THE ALLELOPATHIC PROPERTIES OF SUNFLOWER, *HELIANTHUS ANNUUS* L.

by

SHIRLEY ANNE FRASER

Bachelor of Rural Science

A thesis submitted for the degree
of Master of Rural Science of the
University of New England.

Department of Agronomy & Soil Science,
University of New England,
ARMIDALE. New South Wales, 2351,
Australia.

April, 1983.

[redacted]

PREFACE

I certify that this thesis has not previously been submitted for any degree and is not being currently submitted for any other degree.

I certify that all sources and help received in the preparation of this thesis have been acknowledged.

[redacted]

Shirley Anne Fraser.

[redacted]

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

The following project was carried out at the Department of Agronomy and Soil Science, at the University of New England. The author wishes to thank the many members of the Department, and the University, who helped with the design and running of the project, the writing of the thesis, and the financial support of the author.

Specifically, she would like to thank Associate Professor John Lovett for his advice on the project and his constructive criticism of the thesis material; Dr. Vic Bofinger of the Mathematics Department for his help with the statistics and data interpretation; Dr. Rob Davidson of the C.S.I.R.O. for his encouragement and valuable assistance throughout the duration of the project; Associate Professor John Brown and Dr. Steve Allen of the Botany Department for information on the current disease status of Australian crop sunflowers; Dr. D.S. (Woody) Horning of the Macleay Museum, University of Sydney for information on leaf surface structures and Dr. Elroy Rice of the Department of Botany and Microbiology, University of Oklahoma for specific information on the nature of chemicals found in, and the taxonomy of, the wild North American sunflower.

Messrs. Gary Cluley, Charles (Jock) Gibbon, Roy Wright and David Randall are thanked for their technical assistance, and Miss Janet Gorst, Ms. Judy Levitt, Mrs. Wendy Mason, Mr. Rajan Amartalingam and Miss Jenny Alvin for their technical and editorial assistance.

Messrs. Mike Speak and Peter Garlick of the Electron Microscope Unit are thanked for their assistance, and patience. Ms. Shirley Dawson of the Photography Unit is also thanked for assistance with the light microscope work.

Dr. Alan Duffield of the Biomedical Mass Spectrometry Unit, University of New South Wales and his team are gratefully thanked for their assistance with analyses of solutions, and for much help given while trying to identify the components of the solutions.

Thanks also go to Dr. Keith White of the Arthur Yates and Co. Pty. Ltd., Narromine, for supplying seed of the Suncross 53 parent line OR1, and for making available information about the genetics of the line; to Mr. Robert Macpherson for supplying germination data of OR1; and to Dr. Alan Gibson and Ms. A.E. Grant Lipp of the Plant Introduction Service, Canberra, for supplying seeds of, and information on, the three North American wild sunflower biotypes.

Lastly, Laurie O'Donnell for his patience, although it wore a bit thin at times, and his continued support over the last four years.

SUMMARY

Allelochemicals which may have allelopathic effects on other plants, including others of the same species, are released from many plant types including the North American weed or wild biotype sunflower. Both living plants and decaying debris have been shown to release these allelochemicals. Allelopathic responses have been noted in horticultural and agricultural plant communities.

Workers in North America have documented allelotoxic activity in the biotype sunflower, which enables it to be a strong competitor in old-field succession. Many workers suggest that this type of activity is common in weed species, but that it has been bred out of types developed into crop plants to improve yields, and the harvested product.

Experiments were carried out on an Australian naturalised biotype sunflower which showed little evidence for allelopathic activity, however, experiments on an unreleased hybrid cultivar sunflower showed, unexpectedly, consistent allelopathic properties in petri dish trials from living, dried and senesced leaf material. Similar, but less restricting activity was found in the male parent line of the hybrid.

Gas chromatographic/mass spectrometric analyses of leaf wash solutions of the three sunflower types indicated that many organic compounds were common to all types. The hybrid and its parent generally had more compounds, and at higher concentrations than the Australian biotype. An ion mass of 127 was particularly noted; it may belong to the naphthyl group.

Leaf surface structures were examined under both light and

scanning electron microscopy. Glandular trichomes were found on all three sunflower types, but much more abundantly on the hybrid. These may be storage sites for the leaf allelochemicals.

The evidence found for allelopathic activity in the hybrid cultivar is discussed in the context of allelochemicals as agents which may contribute to the defence and/or competitive ability of those plants which possess them in active concentrations, and that their presence may be an heritable factor.

LIST OF TABLES

LIST OF FIGURES

Page

Page

LIST OF PLATES