Proceedings of the Eighth International Symposium on Biological Control of Weeds
2-7 February 1992, Lincoln University, Canterbury, New Zealand.
Delfosse, E.S. and R.R. Scott (eds.). DSIR/CSIRO, Melbourne, pp. 355-9 (1995).

Implications of a Preliminary Survey on the Biological Control Prospects for the Pasture and Rangeland Weed Bathurst Burr, *Xanthium spinosum*, in Australia

A.J. Wapshere,[1] H. Erb[2] and L. Bunster[3]

[1]CSIRO Division of Entomology, GPO Box 1700, Canberra, ACT 2601, Australia
[2]C/- U.S. Department of Agriculture, Agricultural Research Service, International Activities, Argentina, Agricultural Council, ARS Laboratory, U.S. Embassy, Buenos Aires, APO Miami, FL 34034-0001, USA
[3]INIA Subestacion Experimental La Cruz, Chorillos 86, Casilla 3, La Cruz, Quillota Chile

Xanthium spinosum is a widespread pasture and rangeland weed in Australia. Experts in Australia had considered the plant to be indigenous to Chile and that few organisms infested it in South America. However, a recent survey revealed that many insects infest and a few fungi considerably damage the weed in Argentina whereas only a few insects occur and the fungi are less damaging to it in Chile. The survey also indicated that different insect species were most damaging in each of the climate regions surveyed. The implications of these observations are that the origin of *X. spinosum* is east of the Andes and not in Chile, that there is a considerable increased possibility of classical biological control of *X. spinosum* and that different agents would be effective in different parts of the range of *X. spinosum* in Australia.

Introduction

Bathurst burr, *Xanthium spinosum* L. (Asteraceae, Tribe Heliantheae), is a major widespread weed of irrigated cultivations, pastures and rangelands throughout much of eastern Australia, with outlying occurrences in Tasmania, in the Northern Territory, and in Western Australia (Fig. 1). Another *Xanthium* species, Noogoora burr (*X. occidentale* Bertol. or part of *X. strumarium* L. *sensu lato* complex) is also widespread over much the same area of eastern Australia (Hocking & Liddle 1986).

X. spinosum is an annual which overwinters as seed contained in a burr which is the fruit of the plant. The burr contains 2 seeds only. One of them has no dormancy and germinates in the first season after production of the burr. The other has a prolonged dormancy and may not germinate until several years have passed. Seedlings appear in late spring whenever and wherever there is adequate soil moisture. Growth of the plant is rapid afterwards as long as soil moisture remains adequate. Growth, flowering and burr production continue throughout the summer, the plant dying off with the onset of winter drought and/or first frosts. This plant is basically adapted to a warm to hot climate with maximum rainfall in summer but with considerable variation in rainfall from year-to-year (Hocking & Liddle 1986).

The main importance of Bathurst burr is as a contaminant of wool. In the area where it causes, together with its relative Noogoora burr, economic loss to wool production (Sloane Cook & King 1988) (Fig. 2), it was considered the principal species for which control would be the most desirable. The climates of that area (Fig. 2) include: those with a maximum rainfall in summer and winter drought in western Queensland; those with maximum rainfall in summer and no drought in northern New South Wales; those with maximum rainfall in winter and summer drought in western Victoria and central Tablelands and central and southern plains of New South Wales; desertic ones with

drought for most of the year in far western New South Wales (Walter & Lieth 1967).

X. spinosum is a native of South America and was considered to be indigenous to Chile (Hocking & Liddle 1986). It occurs widely there and also throughout most of Argentina, Uruguay and the southern parts of adjacent countries to the north. It has spread from those regions into other parts of South America and around the world (Hocking & Liddle 1986). Prior to this survey only three insect species had been recorded on the weed in Argentina and Chile (Wilson 1960) and it had been considered that there was little possibility for its classical biological control in Australia.

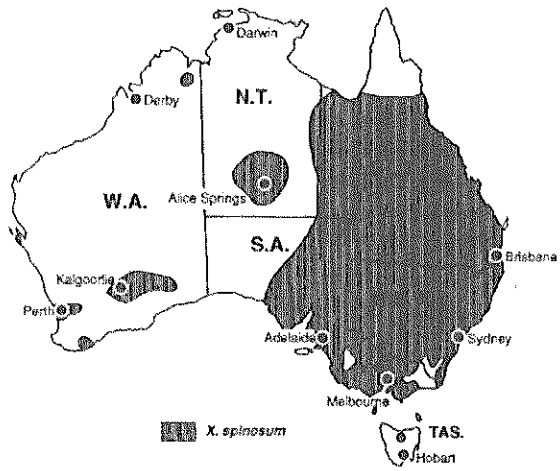

Figure 1. Australian distribution of *Xanthium spinosum*. (Redrawn from Hocking & Liddle 1986).

This paper discusses a recent survey of the organisms infesting *X. spinosum* in Chile and Argentina and the implications of the results of that survey on the possibilities of biological control of the weed in Australia.

Methods

Because of the presumed origin of *X. spinosum* in Chile and because climates similar to the principal area of infestation in Australia occur within Chile and Argentina combined, a survey for potential agents was undertaken in those 2 countries. The survey was carried out in February and March 1991 when the plants would be sufficiently advanced to be readily sighted. By March all plants of this annual had germinated for that year, and by that time the plants were well developed and tall, with long thick stems, flowers and maturing green fruit (burrs). The survey thus sampled the organisms attacking the plant just after the mid point of its annual growth cycle. It did not sample organisms affecting the seedling stages of the plant nor those affecting the burrs once they had dropped from the plant in autumn.

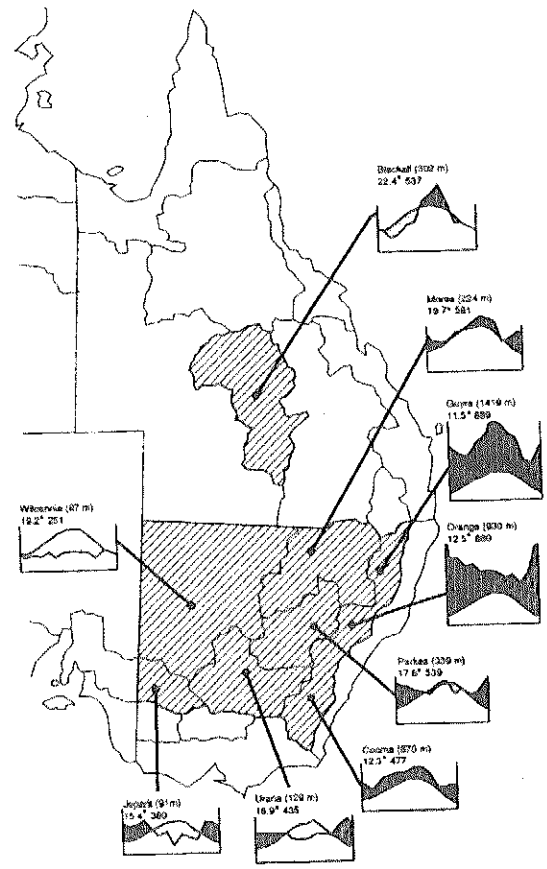

Figure 2. Climates of the regions where *Xanthium* spp. cause economic loss to wool production in Australia. Regions infested from Sloane, Cook & King (1988). Klimadiagrams from Walter & Lieth (1967).

The climates of the area surveyed are shown in Figure 3. In Chile they range from desertic in the North to Mediterranean with summer drought in the central and southern parts. In Argentina they have maximum rainfall in summer and range from those with no winter drought, those with a winter drought, and those with drought for most of the year except for a

brief period of heavier rainfall in summer (Fig. 3) (Walter & Lieth 1967). Throughout this large area, infestations of *X. spinosum* were examined at frequent intervals. Plants were collected, examined and dissected to determine the organisms on them and within their leaves, stems and roots.

Each infestation was visited once during continuous journeys. Thirty-four infestations were examined in Chile and 47 in Argentina. At each infestation, 20-25 large plants were examined together with a similar number of smaller plants when present; if necessary they were collected for further detailed examination. Because the large plants had multiple side stems the number of stems examined was considerably greater than the number of plants selected.

Results

Arthropods

Very few insect species (only 6) and one mite species were found infesting *X. spinosum* in Chile. The most common and/or damaging were: a larva of a large agromyzid stem miner; the leaf feeding, *Systena argentiniensis* Jacoby (Coleoptera: Chrysomelidae); a leaf webbing tetranychid mite, and the seed flies, *Euaresta* spp. (Diptera: Tephritidae), whose larvae destroy the seeds within the burr. However, a large number of different insect species (approximately 30) were found on and in the plant in Argentina. Amongst the most damaging were: the larva of the stem borer, *Emphytoecia versicolor* (Boh.) (Coleoptera: Cerambycidae); 3 tip- and stem-mining weevil larvae (2 *Rhyssomatus* spp. and another species; Coleoptera: Curculionidae); 2 stem boring mordellid larvae; 3 tip and stem mining moth larvae (an oecophorid, *Platphalonidia* sp. (Cochylidae) and another lepidopteran); and larvae of at least 4 species of stem-mining agromyzid. A lepidopteran larva webs the leaves of the top of the stems and the bug, *Gargaphia* sp. (Hemiptera: Tingidae), destroyed leaves by sucking out their cells. As in Chile, the seeds within the burrs were destroyed by larvae of the *Euaresta* spp.

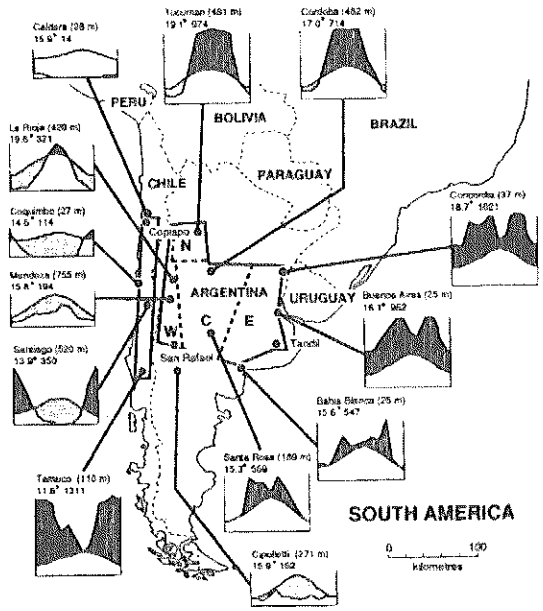

Figure 3. Climates of the areas surveyed in Chile and Argentina for biological control agents on *Xanthium spinosum*. Regions in Argentina: C = Central; E = East; N = North; W = West). Area surveyed within continuous lines. Klimadiagram from Walter & Lieth (1967).

More importantly, as far as their use as biological control agents in Australia, different organisms infest the plant in each of the different climatic regions surveyed. This is particularly seen with the stem-boring/mining insects (Table 1). In eastern Argentina, where there is no winter drought, the principal stem borer of *X. spinosum* was the larvae of the cerambycid *E. versicolor*. In the central region of Argentina, with moderate summer rainfall and winter drought, the stems were mined by mordellid, curculionid and lepidopteran larvae often occurring together. However, in the northern part of the area surveyed in Argentina, with heavier summer rainfall but still with winter drought, agromyzid larvae were the principal stem miners. At least one of these is probably a secondary agent, infesting stems already rotted by fungi in this region which is a marginal habitat for *X. spinosum*. In dry western Argentina, close to the Andes, where there is only a brief period of excess summer rainfall and drought for most of the year, only mordellid larvae were

common in the stems. Finally, in the summer drought and desertic climates of Chile, only a large agromyzid larva, different from those in Argentina, mined the stems (Table 1). Similar climatic restrictions of the leaf feeding and tip feeding insects were apparent but for these insects there was not the replacement by a different insect with similar habits but the absence of attack on that particular part of the plant in the drier regions. This does not mean that these insects are limited to these climatic regions. For example, it is known that *E. versicolor* occurs widely in Argentina. It is however a major element of the insect fauna of *X. spinosum* only in the eastern region. Similarly the other insects are most damaging to the weed in the respective regions indicated.

Table 1. Distribution of stem-mining insects in *Xanthium spinosum* in Chile and Argentina.

Chile	Argentina			
	West	**North**	**Central**	**East**
Agromyzid 1	*Platphalonidia*	*Platphalonidia*	*Platphalonidia*	*Platphalonidia*
	Lepidopteran 1	*Rhyssomatus* 2	*Rhyssomatus* 2	Agromyzid 3
	Mordellid 1	Agromyzid 2	Agromyzid 3	*Emphytoecia versicolor*
	Mordellid 2	Agromyzid 4	Lepidopteran 1	
		Mordellid 1	Curculionid 1	
		Mordellid 2	Mordellid 1	
			Mordellid 2	

Fungi

Regarding the fungi, symptoms of leaf destroying and stem anthracnose fungi, resembling those caused by *Colletotrichum orbiculare* (Berk. & Mont.) Arx. and *Phomopsis* sp. in Australia (Nikandrow *et al.* 1990) were found infesting the plant throughout Argentina regardless of climate although the severity of symptoms was greater in wetter areas than in the drier ones. A root rot fungus destroyed plants in the wetter areas of Argentina. At least six other fungi attack the leaves, stems, roots, and/or burrs of *X. spinosum* in Chile and Argentina including various *Alternaria* spp., *Cladosporium* spp., and the powdery mildew *Erysiphe cichoracearum* DC. In general the fungi were more damaging to the plant in Argentina than in Chile. The anthracnose, stem and root rot fungi were the only organisms observed to cause plant death. None of the insects were observed to kill plants, although plants heavily infested by *E. versicolor* and by the mordellids were clearly unthrifty and the *Gargaphia* sp. and the tip-webbing moth partially defoliated some plants.

Discussion

The results of the preliminary survey of organisms on *X. spinosum* in Chile and Argentina lead to the following 3 main conclusions:

1.) Despite the opinion of some weed scientists in Australia (Hocking & Liddle 1986), Chile is neither the region of origin of *X. spinosum* nor part of its indigenous range. This conclusion is in agreement with botanists and weed experts in Chile who regard the weed as an exotic introduction to their country (Reiche 1903, Baeza 1930, Marticorena & Quezada 1985). The evidence from the distribution of organisms occurring on the plant points to an origin in southern South America east of the Andes.

2.) Despite the opinion of some previous biological control experts in Australia, based on records of only two curculionids on *X. spinosum* in Argentina and a *Euaresta* species in Chile (Wilson 1960), the plant is infested in Argentina by at least as great a number of organisms as many other weeds in their region of origin. There is therefore a considerably increased possibility for the classical biological control of this weed.

3.) The insects causing major damage to the plant, particularly the stem-borers and -miners, are different in different climatic regions within the area surveyed. Therefore, to achieve control of the weed throughout most of the climatic range of *X. spinosum* in Australia, a series of agents would have to be introduced.

Acknowledgments

The authors wish to thank Dr R. Ripa of INIA La Cruz for providing facilities there for Mrs L. Bunster, Dr E. Prado, INIA La Platina, Santiago, for identifications of insects in Chile, Dr H. Cordo and his scientific staff at the USDA-ARS laboratory at Hurlingham for all the help provided when in Buenos Aires and them and Dr C. Garcia of the Queensland Lands Department Laboratory at Tucuman for allowing us to see the insects they had collected from *X. spinosum*, for their identifications and for information on their occurrence. The survey in Argentina and Chile was supported by funds from the Wool Research and Development Council of the Australian Wool Corporation.

References

Baeza, V.M. 1930. *Los Nombres Vulgares de las Plantas Silvestres de Chile y su Concordancia con los Nombres Cientificos.* El Globo, Santiago, 270 p.

Hocking, P.J. and Liddle, M.J. 1986. The Biology of Australian Weeds. 5. *Xanthium occidentale* Bertol. complex and *Xanthium spinosum* L. *Journal of the Australian Institute of Agricultural Science* **52:**191-221.

Marticorena, C. and Quezada, M. 1985. Catalogo de la Flora Vascular de Chile. *Gayana (Botanica)* **42(1-2):**1-157.

Nikandrow, A, Weidemann, G.J. and Auld, B.A. 1990. Incidence and pathogenicity of *Colletotrichum orbiculare* and a *Phomopsis* sp. on *Xanthium* spp. *Plant Disease* **74:** 796-9.

Reiche, C. 1903. *Las Malezas que Invaden los Cultivos de Chile y el Reconocimiento de sus Semillas.* Franco-Chilena, Santiago, p.152.

Sloane, Cook and King. 1988. *The Economic Impact of Pasture Weeds, Pests & Diseases on the Australian Wool Industry.* Australian Wool Corporation, Sydney, 71 p.

Walter, H. and Lieth, H. 1967. *Klimadiagram-Weltatlas,* Fischer, Jena.

Wilson, F. 1960. A Review of the Biological Control of Insects and Weeds in Australia and Australian New Guinea. *Commonwealth Institute of Biological Control Technical Communication No. 1. Commonwealth Agricultural Bureau.* Farnham Royal, 102 p.