Winterfat Seedlings Emerge Best from Shallow Seeding, Moderately Dry Soil[1]

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Highlight

Seeds of winterfat (*Eurotia lanata*) were planted at four depths in three soils held at five moisture levels. Emergence was best from the 1/16-inch depth, and when soil moisture was nearer field capacity than saturation.

Winterfat (*Eurotia lanata* (Pursh) Moq.) is a desirable shrub for revegetating semiarid ranges. Results of direct seeding of winterfat in New Mexico, however, have been erratic. One reason for lack of success has been unfavorable weather following seeding. Another reason may have been that the seeds were covered too deeply. Recently it was found that, in wet soil at least, establishment of winterfat seedlings is best when seeds are planted on the surface (Springfield, 1970). Wilson (1931) also observed that winterfat fruits would germinate on the soil surface if there were several days of wet weather. Other investigators have reported better results from shallow than from deep planting (Hilton, 1941; Riedl et al., 1964; Statler, 1967).

Objectives of this study were to determine the effects of depth of seeding, soil texture, and soil moisture level on seedling emergence.

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Methods

Seeds were planted July 24, 1969, in small plastic pots. Treatments were completely randomized in a $3 \times 4 \times 5$ factorial design. Each combination of depth, soil, and moisture level (Table 1) was replicated three times. Ten viable seeds were planted in each pot. The seeds, threshed by hand from fruits collected November 1, 1968 near Corona, New Mexico, numbered 189,000 per pound.

Seeding depths—which were precisely measured—were 1/16, 1/8, 1/4, and 1/2 inch.

Five of the moisture levels in Table 1 (all except wilting) were included in the tests. These levels were achieved by adding to a constant weight of oven-dried soil the calculated amount of distilled water. The gross weight of each pot—soil plus water for a specific moisture level—was marked on the pot. To insure that moisture levels remained essentially as prescribed throughout the experiment, evaporation losses were minimized by suspending a sheet of plastic 3 inches above the pots. Moisture losses, determined by daily weighing, were negligible. Water was added when the loss exceeded 0.5 gram.

The experiment was conducted on laboratory benches at room temperature. Air and soil temperatures were monitored. Soil temperatures were measured with thermistors placed at different depths (Swanson, 1967). There were no significant differences in temperatures among moisture levels, seeding depths, or soils. Average temperatures during the 2 weeks when seedlings were emerging were:

	Range	Mean
Air	68.5 to 83.7	75.2
Soil	67.6 to 78.0	72.4

Seedlings, counted each day until emergence stopped, August 4, 1969, were considered emerged when the cotyledons were 1/2 inch above the soil surface. Seedling emergence percentages were transformed to arc sin for analysis of variance.

Table 1. Characteristics of three soils[1] tested for emergence of winterfat seedlings in northern New Mexico.

Soil identification and location	Texture	pH (saturation paste)	Moisture percentage, by condition: Level of saturation: Full	5/6	2/3	1/2	Field capacity (1/3 bar)	Wilting (15 bar)
Silver Hill 8 mi. W of Magdalena	Loamy sand	7.6	27.4	22.8	18.3	13.7	6.4	3.6
QRA 8 mi. W of Santa Fe	Sandy loam	7.1	30.6	25.5	20.4	15.3	11.8	5.3
Wingate 18 mi. E of Gallup	Clay	7.8	46.8	39.0	31.2	23.4	18.9	11.9

[1] Moisture-holding characteristics of the soils determined by Ralph E. Campbell, Soil Scientist, Rocky Mountain Forest and Range Experiment Station, Albuquerque.

Results and Discussion

The 1/16-inch planting depth was substantially better than the other depths (Table 2). Very few seedlings emerged from 1/4 inch (mainly in the clay soil), and not a single seedling came up from seeds planted 1/2 inch deep.

Seedling emergence was significantly better in the clay and loamy sand than in the sandy loam. In a previous study more seedlings became established in the sandy loam than in the other two soils, but most of those seedlings resulted from seeds planted on the surface of wet soil (Springfield, 1970).

Seedling emergence was inversely related to moisture level. Winterfat seeds on blotters in petri dishes germinated best when there was little or no moisture stress (Springfield, 1968). In this experiment, however, emergence was better in moderately dry than in wet soil. Averages for all soils and depths show emergence declined gradually from 1/2 to 2/3 saturation, then dropped rather sharply. Emergence was least when soils were 5/6 or fully saturated.

Differences in emergence from the three depths of seeding were not consistent throughout the range in moisture studied. Likewise, the relationship between depths of seeding and soils was not consistent. Seeds planted 1/16 inch deep produced as many seedlings in loamy sand as in clay soil. When seeds were planted 1/8 or 1/4 inch deep, emergence was best in the clay. Production of seedlings in the sandy loam soil was proportionately much poorer from seeds planted 1/8 or 1/4 inch than from those planted 1/16 inch.

The really puzzling question is: why was seedling emergence so poor in wet soil? Even the seeds planted only 1/16

Table 2. Percent emergence of winterfat seedlings from seeds planted at three depths in three soils held at five moisture levels.[1]

Soil identification and depth of seeding	Percent emergence, by moisture level: Level of saturation: Full	5/6	2/3	1/2	Field capacity
Silver Hill					
1/16 inch	13 b	23 b	87 a	80 a	87 a
1/8 inch	0 c	7 c	67 a	40 b	43 b
1/4 inch	0 a	0 a	3 a	0 a	7 a
QRA					
1/16 inch	7 c	13 bc	23 b	67 a	73 a
1/8 inch	3 b	3 b	7 ab	17 a	20 a
1/4 inch	0	0	0	0	0
Wingate					
1/16 inch	23 c	27 c	50 b	87 a	87 a
1/8 inch	17 b	20 b	57 a	60 a	57 a
1/4 inch	0 b	0 b	10 ab	10 ab	23 a

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

inch deep failed to produce many seedlings in saturated or near-saturated soil. Poor aeration is perhaps the most obvious explanation, but undefined soil physical factors also may be involved. In a previous experiment, germinated seeds and fairly well-developed seedlings were found curled and compressed beneath a layer of soil at the same depth the seeds had been planted. The seeds had germinated, but the young seedlings did not have enough thrusting capacity to push through the soil. Investigations have not progressed to the point where combinations of soil and moisture that most restrict the upward growth of winterfat seedlings can be specified. The results do suggest, however, that clay was less of a barrier to an emerging seedling than either the sandy loam or loamy sand. Only in the clay soil did a reasonable number of seedlings emerge from the ¼-inch depth, and only in the clay was there fair emergence from seeds planted ⅛ inch deep in wet soil. Of course, soil characteristics other than texture may have affected the results.

Evidence from corollary investigations indicates that density of the germination medium, as well as aeration, probably influences the emergence of winterfat seedlings. Seeds were planted 10 mm deep in sand, perlite, and vermiculite held at ½, ¾, and full saturation. Practically no seedlings emerged in the sand, regardless of moisture content. Percent emergence in the less dense media was:

Saturation level	Perlite	Vermiculite
½	50	100
¾	30	95
Full	10	80

Conclusions

Shallow planting of winterfat seeds is important, regardless of soil moisture content or kind of soil. Fewer seedlings emerged in wet soil than in moderately dry soil, even when seeds were planted shallow. Soil texture, and possibly other soil characteristics, may affect emergence. Moreover, although the explanations are not clearcut, there were indications that (1) winterfat is somewhat sensitive to deficient aeration, and (2) dense soil, especially when it is wet, impedes emergence of winterfat seedlings.

Future investigations should be aimed at increasing knowledge about:

1. the inherent capacity of the seedling to break through the soil surface;
2. the effects of aeration on germination and seedling development; and
3. the physical characteristics of various soils, wet and dry, in relation to seedling emergence.

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