Technical Notes
A technique to determine seed location in relation to seedbed preparation treatments

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Abstract

Distribution of seeds buried by different seedbed preparation techniques can be determined by seeding small plots at a high rate, wetting the soil and extracting soil cores in plastic vials. Seeds can be located with a dissecting scope when cores are split in half. Although the technique may slightly underestimate the percentage of small buried seeds like those of Lehmann lovegrass (*Eragrostis lehmanniana* Nees), it permits the analysis of large numbers of samples.

Key Words: seed placement, seedbed preparation, seed depth, seed burial, revegetation

Artificial seeding of semiarid rangelands is often unsuccessful partly because of limited understanding of the response of seeds to different seedbeds. Of particular interest is the effect of seedbed preparation treatments on seed placement, and the location of seeds that produce emergent seedlings. Seeds buried too deeply may not produce emergent seedlings. In contrast, seeds buried too shallow may also fail to produce seedlings due to limited soil water.

Several seed location techniques are used. Most are used to determine total populations of viable seeds in the seedbank (Malone 1967, Jerling 1983, Staaf et al. 1987), or numbers of seeds at various depths in the seedbed (Moore and Wein 1977, Fay and Olson 1978, Granstrom 1982, Pareja et al. 1985). Other methods are used to determine numbers of seeds that survive (Archibold 1979) or are stimulated to germinate or emerge by various cultural treatments (Wesson and Wareing 1969). Interest has recently developed in assessing the accuracy of seed placement by drills (Choudhary et al. 1985, Kaviani et al. 1985).

Most seed location techniques involve: (1) germinating seeds from seedbed samples, (2) sieving to isolate seeds, (3) tracing seedlings to their seeds, and (4) X-raying seedbed samples.

Determining the effects of seedbed preparation techniques on seed placement and seedling emergence requires a seed location technique that determines seed depths with minimal disturbance in fragile seedbeds. The method should be rapid to permit analysis of samples in highly variable seedbeds.

Our objective is to describe a new seed location technique used to help determine the location of seeds after various seedbed preparation treatments on a sandy loam soil in southern Arizona, and show evidence of its accuracy as an estimator of seed location.

New Technique

Plots 1 m^2 in area were broadcast seeded to cover the surface with a single layer of seeds of either 'Vaughn' sideoats grama (*Bouteloua curtipendula* (Michx.) Torr), 'A-130' blue panic (*Panicum antidotale* Retz.), 'A-68' Lehmann lovegrass (*Eragrostis lehmanniana* Nees) or 'Cochise' atherstone lovegrass (*Eragrostis lehmanniana* Nees × *E. tricophera* Coss and Dur.). Plots were then treated with heavy cattle trampling (herding 5 cattle around a 6-m^2 paddock for 20 minutes), light cattle trampling (approximately 10 hoof prints per m^2), land imprinting, root plowing or ripping, or left undisturbed. Plots that were imprinted or lightly or heavily trampled by cattle were seeded before treatment, while plowed or ripped plots were seeded after plowing or ripping. The soil was a sandy loam (fine, mixed, thermic Ustollic Haplargid). Plots were sampled after treatment when the soil was dry by protecting the seedbed with a layer of cotton cloth and then sprinkling the sample area with water until the soil was saturated to 3 to 5 cm. Plots were also sampled after rain when the soil water content was near field capacity. Soil plugs were collected by inserting a 3.5-cm diameter by 6-cm high plastic vial into the seedbed. The vial was extracted from the soil, capped, immersed in liquid nitrogen until the soil was frozen (10–20 seconds) and placed in an ice chest lined with dry ice for transport to a freezer. Freezing the soil plugs has the potential to move seeds slightly and therefore is recommended only to minimize disturbance during transport.

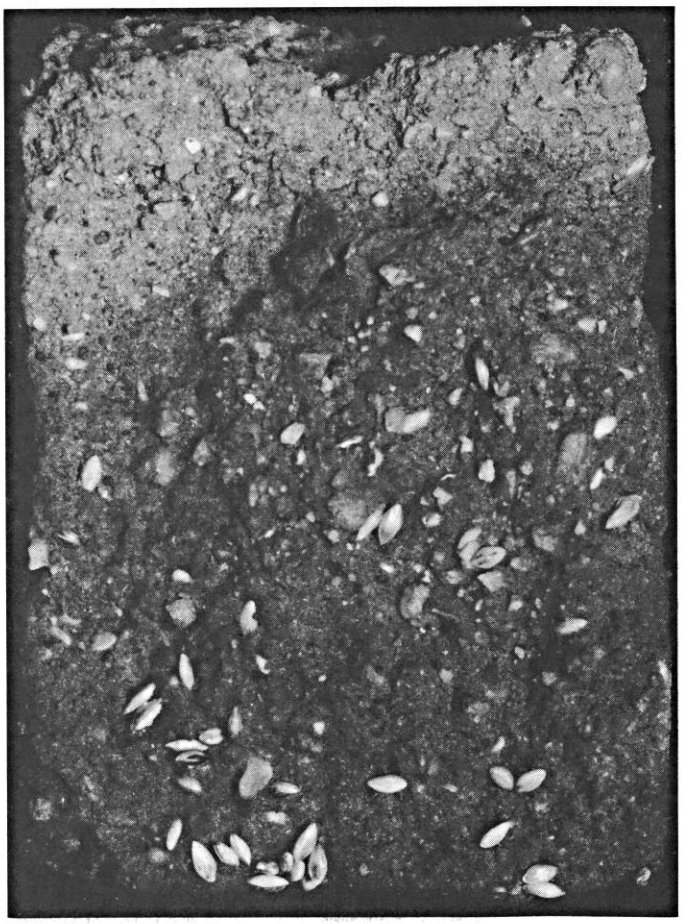

Fig. 1. View of split soil plug showing blue panic seeds (3X).

In the laboratory, each frozen soil plug was placed upright in a shallow water bath for about 2 minutes until it slid easily from the

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vial. After thawing, each plug was carefully split in half with a micro spatula. Each half was then placed in a cradle made from a plastic vial cut in half, and the cradle was placed in a soil plug holder. The holder was placed under a dissecting scope, the outline of each soil plug was drawn on a plastic transparency and each visible seed was located and marked on the transparency (Fig. 1).

Seed depth was determined by measuring the distance from the seed to the soil surface. The data were recorded as percent of seeds found at particular depths in the seedbed.

Ease in locating seeds in the plugs was dependent upon seed size. Sideoats grama and blue panic seeds (5 × 1 mm, and 2 × 1 mm) were easily seen under a lighted magnifying glass or dissecting scope set at 10 power. Lehmann and Cochise lovegrass seeds (0.75 × 0.5 mm) required a dissecting scope set at 20 to 30 power. Because buried seeds were often obscured by soil, numbers of buried seeds in relation to surface seeds could have been slightly underestimated.

The technique was used during the summers of 1987 and 1988. Approximately 1,440 soil plugs were collected during each year. Plugs were collected immediately after seedbed preparation, after summer thunderstorms, and after seedling emergence. A crew of 3 to 4 people collected approximately 500 plugs in about 4 hours. In the laboratory, each plug was analyzed in about 10 minutes. Approximate cost per plug including labor was $1.00. The technique permitted quantification of depth of seed burial and seedling emergence. This information was helpful in explaining differences in seedling emergence associated with the different seedbed preparation treatments (Winkel et al. 1991).

Technique Test

An experiment was conducted to determine the accuracy with which the method estimated the percent of seeds at different depths. Three wooden boxes 100 × 20 by 10-cm deep were filled with sandy loam soil (fine, mixed, thermic Ustollic Haplargid) passed through a 2-mm sieve. While filling the boxes, seeds of Lehmann lovegrass, blue panic, and sideoats grama, (1 species per box) were spread evenly at 5-mm intervals from 20-mm deep to the soil surface with the following percentages of total seeds: 20 mm, 5%; 15 mm, 10%; 10 mm, 15%; 5 mm, 20%; and the soil surface, 50%. After sowing, the soil was sprinkled with water until saturated and then 20 soil plugs per box from randomly preselected positions were extracted and examined as described above.

Data from the 40 plug halves per box were pooled, and estimated seed percentages from the plugs were compared to the known percentages with correlation analysis. Coefficients of determination (r^2) between percentages of known and estimated seeds at different depths of sideoats grama, blue panic, and Lehmann lovegrass were 0.80, 0.72, and 0.92, respectively (Fig. 2). Comparisons of regression lines with 1 to 1 lines indicated that the technique overestimated the percentage of all 3 species on the surface, and underestimated the percentage of all species and particularly Lehmann lovegrass at all other depths (Fig. 2). The small size of Lehmann lovegrass seeds may limit their visual detection and result in underestimation. The seed location technique permitted estimation of the location of ungerminated and germinated seeds of different species in various seedbeds.

Although this technique is impractical for determining seed location for normal seeding rates, its use with extremely high rates can help determine the effects of seedbed preparation treatments on seed burial. Relative seed burial under high seeding rates should be similar to those under normal rates for a given seedbed preparation treatment.

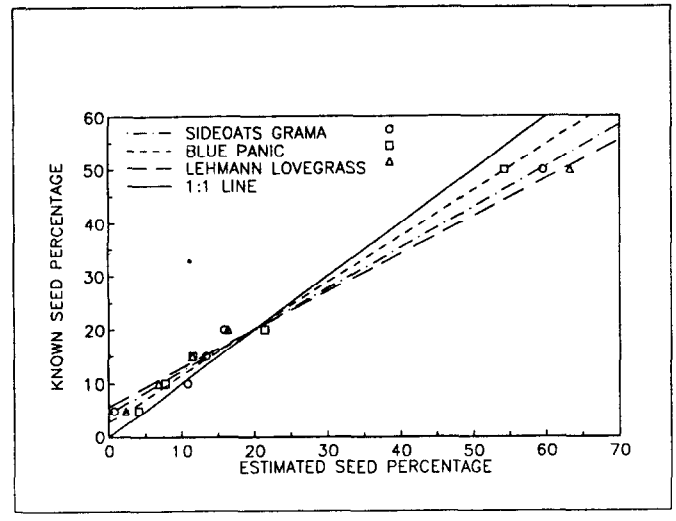

Fig. 2. Linear regressions of estimated percentage of total seeds found on known percentage of total seeds placed at different soil depths for 3 grass species using a vial sampling technique. Each symbol is the mean of 20 samples. Coefficients of determination (r^2) for sideoats grama, blue panic and Lehmann lovegrass were 0.80, 0.72 and 0.92, respectively. Regression equations for sideoats grama, blue panic, and Lehmann lovegrass are Y = 0.77 (X) + 4.58, Y = 0.87 (X) + 2.85 and Y = 0.71 (X) + 5.78, respectively.

Literature Cited

Archibold, O.W. 1979. Buried viable propagules as a factor in postfire regeneration in northern Saskatchewan. Can. J. Bot. 57:54-58.

Choudhary, M.A., G.P. Yu, and C.J. Baker. 1985. Seed placement effects on seedling establishment in direct-drilled fields. Soil Till. Res. 6:79-93.

Fay, P.K., and W.A. Olson. 1978. Technique for separating weed seed from soil. Weed Sci. 26:530-533.

Granstrom, A. 1982. Seed banks in five boreal forest stands originating between 1810 and 1963. Can. J. Bot. 60:1815-1821.

Jerling, L. 1983. Composition and viability of the seed bank along a successional gradient on a Baltic sea shore meadow. Holarctic Ecol. 6:150-156.

Kaviani, N., R.N. Gibbs, and R.F. Horrell. 1985. Seed placement measuring technique for direct drilling machines—a note. New Zealand J. Exp. Agr. 13:191-194.

Malone, C.R. 1967. A rapid method for enumeration of viable seeds in soil. Weed Sci. 15:381-382.

Moore, J.M., and R.W. Wein. 1977. Viable seed populations by soil depth and potential site recolonization after disturbance. Can. J. Bot. 55:2408-2412.

Pareja, M.R., D.W. Staniforth, and G.P. Pareja. 1985. Disturbance of weed seed among soil structural units. Weed Sci. 33:182-189.

Staaf, H., M. Jonsson, and L. Olsen. 1987. Buried germinative seeds in mature beech forests with different herbaceous vegetation and soil types. Holarctic Ecol. 10:268-277.

Wesson, G., and P.F. Wareing. 1969. The role of light in the germination of naturally occurring populations of buried weed seeds. J. Exp. Bot. 20:402-413.

Winkel, V.K., B.A. Roundy, and D.K. Blough. 1991. Effects of seedbed preparation and cattle trampling on burial of grass seeds. J. Range Manage. 44:(In Press).