necessitate early application of postemergence herbicides to anoda weed and hairy wandering jew for worthwhile control.

Acknowledgements

I am grateful to Mr G. R. Harch for technical assistance and to my colleagues in the Queensland Department of Primary Industries for their advice.

References

Chandler, J.M. and Oliver, L.R. (1979). Spurred Anoda — A potential weed in southern crops. *Science and Education Administration, Agricultural Reviews and Manuals, Southern Series, No. 2.*

Gummesson, G. (1976). Weed control in peas and field beans. Weeds and weed control. *Proceedings of the 17th Swedish Weed Conference* **17**:66–9.

Lubigan, R.T., and Mercado, B.L. (1977). Chemical control of *Scirpus maritimus* and mixed *S. maritimus–Echinochloa crus-galli* populations in lowland transplanted rice. *Philippine Agriculturist* **60**:280–4.

McWhorter, C.G. and Barrentine, W.L. (1979). Weed control in soybeans *(Glycine max)* with mefluidide applied postemergence. *Weed Science* **27**:42–7.

Oliver, L.R., Lambert, W.M. and Mathis, W.D. (1976). Overtop herbicide applications for cocklebur control in soybean. *Proceedings 29th Annual Meeting Southern Weed Science Society* **29**:96–102.

Rawson, J.E., Langford, S., Saint-Smith, J.H., Colbran, R.C. and McCarthy, G.J.P. (1972). Peanut growing. *Queensland Agricultural Journal* **98**:506–12.

REVIEWS

Perspectives and priorities in weed research and control

The First Council of Australian Weed Science Societies Oration, given at the Seventh Conference of the Asian-Pacific Weed Science Society, Sydney, 1979.

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In their challenging preface to *The World's Worst Weeds*, Holm, Plucknett, Pancho and Herberger (1977) questioned the priorities of a world that can put man on the moon but cannot feed all its people. They suggested that this situation may have arisen because weeds have always been rather casually accepted as an inevitable nuisance whereas the knowledge needed to construct and operate enormous buildings, supersonic aircraft and space vehicles has been developed comparatively recently. We build these things, not because we really need them but because we have the technology to do so.

Furthermore, many millions of dollars are spent on research into the biology and control of a few species of weeds of secondary importance for world food production but several of the world's most destructive weeds cannot be controlled in many of the crops where they are found. They asked bluntly 'Have weed scientists got their priorities right?'

From the distant hill of retirement, I make bold to take up this challenge, to look at weed problems in perspective and to make some personal comments on priorities. I have no new facts to offer and most of the points I shall make have been made before. I do not expect everyone to agree with what I say but perhaps I may leave you with some food for thought.

My comments are based on the concept that without man there are no weeds — they are merely plants. Just as beauty is in the eye of the beholder, so our perception of a plant as a weed depends on our point of view.

In 1608, William Shakespeare described in poetic terms the fate of neglected farm land and the impact of weeds (*King Henry the Fifth*, Act V, Scene II). Describing the state of France after years of war, the Duke of Burgundy lamented

> And all her husbandry doth lie on heaps,
> Corrupting in its own fertility.
> .... her fallow leas
> The darnel, hemlock and rank fumitory,
> Doth root upon, while that the coulter rusts
> That should deracinate such savagery;
> The even mead, ...
> Wanting the scythe, all uncorrected, rank,
> Conceives by idleness and nothing teems
> But hateful docks, rough thistles, kecksies, burrs,
> Losing both beauty and utility.

Plants become weeds only when they affect man's activities by restricting the quantity or quality of food, fibre or industrial materials he grows for his use, by affecting his health or by offending him in some other way.

Virtually all aspects of weed research, management and control are influenced by this concept. If we forget it or ignore it, we may either fail to follow the most profitable paths in research or management or squander time and material resources in work that is not really relevant to the needs of the human communities we are trying to serve.

After 30 years of personal involvement in weed research, extension, administration and legislation, I am no longer part of the daily struggle. Looking back at the battlefield I can see it in better perspective, yet remain conscious of the elements that make up the scene. First I propose to look at the nature of weed problems, then try to analyse the elements that comprise them and finally to consider some means for resolving them.

The nature of weed problems

Weeds have posed problems for man ever since he moved away from the role of hunter and food gatherer and learned to grow plants and manage animals for his own use. During this evolutionary process he has changed and is changing stable ecosystems into unstable ones. The more extensive and intensive his activities become, the greater is the instability he imposes on natural ecosystems and the greater are the problems of coping with diseases and pests that affect the plants he is trying to grow. Although it is widely recognized that weeds are the most damaging and costly of all the pests that limit agricultural production, these unwanted plants are often taken for granted.

I do not accept the simple, rather trite definition that a weed is 'a plant out of place'. This may be apt from the human point of view but from the plant's point of view it is entirely wrong. We must accept that a weed is a plant in the best possible place – for the plant. Weeds are successful plants that survive and flourish in spite of our efforts to kill them or suppress them.

To me, a weed is simply a plant growing in a place where we do not want it to grow. It is important to keep in mind that the 'we' in this context is always related to the realities of a particular human culture and pattern of land use. It is literally true that one man's weed can be another man's crop or *vice versa*.

Since weed problems are created by the activities of man and since we are concerned primarily with their effects on man, it is man's responsibility to resolve them. The measure of his success lies in his ability to maintain or improve levels of productivity or quality of life, either by controlling the unwanted plants or learning to live with them.

The farmer knows which plants he is trying to grow and which ones he considers to be weeds. He may not be fully aware of the extent of his losses due to weeds but he knows he would be better off without them. However, often he finds it impossible to kill them all so he has to make decisions as to what actually can be done with the resources at his disposal. At the community level, such decision making becomes even more difficult and complex.

If we are to make rational decisions in respect of research, management or control, we need to know which weeds are impairing productivity, whether they are associated with particular crops, cropping systems or other land use practices and whether the problems have existed for a long time or are relatively recent. Only then can we proceed to logical consideration of the elements of the problem.

The elements in weed problems

There are many elements involved, all interacting with one another in a complex, almost infinitely variable pattern of permutations and combinations.

The principal elements as I see them fall into the three main groups shown in Figure 1 and set out in some detail in Table 1.

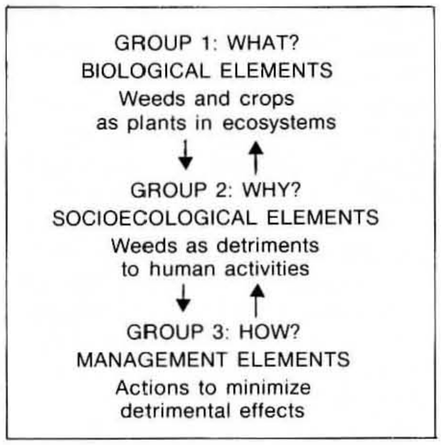

Figure 1 Elements in weed problems

Table 1
Elements in weed problems

GROUP 1: BIOLOGICAL ELEMENTS
weeds and crops as plants in ecosystems

GENETIC	ENVIRONMENTAL
Identity of plants: species: biotypes	Substrates: nature: physical state
Morphology: morphogenesis	Available nutrients and moisture
Anatomy: growth form	Precipitation: nature: amount: distribution
Means of propagation and dispersal	Temperature: humidity
Genetic constitution	Light: photoperiod
Mutations	Wind
Breeding mechanisms: apomixis	Time
Life history: competitive ability	Fire: disturbance
Physiology: allelopathy	Predators: diseases
Reaction to herbicides	

GROUP 2: SOCIOECOLOGICAL ELEMENTS
weeds as detriments to human activities

Nature of human communities	Total resources
Life styles, traditions and habits	energy and materials
Patterns of land use	knowledge and skills
Community needs and desires	time
for foodstuffs	Community capacity for change
for other products	Community attitudes to change
Present effects of weeds	
on land use and productivity	
on people	

GROUP 3: MANAGEMENT ELEMENTS
actions to minimize detrimental effects

Community needs and aspirations	Available resources
Acceptable goals	Management implementation
Objectives	methods
Motivation and incentives	organization
Effects on community	execution
short-term	Costs and returns
long-term	Effects on environment

These elements interact with one another both within and between the groups. Almost any of those in the biological and socioecological groups can directly limit or exacerbate a weed problem or can impose constraints on management strategies. Those in the management group can influence the behaviour of the weeds, crops and human communities directly or indirectly. They can either act as constraints or offer opportunities for changing the quality of human life or patterns of land use.

In the biological group, most of the elements can be observed or measured. Objective assessment, therefore, is theoretically possible. It is not always achieved in practice, either because facts are not available for all relevant parameters or because decision makers do not give sufficient weight to this kind of information.

Some of the elements in the socioecological group are tangible enough to permit objective assessment but many involve value judgements and can only be assessed subjectively. As with any subjective assessment, conclusions depend not only on the situation but also on the perception, experience and background of the assessor.

In the management group, virtually all the elements call for subjective judgement. Their successful synthesis requires managerial skill and executive ability as well as an understanding of relevant biological facts, appreciation of socioecological situations and access to appropriate resources.

The resolution of weed problems

As weed scientists we should keep in mind that we ourselves do not control the weeds in the field. That is the function of the farmer, grazier, rancher or specialist operator. Certainly we should contribute knowledge and we should try to help in developing skills. However, without motivation, resources and hard work by many people, all the knowledge in the world will not kill one weed or mitigate its effects on the economy.

The primary task of weed scientists is to gather and evaluate facts about the nature and behaviour of particular weedy plants and the ecosystems in which they occur, to determine their reactions to various treatments or to help in devising methods for managing or controlling them. Before we commit limited resources of time, manpower, energy, money and materials to research, extension or control activity, we must look seriously at the question 'Why is this plant considered to be a weed?'

As emphasized by Quinlivan (1972) we need to examine the basis for deciding whether a particular plant is good or useful, of indifferent value or whether it deserves the disreputable status of a weed. Most of all, we need to know as much as possible about the nature of the plant, its behaviour, its place in particular ecosystems and its effects on human activities.

There are no general answers applicable to the same plant in all situations and in all human communities. The question must be examined in the socioecological context of particular situations within each particular human culture. Criteria for deciding when a plant becomes a weed vary from culture to culture and may change with changes in patterns of land use, life styles, community needs or aspirations.

To be more specific, I offer Table 2 as an example of the kinds of questions we should consider before making major commitments to research, extension or control work on weeds.

Often these questions are not asked at all and decisions on research and control of weeds are made on the basis of expediency, emotion or political pressures from particular sections of the community. Frequently, these decisions are made without any real understanding of relevant biological and ecological facts or awareness of possible ecological consequences. Sometimes they are based on an unspoken assumption that present patterns of land use will continue and that present resources will always be available. Often there seems to be unbounded faith in the capacity of science and technology to produce new materials or devise new techniques for retrieving the situation if things go wrong.

However, we are now aware that many agricultural and pastoral ecosystems are fragile and that in maintaining them we have been drawing heavily on fossil resources, particularly hydrocarbons. These resources are not unlimited and some of them are diminishing at an alarming rate.

In many communities, increased productivity of crops and pastures has been achieved by greater dependence on monoculture. Many systems of monoculture have aggravated weed problems and have left us ex-

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Table 2

Resolution of weed problems: Questions to be asked

1 Is the plant impairing productivity, increasing costs or otherwise adversely affecting human activities?
2 What are the weedy characteristics of the plant? Is it
- an invader of disturbed land?
- a survivor of the original vegetation?
- an unsown species taking advantage of conditions created for the growing of crops or pastures?
- a plant adapted to replace sown species on a degrading ecosystem?
- a plant occupying unused land?
- a plant with intrinsically harmful or undesirable characteristics?

3 Has the plant any useful properties?
4 Has the plant reached the limits of its potential ecological range?
5 Is the plant a new arrival?
6 Does the plant adversely affect human communities elsewhere?
7 If so, are our socioecological situations similar to those where the plant is troublesome?
8 Do local populations of the plant comprise more than one biotype?
9 Have the species and biotypes been positively identified?
10 Are local biotypes identical with those troublesome elsewhere?
11 Is there a possibility of spontaneous cross-breeding between biotypes?
12 Is adequate information available on morphology, means of propagation, competitive ability, physiology, ecological preferences and reactions to control agents for the biotypes concerned?
13 To what extent can the plant be tolerated in our own situations?
14 Are present local practices adequate to keep it within acceptable limits?
15 Are more effective, more efficient, less costly or less time-consuming control methods known?
16 Would these methods be applicable in our own socioecological situations?
17 If so, what additional inputs of knowledge, skill, energy, materials, money or other resources would be required?
18 Are these resources available and, if so, would returns justify the extra costs involved?
19 What are the likely consequences of taking no specific action to control the weed?

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tremely vulnerable to shortages of energy, fertilizers and pesticides. In some cases, the very crops or pasture plants we have introduced to increase productivity have proved to be troublesome weeds or poisonous plants.

Priorities

Because weed control is only one field that makes demands on our limited resources of time, knowledge, skill, money and materials, it is important to consider carefully our priorities in implementing research, extension and management activities. Decision making in this, as in any other field of human endeavour, is a political process.

Politics has been defined as the science of civil government and is often described as the art of the possible. In practice, it often seems to be more artful than scientific. Be that as it may, it is desirable that political decisions should be made only after careful assessment of facts and possibilities. It is our responsibility as scientists to supply facts, to evaluate them as objectively as we can and to point out to the decision makers the possible consequences of particular lines of action.

In considering priorities for planning and execution of research, extension or management of weeds, it is essential to look carefully at the questions in Table 2 (above) and to determine if we can which are the limiting factors in our own situation and what is needed to offset these limiting factors.

For example, do we need more research or more education, better motivation, different skills or more resources to improve weed control at the farm level or on public land? Do we need legislation to coerce reluctant people into attacking weeds that pose a potential threat to the livelihood of the whole community?

We have already seen that no general answers to these questions are possible and that each human community must make its own judgements on the importance of each weed and on priorities for dealing with them.

However, whatever the other priorities, it is essential that the plants concerned be correctly identified. Accurate identification provides a reliable key to unlock the storehouse of the world's knowledge about the plant and its behaviour in other places. If the identification is not accurate, you will, of course, have the wrong key, open the wrong doors and bring forth a lot of misleading information.

Research

From Table 1 (above), it is apparent that there are many potential fields for research. Every day research papers on weeds pour from the scientific presses of the world and it is apparent that a great deal of research is proceeding in many places.

Holm *et al.* (1977) questioned whether all this work was well planned, purposeful or relevant to the solution of particular weed problems. They stated 'it seems a waste of time that often the same experiments are repeated over and over again across the world ... because we have not tried or have not been able to communicate with one another. There are many things we already know about our weed species and their control and there are some experiments which do not have to be performed again.'

In their book they did a great service to weed science by assembling comprehensive information on what was known about many of the world's serious weeds. Critical compilations of this kind are needed for many more species.

Before committing themselves to any major new projects on particular weeds, it is most important that research workers study carefully all available data. However, it is just as important to consider the biological and socioecological contexts in which reported research results were obtained. By doing so, we can avoid the trap of blind extrapolation of conclusions from one region to another. Just because a particular plant species is a problem in one place it does not follow automatically that it will be equally pernicious in other places or that control measures that are appropriate in one society will be equally successful in others. The converse also is true. Plants that are fairly innocuous in one country may become serious weeds in another.

By all means gather facts from whatever sources can supply them, but please weigh and evaluate those facts in the light of your own particular situation. Do not be misled by the inclusion in or omission of your plant from any list of the 'world's worst weeds'.

Let us look more closely at recent trends in weed research. We all know that the release of selective phenoxy herbicides in the mid 1940s was followed by greatly increased use of chemical methods for controlling weeds. During the last 30 years or so the greatest part of research on weeds has been devoted to chemical control. Without the herbicides and technology developed as a result of these researches, the present high levels of agricultural production could not be sustained in many parts of the world.

However, although the first selective herbicides were the products of purely academic research into growth substances in plants, much of the subsequent work on herbicides seemed to be focused on merely killing weeds. Often little consideration was given to other biological and ecological factors involved. Until fairly recently, possible long-term effects of regular use of particular herbicides on agriculture, human communities or the environment were largely left unexplored.

In fact, many farmers (and I suspect some scientists and extension officers as well) came to equate weed control with the use of herbicides. When a weed started to worry them, how many farmers and public decision makers have turned to us and asked 'What chemical can we use to kill it?'

It seems to me that in recent years there has been a move towards a more balanced approach to weed research. In this regard, Table 3 is of some interest. It shows the main subject matter of papers presented at the seven Asian-Pacific Weed Science Society conferences since 1967. The subject classifications are very broad. Papers dealing with more than one aspect of a weed problem have been allocated to the category that seemed most appropriate to the main subject matter.

At the first five conferences, papers on herbicides and chemical control represented 63 to 80% of all those presented. At the last two conferences, this proportion fell to 35% and 46% respectively. Since 1975 there has been a marked increase in the number of papers on biology and ecology of weeds and at the last two conferences a great increase in papers on management and control systems. Papers on biological control are still few and far between but their numbers have increased slightly.

I believe that somewhat similar trends would show up in an analysis of papers at other weeds conferences and possibly also in the general scientific literature on weeds and related agricultural topics.

One obvious need is for accelerated

Table 3
Papers presented at Asian-Pacific Weed Science Societies Conferences

Subject	1967		1969		1971		1973		1975		1977		1979	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
General[1]	11	21.1	5	10.6	4	8.5	7	9.1	1	1.0	8	9.3	12	12.4
Biology and Ecology	4	7.7	7	14.9	2	4.3	12	15.6	21	20.6	30	34.9	21	21.6
Chemical Control	33	63.5	33	70.2	38	80.8	52	67.5	76	74.5	35	40.7	45	46.4
Management and Control Systems	3	5.8	2	4.3	3	6.4	6	7.8	2	2.0	9	10.5	15	15.5
Biological Control	1	1.9	–	–	–	–	–	–	2	2.0	4	4.6	4	4.1
Total	52		47		47		77		102		86		97	

[1] Excluding background papers but including extension, legislation and teaching
No. Number of papers
% Percentage of papers

and purposeful research on the use of fossil hydrocarbons in weed control, not only as sources of energy but also as raw materials for pesticides and fertilizers. Two aspects need investigation, conservation of existing resources and a search for substitutes for petroleum products.

Conservation of existing resources demands an ecological approach to particular problems and reappraisal of what we know, what we need to know and how to achieve particular objectives (see Table 1 above). Methods and materials must be appropriate to life styles and materials available and different priorities will apply in different human communities.

The search for substitutes will be more difficult. Workers in many fields are studying possible energy substitutes and we should be able to draw on them for much useful information. Particular tasks for weed scientists are to find alternative sources of hydrocarbons or other raw materials for chemical synthesis and to look more closely at the feasibility of other means of weed control and management. Inevitably, this work will be costly and time-consuming and will involve close study of the ecological processes involved in maintaining suitable conditions for growth of crops and pastures.

If we are to be ready to meet the challenges of the twenty-first century, we must begin this work now. Above all, we must abandon *ad hoc* cosmetic approaches to weeds and deploy our resources into fields where research is most needed and most likely to be of value to our own particular communities.

Action

At the First Asian-Pacific Weed Control Interchange in Honolulu in 1967, Cates (1969) pointed out that agricultural research will remain a dead letter unless appropriate methods are developed for translating results into agricultural practice. He also commented that there are few things more incongruous than having an up-to-date experimental station surrounded by a primitive agricultural community.

Weeds do not care whether you are growing crops for your own survival or for monetary gain. They just go on doing what comes naturally – growing, multiplying and at the same time reducing the harvest man reaps for his labour.

Where weeds are obviously limiting crop production or affecting quality, it is in the farmer's own interest to control them and you would expect him to do this as a matter of course. However, this is not always feasible in the real world. It depends on his knowledge, skill, resources, motivation and goals. These in turn depend on his opportunities, situation, traditions and life style. Millions of people are shackled by the yoke of peasantry because they have no alternatives or because they can conceive no other life style.

Priorities for action are determined by socioecological conditions even more directly than they are for research. In many cases we know how to control the weeds but lack the means to put these better methods into practice.

It is essential that actions to manage weeds be tailored to fit the societies in which they operate. Too often we see sincere, well-meaning attempts to translate results of sophisticated research from advanced technological societies into simpler, less sophisticated societies. These improved techniques usually demand large inputs of capital and non-renewable resources and relatively small utilization of what may be the most abundant resource, people powered by solar energy.

Decision makers in the action field must ask the basic question, 'How can we manage the ecosystem to prevent weeds from impairing output?'

Any automotive engineer or mechanic can tell you that a motor car is a complex system comprising many hundreds of separate components. However, you do not need to be a mechanic to drive a car. All you need to know is how to operate the components that control the system – steering wheel, accelerator, transmission and brake. Similarly, if you can determine which of the elements in Table 1 (above) control or limit the system, you may find some that can be manipulated to your advantage. The first priority in management is to look for such limiting and controlling factors and to assess the feasibility of using available resources to achieve defined objectives.

Some of you will be familiar with the stimulating and down-to-earth paper by Amor and Twentyman (1974). These authors challenged present priorities for decision-making in regard to legislative control of 'noxious' weeds and presented a flowchart to assist in this process. Their chart called for consideration of the place occupied by particular weeds in the ecological succession, for subjective assessment of nuisance value, cost of control and potential spread and for the integration of all these factors into political decisions leading to appropriate action. Although this chart was devised for use in the legislative field, it is a good example of the kind of process that can be applied to determination of priorities in other fields of weed control.

In sophisticated societies it makes sense to conserve the scarcest resource, manpower, and to utilize other resources such as machinery, fossil energy and highly developed techniques based on petroleum products. In more primitive communities these techniques may be wasteful and inappropriate as well as economically foolish. It is essential to choose techniques that are appropriate to the capacity, needs and aspirations of the societies in which they are to be applied.

As already mentioned, even in sophisticated societies we may not be free to choose the most efficient methods for much longer. In the not-too-distant future, available resources of liquid petroleum might well become the most important limiting factor.

Modern agriculture depends very heavily on petroleum products for energy, fertilizers and pesticides, including herbicides. We need to start thinking now about how to make the best use of these diminishing resources. Development of new materials and new technology to the action stage is a very slow business and we do not have much time.

Conclusion

In some countries, agricultural technology has reached the stage where less than 8% of the entire population can feed all their own people and produce exportable surpluses as well. At the same time, in other countries we have the spectre of millions of people toiling long hours in the fields and being unable to feed themselves adequately. We know that weeds, if allowed to get out of hand, can reduce productivity to a point where the highly sophisticated farmer may operate at a financial loss and the peasant farmer may starve to death.

It is our task to devise means for minimizing the adverse effects of weeds on agricultural and pastoral production. We need to give urgent attention to four main aspects of weeds and weed control.

First, we must reconsider our attitudes to weeds and decide which particular weedy plants cannot be tolerated at all, which ones we can afford to live with and what levels of infestation can be tolerated in any particular crop or situation.

Second, we must maintain and intensify research on the biology and ecology of weeds and the crops or pastures affected by them. Particularly, we should seek to identify limiting and controlling factors within each ecosystem and try to determine which ones of these are amenable to manipulation or management.

Third, we must continue work on the development of materials and techniques for managing and controlling weeds. We should pay particular attention to devising more efficient ways to use energy, herbicides and fertilizers and look for alternative sources for some of the energy and materials now derived from liquid petroleum.

Fourth, we must rethink our guidelines on education and re-define the objectives of legislation for the control of weeds in general and 'noxious' weeds in particular. In Australia several scientists, including Moore (1971, 1975), Quinlivan (1972), and Amor and Twentyman (1974), have pointed out the need to do this. Indeed, Moore (1975) went so far as to state that for those plants that are clearly harmful but already widespread, research would seem to be more effective than legislation, that in many instances the attack may be more usefully directed at the site rather than at the plant and that resources wasted in efforts to control the plant where it is doing no harm might be better directed towards research on its biology and ecology.

It is high time that these ideas were taken seriously by decision makers at the political level. If we could deploy as much time, energy and resources to the improvement of agricultural technology as we have to the development of industrial technology, then it is just possible that, in time, we might be able to feed all our people adequately.

Who knows? We might even be able to afford the luxury of sending men to walk on the moon. After all, we already know how to do that!

References

Amor, R. L. and Twentyman, J. D. (1974). Objectives of, and objections to, Australian noxious weed legislation. *Journal of the Australian Institute of Agricultural Science* **40**:194–203.

Cates, A. H. (1969). A practical approach to weed control in the south-west Pacific. In: R. R. Romanowski, Jr., D. L. Plucknett and H. F. Clay (Editors), *Weed Control Basic to Agriculture Development*. East–West Center, University of Hawaii, Honolulu. pp. 11–15.

Holm, LeRoy G., Plucknett, D. L., Pancho, J. V. and Herberger, J. P. (1977). *The World's Worst Weeds*. East–West Center, University of Hawaii, Honolulu.

Moore, R. M. (1971). Weeds and weed control in Australia. *Journal of the Australian Institute of Agricultural Science* **37**:181–91.

Moore, R. M. (1975). An ecologist's concept of a noxious weed: plant outlaw? *Journal of the Australian Institute of Agricultural Science* **41**:119–21.

Quinlivan, B. J. (1972). An ecological basis for decision-making. *Journal of the Australian Institute of Agricultural Science* **38**:283–6.

Glossary of terms

Absorption — Movement of a chemical into a plant, animal, or the soil. Plants absorb through leaves, stems, or roots, while animals absorb through skin, breathing organs, stomach, mouth, or intestines. Signifying that a substance is taken into something. Compare to Adsorption.

Acceptable Daily Intake (A.D.I.) — The daily intake of a chemical which, during an entire lifetime, appears to be without appreciable risk on the basis of all the known facts at the time. It is expressed in milligrams of the chemical per kilogram of body weight (mg/kg/day). It is derived by extrapolation from the no-toxic-effect level observed on long-term (lifetime) feeding studies on the most sensitive animal species and incorporating an appropriately large safety factor.

Accumulative Pesticides — Those chemicals which tend to build up in animals or the environment.

Acid Equivalent — The amount of active constituent expressed in terms of the parent organic acid contained in a given salt, ester, or formulation.

Active Constituent — The biologically active part of the agricultural chemical present in a formulation. (To be used in preference to Active Ingredient.)

The chemical(s) in a formulated product that is (are) principally responsible for the biological effects and that is (are) shown as active constituent(s) on pesticide labels.

Active Ingredient — The same as Active Constituent which is the term preferred in Australia.

Actual Dosage — The amount of active ingredient (not formulated product) which is applied to an area or other target.

Adsorption — The process by which a substance is held (bound) in the form of a surface film of molecules of a gas or a dissolved or suspended substance upon the surface of a solid, e.g. the adsorption of particles of dust to a leaf, the adsorption of gases to charcoal in the filter of a gas mask. In adsorption, a substance is adsorbed onto something. See Absorption.