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‘Managing legume and fertiliser N for northern grains cropping’ – a manual about N

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Introduction

This 88-page manual summarises current information on fertiliser and legume nitrogen (N) for broad-acre cropping in Australia’s northern grains region, with particular emphasis on the legume N (Figure 1). The manual also contains instructions, underpinning technical information and background science for ‘NBudget’ – the Excel based calculator for estimating the fertiliser N requirements of both summer and winter cereal and oilseed crops and dinitrogen (N_2) fixation by legumes (see accompanying paper). The calculator is attached to the manual as a CD.

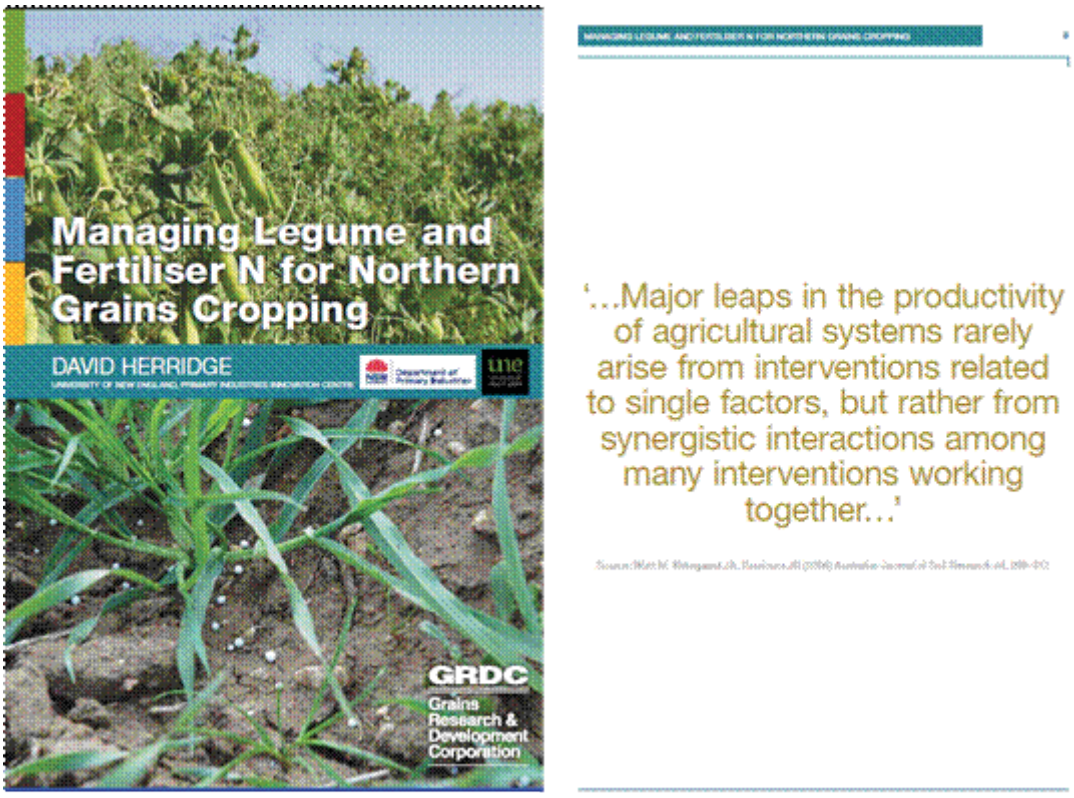

Figure 1. Manual cover and inside cover

Data and concepts that underpin the manual and calculator were sourced from the many published and unpublished experiments conducted primarily by the farming systems and plant nutrition programs of the NSW and Qld government agencies during the past 30 years. The manual interprets and reports not only the data but also the knowledge and insight of the Australian and international scientists who have worked and published in the fields of soil and plant N. Special mention should be made here of the contributions of the late Harry Marcellos, Warwick Felton, David Doyle, Ian Holford and Graeme Schwenke of the NSW DPI (Department of Agriculture) and Wayne Strong, Ram Dalal, David Freebairn and Greg Thomas of the former Queensland Department of Primary Industries.

Why focus on N?

Plant-available (mineral) N is a major driver of agricultural productivity and profitability. Nitrogen is a component of chlorophyll, the green pigment found in almost all plants and responsible for photosynthesis in which carbon from carbon dioxide in the atmosphere is fixed by the plant into sugars in the presence of sunlight. Photosynthesis is the source of almost all of the energy for animal and human life. When plants are N-deficient, they lack chlorophyll (termed chlorotic), appear yellow and are unthrifty. For grain crops, N deficiency means reduced yield and low grain proteins.

Mineral N in the soil is also required for the formation of humus (stable soil organic matter), necessary for soil health and land sustainability. Nitrogen in one of its gaseous forms, nitrous oxide (N_2O), is a potent greenhouse gas and N as nitrate is potentially dangerous to human health when leached into in groundwater that is used for drinking. The challenge facing farmers is that they need to supply sufficient N to their plant-soil systems to optimise yields, profitability and soil health, whilst at the same time minimising the environmental risks associated with greenhouse gas emissions and nitrate pollution of water tables.

Structure of the manual

There are six chapters plus appendices and references in the manual. Each chapter is self contained although written in such a way that one chapter leads logically into the next.

Chapter 1 provides a brief overview of grain cropping in Australian agriculture. The northern grains region is introduced to be followed by an outline of research on N in the region that commenced in the 1960s and which led to the development of N management tools and programs for farmers and their advisors during the 1990s. The N cycle in agricultural systems is examined in terms of how N is added to the soil, how it is moved around and stored in the soil, how it is lost from the soil and, finally, how the soil biology make it all happen.

Chapter 2 defines the problem of declining soil organic matter in grain cropping soils in the region. Variations in nitrate-N concentrations in the root zone are described to provide a sense of how much they vary with cropping and during the post-crop fallow. Potential loss mechanisms – leaching and denitrification – are introduced with brief discussion on their relative significance.

Chapter 3 explores legume N_2 fixation and the farming practices that affect it. Rhizobial inoculants and the inoculation of legumes are also covered. The chapter examines the rotational benefits of legumes, defined by their ability to fix N, improve the mineral and organic N contents of soils in which they grow and to act as a break for soil- and stubble-borne diseases of cereals.

Chapter 4 examines mineral and organic fertilisers, particularly related to the efficiency with which the N is utilised by the target crop. The chapter also examines the fate of fertiliser N as it is processed in the soil to a plant-available form and is either taken up by the growing crop, left unused in the soil, lost from the soil or immobilised into the soil organic matter.

Chapter 5 provides a brief overview of 'NBudget' and how it would be used for specific paddocks. Examples are provided of the accuracy with which the tool predicted soil nitrate levels, i.e. validation.

Chapter 6 considers the science that underpins 'NBudget', covering key issues such as the accumulation of nitrate in the soil resulting from mineralisation of native soil organic matter and fresh crop residues, the efficiency with which water is stored in the soil during the pre-crop fallow to the development of the functions describing legume N_2 fixation.

The appendices contain graphs and tables relevant to 'NBudget'. The cited references (235 in all) constitute the final section of the manual.

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Acknowledgements

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