ERADICATION AND UTILIZATION OF WATER HYACINTH*

V. RAMACHANDRAN, T. RAMAPRABHU AND P. V. G. K. REDDY
Central Inland Fisheries Research Substation, Cuttack

THOUGH Jagadeesh and Lakshminarayana[1] have added some information on the use of 2, 4-D for the control of water hyacinth and the use of the plant for removal of nutrients from polluted waters to the original review by Sharma[2] the information given is still far from complete. 2, 4-D has been extensively used not only in America and Africa but also in many other parts of the world including India[3–32] for the eradication of water hyacinth. Philipose[33,34,36] and Chakravarty[37] have reviewed the work done in India on this problem. The cost of manual clearance and control by 2, 4-D have been compared by Philipose[35] and Ramachandran[26] and reasons for favouring chemical control are adduced. Physical removal of water hyacinth depletes the medium of all nutrients that have been robbed from it by the dense infestation. A possible increase in nutrients like phosphate after killing and disintegration of water hyacinth by 2, 4-D has been indicated in Indian ponds.[55] A simple and economically feasible technique for the treatment of even the densest infestation has been evolved[26,27] and this has been recently adopted by municipal authorities at Cuttack. Besides 2, 4-D, and M.C.P.A., Silvex, a formulation of 2-(2, 4, 5-trichlorophenoxy) propionic acid,[36,47] Diquat, Amitrole-T,[22,23,25,32,39,47] and Simazine[26] have also been effectively used in controlling this weed. 2, 4, 5-T was found to be more effective than 2, 4-D[24] though Hitchcock *et al.*[46] found the reverse to be true. Recently, aqueous ammonia applied at the root zone was found to kill the plants totally (Central Inland Fisheries Research Institute Report, 1968 and 1969).

Biological control by the weevil, *Neochetina bruchi*, stem-borers *Aciqona ignitalis* and *Epipaqis albiquttalis*, aquatic grasshopper, *Cornops longicorne* and the mite *Leptogalumna* are reported to be promising.[40] Bennett and Zwolffer[40] refer to work done by Rao and Sankaran in India in this direction. Attempts to control *Eichhornia crassipes* by the snail *Marisa cornuarieties* have proved only partly successful.[41] Attempts have been made for controlling water hyacinth by use of fish like grass carp (*Ctenopharyngodon idella*), *Tilapia melanopleura*,[49–52] and also for using it as feed for fish.[49,53,54]

The utilization of water hyacinth for nutrient removal was first demonstrated by Sheffield[42] as a practical means of eliminating nitrogen and phosphorus before they are effluented into watercourses. He developed a pilot plant consisting of an 'aquatic plant pond' with water hyacinth, an air stripping unit and a flocculation and settling unit. The removal of nitrogen and phosphorus in the above process was far superior to that of an algal pond studied for comparison as seen in Table I.

TABLE I

Type of process	Nitrate-N		Ammonia-N		Phosphate	
	Final effluent conc.	Per cent. removal	Final effluent conc.	Per cent. removal	Final effluent conc.	Per cent. removal
*Algal pond effluent	5·0 mg/l	67	7·0 mg/l	88	1·0 mg/l	99
†Aquatic pond effluent	0·2 mg/l	99	0·1 mg/l	99*	0·7 mg/l	99*
Difference in processes	4·8 mg/l	33	6·9 mg/l	11	0·3 mg/l	0

* Max. removal, † Average removal. (From Sheffield, 1967).

Taylor and Robins[43] have determined the amino-acid composition of water hyacinth and found that its lysine content is sufficient to improve a corn diet. The following levels of essential amino-acids in 100 g of crude protein were recorded by them :

Methionine	..	0·72 g
Phenylalanine	..	4·72 g
Thremine	..	4·32 g
Lysine	..	5·34 g
Isoleucine	..	4·32 g
Valine	..	0·27 g
Leucine	..	7·20 g

They reported also that higher protein levels were found in June and July and younger plants are richer in protein. According to Waterlow as quoted by Taylor and Robbins,[43] biological value of leaf protein of water hyacinth is reported to be equal to that of milk. The crude protein content of water hyacinth has been

* Published with the kind permission of Director, Central Inland Fisheries Research Institute, Barrackpore.

estimated to be 12-18% dry weight and 1·1% wet weight.[44] Van Vuran[45] estimated that under suitable climatic conditions, one acre of water hyacinth would remove 3,075 pounds of nitrogen per year. Singh[48] has tried its use as a compost for growing vegetables and found that its phosphorus content is higher than in composts of other aquatic weeds.

1. Jagadeesh, K. M. and Lakshminarayana, C. S., *Curr. Sci.*, 1971, **40** (7), 148.
2. Sharma, A., *Ibid.*, 1971, **40** (3), 51.
3. Ahlgreen, G. H., Klingman, G. C. and Wolf. B. E., *Principles of Weed Control*. John Wiley & Sons, New York, Chapman & Hall Ltd., London, 1951, p. 368.
4. Long, H. C. and Brenchley, W. E., *Suppression of Weeds by Fertilizers and Chemicals*, Crosy Lockwood & Son Ltd., 1949.
5. de Ong, E. R., *Insect, Fungus and Weed Control*, Chemical Publishing Co., Inc., N.Y., 1963, p. 400.
6. Kar, B. K., *Sci. & Cult.*, 1947, **12** (11), 545.
7. Mitra, G. P., *Ibid.*, 1948, **14** (4), 143
8. Padwick, G. W., *Indian Farming*, 1948, **9** (12), 497.
9. Joshi, L. M., Pantulu, V. R. and Padmanabhan, S. Y., *Ibid.*, **11**, 545.
10. Tin, U. P., Baruah and Baruah, H. K., *Sci. & Cult.*, 1949, **15** (3), 106.
11. Singh, S. B., *Proc. 49th Ind. Sci. Congr., Absts.*, Part III, No. 107, 393.
12. Sen, A. C., *Sci. & Cult.*, 1957, **23**, 315.
13. Saha, K. C., Sen, D. P. and Muhury, G. N., *Ibid.*, 1958, **23** (10), 556.
14. Baruah, H. K., Das, N. and Baruah, P., *J. Univ. Gauhati*, **6**, 103.
15. Ball, E. W., *Proc. of the Thirteenth Annual Conf. S.E. Assn. Game and Fish Commrs.*, Baltimore, Maryland, 1959, p. 259.
16. Lawrence, J. M. and Geagan, D. W., *Proc. of the S.E. Assn. Game and Fish Commrs.*, New Orleans, Louisiana, 1954, p. 114.
17. Surber, E. W., *U.S. Dept. of Interior, Fish and Wildlife Service Fishery Leaflet*, 1949, **344**, 20.
18. Menon, C. T., *Prog. Fish Cult.*, 1965, **27** (4), 228.
19. Smolka, H., *Weed. Abstr.*, 1964, **13** (4), 1085, 202.
20. Vaas, K. F., *Contr., Gen., Agr. Res. Sta. Bogor.*, Indonesia, 1951, **120**, 1.
21. Lawrence, J. M., *Progr. Fish Cult.*, 1955, **17** (3), 141.
22. Stephens, J. C. *et al.*, *J. Irr. and Drain Divn.* ASCF., 1963, **89**, No. IR2, 31.
23. Harrison, D. S., *Aquatic Weed Control*, Univ. of Florida Agr. Exin. Ser. Circular 219A, 1964, p. 16.
24. Misra, G. and Das, N., *Hyacinth Control J.*, 1969, **8**, 22.
25. Blackburn, R. D. and Weldon, L. W., *Suggested Control Measures for Common Aquatic Weeds of Florida*, U.S. Dept. of Agric., ARS, C.R.A., Fort Lauderdale, Florida, 1963. p. 9 (Mimeo).
26. Ramachandran, V., *Report on the Infestation of Water Hyacinth in Marikollong Bheel (Newgong, Assam) with Recommendations for its Eradication*, Bull. No. 2, C.I.F.R.I., Barrackpore, (*Via.* Calcutta), 1963, p. 13 (Mimeo).
27. — and Ramaprabhu, T., *FAO Fish Repts. No. 44*, 1968, **5**, 92.
28. —, *Indian Fmg.*, 1969, **19** (9), 75.
29. Pickworth, G., *Fmg., S. Africa*, 1969, **45** (3), 13.
30. Green, K. P., *Agric. Gaz. N.S.W.*, 1969, **80**, (11), 628.
31. Bauer, S., *Agric. Aviat.*, 1968, **8** (4), 116.
32. Dawood, D. L. *et al.*, *Bull. W.H.O.*, 1965, **32**, 269.
33. Philipose, M. T., *A Report on the Present Status of Aquatic Weed Control in the Indo-Pacific Countries*, IPFC/C.57/UP (25), 1957, p. 16 (Mimeo).
34. —, *Some Practical Hints for the Control of Common Aquatic Weeds in Fishery Waters of India*, C.I.F.R. Station, Barrackpore, West Bengal, 1959, p. 12 (Mimeo).
35. —, *Indian Livestock*, 1963, **1** (2), 20, 34.
36. —, *FAO Fish Repts. No. 44*, 1968, **5**, 26.
37. Chakravarty, S. C., *Indian Agric.*, 1963, **8** (1/2), 1.
38. Thomptson, W. W., Pierce, P. C. and Wyatt, H. N., *Proc. 13th Ann. Conf. S.E. Assn. Gameand Fish Commrs.*, Baltimore, Maryland, 1959, 101.
39. Blackburn, R. D. and Weldon, L. W., *Weed Absts.*, 1964, **13** (2), 440.
40. Bennett, F. D. and Zwolffer, H., *Hyacinth Control J.*, 1968, **7**, 44.
41. Seaman and Porterfield, *Weeds*, 1964, **12** (2), 87.
42. Sheffield, C. W., *Hyacinth Control J.*, 1967, **6**, 27.
43. Taylor, K. G. and Robbins, R. C., *Ibid.*, 1968, **7**, 24.
44. Claude, E., Boyd, *Ibid.*, 1968, **7**, 26.
45. Van Vuran, J. P. J., *Soil Fertility and Sewage*, Dover Publications, New York, 1948.
46. Hitchcock *et al.*, *Boyce Thompson Inst.*, 1950, **16**, 91.
47. Blackburn, R. D., *FAO Fish Repts. No. 44*, 1968, **5**, 1.
48. Singh, S. B., *IPFC, Proc.*, 1962, Sec. II, 141.
49. — *et al.*, *Ibid.*, 12 (II), 220.
50. Avault, J. W., Jr., *Proc. 18th Ann. Meet. S. Weed Conf.*, 1965, Dallas, Texas.
51. —, *Progr. Fish Cult.*, **27** (4), 207.
52. —, Smitherman, R. O. and Shell, E. W., *FAO Fish Repts. No. 44*, 1968, **5**, 109.
53. Ling, S. W., *Internat. Inland Fish. Training Centre*, Indonesia, FAO Publ., 1955, **1**, 3. 23, 12.
54. —, *FAO Fish Repts. No. 44*, 1968, **3**, 291.
55. *Annual Report of Central Inland Fisheries Research Institute*, Barrackpore, 1970.