SAND AND HYDROGEL SEED COVERING IMPROVES GERMINATION OF SEVERAL HARDWOODS IN A SOIL THAT CRUSTS

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Abstract

Soil, sand, and sand plus hydrogel were tested as seed coverings in a silt loam soil that crusts when dry. Plum and dogwood established best under soil. Chokecherry, crabapple, and juneberry established best under sand. Honeysuckle, buffaloberry, cotoneaster, and lilac established best under sand plus 1.8% hydrogel. Covering made no difference for Russian olive.

Introduction

At the Lincoln-Oakes Nurseries, Bismark, N. Dakota, the soil is a level Mandan silt loam (Pachic Haploboroll, coarse-silty over sandy or sandy skeletal, mixed) that forms strong crusts when it dries, frequently reducing seedling emergence. Many nurseries use sand to cover the seed because it is easily penetrated, but sand is also easily washed or blown away. Furthermore, it has little moisture-holding capacity and needs frequent irrigation. Water-Saver,[1] a very hydrophyllic starch-acrylamid copolymer, has been reported useful in horticulture to raise the moistureholding capacity of a growing medium (Gehring and Lewis 1980, Mundy 1981). Perhaps, it was thought, if this material were incorporated in sand, it would increase the moisture-holding capacity over sand alone and help hold the sand in place.

Preliminary experiments at Lincoln-Oakes Nursery in 1980 indicated that (1) incorporating Water-Saver into the soil surface was not useful, and (2) that blowing and washing of a sand covering could be reduced by placing the seed at the bottom of a V-shaped groove, and covering with sand only to the surface of the soil.

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1 The use of trade and company names is for the benefit of the reader; such use does not constitute an official endorsement or approval of any service or product by the U.S. Department of Agriculture to the exclusion of others that may be suitable. Water-Saver is one of several brands of "hydrogel" or "super-slurper" commercially available.

Methods and Materials

Raised beds were prepared by rototilling a bare field, and cutting four V-shaped furrows 3 cm deep. Each row was sown with a different hardwood species at the standard rate used by the nursery. The seed was then covered to the level of the bed with one of the following: soil; fine sand only; fine sand plus 0.4%, 1.2%, or 1.8,. Water-Saver by the volume. Water-Saver is a granular material that mixes easily with dry to damp sand in a cement mixer. Each treatment spanned a 2m length of bed. The field plot design was a randomized complete block with 8 replications.

Nursery personnel kept the plots weeded, watered, fertilized, etc as needed.

The seed was sown at the normal time for each species. Cotoneaster (Cotoneaster lucida Schlecht.) was sown August 12, 1980. Lilac (Syringa vulgaris L.), crabapple (Malus baccata (L.) Borkh.), plum (Prunus americana Marsh.), chokecherry (Prunus virginiana 1..), buffaloberry (Shepherdia argentea (Pursh. Nutt.), honeysuckle (Lonicera tatarica L.), dogwood (Cornus stolonifera Michx.), and juneberry Amelanchier alnifolia (Nuts. were sown September 25, 1980. Honeysuckle, lilac, and buffaloberry were sown again in the spring, on May 12, 1981, as was Russian olive (Eleagnus angustifolia L.).

Seedlings of each species on the middle 1.3-m segment of each plot were counted June 29, 1982, when germination was complete and the stand of seedlings well established.

Variance of the seedling counts was analyzed and seed coverings compared within species. For species planted both spring and fall, the effect of seed covering at different plant dates was analyzed.

Results and Discussion

There were striking differences between the reaction of different species to various seed covering (Table 1). Germination and establishment of plum was much better when covered with soil than with any of the sand treatments. Plum seed is very large (ca. 520 mg each), and it is possible that the furrow should have been much deeper than 3 cm to keep the seed from drying out. The sand covering was still in place when the seedlings were counted, but even with Water-Saver added, the sand probably still had less water-holding capacity than the soil.

Dogwood established equally well under soil or sand plus 1.8% Water-Saver, but very poorly under sand alone or with less Water-Saver. Here again, the need for adequate moisture probably explains the result. Dogwood seed is small (ca. 25 mg each) and the depth of planting was surely adequate.

Response of the Russian olive was not significantly different among any of the treatments.

All of the other species tested germinated and established better with sand covering than with soil covering. Crabapple, chokecherry, juneberry, and spring-planted buffaloberry showed little or no difference in response to various levels of WaterSaver. Sand alone was better than or equal to sand plus WaterSaver.

There was an additional gain in seedling establishment with sand plus 1.8% Water-Saver as a covering for cotoneaster, lilac, fallplanted buffaloberry, and honeysuckle. Spring-planted honeysuckle was much more successful than fall planted, and the magnitude of the response to Water-Saver was less in the spring than in the fall. Generally, smaller concentrations of WaterSaver were less effective.

The rationale for choosing Water-Saver concentrations was as follows: (1) 0.4% is the smallest amount that will noticeably change the properties of sand; (2) 1.8% is sufficient to cause appreciable swelling when the sand is wetted and forms a light crust when dry; (3) higher concentrations risk forming a crust hard enough to impede seedling penetration when dry and risk heaving the seedling from the soil when wetted; (4) 1.22 was estimated to be an economical and effective intermediate concentration. However, based on these trials, 1.8% appears to be the best choice for a gain in seedling establishment compared to sand alone.

Preliminary experiments indicated that filling a V-groove with sand to level of the bed was an effective way to keep the sand from washing or blowing away; yet, six weeks after spring sowing, soil and sand had become so mixed that the sand-covered rows were barely discernable. However, addition of Water-Saver to the sand helped keep it in place.

Management Implications

Sand covering applied at a rate of about 9.2 m^3/ha (4.7 cubic yards per acre) is more expensive than soil covering, because it is an additional material to handle and distribute. Addition of 1.8% Water-Saver or 165 1/ha (17.5 gallons/acre) raises the cost further. These costs must be justified by an increase in seedling stand establishment.

Seed covering recommendations by species are listed in Table 2. In those cases where soil covering is as good or better than sand covering:

$$\text{benefit ratio} \quad \frac{\text{average number of seedlings with soil covering}}{\text{average number of seedlings with sand covering}}$$

where sand covering is better than soil covering:

$$\text{benefit ratio - avers} \frac{\text{a number of seedlings with sand covering}}{\text{average number of seedlings with soil covering}}$$

Where sand plus 1.8% Water-Saver is a better covering than sand alone:

$$\text{benefit ratio -} \frac{\text{average number of seedlings with sand + Water-Saver}}{\text{average number of seedlings with sand only}}$$

A benefit ratio close to 1.0 means there is little difference between seed coverings. A large benefit ratio means a large increase in numbers of established seedlings using the recommended covering.

These recommendations should be accepted with caution, as they are based on results from a single year at a single nursery. Other methods of application of Water-Saver, such as coating the seed or spraying a solution, were not tried but may have merit.

REFERENCES

Gehring, J.M., and A.J. Lewis III. 1980. Effect of hydrogel on wilting and moisture stress of bedding plants. J. Am. Soc. liort. Sci. 105(4): 511-513.

Munday, Vivian. 1981. Effect of Terra-sorb on the water holding capacity of metro-mix 300 and on the germination of Phaseolus vulgaris "Topcrop." SNA Nursery Res. J. 7(1), 8 p.

Table 2. - Recommended seed coverings for nurseries with silty soils that crust.

Species	Benefit-ratio
A. Cover with soil, not sand.	
Plum	10.4
Dogwood	5.4
Russian Olive	1.2
B. Cover with sand, not soil.	
Lilac	4.2
Honeysuckle	4.1
Crabapple	3.1
Juneberry	2.5
Cotoneaster	2.3
Chokecherry	2.3
Buffaloberry	
- spring planted	1.8
- fall planted	1.1
C. Additional benefits using sand plus 1.8% Water-Saver over sand alone.	
Honeysuckle - fall planted	3.3
spring planted	1.7
Buffaloberry - fall planted	2.3
Cotoneaster	2.1
Lilac	2.1

See text for explanation.