PROGRESS REPORT ON PROPAGATION OF JUNIPERUS FOR CONSERVATION PLANTING[1,3]

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Abstract.--Rocky mountain juniper and eastern red cedar are important species for conservation plantings in the Intermountain region. Nurseries often have difficulty in meeting the demand for junipers because of slow and variable seed germination and a long production cycle. This project was initiated in part to examine an alternative production method using vegetative propagation. The project has two goals, one to improve the planting stock available and two, to shorten the production cycle by vegetative propagation. For improving planting stock, 12 year old select plants from a regionwide planting. Studies examining season of collection and root-promoting growth regulator effects on rooting are in progress. The study for the second phase of the project involves looking at rooting of cuttings from young stock plants (less than three years) for transplanting into bareroot nurseries and is still in progress.

Introduction

Eastern red cedar (*Juniperus virginiana* L.) and Rocky Mountain juniper (*J. scopulorum* Sarg.) are important conservation species in the Intermountain region. They are essential components in windbreaks, living snow fences and wildlife plantings. In the 13 states that constitute this region (AZ, CO, KS, MT, ND, NE, NM, NV, OK, SD, TX, UT, WY) over 2 million juniper seedlings are produced each year (Anon. 1989). The increased demand for conservation plantings has resulted in an increased demand for juniper seedlings as well. In 1992, state and federal nurseries in this region supplied only 50% of the demand for junipers. This constitutes a shortage of over 2 million seedlings. This deficit will likely increase as demand for conservation plantings increases.

Currently, the production of juniper both as containerized and bareroot seedlings, is exclusively by sexual propagation. Seed requires two years on the tree to mature. Furthermore, seedling production in the nursery can require up to three years if seeding occurs in the Fall. Thus, the process from flower primordia initiation to transplanting can require five years. The major difficulty in juniper production is achieving consistent emergence following sowing. Germination rates of 20-50% are not uncommon (Rietveld 1989).

Another approach to producing juniper planting stock is through asexual or vegetative propagation. This approach has several advantages and is the exclusive technique used in the propagation of ornamental junipers. First, vegetative propagation permits the use of elite genotypes developed by the USDA Forest Service tree improvement program. Van Haverbeke and King (1990) identified superior selections for the Intermountain region. These selections include male clones preferred for some windbreak plantings, disease resistant clones, and clones selected for superior survival and growth in the region.

The second advantage is vegetative propagation could reduce the time required to produce bareroot nursery stock. The current scheme requires 2-3 years to produce plantable stock depending on the nursery. It is conceivable, based on the ornamental nursery industry, that plantable stock could be produced in one year using vegetative propagation.

The third advantage is the possibility of improved management and reduced costs associated with producing plant material. Vegetative propagation would reduce or eliminate inadequate utilization of bed space through poor germination or excessive stocking. It could eliminate thinning costs, reduce transplant costs, and reduce losses to inclement weather. Through improved management practices, it is conceivable that the current 50% shortfall in juniper seedlings could be eliminated with little increase in production area or costs.

Objectives

The objectives of this project are to develop techniques for vegetative propagation of older juniper to allow for genetic improvement of planting stock. In addition, to develop techniques to shorten the production cycle for junipers for conservation nurseries.

Materials and Methods

Improvement of Planting Stock: The junipers planted as part of the GP-13 trial throughout the Great Plains were used in the experiments for improving planting stock. The plantations were established in 1980-1981, and include the Horning State Farm, NE, the Los Lunas Experiment Station, NM, and the Mandan, ND planting. The Rocky Mountain juniper did not establish and survive well at the Nebraska site, so only eastern red cedar could be sampled from that location. Both species could be sampled from the other locations. A total of 13 eastern red cedar seed sources (45 genotypes) and 14 Rocky Mountain juniper seed sources (49 genotypes) are being tested in all the studies in this phase of the project.

Timing of collection of cuttings: The purpose of this study was to determine the optimum collection time for rooting stem cuttings. Four collection times were selected to evaluate seasonal differences in rooting potential. Cuttings are collected in February/March, March/April, June, October 1993 and January 1994. Cuttings are collected in the field, placed in a cooler and processed within 48 hours of collection. All cuttings are taken from the lower half of the crown.

The study was initiated in February 1993 with collections of eastern red cedar from the Horning State Farm, NE GP-13 juniper planting. Collections from this site are February 1993, March 1993, June 1993, October 1993 and December 1993. Six seed sources and 4 half-sib trees are sampled from each source. Sampling involves 10 cuttings from each tree for each collection.

Rocky Mountain juniper is sampled from the Los Lunas, NM GP-13 juniper planting. Seven seed sources and 4 half-sib trees from each source are sampled. Ten cuttings from each tree for each collection are sampled. Collections from this site are made in March 1993, April 1993, June 1993, October 1993 and December 1993.

In addition, three eastern red cedar and three Rocky Mountain juniper seed sources are being sampled from the Mandan, ND GP-13 planting. Three trees from each seed source are sampled with 10 cuttings from each tree each collection. Collections from this site are July 1993, October 1993, December 1993 and March 1994.

Cutting type and position: The purpose of this study was to determine if cutting type and location on stock plant are related to rooting potential. There are two types of cuttings present on juniper trees, the first is the recently expanded shoot with small, flat needles often referred to as juvenile. The second type is the mature shoot with open, appressed needles. Three locations on the tree were defined for this study, the upper one-third of the crown, the middle one-third of the crown and the lower one-third of the crown.

This study was initiated in February with two eastern red cedar trees sampled from Nebraska and in March with two Rocky Mountain juniper trees sampled from New Mexico. From each crown location and cutting type 15 cuttings were sampled for a total of 90 cuttings per tree.

Plant Growth Regulator Application: The purpose of this study was to determine the optimum level of root promoting growth regulator and see if level changes with season of collection of cuttings. The same dates were used for collection as with the timing of collection study. All cuttings were from the Los Lunas plantation and both eastern red cedar and Rocky Mountain juniper were sampled. Four seed sources and three trees per source for each species were sampled. Twenty cuttings were sampled from each tree, with five cuttings for each plant growth regulator treatment. The treatments included 10,000 ppm IBA + 5000 ppm NAA, 5000 ppm IBA + 2500 ppm NAA, 3333 ppm IBA + 1667 NAA, all using Dip'n Grow® (Astoria-Pacific, Clackamas, OR) liquid as a quick dip, and 8000 ppm IBA applied as talc using Hormodin 3® (MSD-AGVET, Rahway, NJ)[4].

General Propagation Methods

Cuttings were treated with 5000 ppm IBA + 2500 ppm NAA as a liquid quick dip (1:1 Dip'n Grow®), except for those cuttings in the plant growth regulator study (Henry et al. 1992). Cuttings are placed in a 1:1:1 (v:v:v) mixture of peat:perlite:vermiculite in 164 ml Ray Leach "Cone-tainer" C-10 cells. Cuttings were placed on the propagation bench for 16 weeks with bottom heat at $18^{\circ}C$. Air temperatures in the greenhouse ranged from $7.2^{\circ}C$ to $25.5^{\circ}C$. Heating began at $7.2^{\circ}C$ and cooling at $10^{\circ}C$ (Russell et al. 1990). An overhead mist system applied mist to the cuttings 12 times during daylight hours, the bench was enclosed in a fabric tent which was kept moist by overhead mist. Periodically the cuttings were hand-watered to maintain proper levels of moisture in the rooting media. Applications of fungicide and insecticide were made as needed. After 16 weeks the cuttings were removed and evaluated. Rooted cuttings were potted for future use as mother plants. Cuttings with well-developed callus were replaced on the bench for potential root development.

Reduction of production cycle: The purpose of this study was to examine the effects of rooting volume and container diameter on rooting of cuttings. Also, to determine length of time needed to fill rooting volume for transplant and/or outplanting. The study used eight container sizes ranging from 39 ml to 164 ml (Table 1).

Eastern red cedar cuttings were taken from 2-0 bareroot stock plants and from 9 month container-grown stock plants. Rocky Mountain juniper cuttings were taken from container-grown stock plants. Cuttings ranged from 3 cm to 12 cm. Containers were filled with 1:1:1 peat:perlite:vermiculite (v:v:v). Cuttings were taken from stock plants and immediately treated with 1333 ppm IBA + 667 ppm NAA liquid quick dip (Dip'n Grow®) and placed in the rooting environment (Major and Grossnickle 1990). For each species 20 cuttings per container type were stuck for evaluation with three replications. The remaining cells in the containers were filled with cuttings to provide a buffer zone around the cuttings in the study.

The rooting bench had bottom heat ($18^{o}C$) and an overhead mist system which came on twice hourly for 4 sec during daylight hours. Shade cloth (63%) was placed above the bench system. The greenhouse conditions were as described above. The study was initiated in April, 1993. Cuttings will be evaluated as 50% of the cells show roots out the bottom. Time until roots appear at base will be recorded for each container type and species. Rooted cuttings will be evaluated on root number, total root length of primary roots, root branching, whether or not the plug was full, and shoot length.

Results

Timing of collection of cuttings: Cuttings from the first two collections in this study were evaluated June 1993 and August 1993. None of the eastern red cedar cuttings from the first collection in February rooted and only two cuttings (of 240) rooted from the second collection in March. Three Rocky Mountain juniper cuttings rooted (of 280) from the first collection in March and only two cuttings rooted from the second collection in April. However, with the Rocky Mountain juniper, all the rooted cuttings were from the same seed source. More of the cuttings callused from the first collection than from the second collection for both species.

Cutting type and position: Cuttings were evaluated June, 1993 for rooting and callusing. Only three eastern red cedar cuttings rooted out of 180 cuttings sampled. Thirty eight of the cuttings developed callus. None of the Rocky Mountain juniper cuttings rooted and 29 of 180 cuttings showed callus development. Because of the poor rooting response, no conclusions could be made about cutting position and type and rooting. However, all of the eastern red cedar cuttings with callus were the juvenile type shoot cuttings and 90% of the Rocky Mountain juniper cuttings with callus development were the juvenile type shoot cuttings.

Plant Growth Regulator Application: Cuttings from the April collection were evaluated in August 1993. Of 240 eastern red cedar cuttings, 39 rooted (16%) and 8 of 240 (3%) Rocky Mountain juniper cuttings rooted. Cuttings treated with the full strength Dip'N Grow (10,000 ppm IBA + 5000 ppm NAA) showed best rooting for eastern red cedar (Figure 1). The Rocky Mountain juniper cuttings treated with 5000 ppm IBA + 2500 ppm NAA rooted slightly better than cuttings treated with full strength Dip'N Grow (Figure 1). Cuttings from the Texas and Nebraska eastern red cedar seed sources rooted more frequently than cuttings from the other two seed sources sampled (Oklahoma and Kansas).

Reduction of production cycle: This study has not been fully evaluated. Based on appearance of roots from the base of the containers, eastern red cedar cuttings appear to be rooting faster than the Rocky Mountain juniper cuttings (Figure 3). Cell volume appears to influence rate of appearance of roots from the base of the container more than cell depth.

Discussion

Although most of the experiments discussed are still in progress, the preliminary results are encouraging. While rooting for cuttings from the older stock plants is low, results of the growth regulator study indicate rooting is possible for both species. In addition, rooting is expected to be greater of cuttings collected in the fall and/or winter. The initial results of the container study indicate that rooting of cuttings from young stock plants holds great potential for reducing the production cycle of junipers. The eastern red cedar is rooting faster than the Rocky Mountain juniper cuttings. However, this difference may be explained by difference in conditions of the stock plants. The eastern red cedar stock plants had been hardened off or were bareroot transplants recently removed from storage. The Rocky Mountain juniper was from actively growing greenhouse stock plants. These differences will be examined in future experiments.

[4]Mention of specific compounds does not constitute an endorsement of those compounds.

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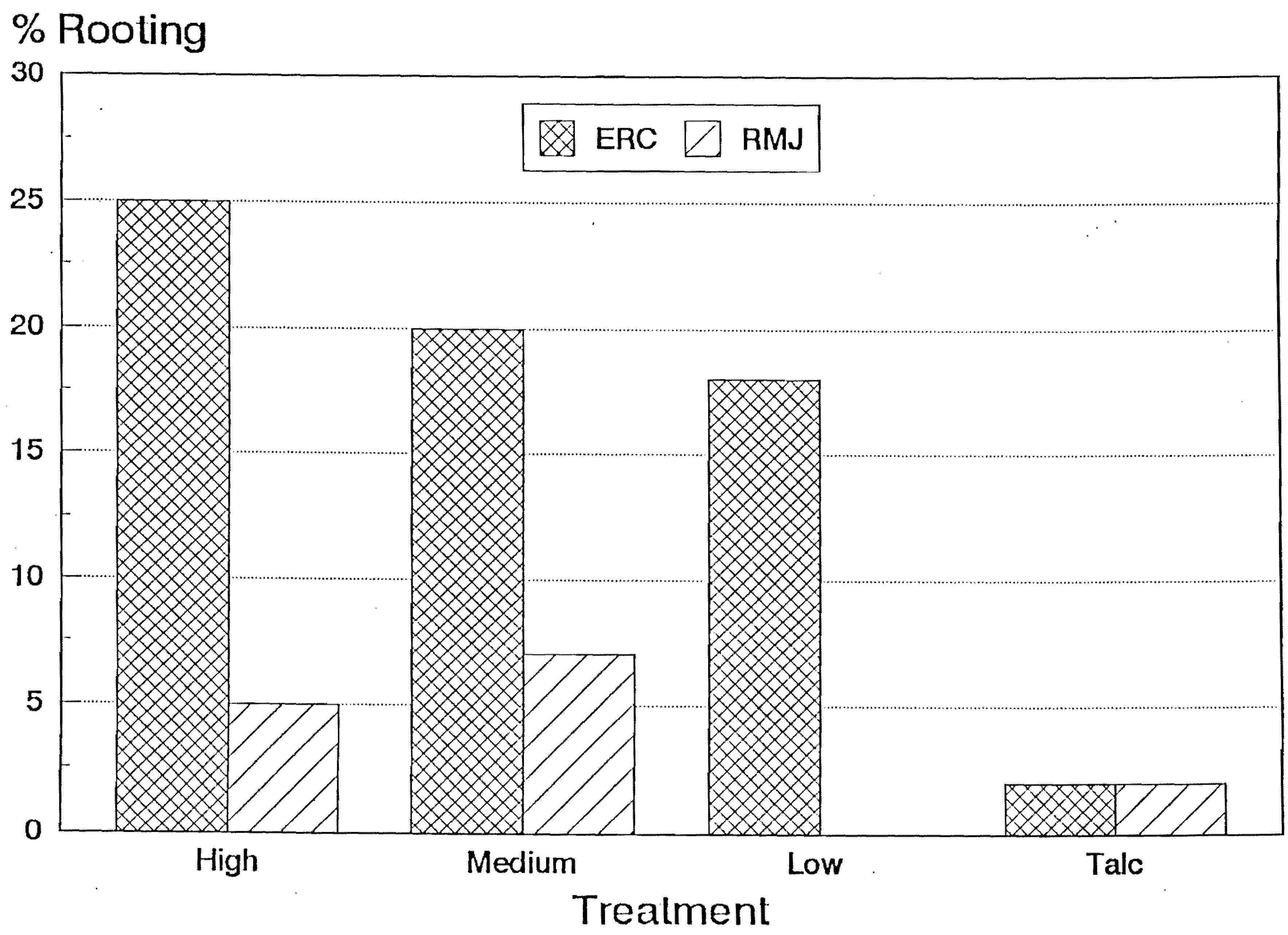
Table 1. Container types and sizes used in study. (All containers from Stuewe and Sons, Inc. Corvallis, OR.)

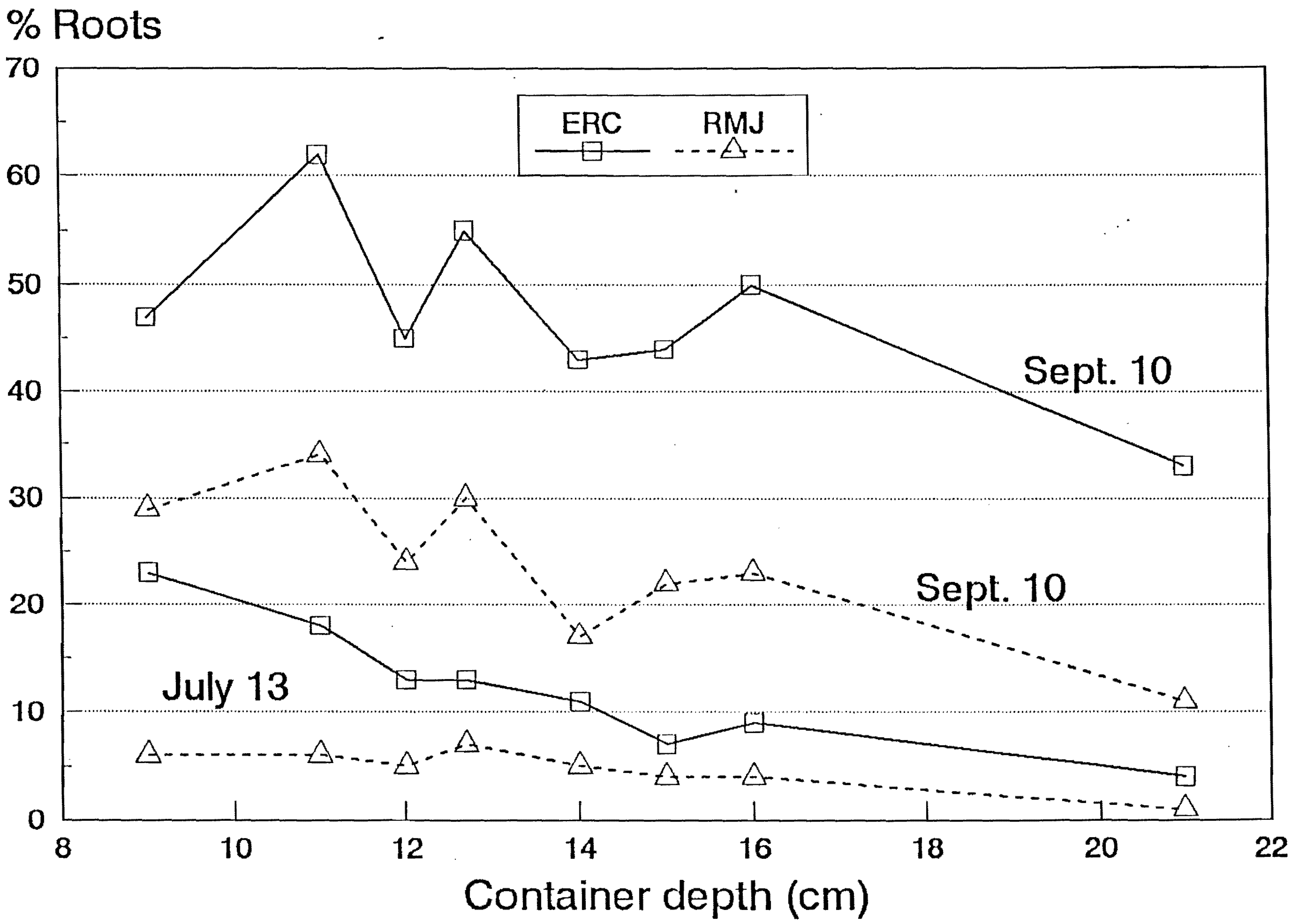
Container	Volume (ml)	Diameter (cm)	Depth (cm)	No./m^2
First Choice Block™2A	39	2.5	11	1109
Ropack® Multi-Pot™ 5-104	49	2.5 X 3.2	9	1206
First Choice Block™ 4	65	3.1	12.7	764
Ray Leach "Cone-tainer"™ C-4	66	2.5	16	1076
First Choice Block™ 5	77	3.1	15	667
Ropack® Multi-Pot™ 3-96	98	3.8	12	441
Ray Leach "Cone-tainer"™ C-7	115	3.8	14	528
Ray Leach "Cone-tainer"™ C-10	164	3.8	21	528

Figure 1. Rooting of mature eastern red cedar and Rocky Mountain juniper cuttings collected in April, 1993 and treated with various levels of plant growth regulators. High = 10,000 ppm IBA/5,000 ppm NAA; Medium = 5,000 ppm IBA/2,500 ppm NAA; Low = 3,333 ppm IBA /1,667 ppm NAA; Talc = 8,000 ppm IBA powder.

Figure 2. Percentage of eastern red cedar and Rocky Mountain juniper cuttings with roots appearing from base of container over time.



% Rooting
30
25
20
15
10
5
0
ERC
RMJ
High
Medium
Low
Talc
Treatment



% Roots
70
60
50
40
30
20
10
0
ERC
RMJ
Sept. 10
Sept. 10
July 13
8
10
12
14
16
18
20
22
Container depth (cm)