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Agronomic and Fertilizer Management of Barley in Alberta

Barley production in Canada is focused primarily in the prairie provinces of Alberta, Saskatchewan and Manitoba (Table 1). Approximately 94 per cent of barley of production in Canada is in the prairie provinces, with Alberta generally producing the most. Barley is the third most commonly grown crop on the prairies, after wheat and canola.

Barley production

Barley production in Alberta is primarily for grain for malt or livestock feed with lesser amounts grown for silage for the feedlot industry. Most of the barley production in Alberta is rain fed. A small proportion of barley is grown under irrigation in Alberta. In 2007, some 72,000 and 37,000 hectares (ha) were seeded to irrigated barley for grain and silage production, respectively.

Western Canadian barley production has averaged 12 million metric tones (MMT) annually over the last 10 years (1998 to 2007), of which approximately 9 MMT has been malt barley varieties (Table 1). However, the selection of barley for malt quality is generally only 25 to 30 per cent of malt barley production.

Currently, 2-row malting barley varieties dominate western Canada's malting barley production, accounting for approximately 50 per cent of total seeded area, with 6-row malting varieties at about 10 to 15 per cent.

The remaining seeded area is devoted primarily to feed varieties. As a result, about 2.5 MMT of total production is used for malt with the remaining production used for livestock feed or export. In the future, with increasing demand by Asian markets, the malt selection rate could potentially increase to 40 per cent of current malt variety production.

Historically, about 80 to 90 per cent of the malt varieties grown are 2-row types. In western Canada, top 2-row malt grades have returned a premium of almost $50.00 per acre (ac) over feed market prices.

The challenge in the future for prairie farmers will be production of the newest malt barley varieties with a careful focus on agronomic practices including crop rotations for disease management, seeding dates, seeding rates and fertilizer management to ensure barley seed production will meet malt quality standards.

Table 1. Barley production in Canada in 2007 and the average of 1998 to 2007

	2007	1998 - 2007 Average
	Hectares (per cent)	
Canada	4,396,114	4,623,966
Eastern provinces		
Prince Edward Island	34,399 (0.7)	36,529 (0.7)
Nova Scotia	2,832 (0.06)	4,223 (0.09)
New Brunswick	14,569 (0.03)	15,549 (0.3)
Quebec	95,022 (2.2)	128,336 (2.8)
Ontario	68,798 (1.6)	111,494 (2.4)
Western provinces		
Manitoba	412,788 (9.4)	437,383 (9.5)
Saskatchewan	1,780,655 (40.5)	1,854,412 (40.1)
Alberta	1,962,768 (44.6)	1,998,976 (43.2)
British Columbia	24,281 (0.5)	37,060 (0.8)

(Source: Statistics Canada Table 001-0017, Field Crop Reporting Series – 3401)

Variety selection

In the 1990's, Harrington, a 2-row barley, was traditionally the most popular variety grown for malt in western Canada. Since 2004, newer malt varieties such as AC Metcalfe, CDC Kendall and CDC Copeland, have increased in popularity.

A number of general purpose barley varieties are available in Alberta, with varieties suited to different agro-ecological areas of the province.

For more information on barley varieties and selection, refer to:

Barley Production in Alberta: Selecting Varieties available online at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/crop4935

Varieties of Cereals and Oilseed Crops for Alberta, Agdex 100/32, available online at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex4069?opendocument

Barley cropping systems

Before the early 1990's on the prairies, barley was traditionally grown under conventional cultivation. In the drier regions of the prairies, hard red spring wheat was the most common cereal crop grown, followed by barley. Barley was most commonly grown on summerfallow in the drier regions, and in moister regions, it was predominantly grown on stubble.

Prior to 1990, barley was mostly grown using conventional tillage and seeding equipment. During the 1990's, with the development of no-till seeding equipment, there was a gradual shift from conventional cultivation and seeding to direct seeding barley. In 1991, only 3 per cent of Alberta cropland was direct-seeded; however by 2006, 47 per cent of all land in the province was direct seeded. In Saskatchewan, 60 per cent of all cropland was direct seeded in 2006.

The shift toward direct seeding has resulted in increased soil moisture conservation, which, in turn, has reduced the amount of land in summerfallow across the prairies. This approach has led to a shift in cropping systems used by prairie farmers.

More diverse crop rotations have been adopted that include annual crops (other cereals, oilseed and pulse crops). This shift to more diverse crop rotations has created a sustainable environment to reduce root and leaf disease problems and also made it more difficult for weeds to adapt.

Barley yields are greatly influenced by water availability. In a study with feed barley at 20 sites in southern and central Alberta (Brown, Dark Brown and Black soil zones), researchers found that the average water use efficiency (the amount of grain produced per mm of water) at these sites was 15 kg/ha/mm (range 11 - 20).

Improved water use efficiency results in more grain produced per mm of water. The potential to increase barley yield through increased water use efficiency occurs when greater amounts of soil moisture are conserved and greater amounts of precipitation are stored by using good agronomic practices. This value was similar to the 16 kg/ha/mm obtained on soils in the Peace region of northern Alberta.

Higher water use efficiency in the Brown and Dark Brown soil zones can be attributed to improved cultivars and to improved agronomic practices, including direct seeding, which conserves soil moisture. The relationship of grain yield to water use was not linear (Figure 1). From Figure 1, grain yield steadily increases with increased water up to about 350 mm of water, then the increase flattens out and at 450 mm, the yield may even decline due to excess water.

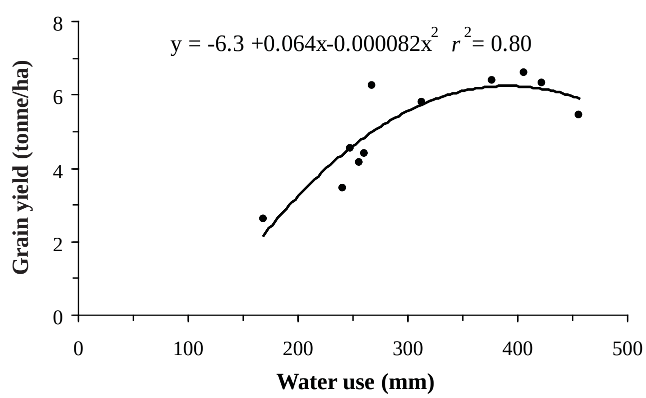

Figure 1. Relationship of barley grain yield (AC Lacombe, 120 kg N/ha) to total water use (precipitation + soil water depletion to 0.9 m between planting and harvest) in south Alberta
(McKenzie et al. 2004b)

In a study with malt barley at 12 dryland and 2 irrigated sites in southern Alberta, researchers found that total water use ranged from 133 to 497 mm, while water use efficiency ranged from 9 to 26 kg grain/ha/mm. The average water use efficiency was 17 kg grain/ha/mm.

The relationship of barley grain yield to water use is affected by potential evapotranspiration and the timing, duration and intensity of periods of water deficit. Producers can optimize barley yields by also optimizing water use through good agronomic practices such as early seeding (discussed in the next section) and using soil moisture conservation practices such as direct seeding.

A benefit of including barley in prairie crop rotations is that soil organic matter levels and soil quality can be maintained or even improved by including a fibrous-rooted crop such as barley in the rotation. After grain harvest in direct seeded cropping systems, leaving barley residue well spread on the soil surface helps protect soil from wind and water erosion, reduces soil moisture evaporation losses and leaves weed seeds stranded on the soil surface. A further benefit of including barley in more diverse crop rotations in western Canada is that the practice assists with the interruption of weed populations and some diseases.

Cultural practices

Seeding date

Barley grown in Alberta is generally higher yielding when seeded in early spring versus seeding in late spring. In southern Alberta, a study by McKenzie showed that delayed seeding from late April to mid-May reduced grain yield at 11 of 12 research sites. This finding was consistent with other studies. The average yield loss of 20 per cent from first to last seeding date in the McKenzie study was less than observed in Minnesota (35 per cent) and central Alberta (47 per cent), likely due to the shorter time period between the first and last seeding dates in the McKenzie study (≈ 3 weeks) versus the latter studies (5 to 6 weeks).

Early seeded barley tends to have a yield advantage in Alberta because the crop can capitalize on early spring moisture, longer spring days and slightly cooler temperatures before the hottest part of the summer; therefore, moisture use is optimized resulting in higher crop yields. Research also suggests early seeded barley is often less affected by leaf diseases.

Row spacing

The highest yields of barley are generally produced from rows spaced 15 to 25 cm apart. Most commercial seed drills used in western Canada have furrow openers spaced 15, 18 or 23 cm apart. Weed growth tends to be more abundant in rows spaced more than 23 cm apart than in narrower rows.

When barley is swathed, support can be a problem as row width is increased. Seed openers that do not place the seed in rows, but scatter the seed in a 5, 7, or 10 cm band usually have good yield potential and have the advantage of higher safe amounts of fertilizer that can be seed-placed.

Seeding rate

Studies in southeastern Saskatchewan found that plant densities of 136 to 176 plants/m^2 resulted in near maximum yields. Feed barley seeded at 400 seeds/m^2 generally resulted in higher yields versus seeding at 200 seeds/m^2 at sites located on Black and Gray Wooded soils in Alberta. Further, barley was more competitive with weeds at the higher seeding rate.

In a seeding rate study with malt barley, the lowest seeding rate to achieve 150 plants/m^2 resulted in plant densities that gave near maximum yields. A modest increase in grain yield occurred with an increased seeding rate to 350 seeds/m^2. Assuming that grain yields must increase four times the increase in seeding rate, optimum seeding rates in the McKenzie study were about 200 plants/m^2 under natural rainfall conditions and 300 plants/m^2 under irrigated conditions.

Research has shown that high seeding rates are more likely to reduce kernel size and malt quality than to increase it. Similar previous studies also observed that increased seeding rates reduced kernel size.

Under dry conditions, lower than normal seeding rates may actually increase crop yield by reducing plant competition for soil moisture in drier regions of the prairies. Under ideal moisture conditions, higher than normal seeding rates can increase crop competitiveness and yield.

As a general rule, malt barley should be seeded at a rate of 15 to 20 seeds/ft^2 in the Brown and Dark Brown soil zones, at 20 to 25 seeds/ft^2 in the Thin Black and Black soil zones and at 25 seeds/ft^2 under optimum irrigation.

Again as a general rule, barley for feed grain production should be seeded at a rate of 20 to 25 seeds/ft^2 in the Brown and Dark Brown soil zones, at 25 to 30 seeds/ft^2 in the Thin Black and Black soil zones and at 30 to 35 seeds/ft^2 under optimum irrigation.

When determining barley seeding rates in lb/ac, determine the 1,000 kernel weight in grams for the seed that will be used, determine the per cent germination and decide the target seeding rate in seeds/ft^2. Then, use the Alberta Agriculture Seeding Rate Calculator to determine the seeding rate in lb/ac. The Seeding Rate Calculator is available on line at:
http://www.agric.gov.ab.ca/app19/loadSeedRateCalc

Fertilizer requirements of barley

Achieving high yields of barley requires careful attention to nutrient requirements. Alberta has a range of uniquely different agro-ecological soil and climatic regions, and within each region, a balanced fertilization program must be developed to achieve optimum barley yields.

Nitrogen

Nitrogen (N) is required in higher amounts by barley and is frequently the most limiting nutrient on the Canadian prairies. Research has concluded that N fertilizer application was the most influential agronomic factor controlling yield and quality of malting barley in southern Alberta. Adequate N promotes vigorous plant growth and a larger leaf area with a deep green color.

Nitrogen in older leaves is redistributed to younger leaves to maintain growth. As a result, the older leaves first show the characteristic lighter green to yellow color followed by withering, indicating N deficiency.

The amount of nitrogen fertilizer required depends on four factors:

- level of soil nitrate-nitrogen (NO_3-N)
- mineralization potential of the soil
- stored soil moisture
- expected precipitation

These conditions vary greatly across the agro-ecological areas of Alberta.

As the level of available soil nitrogen increases, the need for N fertilizer decreases, resulting in a lower response to N fertilizer. As stored soil moisture increases or growing season precipitation increases, the need for additional nitrogen fertilizer increases. From research conducted in Alberta, general fertilizer recommendation tables have been developed for barley for various soil and climatic conditions (Table 2).

From Table 2, the amount of nitrogen fertilizer required by barley for optimum yield can be estimated. However, Table 2 provides general recommendations and does not consider crop value and N fertilizer price. A more accurate estimate can be made using an Alberta Agriculture program called Alberta Farm Fertilizer Information Recommendation Manager (AFFIRM) that can be downloaded from the department internet website at: http://www1.agric.gov.ab.ca/$department/softdown.nsf/main?openform&type=AFFIRM&page=information

The program allows the input of crop type, soil zone, soil moisture conditions (or irrigation level), soil test levels of each nutrient, cost of N fertilizer and the expected value of the crop per bushel at harvest.

Table 2. Recommended nitrogen fertilizer rate (lb/ac) in Alberta at various soil test N (NO_3-N) levels in the 0 to 24 inch depth with medium soil moisture

Soil nitrogen	Brown	Dark Brown	Thin Black	Black	Gray Wooded	Irrigation
(0 - 24")	(N lb/ac)					
10	60	75	95	115	105	170
20	50	65	85	105	95	160
30	40	55	75	95	85	150
40	30	45	65	85	75	140
50	20	35	55	75	65	130
60	10	25	45	65	55	120
70	10	15	35	55	45	110
80	0	10	25	45	35	100
90	0	0	15	35	25	90
100	0	0	10	25	15	80
110	0	0	0	15	10	70
120	0	0	0	10	0	60
130	0	0	0	0	0	50
140	0	0	0	0	0	40
150	0	0	0	0	0	30

With this information, the economic rate of N fertilizer required for barley can be calculated using the fertilizer response equations developed from field research. The yield increase tables are based on banded nitrogen fertilizer at 7 to 10 cm in either late fall or spring.

The addition of N fertilizer will increase barley yield and protein content. When direct seeding into soil with medium moisture, it is recommended that the rate of N when using urea (46-0-0) fertilizer should not exceed 25, 40 or 50 lb N/ac, with a seedbed utilization (SBU) of 10, 33 or 50 per cent, respectively, due to the potential toxicity of ammonia to the germinating seedling.

Phosphorus

Most soils across western Canada, in their native condition were very low in plant available phosphorus (P); therefore, the majority of prairie soils were considered phosphorus deficient. Soil phosphorus availability to plants can be assessed by soil sampling and testing to measure the extractable soil phosphate concentration that approximates the amount of plant available soil phosphorus.

Research in Alberta with different soil test P extraction methods determined that the Kelowna method, or modifications of this method, performs reasonably effectively over a wide range of soil types to predict plant available P.

Several modifications of the Kelowna soil test are commonly used by soil testing laboratories on the prairies to predict P fertilizer requirements. Crop response to applied P fertilizer depends, to a large extent, on the quantity of plant available P already in the soil. General soil test P ratings used in Alberta are based on 0 to 15 cm soil sampling depth and are provided in Table 3.

Table 3. Soil test rating for plant available P levels (Kelowna method)

Soil test level rating (0 - 6 inches)	Soil phosphorus (P) (lb/ac)
Very low	0 - 20
Low	20 - 35
Medium	35 - 50
High	50 - 80
Very high	>80

It is also important to note that P levels in some soils have increased over the years as a result of repeated annual P fertilization. As a result, crops grown on some soils are less responsive to fertilizer P application. Additionally, factors such as rate of P fertilizer applied, method of application and chemical form used can all affect plant uptake and response to P fertilizer.

Figure 2 provides examples of fertilizer placement options used for barley. Barley is frequently most responsive to seed-placed P followed by banded phosphate fertilizer in western Canada. Placing P fertilizers in bands minimizes the contact between the soil and the P fertilizer. In contrast, mixing the P with soil exposes it to more soil, resulting in reduced plant availability. Alberta research suggests that placement of P with the seed is frequently better than banded P, and both methods are superior to broadcast-incorporation of P fertilizer.

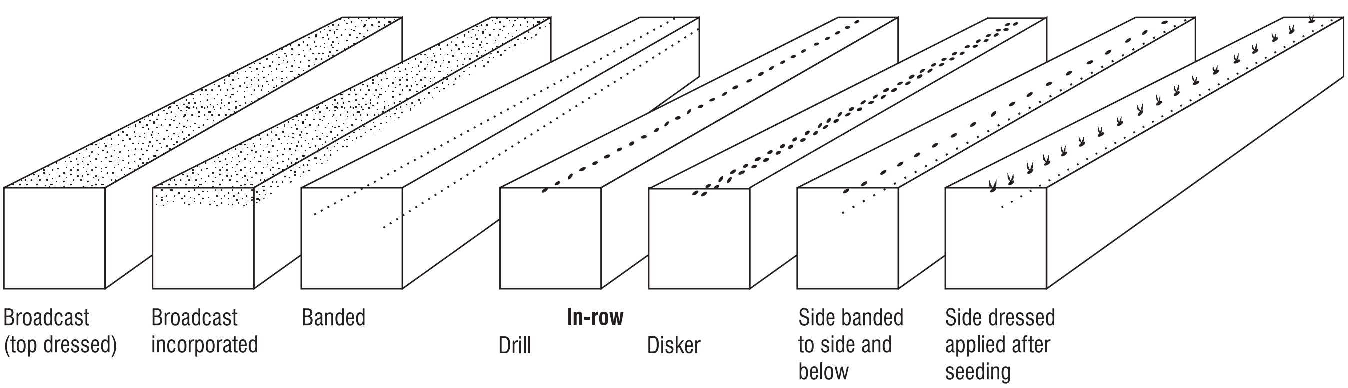

Figure 2. Various methods of phosphate fertilizer application
(McKenzie and Middleton 1997)

Table 4 compares barley response to seed-placed versus banded phosphate fertilizer in southern Alberta on summerfallow and stubble. Seed-placed P is recommended as it is an efficient means of P application, provided the amounts applied do not injure the germinating seed and seedlings. When higher rates of P are used in dry and/or coarse-textured soils, banding away from the seed at planting at times may be superior to placing phosphate with the seed.

To obtain P fertilizer efficiency, adequate rates of nitrogen and other nutrients must also be available to the crop.

Table 4. Response to seed-placed versus banded phosphate fertilizer in an Alberta study

	Barley	
	Fallow	Stubble
Number of sites	7	19
P responsive sites	6	13
Seed-placed P > banded P	4	8
Banded P > seed-placed P	1	0
Seed-placed P = banded P	1	5

(McKenzie and Middleton 1997)

A soil phosphorus calibration and response study with barley was conducted in Alberta from 1991 to 1993. The province-wide study found that barley responded to P fertilizer at 143 of 159 sites (90 per cent) (Table 5). The results indicated the importance of phosphate fertilizer in barley production throughout Alberta and suggested that approximately 80 per cent of Alberta soils were marginally to severely deficient in soil P depending on the interpretation of results. Responses were observed in all major soil zones across Alberta.

However, a more recent study in southern Alberta from 2001 to 2003 found only 4 of 14 sites (29 per cent) with malt barley responded to phosphate fertilizer. With frequent and continued use of phosphate fertilizer, residual levels of P in prairie soils have been gradually increasing, resulting in less frequent response of barley to P fertilizer.

Table 5 provides general phosphate fertilizer recommendations used in Alberta for barley. When soil test P levels are medium to high and significant P fertilizer has been applied in the past 10 to 20 years, an annual maintenance application of phosphate fertilizer can be used to meet crop requirements and replenish soil P that is removed. For greatest efficiency, phosphate fertilizer should be seed-placed with barley.

Table 5. Phosphorus fertilizer recommendations at various soil test levels using Kelowna or modified Kelowna method soil P

Soil phosphorus	Brown	Dark Brown	Thin Black	Black	Gray Wooded	Irrigation
(0 - 6")	(lb P_2O_5/ac)					
0 - 10	35	40	45	45	45	50
10 - 20	30	35	40	40	40	45
20 - 30	20	30	35	35	35	40
30 - 40	15	25	30	30	30	35
40 - 50	15	20	25	25	25	35
50 - 60	15	15	20	20	20	30
60 - 70	15	15	20	20	20	25
70 - 80	0	15	15	15	15	20
80 - 90	0	0	15	15	15	15
>90	0	0	0	0	0	0

(Adapted from McKenzie and Middleton 1997)

For more detailed information on phosphorus, refer to: Phosphorus Fertilizer Application in Crop Production, Agdex 542-3, available online at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex920

Potassium

Barley takes up nearly as much potassium (K) as nitrogen and therefore has a high potassium requirement. However, only 20 per cent of the K taken up is contained in the seed, while the remaining K in the leaves and stems is normally returned to the soil. The majority of western Canadian prairie soils have extractable soil K levels in the range of 400 to over 1,000 lb/ac in the top 0 to 15 cm.

Generally, barley response to K fertilizer has been limited when soil test levels are greater than 250 lb/ac. On fields that test less than 250 lb/ac, or on sandy soils or intensively cropped fields, K fertilizer may be required.

Potassium fertilizers are more efficient when seed-placed or banded. However, even small amounts of seed-placed potassium with barley may reduce germination and emergence. Therefore, if potassium is required, banding may be the better placement method.

The placement of small amounts (10 to 20 lb K_2O/ac) as potassium chloride fertilizer (0-0-60) in the seed-row is becoming an increasingly common practice on the western Canadian prairies. This practice has been adopted in response to some reports of the benefits of chloride fertilizer as being attributable to disease suppression. However, there is limited research to supports this practice.

General potassium fertilizer recommendations for barley on Alberta soils are summarized in Table 6.

On the Canadian prairies, potassium fertilizers have been used much less than nitrogen and phosphorus fertilizers, and therefore, much less research has been done concerning placement. Low rates of seed-placed potassium fertilizer have been an effective method of application. Side banding is also an efficient means of applying potassium, when higher K rates are needed. Generally, seed-placed or side banded potassium is considered best, versus broadcast, followed by incorporation.

For more detailed information on potassium, refer to: *Potassium Fertilizer Application in Crop Production*, Agdex 542-9, available online at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex917

Table 6. Potassium fertilizer recommendations for barley used using a 0.1N NHOAc solution to extract K

Soil potassium	Brown	Dark Brown	Thin Black	Black	Gray Wooded	Irrigation
(0 - 6”)	(lb K_2O/ac)					
0 - 25	100	105	110	115	115	120
25 - 50	95	100	100	105	105	110
50 - 75	85	90	90	95	95	105
75 - 100	75	80	80	85	85	95
100 - 125	70	75	75	80	80	85
125 - 150	60	65	65	70	70	80
150 - 175	55	60	60	65	65	70
175 - 200	45	50	50	55	55	60
200 - 225	35	40	40	45	45	50
225 - 250	30	35	35	40	40	40
250 - 275	20	25	25	30	30	30
275 - 300	20	20	20	20	20	20
>300	0	0	0	0	0	0

Sulphur

Barley has a relatively low requirement for sulphur (S). An 80 bu/ac barley crop (seed and straw) contains approximately 12 to 14 lb/ac of sulphur, of which only 50 per cent is in the seed. Sulphur deficiency occurs commonly on Gray Wooded soils and frequently on well drained, coarse to medium-textured Thin Black and Black soils.

Fertilizers, such as ammonium sulphate (21-0-0-24), which contain sulphate are most commonly used to correct S deficiencies. Generally, only small amounts of sulphur in the range of 10 to 15 lb/ac are required for adequate barley production on sulphur deficient soils.

The best placement is either with the seed or side banded near the seed. Sulphate-sulphur is quite mobile within the soil; therefore, broadcast or broadcast-incorporated application can be satisfactory under adequate moisture conditions and can even be used for in-crop application at early growth stages to correct S deficiency.

However, when dry conditions occur within the soil, even the soluble fertilizer can become stranded above the actively absorbing roots. Therefore, seed-placed or banded sulphate is normally superior.

For more detailed information on sulphur, refer to: *Sulphur Fertilizer Application in Crop Production*, Agdex 542-10, available online at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3526

Micronutrients

Early work on micronutrients in western Canada dates back to the 1960's and identified zinc (Zn), copper (Cu) and manganese (Mn) as potential problem micronutrients. Early work also identified organic (peat) soils as a primary target for micronutrient deficiencies.

Extensive work on the prairies in the early 1980's identified Cu as the most likely micronutrient to produce significant yield responses with barley in Saskatchewan. Researchers reported that 1.2 million ha of soil in Alberta were potentially Cu deficient. These soils are predominantly in the Black and Gray-Black transition soil areas of Alberta. A soil test level of < 0.5 ppm (parts per million) is considered to be potentially copper deficient. Copper deficiencies have also been identified on organic (peat) soils in Alberta.

Copper deficient soils tend to be either sandy or light loam soils with relatively high levels of organic matter (6 - 10 per cent). High levels of soil phosphorus or heavy applications of manure are often associated with a copper deficiency on these soils.

Barley is most sensitive to a copper deficiency. For more detailed information on micronutrients, refer to: *Micronutrient Requirements of Crops*, Agdex 531-1, available online at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex713 and *Copper Deficiency: Diagnosis and Correction*, Agdex 532-3, available online at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3476

Weeds and diseases

Weeds and weed control

Weeds can cause serious yield losses in barley, and control is essential to attain optimum yield and quality. Weeds compete with barley for light, nutrients and moisture. Barley yields are reduced when one or more of these factors is limiting.

Reduction in yield is proportional to the weed population in the crop. In some areas of the Canadian prairies, yields are still reduced by 15 to 20 per cent as a result of weed competition.

Wild oat is the most common weed in western Canada. Some of the more common weeds include wild buckwheat, lamb's-quarters, redroot pigweed, Russian thistle, cow cockle, shepherd's purse, green foxtail, stinkweed, Canada thistle, green smartweed, sow thistle, wild mustard and flixweed.

Weed seeds in barley grain can be responsible for major dockage and grade losses at market time. Excessive weed growth in silage barley can reduce the quality of the fodder and affect palatability. Malting barley with excessive amounts of certain weeds will not achieve malting grades. The cost of weed control must be balanced by the expected increase in return to the producer from an increase in crop production, both in the current year and in future years.

Herbicides are the primary means of controlling weeds commonly found in barley. Most recommended herbicides are relatively cost-efficient and are the only widely applicable means of controlling weeds. However, various preventative measures include using weed-free seed and weed-free machinery.

Physical control measures are used such as direct seeding to leave weed seeds on the surface. Cultural weed control methods include the use of crop rotations with forage crops or fall-seeded cereals to take advantage of weaknesses in the life cycle of existing weeds and thereby eliminate the pests. Increasing seeding rates and early seeding are other effective means used to increase crop competition with weeds.

For detailed information on registered herbicides available for barley refer to Agriculture and Rural Development's most recent issue of the publication *Crop Protection*, Agdex 606-1. This publication is not available online but can be purchased from the Alberta Agriculture and Rural Development Publications Office by calling, toll free, 1-800-292-5697. Also refer to the Alberta Agriculture and Rural Development website Herbicide Selector at: http://www.agric.gov.ab.ca/app23/herbsel

Diseases of barley

Barley diseases of the greatest significance in western Canada include common root rot, net blotch and scald. Fusarium head blight is becoming an increasing concern in Alberta (see: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/prm4518 and http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex92 and http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/faq7473). Most other barley diseases are normally of minor significance.

The use of diverse crop rotations to break disease cycles is recommended. Foliar fungicides can be used to help control fungal leaf diseases.

For more detailed information on barley diseases, refer to Diseases of Cereal Crops available online at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/prm8707?opendocument

For detailed information on registered seed treatments and in-crop fungicides available for barley, refer to the most recent issue of *Crop Protection*, Agdex 606-1. Also refer to the Alberta Agriculture and Rural Development website Fungicide/Insect Selector at: http://www.agric.gov.ab.ca/app100/loadMain

Insect pests of barley

The insect pests of greatest concern in barley are the prairie grain wireworm and cutworms (pale western cutworm and redbacked cutworm). Insects normally of minor concern include aphids, barley thrips and grasshoppers. In drier years on the southern prairies, grasshoppers are occasionally of significant concern. In 2006, a new insect pest, the cereal leaf beetle, was identified in southern Alberta; however, to date, it has not been a significant concern.

For detailed information on registered seed treatments and in-crop insecticides available for barley, refer to the most recent issue of *Crop Protection*, Agdex 606-1. Also refer to the Alberta Agriculture and Rural Development site Fungicide/Insect Selector at: http://www.agric.gov.ab.ca/app100/loadMain

Factors to consider to optimize barley production

In striving to achieve higher barley yield and quality, growers must focus on nutritional and agronomic management at a high level. Improved management techniques should include the following:

- Improved use of crop rotations to minimize the negative effects of leaf and root diseases and some insects.
- Shift to direct seeding barley to improve management of soil moisture and allow for shallow seeding (less than 5 cm) into a moist seedbed. Direct seeding will also improve soil conservation, reduce wind and water erosion, increase soil organic matter and tilth, and will minimize incorporation of weed seeds into soil. All these factors will aid in increased barley yield and quality.
- Appropriate seeding practices, including optimum seeding rates and dates, to achieve optimum yield and crop quality.
- Rapid adoption and use of new barley cultivars and the use of high quality pedigreed seed.
- Development and use of seed treatments to minimize the effect of seedling diseases and insect pests.
- Soil sampling fields yearly to evaluate soil nutrient status to develop optimum nutrient management plans.
- Side-band or mid-row band N fertilizer at the time of seeding at optimum rates to target optimum production and seed placement of phosphate fertilizer.
- Use of herbicides applied early to optimize weed control and minimize effects of weed competition on barley.
- Use of seed treatments for seedling disease and insect control.
- Use of fungicides, when necessary, to control foliar disease.

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