Propagation of Narrowleaf Cottonwood by Stem Cuttings III: Media Density and Slow Release Fertilizer Incorporation.

by:

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Introduction

Narrowleaf cottonwood, (*Populus angustifolia* James) also referred to as narrowleaf poplar and mountain cottonwood commonly occurs at elevations of 1,5200 meters to 2,440 meters in riparian areas of the Rocky Mountains (Elmore and Janish 1987). This species has also been found at upland sites as high as 3,000 meters feet and in riparian areas in excess of 2,500 meters (Harrington and Dreesen, personal observations). The native distribution of narrowleaf cottonwood is widespread occurring throughout the Rocky Mountains from southern Canada to northern Mexico (Little 1968).

Many species in the genus *Populus* are considered easy to root from dormant hardwood cuttings. Many species of *Populus* are traditionally propagated in outdoor nursery beds using 6 to 10 inch cuttings (Morin and Demeritt 1984). In some cases, primarily riparian plantings, cuttings or whips can be successfully used in lieu of rooted cuttings. However when using cottonwood in drier or upland plantings, superior survival and early growth are obtained when using rooted cuttings (Phipps et al. 1977). Little published work exists on the performance of bare-root rooted cuttings versus container grown rooted cuttings of cottonwood.

Published research on container production of narrowleaf cottonwood is lacking. This includes the most basic information such as media composition and fertility. Published studies on other members of the genus report using a 3:1:1 ratio of peat:perlite:vermiculite (v:v:v) (Phipps et al. 1977). Previous work on other cottonwood species indicate a lighter, more porous media may be better (Harrington unpublished data). No work exists on cottonwood species variability toward media composition.

Another aspect of container production of rooted cuttings lacking in published information is fertility. Fertilizing is considered not necessary nor effective prior to new root initiation (Dirr and Heuser 1987). After root initiation, a well balanced fertilizer regime is instrumental in producing vigorous growth of cuttings or seedlings in containers. A common approach to fertilizing container plants in the southwest is to incorporate slow release fertilizer into the growing media (Harrington 1995). This approach is supplemented with liquid based fertilizers after shoot growth begins.

The objectives of this study were to examine the effects of media composition (density), incorporation of slow release fertilizer and/or triple super phosphate on the rooting response and shoot growth of three upland ecotypes of narrowleaf cottonwood.

Methods and Materials

Stem (branch) cuttings used in this study originated from 3-year old stock plants growing at the NRCS-Plant Materials Center in Los Lunas, New Mexico. The stock plants were established from rooted cuttings of materials collected from the Molycorp, Inc. mine in Questa, New Mexico. The original location of the three sources (ecotypes) were small stands of trees growing at three distinct locations on overburden piles at the mine. These areas were the Capulin ecotype (elevation = 2,980 meters); the Raspberry Ridge ecotype (elevation = 3,000 meters); and, the Pinon Knob ecotype (elevation = 2,835 meters). Identities of the stock plants were only maintained by ecotype not by individual tree when establishing the stooling blocks at the Los Lunas PMC. The stooling blocks were established in the spring of 1993.

The three ecotypes evaluated were represented by 4 trees/ecotype. The stem cuttings used in this study were collected in the form of branches during the last week of February 1996. Branches were placed in coolers and brought to the Mora Research Center, Mora, NM and placed into refrigerated storage (2 - 4°C) until used in the study (less than 14 days). Individual branches were subdivided into stem cuttings immediately prior to treatment imposition. Stem cutting length ranged from 10 cm to 15 cm in length and contained a minimum of 3 buds. Subdivision of the stem cuttings was done using a hand pruner. Cuttings were then stuck into appropriate media treatments. No exogenous hormones were applied to the cuttings.

The rooting media evaluated in this study were a 2:1:1, a 1:1:1, and a 1:1:2 ratio of peat:perlite:vermiculite (v:v:v). Media components were mixed using a large paddle mortar mixer. To evaluate the effects of slow release fertilizer (Osmocote 14-14-14; 3 month; 4kg/m^3) and triple super phosphate (600g/m^3) incorporation into the media, these components were added during the media mixing process. Table 1 summarizes the combinations of media and incorporated fertilizers evaluated in this study.

Once cuttings were treated they were stuck in 164 cm^3 Ray-Leach Super Cells. Stem cuttings were placed in a greenhouse on a propagation bench with bottom heat which kept root zone temperature at 24°C. Greenhouse temperatures were 20 - 22°C days and 16 - 18°C nights. Photoperiod was a 10-hr light/14-hr dark with the dark cycle being interrupted twice at 5 hours and 10 hours with 30 minute light periods. Artificial light used to extend the ambient light period and light interruptions was provided by 1000-watt high pressure sodium vapor lamps suspended 3 meters above the stem cuttings.

Cuttings were misted 4 times daily until the majority of cuttings had significant bud break (approximately 3 weeks). Following budbreak, cuttings were irrigated as needed, increasing from once every three days at the beginning of the study to once every day at week 20. Fertilizer applications consisted of foliar feed applications of a 25 ppm N solution of Peter's Foliar Feed following every second irrigation from week 4 through week 12. At week 13, this fertilization was increased to applications of 100 ppm N of Peter's Conifer Grower (20-7-19) every other irrigation . This fertilization rate was retained until the end of the study. At week 20, cuttings were non-destructively analyzed for rooting response, seedling height and number of leaves.

The treatment structure for this study was a factorial design with three ecotypes, three media combinations, two levels of slow release fertilizer, and two levels of triple super phosphate incorporation. This resulted in a total of 36 treatments. The planting design was a randomized complete block design. Each tree/ecotype was represented in each of the 36 treatments by 14 stem cuttings. Data was analyzed using analysis of variance procedures.

Table 1. Media and Fertilizer Treatments Used in this study.

Media (peat:perlite:vermiculite)	Slow Release Fertilizer	Triple Super Phosphate
1:1:1 (light)	Yes	Yes
1:1:1 (light)	Yes	No
1:1:1 (light)	No	Yes
1:1:1 (light)	No	No
1:1:2 (moderate)	Yes	Yes
1:1:2 (moderate)	Yes	No
1:1:2 (moderate)	No	Yes
1:1:2 (moderate)	No	No
2:1:1 (heavy)	Yes	Yes
2:1:1 (heavy)	Yes	No
2:1:1 (heavy)	No	Yes
2:1:1 (heavy)	No	No

Results

Overall, rooting success was, 96.5%. Ecotype, slow release fertilizer and their interaction strongly impacted rooting success (Table 2). The presence of slow release fertilizer in the media decreased rooting of the Pinon Knob ecotype from 98% to 93% (Figure 1). The rooting response of cuttings from the Capulin and Raspberry Ridge ecotypes were not influenced by the presence of the slow release fertilizer.

The presence of slow release fertilizer also influenced the effect of triple super phosphate incorporation on the rooting response. Triple super phosphate in the media resulted in 94% rooting success. However, the combination of triple super phosphate and slow release fertilizer lowered the overall rooting response to 94% (Figure 2).

Ecotype (genetics), the two fertility treatments and their interactions had the greatest influence on shoot growth (Table 3). Media composition had no discernable effects on shoot growth in this study. The influence of ecotype on 20-week shoot height was influenced by the presence of slow release fertilizer in the media. This effect was most pronounced in the shoot growth of rooted stem cuttings from the Capulin ecotype (Figure 3). Twenty week shoot height was over 6 cm greater for stem cuttings growing in media containing slow release fertilizer. The beneficial effects of slow release fertilizer on shoot growth was less pronounced in stem cuttings from the Raspberry Ridge and Pinon Knob ecotypes. When averaged over the study, the presence of slow release fertilizer in the media resulted in approximately a 3 cm improvement in growth after 20 weeks. A similar improvement in shoot growth, approximately 3 cm, was found when triple super phosphate was incorporated into the media.

Those variables which had the greatest impact on shoot growth also had the greatest impact on the number of leaves produced. Ecotype, or genetics, accounted for the greatest amount of the variability found in this attribute (Table 4). Plants generated from stem cuttings originating from the Capulin ecotype had the greatest number of leaves produced (Figures 4, 5).

Table 2. Analysis of variance table for rooting percentage of narrowleaf cottonwood cuttings derived from 3 year-old stock plants growing in Los Lunas.

Source	df	MS	Pr>F
Model	35	61.01	0.0002
Ecotype (E)	2	133.77	0.0059
Media (M)	2	7.78	0.7319
E x M	4	32.59	0.2701
Osmocote (O)	1	224.18	0.0033
E x O	2	280.84	0.0001
M x O	2	0.47	0.9812
E x M x O	4	19.97	0.5251
Super Phosphate (P)	1	2.87	0.7346
E x P	2	66.73	0.0727
M x P	2	22.98	0.3995
E x M x P	4	37.41	0.2054
O x P	1	184.93	0.0074
E x O x P	2	60.08	0.0938
M x O x P	2	15.68	0.5339
E x M x O x P	4	46.71	0.1190
Error	108	24.84	
Total	143		

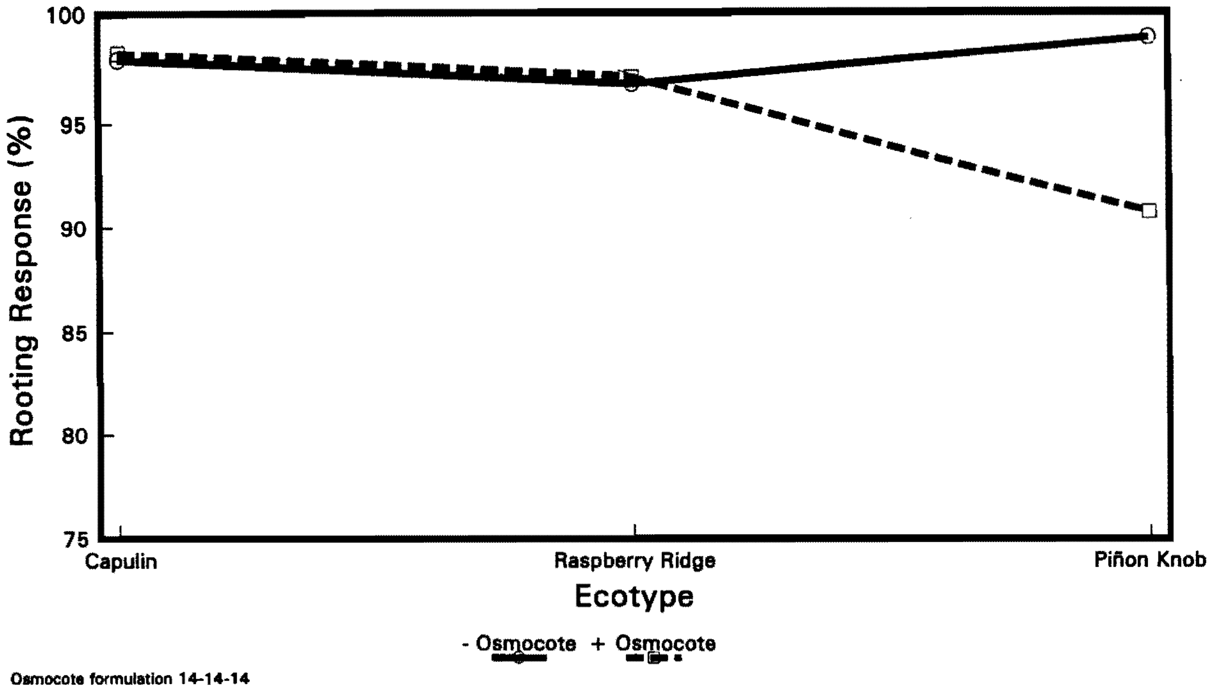

Figure 1. The influence of osmocote incorporation into the media on the rooting response of narrowleaf cottonwood cuttings from three ecotypes of the species.

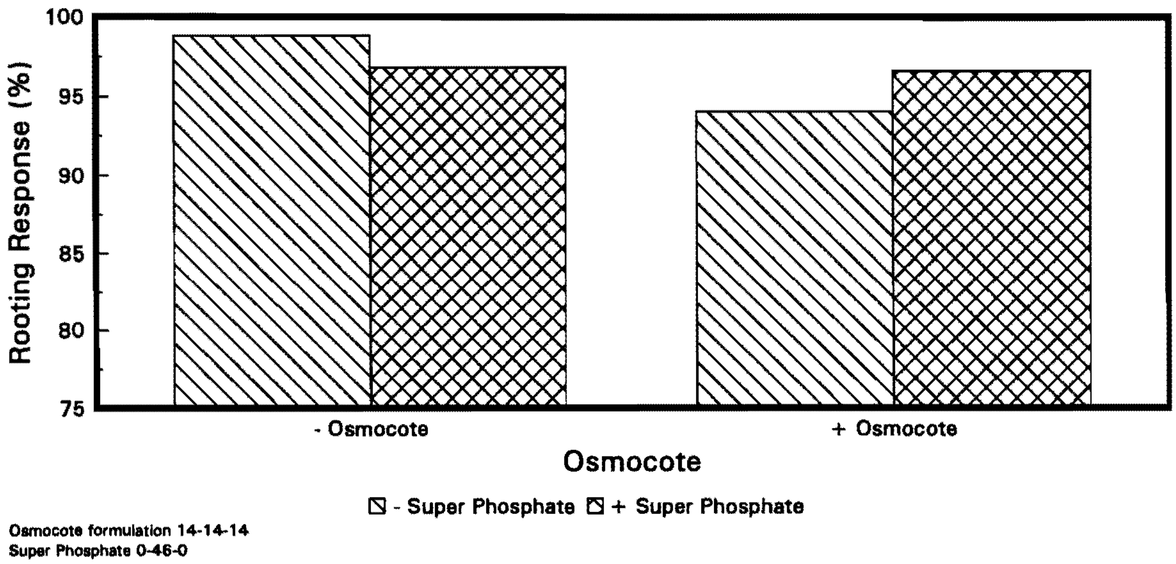

Figure 2. The influence of osmocote and triple super phosphate incorporation into the media on the rooting response of narrowleaf cottonwood cuttings in this study.

Table 3. Analysis of variance table for shoot growth of narrowleaf cottonwood cuttings derived from 3 year-old stock plants growing in Los Lunas.

Source	df	MS	Pr>F
Model	35	806.11	0.0001
Ecotype (E)	2	3238.41	0.0001
Media (M)	2	234.91	0.0759
E x M	4	475.77	0.0003
Osmocote (O)	1	4393.95	0.0001
E x O	2	2169.76	0.0001
M x O	2	110.72	0.2964
E x M x O	4	713.25	0.0001
Super Phosphate (P)	1	2870.20	0.0001
E x P	2	89.30	0.3750
M x P	2	618.73	0.0011
E x M x P	4	212.33	0.0536
O x P	1	455.07	0.0254
E x O x P	2	561.16	0.0021
M x O x P	2	372.15	0.0169
E x M x O x P	4	36.32	0.8094
Error	1969	90.99	
Total	2004		

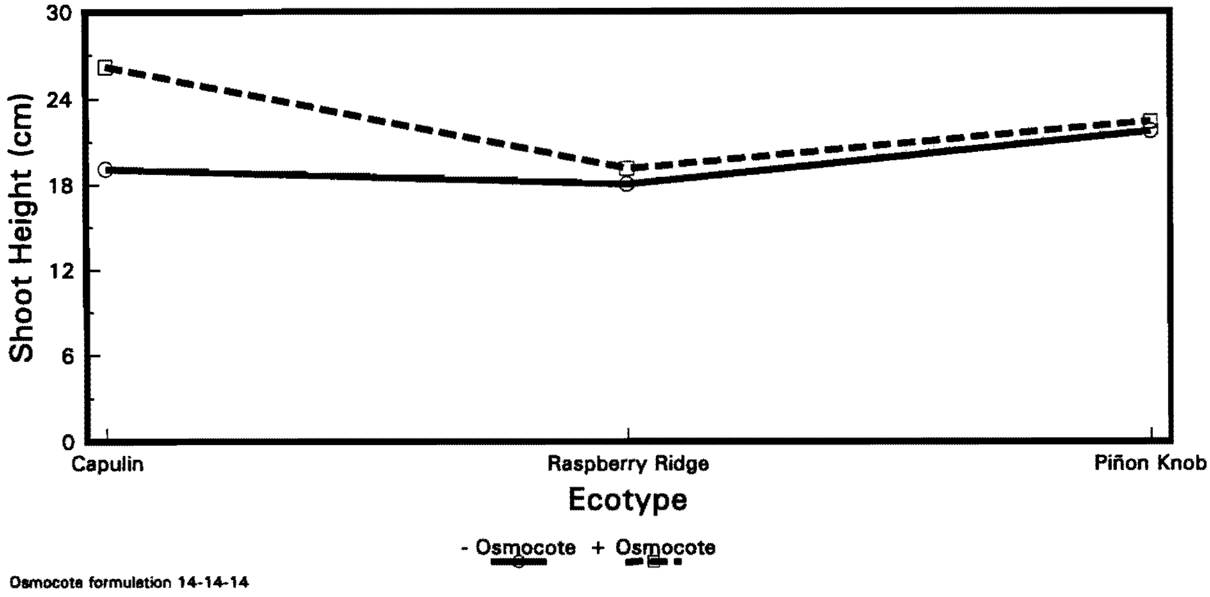

Figure 3. The influence of osmocote incorporation into the media on the shoot growth of rooted narrowleaf cottonwood cuttings from three ecotypes of the species.

Table 4. Analysis of variance table for number of leaves produced on narrowleaf cottonwood cuttings derived from 3 year-old stock plants growing in Los Lunas.

Source	df	MS	Pr>F
Model	35	150.77	0.0001
Ecotype (E)	2	1880.93	0.0001
Media (M)	2	15.45	0.3401
E x M	4	91.06	0.0001
Osmocote (O)	1	194.74	0.0002
E x O	2	128.70	0.0001
M x O	2	2.02	0.8683
E x M x O	4	65.36	0.0011
Super Phosphate (P)	1	8.15	0.4506
E x P	2	18.58	0.2732
M x P	2	21.77	0.2188
E x M x P	4	18.64	0.2669
O x P	1	147.14	0.0014
E x O x P	2	17.13	0.3025
M x O x P	2	5.23	0.6939
E x M x O x P	4	16.34	0.3351
Error	1969	14.31	
Total	2004		

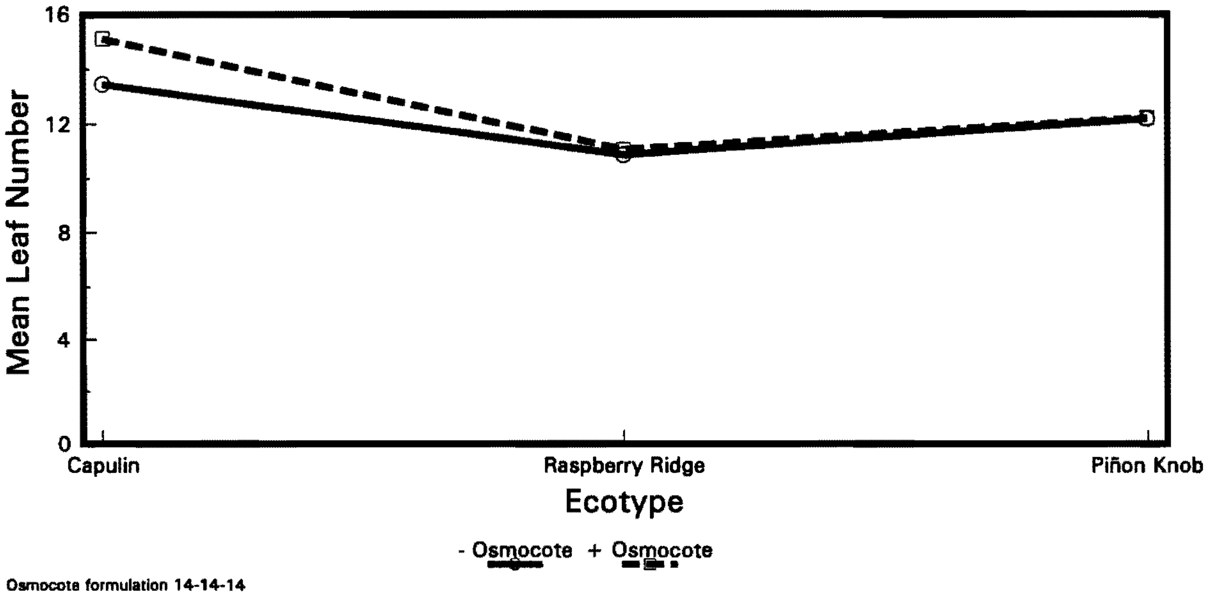

Figure 4. The influence of osmocote incorporation into the media on the number of leaves produced on rooted narrowleaf cottonwood cuttings from three ecotypes of the species.

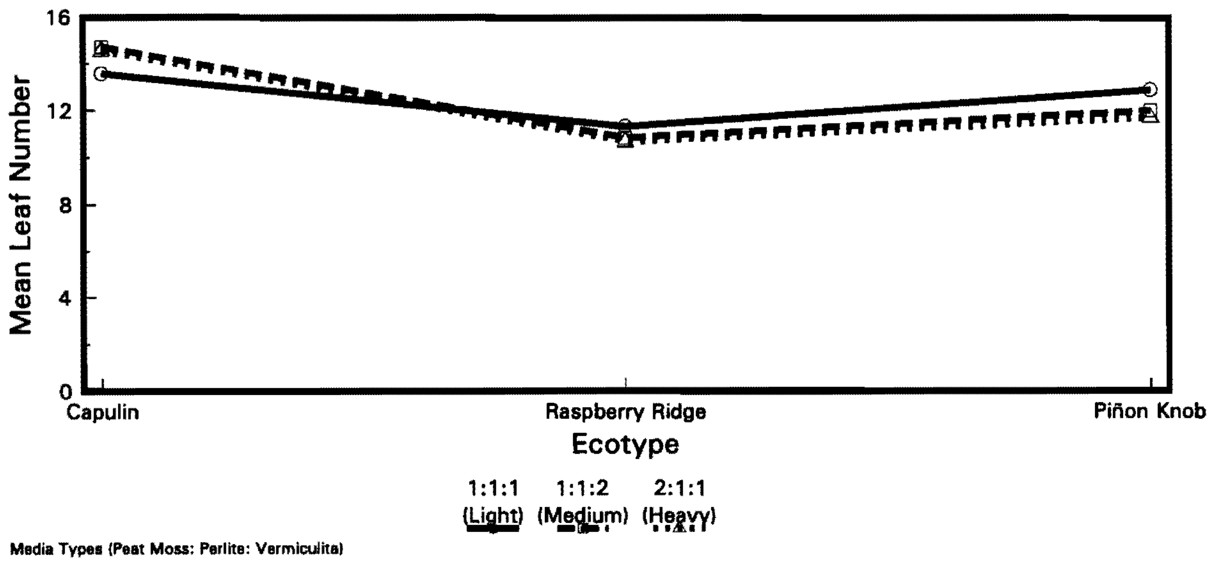

Figure 5. The influence of media density on the number of leaves produced on rooted narrowleaf cottonwood cuttings from three ecotypes of the species.

Applications

Ecotype (genetics) influenced the overall rooting response to the presence of slow release fertilizer in the media. One source out of the three had a negative response to slow release fertilizer. When developing a clonal (vegetative) propagation program, it is necessary to examine the effects of your cultural programs (irrigation, fertilization, media, etc.) on new plant materials. While this make take some time to do, it can results in considerable cost and energy savings. While not evident in the height growth data, the rooted cuttings growing in media containing the slow release fertilizer had deeper green leaves and had set bud by week 20. Alone, triple super phosphate enhanced rooting, however, as a singular treatment it was not as effective as slow release fertilizer which also produced more vigorous shoots.

Root and shoot growth of narrowleaf cottonwood ecotypes evaluated in this study were insensitive to media composition. However, a grower should always run trials to determine the optimum media density for a new species or a unique seed source. As many of us are facing growing wetland and riparian species along with our traditional upland species, media requirements for optimal growth will have to be examined.

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