Reproductive Success of Squirreltail in Medusahead Infested Ranges

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Highlight: *Squirreltail (*Sitanion hystrix*), a native perennial bunchgrass, has exhibited an ability to become established naturally in medusahead (*Taeniatherum asperum*) dominated ranges in Idaho. The reproductive success of squirreltail seedlings averaged 2.6% after 18 months in plots that were broadcast seeded on unprepared seedbeds. Rapid physiologic development of squirreltail seedlings appeared to be the most important characteristic to explain its successful establishment.*

Attempts to establish perennials without removing competition provided by annual grasses have generally failed in the Intermountain Region. The only notable exceptions of any appreciable scale are the few instances of natural establishment of squirreltail (*Sitanion hystrix*) on cheatgrass (*Bromus tectorum*) and medusahead (*Taeniatherum asperum*) ranges in Idaho (Hironaka and Tisdale, 1963; Tisdale et al., 1969). This ability of squirreltail is unique among the many perennial grasses that have been used for revegetation of depleted ranges.

To more fully explore this phenomenon of squirreltail establishment in medusahead infested ranges in southern Idaho, a reproductive success study under field conditions was conducted in 1966-1968.

Study Area and Methods

The major portion of medusahead infestation in Idaho is located in portions of Gem, Payette, and Washington Counties. Annual precipitation ranges from 12

Table 1. Physical characteristics of study sites where squirreltail seeding trials were conducted without removal of competition.

Study sites	Elev. (ft)	Precip. (inch)	Great soil group
Bissel Creek (BCM)*	2,500	12	Brown
Little Willow Flat No. 1 (LWM)	3,000	15	Chestnut
Little Willow Flat No. 2 (LWS)	3,000	15	Chestnut
Riley Butte No. 1 (RBM)	3,500	17	Chernozem
Riley Butte No. 2 (RBS)	3,500	17	Chernozem

*The last letter enclosed in the parenthesis indicates the dominant natural vegetation. M = Medusahead, S = Squirreltail.

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to 17 inches. Most precipitation occurs in winter and spring.

The vegetation was originally a sagebrush-grass type with big sagebrush (*Artemisia tridentata* subsp. *vaseyana* form *"xericensis"*), bluebunch wheatgrass (*Agropyron spicatum*), and Sandberg bluegrass (*Poa sandbergii*) as dominant and co-dominant species. Due to abusive grazing and repeated fires, the perennial vegetation was replaced by cheatgrass and summer annuals. Since the documentation of the presence of medusahead in the area in the mid-forties, medusahead has replaced cheatgrass as the dominant grass over much of the area (Hironaka, 1961; Torell et al., 1961).

Five sites were selected for the study, three dominated by medusahead and two by squirreltail. Major site characteristics are presented in Table 1. Four 5 ft x 5 ft plots, randomly selected, were established with a 25 ft x 25 ft block. Without disturbance to the existing vegetation, the 5 ft x 5 ft plots were broadcast seeded with squirreltail at a rate of 50 seeds/ft^2 during September, 1966. Squirreltail seed was color marked with dilute food coloring to aid in later seed identification, as seed of medusahead and squirreltail are highly similar in appearance. After seeding, 5 surface soil cores were taken from each plot to determine the amount of squirreltail, medusahead, cheatgrass and other seeds present per unit area.

In the spring, twelve 6 inch x 6 inch sampling plots were permanently established in each seeded plot. For convenience in recording and charting, the subplots were further subdivided into nine 2 inch x 2 inch squares.

The plots were sampled 8 times during 1967 and once during the spring of 1968. The locations of individual squirreltail seedlings were charted, and seedling counts and height measurements were recorded at each sampling date.

Results

Germination began during the fall, and seedlings of squirreltail had shoot height of 1½ inches by the end of March. Squirreltail seedling density was greater on medusahead dominated sites than on those where squirreltail dominated. On squirreltail dominated sites, frost heaving was a major factor in winter mortality. These sites had a large proportion of bare ground between established squirreltail plants, and evidence of severe frost heaving was present in the spring. Heaving activity exposed the roots of many squirreltail seedlings, which later died from dessication. Surviving seedlings were located at the bases of mature perennial grasses and in litter-filled depressions. Little or no frost heaving was evident on sites dominated by medusahead, as the presence of heavy litter minimized frost heaving.

As the season progressed, competition from medusahead increased, and squirreltail seedling survival gradually decreased during April and May, except on Riley Butte sites (Table 2). Above-average precipitation during April and May maintained adequate soil moisture for seedling growth on these cooler and more mesic sites and delayed mortality due to moisture stress until after the third week in June.

By the end of June there were still considerable numbers of squirreltail seedlings present on all sites. The average squirreltail seedling had 3 leaves and was 3 inches tall. Medusahead numbers increased between March and June due to late germination. Most of these late-

Table 2. Plants/ft^2 on the reproductive success sites at various dates.

Date	Species	Site[1] BCM	LWM	LWS	RBM	RBS
3/27/67	Squirreltail[2]	24	21	18	19	14
	Annual grasses[3]	53	86	11	394	2
	Forbs	t	5	t	4	t
	Perennial grass[4]	0	0	1.4	0	1.8
5/10/67	Squirreltail	20	14	16		
	Annual grasses	62	71	13	not sampled	
	Forbs	56	5	40		
6/5/67	Squirreltail	16	14	14	23	15
	Annual grasses	38	103	13	568	1
	Forbs	51	59	40	20	4
6/24/67	Squirreltail	13	14	10	23	17
	Annual grasses	38	103	13	568	1
	Forbs	18	23	t	20	5
7/14/67	Squirreltail	3	6	5	2	3
	Annual grasses	38	103	13	568	1
	Forbs	8	21	1	t	3
7/24/67	Squirreltail	1	2	2	0	3
	Annual grasses			(dead)		
	Forbs	8	4	t	t	3
8/14/67	Squirreltail	0	0.33	0.83	0	1.5
	Annual grasses			(dead)		
	Forbs	5	5	t	0	2
11/5/67	Squirreltail	1	0.83	1.33	0	1.2
	Annual grasses	43	271	13	648	2
	Forbs	139	t	t	t	t
	New squirreltail	0	0	81	0	11
3/28/68	Squirreltail	1.3	0.83	1.6	0	1.5

[1] BCM = Bissel Creek; LWM = Little Willow Flat No. 1; LWS = Little Willow Flat No. 2; RBM = Riley Butte No. 1; RBS = Riley Butte No. 2.
[2] Squirreltail seedlings.
[3] Medusahead, cheatgrass, and annual fescue.
[4] Squirreltail, Sandberg bluegrass, and bulbose bluegrass..

Table 3. Soil moisture (%) at 6 and 12 inch depths at the reproductive success sites on six dates.

Date	Depth	Site[1] BCM	LWM	LWS	RBM	RBS
5/9/67	6"	12.2	18.3	23.0	–	17.3
6/8/67	6"	4.4	11.1	13.9	9.8	11.3
	12"	5.2	14.5	14.3	11.6	14.7
6/21/67	6"	5.7	10.7	11.7	9.3	9.9
	12"	7.1	10.4	12.7	9.8	10.7
7/14/67	6"	4.6	6.4	8.9	8.5	8.2
	12"	5.9	8.1	9.5	9.4	10.0
7/25/67	6"	2.6	3.8	6.3	5.6	5.6
	12"	4.5	5.8	8.6	7.5	7.2
8/15/67	6"	2.4	3.1	4.5	4.1	5.3
	12"	1.7	5.6	5.8	7.0	6.4

[1] BCM = Bissel Creek; LWM = Little Willow Flat No. 1; LWS = Little Willow Flat No. 2; RBM = Riley Butte No. 1; RBS = Riley Butte No. 2.

comers did not mature.

The warmer, drier Bissel Creek site produced plants that were phenologically more advanced than plants at the other sites. Medusahead at Bissel Creek was 12 inches high and in head by June 3, while those at Little Willow and Riley Butte sites did not reach the same stage of development until the second week in July.

The density of mature squirreltail was about .7/ft^2 at the two squirreltail sites at Little Willow and Riley Butte. Sandberg bluegrass averaged 0.7 and 1.1 plants/ft^2 at the two sites, respectively. Soil moisture in the perennial grass dominated plots was generally higher than in the companion medusahead plots until the third week in June (Table 3). Most medusahead plants on squirreltail dominated plots failed to complete their life cycle and died before seedheads were formed.

After the third week in June, little or no precipitation fell. Soil moisture steadily depleted and became critically low, especially in the upper foot of soil. The decrease in soil moisture and high summer temperature resulted in large seedling losses between June 20 and July 11. Seedling loss was especially great at the Riley Butte medusahead site, where seedling density fell from 23 to 2 plants/ft^2. Decrease in soil moisture at this site was not correspondingly abrupt, however. It was speculated that rapid increase in temperature may have been a contributory factor. Additional mortality occurred during the remainder of the summer.

Seedlings present in late July and mid-August were reduced to one or two short green leaves from a high number of 4 or 5 leaves. By August the vegetation appeared dead except for a trace of summer forbs that remained green.

Sufficient rain fell in late October for perennial grasses to produce new growth and for winter annuals to germinate. At the squirreltail dominated sites of Little Willow (LWS) and Riley Butte (RBS), 80 and 11 new squirreltail seedlings/ft^2 were counted, respectively. These came from seed of the current crop and carryover seed.

As indicated by charting records of individual seedlings, some squirreltail that had appeared dead as early as July 14 recovered in the fall. Others that were alive in August did not reappear. Except for Riley Butte sites, counts of established seedlings increased in all sites between the August and November sampling dates. Inability to distinguish between dead and dormant seedlings (without plant destruction) caused underestimates of a number of live plants at the end of the growing season.

On March 27 and 28, 1968, the plots were resampled to determine over-winter mortality. Few of those seedlings present the previous fall were missing. In some cases, counts in the spring were higher than those recorded in the previous fall. Some seedlings were either still dormant or were overlooked at the time of fall sampling.

Tillering of seedlings was observed for the first time in March, indicating that tillers were produced during the November-March period. When sampled in late March, most seedlings had produced two to three tillers with six to nine leaves. Average plant height was 4.5 inches.

Discussion

This study documents the successful establishment of squirreltail seedlings in medusahead and squirreltail dominated stands. The results indicate that seedlings are able to become established with relative ease, considering the amount of competition involved. The reproductive success of squirreltail on sites other than the Riley Butte medusahead site averaged more than 2.5% at the end of 18 months. This average is slightly less than that reported for reproductive success of seeded species on prepared seedbeds in central Utah (Cook et al., 1967).

The reasons for the failure of squirreltail seedlings to become established in the Riley Butte medusahead site can only be speculated. Soil moisture depletion was not any more drastic on this site than others, yet a large loss in seedlings occurred (from 23 to 2 seedlings/ft^2) during a 3-week period. The loss was probably due to a combination of factors, particularly small, weak seedlings combined with high temperature and moisture stresses. It appeared that the seedlings on this site were not sufficiently developed to go into dormancy. This ability probably is a function of physiologic maturity rather than chronological age, because most of the seedlings were over 6 months old, having germinated the previous fall.

Provided a seed source is available, squirreltail would probably be the first perennial grass of importance to become established in management programs that encourage the return of perennials. Bluebunch wheatgrass, a climax species, is unable to become established in annual grass ranges in the Intermountain region, without prior removal of competition (Torell et al., 1961; Turner et al., 1963; Harris, 1967).

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