COTTON RESEARCH AND DEVELOPMENT CORPORATION

Projects UNE 18C and 22C

Biocontrol of nutgrass using plant pathogens and its integration into weed management systems

FINAL REPORT

1. Introduction

In recent years there has been much interest in the use of plant pathogens as agents for the biocontrol of weeds. This approach to weed control is particularly relevant to the cotton industry as biocontrol agents are generally perceived to be more environmentally friendly than synthetic herbicides. They often have less adverse effects on non-target plant species, they are less likely to leave toxic residues in plant products and the environment and provide greater operator safety than chemical herbicides. The approach is particularly relevant to nutgrass control because current management practices have failed to control the weed. A list of fungi isolated from disease lesions on purple nutsedge in the USA and Australia are shown in Table 1.

Bioherbicides that have already been successfully used to control weeds include Collego®, which is a dry spore formulation of the fungus *Colletotrichum gloeosporioides*, to control jointvetch in rice and soybean in south-eastern United States. A second mycoherbicide, DeVine® (which is a liquid formulation of chlamydospores of the fungus *Phytophthora palmivora*) has been used to control stranglevine (*Morrenia odorata*) in citrus in Florida.

Co-operative research between NSW Agriculture and UNE's Plant Pathology Laboratory showed that the fungus *Colletotrichum orbiculare* causes only mild symptoms when inoculated onto Noogoora Burr. However, when the fungus is inoculated onto plants infected with rust (*Puccinia xanthii*) it causes very severe damage to plants (Morin, Auld & Brown, 1993). This synergistic interaction between the two plant pathogens indicates that the application of "cocktail mixtures" of specific parasites may greatly improve the effectiveness of bioherbicides as well as extending the range of weeds targeted.

A few attempts have been made to integrate biocontrol methods with conventional chemical management systems. Phatak, Callaway and Vavrina (1987) demonstrated that rust (*Puccinia canaliculata*) - paraquat combinations provided 99% control of yellow nutsedge (*Cyperus esculentus*) in the United States. This compared with 60% control by the rust alone and 10% control with the paraquat alone.

Integration of microbial herbicides as viable components of weed management programs is a challenge that must be accepted by weed scientists.

2. Objectives of the Research

The objectives of this project were:

1. To identify candidate pathogens for the biocontrol of purple nutsedge (*Cyperus rotundus*).

2. To determine the potential of candidate pathogens as augmentive and inundative biocontrol agents of purple nutsedge in cotton.

3. To determine the feasibility of using combinations of pathogens either as a "cocktail mixture" (to broaden the spectrum of weeds affected) or applied at different times (to determine possible synergistic interactions in terms of weed control).

4. To define the conditions under which potential biocontrol pathogens are most likely to succeed and not succeed.

5. To work with weed scientists to determine how biocontrol might best be integrated into weed management systems.

Progress Report

A number of fungi and bacteria were isolated from purple nutsedge but only three of these were shown to be pathogenic by the application of Koch's postulates. These were

Phytophthora cyperi-rotundati
Puccinia cyperi-tagetiformis
Phoma sp.

Phytophthora cyperi-rotundate caused serious disease on the weed but, despite numerous attempts, could not be grown on artificial media. This inability to culture the fungus on laboratory media led to the fungus being discarded as a potential biocontrol candidate.

A rust, *Puccinia cyperi-tageteformis*, was collected from *Cyperus bifax* (a native Australian sedge) in Toowoomba. This rust was used to infect purple nutsedge in glasshouse trials where it caused death of heavily infected leaves followed by rapid regrowth and recovery of the weed.

Phoma sp. was found to be weakly pathogenic on *Cyperus rotundus*, causing leaf pitting and spotting.

The dry conditions during 1994 resulted in very little disease forming on *C. rotundus* in the field.

An extensive disease survey was undertaken in January, 1995, at a time when conditions had been favourable for disease development. Many isolations were made and these were tested for their pathogenicity in early 1995.

In April 1995, Michael Adamson withdrew from his PhD candidature and the project. He had only spent 15 months on the project. It was most unlikely that a new PhD student could be identified at this time of year to replace Michael Adamson. Furthermore, there was insufficient time available for a new person to complete the project. Thus, with reluctance, Dr J F Brown recommended that projects UNE 18C and 22C be terminated on 14 April and 30 June, 1995 respectively

Publications

Adamson, M.K., Brown, J.F. & Ogle, H.J. (1994). Biocontrol of weeds using plant pathogys. *Proceedings of the Seventh Australian Cotton Conference*, Broadbeach, Queensland, p.

Brown, J.F. (1993). Fungi as biocontrol agents. *Research Report 1992*, University of New England, p. 4-12.

Literature cited

Morin, L., Auld, B.A. & Brown, J.F. (1993). Synergy between *Colletotrichum orbiculare* and *Puccinia xanthii* on *Xanthium occidentale*. *Biological Control* **3**, 296-310.

Phatak, S.C., Callaway, M.B. and Vavrina, C. (1987). Biological control and its integration in weed management systems for purple and yellow nutsedge (*Cyperus rotundus* and *C. esculentus*). *Weed Technology* **1**, 84-91.

Table 1 Fungi isolated from Purple nutsedge in the United States and Australia

Species	Disease/other information
United States	
Oomycetes	
Pythium sp.	root rot
Ascomycetes	
Phyllachora cyperi	tar spot
Sclerotinia homoeocarpa	blight
Rusts	
Puccinia canaliculata	heteroecious. Telia on *Cyperus*
Puccinia cyperi - tagetiformis	autoecious
Basidiomycetes	
Thanatephorus cucumeris	roots
Deuteromycetes	
hyphomycetes	
Dactylaria higginsii	leaves
Fusarium	
coelomycetes	
Ascochyta sp.	
Colletotrichum truncatum	
Other	
Rhizoctonia solani	
Australia	
Oomycetes	
Phytophthora cyperi-rotundati	leaf spot, Parramatta NSW
Rust	
Puccinia cyperi-tagetiformis	
Smut	
Cintractia axicola	Queensland
Deuteromycetes	
Cercospora caricis	leaf spot, Parramatta NSW
Phoma sp.	leaf spot, Baulkam Hills NSW
Pyricularia higginsii	