Technical Notes

Secar bluebunch wheatgrass as a competitor to medusahead

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Abstract

A search continues for native perennial range grasses which will compete successfully with introducted annual grasses. Secar bluebunch wheatgrass *(Agropyron spicatum)* is a recently released cultivar selected for seedling vigor. Medusahead *(Taeniatherum asperum)* seeds germinated in about one third the time, were less inhibited by cold temperatures typical of range conditions, and seedlings grew more than twice as fast as Secar in a 30-day trial. Indications are that even this new cultivar will not compete successfully with vigorous medusahead seedlings without initial weed control.

Key Words: germination, seedling vigor, root growth, leaf area, range seeding

Annual grasses such as medusahead [*Taeniatherum asperum* (Sim.) Nevski] and cheatgrass [*Bromus tectorum* L.] have invaded millions of hectares of deteriorated U.S. western rangelands. Medusahead generally has negative value as a forage plant and because of its profuse seed production, adaptation to low fertility range sites, germination at low temperatures, and vigorous seedlings, it effectively outcompetes seedlings of most native perennial species. It is often desirable from a grazing standpoint to replace this and other annuals with valuable native perennial species, but few suitable candidates have been found.

Bluebunch wheatgrass [*Agropyron spicatum* (Pursh) Scribn. and Smith] is the most ubiquitous, widely distributed native perennial found in the Intermountain range region where these introduced annuals are a problem. Because of its broad geographic distribution, from Nogales to Fairbanks, there is hope that some local ecotype may prove to have characteristics of seedling vigor and rapid growth that will allow it to successfully compete with these introduced annuals.

Secar is a recently developed cultivar of bluebunch wheatgrass, selected from a large group of ecosystems at the Soil Conservation Service Plant Materials Center, Pullman, Washington (Anonymous 1979).

It was specifically chosen for superior seedling vigor, rapid growth, and adaptation to stressful range sites. It is the objective of this note to report comparisons of competitive characteristics of Secar and medusahead.

Materials and Methods

Experiments were conducted in both the greenhouse and laboratory. Seeds of Secar were supplied by the Plant Materials Center, Soil Conservation Service, U.S.D.A., Pullman, Washington. Medusahead seeds were collected from a west-facing slope on Klicker Mountain, southeastern Washington, in August 1979, deawned, and stored at room temperature.

Seeds of the 2 species were germinated in trays. Four trays, slanted at 18° were placed in a covered 32 × 17 × 18 cm plastic box. Ten seeds of each species were placed on each half of the slanted tray and covered with filtered paper, kept moist by wicking action from a water supply in the bottom of the box. Four boxes were placed in germination chambers with 12 hours light at 3 constant temperatures: 10, 15, and 22° C; and an alternating one: 25–15 C (12 hours each). Germination percentages were obtained by counting. Seeds were considered germinated when the seminal root emerged 1 mm. Speed of germination was rated by using the Vigor Index formula as described by Maguire (1962):

$$VI = NX/DX$$

where NX = number of seeds germinated on X day and DX = number of days from the beginning of the germination text to X day. Root growth was summed for seedlings of each species, and was converted to rate of total root growth per seedling per day.

Five medusahead and 5 Secar seeds were planted separately in wooden boxes 19 × 10 × 90 cm deep inside dimensions, and replicated in 4 separate boxes. Plants were grown in a 3:1:1 Palouse clay loam:peat moss:perlite autoclaved mixture in the greenhouse at day temperature of 22 ± 3° C for 14 hours, and at a night temperature of 13 ± 2° C for 10 hours. Natural day light was supplemented by fluorescent lights (F 96T12 - cool white) with 700 foot-candles (7535 lux) at plant canopy level. Maximum root depths, leaf lengths, and number were determined at 9, 12, 14, 16, 18, 22, 26, 28, and 30 days after planting. On the 30th day the roots were separated from the soil by washing with a fine jet of water, the shoots were harvested, the leaves were excised, and leaf area in cm^2 was determined with a LI-COR LI-3100 area meter. Root and shoot dry weights were recorded after oven-drying at 60° C for 24 hours. Data were analyzed as a completely randomized design with unequal number of replications because of failure of germination in some Secar seeds.

Results and Discussion

Total germination percentage for each species after 14 days was not affected by temperature treatments (Table 1). However, total germination was significantly different between the 2 species. In 4 days, medusahead reached 92% germination at 10° C, while no germination was observed in Secar seeds (Table 2). In 6 days, medusahead germination was 100% at all temperature treatments. At this time, the lowest germination value (47%) was recorded for Secar at 10° C. The interaction species by temperature was not significant. No effect was observed for the alternating temperature.

Although Secar germination was delayed at 10° C, the final germination percentage at that temperature was not significantly different from other temperatures. Similar results on other wheatgrass species were reported by Ellern and Tadmore (1966) where low temperature (4 to 10° C) delayed germination of several perennial grasses rather than depressing germination percentage. Rapid germination and establishment at low temperatures were characterized as important factors on semiarid sites for seedlings to become successfully established before the advent of the hot, dry weather of summer (Harris 1967).

Speed of germination as indicated by vigor index (Maguire 1962) in Secar was positively correlated to increases of temperature. The vigor index value for the 2 species was lowest at 10° C and highest value was at 22° C; there was a significant difference recorded between the 2 species (Table 1). Medusahead germinated faster than Secar at all temperatures. Germination at the 3 highest temperatures was about the same. It appears the medusahead seedlings may have a competitive advantage of more rapid germination under the conditions tested.

The rate of root growth (cm/plant/day) was positively related to

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Table 1. Effect of 1 variable and 3 constant temperatures on germination percentage, vigor index and root growth of Medusahead and Secar bluebunch wheatgrass.

Species and temperatures (C)	Percent germination (14th day)	Vigor index	Cumulative root growth (cm/plant/day)
Medusahead			
10	100.00 a[1]	24.38 a[2]	0.475 b
15	100.00 a	24.59 a	0.535 b
22	100.00 a	25.00 a	0.545 b
25–15	100.00 a	25.00 a	0.745 a
Secar			
10	82.50 b	12.52 c	0.148 e
15	82.50 b	17.17 b	0.238 d
22	80.00 b	19.03 b	0.303 cd
25–15	72.50 b	16.12 b	0.358 c
Species means			
Medusahead	100.00a	24.74 a	0.58 a
Secar	79.38 b	16.61 b	0.26 b
Temperature means			
10	91.25 a	18.45 b	0.31 c
15	91.25 a	20.88 b	0.39 b
22	90.00 a	22.02 a	0.42 b
25–15	86.25 a	20.56 ab	0.55 a

[1]Means followed by the same letter do not differ significantly from each other at the 5% level of probability using Dunan's multiple range test.
[2](Vigor Index) VI = NX/DX where:
NX = number of seeds germinated/day
DX = number of days from start of germination test to X day Maquire (1962).

temperatures (Table 1), and significantly different between species. The average rate of root growth of Secar at 10° C was significantly lower than at the other temperatures (Table 1). The interaction between species by temperature was significant at the 5% level. This was due to the differential effect of temperature at levels on root growth within each species. The highest rate of root growth for medusahead was reached under alternating temperature conditions and was significantly higher than root growth at fixed temperatures. For Secar, no significant differences were detected between the growth rate at 22 and 25–15° C nor between 22° C and 15° C; however, the mean rate of root growth at 10° C was significantly less than at other temperatures. Since germination in the field normally occurs at low fall temperatures, this indicates an additional competitive advantage for medusahead seedlings.

Table 2. Influence of temperature on germination of Medusahead and Secar bluebunch wheatgrass over time.

	Germination							
	4 days		6 days		9 days		14 days	
Temperature (C°)	Medusahead %	Secar %	Medusahead %	Secar %	Medusahead %	Secar %	Medusahead %	Secar %
10	92.5	0.0	100	47.5	100	82.5	100	82.5
15	95.0	40.0	100	80.0	100	82.5	100	82.5
22	100	70.0	100	77.5	100	80.0	100	80.0
25–15	100	52.5	100	65.0	100	72.5	100	72.5

Table 3. Comparisons of Medusahead and Secar bluebunch wheatgrass seedling growth in wood boxes for 30 days at alternating day/night temperatures of 22/13° C.

Parameter	Medusahead	Secar
Shoot (mg dry wt.)	84.5 a[1]	25.5 b
Root (mg dry wt.)	34.6 a	18.5 b
Leaf area (cm^2)	10.0a	3.8 b
Leaves (number)	11.5 a	4.2 b

[1]Means in the same row followed by the same letter are not significantly different at the 5% level of probability.

Both roots and shoots of medusahead exceeded Secar seedling development, when grown for 30 days at alternating day/night temperatures of 22/13° C. Secar shoot weight averaged only 30% of medusahead shoot weight, and 53% of root weight (Table 3). Similarly, leaf area and leaf numbers averaged only 38 and 36%, respectively, of that produced by medusahead. Initial growth rates are critical in controlling a site when plant species are in competition (Harris 1967). The advantage for medusahead would have been even greater under field conditions, where temperatures are normally colder than in these tests (Young et al. 1968).

Thus, these laboratory and greenhouse tests strongly indicate that seedlings of Secar will not compete successfully with a natural stand of medusahead seedlings on semiarid range sites. Seeds germinate more slowly, and particularly at low temperatures. After germination, the seedlings grow more slowly both in length and mass. Without intervention of control procedures, the population density ratio of Secar seedlings would likely be at least 1:100 favoring medusahead. Considering all these disadvantages, it is doubtful that many seedlings of Secar would survive the first summer season. In range seeding practice using Secar, it then becomes essential to control medusahead (and other annuals) for success.

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