Constraints to adoption of a grain legume: chickpea

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Summary. Grain legumes can make substantial improvements to the sustainability of cropping systems in Australia. This paper summarises at a broad level some of the constraints to improving the uneven adoption of grain legumes, using chickpea as a case study. Adoption of a grain legume into a rotation is considered as a positive decision, one taken actively to replace a competing winter cereal, usually wheat. For chickpea, many of the major limiting factors are not agronomic. Those that are agronomic concern genetic improvement of yields, preventing yield losses, reducing costs and ensuring reliability of supply.

Introduction

In 1990, the then Minister for Primary Industries and Energy, Mr Kerin outlined seven key issues for agriculture in the 1990s *(Agricultural Science* 3 (3) May 1990). The first was; *"What are the barriers to farmers adopting known, economically viable, environmentally sound technologies and practices?"*

One such practice is incorporating grain legumes into broadacre cropping systems. Grain legumes can contribute substantially to the sustainability of cropping systems (3) through reduced nitrogen fertiliser inputs, reduced weed and disease costs, improved income stability through diversification, and improved soil structure and organic matter. Because the benefits of a grain legume crop are captured at a diminishing rate by succeeding crops (7,8) grain legumes need to be grown every third or fourth crop to contribute to the sustainability of cropping rotations. Many major regions do not have a satisfactory level of grain legume cropping (11). Some regions (eg Eyre Peninsula, northern NSW and Queensland) have average rotations of only one year in 20 or more. However, other regions eg Central WA and the Wimmera, have average levels of grain legume cropping that are within the suggested optimum intensity.

This report considers the constraints to adopting chickpea in competition with wheat, a major established crop, as many farmers lower their value of sustainable cropping systems if the benefits are not captured quickly (10). Chickpea was chosen for this study because it is an emerging crop that received strong attention recently and less widely grown and established than lupins or field peas. After consistently increasing from 3,000 ha in 1983-84 to 211,000 ha in 1991-92, the area of chickpea in Australia suddenly declined to 120,000 ha in 1992-93. This decline, attributed to prices falling from $280 per tonne f.o.b. in 1991 to $220 per tonne in 1992 and to a drought in the northern cropping areas, puts a question on the long-term future of chickpea. In the last two years Victoria has succeeded Queensland as the major producer.

Method

Constraints to the adoption of grain legumes cover many forms, which are difficult to compare and evaluate. One method of comparing constraints is to use a common level of semi-quantitative ratings (eg ratings of 0 (best) - 9 (worst)). Hackett (5) proposed a hierarchical system, ranging from A to D in increasing detail, for environmentally related information. I have chosen to focus on his empirical Level C for this exercise (Table 1). Some constraints will not be defined as precisely as possible, whilst others may require a subjective assessment, implying more precision than is actually known.

Of the many ways that constraints could be identified and grouped, I have given one in Table I. I have based them on scientific literature (eg 2,9), personal interviews and articles in the rural press (mostly from *The Land* and *Queensland Graingrower* during 1989 - 1991). Space limitations prevent giving specific references here. The ratings for the Level C constraints given in the table are for the most limiting of many, more specific (Level D) constraints that are not included here for clarity and brevity.

Discussion

As most of the details in Table I are self-explanatory, I will concentrate on the major factors in this discussion. While there may be many important individual constraints, especially for particular crop regions, only the factor(s) I considered most limiting is listed.

Table I. Possible major factors and constraints to adoption of grain legumes. Ratings are from 0 (best) to 9 (worst).

Level A	Level B	Level C Rating:	Chickpea	Wheat	Diff	Limiting factors
1. Yields & Costs	1. Adaptation	1. Climate	4	3	-1	Cold, flooding, rainfall
		2. Soils	5	3	-2	Aeration, salinity, texture
	2. Agronomy	1. Establishment	3	2	-1	Germination %
		2. Nutrition	2	4	2	
		3. Pest control	6	3	-3	Helicoverpa, weeds
		4. Harvesting	4	3	-1	Grain loss
	3. Genotype	1. Enhancing	6	3	-3	Biomass, erect habit, harvest index
		2. Protecting	7	4	-3	Phytophthora, lodging
	4. Storage		3	3	0	
	5. Costs		6	4	-2	Seed, insect control, weed control
2. Quality & Prices	1. Quality	1. Genetic	5	3	-2	Grain size, pale colour
		2. Environmental	4	2	-2	Weather damage, cleaning
		3. Residues	1	1	0	
	2. Marketing	1. Reliability	7	4	-3	Timing and quantity of supply
		2. Structures	5	3	-2	Small market, knowledge of customers
	3. Transport	1. Distance	4	4	0	
		2. Infrastructure	3	3	0	
	4. Prices		4	6	2	
3. Personal	1. Motivation	1. Expectancy	6	3	-3	Yields
		2. Goal setting	6	4	-2	Profits
		3. Risk	6	3	-3	Price
	2. Knowledge & Skills	1. Information	5	2	-3	Research, publications
		2. Experience	7	3	-4	
		3. Training	7	4	-3	
		4. Management	6	5	-1	Marketing
4. External Influences	1. Legal	1. Regulations	2	4	2	
	2. Social	1. Ethics	2	2	0	
		2. Peers	5	3	-2	
		3. Environmental	3	4	1	
	3. Economic	1. Trade	3	3	0	
		2. Services	6	2	-4	Buyers, promoters, products
		3. Financial/credit	6	3	-3	Greater risk, uncertainty

Yields and costs form two sides of the same coin, ie achieving yields involves costs. Adaptation of the species to the cropping environments is the first obvious factor to affect yields. I have been using the computer based model PLANTGRO (6) to predict the adaptation of different crops to the Australian continent (12). The results of this analysis, based on plant responses to 10 climate and 12 soil factors, indicate that adaptation of chickpea is broadly congruent with that of wheat except for being worse in the western wheat belt of Western Australia and better in Central Queensland. Chickpea appears more

tolerant of alkaline soils than lupins and more drought tolerant than field peas, suggesting a competitive advantage for it in some areas.

Experimental yields over 6 t/ha have been reported for Syria (9), but rarely approach 4 t/ha in Australia (I), while farm yields are more likely to peak at 2 t/ha. National average yields of 1.1 t/ha are equivalent to field pea and two thirds that of wheat. Faster dry matter production and a more erect plant habit would improve harvestable yield. Total variable costs are consistently higher for chickpea than longfallow wheat because of higher seed and pesticide costs.

Quality and Price of chickpea, like wheat, depend upon its suitability as a food for human consumption to attract a premium over stockfeed quality field peas and lupins. This price premium needs to be sufficient to at least balance the lower yields and higher costs of producing chickpea, which often means the price is double that of wheat. Higher yields would allow competition in the larger stockfeed market, which also has different quality requirements. Structures to undertake marketing of the Australian crop have been slow to develop, but five organisations are now involved, with varying levels of interest and commitment, in chickpea.

Personal factors are important because growing chickpea is riskier, and requires extra knowledge and skills compared to wheat and therefore growers need extra motivation to adopt them. Growers will be motivated to adopt chickpea if they can see and expect to be able to capture its benefits.

External influences. Research and development allocated for all grain legumes, let alone chickpea, does not approach that for wheat (eg 40% with plant improvement funding). However, there are opportunities to build on related research, eg soybeans, to reduce the specific needs for chickpea. The small size of the chickpea market can create high exit and entry barriers (eg regulations, information needs, market development). International trade in chickpea is dominated by consumption in India and this sets the pace for prices and trade in chickpea for human consumption. India took more than 50% of the Australian crop in 1989-90, with the most of the remainder going to Bangladesh, Pakistan, UK and Iran. Gatignon and Robertson (4) found that organisations that promote an innovation, using incentives (discounts, special trials of the technology, priority delivery, etc) and vertical coordination (including building links to buyers via special seminars and visits to suppliers), have a powerful appeal to potential adopters. Most of the grain legumes lack a major sponsor (eg the Grain Pool of WA for lupins), or "champion" (eg Dr John Gladstones), to undertake these activities.

Implications of these findings flow from the public good aspect of improving the biological sustainability of cropping systems, and from grain legumes being major contributors to this improvement. It is important to improve motivation for growers to adopt grain legumes by removing obstacles, clarifying and setting goals, providing training, and to measure progress objectively. Many principal constraints to adopting chickpea, those with a rank of 7 or 6 in Table I, appear to be associated with personal factors of the growers or with external economic factors. Only five factors, pest control, improved genetic yield, improved genetic protection of yield potential, reduced costs, and improved reliability of supply are closely associated with agronomy. It is extremely difficult for any new crop to get established if the total commitment of research and development, extension and marketing is dispersed and largely based on market share or contribution. Research projects can target the specific constraints noted as most limiting for a particular region or market. Extension activities that emphasise demonstrations and developing product champions raise the growers' expectancy for what can be achieved. Showing the links from performance of tasks and activities to gross margins and profit is also likely to improve motivation for adoption. Training and information to improve familiarity with the crop brings dividends in skills and confidence. Government policies might consider various activities such as incentives, harmonising trade relations, and providing support services and groups with sufficient resources to function effectively.

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