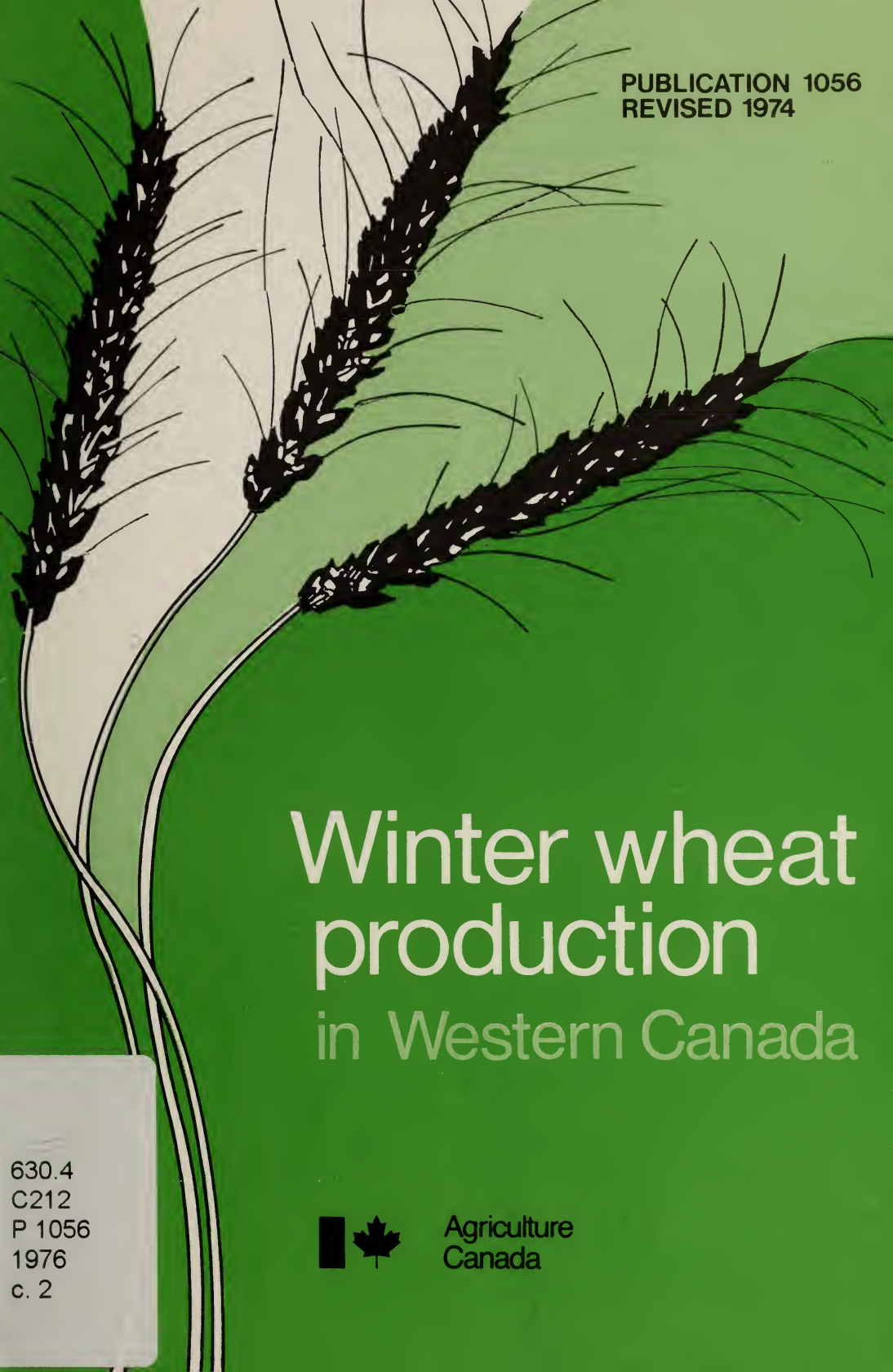

PUBLICATION 1056
REVISED 1974

Winter wheat production in Western Canada

Agriculture Canada

Copies of this publication may be obtained from
INFORMATION DIVISION
CANADA DEPARTMENT OF AGRICULTURE
OTTAWA
K1A 0C7

Printed 1959
Revised 1968, 1974
Reprinted 1975, 1976

8M – 8:76

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INTRODUCTION

Farmers have been growing winter wheat successfully in southern Alberta for over 65 years. They grow most of it in the southwestern corner of the province in an area bordered on the northeast by a line running through Foremost and High River. This area receives the greatest moderating effect from chinook winds. In Saskatchewan, winter wheat is grown successfully in a triangular area between Shaunavon, Val Marie, and Govenlock. Winter wheat is grown also in the intermountain valleys of southern British Columbia. It is possible to grow winter wheat in other areas of Western Canada but with much greater danger of winterkilling.

Winter wheat produced in Western Canada is marketed in the Alberta Red Winter grades. Millers abroad use it for bread flour, and in the export trade it competes with the American hard red winter wheats. In some years considerable quantities are used in Canada for cracker, cookie, biscuit, and pastry flour. The milling and baking quality has been improved by the shift to the variety Winalta.

Growing winter wheat offers the farmer many advantages:

- It often outyields spring wheat.
- Because of its earlier maturity, it suffers less from droughts that may occur during early summer.
- It eases the pressure of spring work and often saves one tillage of the land.
- It is usually cut about 2 weeks earlier than spring wheat, thereby helping to spread the use of harvest labor and machinery.

- Good stands protect the soil against wind and water erosion in the fall.
- It usually competes more successfully with wild oats and certain other weeds than spring-sown wheat does.
- It can provide some fall and early spring pasture.
- It is generally less subject to insect damage.

There are, however, a number of disadvantages:

- Winterkilling is one of the more important hazards. In the areas where winter wheat is best adapted, however, winterkilling has occurred less often than 1 year in 10. This hazard can be reduced by using hardy varieties and proper culture practices.
- Diseases and insect pests may cause severe losses but these may be reduced by proper control measures.
- Sparse fall growth will not protect against wind damage and weed problems.
- Failure to use proper cultural and control practices may result in complete loss of a crop.

VARIETIES

Four varieties of winter wheat, Sundance, Winalta, Kharkov 22 MC, and Yogo, are recommended for Western Canada. Westmont and Gaines are recommended only for British Columbia. Consult your local agricultural extension service for latest recommendations.

SUNDANCE — This hard red winter wheat, released from Lethbridge in 1971, is recommended for Western Canada. It is higher yielding than Winalta, more winter-hardy, equally resistant to shattering, slightly later and taller, and slightly lower in protein content. It is not resistant to wheat diseases common in Alberta or Saskatchewan.

WINALTA — Since its release from the Research Station at Lethbridge in 1961 this winter-hardy, bearded variety has become the most widely grown hard red winter wheat in Alberta. It is shorter strawed, earlier maturing, and more resistant to shattering than Kharkov 22 MC. In milling and baking quality it is superior to the other winter wheats, approaching the hard red spring wheats in this characteristic. It is not resistant to wheat diseases common in Alberta or Saskatchewan.

KHARKOV 22 MC — This variety is very winter-hardy and was widely grown in Alberta before Winalta was licensed. It is bearded, of medium height, more susceptible to lodging than most spring wheats, but more resistant to lodging than Yogo. It is moderately susceptible to shattering at maturity. It is not resistant to wheat diseases common in Alberta or Saskatchewan.

YOGO — It is slightly less winter-hardy and has weaker straw than Kharkov 22 MC. It is bearded, tall, and fairly resistant to shattering. It is resistant to many races of common bunt but not to dwarf bunt or other common diseases of winter wheat.

WESTMONT – This hard red winter wheat, resistant to many races of common and dwarf bunt but very susceptible to stripe rust, is suitable for production only in British Columbia. It is not hardy enough for southern Alberta. Westmont is of medium height, strong-strawed, bearded, and brown-chaffed.

GAINES – This variety is a soft white winter wheat, bearded, short-strawed, and resistant to lodging. It is not as winter-hardy as Winalta and Kharkov 22 MC but is suitable for the southern intermountain valleys of British Columbia. Gaines may be milled as a pastry flour, but its main use is expected to be as poultry and livestock feed. It is resistant to common bunt and most races of dwarf bunt, and has fair field resistance to stripe rust.

CULTURAL PRACTICES

SEEDBED PREPARATION

On fallow. Normal tillage with subsurface cultivators or one-way discs and packers generally makes a satisfactory seedbed for winter wheat. All weeds and volunteer grain should be killed at least 1 week before seeding to help control wheat streak mosaic. Where the soil is very loose, rod-weeding immediately ahead of the drill will produce a fairly firm seedbed. Loose, open soils tend to dry out and cause uneven germination and unthrifty seedling growth.

On stubble. It is possible and sometimes advisable to reseed stubble land to winter wheat if soil moisture is adequate for good germination and early growth.

Winter wheat may be seeded directly into clean mustard or rape stubble. Where it is to follow cereal grain or flax, use a good straw cutter and spreader on the combine when harvesting the preceding crop. If grain stubble is light as it is after a crop of less than 15 bu/ac (1 tonne/ha) and if there are no weeds, preseeding tillage is unnecessary, provided the seed drill selected can place the winter wheat seed into moist soil. Medium amounts of stubble, produced by 15 to 25 bu/ac crops (1 to 1.7 tonnes/ha) can be worked with a one-way discer, or heavy-duty cultivator followed by an oscillating harrow. On heavy stubble or trash, two strokes with disc-type implements followed by harrows may be necessary to produce a seedbed in which disc-type drills will operate properly (see "Seeding Equipment").

Winter wheat sown on stubble may suffer less winter damage than that sown on fallow because the stubble will protect it. Winter wheat seeded into wheat stubble, however, may become more severely infected with root rot and streak mosaic than when seeded on fallow (see "Important Diseases and Their Control").

DATE OF SEEDING

Seed during the first 2 weeks of September for best winter survival, highest yield, and best grade. At higher altitudes in the foothills where early frosts occur, seed during the first week of September. The effects of date of seeding on yield and winter survival are shown in Figure 1. Seeding before September increases the chance of infection with root rot, wheat streak mosaic, and rust. Plants from early

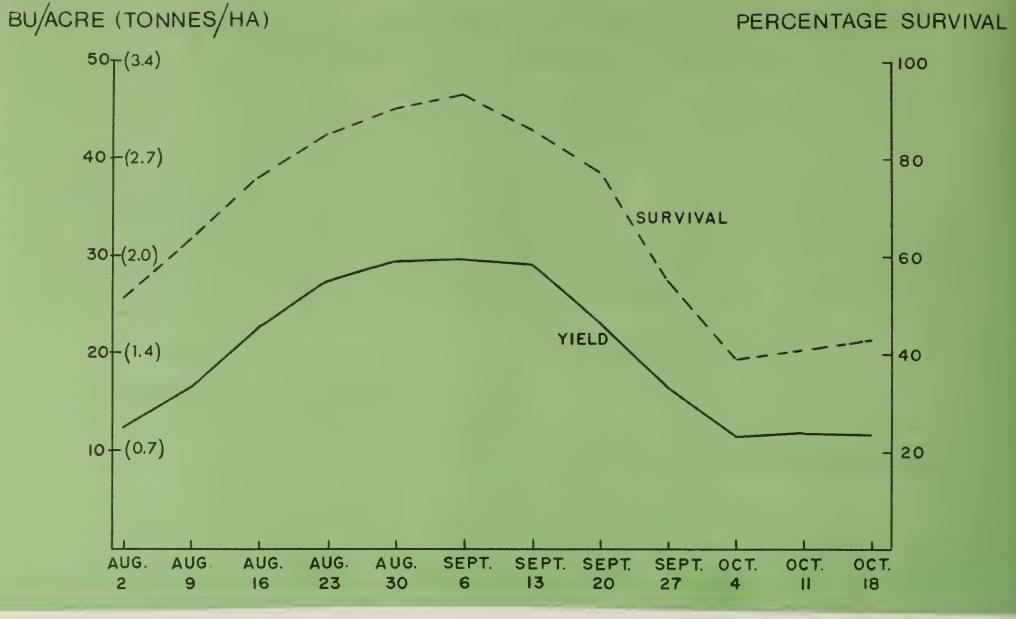

Figure 1. Effect of date of seeding on yield and winter survival of Kharkov 22 MC winter wheat grown on dryland. Lethbridge, Alberta, 1955-1963.

Figure 2. Effect of three depths of seeding on vigor of winter wheat plants sown on the same date on dryland.

seedings may be large enough to use as fall pasture but they often winterkill. Seeding after September 15 usually results in slow germination, patchy emergence, and too little top growth to prevent soil drifting. Plants from late seedings are more likely to winterkill than plants from seedings made during the first 2 weeks of September.

DIRECTION OF SEEDING

Since the prevailing winds on the western prairies are from the west, north-south rows give seedlings the best protection against wind. When soil moisture is limited, however, winter wheat seeded in east-west rows usually yields 2 to 3 bu/ac (135-200 kg/ha) more than that seeded in north-south rows. Greatest advantage may be taken of these factors by seeding diagonally from northwest to southeast.

DEPTH OF SEEDING

Seed 1 to $1^1/_2$ inches deep (25 to 40 mm) into firm, moist soil. Deeper seeding delays emergence and results in weakened plants that are more easily winterkilled (Figure 2). At depths of less than 1 inch (25 mm) the soil is often too dry for good germination and seedling growth. Where soil is dry to depths below $1^1/_2$ inches (40 mm) shallow seeding may be done with a furrow drill (see "Seeding Equipment").

RATE OF SEEDING

Seed at about the same rate as spring wheat. In the Brown soil zone use 50 to 60 lb of seed per acre (56 to 67 kg/ha). In the Dark Brown and Black soil zones where moisture is more plentiful use 60 to 70 lb of seed per acre (67 to 78 kg/ha).

SOIL PACKING

Normal soil compaction from proper seedbed preparation and from the packers on the seed drill is adequate for good winter wheat production. Supplementary packing is usually unnecessary.

SEEDING EQUIPMENT

Winter wheat should be seeded in a moist seedbed and covered with 1 to $1^1/_2$ inches (25 to 40 mm) of packed soil. Select a seeder that does this under the field condition that exists at seeding time.

The double-disc press drill can be used on fallow fields covered with a moderate trash cover [2,000 lb (2,240 kg/ha) or less per acre] if the soil is moist at the 2- to 3-inch depth (5 to 7.5 cm). Seeding winter wheat with a double-disc opener into dry soil often causes uneven germination, unthrifty seedling growth, and reduced yield. The hoe opener, arranged on a press wheel carriage to provide 7-inch spacing (18 cm), handles slightly more trash cover than the double-disc opener. The staggered, three-gang arrangement of the hoe openers provides trash clearance and a moderate furrow-seeding action.

The furrow drill does an excellent job in a seedbed that is dry to a depth of about 4 inches (10 cm). The staggered gang arrangement of the openers aids furrow formation and, hence, proper seed placement when surface soil is dry. The furrow drill seeds through heavy trash cover (3,000 to 4,000 lb/ac) (3,360 to 4,480 kg/ha). The furrow ridges provide more protection from soil drifting than those left by a double-disc opener. Furrow drills should not be operated at high speed, for this may cover the seed with too much soil.

Two types of furrow drill are used for seeding winter wheat. The semideep-furrow drill, equipped with hoe openers, lister-shovel openers, or larger single-disc openers, has row spacings of 9 or 10 inches (23 or 25 cm). The deep-furrow drill is usually equipped with wide lister-shovels but hoe or large single-disc openers also have been used. Deep-furrow drills place the seed in rows 12 to 14 inches apart (30 to 35 cm). Press wheels are used on furrow drills to maintain the shape of the furrow and to pack the soil over the seed. Average yields of winter wheat seeded on fallow with three types of drill at Lethbridge, Alberta, for 11 years, are given in the following table.

Type of seed drill	Yield	
	(bu/acre)	(kg/ha)
Semideep-furrow (hoe openers in 9-inch rows) (23 cm)	29.3	26.37
Deep-furrow (lister openers in 14-inch rows) (35 cm)	28.3	25.47
Double-disc press (7-inch rows) (18 cm)	28.0	25.20

The results of these trials showed some advantage for the use of the furrow drill. Compared with double-disc seeding at 7-inch spacing (18 cm), furrow seeding at 9- and 14-inch spacing (23 to 35 cm) provided better initial plant stands in 3 years when seedbeds were dry, better protection from drifting soil in 2 years, and better protection from winterkilling in 2 years. These occurrences resulted in a yield advantage in 3 years out of 11 for furrow seeding and in 1 year out of 11 for double-disc seeding. Deep-furrow seeding (14-inch rows) (35 cm) provided no advantage over semideep-furrow seeding (9-inch rows) (23 cm).

It is recommended that regular producers of winter wheat, particularly those in the drier regions, use one of the furrow drills. Farmers who occasionally grow winter wheat can use the double-disc press drill with confidence if the seedbed is suitably prepared.

EROSION PROTECTION WITH COVER CROPS

Seeding into a cover crop, particularly on sandy soils, protects winter wheat against damage from soil erosion. A heavy growth of cover crop, however, usually reduces the yield of winter wheat. If the cover crop is not to be used for fall pasture, do not seed it until early August and space the rows up to 3 feet (0.9 m) apart. Oats are better than wheat or barley as a cover crop because they reduce the

yield of winter wheat less, and harbor fewer diseases injurious to winter wheat. When seeding the winter wheat, apply fertilizer to help overcome the yield-reducing effect of the cover crop.

GRAZING

Livestock may fall-graze winter wheat provided enough plant cover is left to protect the soil from erosion. Crops on fine sandy loam soils, which erode easily, should be grazed cautiously. To prevent damage to soil and plants do not let stock graze on soft or wet fields. Do not spring-graze winter wheat.

USE OF FERTILIZERS

Winter wheat usually responds to applications of commercial fertilizers. Since response depends on the location, soil moisture, and cropping history of the soil, soil tests for available plant nutrients should be made regularly to determine the best fertilizer program.

On fallow land in the Dark Brown and Black soil zones winter wheat generally responds well to phosphate fertilizers applied at seeding time at rates of 20 to 40 lb P_2O_5 per acre (22 to 45 kg/ha). More phosphate will be needed on eroded or drifted soils than on noneroded ones.

Some fallow fields also need additional nitrogen. Early spring applications of 30 to 40 lb nitrogen per acre (33 to 45 kg/ha) have been profitable on heavy cold soils, eroded soils, and those carrying a heavy mantle of trash.

Nitrogen applied on fallow land at rates of more than 40 lb/ac (45 kg/ha) may delay maturity by 7 to 10 days.

Winter wheat seeded into stubble land or cover crop should usually be fertilized with 30 to 40 lb nitrogen per acre (33 to 45 kg/ha). Broadcast the fertilizer on the field before or after seeding. Do not apply it with the seed at seeding time.

Stubbled-in winter wheat on eroded fine sandy loam soil in the Dark Brown soil zone should receive 20 to 40 lb (22 to 45 kg/ha) phosphorus (P_2O_5) at seeding time in addition to the nitrogen.

CHEMICAL WEED CONTROL

Winter wheat should be treated in early spring with 2,4-D or MCPA at the rates recommended for spring-sown grain. Do not treat in fall, or in late spring when the crop has reached the shot-blade stage.

HARVESTING

Shattering in some varieties of winter wheat may cause heavy losses. These losses can be reduced by swathing the grain before it is too ripe. Winter wheat may be swathed as soon as most of the kernels are in the late dough stage (30 to 35% moisture). Some of the straw will have a definite greenish hue at this stage but the kernels, which can just be squashed between the fingers and thumb, will be a light golden color.

If swathing is delayed beyond this stage, it is probably more economical to harvest by straight combining.

IMPORTANT DISEASES AND THEIR CONTROL

COMMON BUNT

Common bunt is caused by fungi that are members of the smut family. These fungi can infect winter and spring wheats.

Bunt spores, the "seeds" of the fungi, are carried on the surface of wheat kernels and are sometimes found on the soil. They germinate and penetrate the developing wheat seedlings. The fungus does not greatly affect the appearance of the immature wheat plant. As the plant matures, however, bunt balls filled with black spores form instead of kernels. Many of these bunt balls are broken during threshing and the spores are scattered over the surface of the grain and on the soil. Heavily infested grain has an unpleasant fishy odor. These spores cannot survive in the soil over winter.

Control common bunt by seed treatment, and by use of the resistant varieties, Yogo, Westmont, or Gaines.

DWARF BUNT

Dwarf bunt is very similar to common bunt. The organism causing dwarf bunt, however, can live in the soil for several years. It infects only fall-sown wheat. Plants with dwarf bunt are usually more stunted than those with common bunt. Seed treatment does not control dwarf bunt, but it helps prevent the spread of dwarf bunt spores from seed grain to noninfested soils.

To control dwarf bunt, avoid cropping infested land with winter wheat for 3 years. Treat seed with hexachlorobenzene to kill seed-borne spores. The varieties of winter wheat recommended for the prairies are not resistant to dwarf bunt.

COMMON ROOT ROT

Fungi of common root rot can infect plants throughout the growing season. Infected plants have a brown discoloration of the lower leaf sheaths, stem bases, crowns, and roots. They are short and have few tillers and small heads. Infection in the spring may arise from contaminated seed, but more often it is caused by spores in crop residues and in the surface layer of the soil. Crops sown before September 1 are more subject to root rot than those sown later. Losses from root rot are intensified by hot dry weather. Wheat with root rot is more subject to winterkill.

To control root rot, grow resistant crops such as mustard, flax, or legumes in the rotation. Avoiding susceptible crops for 2 years will reduce the population of the pathogen. Treat seed with a fungicide and sow during the first 2 weeks of September.

TAKE-ALL ROOT ROT

The take-all root rot fungus lives in diseased crop refuse and attacks seedling wheat. The disease occurs on scattered plants or in patches of plants in the Black and Dark Brown soils. Diseased plants are stunted and usually have white heads that are empty or contain only shrunken kernels. The roots are shiny black and so brittle that the plants are easily pulled up.

To control take-all, grow a resistant crop such as oats, or fallow the land for 1 year. Maintain soil fertility at a high level.

WHEAT STREAK MOSAIC

Wheat streak mosaic is caused by a virus. Infected plants have light-green to yellow streaks on the leaves and are often severely stunted. In June, severely infected fields have a yellow to bronze appearance, which is usually most noticeable on the windward side. The virus is spread by the wheat curl mite, which is 1/100 inch long (0.25 mm) and is carried by the wind. Both mite and virus need a continuous supply of live plants, mainly wheat, to survive.

To control the disease, destroy infected green wheat or barley at least a week before seeding. Winter wheat should not be sown beside a mosaic-infected crop

Figure 3. Relative damage by streak mosaic to winter wheat seeded about September 1 (at left) and about August 1 (at right) adjacent to a wheat crop diseased with streak mosaic.

until the crop is mature. Seed between September 1 and September 15. Wheat sown earlier is much more prone to damage by the disease, as shown in Figure 3. No resistant variety of wheat or suitable chemical control is available.

LEAF AND STEM RUST

Occasionally winter wheat may be severely infected with leaf rust, or stem rust, or both. Infection may occur in fall or summer. Crops sown early are more subject to infection in the fall than those sown late. On the other hand, crops sown late are more subject to infection in the summer than those sown early. Severe infection in the fall may weaken the plant. Rust is not known to survive the winter on wheat on the prairies. Rust seldom causes much damage to winter wheat in summer since the crop usually matures before the disease becomes severe.

To reduce damage from rust, seed during the first 2 weeks of September. The varieties of winter wheat recommended for this area are not resistant to stem or leaf rust.

STRIPE RUST

Stripe rust is often severe in British Columbia but it seldom occurs in the Prairie Provinces. It may infect wheat in the fall or the following spring. Yellow stripes appear on the leaves, leaf sheaths, and heads. The disease is favored by cool, wet weather and a mild winter. In British Columbia the causal fungus overwinters on winter wheat and native grasses. The use of resistant varieties is the only practical means of control. Gaines wheat is fairly resistant to stripe rust.

SEED TREATMENT

A good seed treatment should destroy pathogenic organisms on the seed and protect the young seedlings from them in the soil. Fungicides are obtainable as liquids or as powders. Fungicides prepared for application in drill boxes appear to be satisfactory. An insecticide may also be applied if wireworm damage has been evident.

Clean the seed before treating. Fungicides are poisonous, so handle them carefully. Follow the manufacturer's directions precisely. Do not feed treated grain or sell it for other than seed.

INSECT PESTS

Since new insecticides appear frequently, recommendations are not included in this publication. Obtain current recommendations for various insecticides from your local agricultural extension services.

APHIDS

Although aphids may appear in large numbers on the heads of wheat in late summer, they can be safely ignored. Newly emerged winter wheat may become

infested in the fall, but unless the aphids are extremely numerous do not attempt to control them with chemicals.

CUTWORMS

Army cutworms may attack winter wheat, but their damage is usually limited to small patches in the field.

Pale western cutworms also attack winter wheat, but the damage is usually less than in spring wheat. This is because the winter wheat is well past the seedling stage before the cutworms are large enough to cause serious damage.

Where an outbreak of pale western cutworm is forecast, do not work the land during August or early September and delay seeding until mid-September. This will reduce egg laying by cutworm moths.

Insecticides can be used to control cutworms.

GRASSHOPPERS

Adult grasshoppers often move to the new growth of winter wheat after other crops have matured. Therefore, a few grasshoppers spread through stubble or mature crops can become a serious threat when concentrated at the edge of a new crop. Because stubble shelters grasshoppers, it often becomes a source of continued infestations.

If noticeable numbers of grasshoppers are found at the time of seeding. they should be controlled in adjacent stubble and headlands before the crop emerges. If control is required after the crop emerges, an insecticide should be applied as far into the crop as required as well as into the stubble. More than one application may be needed.

HESSIAN FLIES

Hessian flies occasionally damage winter wheat but seldom in the same field for more than 1 year. No control is recommended.

This fly has two generations, one in early May that destroys the main shoot and a second in June that weakens the stem at the second or third internode. The mature larva, which is found inside the leaf sheath, resembles a large flax seed.

WHEAT STEM SAWFLIES

Sawflies seldom damage winter wheat, but they may do so in years when the sawfly flight is early. Where sawflies are a problem, resistant spring wheat such as Cypress should be grown for 1 or 2 years to reduce the infestation. Oilseed crops and oats are immune.

Early swathing reduces losses from fallen heads but does not prevent yield reduction caused by the sawflies feeding in the stems. Swathing should be delayed until the sawflies just begin to cut, at which time the kernels contain 40% moisture. Infestations are usually heaviest at the margins of the field; therefore, one or two rounds with the swather are often enough.

WIREWORMS

Most damage occurs in the spring as wireworms normally move deep in the soil in late August, before the crop is sown. Winter wheat can withstand heavier infestations than spring wheat because it is better established in the spring when the wireworm attack occurs. Treating winter wheat seed with insecticide is of doubtful value. It is better to reduce the wireworm population of a heavily infested field by cropping it with treated spring wheat.

CONVERSION FACTORS FOR METRIC SYSTEM

Imperial units	Approximate conversion factor	Results in:	
LINEAR			
inch	x 25	millimetre	(mm)
foot	x 30	centimetre	(cm)
yard	x 0.9	metre	(m)
mile	x 1.6	kilometre	(km)
AREA			
square inch	x 6.5	square centimetre	(cm^2)
square foot	x 0.09	square metre	(m^2)
acre	x 0.40	hectare	(ha)
VOLUME			
cubic inch	x 16	cubic centimetre	(cm^3)
cubic foot	x 28	cubic decimetre	(dm^3)
cubic yard	x 0.8	cubic metre	(m^3)
fluid ounce	x 28	millilitre	(ml)
pint	x 0.57	litre	(ℓ)
quart	x 1.1	litre	(ℓ)
gallon	x 4.5	litre	(ℓ)
bushel	x 0.36	hectolitre	(hl)
WEIGHT			
ounce	x 28	gram	(g)
pound	x 0.45	kilogram	(kg)
short ton (2000 lb)	x 0.9	tonne	(t)
TEMPERATURE			
degrees Fahrenheit	($^\circ$F-32) x 0.56 or ($^\circ$F-32) x 5/9	degrees Celsius	($^\circ$C)
PRESSURE			
pounds per square inch	x 6.9	kilopascal	(kPa)
POWER			
horsepower	x 746	watt	(W)
	x 0.75	kilowatt	(kW)
SPEED			
feet per second	x 0.30	metres per second	(m/s)
miles per hour	x 1.6	kilometres per hour	(km/h)
AGRICULTURE			
gallons per acre	x 11.23	litres per hectare	(ℓ/ha)
quarts per acre	x 2.8	litres per hectare	(ℓ/ha)
pints per acre	x 1.4	litres per hectare	(ℓ/ha)
fluid ounces per acre	x 70	millilitres per hectare	(ml/ha)
tons per acre	x 2.24	tonnes per hectare	(t/ha)
pounds per acre	x 1.12	kilograms per hectare	(kg/ha)
ounces per acre	x 70	grams per hectare	(g/ha)
plants per acre	x 2.47	plants per hectare	(plants/ha)