Studies On The Control Of Water Hyacinth

1. Response of Water Hyacinth to Two Hormone Herbicides, 2,4-D and 2, 4, 5-T.

G. MISRA AND N. DAS

Department of Botany, Ravenshaw College
Cuttack 3, India

INTRODUCTION

Water hyacinth (*Eichhornia crassipes* (Mart.) Solms) is an obnoxious aquatic weed in the water of Orissa (latitude 17°40'N to 22°33'N and longitude 81°24'E to 87°26'E) as in many other tropical and subtropical countries of the world. MacLean (5) tried a number of inorganic chemicals on water hyacinth. Parija (7) recorded that copper sulphate and barium chloride at a concentration of 0.018% or more killed the water hyacinth. Hildebrand (2) was successful in killing water hyacinth with 0.1% 2,4-D (2,4-dichlorophenoxy acetic acid). Penfound and Minyard (8) found the spraying of butyl ester of 2,4-D in kerosene on the leaves of water hyacinth would kill the weed. Seale and Allison (9) applied 2,4-D aerially in the form of the butyl ester in diesel oil. Hitchcock, Zimmerman, Kirkpatrick, Jr. and Earle (3) noted that the isopropyl and butyl esters of 2,4-D were as effective as the alkanolamine salt. They recommended control of water hyacinth with 1-6 lb/A of 2,4-D. Weldon, Blackburn, DeRigo and Mellen (10) reported that invert (water-in-oil) emulsions were effective for water hyacinth control. The present investigation was conducted to determine the effects of 2,4-D and 2,4,5-T (2,4,5-trichlorophenoxy acetic acid) on water hyacinth.

MATERIAL AND METHODS

Young vigorous water hyacinths were grown in earthenware pots (25 cm x 25 cm). Two plants were grown in each pot. Aqueous solutions of the sodium salts of 2,4-D and 2,4,5-T were applied to the plants at concentrations of 5, 10, 25, 50, 100, 250, 500 and 1000 ppmw. The desired concentrate was applied in a spray volume of 10 mls per pot with a hand sprayer.

Another experiment was conducted in 2 outside ponds where the water hyacinth were growing luxuriantly. Concentrations of 250, 500 and 1000 ppmw were used at the rate of 400 cc per 100 sq. ft. in this experiment. A pinch of household detergent "Surf' was added to the herbicide solution as a wetting agent.

RESULTS AND DISCUSSION

Morphological Responses

There were striking morphological changes in the water hyacinth plants within 24 hours following treatment with both herbicides. The morphological abnormalities such as wilting, drying, epinasty and necrosis of the leaves and bending of the petioles in these experiments were more or less similar to results obtained by other workers (2, 3, 6, 8).

The sodium salt of 2,4,5-T was found to be more effective than the sodium salt of 2,4-D. This does not agree with results obtained by Hitchcock, Zimmerman, Kirkpatrick and Earle (3) who found 2,4-D to be more effective than 2,4,5-T.

The older plants of water hyacinth took more time to be killed than the younger plants. These results agree with the earlier findings of Hitchcock, Zimmerman, Kirkpatrick and Earle (3). The older plants succumbed to herbicidal treatment quicker than the younger plants. In a single plant be it young or old, the older leaves succumbed to the herbicide faster than the younger leaves. The cause for this can be traced to the mechanism of the herbicide action. It has been shown by Ashton, Harvey and Foy (1) that a herbicide is more effective when there is quick penetration into the plant tissues. The older hyacinth leaves have less of a deposit of waxy substances than the younger leaves. Older leaves have a greater number of stomata per unit area than that of the young leaf. The stomatal aperture is more open in an old leaf than that of a young leaf. These morphological features assist in easier and more rapid entry of the herbicide into the older leaves and a greater herbicidal susceptibility.

The time required for the hyacinth to die varies even when sprayed by the same herbicide. It appears that factors other than the nature of the herbicide and concentration affects the rate of killing. Water hyacinth treated with 2,4-D and 2,4,5-T at 1000 ppmw in October required 15 days for complete death as compared to 12 days in April. This agrees with the findings of Hitchcock, Zimmerman, Kirkpatrick and Earle (3). They observed sinking of water hyacinths 30 to 50 days earlier when treated in August than in plants treated in September. The reason for this differential effect in time of application could be due to temperature differences. The high temperature of April accompanied with warm and dry air may have helped in herbicidal penetration. October is a month of low temperature and humid air.

Effect of frequency of Application

One single spray with 2,4-D at concentrations of 5, 10, 25, 50 and 100 ppmw did not affect the water hyacinth. The higher concentrations of 250, 500 and 1000 ppmw killed the plants. The time required for kill was 50, 37 and 30 days respectively (Table 1 and Figure 1) thus correlating time with increased concentrations of herbicide.

TABLE 1. EFFECT OF 2,4-D AND 2,4,5-T ON WATER HYACINTH.

Conc. in ppm	Days required for complete death from time of application					
	Single spray		Alternate day spray		Daily spray	
	2,4-D	2,4,5-T	2,4-D	2,4,5-T	2,4-D	2,4,5-T
100	---	---	---	---	---	20
250	50	44	25	22	21	8
500	37	30	21	20	18	6
1000	30	15	17	10	15	4

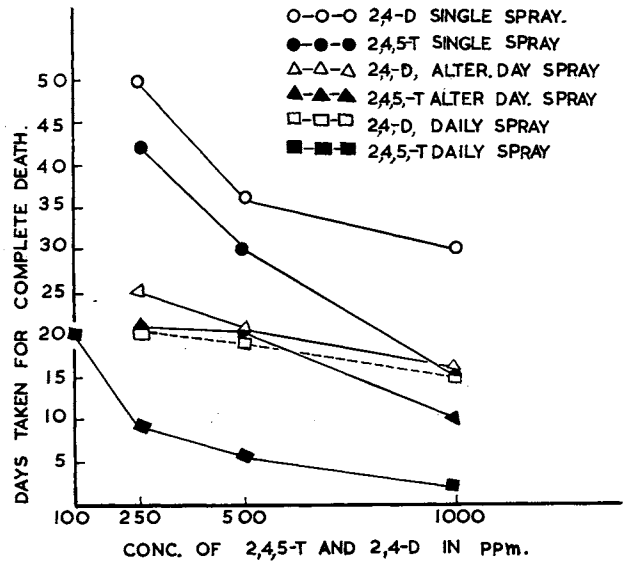

Figure 1. The response of water hyacinth to 3 treatment schedules of 2,4-D and 2,4,5-T.

Single applications of 2,4,5-T were more effective than 2,4-D on water hyacinth. Concentrations of 5, 10 and 25 ppmw of 2,4,5-T had no effect. Slight effects were evident with 50 and 100 ppmw. Concentrations of 250, 500 and 1000 ppmw of 2,4,5-T killed the plants in 44, 30 and 15 days respectively.

Increasing the 2,4-D and 2,4,5-T applications from a single spray to alternate-day spraying resulted in a faster death of the water hyacinth plants (Table 1). 2,4-D at concentrations of 250, 500 and 1000 ppmw killed the plants in 25, 21 and 17 days respectively. 2,4,5-T at concentrations of 250, 500 and 1000 ppmw killed the plants in 22, 20 and 10 days respectively.

Increasing the frequency of application to daily spraying resulted in still faster death of the plant (Table 1). There was a total kill with 2,4-D at the concentrations of 250, 500 and 1000 ppmw in 21, 18 and 15 days respectively and with 2,4,5-T at concentrations of 250, 500 and 1000 ppmw in 8, 6 and 4 days. 2,4,5-T at this spray frequency was also effective at a lower concentration.

Field Experiments

Morphological responses and the symptoms after herbicide spray in the field experiments were more or less the same as were in the pot culture experiments. 2,4,5-T was more effective than 2,4-D. 2,4,5-T at concentrations of 1000, 500 and 250 ppmw killed the plants in 13, 18 and 28 days respectively (Table 2). In field experiments the time taken to kill water hyacinth plants was less than in the pot-culture experiment.

TABLE 2. EFFECT OF 2,4-D AND 2,4,5-T ON WATER HYACINTH.

Conc. in ppm	Days required for complete death from time of application	
	Single Spray	
	2,4-D	2,4,5-T
250	34	28
500	28	18
1000	20	13

SUMMARY

The sodium salts of 2,4-D and 2,4,5-T were studied on water hyacinth, *Eichhornia crassipes*. 2,4,5-T was found to be more effective than 2,4-D. Concentrations of 1000 ppmw of 2,4-D and 2,4,5-T killed water hyacinths within 30 and 15 days respectively. Increasing the frequency of application to daily sprays hastened plant death. Older plants succumbed to herbicidal treatment quicker than young plants. In a single plant, old or young, the older leaves succumbed to herbicidal treatment quicker than the younger leaves. Plants treated in April died sooner than plants treated in October implying an interaction of the season of application and herbicidal effect.

ACKNOWLEDGMENT

Thanks are due to Mr. Robert D. Blackburn, Crops Research Div., ARS, USDA, Fort Lauderdale, Fla. for kindly going through the manuscript and offering some useful suggestions.

LITERATURE CITED

1. Ashton, F. H., W. A. Harvey and C. L. Foy. 1961. Principles of selective weed control. Circ. No. 505, 20 pp, Calif. Agr. Expt. Stn. Ext. Serv.
2. Hildebrand, E. M. 1946. Herbicidal action of 2,4-dichlorophenoxyacetic acid on the water hyacinth, *Eichhornia crassipes*. Science *103*:477-479.
3. Hitchcock, A. E., P. W. Zimmerman, H. Kirkpatrick Jr. and T. T. Earle. 1949. Water hyacinth: its growth, reproduction and practical control by 2,4-D. Contrib. Boyce-Thompson Inst. *15*: 363-401.
4. Hitchcock, A. E., P. W. Zimmerman, H. Kirkpatrick Jr. and T. T. Earle 1950. Growth and reproduction of water hyacinth and alligatorweed and their control by means of 2,4-D. Contrib. Boyce-Thompson Inst. *16*:91-130.
5. MacLean, K. 1922. Agric. J. Ind. *17*:23-40.
6. Mitra, G. P. 1948. Eradication of water hyacinth by methoxone on a field scale trial. Sci. & Cult. *14*:143-145.
7. Parija, P. 1934. Physiological investigations on water hyacinth, *Eichhornia crassipes*, in Orissa with notes on some other aquatic weeds. Indian J. Agr. Sci. *4*:399-429.
8. Penfound, W. T. and V. Minyard. 1947. Relation of light intensity to effect of 2,4-dichlorophenoxyacetic acid on water hyacinth and kidney bean plants. Bot. Gaz. *109*:231-234.
9. Seale, C. C. and R. V. Allison. 1947. Hyacinth control through the use of 2,4-dichlorophenoxyacetic acid in different forms and at various rates of application. Soil Sci. Soc. of Florida Proc. *8*: 97-106.
10. Weldon, L. W., R. D. Blackburn, H. DeRigo and R. T. Mellen Jr. 1966. Use of invert emulsion formulations in aquatic weed control. Hyacinth Control J. *5*:12-15.