

XANTHIUM RUST AS A POSSIBLE BIOLOGICAL CONTROL AGENT OF
BATHURST AND NOOGOORA BURRS IN AUSTRALIA

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INTRODUCTION

Xanthium strumarium L. and *X. spinosum* L. respectively known as Noogoora and Bathurst Burrs are weeds of the summer rainfall grasslands of New South Wales and Queensland in Australia. The burrs, a fruit containing two seeds, contaminate the fleece by becoming enmeshed in the wool, thereby decreasing the value of the clip and increasing the cost of processing the wool.

Puccinia xanthi Schw.

P. xanthii Schw. is an obligate fungal parasite of species of *Xanthium* and *Ambrosia*. It is a microcyclic, autoecious rust occurring only in the telial stage. Only teliospores are produced and these germinate again to produce telia. Other stages such as aecidial, pycnial and uredial are considered to have been lost during the course of evolution (Arthur and Cummins, 1962).

The rust attacks all aerial parts of the plants except the flowers. The large and tumour-like telia occur both externally and within the plant tissue. They cause distinct deformation of the leaves, swelling of the stem nodes and splitting of the petiole and stem epidermis. The mycelium invades the internal tissues of the plant and travels throughout the plant by way of the intercellular spaces and the vascular bundles. The mycelium within the plant forms internal sori in the cortical and medullary parenchyma. The development of the internal sori crushes the cells and produces an internal tumour within which the fungus produces a complete sorus with fully developed teliospores (Kuhnholz-Lordat, 1942; Kuhnholz-Lordat *et al.*, 1951). The leaves of plants suffering from a heavy attack turn yellow, become flaccid and eventually drop off. The infected plants mature more rapidly and die earlier than uninfected ones.

The teliospores are strongly attached to the sori by their pedicels. The externally produced spores remain on the plant until the plant dies or until the leaves wither and dry up. The rust is distributed on and within the dry leaf fragments

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and by occasional heavy winds. These externally produced spores germinate immediately, without any dormancy if given the correct degree of moisture and temperature.

The spores remaining on or inside the dead plant parts are considered to be the means by which the rust hibernates over the long period from the death of the host in early autumn to the reappearance of new plants in early summer of the next year (Kuhnhotz-Lordat, 1942).

P. xanthii is of North American origin and occurs throughout the United States and Southern Canada. It is also recorded in France, Italy and Yugoslavia. It does not occur in Australia and indeed there appears to be no rust in Australia on either *Xanthium* species (McAlpine, 1906).

The rust has recently been found causing severe damage to *X. strumarium* plants in the Po valley in Italy. Teliospores collected from this region are able to attack Australian forms of the two *Xanthium* species but would not attack *Helianthus annuus* L. and a *Dahlia* species, plants belonging to genera closely related to *Xanthium*.

Further studies will be needed to demonstrate the host range and safety of *P. xanthii*.

Studies have also been carried out to evaluate the effect of temperature and humidity on spore germination and plant invasion.

The teliospores of the rust germinate and infect *Xanthium* at temperatures ranging between 10-30°C., the optimum being at 23°C. Twelve hours of free leaf moisture are sufficient for infection of the host.

Effect of Rust attack on X. strumarium in the field

Experiments were also designed to evaluate the damaging effect of the rust on *X. strumarium* plants under field conditions. Small plots of 36 well developed plants from different localities including those from Australian seed were infected by teliospores of the rust and were followed throughout the growing season. One similar plot of 36 plants of the same age was treated regularly with a fungicide against the rust and it served as a control.

Table 1 shows that the dry weight of infected plants, their burr production and the weight of the burrs were clearly inferior to those plants kept free of rust with the fungicide. The germinability of the burrs formed on rusted plants was, however, only slightly reduced compared with the non-rusted plants.

TABLE 1

The effect of infestations by *Puccinia xanthii* on
Xanthium strumarium plants in field plots

Experimental treatment	Average dry weight of mature plants (gm)*	Burrs (Fruit)		
		Number per plant *	Average weight (gm)	% of 720 burrs germinating
Infected by <i>P. xanthii</i>	218.3	103.3	0.41	64
Control (fungicide treated)	348.9	130.2	0.56	71
% reduction due to infection by <i>P. xanthii</i>	37.4	20.7	26.8	9.9

*Figures are averages based on 36 plants in both infected and control plots.

DISCUSSION

Arthur (1929) noted that *P. xanthii* causes a decided decrease in transpiration in *X. strumarium* and as this soft-leaved and short-rooted plant depends on a high rate of through transpiration to maintain its leaf rigidity only a small reduction in transpiration would lead to the leaf flaccidity and eventually to the leaf fall described above.

However, since Noogoora and Bathurst burrs are short-lived, summer annuals, the effectiveness of any biological control agent can be measured by the extent to which burr production and germinability are reduced under field conditions and by the extent to which plants are destroyed before they can seed.

The results given in Table 1 indicate that burr production is reduced to a certain extent by the rust. The reduction observed is not sufficient to provide an effective control of these burrs. Further work is necessary to determine whether the rust can destroy seedlings and plants at an early stage before seeding commences.

Should the rust be effective in this way and should it prove to be as specific as reported the introduction of strains of the rust highly virulent against the Australian forms of *X. strumarium* and *X. spinosum* should be considered.

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