AQUATIC WEED CONTROL

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SUMMARY

PRELIMINARY trial work has been initiated on the control of submerged and floating aquatic weeds with liquid and granulated materials based on fenac, 2,4-D, and 2,4,5-TP. The most promising material is 2,4,5-TP applied both as a liquid and granules.

The aquatic weeds that are troublesome in New Zealand are described and the difficulties in carrying out aquatic weed control trials are discussed.

Aquatic weeds fall into three arbitrary types: submerged, floating, and emergent groups. This paper is a preliminary report on the more difficult to kill floating and submerged aquatics.

The main floating and submerged aquatics that are troublesome as weeds in New Zealand are the duckweeds (usually a mixture of *Lemna minor, Wolffia arrhizia* and *Spirodelia oligarrhizia*), *Potamogeton* species, Cape pond weed (*Aponogeton distachyus*), water thyme or Oxygen weed (*Anacharis* (*Elodea*) *canadensis*), eel grass (*Vallisneria ovalifolia*), *Callitriche verna,* the water fern *Azolla filiculoides* var *rubra,* and algal slime made up of such genera as *Spyrogyra* and *Ulotrix,* also *Lagarosyphon major.* As compared with emergent aquatics such as *Jussiaea diffusa, Ludwigia palustris,* raupo (*Typha angustifolia*), *Glyceria* species, water hyacinth (*Eichhornia crassipes*), *Apium nodiflorum,* water cress (*Nasturtium officinale*), the monkey musk (*Mimulus* species), and water plantain (*Alisma plantago aquatica*), the submerged and floating aquatics are usually difficult to kill and to date no sound recommendations can be made for their control.

With the exception of *Potamogeton* species, the submerged and floating aquatics are usually associated with near to still water or even stagnant water. In confined areas where water movement is nil or slight the control of the more competitive species such as *Glyceria* has allowed the growth of submerged and floating aquatics. This occurs in the Hauraki Gulf area where *Callitriche verna* and duckweeds often appear after the control of *Glyceria* spp. In other areas where emergent growth has slowed the progress of water, control of the emergent weed growth has often led to the control of submerged and floating aquatics. This has occurred in irrigation districts in Central Otago. An appreciation of these factors has often led to simplified control of the less troublesome species such as *Callitriche verna* and the duckweeds.

CHEMICAL CONTROL

A range of chemicals have been tested under New Zealand conditions. For most chemicals only interim results are available.

Chlorinated Aromatics

These materials have been tested very extensively and have not gained in popularity largely because of the ineffective control of weeds, their high cost, and disagreeable properties. Their main use is in slow moving water such as in small ditches. Where water movement is rapid so much chemical is required that cost is prohibitive. For such areas a better approach is to kill emergent weeds with dalapon, dalapon/amitrol, or dalapon/amitrol/2,4-D mixtures, depending on type of weed growth present. If floating or submerged aquatics are still troublesome, chlorinated aromatics applied as a surface spray are more effective than the injection method. The duckweeds, *Callitriche verna, Azolla filiculoides* var *rubra,* are effectively controlled by this method. The concentration of 2,4-D used 2 lb acid equivalent per acre, is usually sufficient to check or kill the above incipient species.

The most troublesome weeds are *Potamogeton* species and eel grass. These plants are not affected by normal 2,4-D concentrations and control is doubtful with 2,4,5-TP. They regrow rapidly after having been checked with chlorinated aromatics. They normally occur in fast moving water and it is doubtful if water progress is impeded materially by these species.

Arsenical Preparations

No trial work has been undertaken with these materials, though the results of large scale sprayings are available. Their use is not warranted, though at sufficiently high concentrations there is no doubt of their extreme effectiveness both in killing weeds such as water thyme and fish.

At concentrations of 2 to 5 p.p.m. the arsenicals are not lethal to most fish, but weed control is poor, particularly in large areas of water.

2,4-D, 2,4,5-TP, and Fenac.

Recently these materials have had preliminary testing in large tracts of water against a mixture of water thyme and *Lagarosiphon major*. At the concentration employed of 5, 10, and 25 p.p.m. for the first acre/foot of water 2,4,5-TP was superior to 2,4-D. Fenac was also superior to 2, 4-D, but was inferior to 2,4, 5-TP.

In more recent trials in large ponds of water where 2,4,5-TP granules were compared with liquid 2,4,5-TP this latter preparation has given the quickest results. The trial was laid down on 24 May 1960 on *Lagarosiphon major* and water thyme, using 2,4,5-TP granules at $3\frac{1}{2}$, 7, and 14 p.p.m. and liquid emulsifiable 2,4,5-TP at 6 and 12 p.p.m. To date the high rate of 12 p.p.m. has given an 80 to 90 per cent knockdown of the *Lagarosiphon major* and water thyme, whereas the granulated materials show no effect.

In a small pond 2,4,5-TP as a liquid preparation applied at 4.8 lb to the acre/foot of water gave a concentration of less than 2 p.p.m. and severely checked water thyme. This treatment plus a determined effort at hand removal followed by a repeated application of 2,4,5-TP appears promising.

2,4,5-TP is a highly safe material to employ where fish have to be considered. Toxicity tests undertaken by the Marine Department showed that trout were not affected at concentrations of 50 p.p.m. Furthermore the fish were repelled by 2,4,5-TP granules and vacated the area, further reducing the chances of poisoning. Toxicity tests were not completed on 2,4-D and fenac, but both these materials were possibly more toxic than 2,4,5-TP.

Though no strict comparison has been made, these materials are less dependent on warm water for activation than the chlorinated aromatics and acrolein.

Acrolein

To date this material has not been tested experimentally in New Zealand. Owing to its properties acrolein, if effective, will mainly be confined to areas where fish are not important. Its action is probably purely contact as for the chlorinated aromatics, so that regrowth may be expected from rooting perennials such as *Potamogeton* spp., etc.

Azolla filiculoides var. *rubra*

This species and algal slime are becoming increasingly prevalent on ponds used for watering stock. Experiments have shown it is definitely killed by PCP in diesel fuel oil at a rate of 4 lb PCP to 20 to 40 gallons of diesel fuel oil per acre. This is the case for related genera, *Salvinia* and *Isoetes;* the former is troublesome in paddy fields in the Middle East. Reinfestation is usually rapid, so that repeated applications are necessary.

The growth of *Azolla* in stagnant ponds may be interdependent on algal slime, the latter supplying nitrogen to the *Azolla*. Experiments have included the addition of simazine at 5 p.p.m. in an attempt to control the algal slime. If this is successful, reinfestation should not occur to the same extent.

Trial Design

Trials on species such as water thyme, when growing in a large tract of shallow water, are difficult to conduct.

The rather disappointing results obtained to date on these species and *Lagarosiphon major* are due probably to the quick diffusion of the small amount of material applied before it is absorbed by the weeds.

This is particularly the case with liquid rather than granular application.

If more than one chemical is employed, plots must be separated by a considerable buffer. From the trial work done to date it is considered the minimum effective plot size is 1 acre and preferably larger for plots where liquid applications are made.

Permanent Control

Permanent control of floating and submerged aquatics cannot be expected from the use of weedkillers. The species contents of the area may be changed, but as it usually is impossible to alter the ecological conditions that first allowed the weeds to grow, any weedkiller application is but a temporary measure.

Over a period of five or six years water hyacinth was controlled in Lake Rotorua with 2,4-D. As the competitive effect of this plant was removed water thyme and *Lagarosiphon major* replaced it. To date these species are probably just as troublesome as water hyacinth and certainly more difficult to control.

On land it is possible to dictate the type of plant growth present so that weed control is positive. The reverse is usually true for aquatics and positive control may be obtained only after a long period of weedkiller use.

Summary of Species Control

1. Submerged and floating aquatics are more difficult to control than emergent aquatics.
2. The most satisfactory control of incipient species such as *Callitriche verna* and duckweeds is usually obtained in drainage areas by removing the emergent aquatics, allowing better movement of water.
3. The use of chlorinated aromatics and possibly acrolein may be confined to the control of *Potamogeton* species, cape pond weed, *Ottelia ovalifolia,* and eel grass as an injection method. As a surface application chlorinated aromatics should prove satisfactory on *Callitriche verna,* duckweeds, and *Azolla filiculoides* var. *rubra* in stagnant or near stagnant waters.
4. The toxicity of chlorinated aromatics and acrolein precludes their use for control of *Lagarosiphon major* and water thyme in large tracts of water inhabited by fish. The most satisfactory control of these species will probably be obtained with 2,4,5-TP applied as granules to give a bottom concentration of 2 to 5 p.p.m. in the first acre/foot of water.

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DISCUSSION

Q.—Could the speaker describe the composition of the granules mentioned in his paper?

A.—They were mostly 10 per cent. material plus filler.

Q.—Has sulphur been used for depositing chemicals on weeds, as in Victorian work?

A.—It is thought that the use of sulphur had not been particularly satisfactory and has been largely superseded by granules.

Q.—Does pollution result from killing weeds in small ponds?

A.—In the use of PCP in small ponds breakdown is very rapid, but a fresh strike of *Azolla* takes place within one month. For control applications may have to be repeated for six months from autumn to spring.

Q.—Have you used soil sterilants of low solubility; for example, monuron has power to sink to bottom and sterilise soil.

A.—Have tried soil sterilants with not much success in water. Have had control where material is applied to a dry surface such as the bottom of a ditch which was subsequently covered with water.

Q.—Has any work been done in the south, where the temperature is colder and the use of granules on frozen ponds would be an easy application technique.

A.—Do not know of any work in New Zealand, because it is difficult to find a frozen pond.

Comment: 2,4-D should not be dismissed. One could use more 2,4-D than 2,4,5-TP because of the price differential. Acrolein is extremely toxic to mucous membranes, and must be injected into the soil.

Q.—Would the decomposition of organic matter remove any oxygen from the water and so seriously affect fish life, whereas the material is normally non-toxic.

A.—Toxicity tests were done in an aquarium. There is usually sufficient deep water for fish to go where serious weeds such as water thyme are treated.