Organic weed management survey: methods used by Australian herb and vegetable growers

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ABSTRACT

Weed management is a major limiting factor for organic growers. To gain an understanding of organic weed management in Australia, a mail survey was conducted with particular attention to herb and vegetable growers. This paper presents results about the use of various weed management methods. Hand weeding was the most commonly reported method, followed by organic mulches, slashing, tillage, rotations, cover crops and timing of operations. Moderately common methods included inter-cropping, grazing, crop selection and flame weeding. Several other methods such as synthetic mulches, steam weeding, strategic fertilisation and solarisation were reported infrequently by respondents. Examples of usage are provided. Half of the respondents used eight or more methods, and many highlighted the importance of an integrated approach to successful and sustainable weed management without herbicides.

KEY WORDS

Organic, sustainable agriculture, integrated weed management, mail survey, horticulture

INTRODUCTION

For many decades, a small number of growers in Australia have been successfully developing and refining farming systems that do not rely on synthetic herbicides to control weeds. In the past few years, interest in organic production has grown considerably and it is projected to grow even further as domestic and export markets increase. Organic production in Australia is currently estimated to be valued at $200-250 million annually (2).

As new growers enter the industry, the demand for information about organic production methods is also increasing. Technical details sought by growers include soil fertility management, plant and animal species selection, rotation sequences, pest and disease control, and post-harvest handling. Weed management, in particular, has also been highlighted as an important production constraint by the organic industry (9). The costs of weed management in organics vary depending on the farming system, with estimates ranging from 30-50% of expenses in intensive horticulture, to 10-30% in broadacre production (E. Wynen, pers. comm.).

Several areas of research in organic weed management have been suggested to refine existing techniques such as cover crop management (1), and to develop newer methods such as thermal weeding (6). Another source of information about organic weed management is the existing knowledge of current farmers, many of whom have been controlling weeds for years without herbicides. Various methods are available to capture such knowledge including telephone or face-to-face interviews, group workshops and mail surveys (8). The latter method can be a relatively simple and cheap way of collecting data from a large number of informants (4).

Since the early 1980s, a number of surveys focussing on organic farming in Australia have presented findings on issues such as the size and scope of the industry, attitudes of growers, economic considerations, production methods and sustainability indicators (5). However, surveys concerned specifically with weed management do not appear to have been conducted. In this paper, some results from a national mail survey of organic growers are presented. The survey was undertaken in late 1998 in order to gain an understanding of how weeds are managed on Australian organic farms. Assistance was sought from all of the accredited certification agencies in Australia in an effort to get feedback from experienced and active organic growers.

The survey was a component of a broader research project looking at weed management techniques in organic herb and vegetable production. Population sampling for the survey was therefore directed towards maximising responses from that sector. This paper presents results about specific weed management methods used by the herb and vegetable growers who responded to the survey.

METHODS

The survey design and administration generally followed the methods of Dillman (4). The survey sought basic information about the farming enterprise and attitudes to weeds, as well as more detailed questions about the weed management strategies. A combination of open text, numerical and scaled responses was used. The sample population was drawn from the current membership of three of the certifying agencies operating in Australia, the Biological Farmers of Australia (BFA), the National Association for Sustainable Agriculture, Australia (NASAA) and the Organic Herb Growers of Australia (OHGA). All other certifying agencies were invited to participate but declined.

Following a pilot evaluation of the questionnaire by ten organic industry representatives and two academic researchers with experience in the design and conduct of farmer surveys, the questionnaire was sent to 762 growers in all states of Australia. The survey was either mailed directly to members or included in a newsletter and posted out by the certification agency (OHGA only). A follow-up mail-out was sent after six weeks to BFA and NASAA members who had not responded to the first mail-out.

In addition to general questions about the respondents and their farms, a series of common weeding methods were listed (plus space for "other methods") and respondents were asked to indicate the regularity of use of each method by circling a number on a scale of 1 - 5 ("Never" to "Always"). These responses are categorised as 1 = not used, 2 or 3 = low regularity, and 4 or 5 = high regularity. Open text responses were also used in the questionnaire and are cited in this paper to illustrate certain points from the scaled responses. The data were analysed statistically in S-Plus?.

RESULTS AND DISCUSSION

The overall return rate for the survey was 43% (n=326), although some respondents did not complete all of the questions, or provided unusable responses to some questions. Seventy percent of the respondents said they grew an herb and/or vegetable crop, and it is that sub-sample (n=229) only that will be discussed in this paper. From that sample, 77% were organically certified and a further 16% were currently "in-conversion" to full organic status.

Weed management methods. Most of the herb and vegetable respondents (80%) believed that weeds were a problem in organic production. However, some growers emphasised that weeds are an inevitable and intrinsic part of the agroecosystem, for example, by providing habitat for beneficial insects. Growers spent a median of sixty-three person-hours/hectare/year on weed management, although this indicator may be unreliable as many respondents stated that they were unable to estimate it (e.g. “no idea!”).

A summary of the responses concerning the regularity of use of various weed management methods is presented in Figure 1. Hand weeding, which included chipping, was the most commonly used method overall (94%), and was also the method most frequently used with high regularity. Eighty percent of growers reported a high level of reliance on this method. Various hand weeding techniques were mentioned by growers such as manual pulling, forks and mattocks for digging out deep rooted species, and hand and wheel hoes in formed beds and close to crop plants.

Several direct methods of weed control were reported frequently and at relatively high regularity levels by a majority of the respondents (≥ 50%). These included the use of organic mulches such as hay, straw, cardboard and newspaper; and mechanical operations such as slashing, ploughing and rotary hoeing. Mulches were considered by respondents to be very effective in controlling weeds and had several other beneficial effects, but they suffered from high purchase and laying cost and they harboured pests and diseases. Slashing was commonly used to minimise weed populations in uncropped areas and to prevent

weed seed set after harvest. Tools used include tractor-mounted slashers, brush-cutters and lawn mowers. Tillage implements varied between respondents, with disc or tine ploughs and rotary hoes being the most common. Other implements reported were deep rippers and inter-row cultivators.

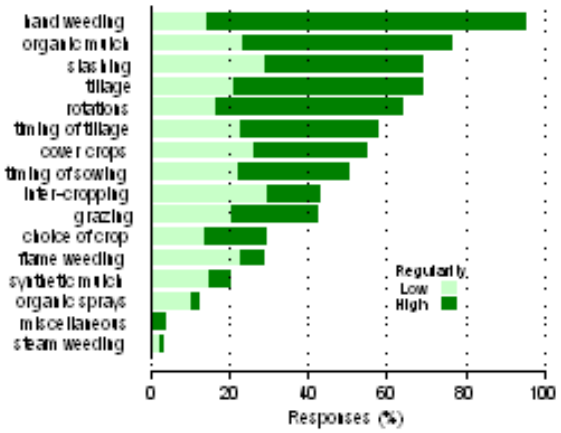

Figure 1. Percentage of herb and vegetable survey respondents that indicated the regularity with which they use various weed management methods. (The light coloured bars signify low regularity, and the dark bars signify high regularity. The values do not sum to 100% as growers generally used more than one method.)

Various cultural methods were also widely used by respondents, but to a lesser extent than the direct methods mentioned above. These methods included rotations, cover crops and timing of operations. Rotations are an essential part of organic farming under the National Standards (7), and appear from the open text responses to be practised by a very large proportion of growers. It is possible that growers are not always conscious of the link between strategic rotations and integrated weed management. Reported rotations generally consisted of various sequences of cash crops, cover crops (green manures) and fallows, with some use of animals. Cover crops used include vetch, clover and oats. The importance of timing of tillage and sowing in weed management was well recognised by respondents.

Weed control methods used by a moderate number (~30 - 40%) of respondents included inter-cropping and grazing. Examples of inter-cropping reported by growers included the use of under-sown legumes, border plantings of lemon grass to exclude kikuyu and hedge rows to limit wind-born weed seed dispersal. Several types of animals were used for managing weeds by grazing such as goats, sheep, cattle, pigs and poultry. Of less importance to respondents were choice of crop and flame weeding. Some growers chose crops to suit the existing weed populations, for example avoiding narrow-leaved crops like onions, which are less competitive against weeds. Flame weeding was reported by almost 30% of respondents, although mostly at low use frequency. Often, only moderate success was achieved with flame weeding and the cost of fuel and labour was often reported to be prohibitive.

Several infrequently used methods (≤ 20%) were also reported. Synthetic mulches such as weed matting (woven black plastic) and polythene film were used occasionally. These materials are permitted by the national organic Standards, but are usually discouraged (7). Novel methods such as organic sprays (e.g. citrus oils, bio-dynamic preparations) and steam weeding were used by a small number of respondents. The "miscellaneous" category included techniques recorded by respondents in the space provided for "other" methods such as solarisation, strategic timing and placement of fertiliser and irrigation and maintaining good farm hygiene practices such as composting off-farm inputs and washing machinery.

Integration of methods. Summarising individual methods may neglect the importance of integration in organic weed management strategies. Analysis of the scaled responses indicates that the median number of methods used was eight, with a maximum of sixteen. Therefore, at least half of the growers were using at least eight techniques to manage weeds. However, this analysis would vary depending on

how "methods" are defined and categorised by the respondents and by the researchers. For example, in the questionnaire, "tillage" was used to cover all mechanical cultivation, ignoring the specialised role of different implements. On the other hand, flame weeding and steam weeding were differentiated in the questionnaire, but could have been combined under "thermal weeding".

Some responses to the open text questions emphasised a number of principles and integrative strategies. In addition to timeliness and the cultural methods already mentioned, other techniques included:

- observing weed life cycles and succession,
- preventing weed seed set,
- paying attention to detail early to save extra effort later,
- planning operations in a logical sequence, and
- gearing "all" operations on their farm towards weed management.

CONCLUSION

Various published reports warn that survey results can be too general (3) and that they are prone to a number of biases (8). These criticisms apply to aspects of this survey. The complexities of integrated organic weed management can't be comprehensively explained in a few open text and multiple-choice questions, so it is inevitable that the findings will be general and descriptive. Biases, however, can be partly reduced by thorough preparation, careful wording of questions and testing of the survey. Some shortcomings of this survey included the inability to control sample selection due to restricted access to membership lists of some certification agencies, the weeding methods presented in the questionnaire were not exhaustive, and highly variable responses were elicited from some questions. The response rate was consistent with many other mail surveys (8); however, because the impact of non-response bias was not tested, it is not known if the sampled population was truly representative.

The main conclusions from the survey regarding organic weed management by organic herb and vegetable growers are as follows.

- Hand weeding is vital for satisfactory weed control.
- Mulching, slashing and tillage are major contributors to suppressing and killing weeds.
- Crop rotations, including cover crops and fallows, are also major weed suppressing techniques.
- Timing of operations, such as tillage and sowing, is commonly used to increase the impact on weeds.
- Inter-cropping, grazing, crop selection and flame weeding are moderately popular strategies.
- Many less common methods are used by individuals to suit their conditions and farming philosophy.
- Most growers rely on at least eight techniques for integrated weed control.

The results highlight the importance of diversity and integration of methods in organic weed management. Organic production strategies may provide insights for research and development in conventional weed management systems.

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