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PLANT MATERIALS TECHNICAL NOTE

INTERMEDIATE WHEATGRASS (*Thinopyrum intermedium* L.): An Introduced Conservation Grass for Use in Montana and Wyoming

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Figure 1. Intermediate wheatgrass.

Introduction

Native to central Europe, the Balkans, and Asia Minor, intermediate wheatgrass has a number of characteristics making it a valued conservation grass in the Northern Great Plains and Intermountain West of North America. Abundant seed production, ease of establishment, and rapid growth to maturity makes this species a profitable crop for seed producers who can attain 350 pounds of seed per dryland acre or 500 pounds under irrigation. This helps keep seed prices low. Adapted to coarse, medium, and fine-textured soils with pH ranging from 5.6 to 8.4, it is a preferred non-native grass for a wide range of conservation plantings on 12- to 30-inch annual precipitation sites. Its strong seedling vigor makes it competitive with weeds and increases seeding success rates. Palatability is rated high for large ungulate wildlife and all classes of livestock, and it maintains forage quality throughout the year, giving producers flexibility in pasture management and grazing rotations. Because of its tall stature, stiff stems, and high yields of good quality forage, it is a preferred hay crop, especially when grown with alfalfa. When left as a standing crop, its tall stature provides nesting cover for game birds and migratory waterfowl, as well as a stockpile crop for winter livestock use. Its short, rhizomatous growth form provides soil stability on conservation plantings where erosion is a concern, but it is not as aggressively invasive as strongly rhizomatous grasses like quackgrass, smooth brome, or Kentucky bluegrass. Its high root mass production in the upper soil profile helps improve soil quality.

Because it is such a versatile conservation grass, a number of intermediate wheatgrass cultivars, selected, and improved materials have been developed. Under the recent taxonomic classification of this species as *Thinopyrum intermedium* (formerly *Elytrigia intermedia*, which was preceded by *Agropyron intermedium*), these varieties can be grouped into either intermediate wheatgrass, or the sub-species pubescent wheatgrass (*Thinopyrum intermedium* spp. *barbulatum*, formerly *Agropyron trichophorum*). Pubescent wheatgrass can be distinguished from intermediate wheatgrass by its short, stiff hairs on the outer glumes, lemma, and palea of the florets, and on the leaves. Plants integrate from the pubescent type to the hairless (glabrous), intermediate type. The pubescent forms are more prevalent than the glabrous forms in its native range in central Asia as precipitation zones grade toward increased drought. This Technical Note will focus on the intermediate wheatgrass varieties.

General Description

Intermediate wheatgrass is an introduced, long-lived, cool-season perennial grass. The seeds have no dormancy, are relatively large averaging 80,000 per pound, but variable depending on the cultivar, and easily seeded through a grain drill. Feeder root growth is abundant in the upper soil profile. Dry weight root production has been measured as high as 7,000 pounds per acre in the upper 8 inches of soil in 5-year-old stands. Rhizomes are generally short, but variable among cultivars. Plants green-up in early spring and most herbage is produced during late spring and early summer, peaking by late July to mid-August. Herbage growth timings are also variable depending on the cultivar. Leaves are 0.16 to 0.31 inches (4-8 mm) wide, green to blue-green in color and sometimes drooping. Stems are stout, stiff and erect, growing 2 to 4 feet tall. The seed spikes may be up to 4 to 8 inches long. Seed is ripe for harvest in mid- to late August.

Adaptation or Range

Intermediate wheatgrass grows throughout western North America. It is adapted to areas with 13 inches of annual rainfall or greater. The species performs best above 3,500 and up to 9,000 feet in elevation. It can be seeded at lower elevations where adequate moisture is available. It is not as drought tolerant as some cultivars of crested wheatgrass (*Agropyron cristatum*), Siberian wheatgrass (*Agropyron fragile*), and Russian wildrye (*Psathyrostachys juncea*). Stands of intermediate wheatgrass are not as susceptible to spring and fall freezing as smooth brome (*Bromus inermis*), meadow brome (*Bromus biebersteinii*), or orchardgrass (*Dactylis glomerata*).

Intermediate wheatgrass prefers well-drained, loamy to clayey-textured soils. It will tolerate slightly acidic to mildly saline conditions. On saline sites, growth is compromised in clay soils with electrical conductivity above 6 millimhos per centimeter, and plants die above 12 millimhos per centimeter. It is somewhat cold-tolerant, can withstand moderate, periodic flooding in the spring, and is very tolerant of fire. The pubescent form can tolerate lower fertility, more alkaline soils, higher elevations, and drier conditions than the intermediate form.

Limitations

This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed.

If precipitation is below 13 inches annually, the pubescent wheatgrass subspecies would be a better selection for a planting.

The species performs poorly on wet, poorly drained, moderately saline to alkaline soils.

Intermediate wheatgrass is reported to have poor stand persistence because of severe winter injury and intensive defoliation. Forage harvest and grazing management can be used to improve

stand persistence. Leaving a 6-inch stubble height going into winter will protect against winter injury. Timing and intensity of grazing affects persistence. Research in North Dakota showed that tiller persistence, a measure of stand persistence, was greater when intermediate wheatgrass was grazed during early vegetative or mid-culm elongation than when grazed during late boot (Hendrickson, et al., 2005). In addition, there was lower tiller persistence when grazed at all stages of growth in dry years compared to wet years. However, a defoliation study showed defoliation intensity, but not moisture stress, reduced tiller recruitment 2.7 times in defoliated plants compared to non-defoliated controls (Hendrickson and Berdahl, 2002). Field planting results suggest well managed stands can last for decades.

Ease of Establishment

Intermediate wheatgrass should be seeded with a drill at a depth of ½-inch or less on medium- to fine-textured soils and no more than 1 inch deep on coarse-textured soils. When seeded alone, a rate of 10 to 12 pounds pure live seed (PLS) per acre, or 21 to 25 PLS seeds per square foot, is recommended. It is compatible with other species, particularly alfalfa. If used as a component of a mix, obtain the amount needed in the mix by multiplying the rate when seeded alone by the percentage planned for the mix. The best dryland results are obtained from seeding in very early spring on heavy- to medium-textured soils and in late fall (dormant) on medium- to light-textured soils. Irrigated lands should be seeded in spring through summer. Late summer (mid-August) seedings are not recommended unless irrigation is available. Light, frequent irrigation is beneficial for stand establishment.

For mined lands, roadsides, and other harsh critical areas, the seeding rate should be increased to 15 to 18 pounds PLS per acre or 31 to 38 PLS seeds per square foot. Light, frequent irrigations are beneficial for stand establishment.

Seedling vigor is good to excellent. It establishes fairly quickly, quicker than meadow brome or smooth brome.

Protect new seedlings from grazing until they are fully established and are able to withstand pulling by grazing animals without being uprooted. It is desirable to cut at least one hay crop prior to grazing. Stands may require weed control measures during establishment. To avoid seedling injury during the establishment year, application of 2,4-D for broadleaf weed management should not be made until plants have reached the four- to six-leaf stage. Mow weeds to a 6-inch height at or prior to their bloom stage.

Conservation Uses

Erosion control/reclamation: Intermediate wheatgrass is well adapted to stabilization of disturbed soils. It can be used in critical and urban areas where irrigation water is limited and to stabilize ditch banks, dikes, and roadsides. This grass can also be used to build soils because of its heavy root production. The release ‘Tegmar’ is preferred for these sites because of its vigorous seedlings, rapid developing rhizomes, drought tolerance, and relatively low litter management resulting from its dwarf form.

Invasive species: Under favorable conditions intermediate wheatgrass provides good weed suppression. Spotted knapweed (*Centaurea stoebe*) biomass production in a 15-year-old intermediate wheatgrass stand was 92 percent less than where there was no intermediate wheatgrass on the same site (Rinella, et al., 2012).

Wildlife: Un-grazed strips of this grass provide good nesting cover for game birds and migratory waterfowl. It is a preferred feed for deer, antelope, and elk in spring, early summer, and fall and is considered a desirable feed for elk in winter.

Hay Production: Intermediate wheatgrass responds very well to irrigation with initial production nearing the level of orchardgrass and meadow brome, and exceeding smooth brome under full irrigation. Compared to crested wheatgrass, total digestible nutrients are higher, lignin content is lower, and protein content is about equal. Intermediate wheatgrass stays green longer and matures later than crested wheatgrass. Hay yields are good both in monoculture and in mixtures with alfalfa where its stiff stems tend to keep alfalfa from lodging. It has enough seedling vigor to either be planted in the same row with the legume or in alternate rows, i.e., grass-alfalfa-grass-alfalfa. When planted with a legume, harvest hay at optimum stage for the legume. This will allow the grass to be harvested prior to flowering and result in very high-quality hay.

It has fairly slow re-growth following clipping and is best adapted to single crop-haying conditions (where rainfall patterns or limited irrigation prevents multiple cuttings in a season). Meadow brome and orchardgrass have much better re-growth characteristics and will normally produce more than intermediate wheatgrass for hay production in multiple cutting situations.

Forage production can be restored and stands may benefit from ripping if sod-bound conditions occur. Care should be taken to avoid excessive tillage because stands may be damaged.

Figure 2. Intermediate wheatgrass pasture.

Figure 3. Intermediate wheatgrass seedhead.

Irrigated Pasture: Intermediate wheatgrass provides a nutritional pasture and is very palatable to all classes of livestock. On established stands, begin grazing in the spring after 10 to 12 inches of new growth. A 6-inch stubble height should be maintained following each grazing and going into winter. Care should be taken to allow proper rest of 21 to 28 days between grazing periods in irrigated and high-moisture situations. Apply nitrogen as needed to maintain vigorous growth. Consider a balance of nitrogen and phosphate fertilizer in order to maintain a legume component in mixed stands. A soil test is recommended to determine fertilizer rates.

Total digestible nutrients for intermediate wheatgrass are adequate for livestock throughout the year. However, crude protein becomes deficient by mid- to late July. Optimum forage quality for grazing begins in mid-May and lasts through mid-July. Using a rotational grazing system, nutritional quality can be extended through September by maintaining immature plants by clipping or grazing seed stems to a 12-inch height.

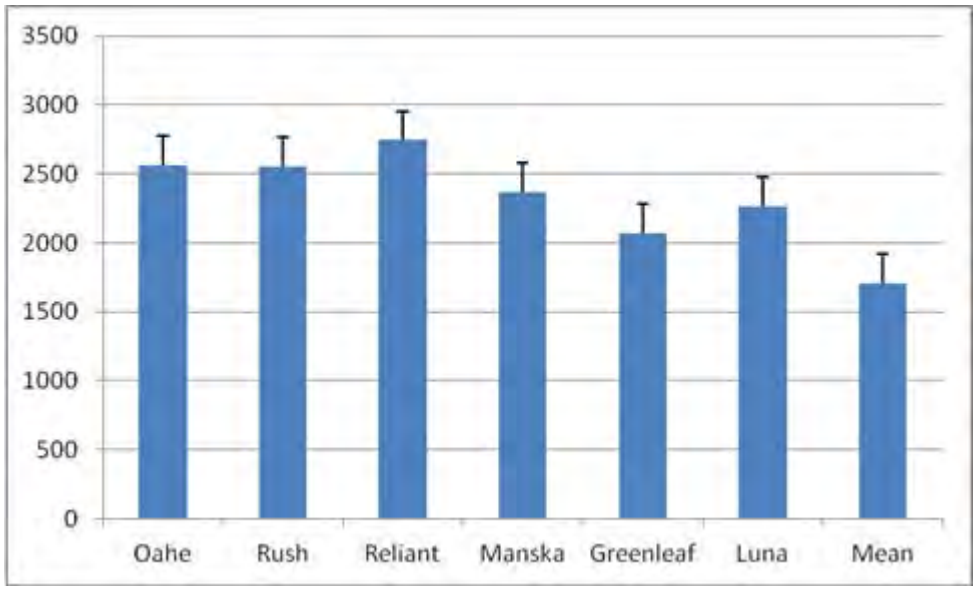

Figure 4. Dry matter production (pounds per acre) averaged across three sites and 3 years from forage trials conducted by Montana State University (Blunt, 2001). 'Oahe', 'Rush', and 'Reliant' are varieties of intermediate wheatgrass. 'Manska', 'Greenleaf', and 'Luna' are pubescent wheatgrass varieties. The mean is the average of all species and varieties included in the trial. The error bar is the least significant difference (LSD) used to determine statistical differences among the varieties.

Dryland pasture: In forage trials on non-irrigated pastures conducted by Montana State University (Blunt, 2001) at three sites across Montana, intermediate wheatgrass varieties generally produced the highest dry matter yields during the first 2 years of the 3-year trial. These years also received the highest precipitation during the study. Averaged over the three sites and 3 years, 'Oahe' intermediate wheatgrass produced 2,562 pounds dry matter per acre annually (see Figure 4), which was significantly greater than 2,172 pounds per acre for 'Hycrest' crested wheatgrass, 1,801 pounds per acre for 'Magnar' basin wildrye, and 1,449 for 'Bozoisky-Select' Russian wildrye (Blunt, 2001). While the analysis in this study did not detect differences among varieties across locations or years, a study of 34 intermedaite wheatgrass varieties by Vogel, et al. (1993) found differences among varieties in forage production and protein content depended on both the location where they were grown, and the climatic conditions of the year. Results of the Montana trial averaged over three sites and 3 years found crude protein concentrations for 'Rush' intermediate wheatgrass was 150 grams per kilogram (15 percent), which was only significantly less than varieties of Altai (*Leymus angustus*), Russian, and basin (*Leymus cinereus*) wildryes. Crude protein was not significantly different among cultivars of intermediate wheatgrass, however, 'Luna' pubescent wheatgrass tended to retain high levels of protein later in the fall than other intermediate wheatgrass varieties, and in 1997 the protein in Luna was significant greater than Oahe, Reliant, and Rush on November 7 (see Figure 5). The percent (or grams per kilogram) *in vitro* digestible dry matter (IVDDM) of intermediate wheatgrass in this study was comparable to varieties of other tame grass species tested. Also, Vogel, et al. (1993) found IVDDM of the 34 intermediate wheatgrass varieties tested were stable across locations and years.

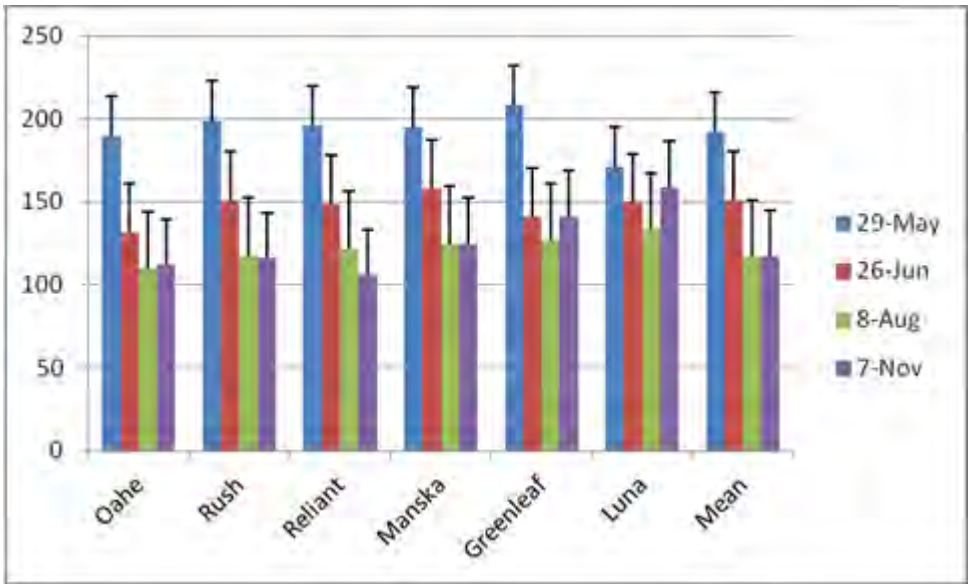

Figure 5. Crude protein concentrations (grams per kilogram) for intermediate wheatgrass grown at the Bridger PMC during 1997 from forage trials conducted by Montana State University (Blunt, 2001). Oahe, Rush, and Reliant are varieties of intermediate wheatgrass. Manska, Greenleaf, and Luna are pubescent wheatgrass varieties. The mean is the average of all species and varieties included in the trial. The error bar is the least significant difference (LSD) used to determine statistical differences among the varieties.

Seed production: Seed production of intermediate wheatgrass is generally not difficult. If fields are maintained in rows and adequate fertility levels are maintained, seed can be produced for 7 to 10 years. Cultivation is required to maintain rows. Row spacing of 36 inches on dryland field (areas with a minimum of 14 inches annual precipitation) and row spacing of 24 to 36 inches irrigated fields are recommended. Seed yields drop significantly after about 4 years of production.

Releases

Releases (year and location) of intermediate wheatgrass include ‘Manifest’ (2007, North Dakota), ‘Haymaker’ (2003, Nebraska), ‘Beefmaker’ (2003, Nebraska), ‘Rush’ (1994, Idaho), ‘Reliant’ (1991, North Dakota), ‘Clarke’ (1980, Saskatchewan), ‘Slate’ (1969, Nebraska), ‘Chief’ (1961, Saskatchewan), ‘Oahe’ (1961, South Dakota), ‘Tegmar’ (1968, Idaho), ‘Amur’ (1952, New Mexico), and ‘Greenar’ (1945, Washington, Oregon, and Idaho). The following releases are recommended for Montana and Wyoming because of their selection from lines adapted to our northern, semi-arid climate.

Manifest intermediate wheatgrass was selected from sources adapted to the northern Great Plains region. It was developed by the Northern Great Plains Research Laboratory and released by Agricultural Research Service (ARS), North Dakota Agriculture Experiment Stations (AES), and Natural Resources Conservation Service (NRCS) Bismarck Plant Materials Center (PMC) in 2007. It was selected for forage yield, seed yield, spring recovery, and resistance to leaf spot. Its higher shoot replacement ratios compared to Reliant, Manska, and Oahe should allow greater recovery from grazing and thus persist longer than those varieties. Manifest has not been tested in the Montana and Wyoming field planting program. In a non-replicated field demonstration in South Dakota harvested on September 9, 4 years after planting, Manifest produced 7,330 pounds of forage per acre compared to 8,308 pounds per acre for Reliant, 7,509 pounds per acre for Beefmaker, and 6,849 pounds per acre for Haymaker.

Reliant intermediate wheatgrass was selected from sources adapted to the Northern Great Plains region. It was developed by the Northern Great Plains Research Laboratory and released by ARS, North Dakota AES, and Bismarck PMC in 1991. It was selected for resistance to leaf spot,

improved vigor, forage, seed production, forage quality, and winter survival. It is of medium height, late maturing and adapted for hay, pasture, and conservation purposes.

Persistence and sustained productivity under hayland management in mixes with alfalfa are the primary advantages of Reliant over other intermediate wheatgrass cultivars. When compared to Oahe and two pubescent varieties in North Dakota trials, Reliant had the most early-season production with 35 percent of total growth occurring by mid-May and 54 percent by early June (Sedivec, 2007). Reliant achieved 90 percent of total production by the third week of June when percent crude protein and total digestible nutrients were highest. This is the recommended timing for harvesting highest quality hay.

Reliant has been tested in three field plantings in Wyoming and none in Montana. In an outdoor classroom planting in Big Horn County, Reliant failed to establish. On a pasture planting intended for early-season grazing on a Major Land Resource Area 48B site in Carbon County, Wyoming, Reliant maintained a “good” stand with good vigor and forage production 12 years after seeding. In a hay planting in Sublettte County, Wyoming, on Major Land Resource Area 34, the Reliant stand was evaluated as “good” with excellent vigor and good forage production 3 years after planting. In dryland forage trials at three sites in Montana, dry matter production, *in vitro* digestible matter, and crude protein of Reliant were comparable to Oahe and Rush when averaged over all sites and years.

Oahe intermediate wheatgrass was selected from seed originating in Russia by South Dakota AES, Brookings, South Dakota and was released in 1961. Named after the Oahe Dam on the Missouri River, it is an abbreviation for the Sioux word meaning "Big House." It was selected for its uniformly bluish-green color, drought tolerance, vigor, rhizomatous traits, and high seed yields. Oahe is adapted for hay, pasture, and conservation purposes.

Forage trials in North Dakota comparing growth patterns of Oahe, Reliant, and two varieties of pubescent wheatgrass found Oahe was the slowest growing in the spring with only 16 percent of total growth by mid-May and 30 percent by mid-June. Peak production was reached by late July to mid-August. Oahe retained the least amount of forage into October, losing 32 percent of peak standing crop by early October.

Oahe has been tested at 19 field plantings across Montana and Wyoming. Oahe failed in a hayland planting in Lincoln County, Wyoming, on a Major Land Resource Area 34 site 10 years after establishing a “good” stand with excellent vigor. On another hayland planting on Major Land Resource Area 58A in Fallon County, Montana, Oahe was initially evaluated as a “fair” stand, it improved to “excellent” with excellent vigor after 5 years, but considered a “failure” 10 years after planting. Another hayland stand declined from “excellent” to “poor” after 7 years, indicating that Oahe may provide good hay for a period of 5 years after which renovation may be needed according to standard hayland crop rotations. Stands of one pasture planting, one dryland pasture planting, and one range planting were evaluated as “excellent” 10 years after planting, suggesting Oahe stands will persist under good grazing management.

Rush intermediate wheatgrass originated from sources in Germany. It was selected by the Aberdeen Plant Materials Center and released by the Idaho AES and Aberdeen PMC in 1994. It was selected for superior seedling emergence and vigor compared to other intermediate wheatgrasses, good spring recovery, good rate of spread by rhizomes, uniform seedheads, wide leaves, high forage production, and high seed production. It has the largest seed of intermediate wheatgrasses, averaging 66,000 seeds per pound. It is adapted for soil erosion control, roadside stabilization, mine spoil stabilization, hayland, both dryland and irrigated pastureland, and forage for livestock and wildlife. It is not adapted to hay mixtures with alfalfa.

Rush was tested in 23 field plantings across Montana and Wyoming. Six plantings ended in failure, two of which were demonstration plantings and one was a plant adaptability trial with very poor initial stand establishment, two were hayland plantings that declined after 10 years, and one was a pasture planting that declined after 10 years. Two additional hayland planting stands were rated as "poor" (8 years old) or "fair" (10 years old). Three pasture planting stands were rated as "fair" after 10 years. One pasture and one hayland planting were rated as "good" after 10 years, and one pasture was rated as "excellent" after 11 years. Pasture and hayland planting stands in the 4- to 7-year-age range were all rated as "good" or "excellent".

Tegmar intermediate wheatgrass was selected by the Pullman Plant Materials Center and released by the Aberdeen Plant Materials Center in 1968. It was selected for its dwarf growth form, (it is about half the height of the other varieties), vigorous seedlings, drought tolerance, and rapidly developing rhizomes. It is a good choice for erosion control and soil stability along roadsides, ditch banks, dam sites, mine reclamation, and grass waterways where forage production is a management problem and not an objective.

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