# THE EFFECT OF NITROGEN MANAGEMENT AND PADDOCK HISTORY ON GROWTH AND YIELD OF BARLEY (*Hordeum vulgare* L.)

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# ABSTRACT

A field experiment was conducted during spring 1983/1984 at four adjacent sites on marginal the cropping soil Tokomaru silt loam to study the effect of nitrogen management and paddock history on growth and yield of barley (Hordeum vulgare L.) cv. Magnum. Six nitrogen treatments were tested in three replications in a randomised complete block design at each site. The treatments were no-N (control), 60 kg N/ha either applied at sowing, growth stage (G.S.) 3, G.S.6 or equally split between G.S.3 and G.S.6 and a higher rate based on soil test results (70-90 kg N/ha depending on site) applied at sowing. Site histories were immediately out of pasture and previously cropped with barley for 1, 2 and 3 years. Crop nitrogen status was monitored by nitrate sap test and plant analysis.

Control plot yield decreased almost linearly from 5.78t/ha directly out of pasture to 3.55 t/ha on the site previously cropped for three years. This indicated that regular cropping without fertiliser nitrogen on this soil could substantially reduce the yield of barley.

Application of nitrogen significantly increased yield over control at all sites. The response in the first year of cropping was probably because of the low accumulation of nitrogen during the pasture phase on this soil. Average yield of plots receiving nitrogen were similar for the first two year of cropping (7.09 and 6.86 t/ha respectively) but declined rapidly for the third and fourth year of cropping (5.90 and 5.94 t/ha respectively). Plots receiving the high nitrogen rate were also unable to maintained yield as cropping increased. The yield decline could have been caused by deteriorated soil physical conditions under continuous cropping. Maintaining adequate nitrogen toward later stages of growth by late or split application was found to be as effective as applying the higher nitrogen rate at sowing especially as soil fertility reduced.

Ear density was the main component affecting yield. Grain number/ear was also an important yield component for crop grown under lower fertility and was increased when nitrogen was applied at sites cropped for 3 and 4 years.

There was differences between predicted yield based on soil test results and actual yield of control plots across the sites. Sap nitrate concentration showed a good relationship with total nitrogen analysis. Both measurements of plant nitrogen at earlier stages of growth were related to the yield. Highest yield (7t/ha) was found to be associated with 4.5% total nitrogen and >6000ppm sap nitrate concentration at about G.S.3.

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# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# 1. INTRODUCTION

Application of fertilizer nitrogen to increase crop yield under intensive agriculture has been a common practice throughout the world. In New Zealand however, the use of nitrogen fertiliser is small compared to its use in Europe and North America (Walker and Ludecke, 1982). This is mainly because the New Zealand agricultural system has developed to almost complete dependence on biological nitrogen fixation by legume-based pasture. Crops are normally grown in rotation with fertility-buiding pasture and little intensive cropping has been practiced (Mcleod, 1968; Stephen, 1982).

Sears (1960) suggested that pasture should be cropped when soil fertility has built up to the stage of grass dominance. The length of the cropping period during which soil fertility and higher crop production can be maintained varies with pasture management and soils (Mcleod, 1968; Greenland, 1971). This situation coupled with the wide variation in climatic conditions across New Zealand complicate the prediction of crop fertiliser nitrogen requirement.

Most previous studies on nitrogen response and requirement of wheat and barley were conducted in the South Island. Little work has been conducted in the North Island particularly on marginal cropping soils. The general conclusion has been that nitrogen requirement of wheat and barley varies depending on paddock history and moisture availability before and during cropping season. For a reliable fertiliser recommendation, such studies should cover the wide range of climate, soils and cultural practices in New Zealand.

To obtain some informations on the influence of paddock history on the response of barley to nitrogen, a field experiment was conducted on a marginal cropping soil in North Island with the following objectives:

1. To study the influence of paddock history on the response of barley to nitrogen application.

2. To study the effect of nitrogen application time (later referred to as nitrogen management) on yield, yield components, growth and nitrogen status of barley.

3. To evaluate some possible methods of assessing nitrogen fertiliser requirements; sap and plant tests and soil tests.