

IOWA AGRICULTURAL EXPERIMENT STATION

AGRONOMY SECTION

Farm Crops

Wheat and Rye Production in Iowa

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General conditions seem to justify a more extensive production of wheat and rye on Iowa farms, both crops being reasonably well adapted to Iowa soil and climate. The most accurate figures available indicate that there is a world shortage of food stuffs which is bound to make a strong demand for cereals during the next few years. Prices for grains, and especially those used primarily for breads, will undoubtedly maintain a high level. Under such circumstances profitable returns are assured to the farmers who produce grain crops.

WINTER WHEAT

Winter wheat is one of the most profitable grain crops grown in Iowa. Average yields as reported by the United States Department of Agriculture for the 10 years, 1907 to 1916, show that the average total returns for an acre of winter wheat were larger than those from either corn, oats, spring wheat, barley or rye. (Table I.)

Winter wheat also provides a more uniform distribution of farm work. The labor of preparing the seed bed and of seeding come at a time when other farm work is less rushing than in the spring season.



Fig. 1. Part of a 56-acre field of Iowa 404 wheat located near Ames which did not winter kill during the 1916-1917 season.

TABLE I. THE AVERAGE VALUE PER ACRE OF GRAIN CROPS
IN IOWA, 1907-1916.

CROPS	Value per Acre
Winter Wheat	\$19.31
Corn	17.50
Barley	16.23
Spring Wheat	14.17
Rye	13.28
Oats	11.73

WINTER WHEAT BETTER THAN SPRING WHEAT.

Winter wheat yielded an average of $5\frac{1}{2}$ bushels per acre more than spring wheat in Iowa during the 10 years, 1907 to 1916, largely because winter wheat matures from a week to ten days earlier than the spring type. Earlier maturity as a rule means less damage from the midsummer drought or hot rainy weather which favors rust attacks. In Iowa later maturing spring wheat is frequently shriveled, shrunken and light in weight, and brings a lower market price than winter wheat. Winter wheat is more satisfactory as a nurse crop for grasses and legumes, since its earlier maturity means less competition for sunlight, moisture and plant food. On light, rolling land the covering it provides during the winter and spring also prevents undue washing and blowing of the soil.

A marked increase in the winter wheat acreage in Iowa and a corresponding decrease in spring wheat acreage is shown by the figures in table II. In 1903, Iowa grew eleven and a half times as many acres of spring wheat as winter, while only ten years later, in 1913, the winter wheat acreage exceeded spring wheat by one-third, or approximately 100,000 acres.

TABLE II. THE ACREAGE OF WINTER AND SPRING WHEAT
IN IOWA BY FIVE-YEAR PERIODS.

Period	Average Winter Wheat Acreage	Average Spring Wheat Acreage
1902-1906	68,704	871,821
1907-1911	164,800	365,800
1912-1916	422,000	318,000

The largest increase of winter wheat acreage in Iowa dates from the introduction and more general distribution of new and harder varieties. Their use has greatly reduced the danger of winter killing and the crop can be grown satisfactorily most seasons in every section of the state, if the proper seeding precautions are observed.

Every Iowa farmer may well grow a small acreage of winter wheat and those most favorably situated may profitably include this grain in their regular cropping system.

WINTER WHEAT SOIL.

The best wheat soils are medium to fine-textured, fertile and well drained such as Iowa's loams, silt loams, and clay loams. The extremely sandy or clayey soils are not so good but may be used. Altho wheat requires less plant food than corn, it responds well to fertile soil. An application of manure, added either before seeding or later as a top dressing, will be of material advantage on most soils. A top dressing of straw or manure will also protect the wheat and lessen the danger of winter killing.*

*For further information regarding soil treatment write to the Soils Department, Ames, Iowa.

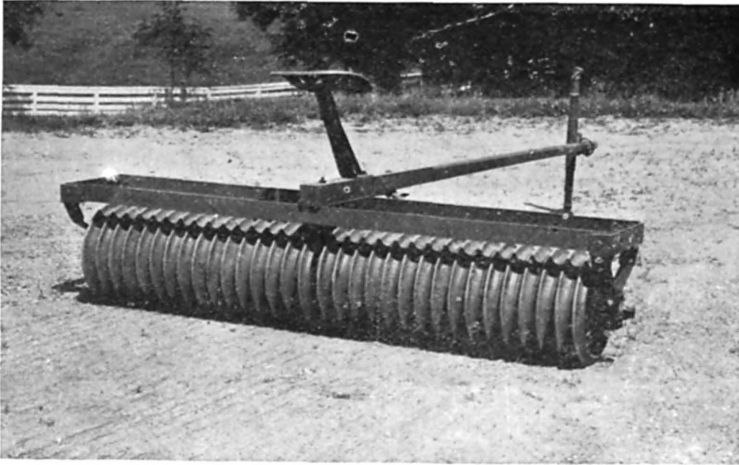


Fig. 2. The corrugated roller pulverizes and compacts the seed bed and is the best implement with which to cultivate the wheat in the spring.

DRAINAGE.

Good drainage is essential. On poorly drained soil there is danger of losing the crop by standing water or by the formation of ice in winter. Poorly drained land also has a tendency to "heave" during late winter and early spring. Wheat seeded on poorly drained land is subject to severe winter killing.

SEED BED PREPARATION.

The preparation of the seed bed largely determines the success of the crop. The seed bed should have a well pulverized surface with a firm and compact sub-surface, and be free of weeds, and amply supplied with moisture and available plant food.

PREPARING SMALL GRAIN LAND.

DISKING. Following a small grain crop it is well to disk the ground immediately after harvest. This creates a dust mulch to conserve the moisture, prevents the formation of clods, and makes plowing easier. In plowing land which has been previously disked, a close connection is established between the furrow slice and the unstirred soil below so that moisture will rise more rapidly when needed. Also, if plowing must be done later or a heavy growth of weeds is to be turned under, disking will make it possible to prepare a better seed bed.

EARLY PLOWING BEST. July or early August plowing is preferable to later plowing, because more time remains for the natural settling of the ground and for firming by frequent cultivations. Early plowing helps free the ground of weeds by destroying them before they mature seed and by causing more weed seed to germinate before the wheat is seeded. It also provides a reservoir for the rains of late summer and produces favorable conditions for plant food to be made available before seeding time. Fairly satisfactory seed beds can be prepared on late plowed land, but experiments show that the yield of grain is usually less than when plowed early.

DEPTH OF PLOWING. The proper depth of plowing depends on the character of the soil, on the amount of material being turned

under, and on the time the work is done. The general recommendation is to plow fairly deep—at least six inches—if it is early in the season, while after August 15 the plowing should be somewhat more shallow as the time before seeding is too short for the deeply plowed ground to settle thoroly. Harrowing after every half day's plowing is very advisable. The ground will pulverize more readily and less moisture will be lost from the freshly turned land if the harrow is used at once.

A WELL PREPARED SEED BED. The best beds are obtained on early and deeply plowed land which is disked or harrowed every two weeks until seeding time. The soil should be cultivated until a well pulverized and firm seed bed is obtained. Late plowed land, especially, demands considerable work to compact thoroly the lower part of the furrow slice. Wheat should not be sown on a poorly compacted seed bed since there is considerable danger of poor germination of the plants freezing or heaving under such conditions.

WHEAT FOLLOWING MEADOW. When clover or grass precedes wheat the first crop may be removed and the seed bed prepared similar to stubble land. Wheat may follow emergency crops such as sorghum and millet if a satisfactory seed bed can be prepared after their maturity.

WHEAT ON CORN LAND. When winter wheat follows corn the common method is to cut the fodder, either shocking it in the field or storing in the silo. If the corn has been well cultivated such ground will require little additional preparation. The sub-surface will be naturally well firmed and it will be necessary only to stir the surface thoroly. This can be accomplished satisfactorily by the use of a disk or spring-tooth harrow, followed by a smoothing harrow. Plowing such land is seldom advisable since it is extremely difficult to firm the soil in the short time before seeding. Cutting up the corn primarily for the wheat seeding means an added expense and in Iowa the corn often will not mature early enough to get the wheat sown in good season.

DRILLING BETWEEN STANDING CORN. Many farmers in Iowa are successfully seeding wheat between the corn rows with a one-horse drill, at the regular time of sowing. This method reduces the expense and the stalks tend to hold the snow in the winter. The practice can not be followed unless the corn has been well cultivated and is free from grass and weeds. If the corn is down badly, it will be impossible to seed the wheat; and if the corn stalks are leaning, a large number of ears will be knocked off. Also where the land is to be seeded down to meadow following wheat the surface will be rather uneven, and the stalks and other rubbish will interfere with the haying machinery during the first year. Wheat sown on corn ground usually produces slightly smaller yields than when put on well prepared land. The method makes it possible, however, to practice a cropping system in which winter wheat can be seeded cheaply, directly following corn. It is reasonably safe and sufficiently profitable to recommend for general use.

SELECTION AND PREPARATION OF SEED.

HARDY VARIETIES SUREST. Hard varieties of wheat, such as Turkey, are best in Iowa. This is a bearded, hard winter wheat and can withstand much more severe winter conditions than the common varieties formerly grown in Iowa. The Red Cross, a beardless winter wheat, is grown successfully in some sections of the state but it has not given quite as large yields in experiments conducted at Ames as the Turkey. The Iowa Agricultural Experiment station has developed a number of pedigreed strains of the Turkey variety and has distributed two of the most promising to farmers for com-



Fig. 3. The disk drill works satisfactorily on both trashy and clean land.

parison with their home varieties. One of these, known as "Iowa 404", is considerably hardier than the parent Turkey variety and yielded approximately $1\frac{3}{4}$ bushels per acre more than common varieties with which it was compared in 90 tests conducted in co-operation with farmers thruout the state during the four years, 1913 to 1916.

LOCAL SEED BEST. Experiments show that seed grown in the locality where it is to be sown, or obtained from a section having similar growing conditions, is more desirable than seed purchased elsewhere. If a suitable variety is being grown, it is seldom necessary to change seed. Owing to the unusual weather conditions serious winter killing occurred this season, however, and many Iowa communities are confronted with a local shortage for their 1917 seeding. No wheat suitable for seed should be marketed for milling purposes until the local and neighboring communities are supplied with the amount needed for seeding. There is sufficient seed available, if it is properly distributed as soon as possible. Every prospective grower should make definite arrangements immediately for his seed supply. Iowa State College does not have seed for sale, but on application the addresses of farmers and seedsmen having such seed for distribution will be sent.

FANNING ADVISABLE. The best quality seed wheat can be obtained by fanning to remove the shriveled, immature and broken wheat kernels. Fanning also removes weed seed, other grains, inert material and smut balls.

SMUTS.

Smutts are fungous diseases which grow inside the tissues of the plant and obtain their food supply from the juices which would otherwise nourish the plant. There are two kinds of wheat smut, the stinking and the loose.

STINKING SMUT. Stinking smut is known also as bunt and covered or closed smut. Its dark brown, dust-like spores ripen about the same time as the wheat and lodge on the surface of the healthy grains during harvesting and thrashing. Stinking smut can be prevented effectively by treating the seed with a formalin

solution, using 1 pint of formalin to 20 gallons of water. Twenty gallons of the solution will treat 40 bushels of wheat. After fanning to remove the smut balls, the seed should be sprinkled with the solution and thoroly stirred until all the grains are moist. After leaving in a covered pile for a few hours, dry the seed by shoveling and spreading in a shallow layer. It may be sown immediately by opening up the drill-feed to allow for the swelling of the seed. If dried thoroly, it can be stored safely for later use. Care should be exercised to avoid treated seed becoming re-infected with smut spores. Sacks, granaries and seeders may be disinfected by washing with the formalin solution. It is usually unnecessary to treat the seed every year but it will gradually become smutty again from infection in thrashing.

LOOSE SMUT. The loose or early smut appears at wheat flowering time. Its spores are blown into the flowers and send germ tubes into the developing seed. The ripened grain appears healthy but has smut threads in its germ instead of spores clinging to the surface as in stinking smut. When the seed is sown the smut develops within the plant and changes the entire head into a mass of smut spores. The only effective remedy for this disease is the modified hot water treatment. After soaking in water of ordinary temperature for from 4 to 6 hours, submerge the wheat, first for a few minutes in water showing approximately 120° Fahrenheit, and then for 10 minutes in water held at 129°. Owing to the inconvenience and difficulty with which grain is accurately treated by this method, it is suggested that if possible new seed which is known not to contain smut be obtained.

SEEDING.

DRILLING PAYS. Experiments conducted at a number of stations show marked advantages for drilling over broadcasting. Drilling gave 4.2 bushels more than broadcasting in a four-year test at the Iowa Agricultural Experiment station. It is only in the exceptionally favorable seasons that broadcasted winter wheat succeeds. Drilling provides a more uniform distribution and covering for the seed, reduces the danger of winter killing, and generally produces larger yields of grain. The shoe drill, the hoe drill or the disk drill will all do satisfactory work on a well prepared seed bed. The disk type is preferred on trashy land.

RATE, DEPTH AND TIME OF SEEDING. The recommended rate of seeding is 5 to 7 pecks per acre. Approximately 2 inches is the proper depth under average soil and seed bed conditions. The time of sowing varies from the first half of September in the southern part of the state to as late as October 1 in the southern tiers of counties. The idea is to seed early enough to allow the plants to get well established and to make sufficient growth to cover the ground before winter begins. The time of seeding in southern and central sections should be delayed as late as possible to lessen the danger from Hessian fly attacks.

HESSIAN FLY.

The Hessian fly is the most common insect pest attacking winter wheat. A fall and spring brood normally appear in Iowa during seasons when the insect is prevalent. The mature fly is a small dark, two-winged insect, which lays its eggs on the leaves of the plant in early fall. These eggs hatch in about a week into larvae, or small pale white worms, which suck the plant juices from the stem within the leaf sheath near the roots. The larvae soon change to the pupae or "flax-seed" stage, remaining inactive until spring when they appear as adult flies. Eggs are again deposited and the same stages of the insect occur before autumn. The larvae of the spring brood, however, locate on the stem above the ground, weak-

ening the plant so that a reduction in grain yield results and often the straw breaks at the point of attack. The most effective control measures consist of: (1) Either deeply plowing under the stubble as soon as possible after harvest, or otherwise burning. This destroys the insect when in the "flax-seed" stage; (2) thorough cultivation or plowing under of all volunteer wheat in early fall and spring to destroy their breeding ground; (3) late seeding by all wheat growers in a community to avoid eggs being deposited on the young wheat, and (4) rotating crops in order to starve the fly. Wheat is the grain on which the insect feeds to the greatest extent, and hence here is more danger of fly attacks where crops are not changed. (For a complete discussion of the Hessian fly write to the Iowa Agricultural Experiment station for Circular No. 22.)

CULTIVATION.

Rolling wheat in the spring soon after the frost is out of the ground is often advisable, especially on "heaved" land. The corrugated roller is best for this purpose since it not only firmly presses the dirt around the exposed wheat roots, but also tends to form a surface mulch which retains moisture and encourages a thrifty plant growth. Drag-harrowing heavy soil in a dry season will stir the surface crust; but the results of rolling have been more satisfactory.

PASTURING.

Moderate pasturing of wheat fields in late fall and winter is frequently practiced in southern wheat sections. The practice is advisable in Iowa only when there is an exceedingly rank fall growth; and then, precautions should be taken not to pasture closely, or when the ground is wet. Late spring pasturing is always to be avoided.

HARVESTING AND THRASHING.

Winter wheat ripens from one week to ten days earlier than most spring sown small grains. Careful shocking with caps is necessary to permit thorough curings and to protect the grain from exposure to rainy weather. Stacking the wheat, especially where thrashing cannot be done until several weeks after harvest, will result in a better quality of grain and straw than where the bundles are left exposed in shocks. Stacking grain adds to the total harvesting and thrashing expense but in many seasons the increased value of the grain will more than balance the additional labor item. Whether or not to stack depends on local arrangements for thrashing, available labor supply and the acreage of the crop.

SPRING WHEAT.

Altho spring wheat cannot be produced as profitably in Iowa as winter wheat, a limited acreage will for various reasons continue to be sown. It will occasionally be used to thicken or replace a stand of winter killed grain. Men moving onto new farms in the spring as owners or tenants will of necessity sow small grain such as spring wheat.

The winter wheat discussion will apply in a general way to spring wheat production and special mention need be made only of those cultural methods which differ. Unless there is danger of the land washing or blowing during the winter the ground for spring wheat may be plowed the previous fall. The plowed furrow slice is best left undisturbed until spring, but should then be cultivated as early as possible. Where cornstalk or stubble land is not worked until spring the ground can be prepared either by plowing to a medium depth or by disking and harrowing.

Seeding as early as possible with a drill is recommended. Altho drilling is not so essential with spring as with winter wheat, there

are sufficient advantages to recommend the practice. The varieties commonly grown in Iowa are—Early Java and Marquis. The early Java is bearded, whereas the Marquis is practically smooth chaffed.

WINTER RYE.

Rye is a comparatively unimportant crop in Iowa. As an average for 10 years the rye acreage of this state was one-sixth as large as winter wheat and one-hundredth as great as the area devoted to oats. Reference to table I shows that the returns from rye are not as large as from most of the other cereals. There is also a relatively small demand and a limited use for rye grain. Rye can be utilized to better advantage than the other small grains for pasture, soiling, green manure and cover crop purposes. It is not likely, however, to replace wheat, oats and barley as a general farm crop.

ADAPTION. Rye thrives best on well drained, fertile loam soils; but will grow better than most grains on light, sandy, poor land, which is not in good physical condition. It is also the best grain for alkali or acid soils. The crop is hardier than winter wheat and therefore is surer when grown under adverse soil and climatic conditions.

CULTURAL METHODS. Rye is seldom sown in Iowa as part of the regular rotation. It is usually grown as a secondary or special purpose crop. The seed bed and seed preparation, as well as the seeding practices, correspond closely to those outlined under winter wheat. When grown for grain, about 6 pecks of seed sown between September 1 and 20 are satisfactory. If the crop is intended for pasture or for green manure and cover purposes a few weeks earlier seeding will provide a larger growth. Eight pecks per acre is the usual seeding rate for pasture and soiling.

VARIETIES. Winter varieties give much larger yields than the spring. Only a few distinct varieties of rye are available. The Rosen, Wisconsin No. 1, Wisconsin No. 2, and Minnesota No. 2 are improved strains which were selected by the Michigan, Wisconsin and Minnesota experiment stations. These varieties have not been grown at the Iowa station, but favorable reports from other states indicate that they will probably give more satisfactory results in Iowa than common winter rye. Seed of the Rosen rye may be purchased thru the Crop Improvement Association, East Lansing, Michigan; the Wisconsin Nos. 1 and 2 can be obtained thru the Agricultural Experiment Association, Madison, Wisconsin; and the addresses of growers of Minnesota No. 2 will be sent upon application to the Minnesota Experiment station, St. Paul, Minnesota.

RUSTS OF WHEAT AND RYE.

Rusts are fungous diseases which attack growing plants and interfere with the manufacture of plant food. Both the orange leaf-rust and the black stem-rust affect wheat and rye. The leaf-rust is common practically every year, but the stem-rust seldom does damage in Iowa. The former occurs earlier in the season, but does not injure the grain so seriously as the latter. Severe attacks of either cause shrivelled kernels and low yields of grain. There are no effective remedies for rusts. They can be prevented to a limited extent, but not completely controlled. The preventative measures which will reduce the seriousness of the attacks are: (1) Thoroughly draining the soil; (2) eradicating the common barberry bush; (3) sowing pure seed on fields free from weeds and grass; (4) using early maturing varieties; and (5) seeding rust-resistant varieties, if they are otherwise desirable