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Deep soil nitrogen testing - a tool for malting barley management

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Abstract

Deep soil nitrogen testing is a risk management tool aimed at assisting growers with malting barley management. A greater proportion of barley crops intended for malting purposes actually achieving malting quality would assist in strengthening Australia's reputation as a consistent supplier of high quality malting barley.

The Victorian TOPCROP Malting Barley State Focus (1999) developed a `rule of thumb' for determining which barley crops had the highest probability of achieving malting quality: *"As soil nitrogen increases above 100 kg/ha → chances of achieving malting quality decreases."*

To confirm this `rule of thumb' a cooperative project was established between the Department of Natural Resources and Environment (NRE) and Pivot Limited (Pivot). Information from 95 paddocks across Victoria, sown to malting barley in 2000, was obtained through a survey of growers who had undertaken a deep soil nitrogen test with Pivot.

The information from the 2000 season confirmed the above `rule of thumb'. Barley paddocks with soil nitrogen at less than 100kg/ha at sowing had a better chance of achieving malting quality than those with soil nitrogen greater than 100kg/ha. High protein was a significant reason for barley crops not achieving malting quality in 1999 and 2000.

Introduction

For many barley growers the challenge of producing malting quality within each of their crop paddocks, and over a number of seasons, involves a number of management considerations. In many cases, the risk of not achieving malting quality and the

associated price reduction, has meant some growers are not growing malting barley and choosing alternative crops.

The amount of nitrogen available to the barley plant during the growing season is a key contributor to the final protein content of the grain and whether a barley crop will achieve malting or feed quality.

In 1999, the TOPCROP Malting Barley State Focus developed a useful `rule of thumb' for determining which barley crops had the highest probability of achieving malting quality (Evans, M. 2000).

The `rule of thumb' to improve the probability of achieving malting quality barley:
"As soil nitrogen increases above 100 kg/ha → chances of achieving malting quality decreases."

An additional `rule of thumb' developed was:
"If soil nitrogen is greater than 150 kg/ha at sowing → don't use this paddock for the production of malting barley."

In 2000, a cooperative project between NRE and Pivot was established to validate these two rules of thumb relating to soil nitrogen and achievement of malting quality barley.

Materials and Methods

In 1999 the Victorian TOPCROP program addressed malting barley production as its first State Focus topic. Seventeen sites were sown across the state in conjunction with local TOPCROP groups. The sites were sown and managed using farmer equipment and all were tested for soil nitrogen in the profile from 0-60 cm. Soil test results were not available to the TOPCROP groups prior to sowing. Hence, malting barley was sown regardless of the soil nitrogen status with paddock selection based solely on grower's experience.

In 2000, information from 95 paddocks across Victoria (Figure 1), sown to malting barley varieties, was obtained through a survey of growers who had undertaken a deep soil nitrogen test with Pivot. This information included soil nitrogen, grain yield, screenings and protein. Soil nitrogen measurements were taken from nitrate nitrogen in the profile from 0-60 cm.

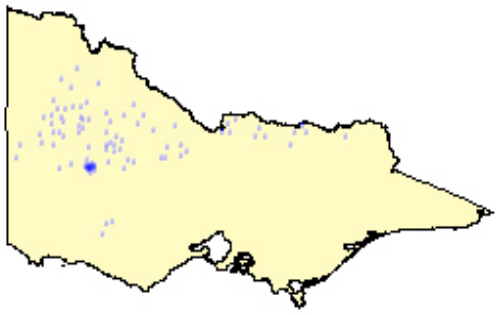

Figure 1. Location of paddocks in this project

In this project, malting quality barley is based on protein 8.5-11.8% (no minimum for Arapiles) and screenings 30% or less below a 2.5 mm screen (Franklin - 10% or less below a 2.2 mm screen). Downgrading due to cleaving, contaminants, abnormal grains, etc. were not considered, as they are not directly related to soil nitrogen status.

Results and Discussion

Quality comparisons

Table 1. Relative percentages of paddocks in survey achieving malting quality compared with feed quality in 1999 and 2000

Year	Malt	Feed	No. Paddocks sampled
1999	69%	31%	17
2000	72%	28%	95

Table 1 shows that the proportion of paddocks in the 1999 and 2000 projects that achieved malting quality were similar. Long term records indicate that the proportion of the Victorian barley crop that achieves malting quality is approximately 55-65% (ABB Annual Reports 1991-1998).

Due to the limited number of paddocks studied in 1999, these paddocks may not necessarily have been a true representation of malting barley production constraints

for the whole state. Anecdotal evidence indicates the proportion of barley crops that achieved malting quality in Victoria in 1999 was less than 50%.

Whilst a much larger number of paddocks were assessed in 2000, these paddocks were selected for malting production after being assessed for deep soil nitrogen. Hence, it can be assumed paddock selection for attainment of malting quality should have been improved in 2000 relative to 1999 (72% of project paddocks achieving malting quality in 2000 was consistent with perceptions of purchasers of malting barley and comments made by barley producers (P. Sidley pers.comm.)).

Reasons for not achieving malting quality

Table 2. Reasons for not achieving malting quality in surveyed paddocks during 1999 and 2000

Quality Parameter	1999	2000
High protein	79%	58%
High protein & high screenings	17%	19%
High screenings	2%	19%
Low protein	2%	4%

High protein was the principle reason for barley crops not achieving malting quality both in 1999 and 2000 (Table 2), despite the fact that growers selected the paddocks in 2000 after conducting a deep soil nitrogen test. Excessive screenings were more of an issue in 2000 than in 1999.

In general, seasonal conditions in 2000 were more favourable than in 1999, with record tonnages of production occurring in many areas during 2000. High yield potential is largely achieved through high grain numbers per square metre, as opposed to enhanced grain weight. Hence, grain numbers per square metre are likely to have been substantially higher in 2000 compared to 1999.

The ability of the barley plant to supply assimilates to the developing grains is influenced by temperature and moisture availability. Under less than optimal conditions a negative relationship between grain numbers per square metre and grain weight is often observed (D. Moody unpub). This is the likely explanation of the increased grain screenings observed in 2000.

Soil nitrogen, yield and quality

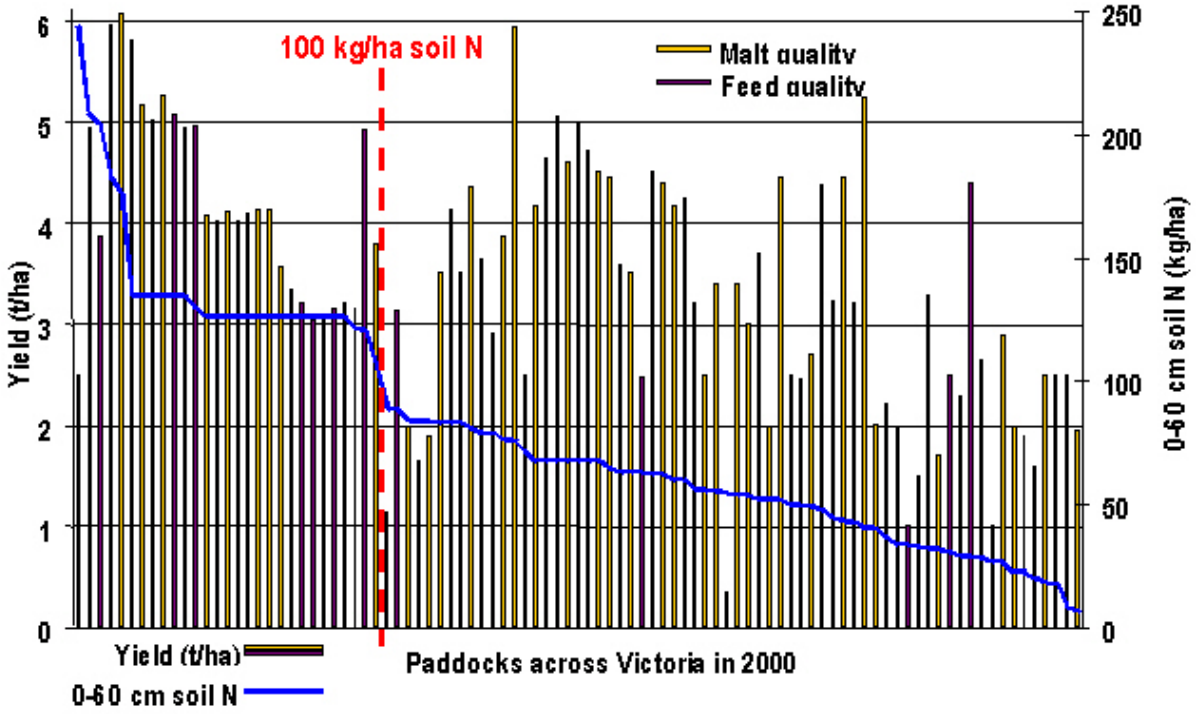

Figure 2. Soil nitrogen, yield and quality of each barley paddock surveyed in 2000. The dashed line indicates soil nitrogen at 100kg/ha

Of those paddocks surveyed in 2000 with soil nitrogen at 100 kg/ha or greater (Figure 2), only 45% achieved malting quality. However, 83% of paddocks with soil nitrogen at 100 kg/ha or less (Figure 2) achieved malting quality (Table 3).

Table 3: Quality in 2000 according to soil nitrogen.

Amount of Soil Nitrogen	Malt	Feed
< 100 kg/ha soil nitrogen	83%	17%
> 100 kg/ha soil nitrogen	45%	55%

Mean soil nitrogen for surveyed paddocks in 2000 was 82kg/ha compared to 118kg/ha in 1999. There are a number of possible scenarios explaining this difference. One possible scenario is that seasonal conditions in 1999 favoured greater mineralisation earlier in the season, resulting in higher soil nitrogen levels at the time of soil sampling compared to the 2000 season. Alternatively, in 2000 some growers may

have utilised the results from the deep soil nitrogen tests to discard paddocks from malting barley production, resulting in average paddock soil nitrogen being biased downwards. It is interesting to note that grain protein levels in 2000 were less of an issue than compared to 1999. It cannot be determined if this were due to the impact of deep soil nitrogen testing prior to paddock selection or due to seasonal conditions resulting in lower grain protein in 2000.

Conclusion

The information gathered from the 2000 season confirmed the rule of thumb from the 1999 TOPCROP Malting Barley State Focus:

"As soil nitrogen increases above 100 kg/ha → chances of achieving malting quality decreases"

There is an ongoing investigation to strengthen the validation of this `rule of thumb'. Information is required over a number of seasons and this data will be gathered from malting barley paddocks that were tested for soil nitrogen to a depth of 60cm in past seasons as well as in the current and future seasons.

Regions in Victoria will be examined to investigate differences in soil nitrogen requirements between regions. Areas across the state, in terms of potential yields, will also be studied.

Results from the 1999 and 2000 seasons concluded that high protein is a key factor in barley crops not achieving malting quality. Factors other than soil nitrogen contributing to high protein and, consequently, not achieving malting quality, will be investigated in detail. Specifically, this refers to factors within the grower's control including time of sowing, distribution of nitrogen in the soil profile and timing of nitrogen application. Although outside the growers control, other factors contributing to malting quality such as growing season rainfall and temperature during grain-filling will also be investigated in order to develop a more comprehensive understanding of influence on the achievement of malting quality barley.

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