

THE DEVELOPMENT OF A MYCOHERBICIDE FOR
BATHURST BURR, *XANTHIUM SPINOSUM*

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The fungus *Colletotrichum orbiculare* (Berk. et Mont.) v. Arx (Walker and Nikandrow, unpublished data) was found causing anthracnose on *X. spinosum* in several locations during a survey in south eastern Australia in 1984 (Nikandrow, Weidemann and Auld, unpublished data). Although usually causing only leaf and stem lesions, a few plants were found occasionally which had apparently been killed by the fungus. Specific isolates of the fungus were pathogenic to *X. spinosum* in preliminary tests, producing symptoms of seedling blight and anthracnose on older plants.

A programme was thus established to assess the potential of using this fungus as an inundative biological control agent (mycoherbicide) against *Xanthium spinosum*, a serious weed of pasture and summer crops. Experiments were initially undertaken to assess *in vitro* fungal production because one of the criteria for a successful commercial mycoherbicide is inexpensive mass production of the infective propagules. Our results indicated that large scale mass production of *C. orbiculare* spores in inexpensive media using submerged liquid culture should be achievable economically. Spore production by shake culture was in excess of 10^6 spores ml^{-1} after 10 days incubation while the spore

viability was 93% (Auld, McRae and Say, 1988).

The response of *X. spinosum* to increasing inoculum concentration was determined because inundative biocontrol depends upon the application of the biocontrol agent at high concentrations (Templeton, Tebeest and Smith, 1979). All plants inoculated with $> 10^6$ spores ml⁻¹ died within 21 days. Sporulation from stem lesions occurred within 4 days of their appearance which allows for secondary natural infection.

A series of controlled environment experiments were conducted on *X. spinosum* plants to establish optimal conditions for disease (McRae and Auld, 1988). The results showed that temperature is not likely to be a limiting factor for this fungus as a mycoherbicide because the temperature range at which maximum disease development occurred was within that which occurs during the growing season of Bathurst burr. Disease development was however increased with increasing dew duration and high relative humidity. In addition, dew within 4 hours of inoculation and a dark period during the dew period significantly increased disease. These factors although restricting the effectiveness of the fungus as a mycoherbicide can to some extent be overcome by artificial inoculation techniques. The humidity level at inoculation and to some extent during the dew period could be increased using more efficient carrier agents, invert emulsions or applying the fungus as a gel or granular preparation. Such inoculum preparations would also overcome problems associated with a time delay between inoculum challenge and onset of dew conditions. Mycoherbicide

application could also be timed to occur when environmental conditions most favour infection. A late afternoon or early evening field application would maximize the effect of natural dew and accommodate the fungal requirement for darkness during infection. Also the fact that effective dew periods for infection were less for high temperatures is encouraging.

Field testing the ability of *C. orbiculare* to control Bathurst burr under a range of climatic and edaphic conditions has commenced. During the last 2 seasons, the fungus has been trialled as a mycoherbicide in artificial burr populations at Orange and Forbes, in natural populations in grazing land at Wellington and as a weed of irrigated soybeans at Yanco. Although definite conclusions cannot be drawn from such a limited data base the results show promise. The death rate after 10 weeks from anthracnose at Orange and Forbes varied between about 78-6% depending upon plant age and severity of the climatic conditions at and following infection. The burrs at these sites suffered from additional stresses associated with transplanting and excessive droughting which were considered to have reduced the effectiveness of the fungus. At five application times at Wellington, all inoculated burr plants had died from anthracnose after 10 weeks. Higher humidity levels associated with a dense population and grass understorey may have contributed to this result. Very high burr mortality rates (approx. 88-99%) were also recorded in soybean after 8 weeks in plants which had been thoroughly wetted.

This research has resulted in a patent owned by the Department of Agriculture. Negotiations are now underway with commercial firms to develop a product based on the fungus.

In addition to continued field trials, histochemical studies are continuing in the laboratory to define the infection process of *C. orbiculare*. This work has a twofold aim. Firstly this knowledge helps to explain the environmental requirements of disease development in the field. More importantly it may lead to a broadening of the host range of this fungus to Noogoora burr and other *Xanthium* species by inclusion to the mycoherbicide formulation of substances which either enhance fungal penetration or reduce plant resistance mechanisms. Fungal penetration enzymes are presently being considered.

References .

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