Workshop to identify research priorities for *Emex* species

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Introduction

The afternoon of the workshop on 11 December 1995 was reserved for an analysis of the opportunities and threats facing research to control *Emex* species (mainly *E. australis*). Time precluded assessing strengths and weaknesses which in any case are probably better examined at the level of each of the participating organizations. The 28 participants were distributed in five groups. An initial discussion was held to frame the problem. Each table was asked to state their concept of the problem. This was followed by table discussions to generate research ideas. The ideas were then presented to the group by soliciting new ideas from each table in succession (round robin). Ideas were sought for each of the following areas: biology, ecology, herbicide, biological and cultural control, education and training, technology transfer, regulatory, economic and regional issues. Once the ideas were consolidated, the participants ranked the ideas for feasibility (is the idea achievable? can it be done?) and for attractiveness (if it could be done, would it be a good thing to do now?). This method is not without criticisms; for example, new work would be favoured over current work. Also the ideas were not exposed to criticism nor were they championed (time not permitting). However, the results can be used as a guide to some of the issues and possible new areas of research.

Table 1 shows how the group at the workshop defined the problem caused by *E. australis*. The problem can be summarized as '*Emex australis* seed populations increase as a result of agricultural practices and a lack (or non-implementation) of suitable control measures. This results in reduced productivity and increased contamination problems'. As is often the case with weeds, the problem is multifaceted, with economic and biological components. The economic component is that the weed problem is largely a result of agricultural practices (pasture/crop rotations) that are not likely to change because of other reasons. The biological component is the plant's ability to produce abundant, long lived seed banks.

Ideas proposed during the round robin are presented in Table 2. These were rated for feasibility and attractiveness (Figure 1). Feasibility and attractiveness are positively correlated ($r^2 = 0.49$) (Figure 1) indicating that participants were possibly not distinguishing between the two attributes. For this reason, caution is required when using this information to set research priorities. Caveats aside, the workshop activities allows the proposal of a set of research topics culled from the suggestions in Table 1 and 2 and emphasizing the ideas allocated to the top right hand quarter of Figure 1.

Key result areas: research directions

i. Update the review of *E. australis* in the Biology of Australian Weeds series. An update is planned for inclusion in a future volume of Biology of Australian Weeds being edited by Groves, Shepherd and Richardson.

ii. Herbicide resistance in *E. australis* is unknown at present, but has arisen in similar species. A pro-active approach of assessing the risk of *E. australis* developing herbicide resistance should be undertaken and complemented by an extension program on the rotation of herbicide combinations to minimize the development of resistance in this weed.

iii. Determine the factors (herbicides, biotic and environmental stresses) affecting seed production by the plant. This work should be undertaken with vii (below) and incorporated into a model of seed production and survival.

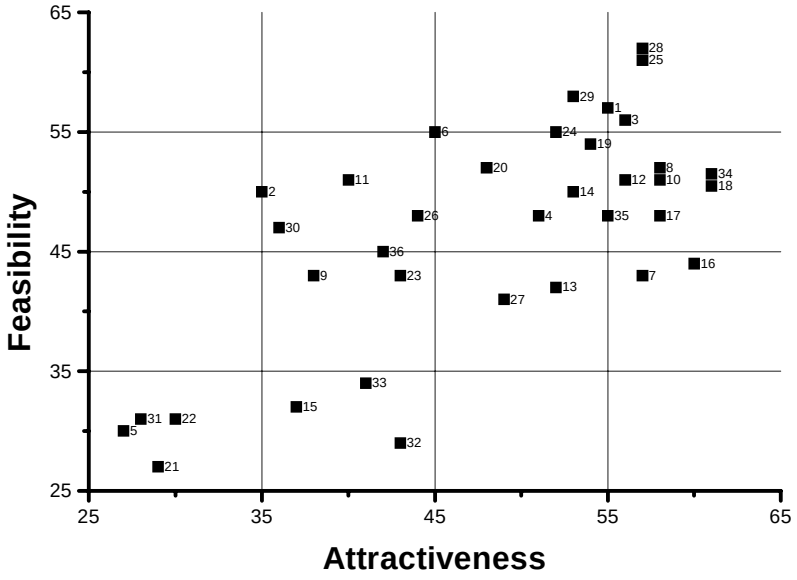

Figure 1. Ranking of research ideas. Each of the ideas in Table 2 was scored by the workshop participants (23 scores were obtained). The ideas were scored for low (L), medium (M) and high (H) feasibility or attractiveness. A composite score for the attractiveness or feasibility of each idea was obtained by the sum of L + 2*M + 3*H.

Table 1. Identification of the problem; ideas presented during the workshop.

1 Reduces productivity and quality of crops, pastures and animals because there is no reliable long term control program.

2 Emex is a major threat; to product quality in horticulture and for human consumption of export grains, to future production of various pulse crops

3 High seed production in non crop year after summer rain, and in some phases of the rotation, causes a population explosion of *E. australis*, resulting in a lack of management options.

4 A focus on pasture is needed – treat pasture as a crop and improve competition between species. Integrate management of *E. australis* across rotations, especially addressing seed bank ecology.

5 Is it really a problem? Is the problem control or extension? For example;
* dry seeding versus wet seeding in lupins,
* lack of control in vines due to cost!!
It is a problem in pasture (mainly overgrazed pasture) rather than crops. Known controls need to be integrated into sustainable rotations.

Table 2. Round robin of ideas to improve control of *Emex* species.

Issues		Research / extension proposed / needed
Biological	1	Factors affecting seed production
	2	Comparative studies of *E. spinosa*, *E. australis* and their hybrids
Ecological	3	Competition studies between *E. australis*, new pulses and oil seeds
	4	Effect of rotating herbicide resistant crops (e.g. Triazine resistant canola, Basta resistant lupin) on weed seed banks
	5	Impact of *E. australis* control on native bird populations
	6	Effects of herbicides on seed quality, e.g. Lontrel
	7	Control to target seed bank: e.g. allelopathy / cultivation
	8	a) Influence of environmental factors on seed bank dynamics – study, model and predict b) Effects of soils, stubble and zero till on dormancy status c) Effects of environmental factors / stresses on seed dormancy
	9	Influence of sheep on pasture ecology with respect to *E. australis*
Herbicide	10	Assess the risk of *E. australis* developing herbicide resistance
	11	Comparative dose responses for all *E. australis* herbicides
	12	Develop registered herbicide packages to use in the legume phase of rotations, then extend to all stages of the rotation
	13	Further development of generic 'out of patent' herbicides
Biocontrol	14	Effect of biological control on seed production and quality
	15	Produce benign (non-toxic) *Phomopsis*
	16	a) Fast track biological control programs b) More evaluation of new bio-control agents especially in combinations
	17	Incorporate biological control into integrated weed management (IWM)
Cultural control	18	a) Put technology into improving pastures 'good pastures, not weeds' b) Sow pasture species to compete against *E. australis*
	19	Maintain a broad IWM perspective
	20	Control *E. australis* germinating in summer to prevent seed bank top up
	21	Reduce palatability of pasture species to improve *E. australis* intake
	22	Evaluate effectiveness of seed catching at harvest
	23	Control *E. australis* in non-agricultural, amenity and conservation areas
Education & training	24	Develop education packages for each control situation
	25	More extension on rotation of herbicide combinations to minimize resistance
	26	Identify communication gaps
Technology transfer	27	Predictive model for *E. australis* germination for control
	28	Review biology of *E. australis* (in Biology of Australian Weeds series)
	29	Devise information package for farmers and for 'technocrats'
	30	Set up *Emex* species email 'fan club' or internet page
Regulatory trends	31	Uniform regulations, especially receival standards
	32	Consumer liability for use of herbicides 'insurance' (minor use registration)
	33	Review patent / new product rules that apply to chemical companies
Economic trends	34	Define / measure the impact of *Emex* species on Australian agriculture
	35	Cost benefit analysis of control of *E. australis* in rotations and horticulture
Regional trends	36	Obtain data on real and potential distribution in Australia – survey distribution of both species

iv. Measure the competitive interactions between *E. australis* and new crops such as pulses, oil seeds and new pasture legumes.

v. Improve extension of information for each control situation, for example the need to sow pasture species to compete against *E. australis*.

vi. Define and measure the impact, including a cost benefit analysis of control of *E. australis* in Australian agriculture.

vii. Study, model and predict the effects of environmental factors / stresses (e.g. soils, cultivation, allelopathy, stubble and zero till) on seed dormancy and seedling recruitment.

viii. Develop registered herbicide packages to use in the legume phase of rotations, then extend to all stages of the rotation. Similar action is possibly required for control in vineyards.

ix. Evaluate new and existing biological control agents for the possibility of incorporation into integrated weed management.

Conclusions

The success of this workshop will be measured by the completion of new research that leads to significant improvements in the control of *E. australis* and *E. spinosa.* A follow-up workshop should be held in four to five years time to examine how much progress has occurred.