The Water Hyacinth *Eichhornia crassipes* in the Ba River, Western Viti Levu, Fiji

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1980

Report of the Institute of Marine Resources.
The University of the South Pacific, Suva, Fiji.

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CONTENTS:

1. INTRODUCTION:

Although originating in South America, the water hyacinth, Eichhornia crassipes causes problems and is classified as a weed in over 50 countries. The spread of aquatic weeds is a global problem, but it is more severe in tropical countries where warm water and high levels of nutrients encourage the rapid growth of aquatic plants. The excessive growth of aquatic weeds has a variety of undesirable effects including choking rivers and drains, interfering with fishing and river traffic and causing undesirable tastes and odours in the water. In addition, large masses of weeds allow stagnant areas of water to form; such areas provide breeding pools for mosquitoes, thereby encouraging the spread of mosquito-borne diseases.

The water hyacinth is a free-floating plant bouyed up by bladder shaped leaf stems. The plant forms attractive blue flowers. The main method of reproduction is by forming vegetative offshoots. The plant therefore, increases to form dense floating mats and several thousand plants may develop during one season from a single original plant. (Klingman 1966).

This present brief survey was conducted at the request of Ba Jaycees Inc., the members of which, expressed concern at the presence of the water hyacinth in the Ba river.

2. INFESTATION OF THE BA RIVER

A survey using an outboard-powered boat was conducted along the Ba River approximately between the villages of Nailega and Vagia (figure 1). Infestations of the water hyacinth were of 3 basic types :-

1. Small to large floating masses of weed. These masses tended to move up and down river with the tide.
2. Floating Masses of weed clinging to the river bank. In many cases, grasses form the shore have invaded and were growing in these masses.
3. Floating barriers of weeds. Some smaller creeks were totally blocked by masses of weed.

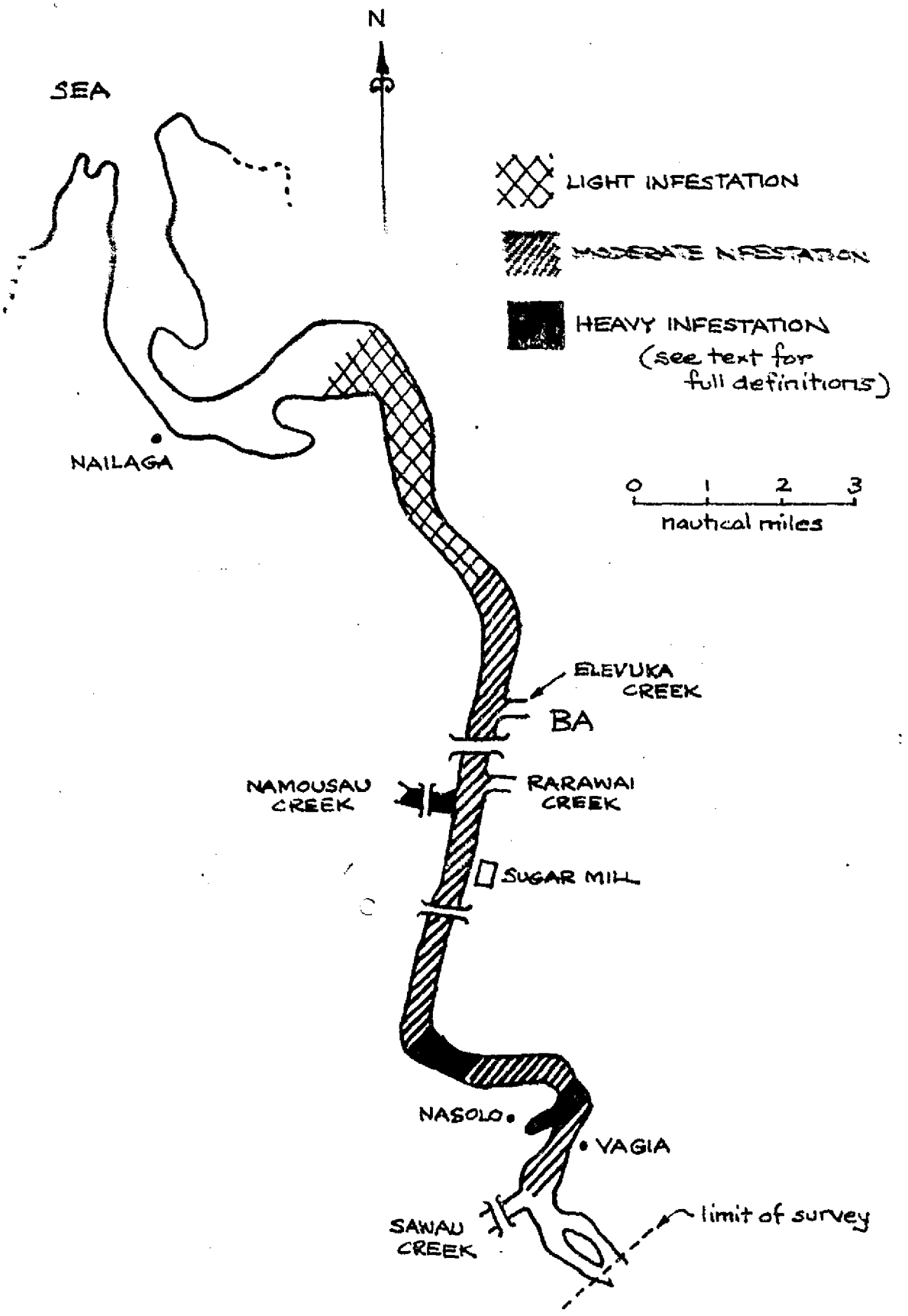

FIGURE 1: Map of the Ba River, Western Viti Levu, Showing the degree of water hyacinth infestation. Light infestation (cross-hatch shading) refer to areas where isolated clumps of weed were found. Moderate infestation (oblique shading) refers to areas with large mats drifting or clinging to the river bank. Heavy infestation (s d black) refers to areas with large anchored mass weed or creeks completely blocked

The general distribution of the water hyacinth in the Ba River is inreated in figure 1. In one heavily infested area (Namousau Creek) the density of weed was over 18 plants per square metre, equivalent to over 14 kg wet weight per square metre. In figure 1, heavily infested (solid black) refers to areas completely blocked or containing large anchored masses of weed. Moderately infested (oblique shading) refers to areas with extensive areas of weed clinging to the bank and large floating mats. Light infestation (cross-hatch shading) refers to areas where isolated clumps of weed were found clinging to the bank or moving with the tide.

Diving observations showed that the floating mats of water hyacinth support a large number of small fish, crustaceans (shrimps) and insects. The floating mats were not attached to the bottom and often there were several metres of clear water beneath the plant masses. The feather-like root systems contained large quantities of fine silt, presumeably filtered out from the flowing river. Sometimes land plants encroaching onto the masses of hyacinth, sent down roots and were anchored to the river bottom in shallow areas. Many large stationary masses appeared to be forming around fallen trees or other obstructions in the river. It appears that extensive stationary mats of the weed may form through a succession of anchoring devises - i.e. by plants first collecting around obstructions such as fallen trees or projections from the river bank. More hyacinths are likely to drift against the growing mass and tangle with other plants on the river bank. Grasses from the shore grow into the floating weeds and provide a more secure anchorage for the mass.

The present rapid growth of the water hyacinth in the Ba River and the resulting infestation are reported to have begun about 6 to 9 months ago. (January to March 1980).

3. METHODS OF CONTROL:

Control is the process of reducing and limiting weed infestations to acceptable levels. Various methods of control have been used at varying degrees of expense and success against aquatic weeds; most of these can be described as either chemical, biological or mechanical control measures.

a) CHEMICAL METHODS OF CONTROL

Although chemical methods are commonly used to control aquatic weeds, their use often involves risks to other forms of plant and animal life. In such an area as the Ba River where much of the local economy is based on fishing and river-side agriculture these risks may be unacceptable.

Some chemicals, such as sodium arsenite which is sometimes used to control aquatic weeds, are highly toxic and concentrations of more than 0.05 ppm are hazardous to humans. Rice which is commonly grown in parts of Viti Levu is reported to be extremely sensitive to arsenic. Most herbicides will also kill phyto-plankton (microscopic floating plants) and other algae, causing many herbivous fish to starve. The mouths of large rivers are generally regarded as important in providing nursery areas, in which many commercial fish spend the early part of their life-cycle. In addition the long term effects of many herbicides are yet to be studied.

In spite of possible dangers associated with their use, chemical herbicides often represent the easiest and most efficient method of controlling aquatic weeds. The chemical 2,4-D (2,4-dichloro-phenoxyacetic acid) is highly effective in killing water hyacinth when used in concentrations of 1.1 to 4.5 kg. per ha of water. Treatment with this concentration will usually cause the weed mats to sink in about 4 to 8 weeks. The treatment should be repeated 8 weeks after the first application and once a year thereafter. (Klingman, 1966). 2,4-D is readily available in Fiji and is generally sold under the name "Cane Spray".

It should be noted that particular chemicals cannot be used in Fiji to control weeds unless then have been approved by the Registrar of Pesticides. Professional advice on the application of chemicals should also be sought from the Ministry of Agriculture and Fisheries.

b) BIOLOGICAL CONTROL

Biological control involves the use of fish, insects, parasites, pathogens or other living species to reduce the population density of the aquatic weed. The classical approach is to introduce a natural enemy of the weed from the weed's country of origin (South America in the case of the water hyacinth). The main advantages of biological control are that its' effects are long-term (i.e. control is continual) and therefore relatively low-cost in the long-run. In addition there are less likely to be harmful side effects.

The basic research, however, which is needed to discover, test introduce and establish a suitable pedator species is expensive. Because of this, biological control is beyound consideration by individuals and is usually undertaken by government research institutions. In Fiji, research is continuing into the use of a South American beetle for the biological control of the water hyacinth. Initial results have shown that the beetle quickly becomes established in weed populations (S.R.Singh, personal communication). Concerned individuals and citizen groups could reasonably ask that regular reports of such research are made available to the public.

c) MECHANICAL CONTROL

Mechanical removal of aquatic weeds is often the most simple and safest way of treating infestations. Methods range from simple hand picking of weeds to the construction of mechanical cutting or harvesting machines. Many of these methods especially weed removal by hand, require a large amount of labour.

Although the development and building of efficient cutting machines can be more appropriately carried out by large institutions and engineering firms, it is possible to design simpler gear that can be built and used by small groups. A specially designed instrument such as the rake or grapnel, shown in figure 2, could be used. The grapnels could be constructed from cheap materials (steel rods and angles)

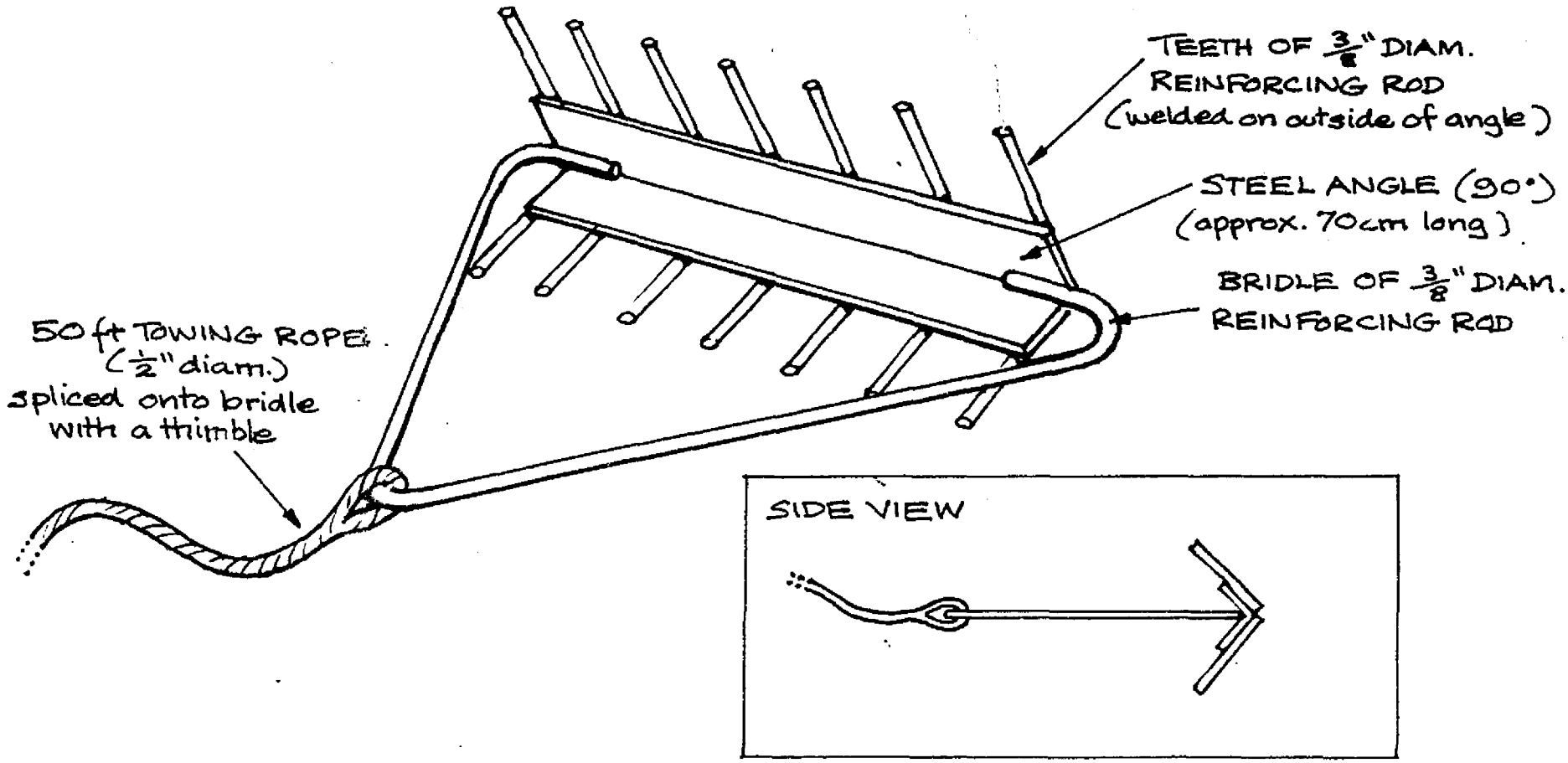

FIGURE 2: A grapnel designed for towing masses of floating aquatic weeds.

and can be used in the following manner. The grapnel is securely fastened to a boat fitted with an outboard motor; the grapnel is then thrown over the top of a quantity of floating water hyacinth. As the teeth bite into the weed mass, the slack in the rope can be taken up and the boat's motor can be engaged. The boat then proceeds to tow the captured portion of weed away from the floating mass. The amount of weed torn away will be related, of course, to the power of the boat's engine. This operation can be repeated, ideally using several boats, to clear masses of weed away from banks and the mouths of blocked creeks.

The method of using grapnels to control weeds is likely to be labour-intensive but may be practical where the use of boats can be donated and large numbers of volunteer workers are available. The main problem with organising such a project is in it's timing. The project would have to be undertaken after rains were sufficient to cause a reasonable amount of flow in the river. At such a time, clumps of weed towed away from the river banks and out of creeks, would be carried out to sea.

4. DISCUSSION

The control of excessive growths of aquatic plants is difficult; much more so than the control of terrestrial weeds. The use of chemicals on aquatic weeds is costly and the aquatic environment may be put at risk. Any adverse effects are not likely to be as localised as they are in the use of herbicides on land.

The use of sophisticated machines is also correspondingly more difficult on or near water. The cost of building and using such machines to harvest aquatic weeds may be amortised by using the weeds in some way. The water hyacinth can be used as stock food, fertilizer or in the manufacture of paper (Nat. Academy of Sciences, 1976). Research is also being carried out on the possible use of the hyacinth in generating gas for industrial or domestic use (R. Solly. personal communication).

However it is not likely that any of these uses make harvesting the water hyacinth economical at present.

In general, chemical, biological and the more sophisticated methods of mechanical control and use of aquatic weeds must be left to governmental or other large institutions. These institutions are likely to have the financial backing and expertise to successfully carry out such a project. Part of the problem of aquatic weed control in Fiji is that the authority responsible for such control is not clearly defined. It is not made clear to the general public which of several authorities including local councils, the Ministry of Health and the Ministry of Agriculture and Fisheries is involved.

5. SUMMARY

The water hyacinth, Eichhornia crassipes, is present in the Ba River in varying degrees of concentration. Some tributaries to the river are so blocked by the weed that boats are unable to pass. In heavily affected areas concentrations exceeded 14 kg wet weight per square metre.

Sophisticated methods of controlling aquatic weeds by the use of biological and/or chemical agents are generally not aamenable to use by other than professional organisations. Biological control usually involves long and costly searches for natural enemies and pathogens. The use of chemicals, although highly effective against aquatic weeds, may involve risks to other forms of aquatic life as well as the user. Expert advise should be obtained on the use of such herbicides. The government should also be pressed into defining where responsibilities lie, in respect to the control of aquatic weeds. In addition, the public should be kept informed of investigations into long-term solutions to the problem.

A mechanical method of control is suggested, using towed grapnels to drag the mats of water hyacinth either up onto the river bank behind tractors or out into faster-flowing areas of the river behind outboard-powered boats. The method is likely to be labour-intensive but perhaps practical where large numbers of volunteer workers can be organised by public-spirited groups.

6. ACKNOWLEDGEMENTS

This brief survey was carried out at the request of Ba Jaycees Inc. through the president Mr. Mohammed Nazim and the immdeiate past-president Mr Bimal Rishiram. A boat was kindly supplied for the survey by Mr Vinod Nagan and fuel by Mr Ahmed Hai of the Central Trading Co. Ltd. Ba.

Dr R. Solly of the U.S.P. and Mr Satya R. Singh, Principal Research Officer at Koronivia Research Station kindly provided information.

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8. GLOSSARY OF TERMS

ACTIVE INGREDIENT (ai)	The chemical in a product that is responsible for the effects.
ACUTE EFFECT	Rapid and severe (opposed to chronic effect).
AMINE	A class of compound derived from ammonia by replacing the hydrogens with organic radicals.
ANNUAL	A plant that completes its life cycle from seed in 1 year.
AQUATIC PLANTS	A plant that grows in water. There are three kinds: submersed, which grows beneath the surface; emersed, which root below but extend above the water, such as cattails and water lilies; and floaters, such as water hyacinths.
BAND APPLICATION	An application to a continuous restricted area such as in or along a crop row rather than over the entire field area.
CHRONIC EFFECT	Slow and long continued effect.
CONTACT HERBICIDE	An herbicide that kills primarily by contact with plant tissue rather than as a result of translocation.
CONTAMINATE	To alter or to render a material unfit for a specified use, as by the introduction of a chemical.
CONTROL	The process of limiting an infestation.
CROP	Useful plants growing where desired.
DELAYED ACTION	As opposed to immediate effect. Some herbicide chemicals (2,4-D; 2,4,5-T; MCP; dalapon) provide a delayed response. Considerable time may elapse before maximum effect can be observed. Usually treated plants stop developing soon after treatment, then gradually die.
GRAPNEL	An instrument with steel teeth used to seize floating or sunken objects.
HERBICIDE	A chemical used for killing or inhibiting the growth of plants.

NECROSIS	The death of all or a part of the plant.
NONSELECTIVE HERBICIDE	An herbicide that can be used to kill plants generally without regard to species.
NOXIOUS WEED	A weed arbitrarily defined by laws as being especially undesirable, troublesome, and difficult to control. Definition will vary according to legal interpretations.
p.p.m.	Concentration in parts per million.
RATE AND DOSAGE	These terms are synonymous. Rate is the preferred term. Rate refers to the amount of active ingredient material (such as 2,4-D acid equivalent) applied to a unit area.
RESIDUAL	To continue over a period of time to have a killing effect on all or specific life forms.
SELECTIVE HERBICIDE	An herbicide that will kill some plant species when applied to a mixed population, but without serious damage to other species.
SENSITIVITY	Not capable of withstanding effects. Many broad-leaved plants are sensitive to 2,4-D.
TOLERANT	Capable of withstadning effects. For example, grasses are tolerant of 2,4-D to the extent that it can be used selectively to control broad-leaved weeds in cereals, pastures, and turf.
TOXIC	Poisonous; injurious to animals and plants through contact or systemic action.
WEED	A plant with a negative value; a nuisance; an organism which causes a diversion of energy from a direction desired by man.
WEED CONTROL	The process of limiting weed infestations so that crops can be grown profitably or other operations can be conducted efficiently.
WEED ERADICATION	The complete elimination from an area of all live plants, plant parts, and seeds of a weed infestation.