Rooting of Juniper in Outdoor Nursery Beds[1]

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Abstract. --Junipers are an important nursery species in the intermountain region, but slow and variable germination makes juniper production difficult. Rooting juniper stem cuttings in outdoor nursery beds may be a feasible alternative to production from seed. Concepts of vegetative propagation important to rooting success, such as stock plant condition and timing, are discussed. Two outdoor production systems for rooting juniper are outlined, along with potential problems that could limit success.

INTRODUCTION

Junipers, including Juniperus virginiana, J. monosperma and J. scopulorum, are important species for conservation plantings in the intermountain region. Nurseries often fail to meet production goals for juniper because these species require long stratification periods and germination is often slow and variable. These factors make juniper a good candidate for vegetative propagation.

Background

The horticulture industry routinely propagates ornamental junipers by cuttings (Hartmann and Kester 1983, Whitcomb 1978). The forest nursery industry has yet to apply this knowledge to the juniper species produced. While differences in rooting among juniper cultivars are common, junipers root relatively easily compared to many other conifers.

Forest nurseries are investigating the possibility of outdoor nursery bed propagation to produce plant material (Table 1). Loblolly and slash pine were rooted from stem cuttings in open air mist beds with 77 and 69% rooting, respectively (Frampton and Hodqes 1990). Radiata pine is commonly rooted in outdoor nursery beds with upwards of 90% success (Menzies et al. 1985). White spruce has been rooted in outdoor beds with mist in Canada with some success (73%); however, bottom heat is necessary to improve rooting (Girouard 1977). However, less than 1% of overall juniper production is rooted each year. This contrasts with the horticulture industry where most selected ornamental juniper cultivars are propagated asexually.

A recent study on rooting of various juniper cultivars, found differences in rooting between and among juniper cultivars, depending on chilling requirement of stock plants (Major and Grossnickle 1990). Rooting ranged from 30% to 100% rooting, and cultivars had different chilling requirements. While few studies have been published on rooting junipers important to the intermountain region, eastern red cedar rooted 90% when rooted in September in a cold frame (Van Elk 1969). Rooting, as a production technique has potential for intermountain nurseries (Table 2).

FACTORS INFLUENCING ROOTING

Important factors influencing rooting of cuttings include stock plant condition, treatment of cuttings and the rooting environment. A brief, general discussion of some of the factors critical to rooting success follows.

Stock Plant Condition

Stock plant age influences rooting success of cuttings. As stock plants age,

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Table 1 -- Results of outdoor nursery bed rooting trials.

Species	Rooting %	Comments	Reference
Eastern Red Cedar	90	September / in cold frame	Van Elk, 1969
Loblolly Pine	69	February / open air beds	Frampton & Hodges 1989
Slash Pine	77	February / open air beds	Frampton & Hodges 1989
Radiata Pine	90	open air beds	Menzies et al. 1985

rooting capacity of stem cuttings decreases. While juvenile cuttings may root at 100%, older cuttings (even 4 to 5 years) may root less well. Juniper is unique among conifers because both juvenile and mature shoots will occur on the same tree. Juvenile shoots have flat, prickly open needles, while the mature shoots have appressed needles. Rooting capacity varies with the different needle types. Cuttings from the more juvenile appearing shoots root more readily than cuttings from shoots with mature needles. In addition, hedging (pruning the top portion of the crown to maintain low growing plants) slows the decline in rooting capacity associated with aging by promoting growth of the juvenile portion of the tree (Libby et al. 1972). Cuttings from hedged 13-year-old yellow cedar stock plants root similarly to cuttings from unhedged 5-year-old stock plants (Russell et al., 1990).

Junipers are often rooted in fall or winter when shoots are dormant. However, timing can be critical because chilling can influence rooting. Chilling exposure and chilling requirement of the stock plant can differ by cultivars of junipers. Juniper cuttings can also be taken in the spring (MacDonald 1986).

Only healthy, vigorous and disease-free stock plants should be used to ensure optimal rooting of stem cuttings. Normal cultural practices to promote high quality stock plants are critical to rooting success. Specific recommendations for fertilizing stock plants are not well

Table 2 -- Advantages and disadvantages of cutting propagation of juniper.

Advantages	Disadvantages
1. 1 year production vs. 2 year for seedling production	1. Maintenance of stock plants (windbreaks)
2. Rapid introduction of select genotypes	2. Increased labor
3. Reliable annual production	3. Decreased genetic diversity
4. Improved quality (from uniform spacing)	4. Probable increase in production costs
5. Opportunity to select for specific criteria: -pest resistance -rooting -color -growth habit	
6. Rapid startup for late orders	

understood. However, excess nitrogen promotes excessive shoot growth and should be avoided (Hartmann and Kester 1983).

Treatment Of Cuttings

Treatment of juniper cuttings routinely involves application of a root promoting growth regulator. Recommendations range from 0.3% to 0.5% IBA, but other auxin-like growth regulators can be used (Whitcomb 1978). Generally, a commercial preparation of the growth regulator in talc form is easiest to use. Exact levels of IBA needed for optimum rooting in a given system may require fine tuning for that species. Recommended levels give a good range to begin; however, different levels may be necessary. Cuttings should also get preventive applications of fungicides to reduce disease occurrence in the nursery beds.

Rooting Environment

The rooting environment is critical to success. Cuttings removed from their source of water (the roots) still lose water by transpiration. Until roots are established, care should be taken to maintain high humidity around the cuttings and to maintain turgidity during processing. Mist is generally used during the day to keep humidity high and to cool the cuttings. In addition, shade in reduces incoming light and reduces the heat load on the cuttings, which in turn, reduces transpiration. Protection from wind also helps reduce the stress on the cuttings.

DESIGNS FOR OUTDOOR NURSERY ROOTING

Open Air Mist Beds

As in any nursery operation, beds are formed in a well-drained soil. Addition of a slow-release fertilizer during soil preparation can enhance root production once cuttings are rooted. Beds for rooting cuttings are essentially the same as beds prepared for seed germination or transplanting. Mist lines should be set up so mist can be applied during the day to maintain high humidity around cuttings and reduce stress. If possible, shade is recommended to reduce incoming heat load and reduce stress. Traditional snow fence shading common to many nurseries may suffice. Wind protection prevents desiccation of the cuttings (Frampton and Hodges 1989, MacDonald 1986).

Polythene Tunnels

An alternative way to root cuttings over winter now used in Great Britain, uses polythene tunnels over the nursery bed (MacDonald, 1986). The tunnels are constructed from wire hoops over the beds to support 1.5 mil plastic, which encloses the beds (Fig. 1). The tunnels are continuous down the bed and are 1 m high. The mist line is suspended down the center of the tunnel, 25 cm above the soil line. During early fall, incoming light should be reduced by half. Clear plastic can be used over winter, but shade may be needed in areas of high light intensity.

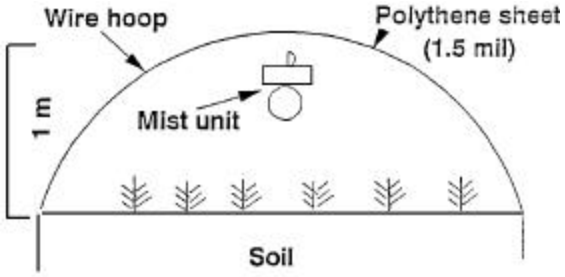

Figure 1--Sectional end view of polythene tunnel (From MacDonald, 1986).

PROCEDURES FOR ROOTING OF JUNIPER STEM CUTTINGS

Sticking Of Cuttings

Cuttings are generally 5 to 15 cm long. The bottom of the cutting is stripped of needles. Fungicide should be applied before cuttings are stuck in the beds or immediately after to prevent diseases. The base of the cutting is treated with growth regulator to promote rooting. Cuttings can be spaced at 7.5 by 7.5 cm in the nursery beds (Hartmann and Kester 1983, MacDonald 1986). It is critical to keep cuttings turgid during the entire process by misting during handling and keeping cuttings in cool, dark storage until ready to plant.

Labor

Cuttings are generally harvested from field- grown stock plants by hand. Cuttings are prepared in a protected environment. Mechanical transplanters can be adapted to stick cuttings into the nursery beds.

Timing

Cuttings can be taken from the stock plant at different times of the year. Cuttings can be taken during the dormant period and stored in a cooler until the growing season. However, weather will determine the rooting requirements of cuttings. Cuttings taken in late winter or early spring can be rooted in the open air mist beds. Cuttings taken in August to September can be rooted over winter in polythene tunnels.

Aftercare of cuttings

Cuttings need to be protected from desiccation and disease for optimal rooting. Cuttings should be monitored for problems in the rooting beds. In open air mist beds, mist is applied frequently during the day to prevent desiccation and heat stress. Mist frequency should increase as temperatures increase. Mist frequency can be reduced after roots begin to develop. Cuttings should also receive normal fertilization to improve growth once cuttings begin to root. By the end of the growing season, cuttings in the open air mist beds should be hardened and cultured like normal seedlings.

In the polythene tunnels, mist should be applied during the day until mid to late October. The mist lines should be removed or drained before freezing occurs. The cuttings should remain in the closed polythene tunnels until the following spring. Depending on the climate, tunnels may need to be ventilated during the winter to prevent excessive heat build-up. Tunnels should removed gradually in spring to allow cuttings to adjust to the environment. Cuttings should be cultured like normal seedlings after the tunnels are removed (Adapted from MacDonald 1986).

Cuttings should be monitored for disease problems because the humid environment required by cuttings is ideal for plant pathogens. Routine prevention practices should be used with on-going efforts to avoid contamination.

UNKNOWN FACTORS

There are still several factors that are unknown for rooting junipers in outdoor nursery beds. These include the exact window of taking cuttings for maximum rooting results. The recommendations included are general guidelines which need to be refined for each site. Success rates reported in literature range from relatively low 30 to high 100%, (Major and Grossnickle 1990, Van Elk 1969). Actual success rates will depend on many variables, some of having been discussed in this article. Another factor is maximum age of stock plants before rooting capacity declines significantly. As mentioned previously, hedging of stock plants can decrease the decline in rooting capacity, In addition, finding stock plants which have the desirable characteristics and root well will take some research.

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