Plant Propagation

Donlin Zhang

Section Editor

Softwood and Semi-Hardwood Cutting Propagation of Shumaka™ Crape Myrtle

Jenny B. Ryals, Patricia R. Knight, Scott Langlois, Eugene K. Blythe, J. Skylar Baldwin, Christine Coker, Gary Bachman, Jim DelPrince, and Anthony T. Bowden

Coastal Research and Extension Center, South Mississippi Branch Experiment Station, P.O. Box 193, Poplarville, MS 39470

j.ryals@msstate.edu

Index Words rooting, root-promoting compounds, auxin, IBA, NAA, *Lagerstroemia*

Significance to Industry Rooting responses, root quality ratings, and initial growth did not show differences among cuttings of Shumaka™ 'CREC-0052' crape myrtle treated or not treated with selected auxin formulations. Evaluation of possible stem position influence on cuttings was also examined. Position 1 was located at the site of attachment to the parent plant and positions 2-4 continued toward the branch tip. When no auxin was applied, both stem positions 3 and 4 rooted 100%. These results suggest that softwood and semi-hardwood cuttings of Shumaka™ crape myrtle will root regardless of stem position or use of auxin.

Nature of Work Crape myrtles, *Lagerstroemia* species and hybrids, are considered a staple in many southern landscapes (8). With many cultivars flowering for more than 100 days, crape myrtle provides an aesthetically appealing landscape element with a diverse color palette (2,5). Mississippi State University has been active in developing new crape myrtle selections, including Shumaka™. Shumaka™ is a hybrid resulting from crossing *Lagerstroemia* 'Arapaho' (6) and an unknown pollen donor. Shumaka™ has a very light pink flower color and large growth habit. Three-year-old plants in a research setting are 20+ feet (6+ meters tall) and have flowered from early June through late August. The bark is smooth to exfoliating, with outer bark that is grayish brown in color.

When releasing a new crape myrtle cultivar to nurseries for propagation and production, understanding how to most efficiently propagate it can aid bringing the plant to market. Propagation of crape myrtle via softwood or hardwood cuttings is widely described as easy (2,3). Wade and Woodward (7) state that propagation of crape myrtle is easiest when using semi-hardwood cuttings from new growth. Byers (2) used 8-inch (20-cm) hardwood cuttings taken after frost and stored overwinter. Dirr and Heuser (3) reported hardwood cuttings from early February rooted better (43%) than those cuttings taken in early January or early March when using bottom heat and peat: perlite or bark. Nursery propagation scheduling and rooting performance determine whether to propagate hardwood, softwood or semi-hardwood cutting. Easy-to-root crops like crape myrtle can be scheduled around crops that have more complicated propagation requirements. To assess the best way to propagate Shumaka™, two studies were conducted. Study 1 evaluated the optimal commercial auxin formulation and concentration and basal wounding for hardwood cutting propagation and Study 2 evaluated the optimal commercial auxin formulation and concentration and impact of cutting stem position for softwood and semi-hardwood cutting propagation of Shumaka™. This paper will discuss results from Study 2. The objective of this research was to evaluate ease of rooting and determine optimal commercial auxin formulation and concentration as well as optimal stem position for spring cutting propagation of Shumaka™.

Five-inch (12.7-cm), 3-4 node medial cuttings were harvested from the parent plant and stuck to a depth of 1-inch (2.5-cm) on 30 April 2018. Propagation medium was 100% perlite placed in 2.5-inch (6.35-cm) containers. Cuttings were placed under intermittent mist applied for 10 sec every 30 min for daylight hours. Treatments included four stem position treatments (with position 1 beginning at site of attachment to parent plant) (Figure 1), two auxin formulations [Hortus IBA Water Soluble Salts™ (Hortus IBA) or Dip'N Grow® (DNG)] and three levels of auxin [0, 500, or 1000 ppm Indole-3-butyric acid (IBA)]. DNG also contains 1-Naphthaleneacetic acid (NAA) at one-half the rate of IBA. Experimental design was a randomized complete block design with five single cutting replications. Data collected after 60 days included rooting percentage, growth index (new shoots), cutting quality (0-5, with 0=dead and 5=transplant-ready cutting), total root number, average root length (of three longest roots), and root quality (0-5, with 0=no roots and 5=healthy, vigorous root system). Data were analyzed using linear mixed models and generalized linear mixed models with the GLIMMIX procedure of SAS (ver. 9.4; SAS Institute Inc., Cary, NC).

Results and Discussion F-tests indicated that rooting percentages, number of roots, average length of three longest roots, rooting quality, cutting quality, and growth indices were similar (Table 1). When no auxin was applied, both stem positions 3 and 4 resulted in 100% rooting. These results suggest that softwood and semi-hardwood cuttings of Shumaka™ crape myrtle will root regardless of stem position or use of auxin.

Rooting percentages for Shumaka™ averaged 90% for cuttings that did not receive auxin and 84% across all treatments, while Dirr and Heuser (3) reported 90 to 100% rooting for softwood cuttings treated with a 1000 ppm IBA solution. Dirr and Heuser (3) also observed that 'Tuscarora', 'Natchez', and 'Muskogee' softwood cuttings treated with no auxin had similar rooting percentages when compared to cuttings treated with 1000 ppm IBA solution; these rooting percentage results were similar to those observed in this study. However, the auxin treated cuttings showed a superior root quality (number and length) when compared to the cuttings treated with no auxin (3). It was observed in this study that there were no statistical differences for the root quality factors (number and length) when comparing cuttings treated with no auxin to cuttings treated with auxin. Blythe et al. (1) reported greater than 90% rooting, when using DNG at a rate of 1000 ppm IBA +500 ppm NAA for 'Natchez' crape myrtle; these results were similar rooting percentages compared to those observed in this study. Differences in rooting percentages may be due to differences in cultivars evaluated or cultural conditions of the parent material (4). Total number of roots for Shumaka™ were very similar to total number of roots reported for 'Natchez' dipped in DNG at a rate of 1000 ppm IBA +500 ppm NAA (1). The total number of roots for Shumaka™ averaged 2.4 more than those reported for 'Natchez' crape myrtle cuttings (1).

This study indicated that softwood and semi-hardwood cuttings of Shumaka™ crape myrtle may be successfully rooted without the use of auxin. Growing easy-to-root species, like crape myrtle, that do not require the use of auxin can benefit propagation nurseries financially and in management practices. Plant production without the use of auxin can provide a savings in output costs spent on auxins, labor costs, and reduction in plant production time.

Literature Cited

1. Blythe, E.K., J.L. Sibley, K.M. Tilt, and J.M. Ruter. 2003. Foliar application of auxin for rooting stem cuttings of selected ornamental crops. J. Environ. Hort. 21:131-136.
2. Byers, D. 1983. Selection and propagation of crape myrtle. Comb. Proc. Int. Plant Prop. Soc. 33:542-545.
3. Dirr, M.A. and C.W. Heuser, Jr. 1987. The Reference Manual of Woody Plant Propagation. Varsity Press, Inc. Athens, Georgia.
4. Hartmann, H.T., D.E. Kester, F.T. Davies, Jr., and R.L. Geneve. 2011. Hartmann & Kester's Plant Propagation: Principles and Practices, 8th ed. Prentice Hall, Boston, Massachusetts.
5. Knight, P.R., J.M. Anderson, W. McLaurin and C. Coker. 2006. Crape myrtle evaluations in south Mississippi. HortScience 41:512 (abstr.).
6. Pooler, M.R. 2006. 'Arapaho' and 'Cheyenne' *Lagerstroemia.* HortScience 41:855-856.
7. Wade, G.L. and J.W. Woodward. 2001. Crape Myrtle Culture. Georgia Coop. Ext. Serv. Leaflet 331.
8. Wilson, J., A. Henn, and B. Layton. 2018. Crapemyrtle: Flower of the South. Publication P2007, Mississippi State University Extension Service, Mississippi State, MS

Table 1. Summary of results using selected treatment combinations on rooting percentage, root number, average length of three longest roots, root quality, cutting quality, and growth of softwood and semi-hardwood cuttings of Shumaka™ crape myrtle.

Treatment	Rooting (%)	Roots (no.)	Avg. length of 3 longest roots (cm)	Root quality rating[y]	Cutting quality rating[x]	Growth index[w]
Stem Pos. 1 control	80	7.3	9.7	2.4	1.7	7.6
Stem Pos. 1 Dip'N Grow® 500 ppm	100	3.2	8.3	1.5	0.6	3.9
Stem Pos. 1 Dip'N Grow® 1000 ppm	20	9.0	9.2	1.6	1.1	4.8
Stem Pos. 1 Hortus IBA™ 500 ppm	40	11.0	12.8	2.4	1.4	7.2
Stem Pos. 1 Hortus IBA™ 1000 ppm	100	7.2	11.6	2.4	1.3	5.7
Stem Pos. 2 control	80	5.0	12.0	2.5	1.6	7.4
Stem Pos. 2 Dip'N Grow® 500 ppm	100	2.6	10.9	2.5	1.5	5.6
Stem Pos. 2 Dip'N Grow® 1000 ppm	80	5.0	13.5	2.3	0.8	3.1
Stem Pos. 2 Hortus IBA™ 500 ppm	100	4.2	10.2	2.2	0.7	4.2
Stem Pos. 2 Hortus IBA™ 1000 ppm	100	4.0	10.5	2.4	0.7	3.9
Stem Pos. 3 control	100	3.6	9.8	2.5	1.4	5.6
Stem Pos. 3 Dip'N Grow® 500 ppm	80	6.3	8.8	2.2	0.6	3.4
Stem Pos. 3 Dip'N Grow® 1000 ppm	100	6.4	13.6	2.5	0.3	2.4
Stem Pos. 3 Hortus IBA™500 ppm	80	6.5	11.4	2.3	1.8	5.8
Stem Pos. 3 Hortus IBA™1000 ppm	80	5.5	12.5	2.1	1.3	4.8
Stem Pos. 4 control	100	2.2	12.1	1.8	0.8	4.0
Stem Pos. 4 Dip'N Grow® 500 ppm	60	7.0	13.3	4.2	0.2	2.2
Stem Pos. 4 Dip'N Grow® 1000 ppm	80	7.3	7.1	2.4	0.0	2.1
Stem Pos. 4 Hortus IBA™500 ppm	100	2.2	7.7	2.3	1.5	4.8
Stem Pos. 4 Hortus IBA™1000 ppm	100	1.8	11.0	2.2	1.2	3.5
Significance (F-test p-value)	0.6604	0.0414*	0.6006	0.8504	0.6729	0.0668

[y]Root quality (0-5, with 0=no roots and 5=healthy, vigorous root system).
[x]Cutting quality (0-5, with 0=dead and 5=transplant ready cutting).
[w]Growth index=(width1+width2+height)/3.
*Although the F-test p-value for root no. was < 0.05, p-values were ≥ 0.05 for all treatment comparisons of interest (adjusted for simultaneous comparisons).

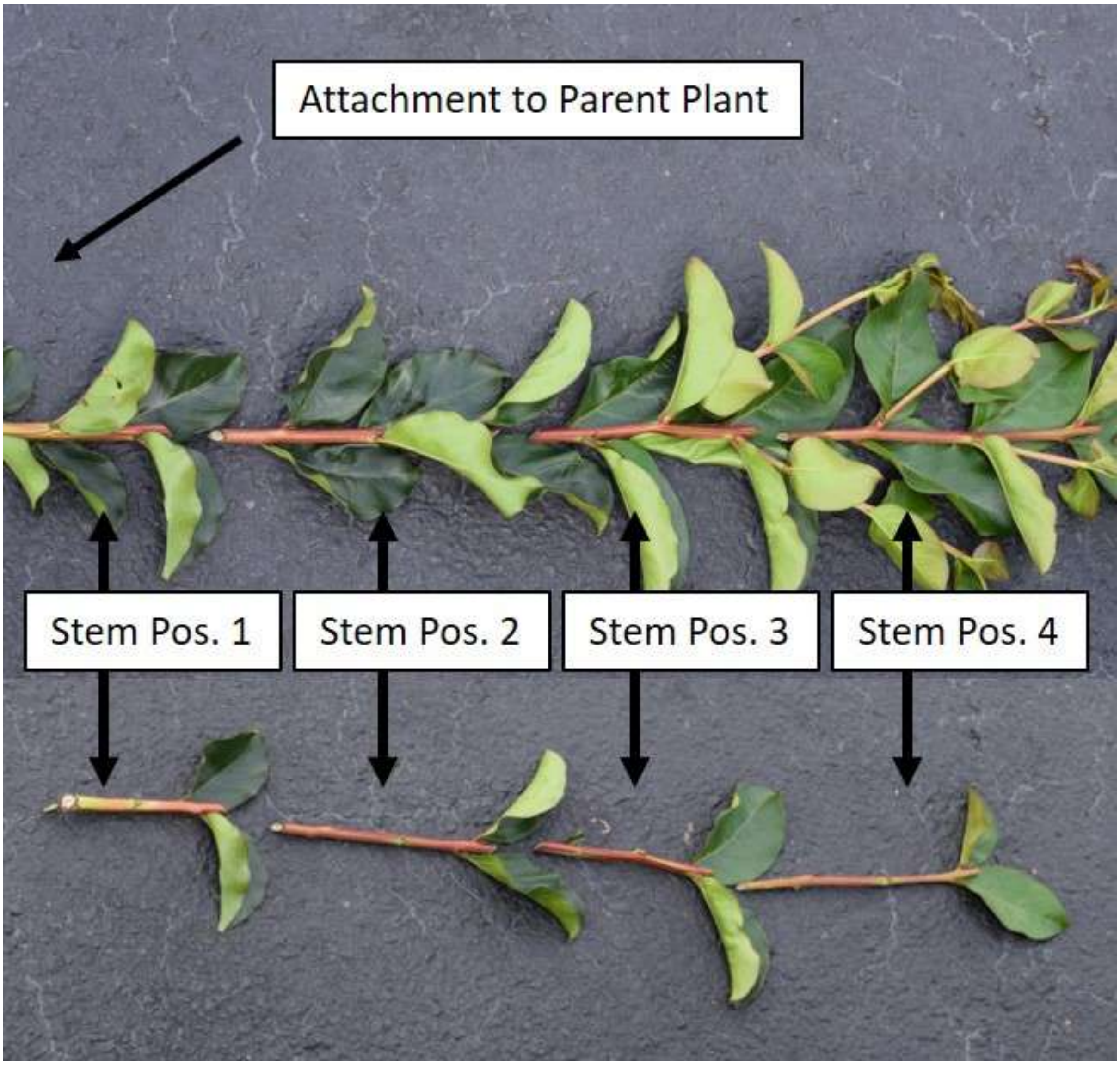

Figure 1. Location of stem positions along branch used for Shumaka™ crape myrtle softwood and semi-hardwood cuttings.

Using a Modified Hydroponic System for Cutting Stock Plants

Robert L. Geneve and Sharon T. Kester

University of Kentucky, Department of Horticulture, Lexington, KY 40546

rgeneve@uky.edu

Index Words Minicuttings, eastern redbud, *Cercis canadensis*, propagation

Significance to Industry Budding and micropropagation are the typical clonal propagation methods for difficult-to-root nursery crops. These methods can be more time consuming and expensive that cutting propagation. The forestry industry has adopted a commercially viable hydroponic stock plant strategy for difficult-to-root species that emphasizes plant nutrition and juvenility to establish cuttings that root at high percentages. A similar system could be established for difficult-to-root nursery crops.

Nature of Work Cutting propagation is a major propagation method for the nursery industry, but there is very little stock plant management compared with the floriculture and forestry industries. Stock management of many herbaceous annual and perennials plants for cutting production has become a very specialized practice with significant production occurring outside the U.S. Its stock plant management is characterized by starting with initially clean disease-free clonal material that is produced in containers under strict nutritional management. For woody plants, a selected number of deciduous forestry trees have been clonally propagated by selecting juvenile starting material for stock plants and then managing stock plants using a modified hydroponic system to optimize stock plant nutrition.

The forestry industry has moved into commercial clonal production for several difficult-to-root crop species including *Eucalyptus* and some conifers (Assis, 2011; Chinnaraj and Malimuthu, 2011). The industry has been very successful with this approach, propagating large quantities of rooted cuttings for planting-out each year. There are three basic stock plant management principles that have allowed for consistent (>90%) cutting success. These include initial selection of juvenile material (stump sprouts, lignotubers or tissue culture), managed stock plant nutrition using a modified hydroponic system, and consistent, timely removal of cuttings to keep cutting wood from maturing. This procedure has been termed “minicuttings” and they result in vigorous rooted cuttings that have better root systems compared to traditional cuttings (Cliffe, 2010). These stock plants produce vigorous managed shoot growth that yield cuttings that consistently root when taken as minicuttings.

The objective of this research was to develop a modified hydroponic system for minicutting production using eastern redbud as a model system. Eastern redbud makes a good model system because in addition to juvenile seedlings, eastern redbud cultivars available from tissue culture present a good juvenile stage starting material for a minicutting stock plant program. In addition, although eastern redbud is difficult-to-root from cuttings, it does show rooting potential during a brief window of time during the growing season.

Plant material: Juvenile eastern redbud (*Cercis canadensis*) plants were raised as seedlings. Mature clones were established as hedged stock blocks at the University of Kentucky research station.

Stock plant production system: Stock plant production systems were established for minicutting production in sand beds and coir bags. Each were irrigated with a modified hydroponic nutrient solution using an automated timing system. Initial experiments compared full-strength with half-strength nutrient solution for stock plant growth. In addition, clonal plants purchased as grafted material were established in hedged stock blocks in field beds. Stock plants were pruned every three weeks two three nodes.
Cutting propagation: Terminal cuttings were rooted under mist. Cuttings were treated with IBA concentrations ranging from 0 to 15,000 ppm as a quick dip. Cuttings were evaluated for rooting percentage, number of roots per cutting.

Results and Discussion Stock plants grow vigorously in the modified hydroponic sand beds. It was determined that plants responded equally well when irrigated at full or half-strength nutrient solutions (Fig. 2). Subsequently, all sand beds were moved to half-strength fertilizer solutions. Stock plants in sand beds have gone through serial rounds of pruning and entering the second year of production, cuttings have been available every three weeks.

A dose response to auxin using seedlings or clonal cuttings from hedged stock plants indicated that cuttings responded to 10,000 and 15,000 ppm auxin as a quick dip. Rooting was very similar for cuttings taken from greenhouse and field-grown stock plants (Fig. 3). Seedling and rootstock cuttings were easier to root compared to cuttings from clonal plants. The highest rooting for clones was below 30%. Also, ‘Oklahoma’ cuttings consistently rooted at lower percentages than ‘Appalachian Red’.

Cutting wood maturity appears to be important for rooting in redbud cuttings. Cuttings taken as short minicuttings did not root as well as those with hardened wood. In the minicutting stage, leaves are very sensitive to desiccation injury. This contrasts with work reported for *Eucalyptus*, where minicuttings rooted better than conventional size cuttings. Continued research will evaluate whether this is a physiological rooting response or sensitivity of redbud minicuttings to the rooting environment.

Acknolegements
This research is supported by a grant from the Horticultural Research Institute and International Plant Propagator’s Society – Eastern Region.

Literature cited

Assis, T.F. 2011. Hybrids and mini-cuttings: a powerful combination that has revolutionized the *Eucalyptus* clonal forestry industry. BMC Proc. 5: I18.

Chinnaraj, S. and C. Malimuthu. 2011. Development of micro-propagation and mini cutting protocol for fast growing *Melia*, *Dalbergia* and *Eucalyptus* clones for pulpwood and bio-energy plantations. BMC Proc. 5: P131.

Cliffe, D. 2010. Growing plants hydroponically for cutting production. Comb. Proc. Intern. Plant Prop. Soc. 60:312-315.

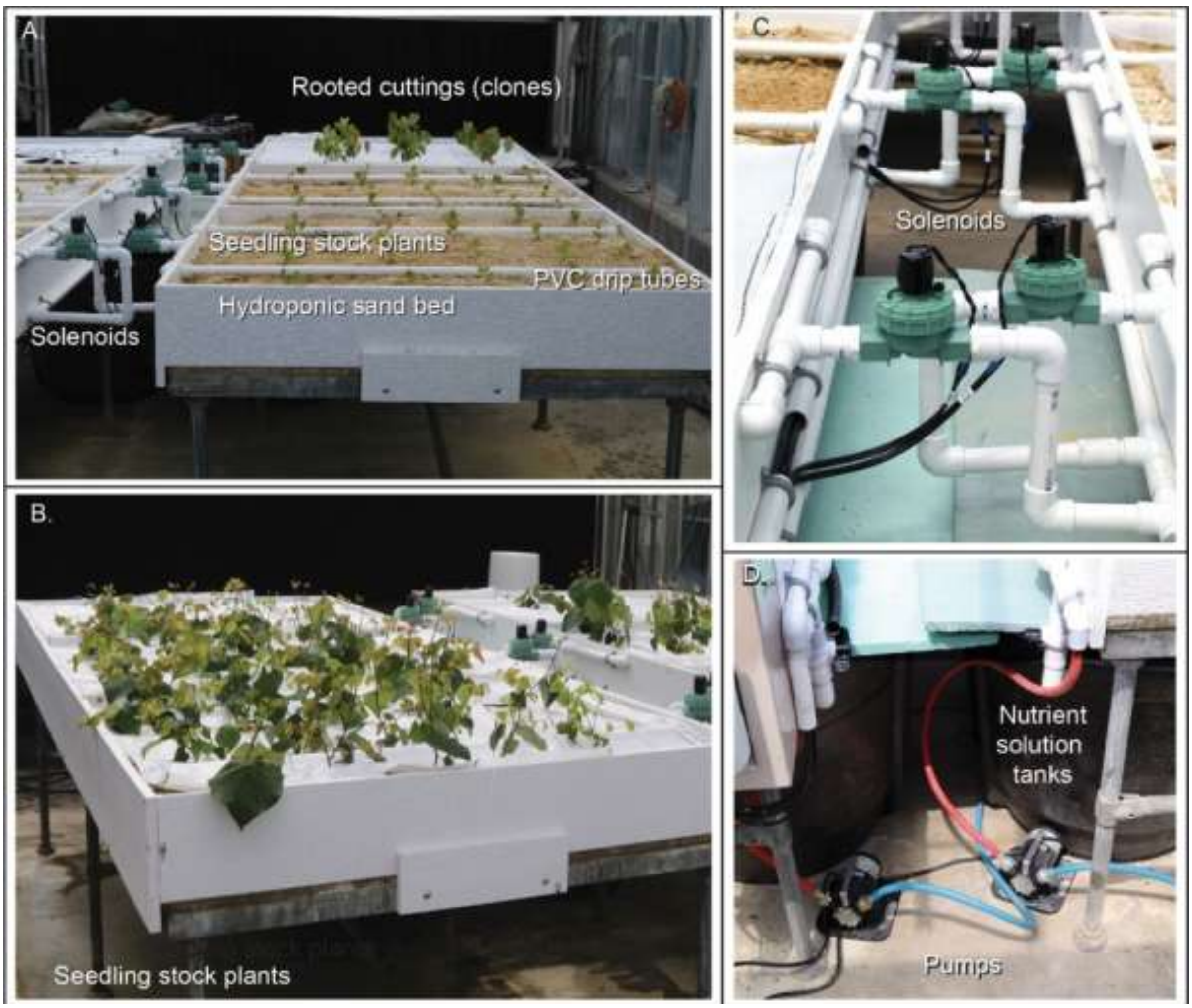

Figure 1. Sand bed production of stock plants. (A) Sand bed. (B) Stock plants after several rounds of hedging. (C and D) System for pumping nutrient solution to sand beds.

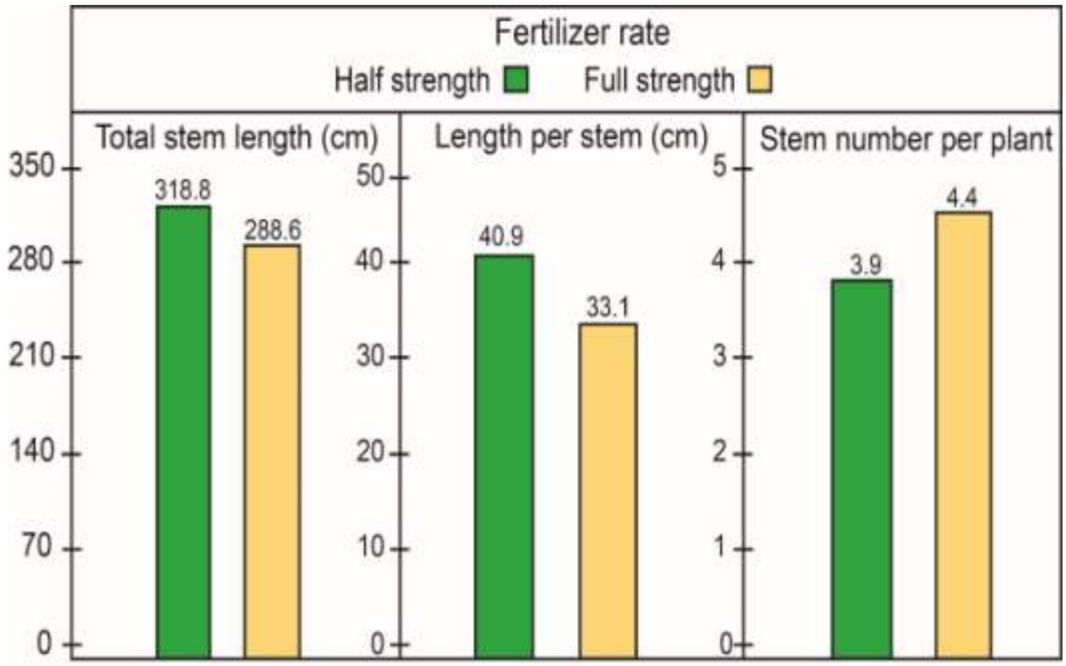

Figure 2. Impact on nutrient solution rate on greenhouse-grown stock plant development.

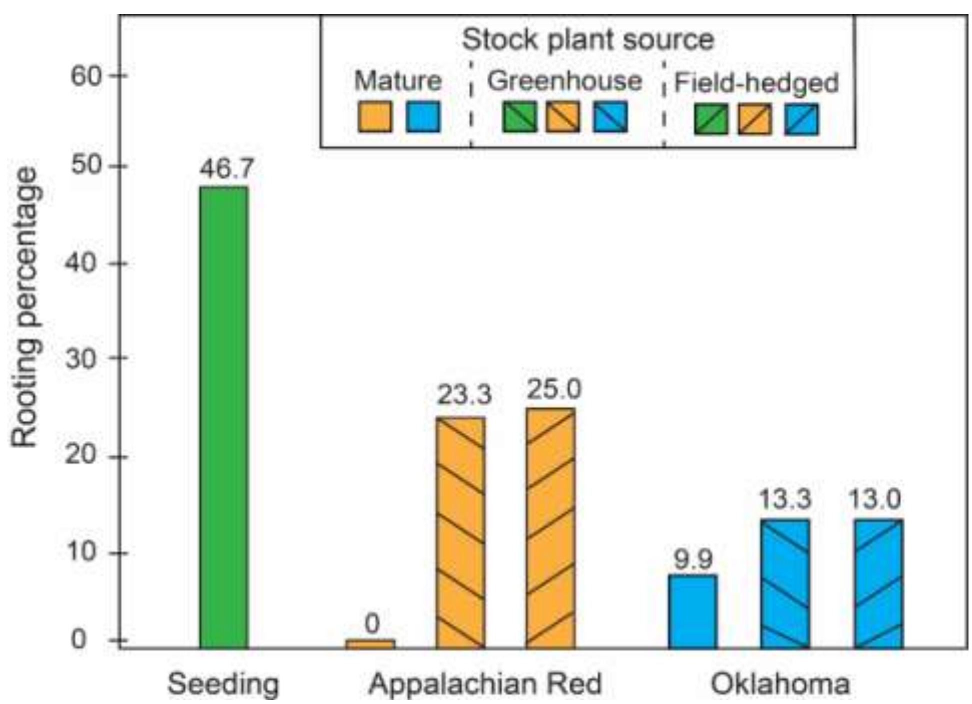

Figure 3. Rooting percentages for seedling and clonal redbud cuttings taken greenhouse or field-managed stock plant plants.

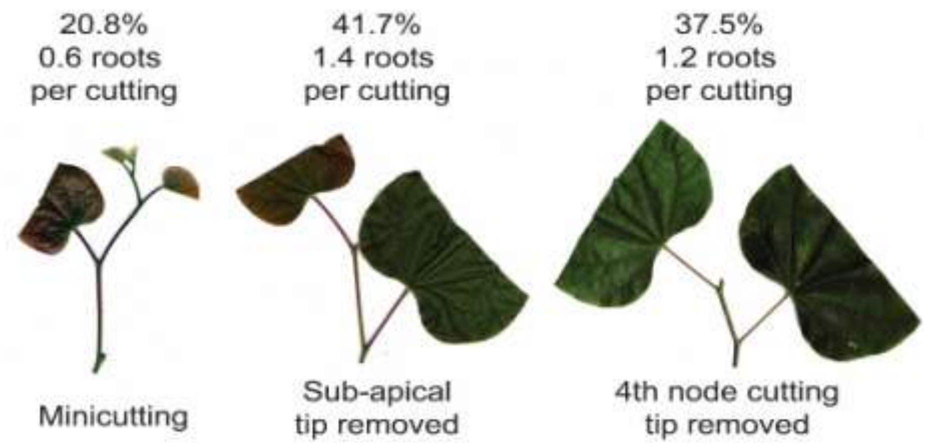

Figure 4. The impact of terminal minicuttings compared to older nodal cuttings.

Plantlet Morphology and Fertilization Frequency Affect Growth and Productivity of Micropropagated *Turbinicarpus saueri* ssp. *ysabelae* (Schlange) (Cactaceae) after Transplanting

Andrés Adolfo Estrada-Luna[1,2]

[1]CINVESTAV-IPN. Km. 9.6, Libramiento Norte, Carretera Irapuato-León. Irapuato, Gto. México. C.P. 36821
[2]Escuela de Agronomía. Universidad De La Salle Bajío. Av. Universidad 602 Col. Lomas del Campestre. León, Gto., México. C.P. 37150

andres.estrada@cinvestav.mx

Index Words *Turbinicarpus*, tissue culture, *in vitro* propagation, massive propagation.

Significance to Industry *Turbinicarpus saueri* ssp. *ysabelae* (Schlange) is a threatened cactus native to Mexico (1, 2). It is highly appreciated by collectors as ornamental plant. However, little information is available in regarding to the biology of the plant including reproductive aspects, culture conditions, fertilization, life cycle, etc., which limits its cultivation (1, 3). After establishing a micropropagation protocol, we conducted this research in which the main objective was to study the effects of fertilization and variations in plant morphology –promoted by fasciation during *in vitro* culture– on plant survival, growth and performance after transplanting and acclimatization. At the same time, we extended our study to investigate the time until the plants reach maturation to evaluate productivity. The information reported here may benefit the nursery and ornamental industry because we completed both a micropropagation stage and the *ex vitro* cultivation and management of this species. This may contribute to re-introduce and recover wild populations or for massive commercial purposes. In general, we found that *T. saueri* ssp. *ysabelae* completed their life cycle after 4 years of plantlet transfer from *in vitro* conditions to greenhouse. Plants positively responded to fertilization. Typically, this species shows a monopodial growth, however, through this protocol it is possible to produce plants with multiple shoots, which may be an attractive ornamental trait.

Nature of Work In a previous research, we established a micropropagation protocol for *T. saueri* ssp. *ysabelae* (Schlange) (4). For the acclimatization stage, we ran a factorial experiment with a randomized design to assess the effects of the type of plantlet regenerated (morphology levels: monopodial and multiple shoot plantlets) and the frequency of fertilization (levels: once a month and once a week) on plant growth and productivity. A total of 4 experimental treatments were evaluated. Plant fertilization was performed with the Long Ashton Nutrient Solution (5). For the first year, all plants were fertilized with 50mL of the nutrient solution (pH adjusted to 5.8). To set up the trial, 60 micropropagated plantlets with well-developed roots were selected for transplanting (n= 15 plantlets). Plantlets were carefully removed from the *in vitro* culture containers, and the roots were washed with distilled water to eliminate agar residues. Plantlets were individually transferred to 2” plastic pots containing an artificial sterile substrate composed by Peat Moss (PREMIER®), coarse sand, and organic fertilizer (supplemented with plant growth promoting rhizobacteria, OrganoDel®) (3:3:1), and was amended with dolomite (0.77 %) to adjust the pH at 6.8 ± 2. For plantlet acclimatization, each pot was covered with a transparent polyethylene bag to create high relative humidity conditions. Acclimatization took place in a greenhouse, in a propagation bed covered with shade cloth to provide 400 µmol m^{-2} s^{-1} of PPFD for the first 15 days. Then, the bags were gradually perforated with a punch machine to produce small holes in the bag and allow air exchange and reduce the relative humidity. After one month of transplanting, the bags were removed from the pots and the light conditions were increased to 800 µmol m^{-2} s^{-1} of PPFD by changing the shade cloth. Plantlets were irrigated with distilled water as needed to avoid dehydration and stressful conditions.

After 12 months of cultivation we determined the percentage of survival and the plants were transferred to 2 L capacity pots, which were filled with the same substrate. From this time on, 100 mL of the nutrient solution per pot was applied for fertilization. The experiment was extended for three more years (4 in total) until the plants matured, bloomed and produced fruits and seeds. The experimental variables evaluated during this stage included plant diameter, plant height, fruits per plant, and number of seeds per fruit and seeds weight per fruit.

Results and Discussion After transplanting to *ex vitro*, acclimatization and one year of greenhouse culture conditions the survival rate of the micropropagated plants was high and no statistical differences were detected among treatments by the ANOVA. The life cycle of micropropagated plantlets of *T. saueri* spp. *ysabelae* was completed 4 years after transplanting, blooming and fruit set were recorded in all treatments. In regarding to plant growth, the ANOVA detected significance in the interaction in data of plant height and diameter, however, it was clear that the monopodial plantlets reached considerable higher height than the plantlets with multiple shoots morphology. In contrast to this, plants with abnormal morphology had considerable higher diameter as the ones with normal morphology. Fertilization had the higher impact in plant growth since both height and diameter increased with more frequent fertilization (Table 1).
In regarding to fruit and seed yields, the ANOVAs resulted significant for fertilization rate in all the three experimental variables evaluated including number of fruits, number of seeds per fruit and the seed weight (mg) per fruit. In addition to this, the plant morphology was also significant for number of fruits. Our study showed that the fruit number per plant was significantly enhanced by the weekly fertilization (46.7) in comparison to the monthly fertilization treatment (34.2). Additionally, plants with multiple shoot morphology were also more productive (14.0) than the ones showing monopodial growth (6.33). The seed number per fruit and the seeds weight per fruit were significantly increased by the higher fertilization rate in monopodial (76.3 and 47.10mg) and multiple shoot plantlets (74.6 and 46.20mg) in comparison to the low fertilization rate treatment (Table 2).

Acknowledgements Authors want to thank the Research Center of Advances Studies of the National Polytechnic Institute (CINVESTAV-IPN).

Literature Cited

1. Gómez-Sánchez A. 2006. Enciclopedia Ilustrada de los Cactos y Otras Suculentas (Descripción de las Especies, Hábitat y Cuidados de Cultivo). Volumen II. Editorial Mundi-Prensa, España. 151 pp.
2. Norma Oficial Mexicana (NOM-059-SEMARNAT-2010). Diario Oficial de la Federación. Órgano del Gobierno Constitucional de los Estados Unidos Mexicanos. México, D. F. jueves 30 de diciembre de 2010.
3. Pilbeam J. and B. Weightman 2006. Ariocarpus et cetera: The special, smaller genera of Mexican cacti. British Cactus and Succulent Society. Norwich, UK. 98-137 pp.
4. Arellano-Perusquía AA and A.A. Estrada-Luna 2014. Morphogenetic Responses Induced by Cytokinins During Micropropagation of *Turbinicarpus ysabelae* (Werderm.) John & Riha. Proceedings of the SNA Research Conference, 59: 247-253.
5. Hewitt EJ. 1966. Sand and water culture methods used in the study of plant nutrition. Technical Communication No. 22, Commonwealth Agricultural Bureaux, Farnham Royal, UK.

Table 1. Effect of fertilization frequency and plant morphology on growth of micropropagated plantlets of *Turbinicarpus saueri* ssp. *ysabelae* (Schlange) (Cactaceae) after 4 years of *ex vitro* transplanting.

Fertilization Frequency	Plant Morphology	Plant Survival (%)	Plant Height (mm)	Plant Diameter (mm)
LoFe $^{+}$	MoMo •	95 ± 5	58.45 ± 0.63	71.99 ± 1,27
LoFe °	MSMo ▪	95 ± 5	31.09 ± 0.38	97.14 ± 0.49
HiFe	MoMo	100 ± 0	105.86 ± 1.22	103.87 ± 1.36
HiFe	MSMo	100 ± 0	89.46 ± 1.92	209.74 ± 4.61
Significance:				
Fertilization (Fe)		NS ⊕	***	***
Plant Morphology (PlMo)		NS	***	***
Fe X Plo		NS	***	***

$^{+}$LoFe: Low Fertilization Frequency
°HiFe: High Fertilization Frequency
•MoMo= Plantlet with Monopodial Morphology
▪MSMo= Plantlet with Multiple Shoot Morphology
⊕ NS= Non significant
*= Significant (0.05)
**= Significant (0.01)
***= Significant (0.001) n=20

Table 2. Effect of fertilization fequency and plant morphology on productivity of micropropagated plants of *Turbinicarpus saueri* ssp. *ysabelae* (Schlange) (Cactaceae) after 4 years of *ex vitro* transplantation.

Fertilization Frequency	Plant morphology	Fruit Number/Plant	Seed Number/Fruit	Seed Weight per Fruit (mg)	Seed Weight(mg)
LoFe [+]	MoMo •	5.00 ± 0.57	52.2 ± 3.66	32.70 ± 3.16	0.63 ± 0.02
LoFe °	MSMo ▪	11.00 ± 1.15	54.2 ± 0.73	35.70 ± 1.12	0.66 ± 0.01
HiFe	MoMo	7.67 ± 0.88	76.3 ± 4.06	47.10 ± 1.79	0.62 ± 0.02
HiFe	MSMo	17.00 ± 1.15	74.6 ± 2.71	46.20 ± 2.09	0.62 ± 0.02
Significance:					
Fertilization (Fe)		***	***	***	NS
Plant Morphology (PlMo)		***	NS	NS	NS
Fe X Plo		NS ⊕	NS	NS	NS

[+]LoFe: Low Fertilization regime

°HiFe: High Fertilization regime

•NoMo= Plant with normal monopodic morphology

▪AbMo= Plant with abnormal multiple shoot morphology

⊕ NS= Non significant

*= Significant (0.05)

**= Significant (0.01)

***= Significant (0.001) n=20