

Principles of Field Crop Production

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He has served on the Boards of several Cooperative Research Centres, is a member, *inter alia*, of the National Committee of Agriculture Fisheries and Food for the Australian Academy of Science, the Research Committee of the Australian Farm Institute, and the Primary Industries Ministerial Advisory Council NSW and Secretary of the Australian Council of Deans of Agriculture.

Introduction

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Australia is renowned for its production of agricultural field crops, particularly because of its consistent, clean, high-quality produce with low levels of pesticide residues. In the now distant past, export prices for a range of rural products have been sufficient, albeit variable, to enable farming families to earn a reasonable living, with subsidies from government.

High inflation rates in the 1970s and 1980s, higher input costs, large fluctuations in market demand, removal of support subsidies by government, and the floating of the Australian dollar have all contributed to a more financially demanding climate for Australian farmers. This is further compounded by the continued support subsidies of international competitors such as the USA and the European Community. With New Zealand, Australian farmers receive the least support of any OECD nation in terms of government subsidies.

Farmers must therefore continually raise productivity to be financially viable, ensuring of course that the product satisfies market requirements. Increasingly, farmers also have to address the issue of environmental sustainability because of community demands, *i.e.* the social licence, and because of the environmental threats of soil salinity and soil acidification. As a consequence, field crop production in Australia requires much higher management skills than before to ensure compatibility between productivity and environmental sustainability. Farm managers must therefore have a strong understanding of all the factors which contribute to or interact with that production.

This book addresses many of the factors that contribute to this process. These factors can be classified into the natural resources factors, climatic factors, crop factors, and the socioeconomic and political components. For a successful outcome of the process, the agronomist and farm manager must appreciate the importance of each of the factors, particularly their interrelationships.

Natural resources

In the past, farmers utilised the natural resources, specifically soil and water, with no particular regard for their long-term maintenance and improvement. Australian soils, because of their structural fragility, reacted poorly to the intensity of cultivation imposed on them by agricultural operations. Major soil erosion by both water and wind has been a regular feature of the Australian landscape, removing valuable topsoil from fields and silting up waterways. Degradation of soils was also expressed in the crusting of the surface, which impeded water infiltration and seedling emergence, and in compacted layers at the base of the plough layer, thus preventing root elongation and encouraging waterlogging. These historical issues are considered in Chapter 1.

Table A Extent and severity of degradation of Australian soils used for crop production (Anon., 1978)

	Extensive cropping	Intensive cropping	Total
Area used (000 ha)	443	24	467
% area needing treatment (management practices only)	32	30	32
% area needing treatment (with works)	34	34	34
% total area needing treatment	66	64	66

A survey of land degradation in Australia (Table A) in the mid-1970s (Anon., 1978) demonstrated that farm practices had to change if the future for agriculture was to be protected. Further, farmers were experiencing problems with soils which were acidifying, while soil salinity was a problem in the irrigation areas and, increasingly, under dryland agriculture, as a result of rising water tables.

Watercourses and storage facilities also deteriorated because, in addition to siltation problems, salinity levels increased, particularly in the Murray River, as did nitrate and phosphate levels. This resulted in the proliferation of blue-green algae, with consequent toxicity problems for livestock and human consumption. This process, known as

eutrophication, focused attention on the contribution of these elements from farming pursuits and from urban sewage effluent.

Because farming is no longer just concerned with the growing of crops, but also with environmental management, the sustainability of farming soils and the associated water resources have become major components of field crop production and must be addressed.

Climatic factors

Agronomists must be aware of the relationships between the physiological requirements of the plant and the likelihood of the climatic zone being able to satisfy those requirements. A knowledge of seasonality and reliability of the climate inputs is paramount to achieving success. In particular, an understanding of the water available to plants and the efficiency of its utilisation holds the key to high yields and also the management of water-induced land degradation.

Climatic change brought about by the greenhouse effect brings a further dimension to crop production and management (as explored in Chapter 2). Adaptability and management of risk become imperatives in modern agriculture and there is greater reliance on weather prediction.

Crop factors

Crop production will always be limited by the most limiting input, particularly moisture and nutrients. In the case of nutrients, fertiliser additions are normally necessary for high yields to be attained. Phosphorus, in particular, is an essential input, and soil nitrogen levels need to be augmented in many cases. There needs to be sufficient fertiliser input to allow the realisation of high yields, but their utilisation depends on the removal of other impediments to yield, such as disease or weeds. Unused fertiliser, particularly nitrates, becomes a source of eutrophication and hence an environmental problem. Maximising production however does not necessarily align with highest profit and management expertise is critical to determining the levels of inputs needed to secure best outcomes.

Pest and disease management becomes critical components in achieving high quality and quantity of produce. Community demands for low pesticide produce has placed pressure on farmers to minimise use of these chemicals, which still remain an integral part of the farming program. However, pesticide resistance is now a major factor to be considered and necessitates a more strategic approach in the use of chemicals. The introduction of genetically modified crop varieties has assisted with reduction in pesticide usage, but their acceptance by the community is still fluid. In addition the stacking of herbicide resistant capability has the effect of increasing pressure on key herbicides and thus builds up pressure on weed resistance.

Socioeconomic and political factors

Crop production processes are not only determined by physical factors but also influenced by those not related to agronomy. The anticipated profitability of a particular crop, for example, often overrides decisions that ought to be made on good agronomic bases. Similarly, concern about likely returns inhibits expenditure on inputs, thus restricting the yield potential of the crop and worsening the income component of the budget. Such decisions also need to be taken in the context of the longer term rather than a season-by-season consideration, since no account is taken of the economic benefits of sound rotation practices.

Profitability also depends on off-farm activities, including foreign exchange rates and government subsidies in competitive countries. Farm products therefore need to be available and of quality good enough to satisfy the markets in order to maintain the custom. Farmers therefore need to focus on crop quality as an essential component and put in place mechanisms for quality to be realised and markets to be satisfied.

The best farming system

In ecological systems there are no simple answers, since simplicity is usually associated with instability. There can therefore be no one best farming system. Farming systems evolve as the knowledge base increases, and as technology develops. Attitudes also change, and farmers are now more environmentally conscious than ever before, in line with community expectations. They have to operate within the constraints imposed at the time - be they

economic, regulatory, or knowledge constraints. However, evolving farming systems must be intensively monitored to measure performance so that adjustments can be made where undesirable trends are identified. Farming systems will also vary with geography which in turn determines growing seasons.

The final outcome will be determined by the number of key factors that have been applied appropriately in the season. The factors that are key will vary somewhat from year to year but the principle remains - the top-performing farmers are those who get all the factors right. This is evidenced by the relationship established with a crop monitoring group at Finley, New South Wales (Figure A).

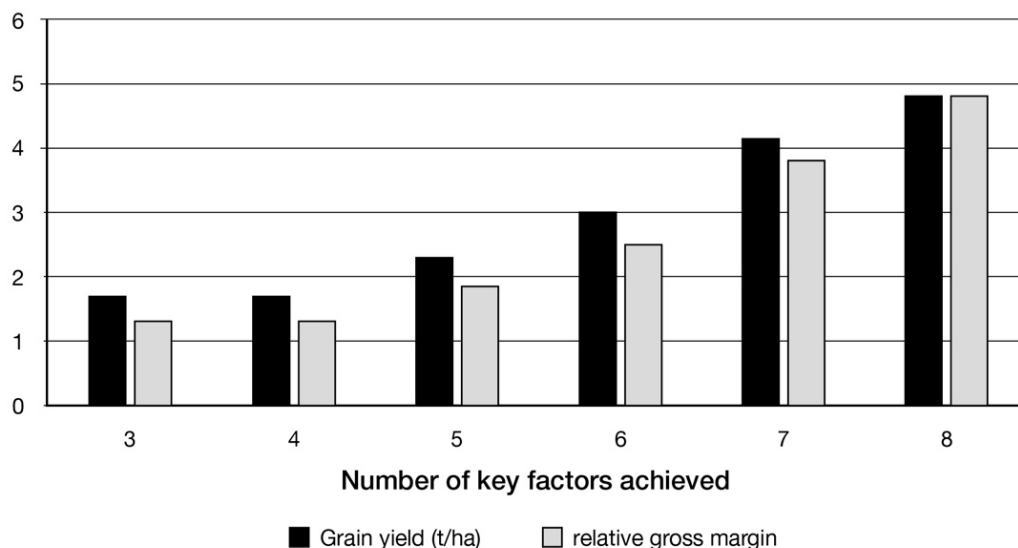


Figure A Relationship between grain yield and relative gross margin established with a crop monitoring group at Finley, New South Wales.

This book aims to provide the necessary background for practitioners and advisers to achieve economically and environmentally sustainable production.