Variable Germination Response to Temperature for Different Sources of Winterfat Seed

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Highlight: *Superior sources of winterfat seed for range revegetation should be sought, but a clearer concept of what constitutes a "superior" type is necessary. Laboratory germination temperature response of seed collected from three sources was determined. Some positive reactions to 5°C prechilling were observed 13-16 weeks after collection. When the same seedlots were subjected to constant temperatures of 5°C, 10°C, and 20°C, seed from plants originating at the lower elevations (Simla, Colorado and Pine Bluffs, Wyoming) germinated best at the lower temperatures, unlike seed collected from a Laramie, Wyoming source. Kinetic studies of germination verified that rates varied among the seedlots, but were not associated with differences during any particular stage of germination. Different temperature responses between seedlots could have practical implications regarding stand establishment.*

Winterfat (*Ceratoides lanata* (Pursh.) Howell, formerly *Eurotia lanata*) has long been considered a valuable range plant in the arid west (Nelson, 1898). Revegetation project managers hesitate to recommend it, however, because of poor results in previous establishment trials and lack of a commercial seed supply.

Both drawbacks would be alleviated by the isolation of an improved plant type. Previous workers found seed quality variation between sites of collection (Riedl et al., 1964; Springfield, 1968), and both reports concluded that superior sources for range revegetation could probably be found.

Germination temperature response of winterfat seed has been studied recently (Springfield 1968, 1972a, 1972b; Workman and West, 1967). The seedlots studied exhibited broad temperature optima, but one study (Springfield, 1968) indicated an interaction in germination between two seedlots with temperature.

Different temperature optima between seedlots could have practical implications regarding stand establishment. This study reports the effect of temperature on germination of two seedlots collected from southeast Wyoming and one seedlot from eastern Colorado.

Materials and Methods

Three winterfat seed sources were selected for this study. Lot W-7403 was collected October 1, 1974, from a vacant area inside the Laramie, Wyo., city limits. Seedlot W-7408 was collected October 10, 1974, from plants whose parent colony grew near Pine Bluffs, Wyo., presently established at the University of Wyoming Animal Science farm west of Laramie. Lot number W-7410 was collected October 21, 1974, near Simla, Colo. Collections from these general areas have been studied previously (Riedl et al., 1964). The seedlots will subsequently be referred to by origin, i.e, 'Laramie,' 'Pine Bluffs,' and 'Simla,' respectively.

Germination was assayed using 11 cm × 11 cm covered plastic boxes containing moist blotter paper. Whole utricles were used, but care was taken to use only filled utricles. There were 50 seeds per box, and four replications per seedlot per treatment. Data were recorded for subsequent analysis as the cumulative number germinated (hypocotyl more than 1 cm long) per box. A completely randomized factorial analysis of variance followed by Duncan's new multiple range test was used on the data.

An experiment was designed to test for a prechilling enhancement of germination of the three seedlots. The experiment was initiated January 28, 1975. Three of the treatments were in a coldroom at 5° ± 1°C for 1, 2, or 3 weeks, then transferred to a Cleland germinator at 20° ± 0.5°C until germination was complete. The fourth treatment (control) was kept in the germinator until germination was complete (14 days).

To obtain temperature response, germination was measured at three constant temperatures because of limited supply of two of the seedlots. Two of the temperatures 5°C and 20°C, were those used in the previous experiment; the third was 10° ± 0.5°C.

Results and Discussion

Responses to prechilling were observed, but were neither major nor consistent (Table 1). The 'Laramie' and 'Pine Bluffs' seedlots appeared to benefit from longer exposures than did the 'Simla' lot. One week at 5°C was actually detrimental to germination of 'Laramie' seed compared to the control and the 3-weeks' treatment, whereas 'Simla' seed germinated best after the 1-week treatment. Springfield (1972b) found positive germination responses to the cool temperature of 44°F (7°C) compared to 56°F (13°C) in one lot of afterripening seed. However, he determined that afterripening in that lot was complete within 25 weeks after harvest, and within 10 weeks in other lots. Since only minor responses were obtained here, it could be concluded that much of the dormancy responsive to prechilling was overcome in the 13-16 weeks between seed collection and start of the experiment.

Since substantial germination occurred after three weeks at 5°C, it was decided that kinetic responses to constant temperatures should be determined. Total germination of the three seedlots in response to three temperatures is illustrated in Figure 1. Temperature optima cannot be precisely determined from these limited data, but they differ somewhat from those found by Springfield (1972a) using a New Mexico seed source. In the Simla seedlot, the germination at 20°C was

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Table 1. Germination (%) response of winterfat seed from three sources to different lengths of exposure to a 5°C prechilling treatment.

Seed lot	Treatment (weeks at 5°C)	Total germination (%)
W-7403 (Laramie)	0	54 abc[1]
	1	52 bc
	2	56 abc
	3	67 a
W-7408 (Pine Bluffs)	0	8 d
	1	18 d
	2	18 d
	3	16 d
W-7410 (Simla)	0	50 c
	1	65 ab
	2	58 abc
	3	54 abc

[1] Means followed by the same letter do not significantly differ at the 5% level.

significantly (5% level) lower than germination at the two lower temperatures. The same trend is seen in Pine Bluffs seed. In the Laramie source, however, germination at 20°C was significantly higher than germinations at the two lower temperatures. Data from a subsequent study (not shown) with this seedlot at 30°C indicated a decline in germination to a level near those at 5°C and 10°C. The differences between lots at each temperature are significant, except between the Laramie and Simla sources at 20°C.

It may be of significance that the Laramie seedlot should display a higher optimum temperature for germination than seedlots from plants originating at lower elevations. It could be postulated that each type of temperature response would lead

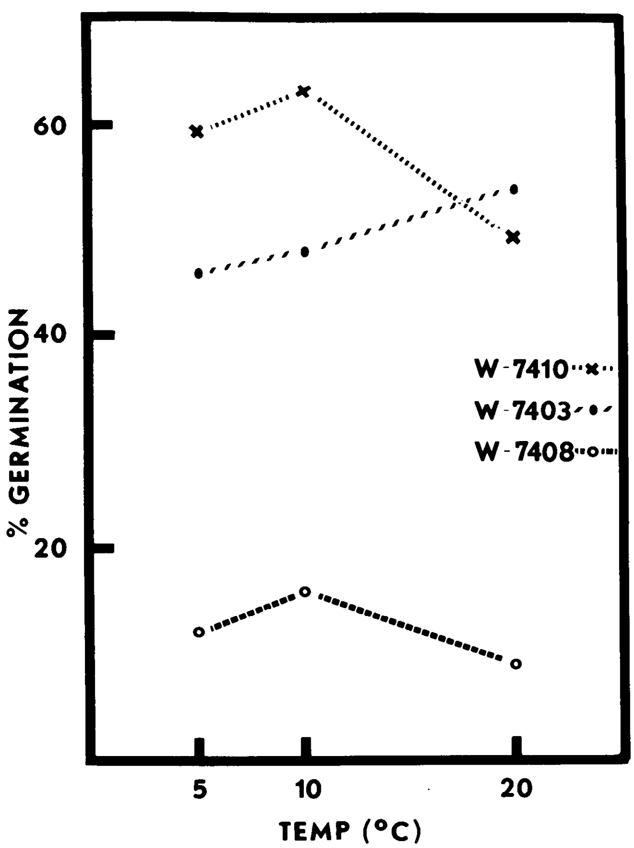

Fig. 1. *Total germination of winterfat seed from three sources at three temperatures.*

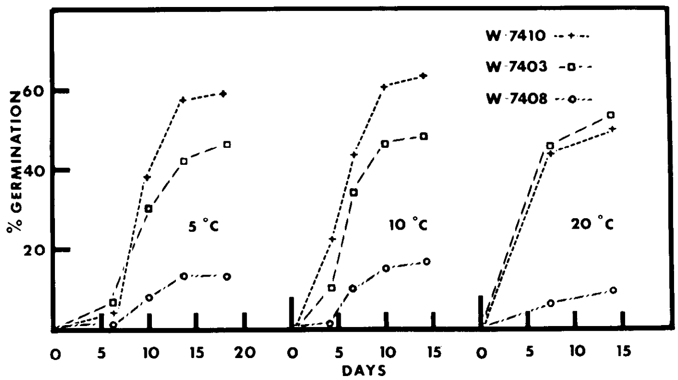

Fig. 2. *Time course of germination for three winterfat seedlots at three temperatures.*

to germination at a time most conducive to seedling survival in each climatic pattern (Koller, 1972). Such a hypothesis would require field testing of establishment, correlated with lab germination temperature responses of an expanded number of seed sources.

Germination kinetics in response to the three temperatures are shown in Figure 2. The germination rate patterns differed slightly among the three seedlots, but were remarkably similar at the intermediate temperature. The poorest quality seed, the Pine Bluffs seedlot, was most affected at the two extreme temperatures, especially 20°C. The other two lots had the same germination rate pattern at 20°C, producing similar total germinations (Fig. 1). The cooler temperatures, however, produced different rate patterns for the Laramie and Simla seedlots. At 5°C, no significant difference in germination was found after 6 days, but was evident after 10 and 14 days. At 10°C, the Simla seed was significantly higher than the Laramie seed after 4 days, but the latter subsequently exhibited a germination rate as high as or higher than the Simla lot. It appeared unlikely, then, that the differences in total germination at different temperatures could be attributed to differential responses of only one aspect or process of germination.

Early spring seeding of winterfat is usually recommended in Wyoming (Riedl et al., 1964). However, since optimum germination temperatures vary according to seed source, seeding date studies should be repeated using dissimilar seed sources. Such studies would confirm or alter current recommendations and could even indicate that source of seed must be taken into account. If a source of seed proves to have merit for range revegetation, recommendations should be made to suit its requirements, rather than requiring the plant to meet current management practices.

Literature Cited

Koller, D. 1972. Environmental control of seed germination. p. 2-101. *In:* Seed Biology Vol. II. T. T. Kozlowski, Ed. Academic Press, N.Y.

Nelson, A. 1898. The Red Desert of Wyoming and its forage resources. U.S. Dep. Agr. Bull. 13. 72 p.

Riedl, W. A., K. H. Asay, J. L. Nelson, and G. M. Telwar. 1964. Studies of *Eurotia lanata* (winterfat). Wyo. Agr. Exp. Sta. Bull. 425. 18 p.

Springfield, H. W. 1968. Germination of winterfat seeds under different moisture stresses and temperatures. J. Range Manage. 21:314-316.

Springfield, H. W. 1972a. Optimum temperatures for germination of winterfat. J. Range Manage. 25:69-70.

Springfield, H. W. 1972b. Winterfat seeds undergo after-ripening. J. Range Manage.25:479-480.

Workman, J. P., and N. E. West. 1967. Germination of *Eurotia lanata* in relation to temperature and salinity. Ecology 48:659-661.