill)	Amchem	0.5	1	-	-	2	-	-	35	-	-	57	-	-
			1.0	3	-	-	5	-	-	40	-	-	62	-	-
			2.0	3	-	-	30	-	-	67	-	-	82	-	-
	Fenac liquid		0.5	2	-	-	5	-	-	40	-	-	74	-	-
			1.0	3	-	-	18	-	-	75	-	-	85	-	-
			2.0	4	-	-	40	-	-	80	-	-	93	-	-
	Control			0	-	-	0	-	-	0	-	-	0	-	-

continued from above			10			12		
		0.5	58	-	-	60	-	-
		1.0	62	-	-	68	-	-
		2.0	83	-	-	86	-	-
		0.5	74	-	-	77	-	-
		1.0	85	-	-	87	-	-
		2.0	95	-	-	98	-	-
			0	-	-	0	-	-

TABLE NO. 6
LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD HYDRILLA

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 2	4	6	8	10	12
11/16/77	Diquat	Chevron	0.01	0	0	0	0	0	0
			0.05	6	51	81	81	80	81
			0.10	12	75	96	98	100	100
			0.20	53	97	100	100	100	100
	Iron sulfate (fe)		0.1	0	0	0	0	0	0
			0.2	0	0	0	0	0	0
			0.4	0	0	0	0	0	0
			0.8	0	0	0	0	0	0
	Copper TEA (Cu)	Sandoz	0.1	0	0	0	0	0	0
			0.2	0	0	0	0	0	0
			0.4	2	10	32	35	23	23
			0.8	6	20	48	58	68	67

(Continued)

TABLE NO. 6 (cont'd)
LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR
PHYTOTOXICITY TOWARD HYDRILLA

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 2	4	6	8	10	12
11/16/77	Diquat + fe	Chevron	0.01 + 0.1	0	0	0	0	0	0
			0.01 + 0.2	0	0	0	0	0	0
			0.01 + 0.4	0	1	1	1	1	1
			0.05 + 0.1	8	47	65	87	91	92
			0.05 + 0.2	8	55	72	87	91	92
			0.05 + 0.4	10	60	75	89	93	93
			0.10 + 0.1	28	85	96	99	99	99
			0.10 + 0.2	27	86	97	100	100	100
			0.10 + 0.4	35	91	97	100	100	100
			0.2 + 0.1	50	95	99	100	100	100
			0.2 + 0.2	50	95	98	100	100	100
			0.2 + 0.4	50	97	97	100	100	100

(Continued)

TABLE NO. 6 (concluded)
LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR
PHYTOTOXICITY TOWARD HYDRILLA

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 2	4	6	8	10	12
11/22/77	Diquat + Cu	Chevron	0.01 + 0.1	0	0	0	0	0	0
			0.01 + 0.2	0	0	0	0	0	0
			0.01 + 0.4	2	6	8	27	13	13
			0.05 + 0.1	11	62	83	97	97	98
			0.05 + 0.2	8	55	76	95	95	95
			0.05 + 0.4	14	62	85	95	94	92
			0.10 + 0.1	30	87	95	99	100	100
			0.10 + 0.2	25	89	98	100	100	99
			0.10 + 0.4	20	85	96	96	97	98
			0.2 + 0.1	52	97	100	100	100	100
			0.2 + 0.2	42	96	99	100	99	99
			0.2 + 0.4	48	87	100	100	100	100
	Control			0	0	0	0	0	0

TABLE NO. 7

1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA(CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT											
				2			4			6			8		
				H	N	CR	H	N	CR	H	N	CR	H	N	CR
3/20/78	Diquat	Chevron	0.02	42	100	0	57	100	0	57	100	0	67	100	1
			0.04	100	100	0	100	100	0	100	100	0	100	100	0
	Diquat + Iron sulfate		0.02 + 0.4	73	100	0	75	100	0	82	100	0	82	100	0
			0.04 + 0.4	100	100	0	100	100	0	100	100	0	100	100	0
	Diquat + Copper TEA [1]		0.02 + 0.4	20	98	22	35	99	33	27	100	37	17	100	38
			0.04 + 0.4	70	99	30	79	100	25	88	100	23	92	100	60
	Control			0	0	0	0	0	0	0	0	0	0	0	0

(Continued)

TABLE NO. 7 (concluded)
1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY
TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT								
				10			12			13		
				H	N	CR	H	N	CR	H	N	CR
3/20/78	Diquat	Chevron	0.02	68	100	3	68	100	6	69	100	7
			0.04	100	100	2	100	100	5	100	100	6
	Diquat + Iron Sulfate		0.02 + 0.4	83	100	4	82	100	5	81	100	8
			0.04 + 0.04	100	100	3	100	100	6	100	100	9
	Diquat + Copper TEA [1/]		0.02 + 0.4	20	100	43	15	100	43	13	100	42
			0.04 + 0.4	97	100	83	98	100	89	99	100	96
	Control			1	1	1	2	1	1	24	8	4

1/ As K-lox.

TABLE NO. 8

LABORATORY EVALUATIONS OF VARIOUS HERBICIDES WITH AND WITHOUT THE ADDITIVE SA-77 TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT											
				2			4			6			8		
				H	N	CR	H	N	CR	H	N	CR	H	N	CR
4/11/78	Diquat	Chevron	0.01	0	15	0	0	78	0	0	83	0	0	84	0
			0.02	3	82	0	34	97	0	36	100	0	38	100	0
			0.05	85	97	0	95	99	0	100	99	0	100	100	0
	Diquat + SA-77 (15 ppmv)	Chevron JBL Int. Chem. Inc.	0.01	99	99	58	100	100	93	100	100	95	100	100	100
			0.02	100	100	82	100	100	98	100	100	98	100	100	98
			0.05	100	100	82	100	100	98	100	100	99	100	100	100
	Diquat + Copper TEA [1]	Chevron Sandoz	0.01 + 0.1	1	80	1	1	93	0	1	99	0	2	100	0
			0.01 + 0.2	1	88	70	1	95	65	3	97	66	7	100	66
			0.01 + 0.4	0	93	78	2	98	83	4	100	86	11	100	87
			0.02 + 0.1	0	96	1	1	98	0	2	100	0	2	100	0
			0.02 + 0.2	0	96	8	0	98	8	0	100	12	0	100	13

(Continued)

TABLE NO. 8 (cont'd)
LABORATORY EVALUATIONS OF VARIOUS HERBICIDES WITH AND WITHOUT THE ADDITIVE SA-77
TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT								
				10			12			14		
				H	N	CR	H	N	CR	H	N	CR
4/11/78	Diquat	Chevron	0.01	0	86	0	0	91	1	0	91	2
			0.02	50	100	0	57	100	0	59	100	1
			0.05	100	100	0	100	100	0	100	100	1
	Diquat + SA-77 (15 ppmv)	Chevron JBL Int. Chem. Inc.	0.01	100	100	100	100	100	100	100	100	100
			0.02	100	100	100	100	100	100	100	100	100
			0.05	100	100	100	100	100	100	100	100	100
	Diquat + Copper TEA [1]	Chevron Sandoz	0.01 + 0.1	2	100	0	2	100	1	2	100	1
			0.01 + 0.2	5	100	63	5	100	63	4	100	61
			0.01 + 0.4	11	100	85	10	100	84	9	100	84
			0.02 + 0.1	2	100	0	3	100	1	2	100	1
			0.02 + 0.2	0	100	17	1	100	17	1	100	13

(Continued)

TABLE NO. 8 (cont'd)
LABORATORY EVALUATIONS OF VARIOUS HERBICIDES WITH AND WITHOUT THE ADDITIVE SA-77
TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT											
				2			4			6			8		
				H	N	CR	H	N	CR	H	N	CR	H	N	CR
4/11/78	Diquat + Copper TEA [17]	Chevron	0.02 + 0.4	1	96	43	3	97	48	5	98	50	10	100	55
		Sandoz	0.05 + 0.1	68	99	5	32	99	4	100	100	9	100	100	16
			0.05 + 0.2	10	95	9	95	99	9	99	100	20	98	100	24
			0.05 + 0.4	38	96	18	87	99	20	96	100	40	98	100	76
	Diquat + Copper TEA [17] + SA-77 (15 ppmv)	Chevron	0.01 + 0.1	100	98	85	100	100	100	100	100	100	100	100	100
		Sandoz JBL Int. Chem.	0.01 + 0.2	95	94	78	90	99	80	88	100	73	77	100	70
			0.01 + 0.4	100	91	85	100	100	100	100	100	100	100	100	100
			0.02 + 0.1	97	94	80	97	100	85	97	100	78	90	100	77
			0.02 + 0.2	100	92	90	100	100	100	100	100	100	100	100	100
			0.02 + 0.4	95	98	82	87	100	77	87	100	67	87	100	63

(Continued)

TABLE NO. 8 (cont'd)
LABORATORY EVALUATIONS OF VARIOUS HERBICIDES WITH AND WITHOUT THE ADDITIVE SA-77
TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT								
				10			12			14		
				H	N	CR	H	N	CR	H	N	CR
4/11/78	Diquat + Copper TEA [1/]	Chevron Sandoz	0.02 + 0.1	11	100	54	11	100	52	10	100	50
			0.05 + 0.1	100	100	16	100	100	16	100	100	16
			0.05 + 0.2	96	100	23	95	100	20	91	100	18
			0.05 + 0.4	98	100	51	98	100	47	96	100	45
	Diquat + Copper TEA [1/] + SA-77 (15 ppmv)	Chevron Sandoz JBL Int. Chem.	0.01 + 0.1	100	100	100	100	100	100	100	100	100
			0.01 + 0.2	77	100	65	73	100	60	72	100	60
			0.01 + 0.4	100	100	100	100	100	100	100	100	100
			0.02 + 0.1	89	100	75	89	100	64	89	100	62
			0.02 + 0.2	100	100	100	100	100	100	100	100	100
			0.02 + 0.4	87	100	63	87	100	58	83	100	55

(Continued)

TABLE NO. 8 (cont'd)
LABORATORY EVALUATIONS OF VARIOUS HERBICIDES WITH AND WITHOUT THE ADDITIVE SA-77
TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT											
				2			4			6			8		
				H	N	CR	H	N	CR	H	N	CR	H	N	CR
4/11/78	Diquat + Copper TEA [1/]	Chevron	0.05 + 0.1	100	97	87	100	99	89	100	100	88	100	100	88
	SA-77 (15 ppmv)	Sandoz JBL Int. Chem.	0.05 + 0.2	100	66	85	100	100	90	100	100	70	100	100	67
			0.05 + 0.4	100	97	63	100	100	96	100	100	90	100	100	90
	Diquat + Iron Sulfate	Chevron	0.01 + 0.1	0	90	0	0	98	0	0	99	0	2	100	0
			0.01 + 0.2	0	14	0	0	5	0	0	14	0	0	80	0
			0.01 + 0.4	1	67	0	1	64	0	3	91	0	2	98	0
			0.02 + 0.1	0	75	0	2	79	0	29	86	0	35	100	0
			0.02 + 0.2	1	96	0	1	99	0	35	100	0	47	100	0
			0.02 + 0.4	1	88	0	5	95	0	33	99	0	33	100	0

(Continued)

TABLE NO. 8 (cont'd)

LABORATORY EVALUATIONS OF VARIOUS HERBICIDES WITH AND WITHOUT THE ADDITIVE SA-77 TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT								
				10			12			14		
				H	N	CR	H	N	CR	H	N	CR
4/11/78	Diquat + Copper TEA + SA-77 (15 ppmv)	Chevron Sandoz JBL Int. Chem.	0.05 + 0.1	100	100	88	100	100	68	100	100	68
			0.05 + 0.2	100	100	63	100	100	45	100	100	42
			0.05 + 0.4	100	100	88	100	100	73	100	100	22
	Diquat + Iron Sulfate	Chevron	0.01 + 0.1	2	100	0	6	100	0	7	100	1
			0.01 + 0.2	0	92	2	0	96	2	1	99	3
			0.01 + 0.4	1	99	0	2	100	1	2	100	1
			0.02 + 0.1	36	100	0	37	100	0	38	100	2
			0.02 + 0.2	41	100	1	50	100	1	57	100	2
			0.02 + 0.4	33	100	1	34	100	1	35	100	4

(Continued)

TABLE NO. 8 (cont'd)
LABORATORY EVALUATIONS OF VARIOUS HERBICIDES WITH AND WITHOUT THE ADDITIVE SA-77
TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 2			4			6			8		
				H	N	CR	H	N	CR	H	N	CR	H	N	CR
4/11/78	Diquat + Iron Sulfate	Chevron	0.05 + 0.1	90	96	0	98	99	0	100	99	0	100	100	0
			0.05 + 0.2	88	89	0	96	99	0	99	99	0	100	100	0
			0.05 + 0.4	84	97	0	98	99	0	98	100	0	99	100	0
	Potassium Endothall	Pennwalt	0.1	0	1	0	2	4	0	2	5	0	2	26	0
			0.25	0	3	0	2	3	0	2	12	0	2	25	0
			0.5	0	2	0	2	3	0	5	3	0	21	12	0
			1.0	6	5	0	15	5	0	33	6	0	89	20	0
	Potassium Endothall + SA-77 (15 ppmv)	Pennwalt JBL Int. Chem.	0.1	100	92	87	100	100	98	100	100	98	100	100	92
			0.25	100	100	55	100	100	90	100	100	97	100	100	92
			0.5	100	95	62	100	100	93	100	100	97	100	100	94
			1.0	100	96	67	100	100	75	100	100	88	100	100	87

(Continued)

TABLE NO. 8 (cont'd)
LABORATORY EVALUATIONS OF VARIOUS HERBICIDES WITH AND WITHOUT THE ADDITIVE SA-77
TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT								
				10			12			14		
				H	N	CR	H	N	CR	H	N	CR
4/11/78	Diquat + Iron Sulfate	Chevron	0.05 + 0.1	100	100	0	100	100	2	100	100	6
			0.05 + 0.2	100	100	1	100	100	1	100	100	2
			0.05 + 0.4	99	100	1	99	100	1	99	100	3
	Potassium Endothall	Pennwalt	0.1	2	39	0	2	66	0	2	61	1
			0.25	2	66	1	2	67	1	2	68	2
			0.5	30	10	0	30	15	0	32	33	2
			1.0	95	18	0	96	24	1	97	31	2
	Potassium Endothall + SA-77 (15 ppmv)	Pennwalt JBL. Int. Chem.	0.1	100	100	88	100	100	83	100	100	73
			0.25	100	100	92	100	100	86	100	100	65
			0.5	100	100	93	100	100	93	100	100	90
			1.0	100	100	75	100	100	75	100	100	70

(Continued)

TABLE NO. 8 (cont'd)

LABORATORY EVALUATIONS OF VARIOUS HERBICIDES WITH AND WITHOUT THE ADDITIVE SA-77
TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT											
				2			4			6			8		
				H	N	CR	H	N	CR	H	N	CR	H	N	CR
4/11/78	Control + SA-77 (15 ppmv)	JBL Int. Chem.	0.0	100	96	68	100	100	79	100	100	88	100	100	87
	Control		0.0	0	0	0	0	0	0	0	0	0	0	0	0

(Continued)

TABLE NO. 8 (concluded)
LABORATORY EVALUATIONS OF VARIOUS HERBICIDES WITH AND WITHOUT THE ADDITIVE SA-77
TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT								
				10			12			14		
				H	N	CR	H	N	CR	H	N	CR
4/11/78	Control + SA-77 (15 ppmv)	JBL Int. Chem	0.0	100	100	89	100	100	85	100	100	78
	Control		0.0	0	2	0	0	18	0	3	36	2

1/ Copper-triethanolamine as K-lox.

TABLE NO. 9
1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY
TOWARD COMBINED HYDRILLA (H) NAIAD (N)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 2		4		6		8	
				H	N	H	N	H	N	H	N
2/15/78	Fenac Ferric salt Gr. NB 1094-60	Amchem	0.25	0	0	1	0	0	0	0	2
			0.5	0	0	1	0	2	0	2	2
			1.0	0	0	2	0	4	1	4	5
			2.0	0	0	7	0	33	2	57	20
	Control			0	0	0	0	0	0	0	0
2/24/78	Fenac Cu salt 77A 590 NB 1081-99	Amchem	0.25	0	0	0	0	0	4	1	13
			0.5	0	0	0	0	1	5	1	7
			1.0	0	0	5	0	18	2	20	3
			2.0	0	0	5	0	26	7	35	7
	Control			0	0	0	0	0	0	0	0

(Continued)

TABLE NO. 9 (cont'd)
1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY
TOWARD COMBINED HYDRILLA (H) NAIAD (N)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 10		12		14	
				H	N	H	N	H	N
2/15/78	Fenac Ferric salt Gr. NB 1094-60	Amchem	0.25	0	2	0	2	0	33
			0.5	2	2	2	3	4	12
			1.0	4	8	4	36	5	67
			2.0	62	22	63	45	68	88
	Control			0	0	1	0	2	7
2/24/78	Fenac Cu salt 77A 590 NB 1081-99	Amchem	0.25	1	11	3	11	3	11
			0.5	2	9	3	3	4	19
			1.0	13	7	15	13	28	28
			2.0	37	10	37	13	39	55
	Control			0	0	0	0	0	1

(Continued)

TABLE NO. 9 (cont'd)
1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY
TOWARD COMBINED HYDRILLA (H) NAIAD(N)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 2		4		6		8	
				H	N	H	N	H	N	H	N
3/13/78	Fenac Dry Sodium salt	Amchem	0.25	0	0	2	1	3	2	3	2
			0.5	1	0	2	7	4	35	4	63
			1.0	2	1	6	18	10	45	10	48
	Fenac + Dicamba AL 3591 Amchem 66-67	Amchem	0.25 + 0.08	1	0	3	2	3	2	5	2
			0.5 + 0.16	2	0	12	3	15	5	18	8
			1.0 + 0.33	2	0	13	8	18	10	25	12
			2.0 + 0.66	3	2	18	5	23	10	23	38
Control				0	0	0	0	0	0	0	0

(Continued)

TABLE NO. 9 (cont'd)
1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY
TOWARD COMBINED HYDRILLA (H) NAIAD (N)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT					
				10		12		14	
				H	N	H	N	H	N
3/13/78	Fenac Dry Sodium salt	Amchem	0.25	4	3	4	19	3	45
			0.5	4	79	5	80	10	97
			1.0	10	66	11	72	15	82
			2.0	19	52	22	67	35	72
	Fenac + Dicamba AL 3591 Amchem 66-67		0.25 + 0.08	5	20	5	50	10	70
			0.5 + 0.16	22	43	25	38	25	43
			1.0 + 0.33	32	62	38	73	38	80
			2.0 + 0.66	47	67	60	72	60	93
	Control			0	0	0	0	3	1

(Continued)

TABLE NO. 9 (cont'd)
1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY
TOWARD COMBINED HYDRILLA (H) NAIAD (N)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 2		4		6		8	
				H	N	H	N	H	N	H	N
2/3/78	Fenac plus (A 08563)	Amchem	0.25	0	0	0	4	1	17	3	47
			0.5	0	0	1	2	1	5	4	43
			1.0	1	0	3	22	5	69	16	72
			2.0	4	4	9	71	17	72	50	99
	Fenac Liquid (A 70316)	Amchem	0.25	1	3	4	65	4	22	4	38
			0.5	0	2	3	36	3	37	3	43
			1.0	1	4	5	68	6	68	10	80
			2.0	2	1	7	20	11	31	21	40
	Control			0	2	0	2	0	2	0	1

(Continued)

TABLE NO. 9 (cont'd)

1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD COMBINED HYDRILLA (H) NAIAD (N)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 10		12		14	
				H	N	H	N	H	N
2/3/78	Fenac plus (A 08563)	Amchem	0.25	5	48	7	48	9	50
			0.5	6	62	6	63	7	68
			1.0	21	95	22	99	27	99
			2.0	67	100	67	100	70	100
	Fenac Liquid (A 70316)	Amchem	0.25	5	52	5	55	6	65
			0.5	9	50	9	50	10	65
			1.0	13	90	13	90	15	90
			2.0	37	50	40	50	43	88
	Control			0	0	0	0	0	1

(Continued)

TABLE NO. 9 (cont'd)

1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD COMBINED HYDRILLA (H) NAIAD (N)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 2		4		6		8	
				H	N	H	N	H	N	H	N
2/8/78	Fenac granule (77-A 591)	Amchem	0.25	0	0	1	0	1	0	9	2
			0.5	0	0	2	0	4	0	19	1
			1.0	0	0	2	0	4	1	32	35
			2.0	1	0	75	0	98	3	99	50
	Fenac granule (77-A 604)	Amchem	0.25	0	0	1	1	1	1	8	23
			0.5	0	0	9	0	38	1	58	7
			1.0	0	0	53	0	58	2	65	14
			2.0	0	0	7	0	40	19	51	35
	Control			0	0	0	0	0	0	0	0

(Continued)

TABLE NO. 9 (cont'd)

1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD COMBINED HYDRILLA (H) NAIAD (N)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 10 H	10 N	12 H	12 N	14 H	14 N
2/8/78	Fenac granule (77-A 591)	Amchem	0.25	9	5	12	10	12	50
			0.5	22	11	24	17	25	23
			1.0	34	43	45	45	47	67
			2.0	99	62	99	77	100	89
	Fenac granule (77-A 604)	Amchem	0.25	8	30	8	38	9	45
			0.5	60	38	60	41	60	55
			1.0	71	30	72	37	78	40
			2.0	62	40	63	45	68	58
	Control			0	0	1	0	1	0

(Continued)

TABLE NO. 9 (cont'd)

1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD COMBINED HYDRILLA (H) NAIAD (N)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 2		4		6		8	
				H	N	H	N	H	N	H	N
2/10/78	Fenac (77-A 599)	Amchem	0.25	0	0	6	0	15	2	27	17
			0.5	0	0	23	2	63	2	73	31
			1.0	0	0	42	1	78	7	81	30
			2.0	0	1	67	3	90	12	95	18
	Fenac liquid Potassium salt (AL 3589)	Amchem	0.25	0	0	3	1	7	0	7	10
			0.5	0	0	4	0	17	0	34	7
			1.0	0	0	60	17	90	25	93	41
			2.0	2	0	99	17	99	34	99	48
	Control			0	0	0	0	0	0	1	0

(Continued)

TABLE NO. 9 (cont'd)
1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY
TOWARD COMBINED HYDRILLA (H) NAIAD (N)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 10		12		14	
				H	N	H	N	H	N
2/10/78	Fenac (77-A 599)	Amchem	0.25	30	22	36	45	40	52
			0.5	90	48	91	66	97	96
			1.0	91	47	91	55	95	83
			2.0	95	90	98	95	98	96
	Fenac liquid Potassium Salt (AL 3589)	Amchem	0.25	33	11	31	11	38	38
			0.5	37	15	42	5	47	40
			1.0	96	47	96	96	98	100
			2.0	99	63	99	84	99	92
	Control			0	0	0	1	0	0

(Continued)

TABLE NO. 9 (cont'd)

1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD COMBINED HYDRILLA (H) NAIAD (N)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 2		4		6		8	
				H	N	H	N	H	N	H	N
2/10/78	Fenac Potassium/ Sodium 77-A 599 (AL 3588)	Amchem	0.25	0	0	6	0	15	2	27	17
			0.5	0	0	23	2	63	2	73	31
			1.0	0	0	42	1	78	7	81	30
			2.0	0	1	67	3	90	18	95	18
	Fenac liquid Potassium salt (AL 3589)		0.25	0	0	3	1	7	0	7	10
			0.5	0	0	4	0	17	0	34	7
			1.0	0	0	60	17	90	25	93	41
			2.0	2	0	99	17	99	34	99	48
	Control			0	0	0	0	0	0	1	0

(Continued)

TABLE NO. 9 (concluded)
1978 LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY
TOWARD COMBINED HYDRILLA (H) NAIAD (N)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 10 H	10 N	12 H	12 N	14 H	14 N
2/10/78	Fenac Potassium/ Sodium 77-A 599 (AL 3588)	Amchem	0.25	30	22	36	45	40	52
			0.5	90	48	91	66	97	96
			1.0	91	47	91	55	95	83
			2.0	95	90	98	95	98	96
	Fenac liquid Potassium salt (AL 3589)		0.25	33	11	33	11	38	38
			0.5	37	15	42	5	47	40
			1.0	96	47	96	96	98	100
			2.0	99	63	99	84	99	92
	Control			0	0	0	1	0	0

TABLE NO. 10
1978 LABORATORY EVALUATIONS OF THE KALO COMPOUND FOR PHYTOTOXICITY
TOWARD COMBINED HYDRILLA (H) NAIAD(N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT											
				2			4			6			8		
				H	N	CR	H	N	CR	H	N	CR	H	N	CR
4/13/78	Confidential	KALO	0.25	0	1	0	0	2	0	0	4	0	0	4	1
			0.5	0	1	0	0	1	0	0	3	0	0	3	0
			1.0	0	1	0	0	3	0	1	4	0	1	8	0
			2.0	1	1	0	2	1	0	5	4	1	5	7	0
			4.0	0	1	0	0	1	0	12	5	0	15	9	1
	Control			0	1	0	1	1	0	0	1	0	0	2	0

(Continued)

TABLE NO. 10 (concluded)
1978 LABORATORY EVALUATIONS OF THE KALO COMPOUND FOR PHYTOTOXICITY
TOWARD COMBINED HYDRILLA (H) NAIAD (N) CHARA (CR)

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT											
				10			12			14			16		
				H	N	CR	H	N	CR	H	N	CR	H	N	CR
4/13/78	Confidential	KALO	0.25	0	6	1	0	17	1	0	25	1	3	26	2
			0.5	1	4	0	1	18	0	1	18	1	2	20	1
			1.0	1	13	1	1	49	1	1	56	3	2	43	3
			2.0	7	10	1	15	10	1	16	12	4	27	22	4
			4.0	17	7	1	21	9	1	27	46	3	38	55	7
	Control			1	7	1	1	22	1	5	28	3	6	28	3

TABLE NO. 11
LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD HYDRILLA TUBERS[1/]

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - TIME POSTTREATMENT											
				2 day		5 day		1 wk		2 wks		3 wks		4 wks	
				G	E	G	E	G	E	G	E	G	E	G	E
12/5/77	Terbutryn (in pots)	Ciba-Geigy	0.1	0	0	1	0	7	0	12	0	12	23	12	70
			0.2	0	0	2	0	10	0	12	2	12	25	12	77
			0.4	0	0	2	0	10	0	13	3	13	26	13	78
			1.0	0	0	2	0	8	0	11	5	11	30	10	78
	Control			0	0	1	0	7	0	11	0	11	0	11	0

continued from above			5 wks		6 wks		7 wks		8 wks		9 wks	
			G	E	G	E	G	E	G	E	G	E
		0.1	11	73	10	70	10	70	7	73	7	75
		0.2	8	80	7	80	7	80	6	82	7	83
		0.4	9	78	7	78	7	78	7	81	7	81
		1.0	9	78	8	80	8	78	8	78	8	78
	Control		11	0	11	0	11	0	11	0	11	1

continued from above			10 wks		11 wks		12 wks	
			G	E	G	E	G	E
		0.1	6	77	5	73	5	73
		0.2	7	80	6	77	6	72
		0.4	7	80	6	77	6	70
		1.0	7	73	7	70	7	65
	Control		11	1	11	3	11	7

(Continued)

TABLE NO. 11 (concluded)
LABORATORY EVALUATIONS OF VARIOUS HERBICIDES FOR PHYTOTOXICITY TOWARD HYDRILLA TUBERS[1/]

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - TIME POSTTREATMENT											
				2 day		5 day		1 wk		2 wks		3 wks		4 wks	
				G	E	G	E	G	E	G	E	G	E	G	E
12/5/77	Terbutryn (no pots)	Ciba-Geigy	0.1	0	0	0	0	13	1	14	62	14	62	14	85
			0.2	0	0	0	0	12	1	12	88	12	88	7	95
			0.4	0	0	1	0	12	1	13	84	13	84	8	93
			1.0	0	0	0	0	12	1	14	92	14	92	10	93
	Control			0	0	1	0	11	0	13	0	13	0	13	0

continued from above			5 wks		6 wks		7 wks		8 wks		9 wks	
			G	E	G	E	G	E	G	E	G	E
		0.1	10	87	9	89	8	89	7	91	6	91
		0.2	5	95	5	95	5	95	5	95	4	96
		0.4	6	94	5	94	5	91	5	91	4	92
		1.0	8	91	8	91	7	92	6	92	6	92
	Control		13	1	13	1	13	1	13	1	13	2

continued from above			10 wks		11 wks		12 wks	
			G	E	G	E	G	E
		0.1	6	87	6	83	6	78
		0.2	5	96	4	91	5	87
		0.4	5	94	5	93	5	91
		1.0	7	90	7	63	7	61
	Control		13	2	13	2	13	3

1/ G = number germinated out of 15 total; E = evaluation (% injury).

TABLE NO. 12
OUTSIDE AQUARIA EVALUATIONS OF ASULAM FOR PHYTOTOXICITY TOWARD HYDRILLA

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT													
				2	4	6	8	10	12	14	16	18	20	22	24	26	28
9/12/77	Asulam	Rhodia	1.0	0	1	2	4	5	9	18	23	32	42	45	45	45	45
			2.0	0	2	5	11	16	27	35	47	62	75	78	78	78	80
			5.0	1	2	2	6	17	52	77	82	87	89	90	91	91	91
	Control			0	1	1	1	1	1	1	1	1	3	3	5	5	5

TABLE NO. 13
OUTSIDE AQUARIA EVALUATIONS OF EL-171 FOR
PHYTOTOXICITY TOWARD HYDRILLA

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 2	4	6	8	10	12	14	16
11/11/77	EL-171	Elanco	1.0	0	1	5	6	11	15	23	30
			2.0	0	2	7	7	14	17	22	26
	Control			0	0	1	2	2	2	6	9
continued from above				18	20	22	24	26	28	30	32
			1.0	38	58	63	72	72	72	72	73
			2.0	32	50	65	75	82	82	87	88
	Control			13	18	21	21	19	18	17	16

TABLE NO. 14
OUTSIDE AQUARIA EVALUATIONS OF EL-509 FOR
GROWTH INHIBITION TOWARD HYDRILLA

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT REGROWTH - WEEKS POSTTREATMENT 1/													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14
10/28/77	EL-509	Elanco	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Control			0	3	13	23	47	60	70	80	84	88	91	91	91	91
continued from above				15	16	17	18	19	20	21	22	23	24	25	26	27	28
			1.0	0	0	0	0	0	0	1	1	3	4	7	9	12	16
	Control			91	91	91	91	92	92	92	92	92	92	94	95	95	95
continued from above				29	30	31	32	33	34	35	36	37	38	39	40	41	42
			1.0	16	16	16	16	19	22	28	48	62	76	78	85	91	96
	Control			95	95	95	95	96	96	96	97	97	97	98	99	99	99
continued from above				43	44	45	46										
			1.0	96	97	97	99										
	Control			99	99	99	100										

1/ Aquaria retreated at 1.0 mg/l at 24 weeks.

TABLE NO. 15
RESPONSE OF HYDRILLA IN OUTSIDE AQUARIA TO VARIOUS CONCENTRATIONS OF FENAC AND COPPER, ALONE OR IN COMBINATION

mg/l TREATMENT RATE		AVERAGE PERCENT CONTROL (3 replicates) WEEKS POSTTREATMENT															Avg. BIOMASS (Grams dry wt./m^2)
Fenac + Cu[1/]		2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	30
0.5	0.5	5	10	16	30	30	32	33	33	30	24	20	17	16	14	11	192 bcd[2/]
0.5	1.0	5	19	23	27	30	31	32	31	29	29	23	20	12	10	9	322 d
0.5	2.0	8	56	60	63	64	64	64	64	63	61	50	41	34	33	33	230 bcd
1.0	1.0	6	23	30	30	34	38	40	40	39	40	29	28	16	10	9	283 cd
1.0	2.0	36	55	61	61	61	70	71	78	75	68	68	69	69	66	66	142 abc
2.0	1.0	32	78	82	83	83	85	85	87	87	90	91	86	77	71	69	89 ab
2.0	2.0	72	94	96	96	96	97	97	97	97	97	98	98	99	99	99	5 a
-	0.5	3	6	7	8	8	8	9	11	12	12	12	9	6	4	3	238 bcd
-	1.0	7	8	8	6	5	4	3	3	3	3	3	2	3	2	2	238 bcd
-	2.0	8	23	25	24	19	20	22	24	28	27	22	21	19	11	7	302 cd
1.0	-	1	1	2	2	3	3	4	6	6	11	10	10	7	6	5	334 d
2.0	-	3	3	4	4	5	8	9	10	14	21	22	23	24	24	24	308 cd
Control		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	665 e

1/ Copper from K-lox triethanolamine complex.

2/ Means followed by the same letter are not significantly different (P = 0.05) as determined by Duncan's multiple range test.

TABLE NO. 16
1978 LABORATORY BIOASSAY FOR PERSISTENCE OF COMBINATIONS OF FENAC AND COPPER ON HYDRILLA TUBERS [1/]

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	TIME POSTTREATMENT 2 day G	2 day E [2/]	5 day G	5 day E	1 wk G	1 wk E	2 wk G	2 wk E	3 wk G	3 wk E
2/21/78	Fenac + Copper TEA [3/]	Amchem.	0.5 + 0.5	0	0	7	0	7	0	7	15	8	77
	Copper TEA [3/]		0.5	0	0	5	0	6	0	7	0	7	0
			1.0	0	0	6	0	6	0	7	0	9	0
	Control			0	0	9	0	7	0	9	0	9	0

continued from above				4 wk G	4 wk E	5 wk G	5 wk E	6 wk G	6 wk E	7 wk G	7 wk E	8 wk G	8 wk E
			0.5 + 0.5	7	80	1	87	1	80	2	80	2	80
			0.5	6	0	5	0	5	0	6	0	6	0
			1.0	9	0	9	0	9	0	9	0	9	0
	Control			9	0	9	0	9	0	9	0	9	0

(Continued)

TABLE NO. 16 (Concluded)
1978 LABORATORY BIOASSAY FOR PERSISTENCE OF COMBINATIONS
OF FENAC AND COPPER ON HYDRILLA TUBERS[1]/

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	TIME POSTTREATMENT 9 wk G	9 wk E	10 wk G	10 wk E	11 wk G	11 wk E	12 wk G	12 wk E	13 wk G	13 wk E
2/21/78	Fenac + Copper TEA[3]/	Amchem	0.5 + 0.5	1	85	1	92	1	92	1	92	1	93
	Copper TEA[3]/		0.5	6	0	6	0	6	0	6	0	5	0
			1.0	9	0	9	0	9	0	9	0	9	0
	Control			9	0	9	0	9	0	9	0	9	0

continued from above				14 wk G	14 wk E	15 wk G	15 wk E	16 wk G	16 wk E	17 wk G	17 wk E
			0.5 + 0.5	1	93	0	100	0	100	0	100
			0.5	5	6	6	4	5	5	5	11
			1.0	9	3	9	3	9	3	9	6
				9	2	9	2	9	5	9	37

1/ Chemicals applied to hydrilla in outside aquaria on 11/30/77. 12-week posttreatment tubers were placed in water samples from the test aquaria to bioassay for persistence of the compounds.

2/ G = number germinated out of 10 total; E = Evaluation (% injury).

3/ Triethanolamine as K-lox.

TABLE NO. 17
OUTSIDE AQUARIA EVALUATIONS OF THE HERBICIDE HEXAZINONE
FOR PHYTOTOXICITY TOWARD HYDRILLA

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - TIME POSTTREATMENT 8 days	16 days	1 mo	2 mo	3 mo	4 mo	5 mo
8/8/77	Hexazinone	Du Pont	0.5	1	5	6	13	66	93	95
			1.0	2	6	26	27	95	99	99
	Control			0	0	0	0	0	0	0

continued from above			6 mo	7 mo	8 mo	9 mo	10 mo	11 mo
		0.5	99	100	100	100	100	100
		1.0	100	100	100	100	100	100
	Control		0	0	1	2	4	14

TABLE NO. 18
UPTAKE OF HEXAZINONE BY HYDRILLA AT
VARIOUS DAYS AFTER TREATMENT
IN OUTSIDE AQUARIA

TREATMENT RATE (mg/l)	DAYS 0	0.5	1	2	4	8	16
0.0	N.D. 1/	-	N.D.	-	N.D.	N.D.	0.37
0.5	N.D.	-	0.69 2/	-	0.84	0.83	0.87
1.0	N.D.	-	0.86	-	0.12	0.73	0.97

1/ None detected.

2/ mg/kg concentrations in tissue; values represent estimate from one of three replicates.

TABLE NO. 19
EFFECTS OF HEXAZINONE ON PROPAGULE
PRODUCTION AND GROWTH OF HYDRILLA VERTICILLATA IN
OUTSIDE AQUARIA 11 MONTHS POSTTREATMENT
(Average values per m^2 of 3 replicates)

TREATMENT RATE	GRAMS DRY WT. STANDING CROP	TOTAL TUBERS	PERCENT SPROUTED	TOTAL TURIONS	PERCENT SPROUTED
0.5 mg/l	0	8	92	0	0
1.0 mg/l	0	0	0	0	0
Control 1/	665	1068	12	51	23

1/ Represents 13 months growth from 6/10/77.

TABLE NO. 20
1978 OUTSIDE AQUARIA BIOASSAY FOR PERSISTENCE OF HEXAZINONE
WITH POTTED HYDRILLA CUTTINGS 1/

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTINTRODUCTION 1	2	3	4	5	6	7	8
4/20/78	Hexazinone	Du Pont	0.5	3	48	68	75	88	88	89	92
			1.0	2	42	85	99	100	100	100	100
	Control			0	0	0	0	0	0	0	2
continued from above				9	10	11					
			0.5	97	100	100					
			1.0	100	100	100					
	Control			9	13	17					

1/ Hexazinone applied to hydrilla 8/8/77. Eight months posttreatment potted hydrilla cuttings were placed in aquaria to test for persistence of hexazinone.

TABLE NO. 21
FIELD EVALUATIONS OF HEXAZINONE FOR
PHYTOTOXICITY TOWARD HYDRILLA

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE kg/ha	PERCENT CONTROL - TIME POSTTREATMENT 5 days	14 days	29 days	2 mo	3 mo	4 mo	5 mo	6 mo	9 mo	12 mo
6/16/77	Hexazinone	Du Pont	1.7	0	1	1	0	0	0	0	0	Q	0
			3.4	15	35	40	80	87	87	95	99	99	98
			6.7	0	40	50	99	99	60	50	25	0	0
	Control			0	0	0	0	0	0	0	0	0	0

TABLE NO. 22
FIELD EVALUATIONS OF HEXAZINONE FOR PHYTOTOXICITY
TOWARD HYDRILLA - ENVIRONMENTAL DATA

1.7 kg/ha

TIME INTERVAL	OBSERVATION DATE	ppm DISSOLVED OXYGEN TOP	MID	BTM	TEMPERATURE C TOP	MID	BTM	pH COMPOSITE
- 1 day	15 June 77	2.1	1.6	2.2	28.1	28.0	27.9	7.5
+ 5 days	21 June 77	0.4	0.26	0.06	28.0	28.0	27.9	7.3
+ 14 days	30 June 77	0.0	0.0	0.0	30.9	30.9	30.9	7.3
+ 29 days	15 July 77	0.0	0.0	0.0	30.0	29.5	29.0	7.3
+ 2 mo	17 Aug 77	1.3	1.2	1.2	30.8	30.8	30.6	7.3
+ 3 mo	16 Sept 77	1.9	1.8	1.9	31.0	31.0	30.9	7.4
+ 4 mo	17 Oct 77	2.6	2.5	2.6	29.4	29.3	29.3	7.3
+ 5 mo	15 Nov 77	3.9	3.9	3.9	26.3	26.2	26.1	7.4
+ 6 mo	20 Dec 77	4.6	4.6	4.5	17.0	17.0	17.0	7.4

(Continued)

TABLE NO. 22 (cont'd)
FIELD EVALUATIONS OF HEXAZINONE FOR PHYTOTOXICITY
TOWARD HYDRILLA - ENVIRONMENTAL DATA

3.4 kg/ha

TIME INTERVAL	OBSERVATION DATE	ppm DISSOLVED OXYGEN TOP	MID	BTM	TEMPERATURE C TOP	MID	BTM	pH COMPOSITE
- 1 day	15 June 77	3.2	2.9	4.3	37.0	28.5	26.6	9.4
+ 5 days	21 June 77	0.0	0.0	0.0	30.5	27.2	26.6	7.2
+ 14 days	30 June 77	0.0	0.0	0.0	33.2	28.0	27.0	7.3
+ 29 days	15 July 77	0.2	0.0	0.0	34.5	30.0	27.0	7.3
+ 2 mo	17 Aug 77	1.9	1.7	1.7	31.2	31.0	31.0	7.3
+ 3 mo	16 Sept 77	3.0	2.9	2.9	31.0	29.8	29.7	7.3
+ 4 mo	17 Oct 77	5.7	5.5	5.5	29.7	29.6	29.5	7.3
+ 5 mo	15 Nov 77	6.3	6.2	6.2	26.4	26.3	26.4	7.6
+ 6 mo	20 Dec 77	6.3	6.3	6.3	15.2	15.2	15.2	7.9
+ 9 mo	15 Mar 78	7.9	8.1	8.2	25.0	25.0	25.0	8.1
+ 12 mo	16 June 78	7.5	7.6	7.5	32.0	32.0	31.0	8.3

(Continued)

TABLE NO. 22 (cont'd)
FIELD EVALUATIONS OF HEXAZINONE FOR PHYTOTOXICITY
TOWARD HYDRILLA - ENVIRONMENTAL DATA

6.7 kg/ha

TIME INTERVAL	OBSERVATION DATE	ppm DISSOLVED OXYGEN TOP	MID	BTM	TEMPERATURE C TOP	MID	BTM	pH COMPOSITE
- 1 day	15 June 77	8.2	7.8	7.4	32.4	32.0	32.0	7.4
+ 5 days	21 June 77	0.0	0.0	0.0	31.2	30.5	29.5	7.2
+ 14 days	30 June 77	8.9	6.5	5.6	32.0	31.8	31.0	8.1
+ 29 days	15 July 77	3.6	3.4	2.5	32.5	32.0	30.0	8.3
+ 2 mo	17 Aug 77	3.8	3.9	3.8	32.9	32.7	32.8	8.2
+ 3 mo	16 Sept 77	4.6	4.6	4.5	31.7	31.7	31.5	8.1
+ 4 mo	17 Oct 77	4.8	4.8	4.7	29.7	29.5	29.5	8.1
+ 5 mo	15 Nov 77	5.5	5.6	5.6	26.5	26.4	26.3	8.0
+ 6 mo	20 Dec 77	5.9	5.9	5.9	15.7	15.7	15.7	8.1
+ 9 mo	15 Mar 78	8.4	8.4	8.5	25.0	25.0	25.0	7.4
+ 12 mo	16 June 78	8.0	8.1	8.1	32.0	31.1	31.1	9.3

(Continued)

TABLE NO. 22 (concluded)
FIELD EVALUATIONS OF HEXAZINONE FOR PHYTOTOXICITY
TOWARD HYDRILLA - ENVIRONMENTAL DATA

Control

TIME INTERVAL	OBSERVATION DATE	ppm DISSOLVED OXYGEN TOP	MID	BTM	TEMPERATURE C TOP	MID	BTM	pH COMPOSITE
- 1 day	15 June 77	8.2	8.1	9.8	34.0	32.0	30.0	8.4
+ 5 days	21 June 77	6.3	6.1	6.4	30.5	30.0	29.9	7.9
+ 14 days	30 June 77	3.9	3.2	3.8	31.4	30.9	30.1	7.5
+ 29 days	15 July 77	3.2	2.7	3.0	31.1	30.8	30.5	8.1
+ 2 mo	17 Aug 77	4.1	4.0	4.0	32.4	32.2	32.0	7.9
+ 3 mo	16 Sept 77	5.3	5.2	5.2	31.8	31.8	31.7	7.8
+ 4 mo	17 Oct 77	5.9	5.9	5.8	29.6	29.6	29.5	7.6
+ 5 mo	15 Nov 77	6.1	6.1	6.0	26.3	26.3	26.2	7.6
+ 6 mo	20 Dec 77	6.2	6.2	6.2	16.0	16.0	16.0	7.5
+ 9 mo	15 Mar 78	6.3	6.3	6.3	25.0	24.9	24.9	7.5
+ 12 mo	16 June 78	6.5	6.4	6.4	32.0	31.0	30.5	8.3

TABLE NO. 23
FIELD EVALUATIONS OF FENAC FOR
PHYTOTOXICITY TOWARD HYDRILLA

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - TIME POSTTREATMENT							
				2 wks	4 wks	6 wks	2 mo	3 mo	4 mo	5 mo	6 mo
11/2/77	Fenac	Amchem	2.0 1/	0	7	30	50	62	75	85	95

continued from above:	7 mo	8 mo	9 mo	10 mo
	98	99	99	99

1/ 2.0 mg/l applied to a 10.8-acre area. Total lake volume concentration equals 0.87 mg/l.

TABLE NO. 24
OUTSIDE AQUARIA EVALUATIONS OF VARIOUS HERBICIDES
FOR PHYTOTOXICITY TOWARD CHARA

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE mg/l	PERCENT CONTROL - WEEKS POSTTREATMENT 2	4	6	8	10	12	14	16	18	20
11/28/77	Terbutryn	Ciba-Geigy	0.1	4	5	4	9	26	67	83	87	88	90
			0.2	2	3	10	20	72	91	100	100	100	100
			0.4	4	6	11	54	77	92	93	97	99	100
	Control			0	0	0	0	0	0	0	0	1	1
4/26/78	Hexazinone DPX 3674-60 DF	Du Pont	0.25	4	6	30	78	88	94	97			
			0.50	51	52	100	100	100	100	100			
	Control			1	1	1	1	1	1	1			

TABLE NO. 25
OUTSIDE AQUARIA EVALUATIONS OF VARIOUS HERBICIDES
FOR PHYTOTOXICITY TOWARD CHARA

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE	PERCENT CONTROL - WEEKS POSTTREATMENT 2	4	6	8	10	12	14	16
12/20/77	Copper TEA 1/ (granules)	Applied Biochemists	113.1 kg/ha	8	17	78	83	83	83	82	79
	Copper TEA 2/ (granules)	Applied Biochemists	67.2 kg/ha	5	25	62	70	78	80	83	84
	Terbutryn	Ciba-Geigy	0.05 mg/l	0	2	4	5	47	75	82	86
	Control			0	0	0	0	0	1	1	1

(Continued)

TABLE NO. 25 (concluded)
OUTSIDE AQUARIA EVALUATIONS OF VARIOUS HERBICIDES
FOR PHYTOTOXICITY TOWARD CHARA

EVALUATION DATE	CHEMICAL DESIGNATION	COMPANY OR SOURCE	RATE	PERCENT CONTROL - WEEKS POSTTREATMENT 18	20	22	24	26	28	30
12/20/77	Copper TEA 1/ (granules)	Applied Biochemists	113.1 kg/ha	78	77	73	65	50	15	13
	Copper TEA 2/ (granules)	Applied Biochemists	67.2 kg/ha	84	75	70	65	45	22	15
	Terbutryn	Ciba-Geigy	0.05 mg/l	86	87	87	87	85	82	81
	Control			1	1	1	1	1	1	1

1/ As Cutrine-triethanolamine.

2/ As Cutrine-plus.

TABLE NO. 26
NAMES AND SOURCES OF CHEMICALS EVALUATED IN FISCAL YEAR 1978

COMMON NAME	CHEMICAL NAME	SOURCE
Asulam	Methyl sulfanilylcarbamate (sodium salt)	Rhodia Inc., Agricultural Division Somerset, New Jersey 08873
Copper TEA	Copper-triethanolamine complex	Sandoz, Inc., Crop Protection 480 Camino Del Rio South San Diego, California 92108 (K-lox) Applied Biochemists, Inc. P. O. Box 25 Mequon, Wisconsin 53092 (Cutrine-plus)
Dalapon	2,2-dichloropropionic acid (sodium, magnesium salts)	Dow Chemical Company P. O. Box 1706 Midland, Michigan 48640
Diquat	6,7-dihydrodipyrido(1,2-a:2',1'-c) pyrazinediium dibromide	Chevron Chemical Company, Ortho Div. 940 Hensley Street Richmond, California 94804
Diuron	3-(3,4-dichlorophenyl)-1,1-dimethylurea	E. I. duPont de Nemours & Company Biochemicals Department Wilmington, Delaware 19898
EL-509	a-(4-chlorophenyl)-a-(1-methylethyl)-5-pryimidinemethanol	Eli Lilly and Company Elanco Products Company Division Indianapolis, Indiana

(Continued)

TABLE NO. 26 (cont'd)
NAMES AND SOURCES OF CHEMICALS EVALUATED IN FISCAL YEAR 1978

COMMON NAME	CHEMICAL NAME	SOURCE
Endothall	Dipotassium salt of 7-oxabicyclo(2.2.1)heptane-2,3-dicarboxylic acid	Pennwalt Corporation Agricultural Chemical Division 1630 E. Shaw Avenue Fresno, California 93710
Fenac	Salts of 2,3,6-trichlorophenylacetic acid	Amchem Products Inc. Agricultural Chemicals Division Ambler, Pennsylvania 19002
Fluridone	1-methyl-3-phenyl-5-(3-trifluoromethyl, phenyl)-4(1H)-pyridinone	Eli Lilly and Company Elanco Products Company Division Indianapolis, Indiana
Glyphosate	N-(phosphonomethyl)glycine	Monsanto Company Agricultural Products St. Louis, Missouri 63166
Hexazinone	3-cyclohexyl-6-(dimethylamine)-1'-methyl-1,3,5-triazine-2,4(1H,3H)-dione	E. I. du Pont de Nemours & Company Biochemicals Department Wilmington, Delaware 19898
Metribuzin	4-Amino 6-(1,1-dimethylethyl)3-(methlythio)-1,2,4-triazin-5(4H)-one	E. I. du Pont de Nemours & Company Biochemicals Department Wilmington, Delaware 19898

(Continued)

TABLE NO. 26 (concluded)
NAMES AND SOURCES OF CHEMICALS EVALUATED IN FISCAL YEAR 1978

COMMON NAME	CHEMICAL NAME	SOURCE
RH-2915	2-chloro-1-(3 ethoxy-4 nitrophenoxy)-4-(trifluoromethyl)benzene	Rohm and Haas Company Research Laboratories Spring House, Pennsylvania 19477
SA-77	d-limonene and an unspecified mix of emulsifiers	JLB International Chemicals Inc. P. O. Box 457 Hialeah, Florida 33010
2,4-D	Dodecyl and tetradecyl amine salts of 2,4-dichlorophenoxy acetic acid	Amchem Products Inc. Agricultural Chemicals Division Ambler, Pennsylvania 19002
Terbutryn	2-(tert-butylamino)-4-ethylamino)-6-(methylthio)-s-triazine(2-methylthio-4-ethylamino-6-tert-butylamino-s-triazine)	Ciba-Geigy Corporation Agricultural Division P. O. Box 11422 Greensboro, North Carolina 27409