Propagation of Juniperus for Conservation Planting

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Abstract — Current nursery practices in the Great Plains often fail to produce acceptable crops of Rocky Mountain juniper and eastern redcedar. Research and anecdotal evidence from other regions of the country have suggested alternatives to the current practice of-fall sowing seed and covering the beds with clear plastic and shade-frame. In this study, we compared seed germination under several alternatives to the conventional clear plastic treatment. We also compared seed germination among five seed sources of Rocky Mountain juniper and one source of eastern redcedar. In general, the clear plastic resulted in the highest rates of seed germination and germination was higher for eastern redcedar than for any of the Rocky Mountain juniper sources. The increased germination under the clear plastic appears to be related to better heat and moisture retention under the plastic than the alternative treatments.

INTRODUCTION

Historically, Rocky Mountain juniper *(Juniperus scopulorum* Sarg.) and eastern redcedar *(Juniperus virginiana* L.) have been difficult to propagate from seed in forest nurseries. Consistently low and variable germination rates, winter injury, genetic variability, and a lack of understanding of seed dormancy have contributed to this dilemma (Rietveld 1989, VanHaverbeke and Comer 1985). Presently there is widespread interest in conservation tree plantings in the Great Plains and Intermountain regions. As interest demand has increased, the demand for *Juniperus* planting stock has increased concomitantly as juniper and redcedar play an integral role in many conservation plantings. Because of their tight crown form and tolerance to a wide range of site conditions, *Juniperus* species are highly valued for windbreaks, living snowfences, wildlife cover, and mine reclamation. However, due to the difficulties in propagating eastern redcedar and Rocky Mountain juniper from seed, conservation nurseries are not always able to meet the demand for seedlings. If, as expected, the trend in conservation tree planting continues to increase these deficits will likely become more common.

The fundamental problem with producing consistent crops of Rocky Mountain juniper and eastern redcedar seedlings is that overcoming seed dormancy is often difficult. *Juniperus* seed have both seed-coat and embryo dormancy. Over the years, nursery managers have devel-

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oped a number of techniques to overcome seed dormancy and produce a stand of seedlings. At the USDA Forest Service Bessey Tree Nursery the traditional practice has been to fall-sow the seed and then cover the nursery bed with clear plastic and shade-frame. While this practice has generally produced reliable crops of eastern redcedar, the results with Rocky Mountain juniper have been inconsistent. Furthermore, laying plastic and shade-frame is labor-intensive and increasing concerns with plastic disposal threaten to make the cost of this practice prohibitive. A number of products and practices recently have been shown to be effective mulches in other regions. These include sowing cover crops, Hydromulch ®, latex ground cover, and frost fabrics (Stauder 1994, Wichman 1994, Racey 1987). In order to evaluate the potential of these materials and practices as an alternative to clear plastic, we conducted the following trial at the Bessey nursery in 1993 and 1994.

MATERIALS AND METHODS

We established the field trial in the late summer of 1993. The trial was installed as a split-plot design with three replications. The seed-bed treatment was the main plot effect and seed source was the sub-plot effect. We sowed 144 seeds from one of six seedlots in each sub-plot. The seed-bed treatments are listed in Table 1 and seedlots are listed in Table 2. We sowed the seed using a progeny seed sower developed by the USDA Forest Service Missoula Technology Development Center (Herzberg 1991). The seed-bed treatments were installed immediately after sowing the seed. Soil temperature at 5 cm was monitored on each plot in one replicate with an automatic data recorder (Note: due to equipment malfunctions, only temperature data from November - February is presented here). We measured soil moisture in the upper 15 cm of soil in mid-March and mid-May, 1994 using a Time Domain Reflectometry soil moisture gauge (TRASE model 6050 X1, Soil Moisture Equipment, Inc. Santa Barbara, CA). Soil mois-

Table 1. Cover treatments applied to nursery beds in Juniperus trials at USDA Forest Service Bessey Nursery, Halsey, Nebraska Winter, 1994.

Treatment	Description
Clear plastic	Conventional nursery practice, clear plastic laid over seed-bed after fall sowing and covered with shade frame
Visqueen ® (Ethyl Visqueen Film Products, Dallas, TX)	Opaque, perforated white plastic, laid over seed-bed after sowing
Agrolock ® (Swift Adhesives Division, Reichold Chemicals, Downers Grove, IL)	White latex ground cover applied immediately after sowing
N-sulate ® (DeWitt Company, Fort Collins, CO)	White fabric ground cover
Ramie fibre mat	Brown ground cover made of natural fibers
Hydromulch ® (Centron Fiber Corp., Wellsville, KS)	Green slurry made from recycled paper
Oat cover	Oats sown as cover crop immediately after sowing Juniperus seed

Table 2. Eastern redcedar (ERC) and Rocky Mountain juniper (RMJ) seed used for seed-bed trials at USDA Forest Service Bessey nursery, Halsey, Nebraska, Winter, 1994.

Seedlot Number	Location or Seed zone	Year Collected	Seed provided by:
ERC	Anselmo-Merna, NE	1987	USDA Forest Service Bessey Nursery
RMJ-1	Saguaches, CO	1992	Colorado State Nursery
RMJ-2	Crestone, CO	1988	Colorado State Nursery
RMJ-3	Wasta, SD	1988	USDA Forest Service Bessey Nursery
RMJ-4	Creighton-Wall, SD	1983	Big Sioux Nursery South Dakota
RMJ-5	Wasta, SD	1988	USDA Forest Service Bessey Nursery

ture was measured at three locations within each seed-bed (main plot) treatment. We tested for seed-bed treatment effects by analysis of variance using a randomized block model. We counted the total number of seedlings that emerged in each plot on June 14, 1994. For statistical analyses, germination percentage data were transformed using a square root transformation (Steel and Torrie 1960). Seed-bed treatment and seed source effects on germination were tested by analysis variance using a split-plot model.

RESULTS

Both seed source and seed-bed treatment had a significant effect on seed germination in the field (Table 3). The eastern redcedar seed had higher germination rates than any of the Rocky Mountain juniper seed lots. Seed source RMJ-4 (SD) had the highest germination percentage of the Rocky Mountain juniper seed lots.

Seed germination was low under all treatments. The low overall germination was at least partially attributable to the sowing technique. Although the progeny seeder was useful in sowing exact numbers of seed, it did not sow the seed as deep as the operational sower. The range of germination observed varied from 5.5% under the clear plastic

Table 3. Germination percentage of Juniperus seedlots under various mulch treatments at Bessey Nursery, Halsey, Nebraska, 1994.

Mulch treatment	Seedlot ERC-1	RMJ-1	RMJ-2	RMJ-3	RMJ-4	RMJ-5	mean
Clear plastic	18.3	3.0	1.9	3.7	13.2	2.3	5.47x
Visqueen	0.9	0.5	0.9	0.7	0.7	0.9	0.49y
Ramie Fibre Mat	1.4	0.7	1.6	0.9	0.7	0	0.41y
Hydromulch	0	0.7	0.2	0.2	0.9	0	0.11y
Oat Cover	0.2	0	0.5	0.2	0.2	0.2	0.08y
N-sulate	0.2	0.5	0	0	0.2	0	0.02y
Agrolock	0	0	0	0	0	0	0y
mean	0.92a	0.26bc	0.28bc	0.34abc	0.75ab	0.13c	

NOTE: Means followed by the same letter are not significantly different at 0.05 level. Means separated by Tukey's Studentized range test.

to 0% under the Agrolock ® treatment (Fig. 1). The increase in germination associated with the clear plastic appears to be related to increased soil moisture and soil temperature. On the March evaluation date soil moisture was highest under the clear plastic and lowest beneath the Hydromulch (Table 4). The clear plastic also resulted in the highest mean soil temperature as compared to the other treatments (Fig. 2).

CONCLUSION

Although alternative mulches have been effective in other nursery situations, the results here do not suggest that they will improve the production of fall sown juniper or redcedar over clear plastic. However, we will continue to explore alternative cultural practices to laying clear

Table 4. Seed-bed soil moisture under various mulch treatments at Bessey Nursery, Halsey, Nebraska, 1994.

Mulch treatment	Measurement date March	May
Clear plastic	7.05a	12.43a
Oat Cover	6.51a	12.21a
N-sulate	6.39ab	11.84a
Visqueen	6.23ab	11.44a
Fallow	6.19ab	12.11a
Ramie Fibre mat	6.06ab	11.21a
Agrolock	5.22bc	10.80a
Hydromulch	4.78c	10.76a
mean	6.05	11.61

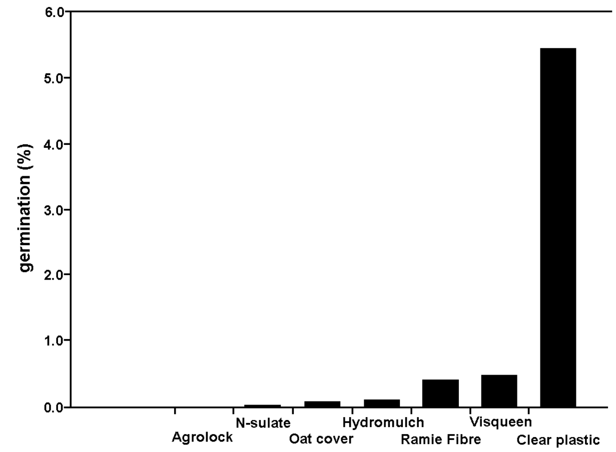

Figure 1. Germination of eastern redcedar and Rocky Mountain juniper seeds under various seed-bed treatments. All seedlots combined. Bessey Nursery, Halsey, NE. 1994.

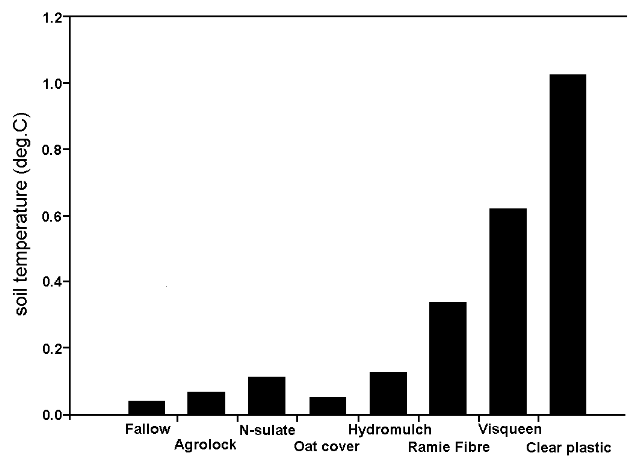

Figure 2. Mean soil temperatures under various seed-bed treatments. Bessey Nursery, Halsey, NE. November, 1993 - March, 1994.

NOTE: Means followed by the same letter are not significantly different at 0.05 level. Means separated by Tukey's Studentized range test.

plastic. One possible alternative practice is to place the seed in long stratification regimes (i.e. 90-120 day warm-moist plus 90-120 days cool moist) and then spring sow the seed. This approach was successful for eastern redcedar in a preliminary trial at the Bessey nursery and we will evaluate its application to Rocky Mountain juniper in the spring of 1995.

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