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Developing a Grazing-tolerant Native Grass for Bluebunch Wheatgrass Sites

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Bluebunch wheatgrass is an important native range grass in western North America which exhibits high forage quality and wide adaptation. Because of high palatability and poor grazing tolerance, its dominance has declined since the introduction of livestock. Grazing at the boot stage reduces vigor and competitiveness for several years, and increases susceptibility to further grazing damage (Miller et al. 1986). Bluebunch wheatgrass' poor seedling vigor has also limited its use by increasing difficulty of establishment. This is particularly so with the

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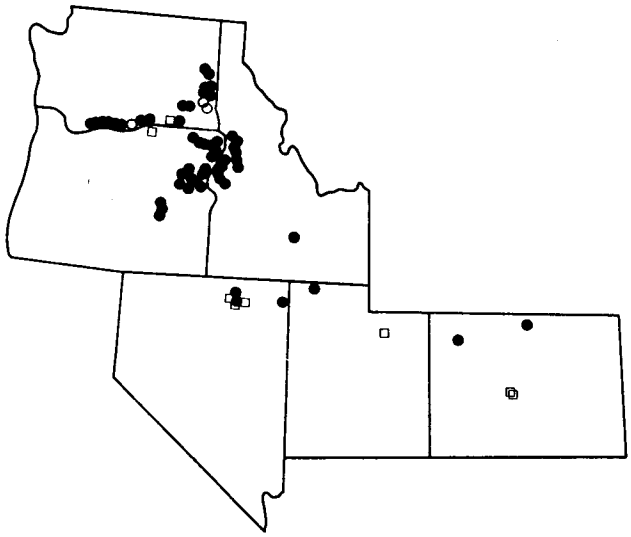

Fig. 2. *Bluebunch wheatgrass (solid circles), thickspike wheatgrass (open squares), and Snake River wheatgrass (open circles) collection sites.*

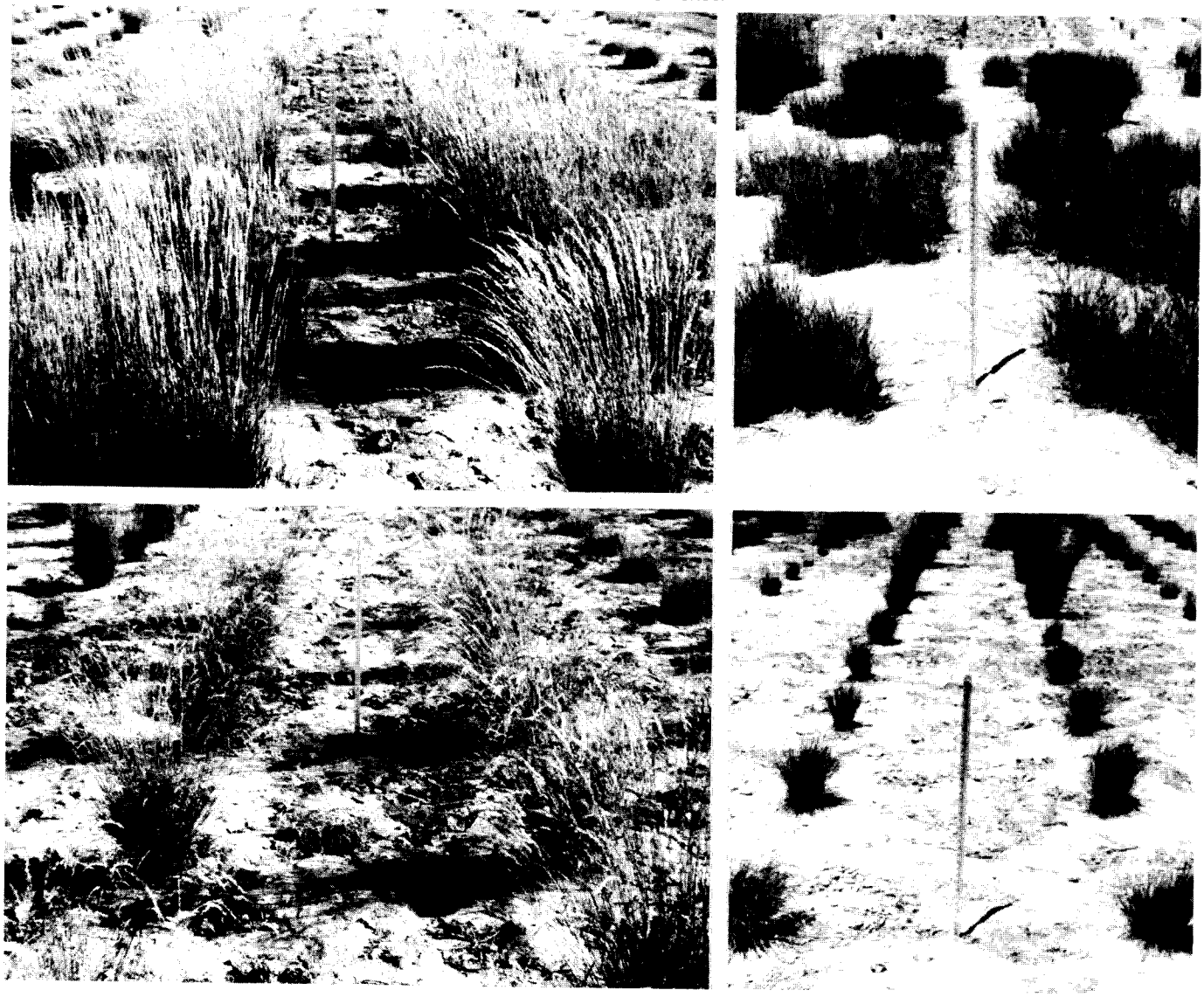

Fig. 1. *T21076 thickspike wheatgrass (top) and Secar Snake River wheatgrass (bottom) in North Logan, Utah. Unclipped plants 15 June 1989 (left) and regrowth 21 June 1989 from 10-cm clipping 19 May 1989 (right).*

old variety Whitmar, but the new variety Goldar is improved for this trait.

Approach to Breeding an Improved Grass

We intend to develop an improved native grass without some of bluebunch wheatgrass' problems. Such a grass would be adapted to bluebunch wheatgrass sites, yet would be more vigorous, grazing tolerant, and easier to establish than bluebunch wheatgrass. Our approach is to hybridize thickspike wheatgrass, termed northern wheatgrass in Canada, with the newly recognized Snake River wheatgrass (Carlson 1986), which is similar in appearance to bluebunch wheatgrass, but more grazing tolerant.

Carlson (1986) first recognized Snake River wheatgrass as an entity distinct from bluebunch wheatgrass. Snake River wheatgrass is found primarily in the Salmon, Snake, and Columbia River drainages of the Pacific Northwest, a much more limited distribution than either bluebunch wheatgrass or thickspike wheatgrass. The original specimen for taxonomic identification was collected in the Snake River Canyon, Whitman County, Washington, on the north side of the river between Pullman and Wawawai (rhymes with Hawaii). The variety Secar, originally released as a bluebunch wheatgrass, is now known to be a Snake River wheatgrass.

The bunch habit of Snake River wheatgrass easily distinguishes it from the native rhizomatous thickspike wheatgrass (Fig. 1). Despite this and other prominent differences, these two grasses are so closely related they are now considered two subspecies of a single species (Carlson 1986). Thickspike wheatgrass is considered to be grazing tolerant, but less palatable and productive than bluebunch wheatgrass. Its seedling vigor is considerably greater than that of bluebunch wheatgrass, and stands thicken over time because of its vigorous rhizomes. But seed production of thickspike wheatgrass is poorer than bluebunch wheatgrass and Snake River wheatgrass. Three varieties have been released, including Critana, Elbee, and Sodar (a form of thickspike wheatgrass called streambank wheatgrass).

We have made 8 native-site collections of thickspike wheatgrass in Nevada (3), Colorado (2), Oregon (1), Utah (1), and Washington (1), but have only collected Snake River wheatgrass at 3 Washington sites (Fig. 2). Snake River wheatgrass is most common in southeastern Washington and adjacent portions of Idaho. Bluebunch wheatgrass is much more common in the areas we have collected than either thickspike wheatgrass or Snake River wheatgrass. We have made 54 bluebunch wheatgrass collections in Oregon (19), Washington (17), Idaho (12), Nevada (3), Colorado (2), and Utah (1).

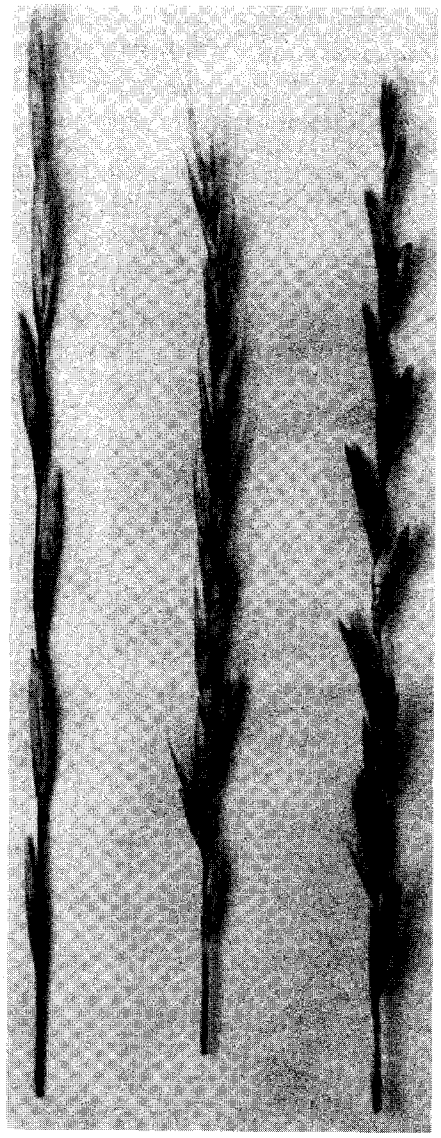

Fig. 3. *Comparative spike morphology of awned and awnless bluebunch wheatgrass (left), Snake River wheatgrass (center), and thickspike wheatgrass (right).*

Identification of Snake River Wheatgrass

Snake River wheatgrass is similar to bluebunch wheatgrass in its bunch habit, general morphology, and habitat preference, but is generally more productive and easier to establish (Carlson and Dewey 1987). Bluebunch wheatgrass may be awned (bearded) or awnless, but Snake River wheatgrass in its natural state is always awned. Though similar in appearance, Snake River wheatgrass and bluebunch wheatgrass can be distinguished on the basis of spikelet size, spike internode length, and glume shape. Snake River wheatgrass spikelets are shorter, wider, and separated by shorter internodes than bluebunch wheatgrass spikelets (Carlson 1986) (Fig. 3). Thus, Snake River wheatgrass spikes appear more compact. Snake River wheatgrass glumes are narrow and tapered, while bluebunch wheatgrass glumes are wide and blunt (Fig. 4).

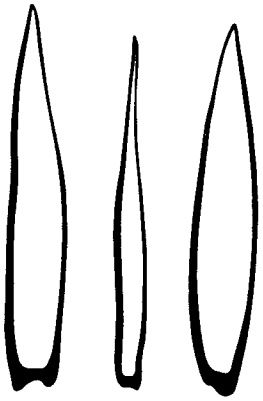

Fig. 4. *Comparative glume morphology of bluebunch wheatgrass (left), Snake River wheatgrass (center), and thickspike wheatgrass (right).*

We have also been able to distinguish Snake River wheatgrass from thickspike wheatgrass and bluebunch wheatgrass at the seedling stage. Immature leaves of Snake River wheatgrass seedlings are covered with dense hairs but lack barbs on their margins, while immature leaves of bluebunch wheatgrass seedlings have few hairs but exhibit conspicuous marginal barbs (Fig. 5). The hairs give leaves of Snake River wheatgrass seedlings a velvety texture,

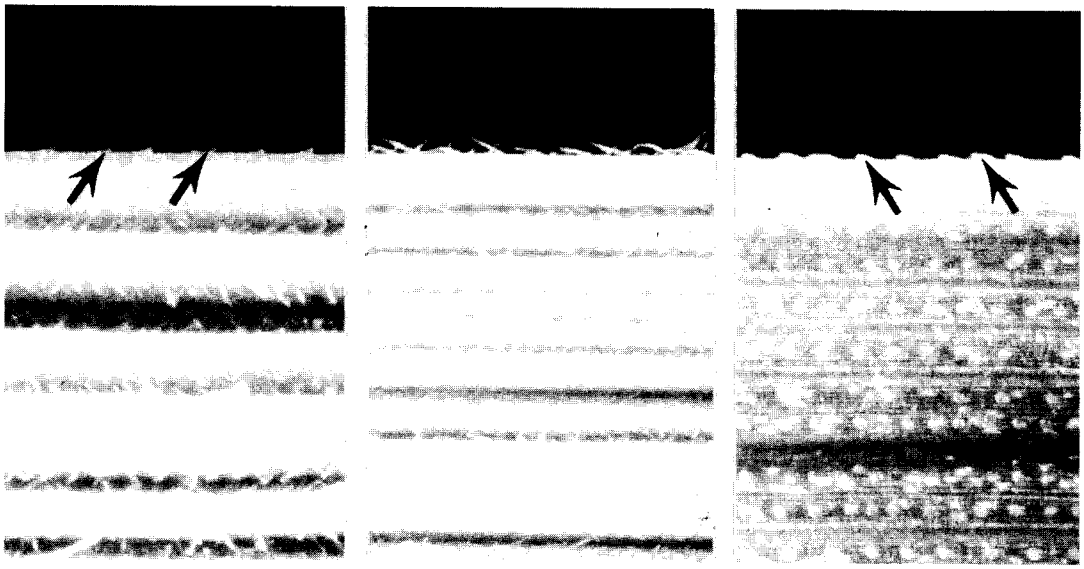

Fig. 5. *Comparative immature leaf morphology of bluebunch wheatgrass (left), Snake River wheatgrass (center), and thickspike wheatgrass (right). Arrows indicate marginal barbs.*

while leaves of bluebunch wheatgrass seedlings feel slick. These differences are present in immature leaves of established plants, but disappear as leaves matures. Thickspike wheatgrass is more similar to bluebunch wheatgrass than to Snake River wheatgrass for these 2 traits.

Development of the Hybrid Grass

We have used the USDA-SCS T21076 population as the thickspike wheatgrass parent in the hybrids. This is an extremely vigorous and rhizomatous plant and plans have been made by the SCS for its future release as a variety. T21076 was originally collected near The Dalles, Oregon, which receives an average of only 3 inches of rain from March to October. T21076 exhibits far more vigorous stand establishment than other thickspike wheatgrasses evaluated. T21076 also contributes awnlessness but is susceptible to rust, a fungal disease commonly affecting thickspike wheatgrass.

Secar and other populations collected in arid locales (12–13 inches average annual precipitation) of Whitman and Asotin County, Washington, served as Snake River wheatgrass parents in the hybrids. Snake River is awned but exhibits more rust resistance than thickspike wheatgrass. T21076's extensive rhizomes and steminess contrast with Snake River wheatgrass' bunch habit and leafiness.

The hybrid populations are potentially high seed yielders, but this potential has not yet been realized because of incomplete fertility. Some of the pollen aborts, presuma-

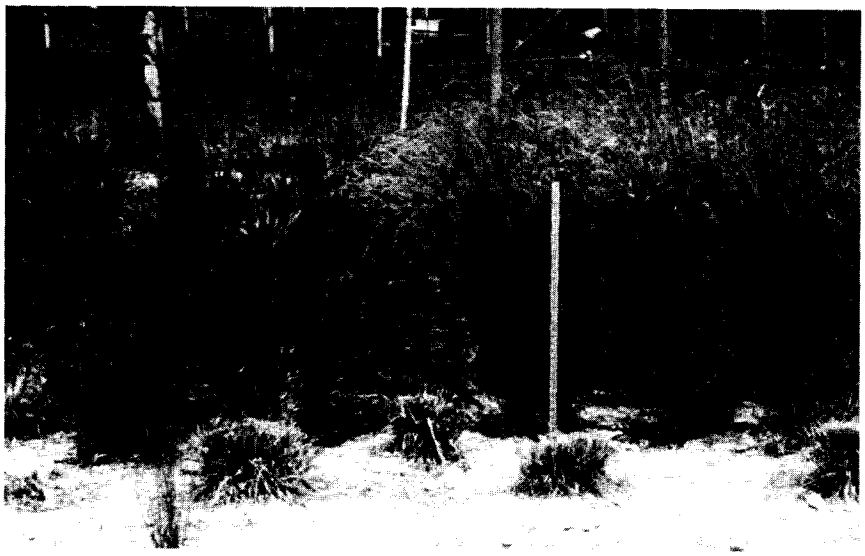

Fig. 6. *Hycrest crested wheatgrass (left) and a Snake River wheatgrass* × thickspike wheatgrass population (right) in North Logan, Utah, 15 June 1989.

bly because of a certain degree of incompatibility between the 2 subspecies. Breeding should be able to increase fertility and resolve this problem.

Awnlessness is a desirable trait because it eliminates the need for deawning in seed processing operations and facilitates utilization by grazing animals. Awns of F_1 plants are short to absent. F_2 and backcross segregation ratios indicate inheritance of the awn is primarily controlled by a single major recessive gene. Since the awn's inheritance is quite simple, it will be relatively easy to develop an awnless variety.

Since Snake River wheatgrass is a bunchgrass and thickspike wheatgrass is rhizomatous, considerable variation for spreading is present in the hybrid populations. Whether rhizomes would contribute to persistence under grazing is unclear. Rhizomes allow horizontal spreading of a clone and might speed recovery after grazing or fire. But bunchgrasses are more prominent in semi-arid environments (Caldwell et al. 1983), and many suspect that they are better competitors in such environments. For example, bluebunch wheatgrass plants in drier environments usually lack rhizomes, while those in more mesic environments may have short rhizomes (Evans and Tisdale 1972). Extensive rhizomes may be undesirable as they often result in a plant of low productivity, which may in turn discourage grazing. Plant materials with the genetic potential for rhizomatous spreading, but which express it only in relatively mesic environments, would probably be most desirable.

Unlike bluebunch wheatgrass, both Snake River wheatgrass and thickspike wheatgrass exhibit considerable regrowth after clipping at the boot stage (Fig. 1). In addition, the hybrid Snake River wheatgrass × thickspike wheatgrass populations exhibit considerable hybrid vigor (Fig. 6). The especially promising ELPX-5 population, which is 75% Snake River wheatgrass/25% thickspike wheatgrass, is vigorous, rust resistant, and leafy at maturity. We intend to breed for improved leafiness, seedling vigor, and seed yield in this population and anticipate development of a variety superior to Whitmar, Secar, or Goldar for revegetation of bluebunch wheatgrass sites.

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