DRAFT

THE
UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
WASHINGTON, D.C.

and

MONTANA AGRICULTURAL EXPERIMENT STATIONS
MONTANA STATE UNIVERSITY
BOZEMAN, MONTANA

and

WYOMING AGRICULTURAL EXPERIMENT STATIONS
UNIVERSITY OF WYOMING
LARAMIE, WYOMING

NOTICE OF RELEASE OF EKALAKA GERMPLASM BUR OAK SELECTED CLASS OF NATURAL GERMPLASM

The U.S. Department of Agriculture, Natural Resources Conservation Service-Bridger Plant Materials Center, Montana Agricultural Experiment Stations-Montana State University, and Wyoming Agricultural Experiment Stations-University of Wyoming, announce the selected class pre-varietal release of Ekalaka Germplasm bur oak *Quercus macrocarpa* Michx. for the northern Great Plains and valleys of the intermountain West. This selection was evaluated and selected by the staff from the USDA-NRCS Plant Materials Center, Bridger, Montana.

As a selected class release, this selection will be referred to as Ekalaka Germplasm bur oak, NRCS accession number 9087732.

Justification for alternative release is based on a critical need for well-adapted plant materials for windbreaks and shelterbelts in the northern Great Plains and Intermountain West. In addition, the emergence of the emerald ash borer will create an urgent demand for medium-stature deciduous trees to replace green ash *Fraxinus pennsylvanica* Marsh in numerous conservation practices. A lack of tested and adapted germplasm and the potential use of non-adapted seed sources further support selected class release. Additionally, this selection originates from a bulk of several northern Great Plains seed sources that should prove well adapted to the conditions in the intended geographic area of use. Ekalaka Germplasm bur oak was selected for superior seedling survival, rate of height growth, and form, relative to other bur oak individual trees and seed sources tested. Ekalaka Germplasm bur oak can also be used in other conservation applications such as reforestation, xeriscaping, woody draw restoration, and wildlife habitat enhancement.

Collection Site/Seed Source Information: The original Ekalaka Germplasm bur oak (accession number 9087732) seed collections were made in various locations across the Great Plains (see TABLE 1). In 1991, the Bridger PMC entered into a cooperative bur oak study initiated by the GP-13 Improved Trees Task Force and

organized by W. R. Schroeder of the Prairie Farm Rehabilitation Administration (PFRA) Shelterbelt Centre at Indian Head, Saskatchewan, and Richard Cunningham of the ARS-Northern Great Plains Research Lab at Mandan, North Dakota. The goals of the study include the following:

TABLE 1. Bur oak seed source origin, Bridger PMC, Bridger, MT.

Accession Number	Seed Source Identification	County of Origin	State
9076042	103	McKenzie	ND
9076043	106	Griggs	ND
9076044	111	Burleigh	ND
9076045	112	Pennington	SD
9076046	122	Bottineau	ND
9076047	128	Oliver	ND
9076048	139	Dunn	ND
9076049	142	Carter	MT
9076050	151	Emmons	ND
9076051	209	Bottineau	ND
9076052	211	Stark	ND
9076053	218	Oliver	ND
9076054	219	McKenzie	ND
9076055	226	Burleigh	ND
9076056	227	Burleigh	ND
9076057	228	Sioux	ND
9076058	236	Morton	ND
9076059	237	Morton	ND
9076060	250	Emmons	ND
9076061	Tree A	Carter	MT
9076062	ETTII	Carter	MT
9076063	Tree B	Carter	MT
9076064	144	Carter	MT
9076065	Tree 3	Carter	MT

1.) to identify the nature and extent of genetic variation among selected sources of bur oak

2.) to provide genetically improved bur oak seed for shelterbelt plantings

3.) to provide germplasm for selection and trait improvement research and advanced generation breeding.

In conjunction with the GP-13 goals, the MITOSIS (Montana Interagency Tree and/or Shrub Improvement Study) program seeks to improve the quality and diversity of the nursery stock produced by the Montana Conservation Seedling Nursery for windbreak and shelterbelt applications. After data was collected for the GP-13 study, selections of individual trees and families with superior traits were retained and used to establish a foundation seed orchard for the production of superior germplasm for release to cooperating agencies and the commercial nursery industry.

Wildland bur oak seed collections were made in 1991 and 1992 from individual trees demonstrating superior phenotypic characteristics. These characteristics included single, straight stems with strong apical dominance, well-formed crowns, at least 30 years of age and the production of abundant crops of sound acorns. Acorns were shipped to study cooperators in 1992 and 1993 for propagation.

Propagation of test plants for this study began in late fall of 1991 when 5 Montana sources were collected and sown in the greenhouse at the PMC. These collections were not all original GP-13 test accessions but were included in the Bridger planting in order to generate more information about the performance of Montana sources of bur oak. On February 25, 1992, the Bridger PMC received 468 acorns representing 16 additional accessions collected from sites in Montana, North Dakota, Oklahoma, and South Dakota.

DRAFT

On February 3, 1993, the Bridger PMC received a second shipment of 300 acorns, representing 10 additional accessions. These accessions were from different trees in the same counties as those received in 1992. All counties represented in the second group of collections were also represented in the first group.

Description: Bur oak or mossycup oak is a medium- to tall-stature deciduous tree widely distributed across the US and native to limited areas in Montana and Wyoming. The bur oak has several desirable attributes including a strong branching structure, drought tolerance, winter hardiness, and freedom from serious insect or disease problems. Acceptance of bur oak for use in windbreaks and shelterbelts has been limited do to a reputation for slow growth and a multi-stemmed habit of seed sources at the western edge of its natural range. The goal of this study was to assemble, evaluate, select and release a population of bur oak demonstrating superior seedling survival, sustained rate of adequate height growth, superior overall plant vigor rating, as well as good overall form.

Bur oak is a hardy, drought-tolerant tree capable of growing over a wide range of soil conditions. A combination of high water use efficiency and a fast growing tap root enable this species to withstand the dry, windy conditions characteristic of the northern plains. Bur oak has a large, native range extending from Nova Scotia, west to Manitoba, south through Kansas to Texas, east to Alabama, and northeast to Virginia and New England. In Montana, it occurs only in Carter County (which is in the extreme southeastern corner of the state) in uncultivated, natural stands. Landscape specimens can be found in many Montana communities over much of the state. Most references list bur oak as hardy in USDA Winter Hardiness Zones 4 to 8, although Zone 2 is given in at least one source. Bur oak is considered only moderately shade tolerant.

Although it favors rich bottomland alluvials, bur oak can grow well on rocky hillsides, limestone soils, dry clays, and other marginal sites -- given full sun conditions. This species even performed better than most others tested on coal-mine spoils of pH 5.6 in eastern Kansas. In the western United States bur oak is considered a pioneer species and is capable of invading prairie grasslands. In the eastern Great Plains it occurs primarily along stream bottoms and stream terraces in association with green ash (*Fraxinus pennsylvanica*), boxelder (*Acer negundo*) and cottonwood (*Populus sp.*). Bur oak is, however, intolerant of flooding.

On good sites, bur oak has a spreading habit with a broad crown, massive bole, and low, large branches. It is capable of reaching heights of 25 to 28 meters (82.0 to 91.9 ft), and individual trees up to 30.5 meters (100 ft) are common on good sites. An individual tree with a height of 51 meters (170 ft) and a d.b.h. (diameter breast high) of 213 centimeters (84 inches) has been reported in the lower Ohio Valley. In Montana, heights of 15 meters (49.2 ft) can be considered about the upper limits of growth.

Although bur oak is monoecious, with both male and female flowers on the same plant, cross pollination between individual trees appears to be favored. Acorns ripen in one year and can fall as early as August or as late as November depending on the tree and location. Acorns can usually germinate immediately without pretreatment but may require some cold stratification when collected from sources in northern climates. The average minimum seed bearing age of forest trees is approximately 35 years with best production typically between 75 to 150 years. Good crops usually occur every 2 to 3 years. It may be necessary to check seed bearing trees regularly in order to assure getting to the acorns before the wildlife do.

Serious insect and disease problems are relatively limited for bur oak in the western United States. Reported insect problems include oak webworm, oak skeletonizer, leaf miner, variable oakleaf caterpillar, June beetles and oak lacebug. Oak lacebug can be a serious problem in shelterbelt plantings, especially during drought conditions. Fungal pathogens are also known to occur but disease does not appear to be a major problem with this species.

In addition to its windbreak and shelterbelt applications, bur oak has several other positive attributes and uses. This species makes an impressive street tree and large landscape plant. Individual trees exhibit wide variation in fall color with some plants turning brilliant shades of red and orange. The wood of bur oak is quite valuable and is often marketed as white oak. Bur oak acorns are a favored food for numerous wildlife species.

Despite its tolerance of a wide range of site conditions, bur oak has not been widely used in conservation plantings. The primary limiting factor for its lack of acceptance has been its reputation for slow rate of height growth, which is about 4.6 to 6.1 meters (15 to 20 ft) per 20 years. In addition, seed sources at the western edge of its natural range tend to have poor form. There appears to be much opportunity for selecting a genetically improved strain capable of sustaining greater rates of height growth and improved form.

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Method of Selection: Ekalaka Germplasm bur oak is being released as a 'Natural–Track' germplasm, i.e., it is being increased without purposeful manipulation. This selection was based on a comparison of 24 seed sources of bur oak from the northern Great Plains. Selection was based on a combination of sustained rate of annual height growth, seedling survival, and plant vigor rating. Final selections appear in TABLE 2.

TABLE 2. Bur oak provenance study, mean performance data, final selections (bold), Bridger, Montana, 2003.

Accession Number	Study I.D.	County	State	Original Number Planted	Number Selected	Percent Survival	Mean Height	Mean Basal Caliper	Mean DBH	Mean Vigor Rating	Percent of Plants with Tree Habit	Mean Number of Leaders	Mean Form Rating
							cm	*mm*	*mm*	*(1-9)*	*%*		*(1-9)*
9076057	**228**	**Sioux**	**ND**	**16**	**9**	**93.8**	**288.7**	**66.4**	**31.3**	**3.1**	**60.0**	**1.5**	**4.0**
9076055	**226**	**Burleigh**	**ND**	**16**	**11**	**93.8**	**282.3**	**61.3**	**29.3**	**3.5**	**93.3**	**1.3**	**4.4**
9076053	**218**	**Oliver**	**ND**	**16**	**9**	**93.8**	**271.3**	**66.7**	**28.2**	**3.5**	**73.3**	**1.9**	**4.1**
9076045	**112**	**Pennington**	**SD**	**14**	**5**	**92.9**	**267.3**	**60.1**	**31.3**	**3.7**	**53.8**	**1.5**	**5.1**
9076061	**Tree A**	**Carter**	**MT**	**16**	**6**	**75.0**	**264.6**	**61.2**	**25.9**	**3.3**	**75.0**	**1.3**	**4.5**
9076048	139	Dunn	ND	14		71.4	264.0	59.4	27.9	3.9	60.0	1.5	5.0
9076062	**ETTII**	**Carter**	**MT**	**16**	**7**	**87.5**	**258.2**	**57.7**	**24.4**	**3.3**	**64.3**	**1.6**	**4.4**
9076050	**151**	**Emmons**	**ND**	**14**	**7**	**92.9**	**257.3**	**56.1**	**30.5**	**3.9**	**76.9**	**1.5**	**4.7**
9076044	**111**	**Burleigh**	**ND**	**15**	**6**	**100.0**	**246.0**	**57.5**	**30.8**	**3.7**	**66.7**	**1.5**	**4.5**
9076056	227	Burleigh	ND	16		81.2	239.6	55.0	28.7	3.5	69.2	1.4	4.7
9076063	**Tree B**	**Carter**	**MT**	**16**	**7**	**87.5**	**229.6**	**58.6**	**24.4**	**3.4**	**71.4**	**1.4**	**4.1**
9076047	128	Oliver	ND	16		87.5	226.1	55.4	25.8	3.4	57.1	1.7	4.4
9076046	122	Bottineau	ND	15		80.0	223.3	46.7	20.9	3.9	66.7	1.4	4.5
9076065	Tree 3	Carter	MT	16		81.2	220.4	58.3	25.1	3.6	84.6	1.4	3.8
9076059	237	Morton	ND	16		81.2	216.9	55.0	26.3	3.8	69.2	1.5	4.8
9076060	250	Emmons	ND	16		93.8	216.0	51.6	22.2	3.9	73.3	1.3	4.1
9076052	211	Stark	ND	16		87.5	205.1	47.9	22.1	4.1	64.3	1.4	4.6
9076042	103	McKenzie	ND	12		66.7	202.5	41.1	25.0	4.4	75.0	1.1	5.0
9076058	236	Morton	ND	16		75.0	199.2	51.0	24.0	4.3	41.7	1.8	5.1
9076043	106	Griggs	ND	16		93.8	198.0	46.1	22.0	4.8	73.3	1.1	4.9
9076064	144	Carter	MT	16		87.5	178.2	41.6	27.8	4.8	57.1	1.4	4.9
9076054	219	McKenzie	ND	14		57.1	172.5	40.9	17.1	4.4	50.0	1.5	5.0
9076049	142	Carter	MT	16		68.7	172.3	48.1	18.2	4.2	54.5	1.5	4.8
9076051	209	Bottineau	ND	16		100.0	139.7	35.8	14.8	4.9	37.5	1.5	5.1
Grand Mean:						84.9	227.8	53.7	25.5	3.9	65.6	1.5	4.6
	Grand Total:			370	67								

Testing: Testing was conducted at the Plant Materials Center at Bridger, Montana. The test site was located at an elevation of 1,128 m (3,700 ft) in a 254- to 330-mm (10- to 13-in) annual precipitation zone. Bridger falls in USDA Winter Hardiness Zone 4b, with annual minimum temperatures of -20 to -25°F (-28.9 to -31.6°C). The site was located in Major Land Resource Area (MLRA) 32, Northern Intermountain Desertic Basin. This classification consists of sites in Montana and Wyoming ranging in elevation from 1,100 to 1,800 m (3,609 to 5,905 ft). The climate averages 125 to 225 mm (4.9 to 8.9 in) of annual precipitation with most precipitation in the spring and fall. Precipitation is low and erratic. The average annual temperature is about 7°C (44.6°F) with an average frost-free period of 120 to 140 days.

The 3.0 acre planting site slopes gradually from east to west and north to south. The soils are Heldt Series, Heldt silty clay loam, fine, montmorillonitic, mesic, Usteric, Camborthid, on 4 to 8 percent slopes. The upper 46 cm (18 in) of the profile are characterized as mildly alkaline, whereas the lower 46 to 152 cm (18 to 60 in) is strongly alkaline. These soils are formed in deep alluvium and have moderate shrink-swell potential, but high frost-action potential. Although permeability is slow, these soils are well-drained and runoff is considered medium with only a slight risk of erosion. The mean annual soil temperature is 8.9 to 10.6°C (48 to 51°F) and the frost-free period is 120 to 130 days. This soil falls in the Windbreak Group 1 suitability group, and is characterized by deep, friable,

nearly level to steep, well-drained soils on stream terraces and fans. Soils in this group are well suited to caragana (*Caragana arborescens* Lam.), honeysuckle (*Lonicera* sp.), lilac (*Syringa* sp.), chokecherry (*Prunus virginiana* L.), American plum (*Prunus americana* Marsh), skunkbush sumac (*Rhus trilobata* Nutt.), buffaloberry [*Shepherdia argentea* (Pursh) Nutt.], sand cherry [*Prunus pumila* var. *besseyi* (Bailey) Gleason], dogwood (*Cornus sericea* L.), and Russian olive (*Elaeagnus angustifolia* L.). The natural vegetation is mixed mid- and short grasses, forbs, shrubs, and cottonwoods along the streams. The dominant vegetation in uncultivated areas adjacent to the site includes bluebunch wheatgrass [*Pseudoroegneria spicata* (Pursh) A. Love], needleandthread (*Hesperostipa comata* Trin. & Rupr.), prairie junegrass [*Koeleria macrantha* (Ledeb.) J.A.Schultes], big sagebrush [*Artemisia tridentata* ssp. *spiciformis* (Osterhout) Kartesz & Gandhi], ponderosa pine (*Juniperus scopulorum* Sarg.), and limber pine (*Pinus flexilis* James). The planting site at Bridger was located at an elevation of 1,128 m (3,700 ft) in a 254- to 330-mm (10- to 13-in) annual precipitation zone.

Propagation of test plants for this study began in fall 1991 when 5 Montana sources were collected and sown in the PMC greenhouse. These collections were not all original GP-13 test accessions but were included in the Bridger planting in order to generate more information about the performance of Montana sources of bur oak. On February 25, 1992, the Bridger PMC received 468 acorns representing 16 additional accessions collected from sites in Montana, North Dakota, Oklahoma, and South Dakota. The collections, shipped in zip-lock bags, were immediately stored in a 37°F walk-in cooler. From February 26 through March 2, 1992, the acorns were planted in 40-cubic-inch Deepots® in Fison's #3® potting mix, watered, and then placed in the greenhouse at 80°F days and 65°F nights under 62 percent shade. Germination and height data were recorded on July 30, 1992.

The oaks were moved outdoors in early August, under the partial shade of a green ash windbreak, for the remainder of the summer. Although generally not severe, some plants did develop symptoms of sunscald. All plants were moved into a temporary, overwinter structure in October after their leaves had abscised. Plants were periodically watered until regular freezing temperatures occurred. In mid-January 1993, a check of the seedlings revealed that rodents had chewed most stems down to the media surface. All accessions were brought into the greenhouse and allowed to break bud. Survival data was taken in April.

On February 3, 1993, the Bridger PMC received a second shipment of 300 acorns, representing 10 additional accessions. These accessions were from different trees in the same counties as those received in 1992. All counties represented in the second group of collections were also represented in the first group. The acorns were handled and processed identically as the initial group, being removed from the cooler and planted in Fisons #4® in Deepots® on March 12, 1993. The plants were watered and left in the headhouse to germinate. Germination data was collected on each accession. All plants were fertigated periodically with 125 ppm NPK. Gnatrol® at a rate of 4 teaspoons-per-gallon was used on two occasions to control fungus gnat larva.

An evaluation of all trees was conducted on March 29, 1994 and April 4, 1994 in order to record pre-planting height. On June 17, 1994, a 24 accession RCB (Randomized Complete Block) design planting was installed in Field 23 at the Bridger PMC with collections from Montana, North Dakota and South Dakota represented. Only accessions containing 12 or more surviving trees were included in the study as test plants. The RCB consisted of 8 blocks, each block consisting of three rows of 16 test positions each. This resulted in a total of 384 RCB planting locations. When available, two trees of each accession were randomized in each block resulting in the planting of 16 trees per accession (see APPENDIX 1). Trees were planted on 14-foot centers between rows and 18 feet within rows occupying an area of approximately 3.0 acres. Holes were drilled with an 8-inch auger a depth of 24 to 30 inches. Each tree was hand planted and then irrigated with approximately 2 gallons of water. Most plants were produced in containers however a small number of additional plants were shipped to Bridger in early 1994 as bareroot stock. Bareroot stock has been identified on the layout and evaluation forms in case differences in performance appear over time.

The entire oak study was flood irrigated four times over the course of the 1994 growing season because of exceptionally hot, dry, windy conditions. The planting was maintained by a combination of roto-mowing, mechanical cultivation and spot spraying of noxious weeds. Each tree was evaluated on October 12, 1994 for survival, height and damage.

On July 18, 1995, extra seedlings held in containers were used to replace dead trees and blanks within the RCB and to establish a border row around the perimeter of the entire planting. Each replacement was given approximately 2 gallons of water at planting and then twice again over the course of the 1995 growing season. No additional irrigation was supplied to any of the 1994 planted trees. As in 1994, mechanical cultivation and spot

spraying were used to maintain the planting. On October 9, 1995, all bur oak were evaluated for survival, height and damage.

Although a 3-wire electric fence was installed around the perimeter of the field prior to planting in 1994, deer browsing was fairly high in 1994 and 1995. A combination of inadequate electrical grounding and poor design was the probable cause of failure. To correct this problem, Vexar® seedling protectors were placed over each tree on October 25, 1995 to deter rabbit and deer predation. A PVC (polyvinyl chloride) sleeve was first placed over each tree and then the seedling protector placed over the tube. The PVC sleeve was then pulled upward leaving the protector in place. This technique prevented branch damage and greatly reduced installation time. The seedling protectors worked well to prevent serious stem and terminal bud damage although browsing of foliage continued over time. In 2000, evidence of girdling from the protectors resulted in their removal from all trees. The fence, which had been inoperative since 1996, was removed in 2001 to facilitate cultivation operations. Final selections were made in March 2004 and all non-selected trees were removed in April. The lower limbs on all selected trees were pruned in July 2004 to facilitate cultivation and seed collection. In August and September 2004, a 6-foot high welded wire fence was constructed around the entire seed orchard to exclude deer. In 2007, a two wire electric fence was attached to the existing welded wire fence at 6 inches and 3 feet above the ground. Evidence of animal predation of the 2007 crop was very limited. The planting continues to be maintained fallow by a combination of hand, mechanical and chemical cultivation. The only herbicide used in this study has been 2 to 4 percent glyphosate solutions to control field bindweed *Convolvulus arvensis* and Canada thistle *Cirsium arvense*. No other herbicides, fertilizers, or fungicides have been used to date. Since 2001, fairly high numbers of aphids have warranted the use of insecticidal soap and paraffinic oil to control these pests. For seed collection information, see Seed Increase.

Results and Discussion

Data has been collected annually since 1999. For mean results and other descriptive statistics, reference the Bridger Plant Materials Center 1996-2003, 2004-2005, and 2006-2007 (pending) Technical Reports.

Final selections in 2004 were based on data from the fall 2003 evaluation. Raw data from the 2003 evaluation appears in APPENDIX 2.

Selection was based on a combination of descriptive statistics (mean height growth, percentage survival, and vigor rating at or above the overall population mean) and a visual (subjective) field review of each tree within a family (seed source). In general, seed sources with mean survival, height growth, and vigor rating at or above overall population means were selected. Additionally, individual trees within a seed selected seed source that did not meet established mean criteria or that did not appear suitable based on the field inspection were omitted. A total of 67 trees from 9 seed sources from 3 states (Montana, North Dakota, and South Dakota) were selected.

Statistical analyses of pseudo-replicates by ANOVA were conducted but not used as a basis for selection. For informational purposes, results will be included in the final draft of this release notice.

Seed Increase: A total of 67 trees selected in 2004 were retained to create an open pollinated seed orchard. All non-selected trees were mechanically removed and sprouts sprayed with glyphosate. Seed production and data collection from the test plot actually began in 1999 when seedlings were 7 or 8 years of age. Two studies were developed to track seed production by individual tree and seed source (MT-02-0008) and determine if seed production correlated with one or more plant growth factors (MT-02-0009). Reference the Bridger Plant Materials Center 1996-2003 Technical Report, Volume 2 – Woody Plant, Propagation, and Germination Research and the Bridger Plant Materials Center 2003-2005 Technical Report for more information.

Annual evaluations for seed production by individual tree began in 1999 with the first evidence of flowering and fruit production. Each evaluation consisted of counting the number of seeds and caps produced by an individual tree in order to estimate total seed production. Seed weight data was also collected and summarized depending on the year.

In 1999 only one tree from Stark, ND, (211-08), produced one acorn. In 2000, a total of 48 test trees representing 20 of the 24 seed sources tested produced at least one acorn. A total of 588 acorns were produced in 2000 when

the trees were 8 or 9 years old. A formal evaluation of bur oak seed production was not possible in 2001 because most acorns were lost to animal predation. It was noted that of the 48 trees that produced acorns in 2000, 47 trees (98 percent) produced evidence of acorns in 2001. An additional 75 trees produced acorns in 2001 for a total of 122 acorn-producing trees in 2001.

There was substantial evidence of seed predation throughout the study again in 2002.

In 2002, a total of 165 test trees representing all 24 tested seed sources produced at least one acorn. An estimated 39,060 acorns were produced in 2002. The highest number of acorns produced by an individual tree was 1,336 by Carter, MT-Tree B II-46. The overall mean number of acorns produced per acorn-producing tree was 236.7 in 2002. In 2002 and 2003, correlation analyses were conducted to determine if plant height, basal caliper, diameter breast high, or vigor rating could be used as indices of seed production and productivity.

In 2003, a total of 188 test trees representing all 24 tested seed sources produced at least one acorn, an increase of 23 trees from the 2002 level. An estimated 9,768 acorns were produced in 2003, a substantial decrease from the 39,060 acorns produced in 2002. The highest number of acorns produced by an individual tree was 610 by Emmons, ND-151-8. The overall mean number of acorns produced per acorn-producing tree was 52.0 in 2003.

In 2004, a total of 144 test trees representing 10 tested seed sources produced at least one acorn. An estimated 6,684 acorns were produced in 2004, a decrease from the 9,768 acorns produced in 2002. The highest number of acorns produced by an individual tree was 586 by Oliver, ND-218-13. The overall estimated mean number of acorns produced per acorn-producing tree was 46.4 in 2004.

As a result of severe late spring frosts in 2005 and 2006, seed production was very low each year and no seed was collected.

Data was again collected on individual tree seed production in 2007. A total of 723.3 pounds (328 kg) of bulk seed representing 201,613 seeds were collected from the orchard and stored in a walk-in cooler for conservation seedling production.

Ekalaka Germplasm bur oak averages 614 seeds per kilogram (279 seeds per pound). Average date of harvest of Ekalaka Germplasm bur oak at the Plant Materials Center, Bridger, Montana, ranges from late August to early October each year with peak production in mid- to late-September.

Ecological Considerations and Evaluation: Bur oak is a long-lived deciduous tree native to Montana and Wyoming. When it reaches reproductive maturity it is a prolific seed producer, but is not weedy. Bur oak stands readily perpetuate themselves through seed shatter, but the seedlings are sensitive to grazing, flooding and fire. The species is very tolerant to cold temperatures. Ekalaka Germplasm bur oak passes the NRCS Plant Materials Program, Environmental Evaluation of Plant Materials Releases (attached) for potential invasiveness.

Anticipated Conservation Use: Ekalaka Germplasm bur oak is intended primarily for use in windbreaks, shelterbelts, and living snowfences. This selection may also be used for other conservation practices including woody draw restoration, riparian forest buffer, wildlife habitat, Xeriscaping®, and re-forestation projects.

Anticipated Area of Adaptation: Ekalaka Germplasm bur oak is a bulk of multiple seed sources originating in the northern Great Plains. Although testing of this selection has been limited to the Bridger, Montana, test site, it should perform well across broad areas of eastern Montana and Wyoming, as well as western North Dakota and South Dakota. Based on the performance data in Bridger, Montana, and in its native range, Ekalaka Germplasm bur oak is best adapted to elevations of 2,000 to 4,000 feet, performing more favorably on lower elevation (valley) sites.

Ekalaka Bur oak will continue to be field tested across its geographic range to assess its performance and adaptation.

Increase and Distribution: Generation G_1 (equivalent to Foundation) seed of Ekalaka Germplasm bur oak will be available from the USDA-Natural Resources Conservation Service (NRCS), Plant Materials Center in Bridger, Montana, through the Foundation Seed Stocks Program at Montana State University-Bozeman or the University of

Wyoming. Limited G_1 seed stock will be available in the spring of 2008. Commercial production of two generations (G_2 and G_3) beyond G_1 are allowed.

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Signatures for release of:
Ekalaka Germplasm bur oak

Date

State Conservationist (Acting)
NRCS
Bozeman, Montana

Date

State Conservationist (Acting)
NRCS
Casper, Wyoming

Director
Montana Agricultural Experiment Station
Montana State University
Bozeman, Montana

Date

Director
Wyoming Agricultural Experiment Station
University of Wyoming
Laramie, Wyoming

Date

Director
Ecological Sciences Division
NRCS
Washington, DC

Date

DRAFT

APPENDIX 1. Bur oak seed source study, RCB design and test plant location, Bridger, Montana.

	Block 1			Block 2			Block 3			Block 4		
	Row 1	Row 2	Row 3	Row 1	Row 2	Row 3	Row 1	Row 2	Row 3	Row 1	Row 2	Row 3
142-21	**142-22**	**142-24**	**142-25**	**142-26**	**142-27**	**142-28**	**142-31**	**142-33**	**209-01**	**209-05**	**209-18**	**209-19**
	9076043-09	9076051-08	9076060-19	9076049-10	9076061-30	9076057-11	9076060-22	9076058-02	9076059-03	(9076051-03)	9076058-15	9076049-05
142-20	106-09	209-08	250-19	142-10-br	T ASII-30	228-11	250-22	236-02	237-03	(209-03)	236-15NT	142-05-br
	9076053-16	9076063-10	9076051-06	9076045-10	9076062-27	9076063-13	9076045-02	9076046-13	9076065-10	(9076051-21)	9076053-18	9076061-24
142-17	218-16	T BII-10	209-06	112-10	ETT II-27	T B II-13	112-02	122-13	T #3-10	(209-21)	218-18	T ASII-24
	9076064-16	9076058-25	9076046-10	9076042-05	9076050-02	9076055-05	9076047-05	9076053-04	9076049-12	9076063-03	9076060-13	9076062-12
136-03	13-1-16	236-25	122-10	103-05	151-02	226-05	128-05	218-04	142-12-br	T B II-03	250-13	ETT II-12
	9076054-03	9076059-24	(9076049-06	9076048-04	9076046-09	9076061-39	9076048-05	9076054-02	9076049-07	9076064-29	9076044-10	9076058-16
136-02	219-03	237-24	142-06-br	139-04	122-09	T AS II-39	139-05	219-02	142-07-br	T #1-10	111-10	236-16
	9076050-08	9076054-13	9076042-11	9076059-22	9076051-10	9076056-20	9076054-08	9076055-02	9076042-10	9076045-15	9076049-09	9076062-39
136-01	151-08	219-13	103-11	237-22	209-10	227-20	219-08	226-02	103-10	112-15	142-09-br	ETT II-39
	9076052-11	9076047-01	9076045-13	9076065-40	9076047-02	9076043-16	9076044-08	9076056-15	9076052-12	9076065-11	9076048-06	9076050-14
130-02	211-11	128-01	112-13	1 1/4-3-22	128-02	106-16	111-08	227-15	211-12	T #3-11	139-06	151-14
	9076061-17	9076064-02	9076053-05	9076047-11	9076053-03	9076052-06	9076063-11	9076050-05	9076061-18	9076055-13	9076047-22	9076044-12
130-01	T ASII-17	13-1-02	218-05	128-11	218-03	211-06	T B II-11	151-05	T ASII-18	226-13	128-22	111-12
	9076045-07	9076059-28	9076062-24	9076062-08	9076055-08	9076046-15	9076058-09	9076059-15	9076064-18	9076060-03	9076042-09	9076046-12
128-23	112-07	237-28	ETT II-24	ETT II-08	226-08	122-15	236-09	237-15	13-1-18	250-03	103-09	122-12
	9076058-18	9076055-01	9076057-17	9076059-17	9076064-12	9076058-13	9076052-02	9076057-07	9076063-41	9076063-46	9076058-24	9076057-03
128-20	236-18	226-01	228-17	237-17	13-1-12	236-13	211-02	228-07	T B II-41	T B II-46	236-24	228-03
	9076043-18	9076048-08	9076062-41	9076051-11	9076060-09	9076053-06	9076050-09	9076043-04	9076056-28	9076059-19	9076045-18	9076057-04
128-17	106-18	139-08	ETT II-41	209-11	250-09	218-06	151-09	106-04	227-28	237-19	112-18	228-04
	9076055-18	9076065-45	9076063-07	9076048-10	9076064-30	9076042-03	9076062-11	9076064-14	9076048-01	9076064-13	9076065-01	9076046-08
128-09	226-18	1 1/4-3-27	T B II-07	139-10	T #1-11	103-03	ETT II-11	13-1-14	139-01	13-1-13	T #3-01	122-08
	9076071-2	9076050-01	9076047-04	9076060-05	9076057-05	9076044-03	9076061-16	9076057-16	9076045-21	9076055-15	9076043-19	9076047-14
127-06	567-02	151-01	128-04	250-05	228-05	111-03	T ASII-16	228-16	112-21	226-15	106-19	128-14
	9076056-08	9076065-16	9076060-01	9076058-21	9076052-07	9076049-11	9076065-06	9076046-01	9076055-11	9076043-10	9076061-21	9076048-09
126-08	227-08	T #3-16	MT-250-01	236-21	211-07	142-11-br	T #3-06	122-01	226-11	106-10	T ASII-21	139-09
	9076046-05	9076057-01	9076049-08	9076056-22	9076065-47	9076044-11	9076062-10	9076044-09	9076042-04	9076056-16	9076053-13	9076059-27
126-07	122-05	228-01	142-08-br	227-22	1 1/4-3-29	111-11	ETT II-10	111-09	103-04	227-16	218-13	237-27
	9076052-22	9076044-05	9076056-04	9076054-11	9076045-04	9076054-06	9076060-08	9076047-03	9076053-09	9076054-14	9076056-17	9076050-03
106-27	211-22	111-05	227-04	219-11	112-04	219-06	250-08	128-03	218-09	219-14	227-17	151-03
	9076042-7	9076048-02	9076044-04	9076050-12	9076063-15	9076043-06	9076051-23	9076051-16	9076043-14	9076052-03	9076052-04	9076042-08
106-26	103-07	139-02	111-04	151-12	T B II-15	106-06	209-23	209-16	106-14	211-03	211-04	103-08
ETT-30	**EKTII-22**	**EKTII-21**	**EKTII-20**	**EKTII-18**	**EKTII-15**	**TASII-33**	**TASII-29**	**TASII-26**	**TASII-25**	**TASII-15**	**TASII-12**	**TASII-11**

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APPENDIX 1 (continued) Bur oak seed source study, RCB design and test plant location, Bridger, Montana.

	Block 5			Block 6			Block 7			Block 8			Border
Row 1	Row 2	Row 3	Row 1	Row 2	Row 3	Row 1	Row 2	Row 3	Row 1	Row 2	Row 3	
218-01	**218-02**	**218-11**	**218-17**	**218-23**	**218-26**	**218-27**	**226-03**	**226-07**	**226-09**	**226-10**	**226-14**	**226-23**
9076048-19	9076066-02	9076042-13	9076053-22	9076063-01	9076044-14	9076065-17	9076055-16	9076056-25	9076060-10	9076051-04	Blank	
139-19-br	126-02	103-13-br	218-22	T B II-01	111-14	T #3-17	226-16	227-25	250-10	209-04		**226-24**
9076050-11	9076051-12	9076057-22	9076064-23	9076059-26	9076042-12	9076065-08	9076049-16	9076062-32	Blank	Blank	9076053-12	
151-11	209-12	228-22	T #1-04	237-26	103-12-br	T #3-08	142-16-br	ETT II-32			218-12	**227-01**
9076059-04	9076053-10	9076055-19	9076052-08	9076043-17	9076052-01	9076048-17	9076053-07	9076051-09	9076043-22	9076051-13	9076049-15	
237-04	218-10	226-19	211-08	106-17	211-01	139-17-br	218-07	209-09	106-22-br	209-13	142-15-br	**227-03**
9076064-26	9076059-02	9076044-01	9076051-17	9076062-23	9076057-12	9076064-28	9076052-18	9076055-04	9076043-23	9076057-27	9076065-09	
T #1-07	237-02	111-01	209-17	ETT II-23	228-12	T #1-09	211-18	226-04	106-23-br	228-27	T #3-09	**227-05**
9076049-02	9076055-12	9076044-13	9076048-15	9076051-02	9076058-20	9076056-12	9076071-03	Blank	9076055-17	9076061-13	9076059-10	
142-02-br	226-12	111-13	139-15-br	209-02	236-20	227-12	567-03		226-17	T ASII-13	237-10	**227-07**
9076049-04	9076053-14	9076065-44	9076063-49	9076061-37	9076060-12	9076048-18	9076047-08	9076063-43	9076046-22	Blank	Blank	
142-04-br	218-14	1 1/4-3-26	T B II-49	T ASII-37	250-12	139-18-br	128-08	T B II-43	122-22-br			**227-09**
9076048-14	9076062-07	9076047-16	9076055-06	9076056-27	9076050-04	9076064-21	9076045-12	9076043-21	9076058-14	9076065-07	9076052-20	
139-14-br	ETT II-07	128-16	226-06	227-27	151-04	T #1-02	112-12	106-21-br	236-14	T #3-07	211-20	**227-14**
9076042-14	9076052-15	9076058-05	9076055-20	9076058-22	9076049-01	9076044-06	9076061-42	9076045-16	Blank	9076060-20	9076056-02	
103-14-br	211-15	236-05	226-20	236-22	142-01-br	111-06	T ASII-42	112-16		250-20	227-02	**227-18**
9076045-06	9076045-14	9076054-01	9076064-11	9076048-16	9076065-39	9076054-12	9076053-21	9076060-14	9076044-15	Blank	9076057-21	
112-06	112-14	219-01	13-1-11	139-16-br	1 1/4-3-21	219-12	218-21	250-14	111-15		228-21	**227-19**
9076065-43	9076046-04	9076043-11	9076054-07	9076060-21	9076054-05	9076043-20	9076062-04	9076052-23	9076056-24	9076055-22	9076052-10	
1 1/4-3-25	122-04	106-11	219-07	250-21	219-05	106-20-br	ETT II-04	211-23	227-24	226-22	211-10	**227-21**
9076056-13	9076063-05	9076051-07	9076057-08	9076047-13	9076061-23	9076057-14	9076047-15	9076059-08	Blank	9076053-19	9076062-06	
227-13	T B II-05	209-07	228-08	128-13	T ASII-23	228-14	128-15	237-08		218-19	ETT II-06	**227-23**
9076061-01	9076064-24	9076060-25	9076045-05	9076043-07	9076053-25	9076051-20	9076059-06	9076049-14	9076059-09	Blank	9076047-21	
T ASII-01	T #1-05	250-25	112-05	106-07	218-25	209-20	237-06	142-14-br	237-09		128-21	**227-29**
9076046-11	9076062-13	9076056-11	9076062-14	9076044-07	9076042-15	9076060-23	9076046-20	9076063-04	9076047-10	9076062-09	9076063-54	
122-11	ETT II-13	227-11	ETT II-14	111-07	103-15-br	250-23	122-20-br	T B II-04	128-10	ETT II-09	T B II-54	**142-19**
9076058-23	9076057-02	9076050-15	9076050-13	9076056-10	9076045-01	9076066-03	9076050-16	9076046-21	9076058-10	Blank	9076049-13	
236-23	228-02	151-15	151-13	227-10	112-01	126-03	151-16	122-21-br	236-10		142-13-br	**237-05**
9076043-08	9076054-09	9076047-07	9076059-01	9076046-18	9076065-18	9076057-23	9076044-02	9076058-17	Blank	9076063-06	9076061-02	
106-08	219-09	128-07	237-01	122-18-br	T #3-18	228-23	111-02	236-17		T B II-06	T ASII-02	**237-07**
9076063-02	9076060-15	9076061-43	9076049-03	9076047-18	9076046-19	9076061-14	9076058-19	Blank	Blank	9076064-37	9076064-36	
T B II-02	250-15	T ASII-43	142-03-br	128-18	122-19-br	T ASII-14	236-19			T #1-04	T #1-03	**237-11**
TASII-10	**TASII-09**	**TASII-08**	**TASII-06**	**TASII-05**	**TASII-04**	**250-26**	**250-18**	**250-17**	**250-06**	**237-23**	**237-16**	**237-12**

APPENDIX 2. Bur oak evaluation data, Bridger, Montana, 2003.

Block	Row	Position	Test Plant	Accession Number	Previous ID Number	Plant Survival	Height	Comments
			(t,nt)			*(0,1)*	*cm*	
1	1	1	nt	9076038	130-R97	1	165.0	1997
1	1	2	t	9076052-22	211-22	1	62.0	
1	1	3	t	9076046-05	122-5	1	255.0	
1	1	4	nt	9076056-26	227-26-R97	1	230.0	1997
1	1	5	nt	9076045	112-R97	1	195.0	1995;1997; low fork
1	1	6	t	9076055-18	226-18	1	360.0	
1	1	7	t	9076043-18	106-18	0		dead
1	1	8	t	9076058-6	236-6-R96	1	162.0	1996
1	1	9	t	9076045-07	112-7	1	460.0	leaves 11/14/03
1	1	10	nt	9076043-25	106-25-R97	1	176.0	1997
1	1	11	t	9076052-11	211-11	1	190.0	
1	1	12	t	9076050-08	151-8	1	250.0	
1	1	13	t	9076054-03	219-3	1	187.0	
1	1	14	t	9076064-16	13-1-16	1	290.0	
1	1	15	t	9076053-16	218-16	1	270.0	
1	1	16	t	9076043-09	106-9	1	215.0	
1	2	1	t	9076048-02	139-2	1	330.0	
1	2	2	t	9076044-05	111-5	0		weed badger blight 2003
1	2	3	t	9076057-01	228-1	1	370.0	
1	2	4	nt	9076065-13	T#3-13-R97	1	185.0	1997,etiolated+M52
1	2	5	t	9076050-01	151-1	1	230.0	
1	2	6	t	9076065-45	1 1/4-3-27	1	370.0	
1	2	7	t	9076048-08	139-8	1	270.0	
1	2	8	t	9076055-01	MT-226-1	1	435.0	
1	2	9	t	9076059-28	237-28	1	225.0	
1	2	10	t	9076064-02	13-1-2	1	62.0	
1	2	11	t	9076047-01	128-1	1	140.0	
1	2	12	t	9076054-13	219-13	0		dead
1	2	13	t	9076059-24	237-24	1	190.0	
1	2	14	t	9076058-25	236-25	1	270.0	
1	2	15	t	9076063-10	Tree B II-10	0		dead
1	2	16	t	9076051-08	209-8	1	175.0	
1	3	1	t	9076044-04	111-4	1	180.0	
1	3	2	t	9076056-04	227-4	1	240.0	corky
1	3	3	t	9076049-08	142-8	1	120.0	bareroot;corky
1	3	4	nt	9076060-24	MT-250-24-R97	1	262.0	1997
1	3	5	t	9076047-04	128-4	1	290.0	low fork

APPENDIX 2. Bur oak evaluation data, Bridger, Montana, 2003.

Block	Row	Position	Test Plant	Accession Number	Previous ID Number	Plant Survival	Height	Comments
			(t,nt)			*(0,1)*	*cm*	
1	3	6	t	9076063-07	Tree B II-7	1	285.0	low fork
1	3	7	nt	9076043-24	106-24-R97	1	310.0	1997
1	3	8	t	9076057-17	228-17	1	237.0	
1	3	9	t	9076062-24	E.T.T.II-24	1	345.0	
1	3	10	t	9076053-05	218-5	1	390.0	
1	3	11	t	9076045-13	112-13	1	50.0	
1	3	12	t	9076042-11	103-11	1	278.0	
1	3	13	t	9076049-18	142-18-R95	1	212.0	1995
1	3	14	t	9076046-10	122-10	1	225.0	low fork,corky
1	3	15	t	9076051-06	209-6	1	120.0	
1	3	16	t	9076060-19	250-19	1	165.0	etiolated
2	1	1	t	9076050-12	151-12	1	345.0	
2	1	2	t	9076054-11	219-11	1	87.0	
2	1	3	t	9076056-22	227-22	1	390.0	corky
2	1	4	t	9076058-21	236-21	1	255.0	corky
2	1	5	t	9076060-05	250-5	1	335.0	
2	1	6	t	9076048-10	139-10	1	270.0	corky
2	1	7	t	9076051-11	209-11	1	287.0	
2	1	8	t	9076059-17	237-17	1	290.0	corky,*Vexar branch problem
2	1	9	t	9076062-08	E.T.T.II-8	1	100.0	poorly planted
2	1	10	t	9076047-11	128-11	1	285.0	
2	1	11	t	9076065-40	1 1/4-3-22	1	305.0	
2	1	12	nt	9076063-35	T.BII-35-R97	1	275.0	1997;forked low
2	1	13	t	9076048-04	139-4	1	310.0	
2	1	14	t	9076042-05	103-5	1	137.0	
2	1	15	t	9076045-10	112-10	1	362.0	
2	1	16	t	9076049-10	142-10	1	135.0	barer;corky
2	2	1	t	9076063-15	Tree B II-15	1	330.0	exc. form, but low fork?
2	2	2	t	9076045-04	112-4	1	325.0	leaf retention 11/14/03
2	2	3	nt	Blank	Blank	0		dead 1998
2	2	4	t	9076052-07	211-7	1	310.0	
2	2	5	t	9076057-05	228-5	1	320.0	
2	2	6	nt	9076072-4	3/4-C-4-R97	1	242.0	1997;low fork
2	2	7	t	9076060-09	250-9	1	200.0	etiolated
2	2	8	t	9076064-12	13-1-12	1	135.0	
2	2	9	t	9076055-08	226-8	1	290.0	

APPENDIX 2. Bur oak evaluation data, Bridger, Montana, 2003.

Block	Row	Position	Test Plant	Accession Number	Previous ID Number	Plant Survival	Height	Comments
			(t,nt)			*(0,1)*	*cm*	
2	2	10	t	9076053-03	218-3	1	450.0	
2	2	11	t	9076047-02	128-2	1	60.0	
2	2	12	t	9076051-10	209-10	1	25.0	
2	2	13	t	9076046-09	122-9	1	152.0	etiolated
2	2	14	t	9076050-02	151-2	1	420.0	bean pole shape
2	2	15	nt	9076063-39	T.B.II-39-R97	1	200.0	1997
2	2	16	t	9076061-30	Tree AS II-30	1	320.0	
2	3	1	t	9076043-06	106-6	1	300.0	
2	3	2	nt	9076063-37	T.BII-37-R97	1	212.0	1997
2	3	3	t	9076044-11	111-11	1	265.0	forked low
2	3	4	t	9076049-11	142-11	0		bareroot;dead
2	3	5	t	9076044-03	111-3	1	330.0	
2	3	6	t	9076042-03	103-3	1	218.0	narrow
2	3	7	t	9076053-06	218-6	1	250.0	
2	3	8	t	9076058-13	236-13	0		dead
2	3	9	t	9076046-15	122-15	1	227.0	
2	3	10	t	9076052-06	211-6	1	245.0	
2	3	11	t	9076043-16	106-16	1	25.0	barely alive
2	3	12	t	9076056-20	227-20	1	190.0	
2	3	13	t	9076061-39	Tree AS II-39	1	180.0	
2	3	14	t	9076055-05	226-5	1	377.0	narrow
2	3	15	t	9076063-13	Tree B II-13	0		dead
2	3	16	t	9076057-11	228-11	1	287.0	
3	1	1	t	9076051-23	209-23	1	68.0	deer broke leader
3	1	2	t	9076060-08	250-8	1	55.0	
3	1	3	t	9076062-10	E.T.T.II-10	1	270.0	low fork
3	1	4	t	9076065-06	Tree #3-6	1	227.0	
3	1	5	t	9076061-16	Tree AS II-16	1	315.0	
3	1	6	t	9076062-11	E.T.T.II-11	1	278.0	low fork
3	1	7	t	9076050-09	151-9	1	80.0	
3	1	8	t	9076052-02	211-2	1	226.0	
3	1	9	t	9076058-09	236-9	1	365.0	
3	1	10	t	9076063-11	Tree B II-11	1	160.0	etiolated
3	1	11	t	9076044-08	111-8	1	352.0	
3	1	12	t	9076054-08	219-8	0		dead
3	1	13	t	9076048-05	139-5	1	322.0	
3	1	14	t	9076047-05	128-5	1	280.0	low fork

APPENDIX 2. Bur oak evaluation data, Bridger, Montana, 2003.

Block	Row	Position	Test Plant	Accession Number	Previous ID Number	Plant Survival	Height	Comments
			(t,nt)			*(0,1)*	*cm*	
3	1	15	t	9076045-02	112-2	1	330.0	low fork,*87.98 w/o swell
3	1	16	t	9076060-22	250-22	1	302.0	
3	2	1	t	9076051-16	209-16	1	62.0	deer broke leader
3	2	2	t	9076047-03	128-3	0		dead
3	2	3	t	9076044-09	111-9	1	430.0	
3	2	4	t	9076046-?	122-?-R96	1	175.0	1996
3	2	5	t	9076057-16	228-16	1	376.0	*Vexar branch problem
3	2	6	t	9076064-14	13-1-14	1	334.0	
3	2	7	t	9076043-04	106-4	1	385.0	low fork
3	2	8	t	9076057-07	228-7	1	248.0	
3	2	9	t	9076059-15	237-15	1	248.0	
3	2	10	t	9076050-05	151-5	1	255.0	
3	2	11	t	9076056-15	227-15	1	250.0	
3	2	12	t	9076055-02	226-2	1	280.0	
3	2	13	t	9076054-02	219-2	1	175.0	etiolated
3	2	14	t	9076053-04	218-4	1	215.0	low forks
3	2	15	t	9076046-13	122-13	0		dead
3	2	16	t	9076058-02	236-2	1	200.0	
3	3	1	t	9076043-14	106-14	1	155.0	
3	3	2	nt	9076053-20	218-20-R97	1	290.0	1997
3	3	3	t	9076042-04	103-4	1	220.0	
3	3	4	nt	9076063-24	T.BII-24-R97	1	124.0	1997
3	3	5	t	9076045-21	112-21	1	227.0	
3	3	6	t	9076048-01	139-1	0		dead
3	3	7	t	9076056-28	227-28	0		dead
3	3	8	t	9076063-41	Tree B II-41	1	65.0	
3	3	9	t	9076064-18	13-1-18	0		dead 2003
3	3	10	nt	Blank	Blank	0		dead 1998
3	3	11	t	9076052-12	211-12	1	183.0	
3	3	12	t	9076042-10	103-10	1	110.0	heavy deer damage
3	3	13	**nt**	9076049-29	*142-29-R97*	1	187.0	bareroot;1997
3	3	14	t	9076049-12	142-12	1	100.0	bareroot
3	3	15	nt	9076049-3	11/2-2-3-R97	1	295.0	1997
3	3	16	t	9076059-03	237-3	0		dead
4	1	1	t	9076052-03	211-3	1	155.0	
4	1	2	t	9076054-14	219-14	1	326.0	
4	1	3	t	9076056-16	227-16	1	450.0	low fork

APPENDIX 2. Bur oak evaluation data, Bridger, Montana, 2003.

Block	Row	Position	Test Plant	Accession Number	Previous ID Number	Plant Survival	Height	Comments
			(t,nt)			*(0,1)*	*cm*	
4	1	4	t	9076043-10	106-10	0		dead 2003
4	1	5	t	9076055-15	226-15	1	425.0	*Vexar branch problem
4	1	6	t	9076064-13	13-1-13	1	385.0	
4	1	7	t	9076059-19	237-19	1	352.0	low fork
4	1	8	t	9076063-46	Tree B II-46	1	377.0	
4	1	9	t	9076060-03	250-3	1	252.0	
4	1	10	t	9076055-13	226-13	1	440.0	corky
4	1	11	t	9076065-11	Tree #3-11	1	210.0	
4	1	12	t	9076045-15	112-15	1	290.0	
4	1	13	t	9076064-29	Tree #1-10	1	130.0	
4	1	14	t	9076063-03	Tree B II-3	1	305.0	small dead leaves??
4	1	15	t	9076051-21	209-21-R95	1	148.0	1995
4	1	16	t	9076051-03	209-3-R95	1	185.0	1995
4	2	1	t	9076052-04	211-4	0		dead
4	2	2	t	9076056-17	227-17	0		dead
4	2	3	t	9076053-13	218-13	1	350.0	
4	2	4	t	9076061-21	Tree AS II-21	1	380.0	high fork
4	2	5	t	9076043-19	106-19	1	33.0	
4	2	6	t	9076065-01	Tree #3-1	1	196.0	
4	2	7	t	9076045-18	112-18	0		dead
4	2	8	t	9076058-24	236-24	1	47.0	barely alive
4	2	9	t	9076042-09	103-09	1	335.0	
4	2	10	t	9076047-22	128-22	1	300.0	
4	2	11	t	9076048-06	139-6	1	220.0	
4	2	12	**nt**	9076065-24	1/4-3-24-R97	1	300.0	1996;1997
4	2	13	t	9076044-10	111-10	1	376.0	
4	2	14	t	9076060-13	250-13	1	225.0	
4	2	15	t	9076053-18	218-18	1	190.0	
4	2	16	nt	9076058-15	236-15NT-R95	1	245.0	1995;nontest;
4	3	1	t	9076042-08	103-8	1	302.0	
4	3	2	t	9076050-03	151-3	1	285.0	low fork
4	3	3	t	9076059-27	237-27	1	105.0	
4	3	4	t	9076048-09	139-9	1	407.0	low fork
4	3	5	t	9076047-14	128-14	1	303.0	low fork
4	3	6	t	9076046-08	122-8	1	268.0	
4	3	7	t	9076057-04	228-4	1	302.0	
4	3	8	t	9076057-03	228-3	1	175.0	low fork

APPENDIX 2. Bur oak evaluation data, Bridger, Montana, 2003.

Block	Row	Position	Test Plant	Accession Number	Previous ID Number	Plant Survival	Height	Comments
			(t,nt)			*(0,1)*	*cm*	
4	3	9	t	9076046-12	122-12	1	260.0	
4	3	10	t	9076044-12	111-12	1	100.0	
4	3	11	t	9076050-14	151-14	1	425.0	
4	3	12	t	9076062-39	E.T.T.II-39	1	287.0	
4	3	13	t	9076058-16	236-16	1	55.0	
4	3	14	t	9076062-12	E.T.T.II-12	1	280.0	
4	3	15	t	9076061-24	Tree AS II-24	1	280.0	low fork
4	3	16	t	9076049-05	142-5	1	224.0	bareroot
5	1	1	t	9076063-02	Tree B II-2	1	296.0	low fork
5	1	2	t	9076043-08	106-8	1	276.0	
5	1	3	t	9076058-23	236-23	1	262.0	low fork
5	1	4	nt	9076060-11	250-11-R97	1	170.0	1997
5	1	5	t	9076061-14	Tree AS II-14	1	240.0	
5	1	6	t	9076056-13	227-13	1	390.0	low fork
5	1	7	t	9076065-43	1 1/4-3-25	1	95.0	
5	1	8	t	9076045-06	112-6	1	400.0	low fork
5	1	9	nt	Blank	Blank	0		1995, dead
5	1	10	t	9076048-14	139-14	1	177.0	bareroot
5	1	11	t	9076049-04	142-04	1	220.0	bareroot
5	1	12	nt	Blank	Blank	1	37.0	bareroot;alive
5	1	13	t	9076064-26	Tree #1-7	1	360.0	
5	1	14	t	9076059-04	237-4	1	360.0	
5	1	15	t	9076050-11	151-11	1	249.0	
5	1	16	nt	9076066-01	126-1-R95	1	277.0	1995
5	2	1	t	9076060-15	250-15	1	348.0	
5	2	2	t	9076054-09	219-9	1	280.0	low fork
5	2	3	t	9076057-02	228-2	1	258.0	
5	2	4	t	9076062-13	E.T.T.II-13	1	390.0	
5	2	5	t	9076064-24	Tree #1-5	1	326.0	
5	2	6	t	9076063-05	Tree B II-5	1	227.0	
5	2	7	t	9076046-04	122-4	1	287.0	
5	2	8	t	9076045-14	112-14	1	199.0	
5	2	9	t	9076052-15	211-15	1	235.0	
5	2	10	t	9076062-07	E.T.T.II-7	1	307.0	low fork
5	2	11	t	9076053-14	218-14	1	310.0	low fork
5	2	12	t	9076055-12	226-12	1	290.0	
5	2	13	nt	Blank	Blank	0		dead

APPENDIX 2. Bur oak evaluation data, Bridger, Montana, 2003.

Block	Row	Position	Test Plant	Accession Number	Previous ID Number	Plant Survival	Height	Comments
			(t,nt)			*(0,1)*	*cm*	
5	2	14	t	9076053-10	218-10	1	300.0	
5	2	15	t	9076051-12	209-12	1	145.0	etiolated
5	2	16	nt	9076066-02	126-2-R95	1	80.0	1995
5	3	1	t	9076061-43	Tree AS II-43	1	325.0	low fork
5	3	2	t	9076047-07	128-7	1	397.0	
5	3	3	t	9076050-15	151-15	1	328.0	
5	3	4	t	9076056-11	227-11	1	271.0	
5	3	5	t	9076060-25	250-25	1	342.0	
5	3	6	t	9076051-07	209-7	1	132.0	
5	3	7	t	9076043-11	106-11	1	220.0	
5	3	8	nt	Blank	Blank	0		dead
5	3	9	t	9076058-05	236-5	0		dead
5	3	10	t	9076047-16	128-16	1	351.0	low fork
5	3	11	t	9076065-44	1 1/4-3-26	1	202.0	
5	3	12	t	9076044-13	111-13	1	370.0	
5	3	13	t	9076044-01	111-1	1	52.0	
5	3	14	t	9076055-19	226-19	1	85.0	
5	3	15	nt	Blank	Blank	0		dead 1998
5	3	16	nt	9076067-01	127-1-R95	1	230.0	1995
6	1	1	t	9076049-03	142-3	1	228.0	barer;dk bark, v. corky
6	1	2	t	9076059-01	237-1	1	237.0	low fork
6	1	3	t	9076050-13	151-13	1	370.0	
6	1	4	t	9076062-14	E.T.T.II-14	1	310.0	v. corky
6	1	5	t	9076045-05	112-5	1	226.0	
6	1	6	t	9076057-08	228-8	1	412.0	exceptionally nice
6	1	7	t	9076054-07	219-7	1	299.0	
6	1	8	t	Blank	Blank	0		dead 1998
6	1	9	t	9076055-20	226-20	1	302.0	
6	1	10	t	9076055-06	226-6	1	290.0	
6	1	11	t	9076063-49	Tree B II-49	1	349.0	low fork
6	1	12	t	9076048-15	139-15	1	280.0	bareroot
6	1	13	t	9076051-17	209-17	1	130.0	rub, *dead leader
6	1	14	t	9076052-08	211-8	1	260.0	
6	1	15	t	9076064-23	Tree #1-4	1	137.0	
6	1	16	t	9076053-22	218-22	1	222.0	low fork
6	2	1	t	9076047-18	128-18	1	275.0	
6	2	2	t	9076046-18	122-18	1	309.0	bareroot;dk, corky bark

APPENDIX 2. Bur oak evaluation data, Bridger, Montana, 2003.

Block	Row	Position	Test Plant	Accession Number	Previous ID Number	Plant Survival	Height	Comments
			(t,nt)			*(0,1)*	*cm*	
6	2	3	t	9076056-10	227-10	1	269.0	
6	2	4	t	9076044-07	111-7	1	352.0	low forks
6	2	5	t	9076043-07	106-7	1	355.0	
6	2	6	t	9076047-13	128-13	1	138.0	low fork
6	2	7	t	9076060-21	250-21	1	306.0	low fork
6	2	8	t	9076048-16	139-16	1	306.0	bareroot;corky, low fork
6	2	9	t	9076058-22	236-22	1	307.0	
6	2	10	t	9076056-27	227-27	1	212.0	
6	2	11	t	9076061-37	Tree AS II-37	1	313.0	
6	2	12	t	9076051-02	209-2	1	276.0	corky
6	2	13	t	9076062-23	E.T.T.II-23	1	423.0	
6	2	14	t	9076043-17	106-17	1	248.0	
6	2	15	t	9076059-26	237-26	1	225.0	
6	2	16	t	9076063-01	Tree B II-1	1	227.0	
6	3	1	t	9076046-19	122-19	1	277.0	
6	3	2	t	9076065-18	Tree #3-18	1	229.0	low fork
6	3	3	t	9076045-01	112-1	1	337.0	
6	3	4	t	9076042-15	103-15	1	148.0	bareroot;low fork,etiolated
6	3	5	t	9076053-25	218-25	1	362.0	
6	3	6	t	9076061-23	Tree AS II-23	1	297.0	low forks
6	3	7	t	9076054-05	219-5	1		v. small
6	3	8	t	9076065-39	1 1/4-3-21	1	303.0	
6	3	9	t	9076049-01	142-1	0		bareroot; dead
6	3	10	t	9076050-04	151-4	1	345.0	high fork
6	3	11	t	9076060-12	250-12	1	141.0	etiolated
6	3	12	t	*9076058-20*	*236-20*	0		dead
6	3	13	t	9076057-12	228-12	1	382.0	
6	3	14	t	9076052-01	211-01	1	378.0	3-4 caps
6	3	15	nt	Blank	Blank	0		1995;nontest;dead
6	3	16	t	9076044-14	111-14	1	273.0	
7	1	1	nt	Blank	Blank	0		dead
7	1	2	t	9076057-23	228-23	1	324.0	low fork
7	1	3	nt	Blank	Blank	0		1995
7	1	4	t	9076060-23	250-23	1	269.0	
7	1	5	t	9076051-20	209-20	1	177.0	low fork
7	1	6	t	9076057-14	228-14	1	406.0	
7	1	7	t	9076043-20	106-20	1	405.0	bareroot

APPENDIX 2. Bur oak evaluation data, Bridger, Montana, 2003.

Block	Row	Position	Test Plant	Accession Number	Previous ID Number	Plant Survival	Height	Comments
			(t,nt)			*(0,1)*	*cm*	
7	1	8	t	9076054-12	219-12	1	150.0	*dead leader
7	1	9	t	9076044-06	111-6	1	285.0	
7	1	10	t	9076064-21	Tree #1-2	1	176.0	low fork, etiolated
7	1	11	nt	9076066-06	126-6	1	262.0	1995,*vexar problem
7	1	12	t	9076056-12	227-12	1	345.0	
7	1	13	t	9076064-28	Tree #1-9	1	92.0	low fork, short
7	1	14	nt	Blank	Blank	0		1996; dead
7	1	15	t	9076065-08	Tree #3-8	1	400.0	
7	1	16	t	9076065-17	Tree #3-17	1	260.0	few
7	2	1	nt	Blank	Blank	0		dead
7	2	2	t	9076044-02	111-2	1	350.0	*vexar
7	2	3	t	9076050-16	151-16	1	50.0	
7	2	4	t	9076046-20	122-20	1	239.0	bareroot
7	2	5	t	9076059-06	237-6	1	151.0	*dead leader
7	2	6	t	9076047-15	120-15	1	332.0	low fork
7	2	7	t	9076062-04	E.T.T.II-42	1	172.0	
7	2	8	t	9076053-21	218-21	1	294.0	high fork
7	2	9	t	9076061-42	Tree AS II-42	1	162.0	etiolated
7	2	10	t	9076045-12	112-12	1	473.0	
7	2	11	t	9076047-08	128-8	1	251.0	
7	2	12	nt	Blank	Blank	0		1995
7	2	13	t	9076052-18	211-18	1	345.0	dark, corky
7	2	14	t	9076053-07	218-7	1	362.0	
7	2	15	t	9076049-16	142-16	1	180.0	bareroot; lo fork,etiolated
7	2	16	t	9076055-16	226-16	1	177.0	etiolated
7	3	1	nt	9076067-04	127-4	1	216.0	1995; low fork
7	3	2	t	9076058-17	236-17	1	302.0	narrow,*vexar problem
7	3	3	t	9076046-21	122-21	1	311.0	bareroot
7	3	4	t	9076063-04	Tree B II-4	1	215.0	
7	3	5	t	9076049-14	142-14	1	234.0	very corky
7	3	6	t	9076059-08	237-8	1	306.0	
7	3	7	t	*9076052-23*	*211-23*	1	91.0	low fork
7	3	8	t	9076060-14	250-14	1	270.0	*vexar problem
7	3	9	t	9076045-16	112-16	1	35.0	
7	3	10	t	9076043-21	106-21	1	222.0	bareroot
7	3	11	t	9076063-43	Tree B II-43	1	202.0	
7	3	12	nt	9076067-02	127-2	1	230.0	1995

APPENDIX 2. Bur oak evaluation data, Bridger, Montana, 2003.

Block	Row	Position	Test Plant	Accession Number	Previous ID Number	Plant Survival	Height	Comments
			(t,nt)			*(0,1)*	*cm*	
7	3	13	t	9076055-04	226-4	1	373.0	high fork
7	3	14	t	9076051-09	209-9	1	295.0	
7	3	15	t	9076062-32	E.T.T.II-32	1	187.0	low fork, etiolated
7	3	16	t	9076056-25	227-25	1	108.0	
8	1	1	nt	9076057-15	228-15NT	1	190.0	1995nontest
8	1	2	nt	9076057-06	228-6NT	1	226.0	1995;nontest
8	1	3	t	9076058-10	236-10	1	320.0	
8	1	4	nt	9076047-12	128-12-R97	1	165.0	1997
8	1	5	t	9076059-09	237-9	1	141.0	low fork
8	1	6	nt	9076066-05	126-5	1	324.0	1995
8	1	7	t	9076056-24	227-24	1	331.0	
8	1	8	t	9076044-15	111-15	1	138.0	
8	1	9	nt	9076067-07	127-7	1	251.0	1995
8	1	10	t	9076058-14	236-14	1	140.0	ornamntl;multi.leaders
8	1	11	nt	Blank	Blank	1	63.0	bareroot; alive
8	1	12	t	9076055-17	226-17	1	270.0	high fork
8	1	13	t	9076043-23	106-23	1	182.0	bareroot
8	1	14	t	9076043-22	106-22	1	159.0	bareroot
8	1	15	nt	Blank	Blank	0		1995, dead
8	1	16	t	9076060-10	250-10	1	139.0	deer killed leader
8	2	1	t	9076064-37	*13-1-37*	1	270.0	high fork
8	2	2	t	9076063-06	Tree B II-6	1	280.0	low fork*vexar
8	2	3	nt	9076057-29	228-29NT	1	356.0	1995;nontest
8	2	4	t	9076062-09	E.T.T.II-9	1	260.0	
8	2	5	nt	9076057-24	228-24NT	1	312.0	1995;nontest;low fork
8	2	6	t	9076053-19	218-19	1	362.0	
8	2	7	t	9076055-22	226-22	1	280.0	
8	2	8	nt	9076057-20	228-20NT	1	326.0	1995;nontest
8	2	9	t	9076060-20	250-20	1	300.0	
8	2	10	t	9076065-07	Tree #3-7	1	193.0	leaf retention 11/17/03
8	2	11	nt	9076057-19	228-19NT	1	301.0	1995;nontest
8	2	12	t	9076061-13	Tree AS II-13	1	300.0	*vexar problem
8	2	13	t	9076057-27	228-27	1	295.0	
8	2	14	t	9076051-13	209-13	1	135.0	
8	2	15	nt	9076057-18	228-18NT	1	176.0	1995;nontest
8	2	16	t	9076051-04	209-4	1	44.0	
8	3	1	t	9076064-36	*13-1-36*	1	139.0	

APPENDIX 2. Bur oak evaluation data, Bridger, Montana, 2003.

Block	Row	Position	Test Plant	Accession Number	Previous ID Number	Plant Survival	Height	Comments
			(t,nt)			*(0,1)*	*cm*	
8	3	2	t	9076061-02	Tree AS II-2	1	243.0	
8	3	3	t	9076049-13	142-13	1	251.0	bareroot
8	3	4	t	9076063-54	Tree B II-54	1	248.0	
8	3	5	t	9076047-21	128-21	1	220.0	
8	3	6	t	9076062-06	E.T.T.II-6	1	445.0	low fork
8	3	7	t	9076052-10	211-10	1	209.0	
8	3	8	t	9076057-21	228-21	1	258.0	low fork
8	3	9	t	9076056-02	227-2	1	246.0	
8	3	10	t	9076052-20	211-20	1	324.0	dk,corky bark; low fork
8	3	11	nt	9076057-28	228-28NT	1	258.0	1995;nontest
8	3	12	t	9076059-10	237-10	1	230.0	
8	3	13	t	9076065-09	Tree #3-9	1	187.0	deer
8	3	14	t	9076049-15	142-15	1	170.0	bareroot
8	3	15	t	9076053-12	218-12	1	182.0	
8	3	16	nt	9076057-26	228-26NT	1	140.0	1995;nontest

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