



B-400

A NEW, EARLY VARIETY OF
WINTER BARLEY FOR MISSOURI

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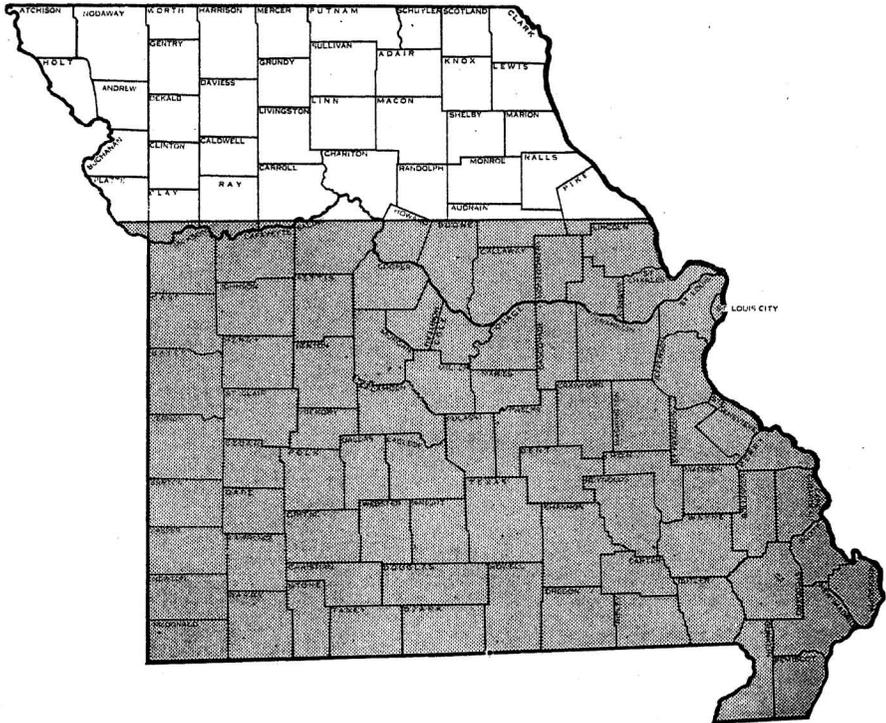


Fig. 1.—With good cultural practices, the new B-400 variety of winter barley is a safe crop to grow in central and southern Missouri as shown by the shaded area on this map.

B-400, A NEW, EARLY VARIETY OF WINTER BARLEY FOR MISSOURI

J. M. POEHLMAN¹

Mo. B-400 is a new, early maturing variety of winter barley adapted to central and southern Missouri. Its superior qualities are earliness, high grain yield, strong straw and disease resistance. B-400 is fully winter hardy in southern and central Missouri, where barley is now being grown. The rapid and vigorous growth of B-400 makes it an excellent variety to use for fall pasture.

How B-400 Was Developed

In 1936, the late B. M. King made a large number of crosses between various winter hardy varieties of the rough-awned Tennessee winter type, and selections from the local Missouri Early Beardless variety. One of these rough-awned varieties, Kentucky No. 5, was crossed with four Missouri Early Beardless selections chosen on the basis of their earliness, vigor, and freedom from loose smut. In the third generation the four crosses were bulked and continued in the breeding nursery as a Kentucky 5 x Missouri Early Beardless cross. The strain described here, under the name Mo. B-400², was increased from a single plant selection made by the writer in 1942 from the sixth generation of this bulk progeny. It has been tested under the experimental numbers Mo. B-546 and C. I. 7568.

Mr. King's original objective in making these crosses was to obtain a more winter-hardy, hooded variety. Although both hooded and awned selections were originally made in about equal proportions from the bulked progenies of the Kentucky 5 x Missouri Early Beardless cross, all of the hooded selections were rapidly eliminated from the breeding nursery as a result of their shattering and low yields. Only the rough awned selections were increased for advanced yield testing. By its earliness, freedom from natural infections of loose smut and resistance in the

¹Acknowledgement is made to W. R. Langford, formerly Assistant Professor of Field Crops, W. P. Sappenfield and C. K. Cloninger, formerly Assistant Instructors in Field Crops, and to Carl Koehler, Graduate Assistant in Field Crops, for assistance in conducting outlying yield tests; and to Richard Morris, Gilman City, Missouri, C. L. Van Buren, Lathrop, Missouri, and to Hoeh Brothers, Uniontown, Missouri, for furnishing land and otherwise assisting with the outlying tests.

²The name, Mo. B-400, has been selected for this variety, conforming to the system of naming crop varieties developed at the Missouri Agricultural Experiment Station. Under this system barley varieties will be designated with the letter B followed by a number in the 400 series.

field to spot blotch, the B-400 selection soon gained favorable recognition in the breeding nursery. Its high yield and winter hardiness was demonstrated in later tests.

Grain Yields of B-400

Comparative grain yields of B-400, Reno and Missouri Early Beardless varieties of winter barley in yield trials conducted in Missouri during the six-year period 1945 to 1951 and in cooperative U. S. Department of Agriculture uniform yield tests¹ for the three years, 1948, 1949, and 1950, are reported here.

Average Grain Yield in:	Number of tests	B-400	Reno	Missouri Early Beardless
		bu/A	bu/A	bu/A
Missouri tests, 1945 to 1951	22	46.7	43.0	33.8
USDA uniform tests, 1948-50	61	46.4	45.7	35.0*

*Yields of Missouri Early Beardless in the uniform test are average of 45 tests in 1948 and 1949 only.

These results show that grain yields of B-400 have consistently exceeded those of Reno and Missouri Early Beardless, varieties commonly grown in Missouri, not only in the Missouri yield trials, but also in the U. S. Department of Agriculture uniform nurseries. The Missouri tests were grown at Columbia, Bethany, Lathrop, Pierce City, Perryville, and Sikeston, Missouri, and the U.S.D.A. uniform nurseries were grown in 13 to 18 states each year in the northern winter barley area. These uniform tests, extending eastward from Kansas and Oklahoma to Virginia and New Jersey, were mostly in a latitude similar to that of Missouri. Results of Missouri tests provide local yield comparisons, while the uniform tests indicate comparative performance over a wider range of soil and seasonal conditions.

Winter Hardiness of B-400

B-400 has a high degree of winter hardiness, almost equaling Reno in this respect. This is illustrated by the comparative survival percentages in Missouri tests as well as in the U. S. Department of Agriculture uniform winter barley nurseries.

Average survival in:	Number of comparisons	B-400	Reno	Missouri Early Beardless
		per cent	per cent	per cent
Missouri tests, 1945-51	23	86	89	78
USDA uniform tests, 1948-50	51	71	74	64*

*Survival of Missouri Early Beardless in uniform tests is an average of 31 comparisons in 1948 and 1949 only.

¹The "uniform tests" are conducted by the Bureau of Plant Industry Soils and Agricultural Engineering, U. S. Department of Agriculture in cooperation with the 13-18 state agricultural experiment stations in the northern winter barley area. About 20 varieties and strains are grown each year in these tests. Acknowledgement is made to Dr. G. A. Wiebe for permission to use this data here.

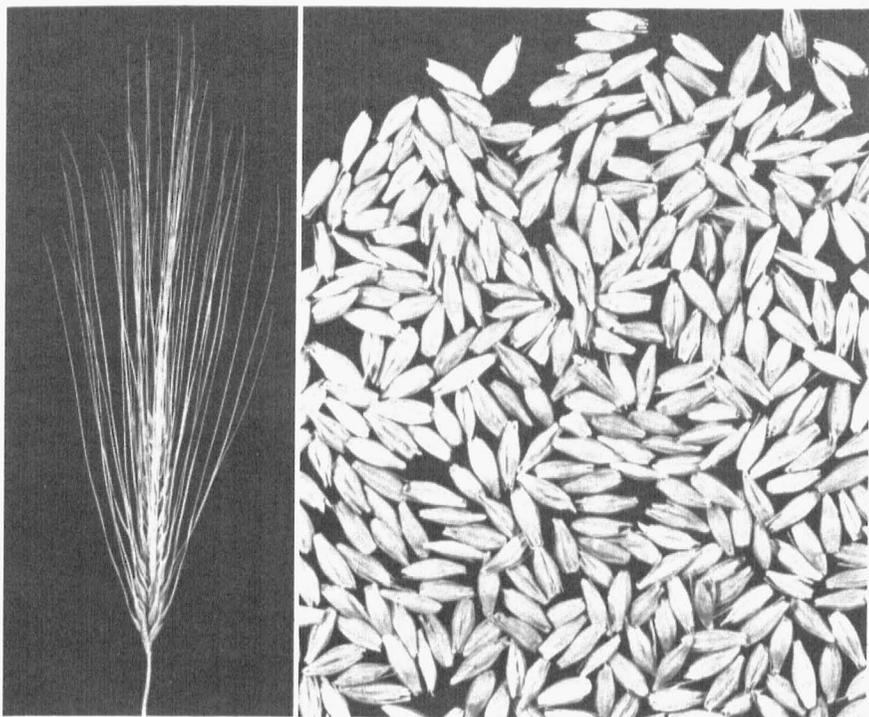


Fig. 2—Head and seed of the B-400 variety of winter barley.

The single quality most needed in a winter barley for Missouri is sufficient hardiness to survive the winters. It is superior winter survival that has contributed to the wide use of Reno in Missouri. The Missouri tests reported above include data from Bethany and Lathrop in northwest Missouri, an area where barley is not generally considered a safe crop, and survival percentages are somewhat lower than if only data from the tests in central and southern Missouri had been included. Likewise many of the stations where the U.S.D.A. uniform nursery was grown are located north of the safe winter barley producing area. But it is from these tests located in areas where winters treat the barley severely, that the true relative hardiness of varieties may be learned.

Our results with tests of B-400 in central and southern Missouri indicate that it is fully hardy and may be safely used in the areas of Missouri where winter barley is now grown. This includes all the area south of the Missouri River and counties bordering the river on the north. Reno will continue to be a recommended variety, along with B-400, north of the Missouri River. Yield tests in the northern area have demonstrated that when winter injury is sufficient to reduce yields, Reno sometimes outyields B-400.



Fig. 3.—Many winter barley varieties and new experimental strains are tested by the Missouri Agricultural Experiment Station at Columbia and on outlying experimental fields. The variety, B-400, was released to Missouri farmers in 1950 after extensive research which began with the crossing of the Kentucky 5 variety and selections from Missouri Early Beardless in 1936.

Earliness of B-400

One of the most desirable qualities of B-400 is its earliness. In date of heading it is similar to Missouri Early Beardless and will average about five days earlier than Reno.

	B-400	Reno	Missouri Early Beardless
Average date of heading at Columbia, Missouri, during the 8-year period, 1944 to 1951	May 7	May 12	May 7

B-400 can usually be harvested during the first ten days of June at Columbia and often by June first to fifth in the southern part of Missouri. This early harvest of a grain feed crop is especially useful to the livestock farmer whose grain supplies are usually low at that time of year. This feature of early harvest also reduces the risk of storm damage, and enables the barley to escape late attacks of disease or insects. Perhaps the most valuable contribution of earliness is the promotion of the legume or grass crop following the barley, as the early variety of barley makes a superior companion crop in which to seed these valuable forages. Also,

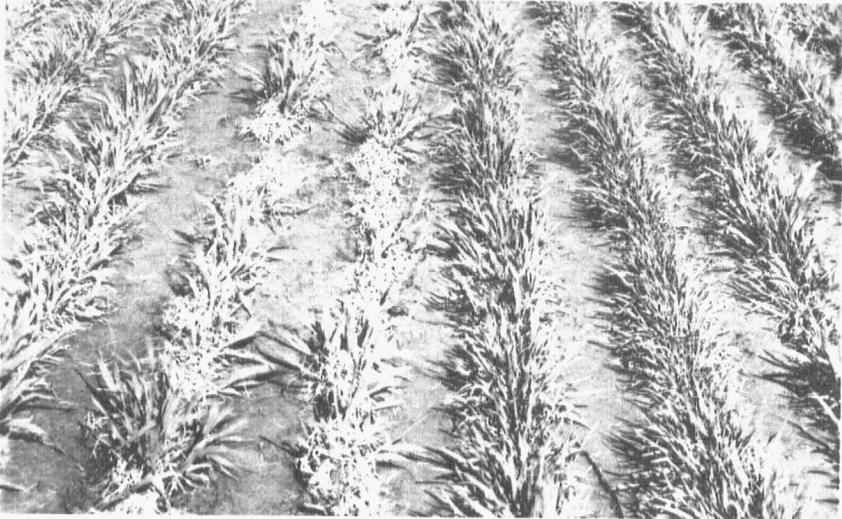


Fig. 4.—Barley varieties vary in their ability to overwinter as may be observed by comparing the survival of a semi-hardy strain (left) with that of a hardy variety (right) in the barley breeding nursery at Columbia. B-400 has proved to be fully hardy in central and southern Missouri.

the practice, increasing in use, of rotating a spring grain crop with soybeans can be most easily carried through by the use of an early maturing grain like the new B-400 variety of barley.

Straw Stiffness of B-400

A feature of B-400 that makes it more desirable than Reno is the stronger straw. A comparison of lodging in B-400, Reno, and Missouri Early Beardless varieties of winter barley is made here. Comparisons were obtained from tests grown at several locations in Missouri and include observations on both binder and combine harvested plots.

	B-400	Reno	Missouri Early Beardless
	per cent	per cent	per cent
Average lodging in 12 tests in Missouri	21	28	29

Barley straw is weaker than straw of wheat or oats. When left for the combine it may break just below the barley head, resulting in some loss of yield. Straw of B-400 is stronger than that of Reno or Missouri Early Beardless, although still not as strong as desired where one plans to combine the barley.

Losses from shattering, in which the seed drops out of the head before harvest, should be distinguished from losses by lodging, which results from bending or breakage of the straw. Neither B-400 nor Reno will shatter as badly as does a hooded variety like Missouri Early Beardless.

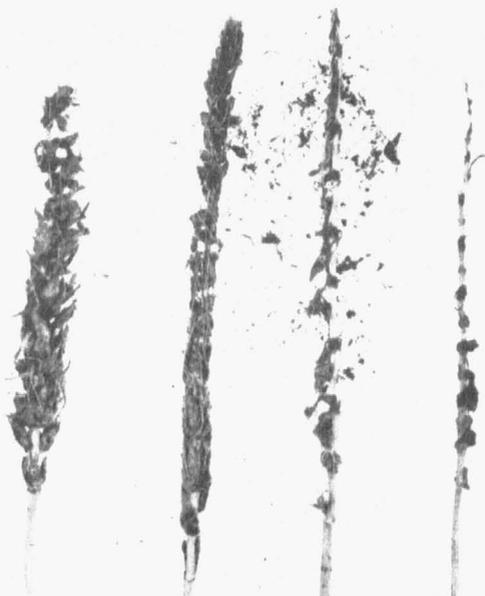


Fig. 5.—These heads of barley have been destroyed by the loose smut fungus, a disease commonly found in the older Reno variety. B-400 has shown good resistance to local strains of this disease.

The height, or length of straw may also affect the amount of lodging, but in this respect the B-400, Reno and Missouri Early Beardless varieties do not differ.

Where barley is to be combined, losses from both lodging and shattering may be reduced by cutting and windrowing the barley at the stage of maturity that it would normally be cut with a binder, and then combining from the windrow with a pickup attachment. The stubble holds the straw off the ground and permits rapid drying of the barley crop.

Bushel Weight of B-400

The bushel-weight of barley is determined, not only by the plumpness of the kernel, but also by the length of the awn or hood which remains attached to the grain. B-400 normally produces a plump, heavy kernel, but the awns have a tendency to break off leaving a short stub, rather than breaking close to the kernel. This prevents the grain from packing closely in the kettle when a measurement of bushel-weight is being made, and reduces the test weight. Comparisons of bushel-weight of B-400, Reno and Missouri Early Beardless are made below:

	B-400	Reno	Missouri Early Beardless
	lbs./bu.	lbs./bu.	lbs./bu.
Comparison of bushel-weight in 22 tests in Missouri, 1945 to 1951	43.2	45.0	37.4

The bushel weight and quality of B-400 may be somewhat improved by setting the concaves in the combine closer together during harvest; through careful regulation, the awns may be broken off closely without unnecessary cracking of the kernels.

Disease Resistance of B-400

One of the serious objections to Reno and similar varieties has been their susceptibility to the smut diseases. The disease resistance of B-400 is an improvement over these older varieties in several respects, as will be described here.

Smut Resistance—Of the three types of smut normally occurring in barley, the floral infecting, brown loose smut (*Ustilago nuda*) is the most serious because it is the most difficult to control

This type of smut infects the flower and develops inside of the seed. The seed appears normal when planted, but as the developing plant matures, it becomes smutted. Seed treatments by which the seeds are dusted with a fungicide are ineffective and only the heat-penetrating hot-water method of treating the seed will kill the smut.* But this method of seed treatment is difficult to employ without special equipment not generally available on the farm, and germination of the seed is often reduced when the seed is treated by this method. The breeding of resistant varieties offers a desirable method for its control.

It was observed very early that the selection named B-400 was relatively free of loose smut while other selections from the same cross, as well as Reno and similar susceptible varieties growing beside it in the breeding nursery, contained many smutted heads from natural infection. When this strain was artificially inoculated with a collection of loose smut from Reno, it remained free of smut, although in Reno, inoculated in a similar manner, there would develop heavy infections of the smut disease.

Comparisons of the percentage of smutted heads in B-400 and Reno from natural infection after these varieties had been growing in adjacent nursery rows for a period of eight years were made in 1951. These are given below along with the average percentages of smutted heads during the six years of artificial inoculation studies.

	B-400	Reno
Per cent of smutted heads in 1951 from natural infection	per cent 0.1	per cent 9.5
Per cent of smutted heads using artificial inoculations (6-year average)	0.5	49.0

These data indicate that B-400 has a great deal of resistance, at least to local collections, of the loose smut organism. This smut resistance has been inherited from the Missouri Early Beardless parentage. It is pos-

*See Missouri Agricultural Experiment Station Bulletin 508, Winter Barley in Missouri.



Fig. 6—Certified seed-increase field of Mo. B-400 winter barley on the Hoeh Brothers Farm, Perry County, Missouri.

sible that other strains of the same loose smut may be present in the field that will later infect B-400. In fact, some artificial inoculations made with collections of smut from different sources strongly indicate this possibility. In most of the certified seed fields of B-400 barley, a trace of loose smut has been observed. This has also been true in the nursery, yet the infection in B-400 has not (in eight years) built up to more than 0.1 per cent. As long as the amount of smut naturally occurring in the field remains at this low level, losses will be insignificant, when compared to the losses resulting from growing a susceptible variety like Reno. Should it become evident that the amount of loose smut in B-400 is increasing, then it would be highly desirable to treat the seed by the hot water method immediately. Even a few bushels treated and planted in an isolated field would provide a source of smut-free seed to use the following year, and might prevent the establishment of a new race of smut to which this variety might prove susceptible.

B-400 is susceptible to the black loose smut (*Ustilago nigra*) and to covered smut (*U. hordei*), but these two smuts may be easily and effectively controlled by treatment of the seed with New Improved Ceresan or Ceresan M. These treatments also have value in controlling various root rotting fungi that are seed borne, and should be carried out regardless of whether the two latter smuts are present.

Mildew Resistance—Mildew is a disease in which a white, mold-like

growth develops on the surface of the leaves soon killing them and reducing the yield of the plant. The development of this disease is favored by warm, humid weather. When these conditions prevail, either in the fall or spring, mildew may be found on winter barley in Missouri, although infections here are never as numerous or as severe as in the more humid areas of the winter barley area and often do not develop at all. B-400 has shown considerable resistance to these epidemics of mildew in the field in Missouri. On this variety the disease will usually produce dark blotches on the leaves, in which some evidence of the mold-like growth may be seen, but the mycelium never spreads and envelops the entire leaf as in susceptible varieties like Reno and Missouri Early Beardless. While this resistance may not be adequate for protection from the more serious outbreaks of the disease, it apparently affords considerable protection from the light epidemics of mildew more common in Missouri.

Spot Blotch Resistance—Spot blotch, caused by the organism *Helminthosporium sativum*, may infect the root system, produce lesions on the seedling plant, or cause a blighting of the heads. The latter symptom is not generally found in Missouri, most infections here generally occur only in the fall when warm humid weather follows early seeding of the barley crop. Under these conditions the root injury, combined with development of lesions on the seedling plant, often results in killing many of the older leaves, and gives a yellow appearance to the field; a condition often spoken of by farmers as barley “yellows.” In the fall of 1944 and again in the fall of 1946, this condition was widespread in the barley breeding nursery at Columbia. Under these conditions the B-400 strain of barley was injured much less severely than Reno or Missouri Early Beardless. Estimates of the percentages of leaf tissue killed on the varieties, are given here.

	B-400	Reno	Missouri Early Beardless
	per cent	per cent	per cent
Per cent of leaf tissue killed, fall 1944	7	15	15
Per cent of leaf tissue killed, fall 1946	2	12	20

The apparent resistance to spot blotch in this barley strain, along with observations on its earliness and freedom from loose smut infections, were important among the reasons for its early selection in the nursery as a possible new variety and its subsequent rapid increase for distribution.

When B-400 was first distributed considerable publicity was given to its resistance to barley “yellows” caused by the spot blotch disease. It should be pointed out that many other conditions—leaf rust injury, aphid injury, fertility deficiencies, drought—can also cause yellowing and a similar appearance in the fall-seeded barley. Under these latter conditions B-400 may be injured as severely as other varieties. Since the organism causing the spot blotch disease is widely distributed and is known to

be differentiated into numerous strains, the resistance of B-400 may also vary in different production areas.

Use of B-400 for Pasture

The rapid and vigorous growth of B-400 makes it a desirable variety to use for fall pasture. It has a wide leaf, like Missouri Early Beardless, and its resistance to mildew and spot blotch reduces the leaf injury that may occur in certain seasons from these diseases. For maximum forage production B-400 should be seeded early and fertilized heavily.

Increase and Distribution of B-400

In the fall of 1947 one bushel of the B-400 barley was seeded on the Southeast Missouri Experiment Field at Sikeston. This has been increased rapidly and in 1951 over 25,000 bushels of certified seed was produced in Missouri. For a list of growers of certified seed, see your *county agent*, or write to the *Missouri Seed Improvement Association, Columbia, Missouri*.

Safe Production of Winter Barley

Winter barley is a safe crop to grow in central and southern Missouri; with good production practices, its use may be extended well into northern Missouri. Below are summarized a few of the production practices that will increase the safety of the winter barley crop in Missouri.

1. **Plant Early.**—When barley is to be used for fall pasture, plant about September 1 in central Missouri, and about September 10 in southern Missouri. If it is not to be used for fall pasture, seeding may be delayed until September 15 in central Missouri or September 30 in southern Missouri. A heavy top growth and full development of the root system before cold weather reduces the winter injury and helps prevent serious losses from soil erosion. There is no danger from excessive growth and jointing if the planting dates above are observed.

2. **Fertilize Well.**—Barley is not a poor land crop. Heavy applications of fertilizer, according to the specific needs of the soil, will promote the early development of a vigorous root system, add to the forage production, and increase winter survival. Excessive applications of nitrogen may cause some lodging. This danger is lessened where the barley crop is pastured.

3. **Plant a Hardy Variety.**—Early planting and heavy fertilization are not substitutes for a hardy variety. B-400 is recommended for use in central and southern Missouri. Reno is also recommended north of the Missouri River.

4. **Treat the Seed Before Planting.**—The value of seed treatment, with New Improved Ceresan or Ceresan M cannot be over-emphasized. It will control the surface-borne smut diseases. It will insure better stands and increase seedling vigor by killing many seed-borne disease fungi.

5. **Control Insects.**—Watch for insect attacks, especially army worms, which may choose to feed on the early ripening barley and can quickly ruin a crop. Your *county agent* can advise you regarding the newest insecticide and its use.