# Quality of Western Canadian Malting Barley

# 1997


**M.J. Edney**

Program Manager, Applied Barley Research

**K.H. Tipples**

Director



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Grain Research Laboratory
Canadian Grain Commission
1404–303 Main Street
Winnipeg MB R3C 3G8
www.cgc.ca

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# Introduction

This crop bulletin describes the quality of malting barley grown in the three prairie provinces of western Canada in 1997. Barley is also the major coarse grain crop grown in western Canada for livestock feed. A separate crop bulletin, *Quality of Western Canadian Feed Barley and Hulless Barley - 1997*, is available.

Barley growers on the Canadian prairies have demonstrated a preference for growing malting barley cultivars, which have accounted on average for 70 percent of the total barley area over the past 50 years. Malting barley is a dual purpose barley—if production cannot be sold at a premium for malting and brewing, then it is used as livestock feed. A large proportion of malting barley production is used domestically as livestock feed or exported as feed barley. Registered feed barley cultivars are not suitable for malting and brewing and, as a result, can be used only for livestock feed.

In Canada, after extensive quality evaluation, malting barley cultivars are granted a three- to five-year interim registration to allow for testing of commercial potential. Provided the line is commercially acceptable, a full registration is then granted. Table 1 lists registered cultivars of two- and six-rowed malting barley, with the year of initial registration.

Surveys of the distribution and preference of barley producers to grow specific malting barley cultivars have been undertaken by the Brewing and Malting Barley Research Institute for the past several years. The surveys are based on information supplied by Alberta Wheat Pool, Cargill, Manitoba Pool Elevators, Parrish and Heimbecker, N.M. Paterson, Pioneer Grain, Saskatchewan Wheat Pool and United Grain Growers.

Figure 1 shows the results of the 1997 survey of acreage planted to barley. Compared to 1996, there has been an increase in the acreage planted to feed barley cultivars at the expense of blue-aleurone six-rowed malting barley and to a lesser extent two-rowed barley cultivars. The proportion of white-aleurone six-rowed malting barley cultivars remained relatively constant.

**Table 1 • Malting barley cultivars registered for western Canada including year of registration**

| | Six-rowed | | Two-rowed | |
|---|---|---|---|---|
| Full registration | Bonanza | 1970 | Klages | 1977 |
| | Argyle | 1981 | Harrington | 1981 |
| | B1602W[1] | 1991 | Manley | 1991 |
| | Duel | 1992 | Stein | 1992 |
| | Tankard | 1992 | B1215 | 1993 |
| | | | AC Oxbow | 1994 |
| Interim registration | BT 421 | 1994 | TR 128 | 1994 |
| | AC BuffaloW | 1994 | TR 129 | 1994 |
| | ExcelW | 1995 | AC Metcalfe | 1994 |
| | RobustW | 1995 | TR 133 | 1995 |
| | BT 941W | 1995 | TR 139 | 1996 |
| | BT 433W | 1996 | TR 145 | 1997 |
| | BT 435W | 1996 | | |
| | StanderW | 1996 | | |
| | FosterW | 1997 | | |

[1] W signifies white aleurone, in contrast to blue aleurone, for six-rowed barley

Figure 2 shows trends in barley production since 1948. Table 2 shows a gradual shift away from Harrington, the two-rowed malting cultivar that has dominated the Canadian prairies for over a decade. Harrington is still the favourite cultivar of producers but this year saw movement towards other two-rowed cultivars such as Stein and AC Oxbow as well as white-aleurone six-rowed malting cultivars and feed cultivars.

Six-rowed malting barley is now dominated by the white-aleurone cultivars. Blue-aleurone cultivars such as Argyle and Bonanza, which once dominated, are grown on insignificant acreages because of increased U.S. demand for white-aleurone six-rowed malting barley.

**Figure 2 • Trends in barley production in the prairie provinces from 1948–97**

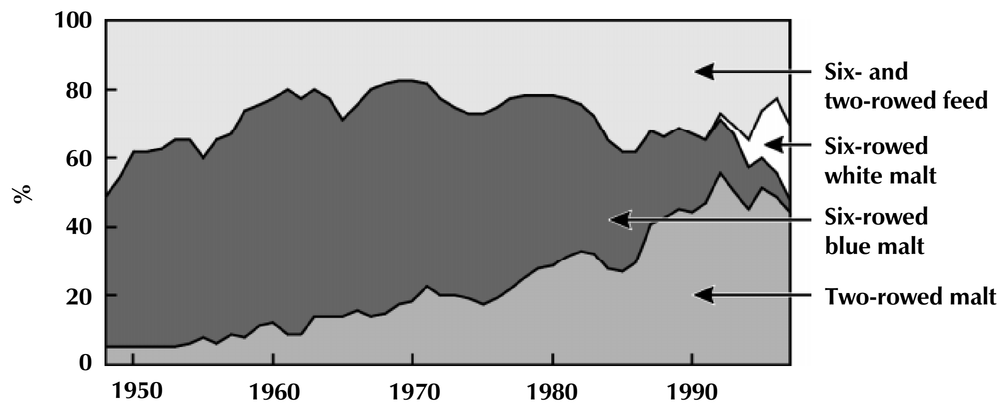


**Table 2 • Seeded area of malting barley cultivars (as percent of total area seeded to malting barley)**

| Six-rowed cultivars | | | | Two-rowed cultivars | | | |
|---|---|---|---|---|---|---|---|
| | 1997 | 1996 | 1993–97 average | | 1997 | 1996 | 1993–97 average |
| White aleurone[1] | 31.4 | 27.3 | 19.8 | Harrington | 35.7 | 40.2 | 43.3 |
| Argyle/Bonanza | 4.3 | 6.5 | 11.5 | Manley | 10.0 | 11.7 | 14.6 |
| Tankard | 1.4 | 1.3 | 1.1 | AC Oxbow | 5.7 | 5.2 | 2.5 |
| Duel | — | 1.3 | 1.8 | Stein | 4.3 | 3.9 | 2.5 |
| | | | | B 1215 | 4.3 | 2.6 | 2.0 |
| | | | | Other | 2.9 | — | 0.9 |
| **Total** | **37.1** | **36.4** | **34.2** | **Total** | **62.9** | **63.6** | **65.8** |

[1] includes B1602, Excel, Robust and Stander

# Growing and harvesting conditions

### Seeding

Barley seeding in 1997 for western Canada was delayed by cool spring conditions, a situation similar to that seen in 1996. Temperatures were significantly below normal during the last half of April and early May. Seeding started in the southwestern areas in the first half of May but was delayed into the last half of May in eastern and northern areas. Specifically, seeding in northern Alberta and northeastern Saskatchewan was delayed by wet soil conditions and the fact that farmers still had to complete a portion of the 1996 harvest.

Flooding in the Red River Valley of Manitoba also caused significant delays. There, seeding did not get underway until early to mid June. Despite the late start to the season, barley planting was nearly 60 percent completed by the end of May and 95 percent completed by the middle of June.

### Growing conditions

June temperatures were near normal in western areas but warmer than normal in the east. Rainfall in June was variable across the prairies, with western areas close to normal and eastern regions receiving below normal amounts. The dry conditions were particularly acute in southwestern Manitoba and southeastern Saskatchewan, resulting in poor germination and reduced yield potential. Above normal temperatures in these areas also contributed to stress. The normal to above normal rainfall was welcomed in the southwest, but in the northwestern areas, especially in Alberta, not only did the rains delay seeding, but the excess soil moisture caused weakened stands and in some cases drowned out the crop.

July temperatures were normal during the first two weeks and above normal in the latter half of the month. July rainfall was below normal in most areas with the exception of Manitoba, where heavy precipitation, especially in the central and eastern portions of the province, resulted in increased disease pressure in cereal crops. The combination of elevated temperatures and little or no precipitation in the rest of the prairies caused crop conditions to decline rapidly in the last half of July.

The hot, dry weather continued for the first two weeks in August, causing further deterioration in crop condition. However, barley matured rapidly and harvesting began in some southern areas by the middle of August. The stress during heading resulted in incomplete filling , which in turn reduced yields. Rains returned to the prairie region in mid-August, which helped improve conditions in some northern areas, but it was too late to help the bulk of the crop.

### Harvesting

The weather during the last half of August and September was nearly ideal across the prairie region. As a result, barley harvesting was 50 percent completed by the first week in September and 95 percent completed by the end of September. Northern Alberta experienced less than ideal weather during September, as heavy rains covered the Peace River region, delaying the harvest and reducing the quality of the crop.

## Production estimates

Barley acreages were down slightly in 1997 on prediction of more favourable prices for oilseeds and pulse crops. However, good overseas demand and increased feeding of livestock on the prairies kept barley acreages well above the 10-year average. As shown in Table 3, seeded barley area on the prairies was down 5 percent compared with 1996 but was still 12 percent higher than the 10-year average.

Total barley production for 1997 was affected by the lower acreages and by inadequate moisture in late July and early August. As a result production was down significantly from the record crop in 1996. Table 3 shows

- Barley production dropped almost 14 percent from 1996 to 1997 across the prairies.
- Production across the prairies was still 10 percent higher than the 10-year average.
- Production in Alberta, which is the major barley-producing province, was 9 percent less than in 1996 and 6 percent more than the 10-year average.
- Severe drought conditions reduced production in Saskatchewan by 17 percent and in Manitoba by 23 percent, compared to 1996.
- Production was 18 percent greater than the 10-year average in Saskatchewan and 7 percent above the 10-year average in Manitoba.

**Table 3 • Barley production in western Canada for 1997, 1996, and the 1988–97 average[1]**

| | Seeded area | | | Production | | |
|---|---|---|---|---|---|---|
| | 1997 | 1996 | 1988–97 average | 1997 | 1996 | 1988–97 average |
| | (thousands of hectares) | | | (thousands of tonnes) | | |
| Manitoba | 567 | 627 | 555 | 1 633 | 2 112 | 1 525 |
| Saskatchewan | 1 821 | 1 902 | 1 531 | 4 463 | 5 356 | 3 771 |
| Alberta[2] | 2 308 | 2 391 | 2 096 | 6 483 | 7 155 | 6 108 |
| **Total** | **4 696** | **4 920** | **4 183** | **12 579** | **14 623** | **11 404** |

[1] Statistics Canada, *Field Crop Reporting Series*, No. 7, October 8, 1997
[2] Alberta figures include small amounts grown in British Columbia

## Sampling and general crop quality

The 1997 malting barley survey was based on 715 320 tonnes of malting barley selected for purchase by Canada Malting Co. Ltd. (Winnipeg, Manitoba and Calgary, Alberta), Dominion Malting Ltd. (Winnipeg), Prairie Malt Ltd. (Biggar, Saskatchewan), Westcan Malting Ltd. (Alix, Alberta), Alberta Wheat Pool (Calgary), Cargill Grain Company (Winnipeg), Manitoba Pool Elevators (Winnipeg), James Richardson & Sons Ltd. (Winnipeg), Saskatchewan Wheat Pool (Winnipeg) and United Grain Growers (Winnipeg).

Selectors for these companies composited barley samples by cultivar and by province and sent these composite samples to the Grain Research Laboratory (GRL) on a regular basis from the beginning of harvest to the middle of October, at which time the survey was terminated.

The samples received by the GRL were further composited, based on province and cultivar, and then micro-malted. In all, the GRL malted 68 composites of selected barley in 1997.

## Malting quality data

### Additional malt analyses

In response to concerns of Canadian malting barley customers, the analysis of the 1997 malt was expanded to include information on free amino nitrogen (FAN) and wort colour. End-users are routinely interested in protein content of malting barley and FAN and colour are two important parameters related to grain protein.

FAN fulfills the amino acid requirements of brewing yeast during fermentation. Adequate amounts of FAN are required for effective and complete fermentation. The level of FAN that a malt can produce during mashing is dependent on the level of protein in the original barley, as well as hydrolysis of the protein during malting and mashing. Canadian malting barley, on average, contains ample amounts of protein as well as a potential to produce adequate levels of protease enzymes required for protein breakdown. Therefore, Canadian barley is known for its high levels of FAN.

The colour of a Congress extract is also dependent on protein content of the original barley as well as the degree to which the protein is degraded during germination. Excess protein degradation can lead to high levels of amino acids and small peptides, which then react with simple sugars in the extract to produce excess colour. The degree of protein degradation, and therefore the potential to develop excess colour, can essentially be controlled in the malt house by giving proper attention to steeping and germinating conditions.

The malting barley survey intentionally uses constant malt conditions, as described in *Methods and definitions*, for all samples, to facilitate comparisons among cultivars. The levels of colour observed, therefore, may not be of commercial acceptability for all samples.

### Harrington

Harrington barley selected for malting in 1997 was of slightly poorer quality than in 1996. Table 4 shows protein contents to be slightly higher relative to 1996 values in Saskatchewan and Manitoba, but lower in Alberta. Germinations were good in all three prairie provinces. Percentages of plump kernels and thousand kernel weights were both lower in 1997 as a result of the hot dry conditions in late July and early August. However, despite the significant drop in thousand kernel weight, the percentage of the crop in the heavy plus intermediate size categories remained relatively constant, suggesting a crop with more uniform kernel size. This would allow for easier processing of barley in malt plants because kernels of different size take up water and germinate at different rates. As a result, finished malt from this year's barley should be more homogeneous than that seen in past years.

The 1997 Harrington barley malted easily with little sign of water sensitivity. The malt quality was good. The uniformity of kernel size plus higher enzyme levels allowed for good modification under our standard micro-malting conditions, which are described under *Methods and definitions*. Low fine/coarse differences were observed and friability levels were similar to those observed the previous year. β-Glucan levels in malt extract were similar to last year and soluble protein was higher. However, because of the poor grain filling in mid-summer, extract levels were significantly lower across the prairies.

### Manley

The barley quality of 1997 Manley was somewhat less than that seen in 1996. Table 5 shows that percentages of plump kernels and thousand kernel weights were lower. Percentages of thin kernels were also lower, though, suggesting a crop with more uniform sized kernels. Germination levels were good but protein contents were higher in all three provinces compared to last year.

The Manley barley selected in 1997 showed less water sensitivity than last year. The malt showed significantly higher levels of enzymes than malt made from 1996 Manley. Levels of extract in Alberta malt were similar to last year but Saskatchewan malt had lower levels. As well, Alberta malt showed better fine/coarse differences than did Saskatchewan malt. Soluble protein contents were good for malt from both provinces while β-glucan levels were higher than in 1996. Levels of friable kernels in Alberta malt were similar to last year but lower in malt from Saskatchewan.

### Stein

The Stein barley grown in 1997 showed good quality, as shown in Table 6. Protein contents were similar to those of last year while percentages of plump kernels were actually up slightly. Thousand kernel weights were a little lower, but still exceeded 40 grams for all samples.

The quality of malt made from Stein was good. Despite some signs of water sensitivity, extract and enzyme levels were some of the highest of any cultivar tested. Fine/coarse differences were good, with adequate, but not excessive, levels of soluble protein. β-Glucan levels were higher than last year in Saskatchewan but still acceptable. Viscosity levels were high for Alberta malt but similar to last year for malt made from Saskatchewan barley.

### AC Oxbow

AC Oxbow barley grown in 1997 was of good quality. Table 6 shows that values for percent plumpness and thousand kernel weight were some of the highest of any barley cultivar analysed. The numbers also suggest that size of kernels was more uniform. However, protein contents were significantly higher and germinations were poor for Manitoba samples.

AC Oxbow showed signs of water sensitivity in barley grown in Manitoba but not in Saskatchewan. High levels of enzymes and uniformity of kernel size allowed the barley to modify quickly as indicated by modification indices such as fine/coarse difference, β-glucan level, viscosity and soluble protein. In fact, protein modification was extreme, with high levels of FAN and excessive colour values under the standard malting conditions described in *Methods and definitions*. A more commercially acceptable malt could have resulted if steeping and malting conditions more suitable for this particular cultivar had been used. AC Oxbow malt had low extract levels, a result of lower kernel weight and higher protein content in the samples tested.

### B1215

The B1215 barley grown in 1997 was of poorer quality than that grown in 1996. Table 7 indicates that kernels were less plump and thousand kernel weights were significantly lower. However, kernel size did appear more homogeneous. Protein contents were also higher but germinations were still good.

Selected B1215 barley showed little water sensitivity in 1997, which, in combination with higher enzyme levels, allowed for more complete modification compared to last year. On average, fine/coarse differences were lower and soluble protein levels were higher than observed for 1996 samples of this cultivar. Viscosities and β-glucan levels tended to be higher than last year. Levels of extract from malt made from 1997 B1215 were lower, a result of higher barley protein content and poorer kernel filling in mid-summer.

### Excel

The quality of 1997 Excel barley crop was poorer than last year. Table 8 shows that percentages of plump kernels and thousand kernel weights were down significantly. However, protein content and germination were similar to last year. The lower percentages of thin kernels, as indicated by difference, plus lower thousand kernel weights suggested a more uniformly sized crop.

Excel from 1997 was less water-sensitive than in previous years and as a result was easier to malt. β-Glucan levels and viscosities were lower than last year. Fine/coarse differences were higher but still acceptable. Protein modification, though, was high, as indicated by the ratio of soluble to total protein. An average colour value of over 2.0°ASBC suggested over modification of protein under the standard malting conditions used (see *Methods and defintions)*. Enzyme levels were good and percentages of friable kernels in Excel malt from 1997 were up slightly.

**Robust**

The quality of Robust barley grown in 1997 was of poorer quality than last year, as shown in Table 9. Protein contents were somewhat higher than last year in the samples tested. Both thousand kernel weights and percentages of plump kernels were down significantly in 1997. Germinations were good.

Robust barley showed very limited water sensitivity in 1997. As a result the malt made from this year's Robust was of better quality. Modification was more complete with lower fine/coarse differences, β-glucan levels and viscosities. Friability percentages were significantly higher and protein modification was better but not extreme. Levels of enzymes in the malt were higher and the percentage of extract from Robust malt was down only slightly in 1997.

**Blue-aleurone six-rowed barley**

The small amount of six-rowed blue-aleurone malting barley received in 1997 was of poorer quality than last year. Table 9 shows that thousand kernel weight and percentage of plump kernels were significantly lower. Protein content was also higher but germination was good.

The warm, dry harvest conditions resulted in significantly less water sensitivity for 1997 blue-aleurone malting barley. Therefore, malting quality is better with a lower level of β-glucan, lower viscosity and a higher level of soluble protein and percentage of friable kernels. Enzyme levels were also up significantly while the extract level was down only slightly.

**Stander**

Stander barley was of good quality in 1997. Thousand kernel weights and percentages of plump kernels were down only slightly. Protein content was lower than last year and germination was good.

The barley showed some signs of water sensitivity but not severe. Table 10 shows that Stander barley modified easily as indicated by low values for fine/coarse difference, β-glucan and viscosity. Extract and enzyme levels were good. However, under the malting conditions used (see *Methods and definitions*), protein modification was extreme, and levels of FAN and extract colour were high. The use of more suitable malting conditions could have resulted in less protein modification and thus more commercially acceptable malt.

**B1602**

The quality of B1602 barley grown in 1997 was of poorer quality than in 1996 as shown in Table 10. Percentage of plump kernels and thousand kernel weight were down significantly, while protein content was higher. Germination was also slightly lower than last year.

Malt made from B1602 grown in 1997 was of somewhat poorer quality than malt from last year's B1602. Endosperm modification was better than was noted in 1996 as indicated by a lower fine/coarse difference, lower β-glucan content, lower viscosity, and a higher percentage of friable kernels. Protein modification was also better while levels of diastatic power and α-amylase were similar to levels seen in 1996. However, the level of extract in this year's malt was down significantly as a result of the hot weather in mid-summer.

**Table 4 • Quality data for 1997 harvest survey composite samples of Harrington malting barley**

| Variety | Harrington | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Origin of selected samples | Alberta | | Saskatchewan | | Manitoba | | Prairie provinces[1] | |
| Crop year | 1997 | 1996 | 1997 | 1996 | 1997 | 1996 | 1997 | 1996 |
| Thousands of tonnes | 190.2 | 176.7 | 267.6 | 366.2 | 3.7 | 4.4 | 461.5 | 547.3 |
| **Barley** | | | | | | | | |
| Physical characteristics | | | | | | | | |
| 1000 kernel weight, g | 39.7 | 42.2 | 39.0 | 41.4 | 38.4 | 41.3 | 39.3 | 41.7 |
| Heavy Grade, over 6/64" sieve, % | 84.4 | 88.4 | 86.7 | 87.7 | 77.9 | 85.5 | 85.7 | 87.9 |
| Intermediate Grade, over 5/64" sieve, % | 11.2 | 9.4 | 11.9 | 9.1 | 19.3 | 10.8 | 11.9 | 9.2 |
| Chemical analysis | | | | | | | | |
| Moisture content[2], % | 10.2 | 9.8 | 10.5 | 10.4 | 9.7 | 9.4 | 10.4 | 10.2 |
| Protein content, % | 11.0 | 11.5 | 10.9 | 10.4 | 11.7 | 11.4 | 11.0 | 10.8 |
| Germination, % , 4 ml | 100 | 100 | 99 | 100 | 100 | 100 | 99 | 100 |
| Germination, % , 8 ml | 96 | 99 | 99 | 98 | 95 | 96 | 98 | 98 |
| **Malt** | | | | | | | | |
| Physical characteristics | | | | | | | | |
| Malt yield, % | 90.8 | 89.9 | 91.2 | 91.1 | 91.2 | 91.2 | 91.0 | 90.7 |
| Friability, % | 84.5 | 82.6 | 87.2 | 88.5 | 83.3 | 82.1 | 86.1 | 86.6 |
| Chemical analysis | | | | | | | | |
| Moisture content, % | 3.5 | 3.3 | 3.5 | 3.4 | 3.4 | 3.0 | 3.5 | 3.4 |
| **Wort** | | | | | | | | |
| Fine-grind extract, % | 79.2 | 79.8 | 79.1 | 80.6 | 79.2 | 80.2 | 79.1 | 80.3 |
| Coarse-grind extract, % | 77.7 | 78.3 | 77.8 | 79.5 | 78.4 | 79.1 | 77.7 | 79.1 |
| F/C difference, % | 1.5 | 1.5 | 1.3 | 1.1 | 0.8 | 1.1 | 1.4 | 1.2 |
| β-Glucan content, ppm | 139 | 140 | 123 | 120 | 103 | 136 | 130 | 127 |
| Viscosity, cps | 1.43 | 1.48 | 1.40 | 1.44 | 1.40 | 1.46 | 1.41 | 1.45 |
| Soluble protein content, % | 5.08 | 4.48 | 4.91 | 4.36 | 5.27 | 5.05 | 4.99 | 4.40 |
| Ratio S/T, % | 44.7 | 41.0 | 43.4 | 42.5 | 45.0 | 44.3 | 43.9 | 42.0 |
| FAN, mg/l | 182 | NA | 177 | NA | 220 | NA | 180 | NA |
| Colour, °ASBC | 1.7 | NA | 1.7 | NA | 1.9 | NA | 1.7 | NA |
| Diastatic power, °L | 112 | 113 | 113 | 111 | 136 | 109 | 113 | 112 |
| α-Amylase, DU | 58.3 | 57.7 | 59.4 | 59.2 | 69.5 | 53.1 | 59.0 | 58.6 |

NA=not available
[1] weighted average values
[2] moisture levels may not represent actual new crop moisture levels as survey samples are not collected or stored in moisture proof containers

**Table 5 • Quality data for 1997 harvest survey composite samples of Manley malting barley**

| Variety | Manley | | | | | |
|---|---|---|---|---|---|---|
| Origin of selected samples | Alberta | | Saskatchewan | | Prairie provinces[1] | |
| Crop year | 1997 | 1996 | 1997 | 1996 | 1997 | 1996 |
| Thousands of tonnes | 11.0 | 16.0 | 32.1 | 65.0 | 43.1 | 81.0 |
| **Barley** | | | | | | |
| Physical characteristics | | | | | | |
| 1000 kernel weight, g | 41.5 | 42.7 | 41.7 | 42.2 | 41.6 | 42.3 |
| Heavy Grade, over 6/64" sieve, % | 84.8 | 86.5 | 82.3 | 83.4 | 82.9 | 83.7 |
| Intermediate Grade, over 5/64" sieve, % | 13.4 | 8.9 | 16.1 | 10.4 | 15.4 | 10.1 |
| Chemical analysis | | | | | | |
| Moisture content[2], % | 9.3 | 11.8 | 10.5 | 10.1 | 10.2 | 10.4 |
| Protein content, % | 10.8 | 10.1 | 11.3 | 10.0 | 11.2 | 10.0 |
| Germination, % , 4 ml | 99 | 100 | 100 | 99 | 100 | 99 |
| Germination, % , 8 ml | 97 | 98 | 98 | 93 | 98 | 94 |
| **Malt** | | | | | | |
| Physical characteristics | | | | | | |
| Malt yield, % | 92.3 | 93.3 | 91.5 | 91.4 | 91.7 | 91.8 |
| Friability, % | 81.4 | 80.9 | 82.9 | 86.2 | 82.5 | 85.1 |
| Chemical analysis | | | | | | |
| Moisture content, % | 3.6 | 3.4 | 3.3 | 3.6 | 3.4 | 3.6 |
| **Wort** | | | | | | |
| Fine-grind extract, % | 80.4 | 80.3 | 78.3 | 80.4 | 78.8 | 80.4 |
| Coarse-grind extract, % | 79.3 | 78.9 | 76.0 | 79.9 | 76.8 | 79.7 |
| F/C difference, % | 1.2 | 1.4 | 2.3 | 0.5 | 2.0 | 0.7 |
| β-Glucan content, ppm | 223 | 103 | 145 | 73 | 165 | 79 |
| Viscosity, cps | 1.46 | 1.47 | 1.40 | 1.42 | 1.42 | 1.43 |
| Soluble protein content, % | 4.74 | 4.02 | 4.71 | 4.13 | 4.72 | 4.11 |
| Ratio S/T, % | 43.9 | 36.5 | 42.3 | 38.8 | 42.7 | 38.3 |
| FAN, mg/l | 158 | NA | 181 | NA | 175 | NA |
| Colour, °ASBC | 1.6 | NA | 1.7 | NA | 1.7 | NA |
| Diastatic power, °L | 134 | 109 | 135 | 123 | 135 | 120 |
| α-Amylase, DU | 57.4 | 50.7 | 64.4 | 58.1 | 62.6 | 56.6 |

NA=not available

[1] weighted average values

[2] moisture levels may not represent actual new crop moisture levels as survey samples are not collected or stored in moisture-proof containers

**Table 6 • Quality data for 1997 harvest survey composite samples of Stein and AC Oxbow malting barley**

| Variety | Stein | | | | AC Oxbow | | | |
|---|---|---|---|---|---|---|---|---|
| Origin of selected samples | Alberta | Saskatchewan | | Prairie provinces[1] | Saskatchewan | | Manitoba | Prairie provinces[1] |
| Crop year | 1997 | 1997 | 1996 | 1997 | 1997 | 1996 | 1997 | 1997 |
| Thousands of tonnes | 24.2 | 7.9 | 18.0 | 32.1 | 7.2 | 50.0 | 10.0 | 17.2 |
| **Barley** | | | | | | | | |
| Physical characteristics | | | | | | | | |
| 1000 kernel weight, g | 42.3 | 40.5 | 43.1 | 41.9 | 43.0 | 44.0 | 39.7 | 41.1 |
| Heavy Grade, over 6/64" sieve, % | 86.9 | 84.7 | 83.7 | 86.4 | 94.7 | 91.2 | 88.8 | 91.3 |
| Intermediate Grade, over 5/64" sieve, % | 11.7 | 14.0 | 9.4 | 12.3 | 4.3 | 3.9 | 10.2 | 7.7 |
| Chemical analysis | | | | | | | | |
| Moisture content[2], % | 11.0 | 10.2 | 11.6 | 10.8 | 11.6 | 10.1 | 9.8 | 10.5 |
| Protein content, % | 11.8 | 10.8 | 10.8 | 11.5 | 12.1 | 10.5 | 12.4 | 12.3 |
| Germination, % , 4 ml | 100 | 100 | 100 | 100 | 99 | 100 | 87 | 92 |
| Germination, % , 8 ml | 92 | 95 | 95 | 92 | 99 | 99 | 88 | 93 |
| **Malt** | | | | | | | | |
| Physical characteristics | | | | | | | | |
| Malt yield, % | 91.5 | 92.5 | 91.0 | 91.8 | 91.3 | 89.7 | 89.6 | 90.3 |
| Friability, % | 82.4 | 87.2 | 88.2 | 83.6 | 80.5 | 84.8 | 76.0 | 77.9 |
| Chemical analysis | | | | | | | | |
| Moisture content, % | 3.2 | 3.8 | 3.5 | 3.4 | 3.3 | 3.6 | 3.5 | 3.4 |
| **Wort** | | | | | | | | |
| Fine-grind extract, % | 80.2 | 79.4 | 81.0 | 80.0 | 78.9 | 80.6 | 79.0 | 79.0 |
| Coarse-grind extract, % | 78.9 | 78.7 | 79.4 | 78.8 | 78.0 | 80.0 | 78.2 | 78.1 |
| F/C difference, % | 1.3 | 0.7 | 1.6 | 1.1 | 0.9 | 0.6 | 0.8 | 0.8 |
| β-Glucan content, ppm | 181 | 178 | 130 | 181 | 78 | 53 | 28 | 49 |
| Viscosity, cps | 1.50 | 1.39 | 1.39 | 1.48 | 1.39 | 1.38 | 1.38 | 1.38 |
| Soluble protein content, % | 4.97 | 4.29 | 4.39 | 4.80 | 5.12 | 4.85 | 6.11 | 5.70 |
| Ratio S/T, % | 43.0 | 39.1 | 40.3 | 42.1 | 44.7 | 45.4 | 51.5 | 48.7 |
| FAN, mg/l | 170 | 145 | NA | 164 | 212 | NA | 260 | 240 |
| Colour, °ASBC | 1.8 | 1.4 | NA | 1.7 | 2.2 | NA | 5.0 | 3.8 |
| Diastatic power, °L | 136 | 125 | 125 | 133 | 129 | 135 | 125 | 127 |
| α-Amylase, DU | 59.3 | 58.2 | 62.7 | 59.1 | 63.6 | 59.6 | 57.0 | 59.8 |

NA=not available

[1] weighted average values

[2] moisture levels may not represent actual new crop moisture levels as survey samples are not collected or stored in moisture-proof containers

**Table 7 • Quality data for 1997 harvest survey composite samples of B1215 malting barley**

| Variety | B1215 | | | | | |
|---|---|---|---|---|---|---|
| Origin of selected samples | Alberta | | Saskatchewan | | Prairie provinces[1] | |
| Crop year | 1997 | 1996 | 1997 | 1996 | 1997 | 1996 |
| Thousands of tonnes | 20.6 | 19.4 | 3.2 | 6.4 | 23.8 | 25.8 |
| **Barley** | | | | | | |
| Physical characteristics | | | | | | |
| 1000 kernel weight, g | 38.6 | 40.5 | 38.8 | 39.9 | 38.6 | 40.3 |
| Heavy Grade, over 6/64" sieve, % | 85.5 | 90.1 | 84.7 | 89.7 | 85.4 | 90.0 |
| Intermediate Grade, over 5/64" sieve, % | 13.2 | 6.3 | 13.5 | 7.5 | 13.3 | 6.6 |
| Chemical analysis | | | | | | |
| Moisture content[2], % | 10.0 | 10.7 | 9.1 | 10.5 | 9.9 | 10.6 |
| Protein content, % | 11.1 | 10.1 | 12.1 | 10.2 | 11.3 | 10.1 |
| Germination, % , 4 ml | 100 | 100 | 98 | 100 | 99 | 100 |
| Germination, % , 8 ml | 97 | 96 | 96 | 91 | 97 | 95 |
| **Malt** | | | | | | |
| Physical characteristics | | | | | | |
| Malt yield, % | 91.5 | 91.9 | 90.6 | 91.1 | 91.4 | 91.7 |
| Friability, % | 83.0 | 84.2 | 85.3 | 82.7 | 83.3 | 83.8 |
| Chemical analysis | | | | | | |
| Moisture content, % | 3.0 | 3.3 | 3.2 | 3.5 | 3.0 | 3.4 |
| **Wort** | | | | | | |
| Fine-grind extract, % | 80.1 | 80.5 | 78.8 | 80.6 | 79.9 | 80.5 |
| Coarse-grind extract, % | 78.4 | 77.5 | 77.6 | 80.4 | 78.3 | 78.2 |
| F/C difference, % | 1.7 | 3.0 | 1.2 | 0.2 | 1.6 | 2.3 |
| β-Glucan content, ppm | 239 | 162 | 170 | 106 | 230 | 148 |
| Viscosity, cps | 1.48 | 1.49 | 1.43 | 1.39 | 1.48 | 1.46 |
| Soluble protein content, % | 4.97 | 4.28 | 4.75 | 4.33 | 4.94 | 4.29 |
| Ratio S/T, % | 46.9 | 38.6 | 41.1 | 40.3 | 46.1 | 39.0 |
| FAN, mg/l | 203 | NA | 208 | NA | 204 | NA |
| Colour, °ASBC | 1.9 | NA | 1.6 | NA | 1.9 | NA |
| Diastatic power, °L | 109 | 109 | 124 | 115 | 111 | 110 |
| α-Amylase, DU | 63.9 | 57.5 | 71.0 | 61.8 | 64.9 | 58.6 |

NA = not available

[1] weighted average values

[2] moisture levels may not represent actual new crop moisture levels as survey samples are not collected or stored in moisture-proof containers

**Table 8 • Quality data for 1997 harvest survey composite samples of Excel malting barley**

| Variety | Excel | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Origin of selected samples | Alberta | Saskatchewan | | Sask/Man | Manitoba | | Prairie provinces[1] | |
| Crop year | 1997 | 1997 | 1996 | 1997 | 1997 | 1996 | 1997 | 1996 |
| Thousands of tonnes | 4.5 | 45.6 | 108.5 | 27.0 | 13.0 | 38.4 | 90.1 | 146.9 |
| **Barley** | | | | | | | | |
| Physical characteristics | | | | | | | | |
| 1000 kernel weight, g | 37.3 | 35.9 | 37.6 | 35.1 | 35.7 | 37.1 | 35.7 | 37.5 |
| Heavy Grade, over 6/64" sieve, % | 85.5 | 80.0 | 90.0 | 77.2 | 70.6 | 80.1 | 78.1 | 87.4 |
| Intermediate Grade, over 5/64" sieve, % | 13.3 | 17.8 | 7.7 | 20.6 | 25.3 | 11.9 | 19.5 | 8.8 |
| Chemical analysis | | | | | | | | |
| Moisture content[2], % | 10.8 | 11.0 | 11.6 | 10.8 | 9.9 | 11.3 | 10.8 | 11.5 |
| Protein content, % | 10.9 | 11.2 | 10.9 | 11.2 | 11.9 | 12.0 | 11.3 | 11.2 |
| Germination, % , 4 ml | 99 | 100 | 98 | 100 | 98 | 99 | 100 | 98 |
| Germination, % , 8 ml | 96 | 96 | 92 | 97 | 96 | 91 | 96 | 92 |
| **Malt** | | | | | | | | |
| Physical characteristics | | | | | | | | |
| Malt yield, % | 92.2 | 91.1 | 91.3 | 90.8 | 90.9 | 89.8 | 91.1 | 90.9 |
| Friability, % | 79.5 | 84.8 | 83.8 | 86.6 | 83.4 | 82.3 | 84.9 | 83.4 |
| Chemical analysis | | | | | | | | |
| Moisture content, % | 3.1 | 3.4 | 3.5 | 3.2 | 3.5 | 3.5 | 3.4 | 3.5 |
| **Wort** | | | | | | | | |
| Fine-grind extract, % | 78.9 | 78.3 | 79.3 | 78.3 | 78.1 | 79.0 | 78.3 | 79.2 |
| Coarse-grind extract, % | 76.9 | 77.4 | 79.0 | 77.9 | 77.3 | 78.2 | 77.5 | 78.8 |
| F/C difference, % | 2.0 | 1.1 | 0.3 | 0.4 | 0.8 | 0.8 | 0.9 | 0.4 |
| β-Glucan content, ppm | 292 | 163 | 235 | 93 | 175 | 232 | 150 | 234 |
| Viscosity, cps | 1.45 | 1.38 | 1.49 | 1.38 | 1.42 | 1.46 | 1.39 | 1.48 |
| Soluble protein content, % | 4.94 | 4.71 | 4.40 | 4.55 | 5.49 | 4.93 | 4.78 | 4.54 |
| Ratio S/T, % | 44.9 | 43.1 | 40.8 | 41.2 | 47.1 | 42.9 | 43.2 | 41.4 |
| FAN, mg/l | 173 | 196 | NA | 194 | 210 | NA | 196 | NA |
| Colour, °ASBC | 1.9 | 2.0 | NA | 2.2 | 2.3 | NA | 2.1 | NA |
| Diastatic power, °L | 116 | 111 | 106 | 115 | 127 | 122 | 115 | 111 |
| α-Amylase, DU | 43.7 | 45.6 | 43.0 | 43.7 | 49.1 | 48.1 | 45.4 | 44.3 |

NA=not available

[1] weighted average values

[2] moisture levels may not represent actual new crop moisture levels as survey samples are not collected or stored in moisture-proof containers

**Table 9 • Quality data for 1997 harvest survey composite samples of Robust and blue-aleurone, six-rowed malting barley**

| Variety | Robust | | | | | | Blue aleurone | |
|---|---|---|---|---|---|---|---|---|
| Origin of selected samples | Sask/Man | | Manitoba | | Prairie provinces[1] | | Saskatchewan | |
| Crop year | 1997 | 1996 | 1997 | 1996 | 1997 | 1996 | 1997 | 1996 |
| Thousands of tonnes | 6.0 | 45.0 | 12.0 | 28.0 | 18.0 | 73.0 | 6.4 | 24.0 |
| **Barley** | | | | | | | | |
| Physical characteristics | | | | | | | | |
| 1000 kernel weight, g | 35.4 | 37.6 | 35.5 | 38.2 | 35.5 | 37.8 | 34.5 | 36.1 |
| Heavy Grade, over 6/64" sieve, % | 79.0 | 90.5 | 79.0 | 88.3 | 79.0 | 89.7 | 75.2 | 79.5 |
| Intermediate Grade, over 5/64" sieve, % | 17.9 | 6.4 | 18.2 | 10.0 | 18.1 | 7.9 | 21.9 | 11.9 |
| Chemical analysis | | | | | | | | |
| Moisture content[2], % | 10.2 | 11.3 | 9.9 | 10.0 | 10.0 | 10.8 | 11.1 | 10.7 |
| Protein content, % | 12.1 | 11.8 | 12.1 | 12.0 | 12.1 | 11.9 | 12.2 | 10.2 |
| Germination, % , 4 ml | 99 | 99 | 99 | 100 | 99 | 99 | 100 | 99 |
| Germination, % , 8 ml | 96 | 88 | 95 | 79 | 95 | 85 | 95 | 83 |
| **Malt** | | | | | | | | |
| Physical characteristics | | | | | | | | |
| Malt yield, % | 91.2 | 93.4 | 91.8 | 94.0 | 91.6 | 93.6 | 90.9 | 92.0 |
| Friability, % | 76.7 | 65.9 | 76.6 | 66.7 | 76.6 | 66.2 | 84.3 | 80.8 |
| Chemical analysis | | | | | | | | |
| Moisture content, % | 3.3 | 3.6 | 3.4 | 3.1 | 3.4 | 3.4 | 3.3 | 3.6 |
| **Wort** | | | | | | | | |
| Fine-grind extract, % | 77.2 | 78.1 | 78.0 | 78.2 | 77.7 | 78.1 | 78.0 | 78.9 |
| Coarse-grind extract, % | 76.4 | 74.5 | 76.3 | 76.5 | 76.3 | 75.3 | 77.1 | 78.2 |
| F/C difference, % | 0.8 | 3.6 | 1.7 | 1.7 | 1.4 | 2.8 | 0.9 | 0.7 |
| β-Glucan content, ppm | 188 | 420 | 218 | 328 | 208 | 385 | 157 | 193 |
| Viscosity, cps | 1.44 | 1.54 | 1.43 | 1.52 | 1.43 | 1.53 | 1.43 | 1.49 |
| Soluble protein content, % | 4.47 | 4.12 | 4.49 | 4.48 | 4.48 | 4.26 | 4.42 | 4.13 |
| Ratio S/T, % | 40.1 | 36.2 | 39.4 | 36.7 | 39.6 | 36.4 | 41.4 | 34.2 |
| FAN, mg/l | 178 | NA | 172 | NA | 174 | NA | 165 | NA |
| Colour, °ASBC | 1.5 | NA | 1.4 | NA | 1.4 | NA | 1.6 | NA |
| Diastatic power, °L | 121 | 126 | 134 | 115 | 130 | 122 | 124 | 111 |
| α-Amylase, DU | 37.0 | 34.8 | 39.4 | 34.6 | 38.6 | 34.7 | 50.4 | 45.4 |

NA=not available

[1] weighted average values

[2] moisture levels may not represent actual new crop moisture levels as survey samples are not collected or stored in moisture-proof containers

**Table 10 • Quality data for 1997 harvest survey composite samples of Stander and B1602 malting barley**

| Variety | Stander | | | | B1602 | |
|---|---|---|---|---|---|---|
| Origin of selected samples | Saskatchewan | Manitoba | | Prairie provinces[1] | Saskatchewan | |
| Crop year | 1997 | 1997 | 1996 | 1997 | 1997 | 1996 |
| **Barley** | | | | | | |
| Physical characteristics | | | | | | |
| 1000 kernel weight, g | 36.3 | 35.3 | 38.6 | 35.7 | 34.5 | 36.0 |
| Heavy Grade, over 6/64" sieve, % | 89.2 | 81.6 | 89.5 | 85.0 | 75.6 | 89.4 |
| Intermediate Grade, over 5/64" sieve, % | 9.2 | 16.5 | 11.0 | 13.3 | 21.2 | 8.5 |
| Chemical analysis | | | | | | |
| Moisture content[2], % | 10.9 | 8.9 | 9.9 | 9.8 | 10.4 | 10.2 |
| Protein content, % | 11.6 | 11.9 | 12.2 | 11.8 | 11.2 | 10.5 |
| Germination, % , 4 ml | 99 | 100 | 99 | 100 | 96 | 99 |
| Germination, % , 8 ml | 95 | 95 | 93 | 95 | 94 | 95 |
| **Malt** | | | | | | |
| Physical characteristics | | | | | | |
| Malt yield, % | 90.6 | 90.8 | 92.0 | 90.7 | 91.9 | 91.9 |
| Friability, % | 86.3 | 82.0 | 82.6 | 83.9 | 80.5 | 76.8 |
| Chemical analysis | | | | | | |
| Moisture content, % | 3.2 | 3.4 | 3.8 | 3.3 | 3.6 | 3.5 |
| **Wort** | | | | | | |
| Fine-grind extract, % | 78.8 | 78.6 | 79.1 | 78.7 | 76.6 | 78.3 |
| Coarse-grind extract, % | 78.5 | 77.7 | 78.6 | 78.1 | 75.3 | 76.5 |
| F/C difference, % | 0.3 | 0.9 | 0.5 | 0.6 | 1.3 | 1.8 |
| β-Glucan content, ppm | 126 | 156 | 195 | 143 | 211 | 255 |
| Viscosity, cps | 1.43 | 1.39 | 1.50 | 1.41 | 1.44 | 1.54 |
| Soluble protein content, % | 4.67 | 5.21 | 4.55 | 4.97 | 4.44 | 3.96 |
| Ratio S/T, % | 42.0 | 46.3 | 42.4 | 44.4 | 37.3 | 35.6 |
| FAN, mg/l | 210 | 234 | NA | 223 | 143 | NA |
| Colour, °ASBC | 1.7 | 2.2 | NA | 2.0 | 1.4 | NA |
| Diastatic power, °L | 129 | 149 | 140 | 140 | 105 | 107 |
| α-Amylase, DU | 53.9 | 55.9 | 57.3 | 55.0 | 44.2 | 42.2 |

NA=not available

[1] weighted average values

[2] moisture levels may not represent actual new crop moisture levels as survey samples are not collected or stored in moisture-proof containers

# Methods and definitions

This section describes methods used at the Grain Research Laboratory. Unless otherwise specified, analytical results for barley and malt are reported on a dry weight basis. The ASBC methods cited are those of the American Society of Brewing Chemists, Eighth Edition, 1992.

**Dockage and assortment**

All samples are passed through a Carter dockage tester equipped with a No. 6 riddle to remove foreign material, and two slotted sieves to sort the barley. Heavy Grade barley is the material retained on a 6/64" (2.38 mm) x 3/4" slotted sieve. Intermediate Grade is barley that passes through the 6/64" x 3/4" sieve but is retained on a 5/64" (1.98 mm) x 3/4" slotted sieve.

**Weight per thousand kernels**

A small sample of dockage-free, Heavy Grade barley is hand-picked to remove any residual foreign material. The weight of 500 kernels picked from this cleaned material is then measured and doubled.

**Moisture content of barley**

Moisture content of barley is predicted using NIR equipment that has been calibrated by the standard ASBC method.

**Moisture content of malt (ASBC)**

Moisture content of malt is determined on a ground sample at 104°C for 3 h in a convection oven.

**Protein content (N x 6.25)**

Protein content is predicted on Heavy Grade barley using NIR equipment that has been calibrated by Combustion Nitrogen Analysis (CNA). CNA is determined on a LECO Model FP-428 CNA analyser calibrated by EDTA. Samples are ground on a UDY Cyclone Sample Mill fitted with a 1.0-mm screen. A 200-mg sample is analysed as received (it is not dried before analysis). A moisture analysis is also performed and results are reported on a dry matter basis.

**Germination energy**

Germination energy is determined by placing 100 kernels of barley on two pieces of Whatman #1 filter paper in a 9.0-cm petri dish and adding 4.0 ml of deionized water. Samples are kept in the dark at room temperature. Germinated kernels are counted after 24, 48 and 72 h.

**Water sensitivity**

Water sensitivity is determined exactly as described for germination energy, except that 8.0 ml of deionized water is added to each petri dish. Water sensitivity is reported as the percentage of kernels that germinate in 8 ml, which can then be compared to the Germination Energy.

**Malting conditions**

Malts are prepared using an Automatic Phoenix Micromalting System designed to handle twenty-four 500-g samples of barley per run. Samples are steeped at 13°C using the following regime: 10 h wet steep, 18 h air rest, 8 h wet steep and 12 h air rest. Samples are germinated for 96 h at 15°C and 100% relative humidity. Kilning is carried out over 48 h as follows: 6 h from 30°C to 48°C, 16 h at 48°C, 8 h from 48°C to 66°C, 10 h at 66°C, 2 h from 66°C to 85°C and 6 h at 85°C.

**Malt mills (ASBC)**

Fine-grind malt is prepared with a Buhler-Miag disc mill set to fine-grind. Coarse-grind malt is prepared with the same mill set to coarse-grind. The settings for fine- and coarse-grinds are based on the screening of a ground ASBC check.

**Fine-grind and coarse-grind extracts (ASBC)**

Extracts are prepared using a Brewing Research Foundation (BRF) mash bath and the Congress mashing procedure from 45°C to 70°C. Specific gravities are determined at 20°C with an Anton Paar DMA 55 digital density meter (LaBerge (1979), *Journal of the American Society of Brewing Chemists* 37:105).

**Wort-soluble protein**

Wort-soluble protein is determined spectrophotometrically using the method of Haslemore and Gill (1995), *Journal of the Institute of Brewing* 101:469.

**Kolbach index (ratio S/T)** Kolbach index is calculated from the formula, (% soluble protein/% malt protein) x 100.

**Free Amino Nitrogen (FAN)** Free amino nitrogen is determined on the fine extract according to the official ASBC method.

**Colour** The colour of the fine extract is determined according to the official method of the ASBC.

**Diastatic power (ASBC)** Diastatic power is determined using the ferricyanide assay for reducing sugars.

**α-Amylase activity** α-Amylase activity is determined using β-limit dextrin, prepared from waxy maize starch as substrate (Briggs (1961), *Journal of the Institute of Brewing* 67:427). Activity determined by this method is converted to Dextrinizing Units (DU) using regression equations that relate this method to the official ASBC procedure.

**β-Glucan content** β-Glucan content is determined in malt extract by flow injection analysis using Calcofluor staining of soluble, high molecular weight β-glucan (Jorgensen (1988), *Carlsberg Res. Commun.* 53:277).

**Viscosity** Viscosity is measured on the fine extract using a Brookfield cone/plate viscometer and reported in centipoises.

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**Figure 1 • Distribution of barley cultivars by crop district for 1997 (as percent of total area seeded to barley) • Alberta**

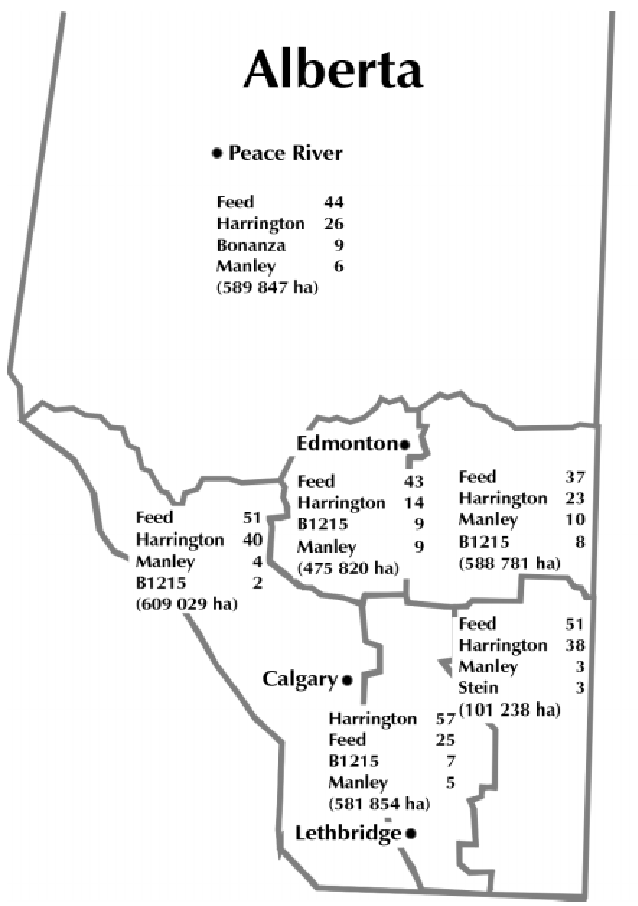

**Figure 1 • Distribution of barley cultivars by crop district for 1997 (as percent of total area seeded to barley) • Saskatchewan**

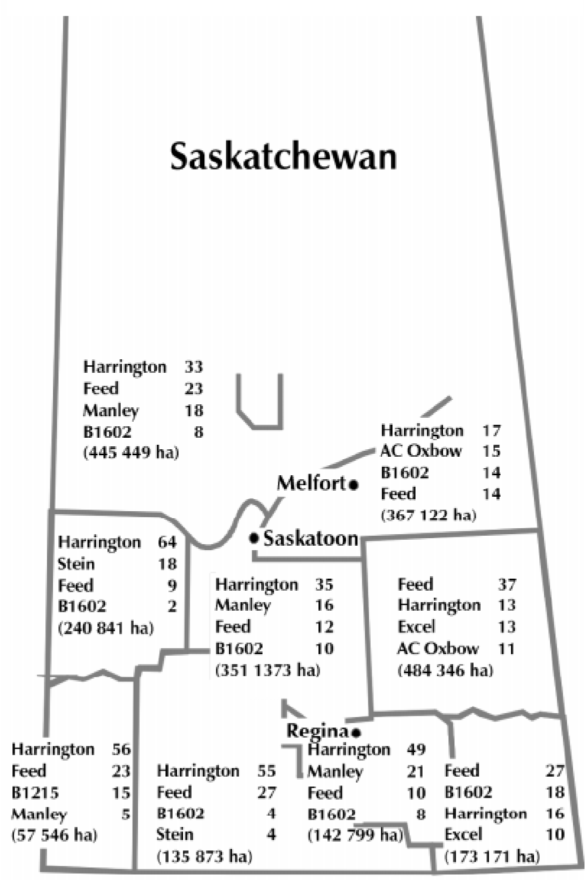

**Figure 1 • Distribution of barley cultivars by crop district for 1997 (as percent of total area seeded to barley) • Manitoba**