MALTING BARLEY — AN EVALUATION OF THE FACTORS AFFECTING YIELD AND QUALITY

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ABSTRACT

This study was carried out to investigate some of the parameters affecting yield and quality of malting barley in the Rangitikei region. Results from a paddock survey, climatic and yield data for the Rangitikei region and data on grain yield and screenings percentage of seed lots received at the Canterbury (NZ) Malting Company in Marton were analysed.

Percentage screenings in the grain fell as paddocks were more intensively cropped presumably because soil N declined. However, yield also reduced. As N levels in the grain or herbage at flowering increased above 1.9% N, percentage of screenings rapidly increased.

Multiple regression analysis indicated that crops with a good yield can be produced if they are sown early in the spring, a good stem density is established and soil or herbage levels are monitored carefully so that excessive levels of fertiliser nitrogen are not applied.

Temperature parameters had a greater effect than rainfall paramaters on grain yield in the Rangitikei region. Best yields were produced in cooler seasons.

INTRODUCTION

In 1988, 40400 tonnes of barley were grown in the Manawatu/Rangitikei region but the Canterbury (NZ) Malting Company at Marton is capable of processing greater quantities. Farmers have a number of alternative cropping and livestock enterprises open to them. If they are to be encouraged to grow more malting barley they must be confident of obtaining high and consistent yields but the information on how to do this is not reliable because of the limited amount of research done in this region.

This study was undertaken to examine some on-farm and weather parameters which may influence yield and quality of malting barley using data which already existed from earlier unpublished paddock surveys (called 'surviments' by Withers and Pringle, 1981) and from published regional data. The Canterbury (NZ) Malting Company also kindly provided information from a number of farms which have consistently supplied their plant.

MATERIALS AND METHODS

Four data sets were used in this study.

1. A paddock 'surviment' undertaken in the 1981/82 season by Dr N.J. Withers. A range of agronomic information was obtained from 48 crops on 29 farms including yield, percentage screenings, sowing date and rate, type and quality of fertiliser used, paddock history and nutrient levels.
2. Yield data for barley grown in the Rangitikei County were obtained from statistics published by the New Zealand Ministry of Agriculture and Fisheries covering a number of seasons.
3. Monthly climatic data (growing degree days, water balance, rainfall, mean temperature and solar radiation) were obtained for 14 successive seasons between 1971 and 1985 for Ohakea (N.Z. Meteorological Site E 05231).
4. Data on grain yield and the percentage of screenings were obtained for seedlines from 12 farms which consistently supplied grain to the Canterbury (NZ) Malting plant at Marton over the period 1981/82 to 1985/86.

Yield and screening data from the 'surviment' were correlated with paddock variables. Multiple regressions were also carried out, initially with all variables but insignificant and one of pairs of highly correlated variables were removed until a final regression was obtained in which all variables were highly significant.

Regional yield was regressed with regional weather data using linear regression. Data from the 12 farms were analysed using multiple regression including dummy variables to account for between-season variability.

RESULTS AND DISCUSSION

Paddock Survey Data

Analysis using simple correlations showed that none of the variables from the paddock survey data were highly associated with grain yield but a number of associations of moderate significance were found.

Grain yield and percentage of screenings are usually regarded as being negatively correlated. No significant relationship between these parameters was found in either the 'surviment' data or that from the 12 farms supplying the Malting Company.

Grain yield and grain nitrogen were negatively correlated with the number of years that the paddock had been cropped (r = −0.442 and −0.511 respectively). Both relationships are well known and would be expected as soil nitrogen levels declined with cropping. As high nitrogen levels are a problem in North Island malting barley, malting barley should preferably be grown after another one or two crops unless soil nitrogen levels have been checked.

Grain yield was moderately well correlated with pH at 0-15 cm and 15-30 cm (r = −0.443, −0.435). Barley is known to be sensitive to acid soils but there has been very little work done to examine possible responses of barley to pH or liming in this district. Results from this study indicate that increasing pH by liming may not benefit barley crops in the Rangitikei.

Yield and screenings were positively correlated with sowing rate (r = 0.431 and 0.515). This is important because it is often recommended that sowing rates should be lowered in malting barley to reduce screenings. If this advice is followed, yield potential is possibly reduced also. This makes the premium paid to the farmer for malting quality grain an important factor in determining whether or not to grow the crop.

Date of sowing was correlated with sowing rate (r = 0.575) indicating that farmers were increasing sowing rates to compensate for the fewer tillers produced by late sown plants.

Consistent relationships were observed between the percentage of screenings and the nitrogen content of both herbage (r = 0.587) and grain (r = 0.414). When the data were plotted and hand fitted lines drawn, it was found that the percentages of screenings initially remained low but rose sharply when the nitrogen content of the grain at harvest or herbage at flowering was about 1.9 - 2.1%N (Figs 1 and 2). Grain nitrogen at these levels is undesirable as it results directly in poor malt quality.

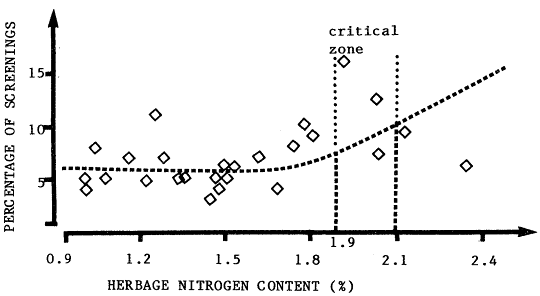

Figure 1: The relation between herbage nitrogen and the amount of small grain (screenings) in crops of barley grown in the Manawatu.

Nitrogen content of both herbage and grain were correlated with the amount of nitrate in the soil at 0-15 cm depth (r = 0.540 and 0.541 respectively).

These relationships between nitrogen content of soil, herbage and grain are of interest because they suggest that by the careful monitoring of these parameters it could be possible to optimise yield, malting quality and the input of nitrogen fertiliser. It is possible that by using nitrogen soil tests and plant sap nitrate tests (Withers and Palenski, 1984) crop yields and quality could be improved more consistently than at present, making the crop more attractive to grow.

When all the paddock data were included in the multiple regression analysis, the number of stems/m², sowing rate, soil pH, sowing date and the amount of nitrogen applied were closely associated with yield. The number of stems/m², sowing date and herbage nitrogen content were closely associated with the percentage of screenings.

These analyses indicate that farmers wishing to grow good yields of high quality malting barley should sow crops early, establish a reasonably high density crop, monitor nitrogen levels and be wary in the application of nitrogen fertiliser.

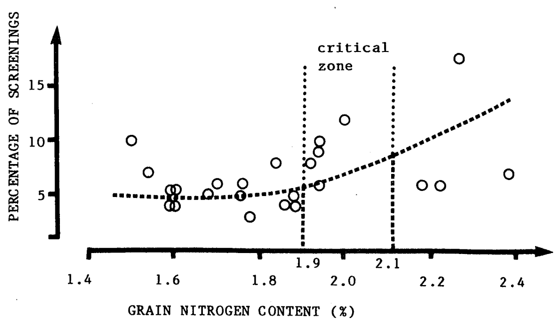

Figure 2: The relation between grain nitrogen and the amount of screenings in crops of barley grown in the Manawatu.

REGIONAL YIELD AND CLIMATE DATA

Linear regressions were calculated using grain yield adjusted for changes in management and cultivar over the survey period as the dependent variable.

Grain yield consistently reduced as the number of degree days over the period from November to February increased (Fig. 3). Four seasons stand out as being inconsistent with the overall trend. In the 1975-76 and 1976-77 seasons, seed treatment using organo-mercury compounds was banned resulting in many crops being badly infected with Net Blotch (*Dreschslera teres*). This is probably the cause of the unusually low yields in those two seasons. In subsequent years, systemic fungicides gave control of this disease (Cromey *et al.*, 1980). Reasons for the unusually high yields for the 1981-82 and 1984-85 seasons are not known.

Other parameters of solar input (average temperature and solar radiation) followed similar trends. There were no apparent trends when grain yield was regressed against rainfall or water balance.

These results indicate that climatic factors relating to temperature or solar radiation are more important in influencing barley yield than rainfall in this district a result of significance if predictions of climatic warming prove

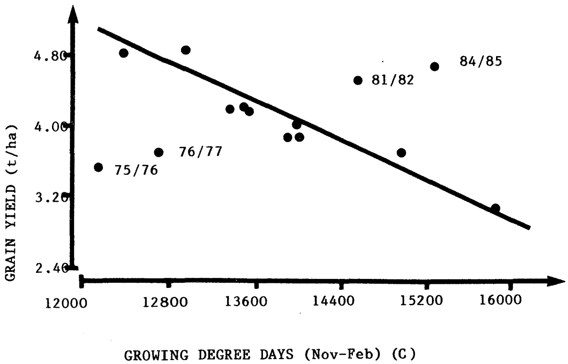

Figure 3: The relation between grain yield (t/ha) and growing degree days (C) accumulated from November to February.

correct. If the Malting Company wants to encourage consistent and high yields of barley they should investigate growing barley in the cooler parts of the district such as the inland belt of soils related to the Kiwitea soil series. There are problems inherent in growing barley in these areas however. Cool summers can result in undesirable seed dormancy which may cause problems during malting. Rainfall in summer can be high which may result in harvesting and sprouting problems.

The total number of degree days accumulated during the total growing season was closely related to the degree days accumulated in the periods October/November or November/December ($r = 0.622$ and 0.805 respectively). Therefore it may be possible to use the accumulation of degree days early in the season to indicate the potential yield for the season. This would assist farmers in making decisions about the level of inputs (e.g. fertilisers or sprays) that might be profitable to use in that season. These are more likely to be profitable in a season with a high yield potential.

CONCLUSIONS

Results from this broad-based study indicate:

1. The percentage of screenings in the grain of malting barley may reduce as the level of soil nitrogen declines under an intensive cropping regime. Grain yield may be adversely affected however. It may be desirable not to grow malting barley straight out of good quality pasture.
2. The percentage of screenings increased rapidly as herbage or grain nitrogen rises above 1.9%N. Herbage soil nitrogen could therefore be a useful monitoring tool when growing malting barley. Soil and herbage N are correlated.
3. Multiple regression analysis indicated that crops with good yield and high quality can be grown if farmers sow early with an adequate density of plants and be cautious when applying nitrogen fertiliser especially on land with high soil nitrogen levels.
4. On a district basis, grain yield is negatively related to parameters of temperature or solar radiation with relatively poor relationship with parameters of rainfall.
5. As degree days early in the season are related to the degree days accumulated for the total season, temperatures early in the season may be used as an indicator of the yield potential for the season.

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