Development and implementation of *Brassica* IPM systems in the Lockyer Valley, Queensland, Australia

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Abstract

In the mid 1980s, *Brassica* vegetable production in southern Queensland was at crisis point with insecticide resistance in diamondback moth, *Plutella xylostella* (L.), leading to frequent spray failures. Through a succession of projects, an Integrated Pest Management (IPM) system targeted at the local *Brassica* pest complex was developed with farmers and industry using participative processes. Strategies included an extensive research and development program, on-farm trial work, demonstration sites, publicity, farmer and industry training, and information development and delivery. An evaluation process incorporated into project work in 1996 showed that changes in industry practice were occurring. Data were collected through a combination of surveys (1996, 1997, 1998, 2001) and focus group interviews (1997).

A key component of our implementation strategy was to ensure farmer and industry participation in the evolving IPM system by applying the concepts of adult education and action learning to project activities. A Brassica Improvement Group (B.I.G.) was formed in 1997 and this farmer-driven learning group has become an important vehicle for IPM extension efforts. This paper explores the contribution B.I.G. has made to positive IPM outcomes in the field. The concept of social capital is used to analyse the robustness of the group, its capacity to continue successful operation and ability to foster IPM with minimal agency support. This study indicates that surviving a change in leadership and focus appear to be critical factors for group sustainability.

Keywords

*Brassica* vegetable crops, integrated pest management, extension, social capital, evaluation

Introduction

The Queensland *Brassica* vegetable industry is estimated at Aus$30 million, which is about 20% of the Australian industry. On average, around 2800 hectares are planted to *Brassica* crops per year (ABS 1997, Harper et al. 1999). Crops are located primarily in the cooler southern regions of Queensland - the Lockyer Valley, Eastern Darling Downs and Granite Belt regions. Cabbage, cauliflower and broccoli are the major crops with smaller quantities of Chinese cabbage and other Asian vegetables grown.

The industry has seen some major changes in the past five years. These are being driven by the increasing market share of chain stores in the domestic markets, declining profitability of vegetable production and demands on farmers to implement more complex food safety, quality assurance and business management systems. This has resulted in some farmers leaving the industry and other farmers expanding their operations to achieve economies of scale. The total area planted to *Brassica* vegetable crops has increased over the past five years (ABS 1993, ABS 1997) and oversupply often has a negative impact on prices.

Within these changing production and marketing conditions, management of pests in *Brassica* crops has also seen some major changes, with Integrated Pest Management (IPM) now seen as best practice. Several factors facilitated this changed approach to managing pests. Traditionally, *Brassica* vegetable crops were grown year round in the Lockyer Valley and farmers relied heavily on scheduled sprays of broad-spectrum insecticides to manage a range of pests. This practice was called into question in the mid 1980s, when *Brassica* production in the Lockyer Valley was at crisis point due to insecticide resistance problems in diamondback moth, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae). Wide spread spray failures, particularly in summer grown crops, mobilised industry and government to search for alternative techniques for managing diamondback moth (DBM).
Through a succession of projects, a practical IPM system was developed with local farmers and industry. DBM was the most difficult pest to manage, but as farmers reduced broad-spectrum insecticide use within an IPM framework, other pests became more problematic. A number of lepidopterous pests have the potential to cause significant crop damage during autumn and spring. These include centre grub, *Hellula hydralis* (Guenée) (Pyralidae: Lepidoptera); cabbage cluster caterpillar, *Crocidolomia pavanona* (Fabricius) (Pyralidae: Lepidoptera); cluster caterpillar, *Spodoptera litura* (F.) (Noctuidae: Lepidoptera) and heliothis, *Heliocoverpa* spp. (Noctuidae: Lepidoptera). Cabbage white butterfly, *Pieris rapae* (L.) (Pieridae: Lepidoptera) can be a sporadic problem in unsprayed crops. Thrips species have caused some concern over the past two to three years in crops where spraying with broad-spectrum insecticides has been significantly reduced. The IPM system of the Lockyer Valley is therefore aimed at managing the pest complex, not only DBM, at the cropping systems level.

The IPM system includes crop scouting, a break in production over summer, use of narrow-spectrum insecticides within a resistance management strategy, protection of natural enemies, release of predators and well-targeted spray application practices. Strategies for developing and implementing the system included an extensive research and development program, on-farm trial work, demonstration sites, publicity, farmer and industry training, and information development and delivery. The progress of IPM development can be divided into three different phases:

1988 to 1990 – implementation of an insecticide resistance management strategy.
1990 to 1995 – reducing reliance on broad-spectrum insecticides by introducing *Bacillus thuringiensis* into the cropping system coupled with a summer production break, crop scouting and improved spray application.
1995 to present – improving and building on the existing IPM system through research into natural enemies, pest monitoring protocols, insecticide spray coverage; and capacity building through developing decision-making tools and delivering training workshops to farmers and industry.

The approach and activities associated with project work from 1988 to 1996 are documented in greater detail by Heisswolf *et al.* (1997).

To increase responsiveness to industry needs and to assess projects against objectives, the IPM program has included a formal evaluation process since 1995. This process has provided information for decision-making to two consecutive projects funded by the Australian Centre for International Agricultural Research (ACIAR).

In early 1998, a local grower group was established to promote information sharing and facilitate IPM implementation. This grower driven-learning group, the Brassica Improvement Group (B.I.G.), has been meeting on a monthly basis during the production season since its inaugural meeting in February 1998.

Since implementation of the Extension Strategy Statement (Department of Primary Industries 1992), group approaches have become an important component of the public extension and farmer interface in Queensland. This has raised questions about group robustness and self-reliance. Groups can be seen as a part of the social capital of a community or industry. In 2000, we explored the dynamics of group formation and development within the context of social capital using B.I.G. as one of our case study groups.

The objective of this paper is to document changes in IPM practice that have occurred since 1990 and to explore the contribution that B.I.G. has made to this IPM outcome in the Lockyer Valley.

**Materials and methods**

Grower participation in project work

A critical component of research and extension work was to encourage grower and industry ownership in the evolving IPM system. Using participative processes based on adult education and action learning principles, we encouraged information flows between all sectors of the *Brassica* industry - researchers, consultants, farmers and agribusiness. The aim of this approach was to ensure research and development activities were well targeted and results could be tested, incorporated and adapted within existing farming systems.

The ACIAR project team actively sought industry involvement in setting research directions for both projects. In 1995, around 50 stakeholders took part in a problem specification workshop in Brisbane to
identify pest management problems and opportunities and to formulate strategic approaches for developing pest management solutions. Two industry representatives took part in a formal mid-term project review in 1996. At the conclusion of this first ACIAR project in 1998, a second industry workshop was held to review progress and identify new and emerging pest management needs using a modified SEARCH process (Dick 1990). Outcomes from this workshop were incorporated into the objectives of the second ACIAR project.

Extension and training activities were formulated using adult education and action learning principles. Adult education encompasses such concepts as learning from peers, building on past experience, taking a problem oriented approach and encouraging interaction and participation (Brookfield 1986, Knowles 1990). Strategies at field days and training activities therefore aimed to provide hands on experiences for participants, focused on small group processes and allowed time for discussion, interaction and questioning. Formal presentations of research results were incorporated within these adult education activities as appropriate.

The action learning cycle (McGill & Beaty 1992) provided a useful framework for structuring many activities. This cycle consists of four phases – plan, act, reflect and decide. For example, after a learning activity, the workshop design would encourage participants to move through the different phases of the action learning cycle by:

- Reflecting on what was learned,
- Deciding how this learning relates to their own situation,
- Planning how this new knowledge might be used on their own farm,
- And then applying this knowledge.

The Brassica Improvement Group

In 1997, a local farmer who had been working closely with the research and development team since 1993, decided to set up the Brassica Improvement Group (B.I.G.). Kevin Niemeyer brought back this idea after visiting cauliflower farmers in Western Australia with a project team member. After canvassing interest in establishing a similar group in the Lockyer Valley with other farmers, agribusiness and agency staff and discussing the potential aims of such a group at several meetings, the first general meeting of B.I.G. was held at the Gatton Research Station in February 1998. Kevin Niemeyer was elected chairman, a local crop scout was elected secretary/ treasurer and the executive was completed with the election of three farmer and two industry representatives. The role of agency staff was to support the group in its organisation and operation.

The objectives of the group were to provide a forum for sharing information, learning and discussion in a social atmosphere. Initially the group focused on IPM issues, but more recently the aim has been to address topical issues of the day. Since February 1998, B.I.G. has met monthly during the Brassica season, from February to October. Attendance numbers vary from 12 to 45, depending on the topic.

Social capital and the Brassica Improvement Group

The main objective in our study on social capital was to explore the factors that influence the establishment and development of effective farmer groups and identify strategies that we could use to support farmer groups become self-reliant and sustainable.

Like the terms “participation”, “extension” and “sustainability”, the concept “social capital” is difficult to define and therefore to measure. In the literature on social capital, different authors interpret the term social capital according to their own ideology and context (Dasgupta & Serageldin 1999, Wall et al. 1998) and there are many views and perspectives on “social capital” and little consensus on how it might be measured (Bourdieu 1986, Coleman 1990, Putnam 1995, Flora 1998, Ostrom 1998, Pretty 1998, Uphoff et al. 1998). The term captures the idea that social bonds and social norms are an important basis for sustainable development. Its value was identified by Jacobs (1961) and Bourdieu (1986), later given a theoretical framework by Coleman (1988, 1990) and brought to wide attention by Putnam (Putnam et al. 1993, Putnam 1995). Solow (1999) describes social capital as “such things as trust, the willingness and capacity to cooperate and coordinate, the habit of contributing to a common effort”. These aspects of social structure and organisation are resources for individuals to use to realise their own personal interests.

For the purposes of our study on the factors impacting on the robustness of farmer groups, we used a typology of social capital developed by Pretty and Ward (2001) for assessing group maturity (Table 1).
These authors propose a series of criteria, which are organised into five discrete categories, for exploring the evolution of groups. Against each criterion, descriptions for assessing group maturity at different stages are given. Three stages of group evolution are proposed; Stage 1 Dependent, Stage 2 Independent and Stage 3 Interdependent.

In February to May 2000, we explored group robustness within the context of social capital using four farmer groups as case studies. One of these groups was the Brassica Improvement Group. A multi perspective approach (Van Beek & Nunn 1995) was used to select respondents for each group studied. The aim was to obtain information about each group from various perspectives, ranging from the group leader, to an outsider who was sceptical, but had good knowledge of the group.

A standardised questioning procedure was developed using the criteria from the Pretty and Ward typology (Table 1). Open-ended personal interviews were conducted over a three-month period in early 2000. Eight people interviewed per group. The qualitative data collected were analysed against the three stages of group evolution proposed by Pretty and Ward (2001) by assigning comments and phrases gathered during interviews into one of the five categories of the typology.

Table 1. Summary of a typology for assessing group maturity proposed by Pretty and Ward (2001). A dependent group is considered at Stage 1, an interdependent group at Stage 3 of group evolution

<table>
<thead>
<tr>
<th>Categories of criteria</th>
<th>Descriptions for assessing group maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worldviews &amp; sense-making Ability and attitude to change, the values and beliefs of individuals within the group</td>
<td>A dependent group tends to be backwards looking, fearful of change with individuals fixed in their attitudes, beliefs and values. An interdependent group actively shapes its own future, accepts change as the norm and uses critical reflection and abstract thinking to develop new insights.</td>
</tr>
<tr>
<td>Internal norms &amp; trust Value of the group to members, level of trust and commitment, sharing of ideas, development of rules and norms.</td>
<td>A dependent group tends to follow externally derived rules, distrusts the new, but shares some ideas and places some value on the group. An interdependent group develops its own rules and norms, expresses the social value of the group and shares ideas within the group as well as externally.</td>
</tr>
<tr>
<td>External links &amp; networks Group links to external networks and sources of support and information</td>
<td>A dependent group has few links with other groups, tends to rely on an external facilitator and information flows are mainly top down. An interdependent group no longer requires an external facilitator, is able to encourage the formation of new groups and is well linked to many external information sources and agencies.</td>
</tr>
<tr>
<td>Technologies &amp; improvements A group’s capacity to experiment and generate solutions.</td>
<td>A dependent group continues to look for external and simplistic solutions to complex problems although there may be some experimentation. An interdependent group looks for solutions to problems within the group and externally, with experiments and redesign leading to adaptation and innovation.</td>
</tr>
<tr>
<td>Group lifespan The resilience of a group and the group’s reason for being.</td>
<td>A dependent group tends to be initiated by an external agency or come together in response to a crisis. Groups under the same program look similar with groups likely to break down with the resolution of the crisis or withdrawal of the external agency. Interdependent groups have successfully achieved initial goals, are setting new goals and are engaged in different activities. They are unlikely to break down and have their own characteristics.</td>
</tr>
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The evaluation process

A participatory planning process involving the ACIAR project team was used to define the evaluation approach and methods at workshops in March 1996 and January 2000. The evaluation hierarchy of Bennett (1975) was used as the model for structuring the evaluation plans. During these workshops, team members
listed their planned activities under the project objective to which the work contributed and then completed a table outlining:

- Resources required
- Anticipated people involvement
- Expected reactions from those involved
- Changes in knowledge, attitudes, skills and aspirations (KASA) which might come about as a result of their planned activities
- Changes in industry practice which would follow on from KASA changes
- Long-term outcomes which might eventuate

Key questions for the evaluation were formulated from workshop results and performance indicators were identified. The evaluation process was designed to integrate with normal project management activities with attainment of project milestones serving as one set of indicators. Evaluation activities designed specifically to monitor changes in pest management practices included:

Baseline and follow-up grower surveys (November 1996 and February 1998) – personal interviews with 20 *Brassica* farmers per survey.

Grower focus groups (October 1997) – two groups were interviewed, Group 1 consisting of 5 farmers with little personal contact with project team members, Group 2 consisting of 7 farmers with regular involvement in project activities.

Agribusiness survey (February 2001) – telephone interviews with 7 pesticide resellers and 5 pest management consultants.

Questionnaires used to review an insecticide resistance management strategy in 1990 (Heisswolf 1992), the 3V Strategy implemented in 1988 (Deuter 1989), served as a resource for survey development in 1995. In this earlier review, 37 Lockyer Valley broccoli farmers and 19 chemical resellers, field officers and consultants were interviewed using structured questionnaires. By linking the two processes, we planned to use results from the 3V Strategy review as baseline data for some of our evaluation outcomes.

**Results and discussion**

Changes in pest management practices

Evaluation results show that Lockyer Valley *Brassica* farmers have gradually implemented various components of IPM since 1990. Changes in pest management practice are summarised using several “IPM indicators” (Table 2). Over the past decade, 60 to 74% of farmers implemented a voluntary three month production break over summer (November to February). Our evaluation however indicates that this practice is coming under pressure due to low prices, with a trend for farmers to lengthen the season to capture higher prices and so shortening the production break.

*Bacillus thuringiensis* (Bt) use has increased dramatically since 1990, mixing of Bt with other insecticides has declined and in 2001, 90% of farmers were using narrow spectrum insecticides to manage pests. This indicates that farmers are aiming to target pest problems more effectively while minimising impact on natural enemies. This is supported by the increased use of crop scouts to make spray decisions and increased knowledge and use of natural enemies. According to survey results, overall there has been an increase in the use of IPM since 1995 although this of course depends on an individual’s definition of IPM.

Is there a link between changes in practice and the establishment of B.I.G?

Results from the focus group interviews conducted in 1997 show that farmers involved with agency staff and project work were more advanced in implementing IPM practices than farmers with less direct contact. The former farmers had a higher tolerance to pest numbers in crops before spraying, were thinking about how to attract and release natural enemies, used crop scouts to make decisions and were looking for strategies to manage secondary pests. Half of these farmers were involved in the establishment of B.I.G.

Farmers with little direct agency contact were moving towards greater Bt use, but still relied on broad-spectrum insecticides. These farmers were aware of the potential of natural enemies and seemed prepared to change their spray practices to protect them. Half the farmers interviewed used crop scouts to cut down their spray costs. Farmers in this group were less likely to attend B.I.G meetings. Both groups of farmers said that widespread implementation of a summer production break and increasing the acreage of crop being monitored for pests had helped with insecticide resistance management.
In the 2001 survey, 71% of chemical resellers and 20% of consultants listed B.I.G. meetings as one of the extension activities that they had attended during the season. This indicates that for some sectors of the agribusiness industry, B.I.G. meetings are an important avenue of interaction and source of information.

The link between IPM implementation and B.I.G. is far from clear although there are indications that the group has had an important influence on IPM development and adoption in the field. A follow up survey of Brassica farmers in 2002 will strengthen the evaluation process. Using personal or telephone interviews, data on the current level of IPM implementation, based on the IPM indicators from the previous surveys, will be collected and linked to involvement with B.I.G. since 1998.

Table 2. Changes in integrated pest management in Lockyer Valley Brassica crops based on percentage of farmers using various pest management practices

<table>
<thead>
<tr>
<th>IPM indicator</th>
<th>1990a</th>
<th>1996b</th>
<th>1998b</th>
<th>2001c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer production break</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 months</td>
<td>70%</td>
<td>74%</td>
<td>60%</td>
<td>44%</td>
</tr>
<tr>
<td>1 month</td>
<td></td>
<td></td>
<td>30%</td>
<td>51%</td>
</tr>
<tr>
<td>Rotating chemical groups</td>
<td>35%</td>
<td>26%</td>
<td>-</td>
<td>90%</td>
</tr>
<tr>
<td>Narrow spectrum insecticides</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>90%</td>
</tr>
<tr>
<td>Bt use overall</td>
<td>19%</td>
<td>95%</td>
<td>95%</td>
<td>-</td>
</tr>
<tr>
<td>Bt mixed with other pesticides</td>
<td></td>
<td>33%</td>
<td>17%</td>
<td>&lt; in 1996</td>
</tr>
<tr>
<td>Improved spray application</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoid spraying in wind</td>
<td></td>
<td>70%</td>
<td>70%</td>
<td>-</td>
</tr>
<tr>
<td>Safety – filtered cabs</td>
<td></td>
<td>22%</td>
<td>44%</td>
<td>-</td>
</tr>
<tr>
<td>Crop scouting</td>
<td>30%</td>
<td>25%</td>
<td>50%</td>
<td>60%</td>
</tr>
<tr>
<td>Conscious protection of natural enemies</td>
<td>-</td>
<td>5%</td>
<td>-</td>
<td>30%</td>
</tr>
<tr>
<td>Release of predators</td>
<td>-</td>
<td>0%</td>
<td>-</td>
<td>10%</td>
</tr>
<tr>
<td>Use of IPM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To some degree</td>
<td></td>
<td>60%</td>
<td>-</td>
<td>70%</td>
</tr>
<tr>
<td>“Advanced”</td>
<td></td>
<td>5%</td>
<td>-</td>
<td>10%</td>
</tr>
</tbody>
</table>

aBroccoli farmers, consultants and resellers interviewed, bCabbage, cauliflower and broccoli farmers interviewed, cConsultants and resellers interviewed

The future of the Brassica Improvement Group

Our case study work on social capital and group sustainability in early 2000 showed that B.I.G. had the potential to evolve into a mature group, but that the group was facing some major threats to its sustainability. As part of the study analysis, we attempted to draw together qualitative data by categorising all words, comments or phrases given by the interviewees into the five sets of criteria proposed by Pretty and Ward (2001).

Within the limitations of this analysis process, B.I.G. appeared to fit into Stage 3 Interdependence for much of the criteria of the Pretty and Ward typology (Table 1), but there are some notable exceptions. The group was well linked to internal and external sources of information, was sharing experimental results and not reliant on an external facilitator for continued functioning, however the commitment of individuals to the group, the level of trust within the group and people’s attitude to change varied.

The success of the group appeared to be strongly linked to the group leader, the initial goal of providing information on IPM had been achieved and there was some doubt as to the resilience of the group in the longer term. Our study indicated that the ability of a group to adapt to a change in leadership and to develop a sense of continuing purpose were critical factors for group evolution.

In 2000, B.I.G. appeared to be at a critical juncture in its development. The group had decided on a maximum of three terms for their executive early in group’s formation and both the chairman and secretary/treasurer were adamant that they would not break this rule and so stood down from the executive for the 2001 season. The agency’s role was to support this decision particularly in light of the findings from our study on group robustness. Our aim was to assist the B.I.G. executive to review their achievements, refocus the aims of the group and resolve the issue of a change of leadership. After three crisis meetings of the
executive over the summer of 2000/01, a new executive was elected in February 2001 and, after a successful 2001 season, the 2002 executive was re-elected with only minor changes at the annual general meeting in October 2001.

B.I.G. is set for another season and appears to be much more robust after having survived its first change of leadership and change in focus. There are other indications that the group is likely to continue with little, if any, agency support:
- The core group of committed members has expanded
- External linkages have diversified
- The group produced a monthly newsletter during the 2001 season
- A member of the group was awarded a four month overseas scholarship
- The group achieved the Healthy Waterways award for South East Queensland in December 2001
- Some group members have formed an Environmental Management group to proactively address wider environmental concerns
- Topics covered at monthly group meetings address a range of issues
- The executive is planning to coordinate on-farm variety trials next season

Viewed against the descriptions in the Pretty and Ward typology (Table 1), these developments indicate that B.I.G. has moved further along the continuum of group evolution since our study in early 2000. For facilitators, this typology appears to be a useful tool for assessing group maturity and designing appropriate processes for supporting groups at different stages of their evolution. Our study of B.I.G. within the social capital context was valuable for highlighting the importance of providing adequate support at a critical period in the group’s life - a change of leadership and focus.

There is some doubt as to whether B.I.G. will continue to play an important role in IPM implementation as the group is now focusing on other topics. It is the group’s decision. In the absence of a pest management crisis, B.I.G. is more likely to focus on profitability issues such as prices, marketing, varieties and reducing input costs. From an agency perspective, B.I.G remains a key extension forum for input on research and development issues and for extending information on IPM and other topics. It will be up to agency staff to negotiate this two-way information flow with the Brassica Improvement Group.

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