that sawdust could serve as a roughage source in wintering rations for breeding stock up to 25% of the total ration.

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Chromatographic Identification of Big Sagebrush Seed

DAVID L. HANKS AND KENT R. JORGENSEN

Highlight: *Paper and thin-layer chromatography of big sagebrush seed provides a rapid, simple means of identifying more palatable forms of this shrub. Methanol extraction of seed for 24 hr followed by two-dimensional paper (n-butanol:acetone:water, 4:1:3; acetic acid: water; 15:85) or single-dimensional thin-layer chromatography (chloroform:methanol:water; 85:10:5) reveals distinctive differences between* Artemisia tridentata *subsp.* tridentata *and the more palatable subsp.* vaseyana *and* wyomingensis. *A bright, iridescent blue spot characterizes the more palatable subspecies; the same spot is much smaller and duller in* A. tridentata *subsp.* tridentata.

Utilization of big sagebrush (*Artemisia tridentata*) as a forage shrub in current range improvement projects has become more promising with the development of techniques by which the more palatable forms of this shrub can be identified (Hanks et al., 1971). Under properly controlled conditions, these forms (subsp. *vaseyana* and *wyomingensis*) can then be used as a seed source for reseeding programs where shrubs are desired for which animals show some grazing preference. However, all too frequently the sources of available seed are from populations where the preferential utilization by big game or livestock is unknown. Under these circumstances, a means of detecting the types of big sagebrush from which the seed lots were collected would be a valuable aid in the proper management of reseeding programs. Taylor et al. (1964) pointed out the differential fluorescence between moist *A. tridentata tridentata* and *A. tridentata vaseyana* seeds. When viewed under long wave ultraviolet light the *A. tridentata vaseyana* seeds fluoresce more brightly. The following procedure describes a more definitive means of distinguishing subsp. *vaseyana* and *wyomingensis* seed from those of the less palatable subsp. *tridentata.*

One-half gram seed samples (98% purity) are placed in vials containing 10 ml absolute methanol and allowed to extract for 24 hr. The extract is decanted and evaporated to a final volume of 1.0 ml. Two-dimension chromatograms are developed by the application of 40 µl of this extract to Whatmann 3 MM chromatographic paper[1] using butanol:acetone: water (4:1:3) as the first solvent system and acetic acid:water (15:85) as the second. The appearance of a bright, iridescent blue spot, R_f = .54/.78

$$(R_f = \frac{\text{distance of spot from origin}}{\text{distance of solvent front from origin}})$$

under ultraviolet light is indicative of either subsp. *vaseyana* or *wyomingensis* seed. If the above spot is present but lacking in iridescence, the seed belongs to the subsp. *tridentata.*

If instant thin-layer chromatography (ITLC) apparatus is available, the time required for seed identification is greatly reduced. The solvent system, chloroform: methanol:water (85:10:5), with silica gel-impregnated Gelman ITLC strips produces a band analogous to the spot described above with an R_f = .67.

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At the time the article was written, David Hanks was plant physiologist, U.S. Department of Agriculture, Forest Service, stationed at the Great Basin Experimental Area, Ephraim, Utah. At present he is assistant professor of microbiology, Northeast Missouri State University, Kirksville. Kent Jorgensen is seed technician, Utah Division of Wildlife Resources, P.O. Box 276, Ephraim.

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[1] The use of trade names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of these products to the exclusion of others which may be suitable.

Small Lysimeters for Measurement of Water Use and Herbage Yield

W. T. HINDS

Highlight: *Small weighing lysimeters provide a useful tool for investigating simultaneously soil water use and plant productivity in annual grasslands. Details of construction, sensitivity and accuracy of weighing, and field and harvest techniques are given. PVC irrigation pipe is used for both the lysimeter and its sleeve–5 inch and 6 inch nominal diameter, respectively. Weight changes equivalent to .002 inch (.05 mm) can be detected, allowing diurnal water use to be determined if desired. Comparisons using shoot harvest and soil water use for Spring, 1971, show good agreement between the lysimeters and the field.*

Weighing lysimeters can provide useful information concerning water relations because they physically confine soil water. However, most lysimeter installations employ relatively large lysimeters to simulate surrounding community conditions, thereby precluding sufficient replication to estimate variability within communities. In Russia, the State Hydrological Institute has carried out extensive experimentation with lysimeters of various sizes, concluding that small lysimeters need not substantially distort either the water or thermal regimes within the lysimeter with respect to the field (Konstantinov, 1966). The lysimeters specified by the Russian Hydrological Institute were 0.05 m^2 in surface area, 0.5 m deep, and were constructed with steel walls. Smaller diameters were discouraged because the conductivity of the walls disturbed the temperature conditions with the lysimeter, while shallower lysimeters were precluded by the expected depth of rooting of the experimental grasses (barley, wheat, and rye). This paper describes a modification of the USSR small lysimeter and discusses some simple field techniques for meaningful replication in the field.

Construction of the Lysimeters

The major disadvantage of small lysimeters for field use is their small surface-to-edge ratio, allowing a greater potential for thermal distortions in the enclosed volume of soil. In the Russian lysimeters,

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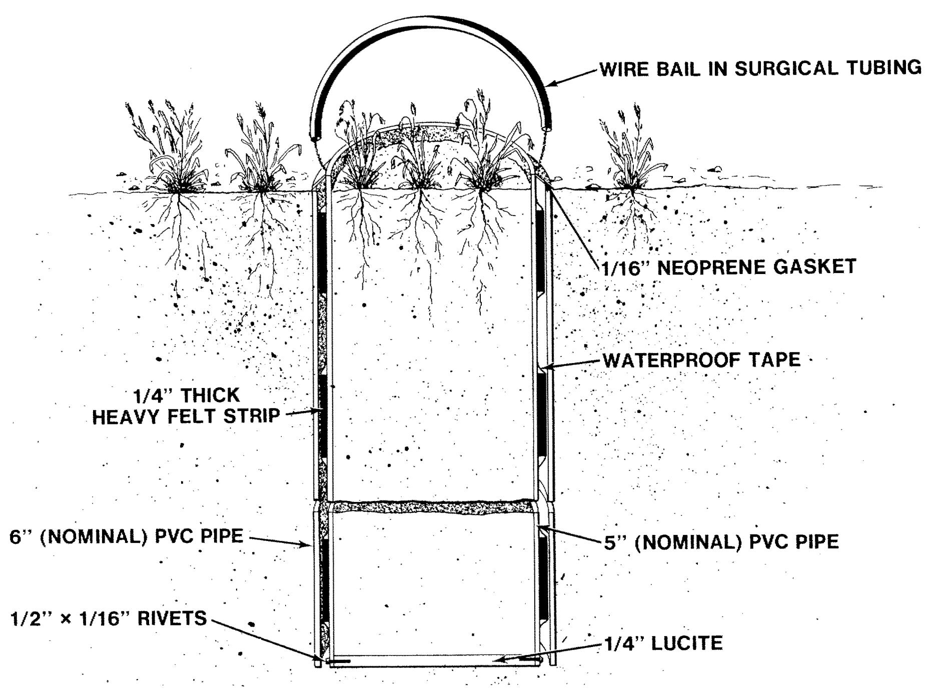

Fig. 1. *Details of construction of small lysimeter. The lysimeters discussed in the text were 60 cm deep, but shallow-rooted plants may not require that depth.*

thermal disturbance was induced by two factors: the high conductivity of the metal walls of the lysimeter and its sleeve; and the air gap between the lysimeter and sleeve. The disadvantages of metal can be avoided by using plastic irrigation pipe (polyvinyl chloride) for both the lysimeter and the sleeve. Nominal 5-inch diameter pipe has an outside diameter (OD) of 5.65 inches (14.4 cm) and an inside diameter (ID) of 5.2 inches (13.2 cm), providing an internal cross section of 138 cm^2. Three or four strips of 0.25-inch-thick felt, about a quarter to a half inch wide, taped around the outer walls of the lysimeter, form "O" rings for a snug fit with the inner walls of the sleeve, which is nominal 6-inch diameter irrigation pipe with an ID of 6.2 inches (15.7 cm). The felt should be covered with waterproof tape, to prevent absorption of water in any form and the tape lubricated with oil or hard grease if necessary. Finally, a neoprene annulus just smaller in ID than the OD of the lysimeter, with an OD just greater than the OD of the sleeve, serves as a shield over the gap between lysimeter and sleeve, preventing wind, rain, and radiation from entering the gap. This series of baffles prevents convection currents between the lysimeter and its sleeve, encouraging horizontal isotherms within the lysimeter, just as in the field. The entire array of baffles and gasket is removed with the lysimeter for weighing. Figure 1 is a detailed cross section of the modified lysimeter.

Field Techniques

Installation of lysimeters in stone-free soil is a simple operation using a screw-type power auger to dig a hole the required depth. The diameter of a 7-inch hole is generally somewhat less than the OD of the 6-inch piping (6.7 inches or 17.0 cm) used for the sleeve, so the sleeve slices off a small amount of soil which must be cleared out of the hole (an ice cream scoop is handy for this). The lysimeter can then be inserted in the sleeve and the annular gasket smoothed as necessary. The entire procedure is more readily accomplished in moist soil rather than dry.

Placing soil in the lysimeters presents much the same problems faced in placing soil in garden pots. In relatively homogeneous soils without well developed horizons, dry soil can be poured into the lysimeter while bumping the lysimeter vigorously to remove excess air. The final bulk density can be controlled by varying the screening of the dry soil before use. Table 1 shows bulk density with different screen size on a sandy loam. Finely screened soil should be added slowly and bumped around in the lysimeter until it feels firm to the touch, lest excess air in the soil be displaced during wetting, causing extensive shrinking.

Table 1. Bulk densities (g/cm^3) attainable as a function of screening size (mesh/inch) of the dry soil.

Screen size	Bulk density
2	1.25[1]
8	1.35
20	1.45

[1] Field conditions.

These lysimeters weigh approximately 35 pounds at field capacity. A portable scale with 25 kg capacity and 5 gram resolution[1] provides sufficient accuracy for determining water losses of 0.002 inch (0.05 mm) from the surface area of the lysimeter. If stationary and covered, this scale will weigh a calibration weight of 8.000 kg to within ±5 grams for periods approaching a year. Weighings of this sensitivity, however, *must* be shielded from wind; otherwise, the variability of the weighings may be increased by factors of five or ten.

To duplicate field conditions of grassland surfaces, soil cores can be taken, using a sharpened section of the 5-inch PVC pipe. The soil core slides readily into the lysimeter when pressed with a heavy weight placed on a plywood circle on top of the core. The maximum practical depth of the core probably depends on soil texture and moisture; for sandy loam, 30 cm was very difficult, but 10 cm was easy. The wet soil in the lysimeter must be "fluffed up" at its surface prior to core insertions to assist hydraulic contact between the core and the underlying lysimeter soil.

Total water loss is readily measured as evaporation from unvegetated soil surfaces and evapotranspiration from vegetated lysimeters. Unvegetated lysimeters are prepared by removing living plants, leaving any mulch intact, before installing them in the field. Comparing water losses from vegetated and unvegetated lysimeters gives the transpirational loss.

Soil temperatures and water potential can be monitored in as great detail as desired, merely by placing thermistors, thermocouples, or psychrometers at the desired depth as the lysimeters are filled.

Herbage yields within the lysimeters are measured by harvesting, but the precision of estimation is generally not the same for roots and shoots. Root estimates are obtained from samples of the soil and cores to be placed in the lysimeters. The samples are washed through, say, a 20-mesh/inch screen and floating root material collected for weighing and ashing necessary to account for soil particles held by the roots. After the period of study, the soil is washed out of the lysimeters with a high pressure water nozzle, with the soil again passing through a 20-mesh/inch screen–this collects all particles of 20-mesh size and larger. This material is then floated in water to separate root material for drying and ashing, just as was the "background" sample. The difference is root growth in the lysimeter, but with a larger standard error than for shoot growth, which is

[1] Maco model 25, is available from Mantes Scale Co., San Francisco, California. Brand names are for reader's convenience and do not constitute endorsement of the product.

Table 2. Average *Bromus tectorum* shoot production (g/m^2) and total water loss (cm) estimated from lysimeters and in the field. Spring 1971, in a field at 1.700 ft elevation.

Location	Shoot production[1]	Water loss[1]
Lysimeter	156 ± 18	16.9 ± 0.6
Field	170 ± 24	16.5 ± 0.8

[1] Numbers following ± are standard errors.

estimated merely by clipping the plants from some cores when preparing the lysimeters and just before washing the soil out of the lysimeters.

Table 2 compares data from the lysimeters and from the field. The field water loss (determined gravimetrically) and herbage yields are very close to those from the lysimeter measurements in both average and variability. Not shown is the precision attainable from periodic weighings—13 lysimeters yielded an average standard error of 0.017 cm/day (9% of the mean) from 10 weighings in 60 days.

Conclusions

The small lysimeters used in groups provide a precise picture of water use during the season and an accurate total for the season. Likewise, the productivity in the lysimeters reflected both the average herbage yield and the natural variability encountered in the field. The lysimeters are not expensive—PVC pipe costs about $1/ft, and construction of each lysimeter takes about 2 hours of shop time. The data attainable through using several to many of these small lysimeters are unparalleled by other lysimeter techniques and consequently offer a potential for new insights into water relations and productivity in annual grasslands with only a modest capital investment.

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VIEWPOINT

A Student's Views on the Future of the Society for Range Management

RICHARD F. MILLER

As a student I am concerned with the future role that the Society for Range Management will play. I believe that the success of range management very much depends upon the strength of this professional organization. Working as individuals we have little chance of making much progress. Working as a unified group through the Society for Range Management we have the opportunity to manage rangeland resources on an ecological basis rather than a political one. The following four points I believe to be essential in managing range resources.

The first of these is adapting to change. As a society of professionals, we must become sensitive to demands and needs placed upon rangeland resources. These needs and demands are constantly changing with time. As the needs of society shift, the demands on range resources shift. To be effective we must adapt ourselves to these constant changes. We should try to project the future by looking at past and present trends. But even then we can get only a vague idea of things to come.

The second point is the image of a rangeman. I believe that our present image limits our full potential as rangeland resource ecologists. A large portion of the general public isn't really sure what a rangeman is. Many special interest groups look at us as livestock managers. Too often we simply manage range resources to suit the needs for livestock production. This creates an image that not only limits our acceptance by other professionals, but even more limits our influence as professionals to the public. I would like to see us project the image of Rangeland Resource Ecologists; professionals who can look at the entire picture and fit the land potentials, on a sound ecological basis, to the needs of the public.

The point is that we must become more influential in the public eye. A large portion of today's management is nothing but legislative fiat. Decisions are based on emotions that obscure the facts. We must base our decisions and statements on sound ecological facts. We must use the correct timing and place for introducing ideas and objectives if they are to have an impact. And, as professionals, we must avoid emotionalism, a tool that is tough to control.

Thirdly, we should become effective in integrating our profession with other professional fields. Sound environmental management requires multiple inputs from such areas as range management, geology, forest management, wildlife management, political science, social science, and a long list of others. Maybe I'm a little biased, but I think the range ecologist certainly has the qualities, with his broad background, to lead such a group.

The last and final point: What are our, the Society for Range Management, goals? I'm sure most of us could state goals that are so broad that we could all agree on them. For example, "To improve the environmental quality and at the same time harvest optimum levels of multiple products on the rangelands." Improvement of environmental quality sounds pretty good, but what is environmental quality? Does it mean clean air or unpolluted waters? What is environmental quality to a dune buggy fanatic may differ considerably from the environmental quality expected by someone who enjoys the quiet and beauty of an unspoiled desert. To many people, environmental quality is just knowing something is there, like the wild horse, even though they may never see it. People get a certain amount of inner satisfaction just by knowing this entity in the environment exists.

For the Society for Range Management to be effective in manipulating sound ecological management, we must work together. We must agree upon a set of goals that we have pinned down and defined. It is extremely difficult to lay down a set of objectives when we have no definable goals.

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