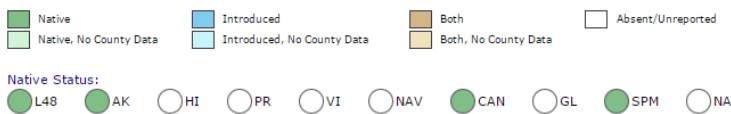
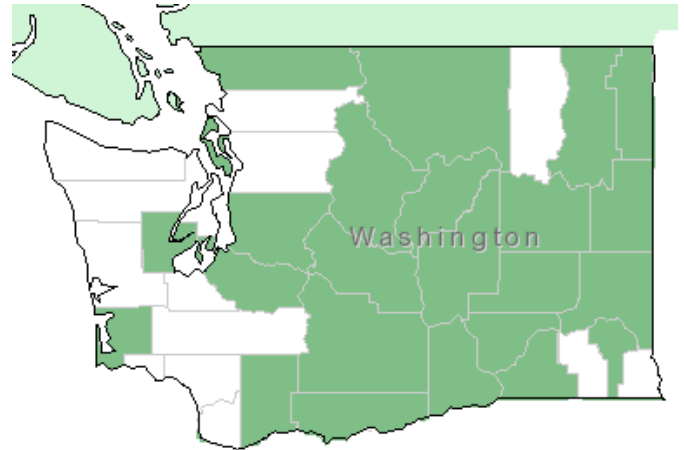
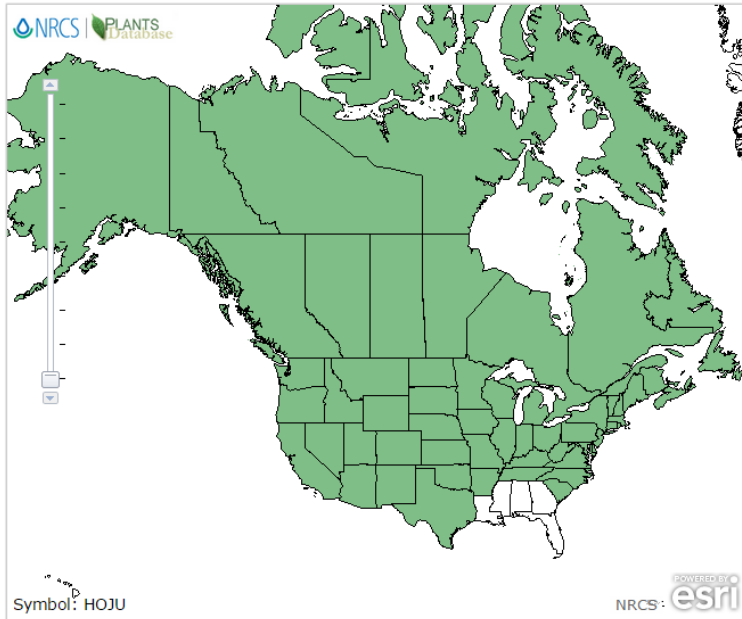


# 1. Plant Propagation Protocol for *Hordeum jubatum*

ESRM 412 – Native Plant Production

Spring 2015

Protocol URL: <https://courses.washington.edu/esrm412/protocols/HOJU.pdf>



<b>TAXONOMY</b>	
<b>Plant Family</b>	
Scientific Name	Poaceae
Common Name	True Grasses
<b>Species Scientific Name</b>	
Scientific Name	<i>Hordeum jubatum</i> L.
Varieties	<i>Hordeum jubatum</i> L. var. <i>boreale</i> (Scribn. & J.G. Sm.), B. Boivin <i>Hordeum jubatum</i> L. var. <i>caespitosum</i> (Scribn. Ex Pammel) Hitchc.
Sub-species	<i>Hordeum jubatum</i> L. subsp. <i>breviaristatum</i> Bowden <i>Hordeum jubatum</i> L. subsp. <i>intermedium</i> Bowden <i>Hordeum jubatum</i> L. subsp. <i>jubatum</i>
Cultivar	H. jubatum is a hybrid of an extinct relative of <i>H. brachyantherum</i> (meadow barley) and an East Asian <i>Hordeum</i> species <sup>6</sup> .
Common Synonym(s)	No synonyms found at this time
Common Name(s)	Foxtail barley, bobtail barley, Squirreltail barley;

	intermediate barley (for subsp. <i>intermedium</i> )
Species Code (as per USDA Plants database)	HOJU
<b>GENERAL INFORMATION</b>	
Geographical range	Common throughout much of North America besides the deep southeast; common on the shores of the Great Lakes <sup>10</sup> ; see above for North America and Washington State distribution.
Ecological distribution	Fields, pastures, roadsides; both saline and alkaline environments, disturbed sites. It can also be considered a weed in some agricultural sites <sup>9</sup> ; grasslands <sup>14</sup> .  Grows in dry to moist conditions; can tolerate sandy loam to clay soils as well as well-drained soils; tolerant of wide range of soil pH conditions <sup>14</sup> .
Climate and elevation range	Most of North America. Can tolerate climate and elevations under 2500 meters <sup>14</sup> ; has been able to successfully grow at elevations above 3,000 in Colorado <sup>7</sup> . Can tolerate USDA hardiness zones 4 through 8 <sup>14</sup> .
Local habitat and abundance	Grows in thick bunches. Common along roadsides. Most prevalent in ecotones or edges of ecosystems, primarily sloughs, salt marshes and grassy slopes <sup>5</sup> .  Can only grow in full sun; intolerant of shady conditions <sup>14</sup> .
Plant strategy type / successional stage	Considered a weedy in Midwest, eastern North America, and can be weedy in Southwest region <sup>1</sup> ; early seral species in grasslands <sup>15</sup> ; colonizer in marsh areas with receding water table <sup>12</sup> . Will go dormant in desert regions during hot spells <sup>1</sup> .  <i>H. jubatum</i> is extremely tolerant of saline environments – experiments by K.S. Badger and I.A. Ungar found that seed production was greater with an increase in soil salinity <sup>3</sup> ; a 1991 study by Badger and Ungar found that the highest seedling survival occurred at highest levels of salinity in a salt marsh environment <sup>2</sup> ; however, germination is shown to decrease with salinity levels higher than 1 percent <sup>16</sup> .
Plant characteristics	<b>General:</b> Adult plant can be up to 60 cm tall. Blooms between May and July <sup>9</sup> . Does not have rootstocks, rhizomes or root buds that are characteristic of other perennial grasses <sup>8</sup> . Cool season grass <sup>1</sup> . <b>Leaves:</b> Leaf blades are long, linear in shape, between

	<p>2.5 – 15 cm long<sup>9</sup>. Leaves often light green or green-yellow in color<sup>1</sup>.</p> <p><b>Flower:</b> Flowers are hermaphrodites (both male and female organs<sup>14</sup>). Flower is a spike, can be between 3 and 10 cm long. Spike often has long needle-like awns that extend from it – can be up to 7 mm long<sup>9</sup>. Flowers in June<sup>14</sup>, golden yellow in color<sup>1</sup>.</p> <p>Pollination between plant parts and plants occurs via wind in the wild. Germination occurs in both spring and fall, however, seedling establishment conditions are often more favorable in the fall<sup>13</sup>.</p> <p><b>Roots:</b> Fibrous<sup>17</sup>.</p> <p><b>Seeds:</b> Elliptical, yellow to brown in color, about ½ a centimeter in length. Each plant can have up to 200 seeds<sup>14</sup>.</p>
<p><b>Propagation of <i>Hordeum jubatum</i> by J.D. Banting, testing effect of light and temperature on germination<sup>4</sup></b></p>	
Ecotype	Seeds were collected from three sites: one in Harrow, Ontario; one in Beaverlodge, Alberta and one in Regina, Saskatchewan.
Propagation Goal	Germinants
Propagation Method	Seed
Product Type	Seedlings in flats with three compartments and bottom drainage.
Stock Type	Native seed collected from three different sites in Canada (see above)
Time to Grow	Seeds were not outplanted in this study.
Target Specifications	Germinants - seeds were being tested for germination patterns in this research.
Propagule Collection Instructions	Seeds were collected from three sites in summer (August) of 1975.
Propagule Processing/Propagule Characteristics	Not specified for this study
Pre-Planting Propagule Treatments	Seeds were stored at room temperature until testing began in 1977. Seeds were threshed on rubber mats to remove seeds from stems and chaff.
Growing Area Preparation / Annual Practices for Perennial Crops	<p>15 x 90 mm petri dishes were covered with two No. 1 Whatman filter papers. Prior to seeding, filter papers were allowed to fully saturate in distilled water, then drip-drained before being placed at the bottom of each dish.</p> <p>Light and heat sources were set up using 20W fluorescent lamps 10 cm above each petri dish.</p>
Establishment Phase Details	50 seeds were each added to each petri dish. Four replicates of each germination condition were created,

	<p>with fluctuations going from 10 to 30 degrees C and 24 hours of light or darkness to as little as 6 hours of either.</p> <p>Results were that germination was much higher at warmer, alternating temperatures (going between a steady 20 degrees C to 30 degrees C). Light appeared to reduce germination. Continuous light had the lowest germination rates. Results were rather uniform across seeds from all three harvesting sites.</p>
Length of Establishment Phase	14 days
Active Growth Phase	Unknown from this series. Plants were discarded after germination study was completed – 14 days.
Length of Active Growth Phase	Unknown, plants discarded after 14 days
Hardening Phase	Unknown
Length of Hardening Phase	Unknown
Harvesting, Storage and	Not conducted for this research.
Length of Storage	Not conducted for this research.
Guidelines for Outplanting / Performance on Typical Sites	To ready seeds for future outplanting, germinate them in darkness with alternating cooler (20 degrees C) and warmer (30 degrees C) temperatures. Other studies have shown <i>H. jubatum</i> has wider germination rates after cold stratification, yet freezing temperatures resulted in higher levels of seed mortality <sup>3</sup> .
Other Comments	None at this time.
<b>K.R. Israelsen, C.V. Ransom and B.L. Waldron propagation tests on effects of salinity<sup>11</sup></b>	
Ecotype	Seed was collected from a site in Cache Junction, Utah. <i>H. jubatum</i> was found at concentrations here that were considered an infestation.
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container Ray Leach Cone-tainers (container size not specified) produced by Stuewe and Sons Inc. Each container had one seed of <i>Hordeum jubatum</i> .
Stock Type	Native seed collected from Cache Junction, Utah.
Time to Grow	Six weeks; however, for this experiment, salinity tolerance was tested for several weeks following, so entire growing period lasted 27 weeks. Two experiments were conducted: the first from March to July 2008 and the second from December 2008 to May 2009.
Target Specifications	Health of <i>H. jubatum</i> after being regularly exposed to high levels of salinity. This was measured by plant biomass clippings taken at six separate intervals during

	the electrical conductivity testing. Plants were allowed to grow to 6 cm above soil surface; everything taller than this was clipped for biomass sampling.
Propagule Collection Instructions	Not specified beyond location. Previous studies have found that seeds can be collected directly from plant (either during spring or fall germination period), stored in cold storage and then sowed directly into soil <sup>14</sup> .
Propagule Processing/Propagule Characteristics	Not specified for this study
Pre-Planting Propagule Treatments	Not specified for this study
Growing Area Preparation / Annual Practices for Perennial Crops	Each seed was planted individually in 3.8 x 21 cm Ray Leach Cone-tainers produced by Stuewe and Sons Inc., in 70-grit silica sand. To prevent sand from coming out off the bottom, capillary matting (10 x 10 cm) was put at the bottom of each cone-tainer. Seeds were grown in a greenhouse in Logan, Utah where temperatures remained 30 degrees Celsius, within +/- 1 degree.
Establishment Phase Details	Seeds were planted 1.5 cm deep (one per cone-tainer) and were hand-watered once a day with tap water.
Length of Establishment Phase	10 days
Active Growth Phase	Seedlings were sub-irrigated in 98-cone flats with a water-based nutrient solution. Nutrient mix contained small amounts of nitrates, sulphates and phosphates. Flats were lefts in the solution for two minutes. When not in use, the solution was covered with heavy black fabric to inhibit the growth of algae. Plant flats were dipped twice a week (Mondays and Thursdays) for six weeks.
Length of Active Growth Phase	Six weeks (42 days)
Hardening Phase	After roots were well-developed (six weeks after seeding), grasses were immersed in salt solution of either 100 mM NaCl (from Fluka Chemical Co.) or 0 mM.
Length of Hardening Phase	2 months (61 days)
Harvesting, Storage and Shipping	Harvesting and storage of seeds not conducted for this study.
Length of Storage	Outplanting not conducted for this study
Guidelines for Outplanting / Performance on Typical Sites	Study results found that <i>H. jubatum</i> can tolerate soil salinity levels above 1% (which was previously considered a threshold for the species) for as much as 512 days, and still retain up to 50 % of its original biomass (approximately 50 % mortality). Foxtail will likely be able to dominate habitats that have fluctuating salinity levels that go above 1 % for short periods of time, as well as those that have continuous salinity levels between 0 and 1%.

Other Comments	None at this time.
<b>INFORMATION SOURCES</b>	
References	See Below
Other Sources Consulted	See Below
Protocol Author	Ashley Blazina
Date Protocol Created or Updated	April 27, 2015

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