Welcome to the Nebraska Wheat Board Wheat Production Handbook. We have integrated research from various sources to produce an easy-to-use guide that can help you manage your crop more efficiently. Wheat is an important commodity in Nebraska, with farmers producing an average of 74 million bushels annually. The grain has sustained family farms in the state for generations and filled consumer needs across the globe with a consistently high-quality product. It has also helped to define Nebraska as a flourishing agricultural mainstay in the United States and around the world. Wheat has tremendous potential to return a profit to your farm, and the work of the Nebraska Wheat Board will only improve that potential over time.

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Designed By: Cody Felber,
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Contents

The Benefits of Wheat in Your Crop Rotation

There are several agronomic advantages when considering adding wheat into your crop rotation. The period when winter wheat needs the most water, the flowering and early grain-fill stage, coincides with the time of year when most areas normally receive the most rain, May and June. As a result, winter wheat usually produces a crop when irrigation is limited. Most of the groundwater-irrigated land will be subject to allocations of 14 to 16 inches of water for at least the next several years.

Winter wheat also can adapt to varying amounts of precipitation.

Wheat has a lot of ways to make grain and will provide at least half a crop even in the worst years. It also works well in rotation with other crops because its peak water need falls earlier than most summer crops now grown in irrigated rotations. During the growing season, winter wheat is very competitive with warm-season weeds. By the time these weeds come on, winter wheat already has developed enough of a canopy to block the sunlight from reaching the weeds.

Introducing wheat into more traditional irrigated crop rotations is advantageous with farmers' existing schedules and workloads. Winter wheat can spread the workload for producers of irrigated row crops. It is planted in September, following dry bean harvest.

Winter wheat also will fit into double-crop and relay-crop rotation systems. Under irrigated conditions, a forage crop can be planted following wheat harvest in July, enabling a farmer to produce two crops in one year.

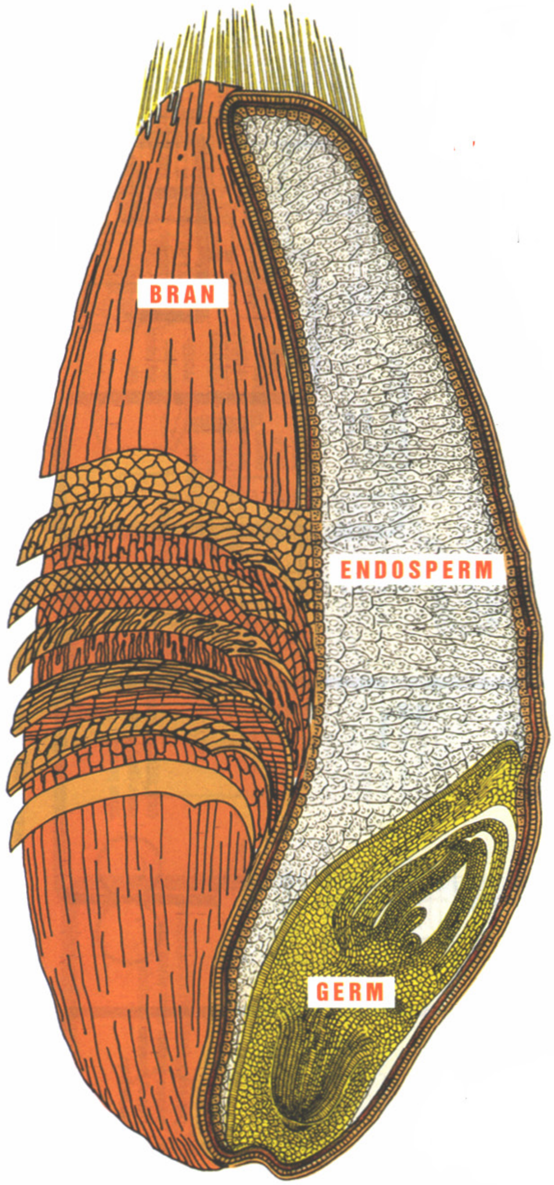
Converting the traditional three-year crop rotation (dry beans/sugar beets/corn) into a four-year rotation by adding winter wheat also has advantages. Sugar beets are susceptible to soil-borne disease; it's good to allow an additional year between one sugar beet crop and the next.

Residue management is another advantage. Winter wheat produces a good amount of useful and resilient crop residue. Many farmers have begun harvesting with stripper headers on combines, which removes only the heads and leaves behind the remainder of the plant. This stubble has a higher silhouette factor than other crops, better protecting the soil from wind erosion. During the winter, it is effective in trapping snow, thus increasing soil moisture.

At the University of Illinois, a team of researchers found that having wheat in the crop rotation helps increase the yield of corn and soybean crops that follow.

A recent three-year summary of the results showed that corn grown in a three-crop rotation (soybean/wheat/corn) yielded 4 percent more than corn in a corn/soybean rotation. Corn in a wheat/soybean/corn rotation produced 6 percent higher yields. Meanwhile, soybeans in both three-crop rotations yielded 4 percent more than soybeans in the corn/soybean rotation.

For producers considering adding wheat to their rotation, late July or early August is the time to think about which variety is best. Nebraska Crop Improvement Association (http://www.unl.edu/ncia/) offers a seed guide that can assist you in picking a variety that is best for you. You may contact the Nebraska Wheat Growers Association for more information on membership and getting started in wheat production at newheatgrowers@gmail.com.



A Kernel of Wheat

The Kernel of Wheat is sometimes called the wheat berry. The kernel is the seed from which the wheat plant grows. Each tiny seed contains three distinct parts that are separated during the milling process to produce flour.

The **Endosperm** makes up about 83 percent of the kernel weight and is the source of white flour

The **Bran** is about 14.5 percent of the kernel weight. Bran is included in whole wheat flour and can also be bought separately.

The **Germ** is about 2.5 percent of the kernel weight. The germ is the embryo or sprouting section of the seed, often separated from flour in milling because the fat content limits flour's shelf-life.

Glossary

Ash Content indicates milling performance and how well the endosperm separates from the bran. Ash content can affect flour color. White flour has low ash content, which is often a high priority among millers, because consumers prefer white flour.

Damaged Kernels are the kernels which may be undesirable for milling because of disease, insect activity, frost or sprout damages.

Dockage is the percentage of wheat, measured by weight, easily removed from a wheat sample using the Carter Dockage Tester.

Foreign Material is any material other than wheat that remains after dockage is removed. Because foreign material may not be removed by normal cleaning equipment, it may have an adverse effect on milling quality.

Moisture Content is an indicator of grain condition and store ability. Moisture content is often standardized (12 or 14 percent moisture basis) for other tests that are affected by moisture content. Lower moisture levels are desired to prevent spoilage in storage.

Protein Content relates to many important processing properties, such as water absorption and gluten strength, and to finished product attributes such as texture and appearance. Higher protein dough usually absorbs more water and takes longer to mix. Hard Red Winter wheat generally has a medium to high protein content, making it suitable for all-purpose flour and yeast raised flour foods.

Shrunken and Broken Kernels are the kernels which were either insufficiently filled during the growing season and as a result have shrunken and shriveled appearance or have been broken in handling. Such kernels may reduce milling yield.

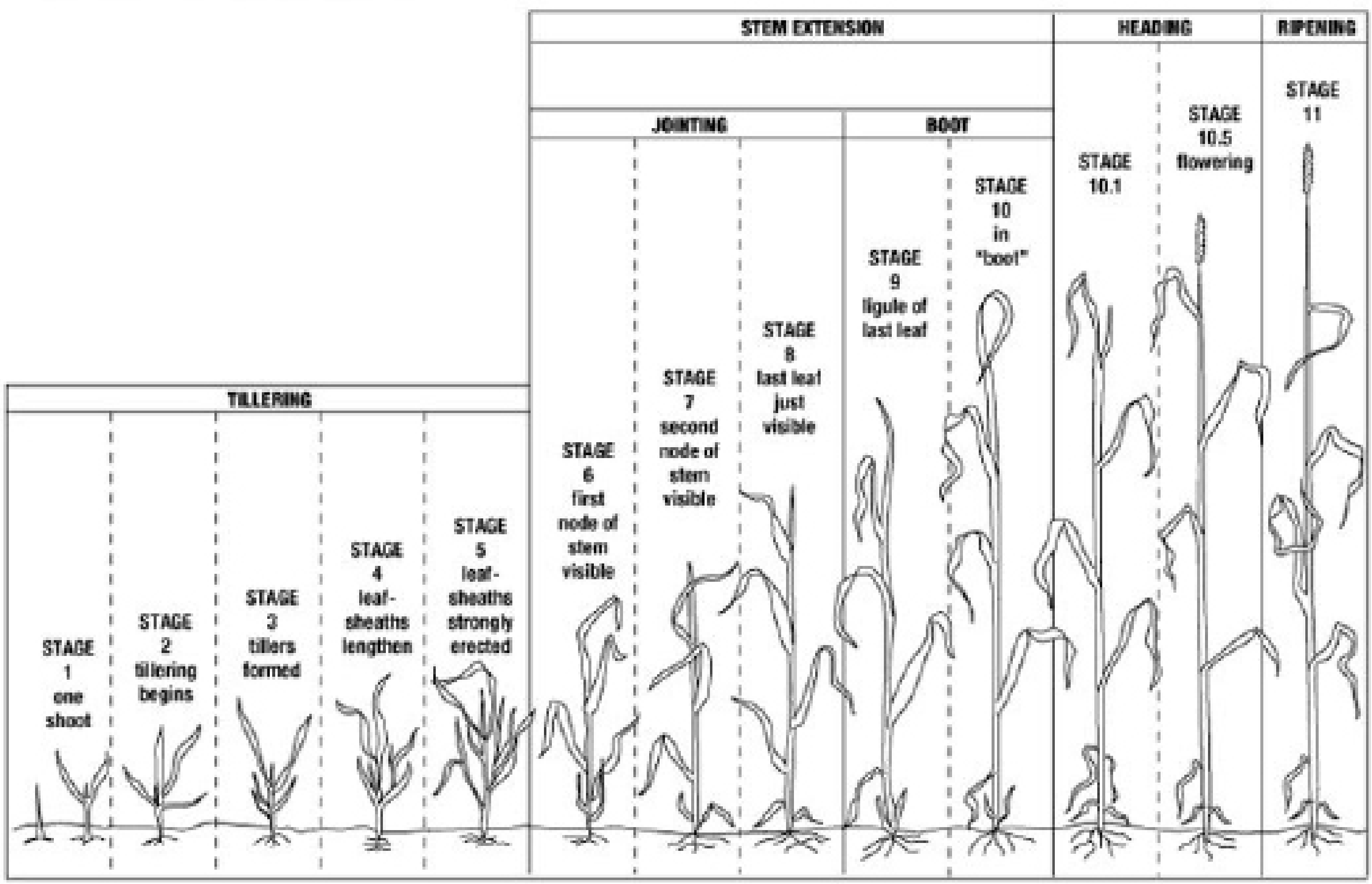
Thousand-kernel weight and kernel diameter provide measurements of kernel size and density important for milling quality. Millers tend to prefer larger berries or at least berries with a consistent size.

Total Defects is the sum of damaged kernels, foreign material and shrunken and broken kernels.

Whole Wheat products are made with the whole wheat kernel. The bran (outer layer) contains the largest amount of fiber (insoluble), B vitamins, trace minerals and a small amount of protein; the endosperm (middle layer) contains mostly protein and carbohydrates along with small amounts of B vitamins, iron and soluble fiber; and the germ (inner part) is a rich source of trace minerals, unsaturated fats, B vitamins, antioxidants, phytochemicals and a minimal amount of high quality protein.

Wheat Growth Stages

Being able to determine the growth stage of wheat is important in deciding cultural practices during the season. Fertilizers, pesticides and other chemicals should or should not be applied at certain points during the plant's life. By understanding what stage the plant is in, you can determine the correct cultural practices.



Nebraska Certified Seed

Certification Requirements

Membership- Any person, partnership, or corporation who intends to produce and/or condition certifiable seed or vegetative plant materials within the state must become a member. Each member must comply with all applicable certification procedures and standards, Nebraska Seed Law and Federal Seed Act requirements.

1. Land Requirements

A. For white wheat an eligible field cannot have produced a white wheat variety for a period of one year unless it was certified seed of the same variety, or used a red wheat variety for two years. For red wheat an eligible field cannot have produced a wheat crop for a period of one year unless certified seed of the same variety was used. A longer interval is recommended if the following conditions persist.

1) In areas of lower rainfall where seeds may remain dormant under fallow conditions.
2) When seed crop to be grown is to follow a crop whose seeds can not be separated thoroughly during conditioning (e.g., wheat in barley, rye or triticale in wheat, barley in oats).
3) Any other cultural practices or typical climatic conditions which enable seed dormancy or seed mixtures.

B. As an additional precaution, no amendments or materials which could be a source of contaminating seeds shall be applied to the field during establishment or any time of the growing season.

2. Field Inspection

Each field shall be inspected by a representative of the N.C.I.A. at least once after the plants are fully headed and before harvest when varietal mixtures and other quality factors can best be determined. Additional inspections may be required at the discretion of the certifying agency.

A. Isolation Requirements

1) **Red wheat, white wheat and triticale-** A certifiable field of either red wheat, white wheat or triticale shall be not less than 20 feet from any field of rye not harvested before bloom. Isolated rye plants shall be subject to the five foot boundary requirement.

2) **Red Wheat and triticale-** To minimize outcrossing, a field planted for the production of the Foundation seed class should be not less than 20 feet from any other variety of wheat or triticale in bloom at the same time with a visible break between varieties. A field for the production of the Registered or Certified class seed should be separated from other varieties of the same crop type by either an uncropped strip 10 feet wide or a 10 foot wide strip equally divided between the two varieties shall be discarded at the time of harvest.

3) **White Wheat-** To minimize out crossing and contamination, a field planted for the production of the Foundation and Registered seed should not be less than 30 feet from any red wheat. Certified seed fields must be located no less than 20 feet away from red wheat. A field planted for the production of the Foundation seed class should be not less than 20 feet from any other variety of white wheat in bloom at the same time with a visible break between varieties. A field for the production of the Registered or Certified class seed should be separated from other white wheat varieties by either an uncropped strip 10 feet wide or a 10 foot wide strip equally divided between the two varieties shall be discarded at the time of harvest.

Nebraska Weed Free Forage Certification Program

Where is Certified Forage Required?

Public and provincial lands that require Weed Free Forage:

-U.S. Forest Service
-Bureau of Land Management
-National Parks and Monument
-Bureau of Reclamation
-Military Reservations
-Tribal Lands
-National Fish & Wildlife Refuges

The Nebraska Department of Roads is requiring certified weed free forage on highway projects. Restrictions may apply to other lands administered by provincial, county, state, or federal agencies. Contact your County Weed Superintendent for current certification information.

Who Should Purchase and Promote Certified Forage?

-Producers and Consumers committed to keeping private and public lands free of noxious weeds.

-Forage Buyers who transport forage products across national, state and county boundaries.

-State and Federal agencies which feed livestock and wildlife on federal, state or private lands or initiate re-vegetation projects.

How is Forage Certified?

Contact the weed superintendent in your county to make an inspection ***prior to harvesting***. Certification is based on a thorough visual inspection. A "Certificate of Inspection" form is issued to the producer/landowner if the crop meets the North American Weed Management Association requirements. The forage certification includes surrounding ditches, fence rows, roads, and easement, right-of-way or buffer zones surrounding the outside edge of the crop.

For more information regarding Weed Free Forage Certification, contact:

Nebraska Weed Control Association
2807 West 2nd Street
Grand Island, NE 68803
Ph: 308-385-5097

Calculations and Conversions

Township = 36 sections, each 1mi^2
Section = 640 acres
Quarter section = half a mile square (160 acres)
Eighth section = half a mile long, north and south, and a quarter of a mile wide-80 acres
A sixteenth section = a quarter mile square (40 acres)
The sections are all numbered 1 to 36, commencing at the northeast corner.

An acre contains 4,840 yd^2, or 43,560 ft^2. A square acre measures 208.71 ft on each side.

Land Measure

To find the number of acres in a body of land, multiply the length by the width and divide the product by 160. When the opposite sides are unequal, add them, and take half the sum for the mean length or width.

Common Measure

Long Measure

12in. = 1ft.
3ft. = 1yd.
5.5yd. = 1rod
320rods = 1mi.
1mi. = 5,280ft.

Square Measure

144in^2 = 1ft^2
9ft^2 = 1yd^2
30.25yd^2 = 1rod^2
160rod^2 = 1 acre

$4{,}840yd^2$ = 1 acre
$43{,}560ft^2$ = 1 acre
640 acres = 1mi
An acre is equal to a square whose side is 208.71 ft.

Dry Measure

2pt = 1qt
8qt = 1 peck
4 pecks = 1bu
1bu. contains $231in^3$ or approximately $1.25ft^3$.

Liquid Measure

4 gills = 1pt
2pt = 1qt
4qt = 1ga
1ga contains $231in^3$.
$1ft^3$. equals 7.5ga.

Cubic Measure

$1728in^3 = 1ft^3$
$27ft^3 = 1yd^3$
$128ft^3$ = 1 cord
$40ft^3$ = 1 ton (shipping)
$2{,}150.42in^3$ = 1 standard bu.
$231in^3$ = 1 U.S. standard ga.
$1ft^3$ = about 4/5 of a bu.

Metric Measurements

Length

1 mm = 0.039in
1 cm = 0.393in
1 m=3.281ft; 1.093yd

1 km = 0.621mi
1in = 25.4mm; 2.54cm
1ft = 0.305m; 30.48cm
1yd = 0.914m; 91.4cm
1mi = 1.609km; 1609m

Area

1cm^2 = 0.155in^2
1m^2 = 10.764ft^2; 1.196yd^2
1ha = 2.471 acres
1km^2 = 0.386mi^2; 247.11 acres
1in^2 = 6.45cm^2
1ft^2 = 0.093m^2; 929cm^2
1yd^2 = 0.836m^2; 8361cm^2
1 acre = 0.405 hectare; 4047m^2
1mi^2 = 2.589km^2; 258.9 hectares

Mass

1g = 0.035oz
1kg = 2.205lbs
1 metric ton (1000 kg) = 2,205lbs
1oz = 28.35g
1lbs = 0.454kg
1 ton (2,000 lbs) = 0.907 metric ton
1 tonne = 1,000kg
1 tonne = 2,204.6lbs

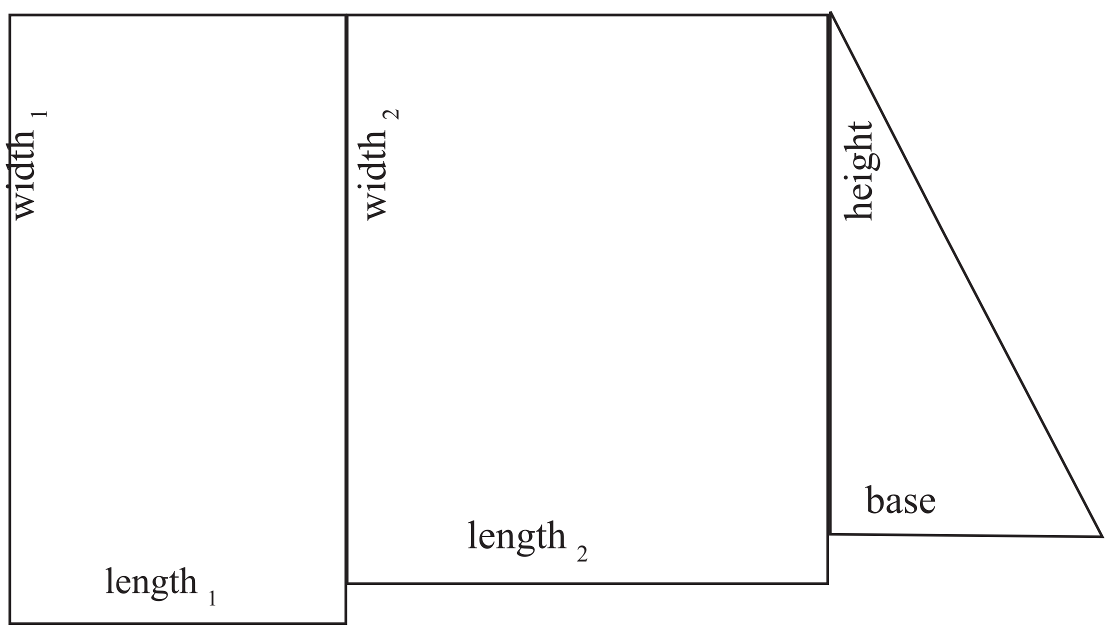
Velocity

1km/hr = 0.621mi/hr
1mi/hr = 1.609km/hr

Power

1(k W=1.341 horsepower
1 horsepower=0.746 (k W)

Reduce irregularly shaped areas to a combination of rectangles, circles and triangles. Calculate the area of each and add them together to get the total area.



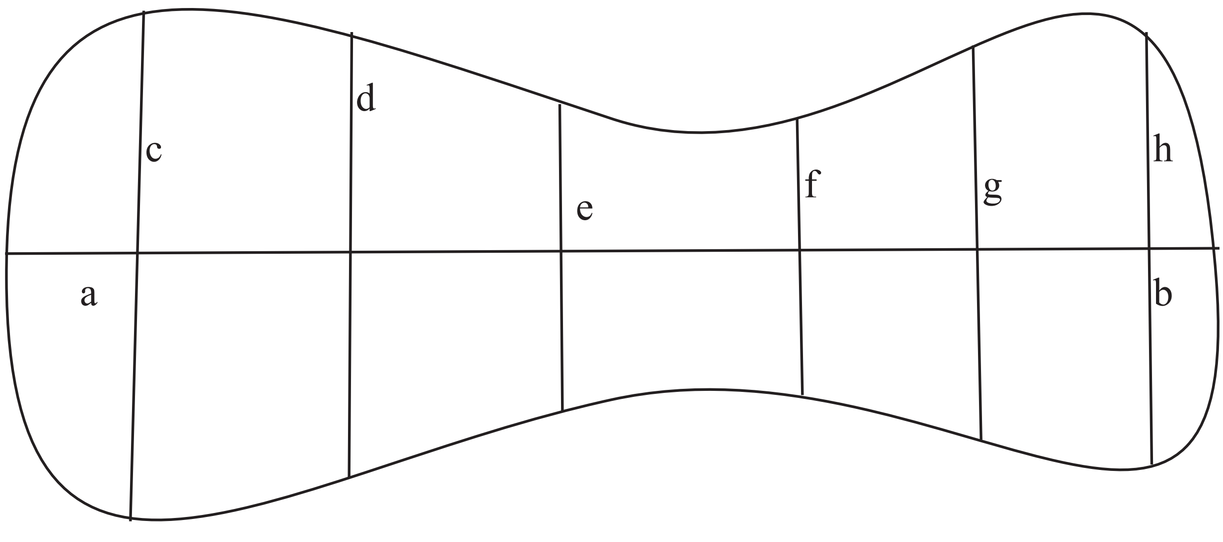
Example: If b=25’, h=25’, L_1=30’, W_1=42’, L_2=33’, W_2=31’, then the equation is:

Area= $((b \times h) / 2) + (L_1 \times W_1) + (L_2 \times W_2)$

$=((25 \times 25) / 2) + (30 \times 42) + (31 \times 33)$

= 2595 sq. ft.

Another way to calculate area is to draw a line down the middle of the property for length. Measure from side to side at several points along this line. Use the averages of these values as the width. Calculate the area as a rectangle.



Example: If ab=45’, c=19’, d=22’, e=15’, f=17’, g=21’, h=22’, then the equation is:

Area=(ab) x [(c+d+e+f+g+h) / 6]

=(45) x [(19+22+15+17+21+22) / 6]

= 870 sq. ft.

Formula's For Estimating Wheat Yields

Bushels =

$$\text{Bushels} = \frac{(\text{Heads per foot}) \times (\text{spikelets per head}) \times (2.3)}{(\text{divided by row space in inches})} \times 0.48 \text{ per acre}$$

Bushels Per Acre of Wheat =

$$\frac{(\text{\# heads/3 foot row}) \times (\text{spikelets/head}) \times (\text{kernels spikelet}) \times 0.142}{(\text{divided by row spacing (inches)})}$$

Table I. Estimated wheat yield potential.

	Number of plants/foot of row											
Row spacing	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
----inches----	---------- bushels/acre ----------											
6.0	10	20	30	40	50	60	—	—	—	—	—	—
7.5	8	16	24	32	40	48	56	64	—	—	—	—
9.0	7	13	20	27	33	40	47	54	60	—	—	—
10.0	6	12	18	24	30	36	42	48	54	60	—	—
12.0	5	10	15	20	25	30	35	40	45	50	55	60
14.0	4	9	13	17	22	26	30	34	39	43	47	52

Table II. Estimating winter wheat yield after stem elongation for the Nebraska Panhandle.*

	Number of tillers/foot of row												
Row spacing	*10*	*15*	*20*	*25*	*30*	*35*	*40*	*45*	*50*	*55*	*60*	*65*	*70*
----inches----	---------- bushels/acre ----------												
6.0	22	34	49	56	67	79	90	101	112	—	—	—	—
7.5	18	27	36	45	54	63	72	81	90	99	108	—	—
9.0	15	22	30	37	45	52	60	67	75	82	90	97	105
10.0	13	20	27	34	40	47	54	61	67	74	81	88	94
12.0	11	17	22	28	34	39	45	51	56	62	67	73	79
14.0	10	14	19	24	29	34	38	43	48	53	58	63	67

*To estimate yields in other Nebraska locations, multiply the table result by one of the following factors: southwest Nebraska, 0.9; central and south central Nebraska, 0.85; southeast Nebraska, 0.75.

OFFICIAL U.S. GRADES AND GRADE REQUIREMENTS					
Grading Factors	**Grades**				
	No. 1	No. 2	No. 3	No. 4	No. 5
HARD RED WINTER - MINIMUM TEST WEIGHTS					
LB/BU	60.0	58.0	56.0	54.0	51.0
MAXIMUM PERCENT LIMITS OF:					
DEFECTS					
Damaged Kernels					
Heat (part of total)	0.2	0.2	0.5	1.0	3.0
Total	2.0	4.0	7.0	10.0	15.0
Foreign Material	0.4	0.7	1.3	3.0	5.0
Shrunken and Broken Kernels	3.0	5.0	8.0	12.0	20.0
Total*	3.0	5.0	8.0	12.0	20.0
WHEAT OF OTHER CLASSES**					
Contrasting Classes	1.0	2.0	3.0	10.0	10.0
Total***	3.0	5.0	10.0	10.0	10.0
Stones	0.1	0.1	0.1	0.1	0.1
MAXIMUM COUNT LIMITS OF:					
OTHER MATERIAL (1,000 gram sample):					
Animal Filth	1	1	1	1	1
Castor Beans	1	1	1	1	1
Crotalaria Seeds	2	2	2	2	2
Glass	0	0	0	0	0
Stones	3	3	3	3	3
Unknown Foreign Substance	3	3	3	3	3
Total****	4	4	4	4	4
INSECT-DAMAGED KERNELS (in 100 grams)	31	31	31	31	31

The Federal Grain Inspection Service (FGIS) of the USDA Grain Inspection, Packers and Stockyards Administration (GIPSA) sets quality standards for grain. Wheat grades are important because they reflect the physical quality and condition of a sample and thus may indicate the general suitability of a sample for milling. Grades are applied when local elevators go to sell their grain for both domestic and international consumption. Grade factors are determined after dockage is removed.

Diseases Affecting Heads and Grain

Common Bunt

Wheat kernels infected by common bunt have a gray-green color and are wider than healthy kernels. Diseased kernels can be seen in developing wheat heads but are often not detected until harvest. The outer layers of diseased kernels remain intact initially, but are easily broken during grain harvest, releasing masses of black, powdery spores. The fungus produces chemicals with a fishy odor, which sometimes causes this disease to be referred to as "stinking smut."

Management: Fungicide seed treatment, disease-free seed sources.

Fusarium head blight

Symptoms of Fusarium head blight include tan or light brown lesions encompassing one or more spikelets. Some diseased spikelets may have a dark brown discoloration at the base and an orange fungal mass along the lower portion of the glume. Grain from plants infected by Fusarium head blight is often shriveled and has a white chalky appearance. Some kernels may have a pink discoloration.

Management: Avoid the most susceptible varieties, avoid planting into corn residue, foliar fungicides.

Ergot

Ergot is a fungus, an ascomycete, that forms sclerotia, ascospores and conidia. The sclerotia vary in size (2-20 millimeters long), depending on the host's seed size which the sclerotia replace, and are purple-black, elongate (spur-like) with white centers. Ascospores are long, thin and septate; conidia are small, round and one-celled.
Management: Use sclerotia-free seed and implement crop rotation with non-host crops such as legumes, corn and sorghum.

Loose smut

The normal head tissue of plants infected by loose smut is completely replaced with dark masses of fungal spores, giving the heads a black powdery appearance. It is possible to see heads damaged by loose smut while much of the head is still inside the boot. Only the central stem of the head is left after the spores are released.
Management: Fungicide seed treatment, disease-free seed sources.

Sooty head molds

Sooty head molds are characterized by a dark green or black mold growth on the surface of mature wheat heads. These molds are part of a naturally occurring complex of organisms that help to decay dead plant debris. Sooty molds are most common when mature wheat is subjected to repeated rains and delayed harvest. This disease also may affect plants that have been damaged by root rot. The sooty head mold growth is normally superficial. Its affect on grain is thought to be minor, but it can make for dusty harvest operations. Sooty molds can contribute to a discoloration of the grain called "black point."
Management: Generally impractical or not needed.

Stagonospora nodorum blotch

This disease causes dark brown or purple lesions on heads. Lesions are often more intense at the top of the glume, with brown streaks or blotches extending down toward the base of the spikelet. The presence of tiny fungal reproductive structures embedded in the tissue can confirm the diagnosis but will require significant magnification.
Management: Genetic resistance, foliar fungicides, crop rotation, fungicide seed treatment.

Diseases Affecting Leaves

Bacterial streak

Early symptoms of bacterial streak include small, water soaked areas between leaf veins. These water-soaked areas become tan streaks within a few days. When the disease is severe, streaks may merge to form large, irregular areas of dead tissue. When dew is present, the bacteria causing this disease may ooze from the lesions and dry to form a clear, thin film. This film flakes easily and is visible when the leaf is viewed from different perspectives.

Management: Avoid highly susceptible varieties.

Barley yellow dwarf

This viral disease causes wheat leaves to have a yellow or red discoloration. The discoloration is often more intense near the tip of affected leaves, giving them a flame-like appearance. Barley yellow dwarf often occurs in patches within a field. The size and distribution of these patches depends on the feeding activity of aphids which spread the barley yellow dwarf virus. Infected plants within these patches may be shorter than neighboring healthy plants.

Management: Genetic resistance, delayed planting date, insecticide seed treatment.

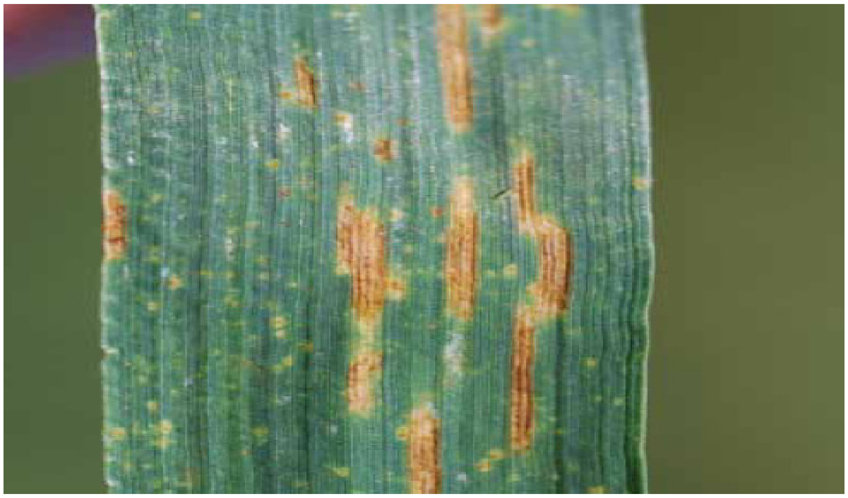
Leaf rust

Small, orangish-brown lesions are key features of leaf rust infections. These blister-like lesions are most common on leaves but can occur on the leaf sheath, which extends from the base of the leaf blade to the stem node. Lesions caused by leaf rust are normally smaller, more round and cause less tearing of the leaf tissue than those caused by stem rust.
Management: Genetic resistance, foliar fungicides.

Powdery mildew

Powdery mildew causes white lesions on leaves and leaf sheaths. Glumes and awns also can be infected when the disease is severe. Fungal growth is largely limited to outer plant surfaces and can be easily wiped away by rubbing a finger across affected areas. Mature lesions may have dark, reproductive structures mixed with the white, cottony growth of the fungus.
Management: Genetic resistance, foliar fungicides.

Septoria tritici blotch



This fungal disease causes tan, elongated lesions on wheat leaves. Lesions may have a yellow margin, but the degree of yellowing varies among varieties. The dark, reproductive structures produced by the fungus are key diagnostic features and can often be seen without magnification. This disease is also known as speckled leaf blotch.
Management: Genetic resistance, foliar fungicides, crop rotation.

Stagonospora nodorum blotch

The lesions of Stagonospora leaf blotch are normally brown or tan and surrounded by a thin, yellow halo. Lesions caused by Stagonospora leaf blotch are more irregular in shape and often have a darker color than those of tan spot. The presence of small, honey-colored fungal reproductive structures is diagnostic for Stagonospora nodorum blotch; however, these reproductive structures are only visible with considerable magnification.
Management: Genetic resistance, foliar fungicides, crop rotation, fungicide seed treatment.

Cephalosporium stripe

Plants infected with Cephalosporium stripe have pronounced yellow stripes running the full length of the leaf blade. The center of the yellow stripe may have a long, brown streak that extends onto the leaf sheath. Splitting the stem of infected plants often reveals small brown streaks within the node tissue. Cephalosporium stripe can also cause areas of stunted, irregular growth within a field. Often, infected plants die prematurely, causing patches of white heads within a field.
Management: Genetic resistance, crop rotation, control grassy weeds.

Stripe rust

Stripe rust causes yellow, blister-like lesions that are arranged in stripes. The disease is most common on leaves, but head tissue also can develop symptoms when the disease is severe. Outside the United States, this disease is sometimes referred to as yellow rust.
Management: Genetic resistance, foliar fungicides.

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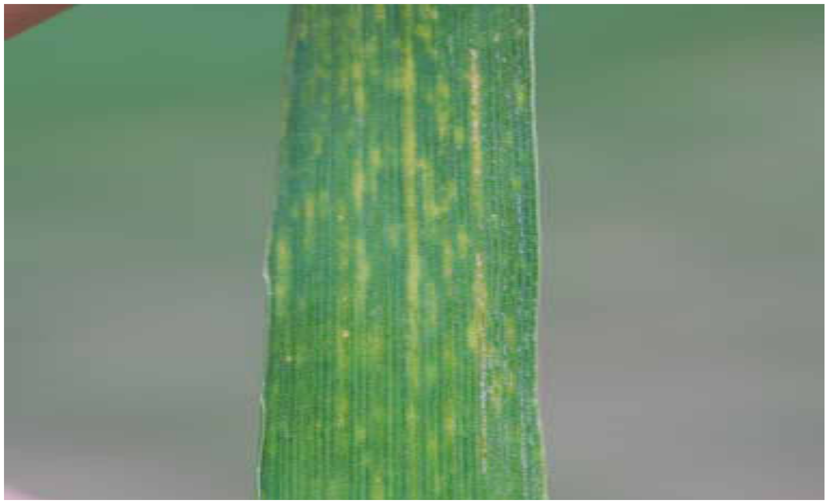
Tan spot

The key diagnostic feature of tan spot is tan lesions with a yellow margin. Mature tan spot lesions often have a dark area in the center. Lesions may merge as they expand, resulting in large sections of diseased leaf tissue. The fungus that causes tan spot survives in the debris of previous wheat crops and produces small black reproductive structures in the spring.
Management: Avoid planting into wheat residue, tillage where appropriate, genetic resistance, foliar fungicides.

Wheat soilborne mosaic

Winter wheat infected by wheat soil borne mosaic develops a pale-yellow discoloration shortly after breaking dormancy in the spring. The incidence of wheat soil borne mosaic is often greater in low areas of a field where moist soil conditions favor growth of the protozoa that spread this viral disease. Leaves of infected plants often have a mosaic pattern of dark green blotches on a pale yellow background. Symptoms normally fade when warm weather slows the viral activity within infected plants.
Management: Genetic resistance.

Wheat spindle streak mosaic



Wheat spindle streak mosaic causes a yellow discoloration to wheat seedlings. This yellow discoloration is often most intense in the wettest areas of a field. Leaves of infected plants have long, yellow streaks that are slightly wider in the middle than at their ends. Symptoms are similar to wheat soil borne mosaic, and plants often are infected with both diseases.
Management: Genetic resistance.

Wheat streak mosaic

Leaves of plants infected with wheat streak mosaic have a bright yellow streaking. Symptoms are often most severe near the leaf tip. The virus that causes wheat streak mosaic survives in volunteer wheat and is spread by wheat curl mites. The disease is often most severe in areas of a field that are closest to these sources of the disease and mites. Commonly, plants infected with wheat streak mosaic are also infected with High Plains disease and Triticum mosaic. The symptoms of these diseases are nearly identical. Disease severity is greater when plants are infected by more than one virus.
Management: Control volunteer wheat, delayed planting date, genetic resistance, avoid planting near maturing corn.

Diseases Affecting Stem and Roots

Stem rust

Stem rust causes blister-like lesions on leaves, leaf sheaths and stems. Infection of glumes and awns is also possible. The reddish-brown spores of the fungus cause considerable tearing as they burst through the outer layers of the plant tissues. Mature stem rust lesions are more elongated than those of leaf rust.
Management: Genetic resistance, foliar fungicides.

Common root rot

Common root rot causes premature death of wheat resulting in patches of white heads scattered throughout a field. Infected plants are often dark at the base and have poor root development. A key diagnostic feature of common root rot is dark-brown lesions on the thin stem extending from the base of the plant to the remnant of the seed. This thin stem is known as the “subcrown internode.” Healthy subcrown internodes should be cream colored and firm.
Management: Crop rotation, control grassy weeds.

Fusarium root, crown and foot rots

Fusarium root, crown and foot rots cause patches of wheat to die prematurely, resulting in areas of white heads within a field. Infected plants are typically brown at the base and have poor root development. During advanced stages of the disease, the Fusarium fungus often produces a pink, cottony growth inside the lower portions of the stem. Often, the disease is most severe after prolonged periods of dry weather.
Management: Crop rotation, control grassy weeds.

Take-all

This fungal disease causes wheat to die prematurely, resulting in patches of white heads in otherwise green fields of wheat. Plants infected by take-all normally have a black discoloration of the lower stem and roots. Frequently, the disease is most severe in wet areas of a field and near field edges where the fungus survives in association with grassy weeds.
Management: Crop rotation, control grassy weeds.

Insect Management

Aphids

Russian Wheat Aphid

Bird Cherry-oat Aphid

Aphids are small, soft-bodied insects that obtain their nutrition by sucking sap from plants. They have two cornicles that protrude from the upper surface of the abdomen near the tail. These “tailpipes” vary in length and may be reduced to mere bumps in some species. During feeding, aphids inject salivary secretions into plant tissues. The salivary secretions of some aphids are toxic and can cause severe tissue damage in the plant. Symptoms of aphid injury include leaf stippling, discoloration or striping. In addition, wilting, premature browning and death of the plants may result.

Management: Controlling volunteer wheat, avoiding early planting of winter wheat and maintaining a healthy crop will help minimize risks. Monitoring aphid populations in the fall and spring and following treatment guidelines are necessary to minimize the risk of serious losses.

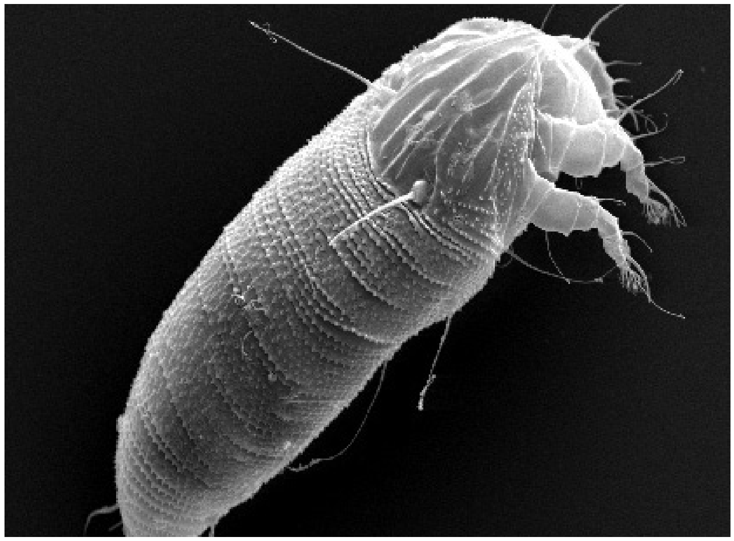
Chinch Bugs

Newly-hatched bugs are small and bright red. All life stages feed on susceptible grass plants between the leaf sheath and stalk. They are red to brown with a white band across their backs during the first four stages. The fifth nymphal stage is nearly black, with a white spot between the developing wings. Chinch bugs have piercing-sucking mouthparts at all stages. They injure host plants by sucking plant juices. They have a characteristic musty odor that is detectable when large numbers are present or when the bugs are crushed.
Management: Integrated program of careful crop management and insecticide application

Hessian Fly

The Hessian fly passes through two generations per year in which adult flies deposit eggs; maggots hatch on the leaves and feed on the stalks; and, after feeding, the maggots pupate into a form commonly recognized as flaxseeds. The flaxseed pupae can often be located near the infested tiller in the spring or associated with broken stems observed in the early summer.
Management: Plant varieties that are resistant to the Hessian fly and plant wheat in the fall after the late summer adult egg laying period has passed.

Wheat Curl Mite



These mites are wingless, cigar-shaped and approximately 0.2 millimeters in length. Unless found in extremely high numbers, these mites generally cause little direct damage in the field other than the characteristic leaf curling and the occasional trapping of the flag leaf. However, both immature and adult Wheat Curl Mites transmit Wheat Streak Mosaic Virus.
Management: Chemical control of mites is believed to be largely ineffective as they predominantly live within leaf whorls. Volunteer wheat and grasses should be destroyed at least 10 days prior to planting in the fall to limit vector survival.

Wireworms

These insects may spend the winter as adults or larvae. Adults are about 1/4 to 3/4 inch long, hard shelled, brown to nearly black with a streamlined body. The adults are called click beetles because when they are on their backs, they will flip up and turn over with a clicking noise. Larvae live from two to six years in the soil feeding primarily on roots. Wireworms eat the germ of the seeds or hollow them out completely, leaving only the seed coat
Management: Wireworms are among the most difficult insects to control. Planter box insecticide seed treatments will reduce damage to the seeds, but will not protect seedlings.

Sawfly

The adult sawfly is a slender wasp about 1/2 inch long with a black abdomen and yellow ringed markings. When observed in the field, sawflies may be recognized by the unusual habit of resting head downward on the stems of grain plants. Sawfly damage is threefold. First, they cause grain yield reduction by their tunneling activity in the infested stems. Additional loss occurs when sawfly-cut stems fall to the ground and become unharvestable. The protein content of grain from the infested stems is also lower.

Management: Crop rotation, delayed planting and fall tillage.

Armyworms

In autumn, fall armyworms may be a problem in seedling plants. Fall armyworms feed on the young plants and eat the plants to the ground, causing a loss of stand. Damage of this type may occur from emergence until a bad frost or freeze eliminates the threat of armyworms. Wheat will usually recover from moderate fall armyworm damage. In the spring, true armyworms are a threat about the time heading begins. Wheat is very attractive to the armyworm, and thick, vigorously growing fields can attract high infestations. Occasionally, when wheat starts to mature, armyworms will move up from leaf feeding and cut the wheat heads from the plant stem.

Management: An infestation level of five to six worms per square foot will justify treatment. Treat only with liquid insecticides during the warmer part of the day.

Field History

Field Number______________________________

Crop and Variety______________________________

Acres____________ Date Seeded______________________________

Tillage Operations______________________________

Fertilizers Applied______________________________

Chemicals Used______________________________

a. Weed Control______________________________
b. Insect Control______________________________
c. Disease Control______________________________

Harvest Date____________________ Yield____________________

Comments______________________________

Field History

Field Number ______________________________

Crop and Variety ______________________________

Acres ____________ Date Seeded ______________________________

Tillage Operations ______________________________

Fertilizers Applied ______________________________

Chemicals Used ______________________________

a. Weed Control ______________________________
b. Insect Control ______________________________
c. Disease Control ______________________________

Harvest Date ______________________ Yield ______________________

Comments ______________________________

Field History

Field Number____

Crop and Variety____

Acres____________ Date Seeded________________________________

Tillage Operations____

Fertilizers Applied____

Chemicals Used____

a. Weed Control_______________________________________
b. Insect Control______________________________________
c. Disease Control_____________________________________

Harvest Date____________________ Yield______________________

Comments____

Field History

Field Number____

Crop and Variety____

Acres______________ Date Seeded____________________________

Tillage Operations____

Fertilizers Applied____

Chemicals Used____

a. Weed Control____________________________________
b. Insect Control____________________________________
c. Disease Control____________________________________

Harvest Date________________________ Yield________________________

Comments____

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Contacts

Nebraska Wheat Board
245 Fallbrook Blvd, Suite 202
Lincoln, NE 68521
Ph: 402-471-2358 | 800-651-6736
Fax: 402-471-3446
Email: wheat.board@nebraska.gov

Nebraska Wheat Growers Association
245 Fallbrook Blvd, Suite 202
Lincoln, NE 68521
Ph: 402-471-2358
Email: newheatgrowers@gmail.com

Nebraska Crop Improvement Association
268 Plant Science Hall
P.O. Box 830911
Lincoln, NE 68583
Ph: 402-472-1444
Fax: 402-472-8652
Email: ncia@unl.edu

Lincoln Inspection Services Inc.
PO Box 22724
Lincoln, NE 68542

505 Garfield St.
Lincoln, NE 68502
Ph: 402-435-4386
Email: office@lincolninspection.com

Husker Genetics
1071 County Road G, Room A
Ithaca, NE 68033
Ph: 402-624-8020
Fax: 402-624-8010
Email: huskergenetics@unl.edu

Panhandle Research and Extension Center
4502 Avenue I
Scottsbluff, NE 69361
Ph: 308-632-1230
Email: phrec@unl.edu

UNL Department of Agronomy & Horticulture
202 Keim Hall
Lincoln, NE 68583
Ph: 402-472-2811
Email: agrohort@unl.edu

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The Nebraska Wheat Board
301 Centennial Mall South
P.O. Box 94912
Lincoln, NE 68509

PHONE: (402) 471-2358
FAX: (402) 471-3446

EMAIL: wheat.board@nebraska.gov
WEBSITE: www.nebraskawheat.com

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