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WINTER WHEAT PRODUCTION

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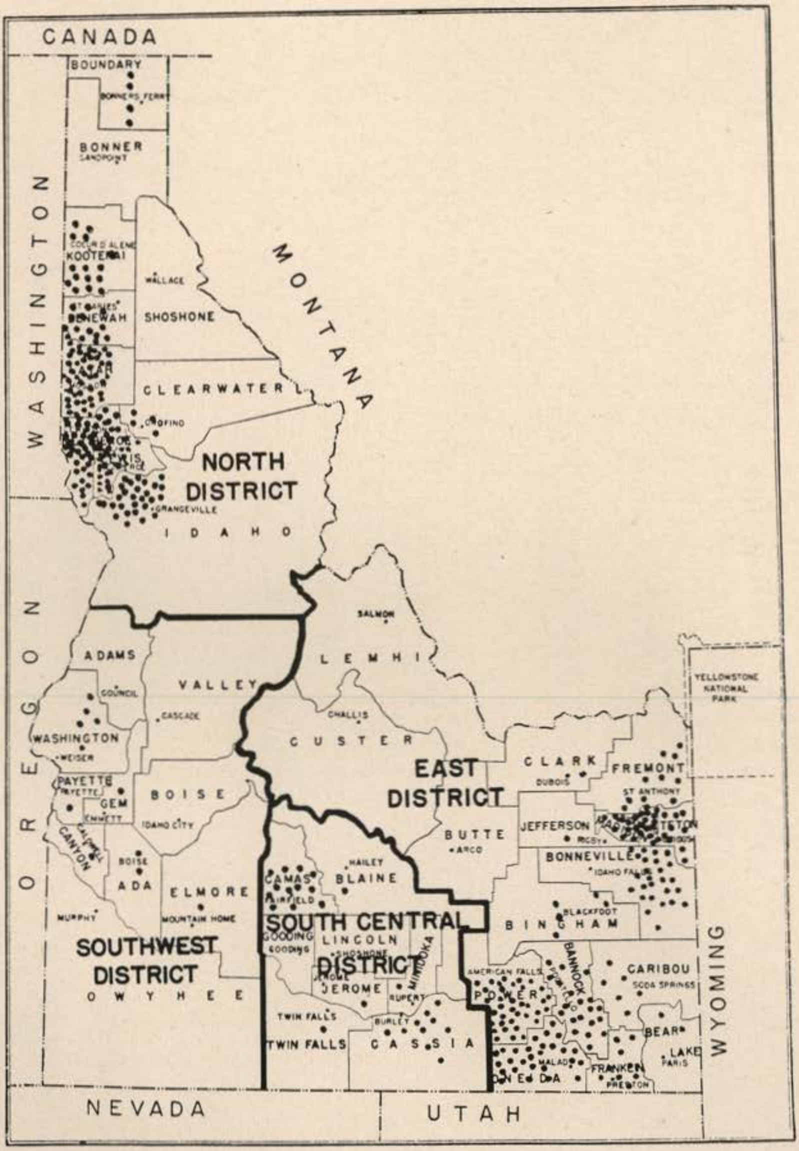

Figure 1 — Distribution of winter wheat production in Idaho in 1958 — Each dot represents 50,000 bushels.

Winter Wheat Production

HOWARD B. ROYLANCE and K. H. KLAGES*

EVEN with restricted production, wheat continues to hold undisputed first place among the crops produced in Idaho. In value, it ranks above all other crops grown in the state. In acreage, wheat is surpassed only by hay.

In 1958, a total of 42,492,000 bushels of wheat was produced in Idaho. Of this amount, 21,996,000 bushels were spring and 20,496,000 bushels were winter wheat. The total value of the crop was $68,000,000.

The tremendous importance of wheat to the economy of Idaho is illustrated by the values of the 10 important crops grown in 1958. All wheat, including both spring and winter wheat, topped the list at 68.0 million dollars, followed in order by potatoes 40.5 million, all hay 45.2, sugar beets 22.0, barley 17.2, dry beans 16.4, corn 5.4, oats 5.6, dry peas 5.4, red clover seed 3.9, and alfalfa seed 2.2.

Wheat production is well distributed over the state. This is evident from Table 1, showing the irrigated and non-irrigated acreages and production in 1958. Of the total acreages, 29.1 percent is on irrigated and 70.9 percent on non-irrigated lands; however, due to the higher yields obtained on the irrigated acreage, they produced 43.8 percent of the total crop, compared to 56.2 for the non-irrigated areas of the state.

Table 2 gives the breakdown between spring and winter wheat production. Spring wheat production is largely confined to the irrigated areas of the southern part of the state. It is of less importance in northern Idaho.

Where wheat is grown on non-irrigated land, winter wheat has a higher yielding capacity than spring wheat. This is evident from the performance of these wheats in the northern district. The same relationship holds true for the other districts of the state.

Table 1.—All wheat production in Idaho in 1958, by crop-reporting districts.

District	Irrigated			Non-irrigated		
	Acres harvested in 1000 acres	Production in 1000 bushels	Bu. p.acre	Acres harvested in 1000 acres	Production in 1000 bushels	Bu. p.acre
Northern	.8	29.9	37.4	289.2	10,960.1	37.9
Southwestern	79.2	3,696.6	46.7	18.8	463.4	24.6
Southcentral	134.6	7,538.5	56.0	72.4	1,421.5	19.6
Eastern	145.4	7,361.0	50.6	495.6	11,021.0	22.2
State total	360.0	18,626.0	51.7	876.0	23,866.0	27.2
Percent of state total wheat	29.1	43.8		70.9	56.2	

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Table 2.—Winter and spring wheat production in Idaho in 1958, by crop-reporting districts.

District	Winter wheat			Spring wheat		
	Acres harvested - 1000 acres	Production - 1000 bushels	Bu. p.acre	Acres harvested - 1000 acres	Production - 1000 bushels	Bu. p.acre
Northern	251.0	10,094.0	40.2	39.0	896.0	23.0
Southwestern	17.0	534.0	31.4	81.0	3,626.0	44.8
Southcentral	53.0	1,224.0	23.1	154.0	7,736.0	50.2
Eastern	351.0	8,644.0	24.6	290.0	9,738.0	33.6
State total	672.0	20,496.0	30.5	564.0	21,996.0	39.0
Percent of state total wheat	54.4	48.2		45.6	51.8	

Where moisture is a limiting factor in production, winter wheat has the advantage of an early start in the spring. Since winter wheat is established in the fall it is able to make considerable growth in early spring before spring wheat can be seeded and before it is able to emerge. Due to this early start in the spring, winter wheat is more economical in its use of water than spring wheat.

Winter Wheat Producing Areas

Winter wheat is produced in commercial quantities in all but one of the 44 counties of the state. The most concentrated producing areas are found in northern and southeastern Idaho. However, the crop is of importance in parts of southcentral and southwestern Idaho. Figure 1 shows the winter wheat producing areas of the state by districts.

The main winter wheat producing area of northern Idaho consists of the Palouse and adjacent areas. This area is well supplied with moisture. Annual precipitation varies from 20 to 27 inches. The grassland soils of this area are fertile and have high moisture-holding capacities. A combination of favorable climatic conditions and soils of a high level of fertility account for the high average wheat yields of this area. The rolling topography of the area influences cropping practices and methods of handling the crop. Soil erosion is a factor and precautions must be taken to prevent soil losses. Climatic conditions in most of the northern portions of Idaho favor the production of soft white wheats well adapted to the production of cracker and pastry flours.

In the southern part of the state, winter wheat is primarily a dryland crop. The annual precipitation within the different producing areas varies from 10 to 20 inches. Due to lower rainfall and higher rates of evaporation than in the northern part of the state, most of the wheat produced in the southern and southeastern areas is hard red winter, used primarily for bread flour. Only limited acreages of winter wheat are produced on the irrigated lands of southern Idaho.

Crop Rotations

Winter wheat is the main cash crop in practically all the winter wheat producing areas of the state. For this reason the crop is given the most favorable place in the rotation.

Typical crop rotations for the various winter wheat producing areas of the state are:

1. Northern Idaho — Palouse and Adjacent Areas

Year	Crop	Cash crop
1.	Barley plus sweet clover and grass	Barley
2.	Sweet clover grass — land plowed, fallowed	None
3.	Winter wheat	Wheat
4.	Peas	Peas
5.	Winter wheat	Wheat

This 5-year rotation provides four cash crops — two winter wheat, one of barley and one of peas — a green manure crop, and a partial fallow. The sweet clover during the second year is plowed under early enough in the season to conserve soil moisture and to make it possible to provide a firm seedbed for the winter wheat crop. This rotation is adapted to the better soils of the area that are well supplied with organic matter and where soil erosion losses are likely to be low.

On thinner soils subject to considerable soil erosion, the above rotation should end the third year, providing for only one winter wheat crop. The first and only winter wheat crop in that case would be followed by barley as a companion crop for sweet clover-grass. If desired, peas could be substituted for the barley. After the soil organic matter has been increased by a 3-year rotation, the rotation may be lengthened to 5 years as outlined.

The sweet clover-grass rotation can be readily modified to provide for a hay crop where there is need for such a crop, or where the soil conditions demand the greater protection it provides. An alfalfa-grass mixture can be substituted for the sweet clover-grass, and left stand for 2 to 3 years. This rotation will reduce the percentage of the farm area in wheat. It provides greater organic matter accumulation and greater soil erosion protection. For the rapid build-up of soil organic matter the last hay crop should be plowed under.

This rotation is adapted to thinner soils or to fields with considerable slope where soil erosion is more likely to cause losses. The alfalfa-grass, during its final year's growth should be plowed under before it exhausts the soil moisture and thus interferes with the making of a firm seedbed for the wheat crop. Dry soil will result in a lumpy, loose seedbed on which it is difficult to establish a good stand. A loose seedbed also increases the possibilities of winter damage or may even result in complete winter killing.

2. Southern Idaho drylands with sufficient moisture for the establishment of sweet clover or alfalfa (13 to 16 inches of annual precipitation)

Year	Crop or practice	Cash crop
1.	Sweet clover-grass	None
2.	Sweet clover-grass, plowed fallow	None
3.	Winter wheat	Wheat
4.	Fallow	None
5.	Winter wheat	Wheat
6.	Fallow	None
7.	Winter wheat	Wheat

This rotation yields 3 wheat crops in 7 years. An additional cash crop may be added in the better moisture areas by establishing the sweet clover in alternate rows with spring wheat, barley or oats. This method has been quite successful in trials at the Tetonia Branch Experiment Station. The establishment of sweet clover with winter wheat has not been successful. Grass is more difficult to establish than either sweet clover or alfalfa. Legume-grass mixtures should be attempted only in relatively high moisture areas. At Tetonia, with 13 inches of annual precipitation, good stands of sweet clover were established. It was planted in alternate rows with spring grains. Grass planted in sweet clover-grass mixtures did not produce adequate stands or enough growth to warrant the additional expense.

Sweet clover-grass or alfalfa-grass mixtures are preferred to pure stands of these legumes because of the greater soil improvement, greater permeability and resistance to both wind and water erosion. Such mixtures can be used only in the higher moisture areas (above 15 inches of annual precipitation) if they are to be established with a spring grain companion crop.

The use of alfalfa in place of sweet clover lengthens the rotation because the alfalfa usually occupies the land for 3 to 4 years. The last year's alfalfa crop should be plowed under to add organic matter to the soil.

Observations at the Tetonia Station and elsewhere have shown less loss from snow mold on wheat following the plowing under of sweet clover and alfalfa than where the winter wheat crop is grown after wheat. The inclusion of grass with alfalfa seems to nullify the snow mold control obtained with alfalfa-wheat rotation.

The sweet clover or alfalfa in the second year of the rotation must be plowed under early before it depletes soil moisture. At

Tetonia, best results were obtained from plowing under sweet clover when the plants were 6 to 12 inches high. This leaves enough moisture for the establishment of a firm seedbed and for the use of the wheat plants during the crop year.

3. Southern Idaho drylands with insufficient moisture for the establishment of sweet clover or alfalfa.

In the very dry areas, winter wheat is grown under an alternate wheat-fallow system. In these areas moisture is the limiting factor in crop production. It is best that remaining straw and chaff be used to protect the soil from wind and water erosion. After a number of cycles of the rotation, depending on the fertility and physical characteristics of the soil, it is good practice to seed the area to a drought-resistant grass such as crested wheatgrass and leave it in grass for 3 to 5 years. Grass restores organic matter and improves the physical condition of the soil. In good years the crested wheatgrass may produce profitable seed crops, or the area may be grazed moderately.

4. Irrigated areas with an abundance of water.

Year	Crop	Cash crop
1.	Barley plus alfalfa-grass	Barley
2. & 3.	Alfalfa-grass	Hay
4.	Potatoes	Potatoes
5.	Beans	Beans
6.	Winter wheat	Wheat
7.	Sugar beets	Beets

This rotation may be changed to meet special situations. It may be shortened by dropping the last year. It may be lengthened by allowing an extra year for hay production. Where beans are not grown, as in the upper Snake River Valley, the winter wheat may follow the alfalfa. Spring wheat may be substituted for the winter wheat.

5. Irrigated areas with insufficient irrigation water

Year	Crop	Cash crop
1.	Barley plus alfalfa-grass	Barley
2. & 3.	Alfalfa-grass	Hay
4.	Beans or early potatoes	Beans or potatoes
5.	Winter wheat	Wheat

Like Rotation 4, this system of cropping may also be modified to meet special conditions. It may be lengthened by including an additional crop such as spring-seeded grain or beans in sixth year. In both of these rotations the final alfalfa-grass crop preceding the potatoes in Rotation 4 or the winter wheat in Rotation 5 should be plowed under to supply the soil with organic matter.

Seedbed Preparation

A good seedbed for winter wheat contains enough moisture to insure prompt germination of the seed and above all is firm so that seedlings may be established readily. Climatic and especially moisture conditions vary a great deal from year to year. At times it becomes necessary to risk seeding in a dry seedbed. A loose seedbed is one of the main contributing factors to winter damage and winter killing.

Much wheat in Idaho is seeded on fallowed or modified-fallow ground. Due to great variations in moisture conditions in the different parts of the state, different methods of handling fallow are necessary. For instance, tillage methods giving best results under the subhumid conditions of northern Idaho are quite different from those used on the drylands of the southern part of the state.

In northern Idaho, fallow is not used as extensively as in the drylands of southern Idaho. This is because of the greater abundance of moisture which reduces the need for the alternate wheat-fallow system. The fallow type of rotation described for the northern part of the state does not include full fallow but a modified fallow during the second year of the rotation. The land is fallowed after the plowing of the green manure crop and until the time of seeding. This results in a clean fallow from midsummer until fall. Such a fallow has a definite disadvantage in that it leaves the soil exposed to the action of wind and water. The reason for its use, in the face of this obvious disadvantage, is that the amount of material produced by the sweet clover-grass is too great to be hendled economically by any other method. The same is true with the handling of large amounts of straw — up to 3 tons or more per acre. This amount of straw is too great to be left on the surface. As a result, plowing rather than a form of stubble mulch tillage is the common practice in the Palouse and adjacent areas.

In the dryland areas of southern Idaho, excellent results are obtained with the stubble mulch type of summer fallow. Here the amount of residue left by the previous crop is not as great as in northern Idaho. It can be left largely on the surface of the soil. Such implements as chisel-tools, duckfoot-tools, sweeps, and modifried mold-board plows are used to disturb and loosen the soil but still leaves most of the straw on the surface. This provides maximum erosion control and holds the snow in place against the force of winter winds. Research at the Tetonia Station has shown that stubble-mulch fallow resulted in better moisture conservation, slightly higher winter wheat yields and better erosion control than either moldboard or disk-prepared fallow.

The main objectives of working the summer fallow after the original tillage are to control weeds and to provide a firm seedbed. Avoid overworking the fallow and pulverizing the surface soil.

A surface too finely brokendown takes up water slowly and offers little resistance to water and wind erosion. The main implements used are the rod weeder, harrow and the duckfoot cultivator. Disks have a tendency to pulverize the soil. The surface of a good fallow areas should be somewhat cloddy, or where stubble mulch tillage is used, covered by the residue of the previous crop. The soil should be firm underneath the surface to provide a close contact between the seeds and the soil particles to insure germination and rapid establishment of the seedlings.

Fertilization

The one element used more than any other for increasing yields of winter wheat in most areas is nitrogen. The lack of this element is readily recognized by the light green or yellowish color of the plants, by dwarfed or stunted plants, by the small amount of tillering and in the case of severe deficiencies by the yellowing and dropping of the lower leaves of the plant. These symptons of nitrogen deficiency are definitely associated with low production.

The availability of nitrogen also is associated with good crop and soil management. It is necessary to convert a portion of the crop residue into soil humus. The nitrogen aids in the decomposition of crop residues. If applied at the proper rate for the area and conditions of growth, it increases the efficiency of water used by the plant. Its use may also increase the quality of the crop because it has a tendency to increase the protein content of the grain. This is especially desirable in the hard red winter wheats.

The amount of nitrogen fertilizer needed depends on a number of factors, such as the fertility of the soil, the type and yield of the previous crop, the amount of straw left on the soil by the preceding crop, fertilizer applied to the previous crop, and on the availability of moisture.

Soils with a high level of fertility need less nitrogen than those of low fertility. The excesive use of the element on fertile soils often leads to severe lodging, lower test weight, reduction in yield and quality, and increased costs of harvesting.

The yield and appearance of the previous crop provides an index of the fertility level of the soil and provides a guide for the most economical rate of fertilizer application. The kind of crop previously grown must also be considered. For instance, where winter wheat follows the turning under of a sweet clover crop no nitrogen fertilization is necessary. If sweet clover-grass or alfalfa-grass is plowed under and the grass portion is high, say in excess of 50 percent, then an application of 40 pounds of nitrogen per acre is usually needed. The nitrogen will aid in the decomposition of the carbonaceous grass roots. Where high amounts of straw were turned under prior to the seeding of winter wheat the amount of nitrogen to be used on the crop should be increased. Straw ties up the soil nitrogen. Enough nitrogen must be applied following heavy applications of straw so that the needs of both the growing plants and the organisms working on the decomposition of the straw may be satisfied.

Where the previous crop received heavy applications of nitrogen and other fertilizer some of the effects of this previous application will be carried over to the current crop.

All plant growth requires water. The greater the growth the more water is needed. The main effect of nitrogen on plants is growth stimulation. Obviously, growth cannot be increased beyond the point where the available water is used up. The applications of balanced amounts of nitrogen to soils deficient in this element will result in the economical use of water. In dry areas, water is the chief limiting factor to plant growth. If the plant is encouraged to use too much of the available water during its early growth, the soil may be depleted of water before the plant reaches maturity. Such a set of conditions, common in dry areas, results in premature ripening and shrunken kernels. Availability of water for the entire growth period should be considered in the use of nitrogen fertilizers.

Rates of nitrogen suggested for the various conditions in the state are indicated below:

Part of State	Condition of growth	Pounds of nitrogen per acre
Northern	Following sweet clover or alfalfa	0
Northern	Following sweet clover-grass (50% grass)	0 - 40
Northern	Soils of high fertility — 3 tons of straw from previous crop	50
Northern	Low fertility — 2 tons of straw from previous crop	60
Northern	Following peas	40
Southern	15 inches or more of precipitation — where soil nitrogen is deficient	40
Southern	Less than 15 inches of precipitation — where soil nitrogen is deficient	30
Irrigated	Depending on soil fertility level, previous crop and fertilization	50 - 80

Drylands of southern Idaho need smaller applications of nitrogen than the northern part of the state. In southern Idaho, 30 to 40 pounds of nitrogen per acre is usually sufficient. Nitrogen increases yields and the protein content of the grain when soil nitrogen is low. High protein content of hard red winter wheat in southern Idaho is desirable. Winter wheat produced in certain areas of southeastern Idaho has been criticized because of its low protein content and associated poor baking quality. Careful use of nitrogen will improve the quality of grain produced in many areas. Avoid excessive use of nitrogen in the dryland areas. It leads to wasteful use of water by the plants, increases costs of production without corresponding increases in yield, and in dry seasons may cause considerable damage to the crop.

Most of the nitrogen used in Idaho is applied either on the summer fallow or prior to the seeding of the crop in fall. The advantage of summer and fall applications is that the fields are accessible. Wet soils interefere with early spring applications. Spring applications must be made early to be effective. The fertilizer must be applied while there is still an abundance of moisture. Applications on dry soils are not effective.

Split applications of nitrogen, one-half of the total amount in fall and the remaining half in spring, give somewhat better results than single applications applied either in the fall or in the spring. The differences in response to split applications as compared to single applications are small. Split applications have a place in areas of high fall and winter rain. Such applications favor fall growth and since they supply nitrogen to the surface from which the element has been leached during the winter, they aid in early spring growth.

Seed and Seed Preparation

The use of high quality seed is one of the essentials to good crop production. Good seed costs little more than low quality seed. Poor seed is too expensive to be used at any time.

Seed classified as "good" for any locality should be of a variety adapted to the area, have a high rate of germination, be pure — free from mixtures of other varieties, other crop and weed seeds — and should be able to produce a quality product. It should be of a variety that is resistant to diseases common to the area. Above all, it should have high yielding ability.

The advantage of certified seed is that the buyer is certain of the variety and the purity of the seed. In many instances certified seed can be purchased for little more than commercial seed. If certified seed is not available, then arrangements frequently can be made to obtain seed of known variety and purity from one of the better fields of the community.

The variety selected determines the quality and marketability of the crop.

Only cleaned seed should be planted. Proper seed cleaning eliminates foreign materials, broken kernels, weed seeds and smut balls. Cleaned seed feeds through the grain drill at a more uniform rate than uncleaned seed. Even delivery of seed from the drill is necessary for the uniform distribution.

Most recommended varieties of winter wheat are now resistant to smut. Seed treatment for smut control is still advisable.

Varieties

There are many good varieties of winter wheat. But, from the standpoint of individual producers, a variety is good only if it fits into the conditions under which the crop is to be grown, and produces a grain of high quality for which there is a market. Omar, a white club wheat, is a high producer of good quality grain in northern Idaho where climatic conditions favor the production of soft white wheats. This variety would be out of place in the drylands of southern Idaho where the climate favors the hard red winter wheats. Omar grown on the drylands of southern Idaho develops a grain of low quality. The kernels are rather hard, intermediate in protein content, and therefore not capable of producing the excellent cake and cookie flour for which the variety was developed and is valued when grown under the subhumid conditions of the Palouse area. Likewise, the hard red winter wheats would be out of place in northern Idaho. These varieties cannot produce good quality bread flour under subhumid conditions.

The winter wheat varieties recommended for the various areas of the state are:

	Use
1. Northern Idaho	
a. Omar — soft white, club, red-chaffed, beardless	cake & cookie
b. Brevor — soft white, common, white-chaffed, beardless	cake & cookie
2. Southern Idaho drylands	
a. Itana — hard red, common, dark brown-chaffed, bearded	bread
b. Columbia — hard red, common, brown-chaffed, bearded	bread
3. Southern Idaho irrigated areas	
a. Omar	
b. Itana	
c. Columbia	

All the varieties listed above have high resistance to common and dwarf smuts. Wasatch and Cache are still listed as varieties of hard red winter wheat for the southern Idaho drylands. As soon as greater quantities of Itana and Columbia seed become available, these two varieties probably will replace Wasatch and Cache. This replacement is justified by the superior quality of wheat produced by these two varieties.

Avoid the introduction of new, untried varieties. The Idaho Agricultural Experiment Station has tested most of the varieties that may be introduced into the state. Their performance record is available. Limiting the number of varieties in any area results in more orderly and profitable marketing. It reduces chances of variety mixtures, and enhances the reputation for quality wheat grown in the area.

Seeding

Two types of drills are used in the seeding of winter wheat. They are the common surface drill with row spacings from 6 to 8 inches, and the deep-furrow drill with 12-inch row spacings. The common surface drill is in general use in northern Idaho. The deep-furrow drill is popular on the drylands of southern Idaho, especially in areas where the stubble mulch fallow is in common use. The wide spacings of these drills are of help in getting through the residue left on the surface of the soil. No differences in yields between surface and furrow seeding are evident from the comparative trial of these two methods of seeding at the Tetonia station. In the dry wheat producing areas, the deep-furrow drill places the seed at a greater depth in contact with soil moisture. This is a particular advantage in dry years. This encourages earlier germination and emergence. The roughening of the soil by the deep furrow drill and the leaving of crop residues on the surface of the ridge offers protection against wind erosion.

The ideal date for seeding varies in different parts of the state, as well as within areas. In the Palouse and adjacent areas, the best seeding date is determined in part by the fertility level of the soil. On soils with a high level of fertility, it is advisable to delay seeding until the latter part of September or early in October. Early seeding on rich soil frequently leads to excessive straw growth and lodging. Since this condition does not exist on lands with lower fertility, seeding on such lands may be made by the middle of September. Early seeding and early emergence permits greater fall growth of wheat and offers better protection against soil erosion. However, excessive straw growth and the danger of severe lodging, which decreases yields and increases harvesting costs, can be effectively avoided on fertile soils by delaying the date of seeding.

In the southern part of the state, the best date of seeding will depend on the elevation. In areas above 5000 feet, it is best to seed during the middle of August or early in September. The purpose is to get the plants well rooted before low temperatures are expected. At elevations below 5000 feet, the crop may be seeded later but preferably before the middle of September.

Rates of seeding are determined by available moisture. Under the rather high moisture conditions in northern Idaho, the standard rate is 60 pounds per acre. Slightly higher rates apply to the irrigated areas. In the dry areas, with 12 to 14 inches of annual precipitation, the best rate is 30 to 40 pounds per acre. Results from the Tetonia Station show highest yields from the use of only 20 pounds of seed per acre seeded around the middle of August. Later dates of seeding require higher rates, for instance 40 pounds for September 1, 60 pounds on September 15, and 80 pounds on October 1. Late seeding dates allow less time for fall stooling. Avoid high rates of seeding in the dry areas. They lead to excessive competition between plants, limit the depth of root penetration and the uptake of water.

The old rule, seed no deeper than necessary, still holds. There may be diferences of opinion as to what "necessary" may mean. The object is to encourage germination and emergence in the shortest time. Seeding deeper than 1 inch on a moist seedbed delays emergence. On dry seedbeds, seeding to a depth of 3 inches may be necessary to place the seed in contact with moisture. Where the seed cannot be placed in moist soil, relatively deep seeding, around 2 inches, is safer than shallow seeding because the seeds will not be encouraged to germinate by light showers which barely penetrate the soil. Germination and emergence with insufficient moisture in the root zones frequently results in thin stands.

Harvesting

Practically all winter wheat is harvested by direct combining. The indirect method of harvesting, by first windrowing the crop and then picking it up with a combine, is used primarily on fields infested with green weeds or has low areas that mature late. The harvesting should be delayed until the moisture content of the grain is down to 13 percent. Cracked and damaged kernels can be avoided by adjustments of the combine, especially of cylinder speeds and clearance. Wheat with broken and damaged kernels or containing pieces of green weeds goes out of condition more rapidly than does clean, undamaged wheat.

Weed Control

Good farming is the basis of weed control. This includes the use of clean seed, proper seedbed preparation, adapted varieties, crop rotations, and proper fertilization. However, weeds do occur. When this happens there is a place for control either by rotary hoe or the use of selective sprays.

Common annual weeds infesting winter wheat fields can be controlled by selective sprays. They are fan weed, gromwell, crowsfoot, Russian thistle, Jim Hill mustard, yellow mustard, tumbling mustard, and prickly lettuce. Perennial weeds that can be held down by selective spraying are Canada thistle, blue-flowering lettuce, bindweed, and whitetop.

The annual weeds listed are controlled by ½ to 1 pound of amine salts of 2,4-D per acre in 5 to 10 gallons of water. The perennial weeds listed above require 1½ to 2 pounds per acre. Use the esters of 2,4-D only early in the season when there is less danger of injury by drifting to susceptible crops. The esters are volatile and will drift, and may damage such susceptible crops as peas, beans, and alfalfa. The use of esters of 2,4-D, 2,4,5-T, and MCP is restricted by law in some areas.

Water is the safest carrier of 2,4-D; it also gives the greatest selectivity. When applying ester types of 2,4-D in dryland areas, oil carriers are used to reduce weight.

The time of applying 2,4-D is important. Annual weeds are easier to kill while young and growing actively than when they are older. Perennial weeds should be given time to develop most of their shoots before spraying. For annual weed control, spray early in the spring after stooling is completed. Herbicides have a tendency to limit stooling. Do not spray winter-injured wheat plants until thay have outgrown that damage. Spray can be applied as late as the early boot stage. Do not apply herbicides when the heads emerge from the boot or during the flowering stage. Since a greater amount of foliage must be covered in late than during early sprayings, increase the amount of water to 10 to 20 gallons per acre, or about double the gallonage for early season applications.

Disease Control

The main diseases of winter wheat are common and dwarf smuts, leaf rust, stem rust and snow mold. The smuts cause the greatest losses and are found in all areas of the state. Leaf rust, and occasionally stripe rust, do some damage. Since stem rust occurs late in the season, it is of far less concern in winter than in spring wheat. Snow scald has caused a great deal of damage at high elevations where snow remains on the ground a long time. In some areas it has caused growers to shift from winter to spring wheat or barley production.

Bunt (stinking or common smut) is caused by a fungus, the living spores of which occure either in the soil or on untreated seed. The fungus infects the young seedlings, grows within them, and produces smut balls instead of wheat kernels. Each smut ball contains thousands of black spores.

Chemicals used to control bunt are quite efficient in killing the spores on the seed. Seedlings from treated seed may also be infested by smut spores living in the soil. Ceresan has been widely used for control. Hexachlorobenzene (HCB) is more effective because it not only kills the spores on the seed but provides a fair degree of protection against soil infection. The hexachlorobenzene (40 percent formulation) is used at the rate of 1 ounce per bushel of seed. Be sure the seed is completely covered by the fungicide. HCB controls smut only on wheat and should not be used for smut control on other cereals.

Dwarf or stubble smut causes dwarfing of the smutted plants. Seed treatment helps prevent spread of spores. The best protection against this disease is the use of resistent varieties.

Where leaf and stripe rust occur early in the season, they do considerable damage to wheat. Both rusts demand rather humid conditions. In the case of severe infestations, these rusts may reduce yields and cause some shriveling of the kernels.

Snow mold, or a similar disease called snowscald, costs wheat farmers in southern Idaho as much as $800,000 in some years. The disease is usually associated with heavy snow on unfrozen ground. Most of the damage takes place during the winter. A part or the entire stand may be killed. The spraying of fields, seeded in late August or early September, with 2½ pounds of Ceresan M2X with a suitable sticker-spreader in 20 gallons of water per acre in October or early November has been effective in controlling snow mold. Due to the expense, usually only those portions of fields are treated where damage is likely to occur.

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What Farmers Should Know About Phosphorus. Extension Bulletin 276.

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