This work showed that Amitrol-T was effective, but additional work was needed to prove out the early findings and determine the limits of use. The following report presented by Seaman at the 1961 Southern Weed Control Conference describes the work done in 1960. Volume of carrier, rates of application, and component parts of the Amitrol-T formulation were tested to determine thir effect. Seaman summarized in abstract form. "A formulation containing 2 lb. of 3-amino-1,2,4-triazole (amitrole) and 2 lb. of ammonium thiocyanate (NH4SCN) per gal. (amitrole-T), gave over 90% control of water hyacinth (Eichhornia crassipes) at rates of 1.5 and 2.0 lb. ai/A, with respect to amitrole, when applied in water at 100 gpa. When applied at 200 gpa, amitrole-T gave over 90% control at rates of 0.5, 1.0, 1.5, and 2.0 lb. ai/A. Similar 3-month evaluations of control by the diethanolamine salt of 2,4-dichlorophenoxyacetic acid (2,4-D) indicated that only 45% control was given at 6 lb. ae/100 gal/A, but 83% control resulted after treatment with 6 lb. ae/200 gal/A, and correspondingly less control was given at lower rates with either volume. The maximum effects of amitrole-T took about 4 weeks longer to develop than did those of 2,4-D, but regrowth of vegetative offshoots (daughter plants), and consequent loss of control, was less in plots treated with amitrole-T than with 2,4-D.

The relatively poor control given by 2,4-D was thought to be related to its poor transport through stolons from parent plants to attached offshoots. Since amitrole has been shown to be more mobile than 2,4-D in other plants, probable superior translocation of amitrole-T may explain its superior control through effective repression of offshoot regrowth. The offshoots were probably protected somewhat by the mature foliage in the dense stands of weeds of this experiment.

The applications of both herbicides at 200 gpa gave better control than those at 100 gpa presumably because the higher volume provided better total coverage and more offshoots were contacted by the spray solution.

Preparations of amitrole alone, amitrole plus hydrochloric acid, NH4SCN alone, and mixtures containing amitrole: NH4SCN ratios of 1:0, 1:0.5, 1:1, 1:2, and 1:3 were also applied to differentiate the roles of these amitrole-T components in terms of water hyacinth control. Amitrole alone and amitrole plus hydochloric acid behaved similarly and yielded only 15% control at 1 lb/100 gal/A and 50% control at 2 lb/100 gal/A. NH4SCN alone was totally ineffective at 3 lb/A. The amitrole: NH4SCN mixtures, each applied at 1 lb ai/100 gal/A with respect to amitrole, all gave better control than did amitrole without NH4SCN at the same rate. The 1:1 mixture, representing commercial amitrole-T in this series, gave 80% control, the 1:2 mixture gave 92% control, and the 1:3 mixture gave 56% control. Further work is planned to ascertain whether or not the apparent optimum control effects given by the 1:2 mixture is sufficiently significant to recommend a change in the commercial formulation to make it a more effective herbicide for water hyacinth control.

Amitrole is not regarded as hazardous to crops and ornamentals as 2,4-D. Since amitrole-T was more effective in single applications than 2,4-D at nearly-equivalent treatment costs, this formulations may be developed as an alternative herbicide to 2,4-D for control of water hyacinth in agricultural and residential areas.

The 1961 work was presented at the Weed Society of America meeting at St. Louis. This was a summary of the three years work. The continuous effectiveness of Amitrol-T was shown, with a possible explanation as to why it had worked well for three years. This abstract summarizes the finding of three years work.

Field tests have been conducted during the past three years to evaluate the efficacy of formulations of 3-amino-1,2,4-triazole (amitrole) to control water hyacinth (Eichhornia crassipes (Mart.) Solms.). Comparisons were made with 2,4-dichlorophenoxyacetic acid (2,4-D), the main herbicide being used for water hyacinth control. Tests in 1960 and 1961 consistently showed that a formulation of amitrole-T containing 2 pounds each of amitrole and ammonium thiocyanate (NH4SCN) was more effective in single applications at rates of 0.5 to 2 pounds ai (amitrole) per acre than similar applications of 2,4-D at 2 to 6 pounds per acre.

Although maximum effects of amitrole-T took about four weeks longer to develop than did those of 2,4-D, regrowth and consequent loss of control were less in plots treated with amitrole-T than in those treated with 2,4-D. Regrowth appeared mainly due to vegetative offshoots probably not contacted directly by the spray solution. In a separate laboratory experiment, amitrole-T applied only to parent plants killed attached offshoot plants, but offshoots survived similar treatments with 2,4-D. It therefore seemed likely that the more effective expression of regrowth by amitrole-T was due to its superior translocation through stolons from parent to offshoot plants.

Amitrole alone was not as effective as mixtures containing NH4SCN, which appeared to be synergistic to the action of amitrole on water hyacinth. Increasing concentrations of NH4SCN gave corresponding increases in control up to an apparent optimum ratio of 1 part amitrole to 2 parts NH4SCN by weight. A higher concentration of NH4SCN in the mixture reduced the effectiveness below that of the commercial formulation of amitrole-T.

In reporting this work, it seems evident that the consistent control in each of three years at different locations offers proof of increased biological activity. The importance of a single application as compared to a minimum of two with 2,4-D makes the economic contribution of Amitrol-T to water hyacinth control significant.

BIBLIOGRAPHY

1. Seaman, D. E. (CRD Div. ARS USDA) Personal communication.
2. Seaman, D. E. 1961. A comparative evaluation of Formulations of Amitrole and 2,4-D for Control of Water Hyacinth. Proc. SWC 14: 287-288.
3. Seaman, D. E. 1961. Control of Water Hyacinth by Amitrol-T. Abstracts 1961 meeting of the Weed Society of America 70-71.

The Correlation Of Mosquito Breeding To Hyacinth Plants

By E. L. Seabrook[1]

This paper is somewhat basically the same as worked up some years ago relative to Palm Beach County's desire and willingness to cooperate in a project for hyacinth eradication, which was in response to a notice of public hearing issued by the U. S. District Engineer's office on May 3rd, 1946. Much of the basic contents of this paper was presented at a public hearing at West Palm Beach, Florida on June 18th, 1946.

Reference is made to Page 9, paragraph 2 and 3 of a report dated July 18th, 1898 by Assistant Engineer J. W. Sackett to Lt. Col. W. H. H. Benyaurd, Corps of Engineers, U. S. Army, which is contained in a letter document No. 91 from the then Acting Secretary of War, and which concerns Water Hyacinth Obstructions.

According to records, hyacinth plants were introduced into the St. Johns River near Jacksonville, Florida by a "little old lady" years ago. After their establishment, it is of interest to note that as pertains to Public Health there was some concern at first as borne out by the following excerpt — "It was apprehensive that the accumulation of these floating masses would be a serious menace of the health of the vicinity, but these fears do not seem to be well grounded, and it is now thought that the plants absorb matter deleterious to health. The impression prevails that upon upper portions of the river, noted for malaria, where the plant has accumulated extensively, much less sickness of the malarial type prevails than formerly. In places in Louisiana where large masses of the plant have been piled upon the banks of canals and bayous and left there to dry up and decay, no bad effect upon the health of those living in the vicinity has been observed. It is therefore safe to assume that as an obstruction to navigation the plant need only be considered, and in adopting methods for destroying the plant or abating its growth, sanitary conditions do not need to be considered."

Since 1898, the date of Assistant Engineer J. W. Sackett's report on hyacinths as related to public health, considerable strides have been made in the advancement of science, especially in the chemical field, for the control of these plants. These developments have proven of paramount importance for the control of malaria and culicine mosquitoes found in association with these aquatic growths. Entomological and related sciences have established that when these plants thrive in abundance,

[1]**Entomologist, Palm Beach County**

they are conducive to mosquito breeding and account for certain mosquito species prevailing in such areas. Research studies establish a definate correlation existing between these plants, which are found to directly and indirectly affect the Public Health and comfort. It is found that the hyacinth plant Eichhornia crassipes (Kunth), and the sometimes associated water lettuce plant, Pistia stratiotes (L) and related floating weeds are responsible for many of our mosquito problems. The importance of these plants and their existing correlation to the past and current mosquito problems are hereby cited.

1. Both plants afford protection for certain mosquito larvae from predacious biological life, thus permitting their development.
2. Both plants are used as host plants by certain pest and disease bearing mosquitoes.
3. These plants interfere with the circulation of water and impede quick water run-off and drainage of certain marsh and low areas thus causing breeding of certain mosquito species as well as being responsible for breeding of the Glade Psorophora and flood water Aedes mosquito in temporarily impounded areas.
4. The cost of applying larvacide is increased when these plants are present in bodies of water to be treated.

In further elaborating on the protection of mosquito larvae from predacious forms of life, it is pointed out that the principal potential vector of malaria in the State of Florida is Anopheles quadrimaculatus, the larvae of which are surface feeders. The larvae of Anopheles quadrimaculatus and Anopheles crucians, a non vector, are found associated with water hyacinth growths. The correlation of the breeding of these mosquitoes to hyacinth growths is now an established and recognized fact, as it has been found that these plants harbor the mosquito larvae and otherwise protect them from fish and other beneficial forms of life which feed on the larvae. In areas where malaria is hazardous, the removal of the plants was one of the accepted control measures for controlling the breeding of the anophline mosquitoes. Now growth harmones of the 2,4-D type have proven effective and relatively inexpensive.

The water hyacinth and lettuce plants are the host plants of three mosquito species, the larvae of which obtain their oxygen beneath the water surface, through the roots of these plants. Data compiled bears out the fact that the hyacinth plant, besides being a host plant of Mansonia perturbans (Walk.), has also been incriminated as a good host of two other Mansonia species, M. titillans (Walk.) and M. indubitans (D. & S.). The annoyance and density of Mansonia perturbans and Mansonia indubitans in certain sections in Florida are at times comparable to the annoyance and density of the "Salt Marsh Mosquitoes" Aedes taeniorhynchus (Wied.). All three species of the genus Mansonia constitute a mosquito problem that is difficult with which to cope — as regular surface applications of oils or preparations of insecticides in petroleum bases are not satisfactory for control, since the larvae are not surface breathers. If emulsions are used in sufficient strength to kill the larvae, injury to fish and beneficial life may result. Eradication of the host plants, which indirectly destroys the larvae, appears to be the most practical method of controlling these Mansonia species. The destruction of the water hyacinth plant would contribute greatly toward controlling these mosquitoes, and species of the Culex genus.

Hyacinth growths often cause barriers, thus retarding drainage of marsh areas and decreasing the circulation of water through constructed systems of mosquito control and drainage ditches thereby contributing to mosquito breeding. These obstructions cause dams, impoundment of water and high water tables which are conducive to mosquito breeding. The interference by hyacinths to normal water functions, further adds to the necessity and importance of a program for their control.

In treating bodies of water mosquito breeding is associated with hyacinths growths, a larger amount of the larvicide is required and the result of the treatment is not as effective. Thus, the cost factor is increased by hyacinth growths not only because of the material cost of the larvacide, but also because of the labor time element and the frequent periodic treatment necessary for adequate control.

On July 3rd the writer had the occasion to personally make observations by boat through the St. Lucie River, Lake Okeechobee and Caloosahatchee River. While enroute west, it was noted that from the second lock at Moore Haven and beyond the following lock, the Caloosahatchee River contained a mass of floating hyacinths drifting toward Ft. Myers. Evidently, previous rains had broken up the masses of these plants in the adjacent ditches and tributaries. This poses somewhat of a complex problem to you people living here and interested in hyacinth control as this reservoir serves as a continuous source for reinfestation.

It is of interest to note that the hyacinth control methods tried and recommended up to 1899 and the experiments conducted incident to 1946 and also recommended included the following:

1. Physical transferral of the plants to adjacent dry land.
2. Towing to accumulation areas by means of rafts and nets and then destroying or allowing the masses to float out to salt water.
3. Burning.
4. Spraying with chemicals including salt water, muriatic acid, sulphuric acid, carbolic acid, kerosene, mixture of salt water and quick lime.
5. Placing log booms so as to permit flotation downstream, but prevent plants drifting upstream.
6. Mechanical destruction by cutting or chapping.

All of these methods were relatively ineffective, costly or for other reasons not desirable. Now, fortunately, with the advent of 2,4-D, we have a chemical that can be successfully used for hyacinth control, thus directly and indirectly increasing the efficiency of our mosquito control program.

History Of Hyacinth Control In Florida

By Angelo Tabita[1] and John W. Woods[2]

Synopsis

Removal of the water hyacinth from the waters of the State and the search for efficient means of accomplishing destruction or control started before 1900, not too many years following the plant's introduction and the beginning of rapid spread. The Corps of Engineers — by authority of the Congress of the United States — and the Florida Game and Fresh Water Fish Commission are two of the principal agencies which have played a significant role in the battle against the water hyacinth. The activities of these two agencies are described herein.

Introduction

The history of man and often his survival has been one of endless battle against the forces of nature. At the outset, and surely by design, the pressures of vegetable and animal life for a dominant position on the earth were kept in balance. Often, by accident, displacement will upset a natural balance and other forms of life are endangered unless a check is provided. This has been the case of the water hyacinth in the United States where in the absence of natural enemies to inhibit its spread it has been necessary for man to employ all possible means to destroy it or prevent its further incursion. Losses from hyacinths and other undesirable plant growth have been tremendous. This paper describes, mainly, the roles of the Corps of Engineers and the Florida Game and Fresh Water Fish Commission in hyacinth control in the State of Florida.

The Water Hyacinth

Description. The water hyacinth is a fresh-water, free-floating plant with bulblike leaf bases and a bushy mass of fibrous roots 6 to 24 inches long. The plant varies in form and size; it has dark green leaves and a spike of lavender flowers. The plant produces seeds which either settle to the bottom or become enmeshed in the mat of floating vegetation; they may germinate after being dormant for 7 years or more. Two crops of plants will mature directly from the seeds during warm weather months, and a third crop will be in such condition as to mature early in the following spring. The principal method of reproduction is by stolons which develop rapidly into healthy plants that generally break away from the parent plant and produce their own individual stolons. The plants have a water content of 94 percent. They form a dense mat on the water and are cabable of doubling in area every month of the growing season.

History. Accounts vary as to the origin of the hyacinth and the manner of its introduction into this country. It is believed to be a native of tropical South America and it was introduced into this country many years ago. Earliest accounts indicate

[1]Hydraulic Engineer, U. S. Army Corps of Engineers, Jacksonville, Fla.
[2]Chief, Fisheries Division, Florida Game and Fresh Water Fish Commission, Tallahassee, Fla.