

## ORGANIC WEED MANAGEMENT RESEARCH IN AUSTRALIA

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**Abstract** Growers have been successfully farming organically in Australia for several decades, producing a wide range of commodities. A large knowledge base has been developed, although often this knowledge hasn't been scientifically tested. Weed management is reported as a major production cost for organic growers and a perceived impediment to conversion to organic production by conventional producers.

A summary of research activities carried out in Australia is presented on a State-by-State basis. Since the 1980s, a number of projects looking at organic or 'low input' farming systems have been carried out in Australia, most including an assessment of effects on weed populations. By integrating the knowledge gained through non-chemical weed research, management solutions may be found and applied to different farming systems, regardless of where they lie on a sustainability-productivity continuum. It is asserted that more research for non-chemical weed management strategies is required.

### INTRODUCTION

Modern organic agriculture has been developing for most of the twentieth century, although its roots may go back a lot further (Lampkin 1990). Organic production is achieved without the use of synthetic chemicals and with an emphasis on specific management practices that seek to take care of the environment and soil health (FAO 1999).

Growers have been farming organically in Australia for several decades, producing commodities such as tree crops, vegetables, grains, meat and dairy products. There are many long-term, financially successful organic farmers who are exemplars of best farming practice (Dumaresq 1997). However, knowledge in the industry is often practitioner-based and not easily available to the wider farming community. The knowledge is often anecdotal and untested scientifically (Rasmussen and Ascard 1995).

Weeds are widely reported as a key constraint in organic agriculture, although not all organic growers believe weeds are a problem. Many farmers express less concern about weeds as their experience increases (Patriquin 1988). Organic weed management relies

on mechanical, biological and cultural methods, but these tools must be used in an integrated, multi-strand approach (Rasmussen and Ascard 1995). In addition to direct and cultural techniques; timeliness, vigilance and an understanding of farm ecology are also important factors in effective weed management (Marshall 1992).

### RESEARCH ACTIVITIES IN AUSTRALIA

Since the 1980s, a number of projects looking at organic farming systems have been carried out in Australia (Derrick 1997). Many of these projects have considered non-chemical weed management as part of a wider study of farming systems. This review concentrates on research conducted by government departments and universities. Research activities reported in industry publications and newsletters have generally not been considered in this review. Research on classical biological control is being conducted widely in Australia (McFadyen 1998), but it is also not covered in this review.

**Australian Capital Territory** A study of wheat seed characteristics found that there was no difference in germination and early growth between seeds from organic and non-organic parent plants, but that larger seeds (with more phosphorus) produced larger seedlings. It was suggested that selecting larger seeds might enhance early crop competitiveness against weeds (Derrick and Ryan 1998).

**New South Wales** A long-term trial on vegetable production systems has been running for eight years at NSW Agriculture, Somersby. The trial involves five production systems including 'organic'. One finding is the important benefits of legume cover crops for weed suppression (Anon 1999). An organic demonstration site has been established at Yanco Agricultural Institute, in which various weed management options are being evaluated in a range of crops including vegetables, cereals and pulses (Robyn Neeson, pers. comm.). Research conducted by NSW Agriculture at Wagga Wagga Agricultural Institute using high density legume rotations has found weed control benefits (Latarnie McDonald, pers. comm.). Mycoherbicides are also being investigated (Auld and Say 1999).

A variety of vegetable production trials with implications for weed management have been carried out in the Sydney region, including studies of *in situ* mulches (Sutton 1998) and inter-cropping (Stirzaker 1996). These cultural methods require skilled management to achieve satisfactory weed control. The use of crop residues in farming rotations is being investigated at the University of New England (UNE). Researchers are interested in the role of allelopathy and resource competition in weed control (Elizabeth Jones, pers. comm.).

A project looking at weed management in organic herb and vegetable production is also in progress at UNE. A national survey of weed management strategies used by organic growers has been conducted, indicating that most growers rely on hand weeding, mulches, slashing and cultivation to manage weeds. Several in-crop weed control methods have been assessed for cost and extent of weed suppression in echinacea and lettuce (Paul Kristiansen, pers. comm.).

**Queensland** A range of trials have been conducted by the Queensland Department of Primary Industry investigating alternatives to chemical use in vegetable production (Henderson 1996, Olsen 1997). Several cover crops have been evaluated, and selected ones are now being tested for weed suppression characteristics at Gatton, Bundaberg and Bowen. Comprehensive experiments looking at alternatives to black plastic film mulch have also been carried out. The most economically effective treatments were *in situ* mulches (Anon 1998a). Combinations of woven plastic weed mat and composted organic materials have been used successfully for weed control in organic echinacea trials (Rob Fletcher, pers. comm.).

At Griffith University, a study is being conducted on the prospects and problems faced by modern organic farmers; the processes by which conventional farmers convert to organic farming; and an assessment of organic farmer attitudes and perspectives on land management issues (Rickson *et al.* 1997).

**South Australia** The 'Biological Farming Systems Trial' is a long-term project at Roseworthy, consisting of four farming systems: organic, biodynamic, integrated and conventional. Weed control methods used include green manuring, rotations, sheep grazing and tillage (Penfold and Miyay 1996). It has been reported that weeds are the major productivity constraint for *all* treatments, organic and conventional (Penfold and Miyay 1998).

Completed research includes an evaluation by Powles (University of Adelaide) of non-chemical methods for managing herbicide resistant annual ryegrass using cultural methods, timing of operations, weed seed harvesting and selecting competitive crops (ARRIP 1999). A substantial decline in weed densities has been reported. Solarisation trials have also been carried out (Powles *et al.* 1988).

**Tasmania** Preliminary research in vegetables has been undertaken using strategic pre-planting cultivation (false seed bed), brush weeders and flaming, and demonstration plots have been established in Devonport (David O'Donnell, pers. comm.). Another study is evaluating the feasibility of long-term trials of farming systems, including organics (Anon 1998b).

Previous non-chemical weed research includes cover crops (Young and Hingston 1993), rotations (Bishop 1993) and solarisation (Bishop 1996). These trials demonstrated varying levels of weed suppression.

**Victoria** Several projects on vegetable production have been completed at the Vegetable Research Station in Frankston, including cover crops, allelopathy, mycoherbicides, cultivation, mulching and other management strategies (Paterson 1992). A study of crop and pasture rotations for organic grain production was undertaken from 1994 to 1997. Weed control was assessed in a system of rotations (pasture, wheat, green manure combinations), sheep grazing and tillage. A long-term demonstration site and an organic resource centre have been established at the Institute for Integrated Agricultural Development at Rutherglen (Newton and Walker 1996).

**Western Australia** Weed control trials have been carried out for potato production, but the results were inconclusive (Parlevliet 1997). An evaluation trial of green manure species, and trials comparing ploughing, slashing and knockdown spraying are being conducted by Agriculture WA (Francis Hoyle, pers. comm.).

Other research includes mycoherbicides (Shivas 1994), critical timing and weed biology studies by Blacklow (University of Western Australia), and rotation and cover crop trials by Bowran (Agriculture WA) (ARRIP 1999).

#### INTEGRATED RESEARCH

The need for greater emphasis on the neglected area of non-chemical weed management was proposed at the previous Australian Weeds Conference (Lovett and

Knights 1996). Over 70% of research presented at recent Australian weeds conferences was concerned with one weed management strategy: herbicides (Hannaford and Howat 1996). The United Nations Food and Agriculture Organisation also sees a need to increase funding for the research, development and extension of organic technologies (FAO 1999).

It may be helpful to recast the 'organics versus conventional' debate from a dichotomy to a continuum, with a wide range of management options and farming systems placed along a line based on agreed measures of sustainability and productivity. Different agricultural systems are able to share technologies and research outcomes (FAO 1999). An example of such interchange in Australia is the project 'Identifying organic practices with wider significance to science or agriculture' (Anon 1998c).

Continued research on *specific methods* of non-chemical weed control is needed for particular crops in particular environments, in order to optimise those methods and determine their range of effective application. In addition, studies of *weed and farm ecology* may provide:

- a greater appreciation of the effects of general farm management activities on weeds,
- a longer-term understanding of weed population dynamics, and
- an integrating framework for employing the various weed control methods available.

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