OPPORTUNITIES AND THREATS TO TEMPERATE OILSEED PRODUCTION IN AUSTRALIAN AND CANADIAN FARMING SYSTEMS

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Abstract

In 1997, a survey was undertaken of prominent Australian canola scientists and industry people, and their counterparts in Canada, as part of an evaluation of opportunities and threats to temperate oilseed production. All fifty-five respondents rated the canola industry as historically successful and most regarded their industry as buoyant. While there were minor differences in the response of the participants according to their country or occupational group, all groups were similar in how they ranked the potentially positive impact of new plant improvement and agronomic technologies, and rated the likely impact of a range of potential threats. The incidence of herbicide-resistant weeds was seen to be the greatest threat to canola production over the next 10-15 years. The results are discussed in relation to potential threats posed by the release of transgenic crops, the dominance of *Brassica* oilseeds and the private ownership of innovations.

Key words: Biotechnology, canola, herbicide-resistant, linola, linseed, production, survey.

Since 1975, many Australian farmers have adopted a suite of modern technologies that address the issue of sustainable production from croplands. This suite includes canola, an oilseed crop that has quadrupled in popularity since 1990 when Australian production first exceeded 100,000 tonnes.

In Canada, the development of a *Brassica* oilseed industry has taken place over a longer period than in Australia, beginning with rapeseed in the early 1940's and continuing strongly after the development in the 1960's and 1970's of canola varieties (oil low in erucic acid, meal low in glucosinolates) from *B. rapa* and *B. napus* (1). Canada is at the forefront of new developments in the production of a range of temperate oilseed species and types, and these developments have considerable implications for Australian agriculture.

This paper outlines the recent history of canola and linseed (*Linum usitatissimum* - flax) in Australia and Canada, establishes the ascending importance of these crops in the farming systems of both countries, and lists a number of new technologies that are being applied to oilseeds. These technologies are explored in terms of their potential, not only to enhance current and future opportunities for oilseeds but also to increase the risk of negative consequences.

Materials and methods

In early 1997, a review of information on local and Canadian oilseed production was undertaken, and a workshop on transgenic crops attended, to obtain background information and to design a survey instrument which contained questions on opportunities and threats to canola production.

The survey was conducted by personal interviews of prominent canola breeders, scientists, agronomist-advisers, industry personnel and farmers in four Canadian Provinces (Manitoba, Saskatchewan, Alberta and Ontario) in June-July, 1997, and in Australia (NSW, Victoria, SA and WA) in August-September, 1997. In Canada, successful interviews were completed with 13 research and development (R&D) scientists and 12 industry participants (drawn from corporate, organisational and farmer groups); in Australia, those surveyed included 17 R&D scientists and 13 industry people. Each interview was based on the formal survey instrument, and was followed by informal discussions and inspections when opportunities occurred. Also, three respondents were questioned about *Linum* crops, as was the President of the Flax Council of Canada.

The results from the canola survey were statistically analysed by an ordinal regression procedure that was suitable for data that were neither continuous nor normally distributed. The data were classified by country (Australia, Canada) and by respondent type (R&D people, industry people).

Table 1: Area harvested ('000 ha) of three crops in Canada and Australia, 1965-1995[a].

Year	Wheat		Rapeseed/Canola		Linseed/Linola	
	Australia	Canada	Australia	Canada	Australia	Canada
1965	7088	11445	-	581	10	939
1970	6478	5042	43	1639	42	1363
1975	8555	9487	16	1748	16	567
1980	11293	11098	24	2080	10	575
1985	11727	13729	74	2803	9	740
1990	9218	14098	67	2529	2	694
1995	9851	11253	406	5273	8	856

[a] Source: FAO

Table 2: Table of counts showing the ratings given by all survey participants for the likely impact on the canola/Brassica industry of each of a range of new technologies.

New Technologies (available over the next 15 yrs or so)	Responses (expected impact)			Total Responses	Regression coefficient [a]	SED
	Neutral or negative	Positive	Strongly positive			
	No.	No.	No.	No.		
Improved disease resistance	3	24	28	55	- 0.66a	0.35
Improved yield, agronomic type	3	28	24	55	- 0.42a	0.35
Herbicide-resistant canola crops	5	31	18	54	0 ab	
New (speciality) oil types	10	29	16	55	0.41bc	0.35
Better farming techniques	10	34	10	54	0.73cd	0.35
Hybrid canola crops	18	26	8	52	1.39de	0.36
Quality assurance programs	21	27	7	55	1.59e	0.36
New marketing tools	21	26	5	52	1.73e	0.36
New chemicals	25	23	4	52	2.06e	0.37

[a] Each regression coefficient is followed by a letter group indicating significant differences (when the coefficients differ by more than two standard errors of the difference (SED), ie. 0.7 approx.)

Results

There are comparable areas of wheat grown in Australia and Canada, and considerable differences between the countries in the areas sown to *Brassica* and *Linum* crops? (Table 1). In 1995, canola and rapeseed production in Canada (6.4 million t) was second only to China (9.8 million t, FAO 1995), and Canada was also the major producer in the world of *Linum* oilseeds (1.1 million t). In Australia during the last decade, there has been a surge in the production of canola to the present level of 600,000 to 800,000 t, but the area of the crop is still only around 10% of the Canadian crop. The Australian development of linola, a low-linolenic acid type of linseed (3), has failed to halt the slide in popularity in Australia of *Linum* crops, the area of which is barely 1% of the Canadian total.

All survey participants in Australia and Canada rated the canola industry as historically successful and most regarded their industry as currently buoyant. They predicted that it would continue to expand or level off in production rather than decline.

Australian R&D people responded more positively than their Canadian counterparts about the likely impact of technology on the canola/*Brassica* industry, but Canadian industry people viewed the future

slightly more favourably than Australian farmers andagribusiness. There was no significant (P<0.05) group x technology interaction and the main effect of technology was significant, meaning that there were certain technologies, (*eg*. improved disease resistance, improved agronomic type, herbicide-resistant canola varieties) that all groups perceived to be more important than other technologies (hybrid canola varieties, quality assurance programs, new marketing tools and new chemicals) (Table 2).

The survey participants rated the likely outcome, over the next 10-15 years or so, to a range of potential threats to the canola/*Brassica* industry, according to a scale extending from strongly negative (the problem will become a serious limitation) to positive (the problem will be avoided or delayed). The main effect of potential threats was highly significant (P<0.01) and there were no significant two- or three-way interactions, indicating that all groups ranked the 18 potential threats in a similar order (Table 3). Easily the most positive outcome was predicted for "accessibility to new technologies". Problems with farming or the weather were viewed neutrally, along with "government interference", "conflict between public/private interests" and "dominance/monopolisation". At the other end of the scale (Table 3), the "incidence of herbicide-resistant weeds" was predicted to produce a negative outcome for the industry, as were a further seven potential threats, ranging from "reduced research capability" to "loss of markets".

Finally, participants were asked to select two of the potential threats which concerned them and indicate both the level of action needed and the bodies responsible for actioning a response. Eighteen of the 55 participants (nine Australians, nine Canadians) selected the issue of herbicide-resistant weeds, blackleg was selected by 14 participants (13 Australians, 1 Canadian) and "other diseases" such as white rust and sclerotinia by 8 (4 Australians, 4 Canadians). The responsibility for action on these threats was seen to be a role more for the industry to resolve through awareness, education, quality assurance and self-regulation programs, rather than for the other sectors to respond independently. Other important issues were markets (selected by 12 respondents), agricultural/environmental conflicts (by 9), potential contamination of oil types (by 9) and reduced? research capacity (by 7).

Table 3: Table of counts showing the ratings given by all survey participants to each of a range of potential threats to the canola/Brassica industry.

Potential threats	Responses (expected impact or outcome)				Total resp.	Regression coefficient[a]	SED
	Strongly negative	Negative	Neutral	Positive			
	No.	No.	No.	No.	No.		
Accessibility to new technologies	1	4	5	42	52	- 3.24 a	0.57
Problems with farming	0	10	33	4	47	- 0.18 b	0.49
Problems with climate, weather	3	8	37	2	50	0 bc	
Government interference	3	16	26	5	50	0.32 bcd	0.49
Conflict between public/priv. interests	3	15	29	4	51	0.33 bcd	0.49
Dominance/monopolisation	5	17	26	1	49	0.80 bcde	0.49
Cost of new technologies	5	19	24	2	50	0.85 cde	0.49
Conflict between science and society	3	24	17	2	46	1.08 de	0.50
Problems with crop rotations	8	22	17	6	53	1.09 de	0.50
Unfavourable terms of trade	4	25	19	1	49	1.12 de	0.50
Loss of markets	11	17	18	3	49	1.37 ef	0.50
Potential contamination of oil types	8	23	17	1	49	1.43 ef	0.50
Incidence of blackleg (more)	8	27	9	6	50	1.46 ef	0.49
Incidence of insects	5	23	6	5	39	1.53 ef	0.52
Conflict between agric & env. sectors	5	34	11	3	53	1.57 ef	0.49
Incidence of other diseases	6	26	6	4	42	1.74 ef	0.50
Reduced research capability	17	21	13	2	53	2.14 f	0.49
Incidence of herbicide-resist. weeds	15	31	9	0	55	2.33 f	0.49

[a] Each regression coefficient is followed by a letter group indicating significant differences (when the coefficients differ by more than two standard errors of the difference (SED), ie. 1.0 approx.)

Discussion

The development of the canola industry in Canada is an inspiring segment of agricultural history (1). The availability of techniques to transfer useful genes into canola from other plants, and the enthusiasm of Canadians to develop canola oilseed types for use in markets currently held by other oilseeds (notably US soybeans), have collectively encouraged investments in innovation to drive the Canadian canola industry forward to a strong position in the production of oilseeds for food and industrial purposes. There are now more than 30 genes available or under development for new canola oil types. A range of herbicide-resistant canola varieties, produced by normal plant breeding (triazine-tolerant, imidazolinone-tolerant) or transgenically (Liberty Link? canola, Roundup Ready? canola), are a commercial reality in Canada (2). The Canadian linseed and linola industry, also, is enjoying an expansion phase due to diversification into food products.

There are some important distinctions between the canola industry in Australia and Canada. These? include a different profile of disease and insect problems, different seasons during which the crop is grown, and the lag in the development and commercialisation of transgenic canola in Australia. In addition, *Linum* crops in Australia are of little current consequence.

In spite of these obvious differences, the canola industry leaders surveyed in each country were remarkably similar in their buoyant outlook and their appreciat- ion of the actual or potential significance of a range of new plant improvement and agronomic technologies. However, the innovations that are being introduced into the Canadian industry will not necessarily become part of the Australian industry unless satisfactory intellectual property agreements are negotiated between public and private research providers, and with commercialisers.

There was also broad agreement on the ranking of potential threats to the canola industry, with some qualifications such as the greater importance of blackleg incidence in Australian canola (5). The greatest challenge will be to avoid an over-reliance on herbicide-tolerant canola to control weeds? - an integrated approach? for the control of weeds is essential to optimise economic gain and to minimise the risk of developing herbicide-resistant weed populations (4). This issue was appropriately ranked as the most important of the perceived threats. Put bluntly, herbicide-tolerant canolas could be squandered if they are not introduced properly.

Another challenge is to develop quality assurance programs that are robust enough to overcome consumer reservations toward food produced from transgenic crops and to eliminate the contamination of food or pharmaceutical oils with industrial oils. The transgenic food issue is resolvable and transgenic Canadian canola has now been approved for import into Japan and the European Union (2). Those surveyed understood these problems, as seen in their response to threats such as "contamination of oil types" and "loss of markets". However, there is no guarantee that the Australian industry will respond cohesively to surmount these problems.

An essential ingredient in the process of threat management is the availability of a pool of scientific expertise, and several respondents expressed concern about the future level of research capability. In recent years, there has been a shift in the balance of research resources and funding from the public sector to the private sector, and this shift has brought with it less security and greater secrecy. However, the survey population did not express a negative perception to potential conflict between private and public interests, nor to dominance/monopolisation. These perceptions may change rapidly if commercial realities impinge on scientific reason.

Conclusions

There are three main recommendations from this survey and study visit.

First, there needs to be more awareness of the potential negative consequences of utilising new oilseed technologies, such as the possible effects of using herbicide-tolerant crops on herbicide resistance in

weed populations (4). The interplay between scientific and commercial imperatives, and the effect of this interplay on best practice in the chain from the producer to the consumer, must be anticipated and monitored.

Second, Australia must increase investment in temperate oilseeds, not only to keep abreast of world developments in canola and Indian mustard (*B. juncea*) improvement but also to add another winter oilseed crop to the *Brassica*-dominated list that is currently available. The obvious candidate is *Linum* because of the existing link (3) between CSIRO and the large Canadian linseed/linola industry.

Finally, there needs to be leadership in continuing and promoting the exchange of scientific and industrial personnel between the grains industries in Australia and Canada, to counter potential restrictions on the conduct and commercialisation of research due to intellectual property issues. The Grains Research and Development Corporation is in a position to facilitate the exchange of people and their ideas.

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