Top Ten Points of Plant Propagation

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INTRODUCTION

Plants, like everything else, require energy. However, plants are self-sufficient and their energy comes from the complex process of photosynthesis which produces carbohydrates. Just as an automobile cannot run without energy from gasoline, neither can a plant "run" unless the energy products produced by photosynthesis are present to support cell division needed to initiate and develop plant parts. Anything we can do as plant propagators and producers, to assist in the energy and related hormonal output of the leaves and buds, helps improve the physiological condition of plant tissues, which is important for rooting of cuttings and subsequent liner plant growth.

Many things have changed since I stuck my first grape cuttings over 40 years ago. I have had the opportunity of instigating, testing, and/or refining many of the newer procedures. The following 10 points are a reminder of important factors involved in plant propagation.

TEN BASIC FACTORS

1) Increased Light Intensity Generally Improves Rooting, Plant Growth, and Minimizes Production Problems. Cell division requires energy; the more energy, the more rapid root growth occurs. The leaves of cuttings will also make the transition from higher light during propagation to full sun with less stress (Hall and Whitcomb, 1974; Whitcomb, 1978; Whitcomb, 1984). By creating an environment with high light intensity and moderate temperatures, I was able to root, for the first time, cuttings of redbud (*Cercis canadensis*) and sugar maple (*Acer saccharum*) (Whitcomb, 1997).

2) Adding Modest Levels of Slow-release Nutrients during Propagation Aids Root Development and Subsequent Liner Plant Growth. As soon as a new root starts to emerge from the base of the cutting, it can absorb nutrients to support leaf functions and energy production via photosynthesis. With some species, growth of the rooted liner is enhanced by slow-release fertilizers (Carney and Whitcomb, 1983; Diver and Whitcomb, 1981; Hathaway and Whitcomb, 1977; Murray and Whitcomb, 1973; Whitcomb et al., 1978). With others species, both rooting percent and subsequent root growth is improved. My first study of this procedure was in 1970. The response of cuttings to slow-release fertilization was especially dramatic, since the general nutritional conditions of the parent plants were poor, relative to today's recommended nutritional levels (Whitcomb, 1978). It took many years before this practice become standard among many propagators. This is but one more benefit from modern slow-release fertilizers.

3) Direct Sticking of Cuttings Helps Improve Performance and Reduce Transplanting. Direct sticking (direct rooting) cuttings into smaller liner pots helps eliminate root loss and minimize shock at transplanting. Direct sticking reduces the number of plants produced per square foot compared to the propagation of multi-cuttings in community rooting flats (trays). However, the yield of good quality cuttings with better performance after transplanting is generally much higher per square foot (Bean and Whitcomb, 1973; Bisher and Whitcomb, 1975; Hickman et al.,1982). My first experiments into this began in 1969. Benefits were modest during the early years, but when combined with other factors noted in this paper, the benefits soared.

A major problem with direct sticking still exists today. Many nurserymen fail to move the rooted cuttings from the smaller liner containers in a timely fashion. The "root-bound" problem of overgrown liner plants can be severe and can stress the plant during production and later transplanting into a landscape site (Bean and Whitcomb, 1975; Bowlin and Whitcomb, 1980; Richards and Whitcomb, 1980; Threadgill and Whitcomb, 1982; Threadgill et al., 1985; Whitcomb, 1974; Whitcomb, 1978). The production focus should be on shifting the rooted liner as quickly as possible into a larger container, not how long the rooted cutting can be held in propagation.

4) Proper Care and Nutrition of the Stock/Mother Plants Plays a Big Role in Cutting Success. The physiological conditions inside the cutting can be enhanced by proper nutrition. Excess nitrogen, proportionate to other nutrients, can suppress rooting as tissues are succulent with lower energy reserves. On the other hand, the more ideal the synchronization of all essential nutrient elements, the greater stored energy levels and the greater the natural branching and growth of the resulting young liner plant (Davis and Whitcomb, 1975; Hickman et al., 1982; Ward and Whitcomb, 1979; Whitcomb, 1973; Whitcomb, 1977; Whitcomb, 1978; Whitcomb, 1981; Whitcomb et al., 1981; Whitcomb, 1992).

5) Rooting with Softwood Cuttings, Rather than Semihardwood or Hardwood Cuttings Often Improves Plant Performance. As mist systems, timers, and management of plant nutrition have improved, the success with propagating softwood cuttings has increased (Bisher and Whitcomb, 1975; Glenn et al., 1976; Hall and Whitcomb, 1974; Murray and Whitcomb, 1973; Whitcomb and Davis, 1970; Whitcomb, 1983; Whitcomb, 1985). With softwood cuttings, rooting hormones are being produced naturally by the growing tip and generally exogenous auxins are not needed, or are applied in lower concentrations (Glenn et al., 1976). When the optimum combination of rooting environment and tissue condition occurs, the cutting can root with less stress and without a reduction in the growth of the terminal bud (Hickman et al., 1982; Whitcomb, 1975; Whitcomb, 1977; Whitcomb, 1984). The result is a vigorous plant with natural branching and reduced need for pruning or training. As an example, for years crapemyrtle (*Lagerstroemia indica*) was propagated from hardwood cuttings taken in winter. The resulting plants would struggle to fill a 1-gal container during a growing season. Today, softwood cuttings taken in late May yield full plants in 1-gal containers by early September (Whitcomb, 1978).

6) Deeper Pots Allow for Better Drainage. There is always a saturated zone in the bottom of a container. Because of the textural difference between the propagation medium and the open drain hole, a perched water table occurs and some water is always retained against gravity at the bottom, even with a very porous mix. If the base of the cutting is in or near the saturated zone where anaerobic conditions can occur, the likelihood of rooting is low and incidence of root rot diseases is high

(Whitcomb, 1978). Pots only slightly deeper reduce this problem (Bisher and Whitcomb, 1975; Bowlin and Whitcomb, 1980; Hathaway and Whitcomb, 1977; Threadgill and Whitcomb, 1982; Threadgill et al., 1985; Whitcomb, 1974).

It has been known for many years that oxygen/aeration in the medium is necessary for rooting. Experiences over many years has lead me to conclude that the amount of oxygen/aeration necessary for root initiation is much higher than for normal root function of the same plant at a later stage of development (Whitcomb 1978). This knowledge applies not only to the rooting of cuttings but to transplant success in many landscape settings with poor soil aeration, especially with B&B and bareroot stock.

7) Water Chemistry Affects Rooting. The purer the water, the better it is for mist propagation. Minerals dissolved in the water used for intermittent mist accumulate on leaf, stem, and bud surfaces with each mist cycle (Whitcomb, 1978). Minerals also accumulate in the rooting medium. For years I heard nurserymen relate problems of propagation. One would have a problem with species X, but not Y, while another would have problems with species Y, but not X. Eventually these comments led to a study where cuttings were taken from a large block of stock plants and divided and transported to four locations with different water sources, where water was the main variable. The cuttings did root differently at the different sites. This led to a series of studies on how water chemistry affects plants (Whitcomb, 1985; Whitcomb, 1988; Whitcomb 1991).

8) Timing — The Perpetual Challenge of When to Take Cuttings. Conditions in plant tissues can change rapidly with physiological development and fluctuating environmental conditions (Davis and Whitcomb, 1975; Hall and Whitcomb, 1974: Hathaway and Whitcomb, 1977; Hickman et al., 1982; Whitcomb, 1977; Whitcomb, 1997). For example: lilacs (*Syringa*) and several tree species have a very narrow window where cuttings root quickly and with high success. Cuttings taken earlier or later may not root at all. Environmental conditions can also change abruptly. For example, in North Central Oklahoma in May 1998, temperatures went abruptly from 21C (70F) highs to 35C (95F), with little rain for the remainder of the summer. This caused tissues to acclimatize and harden quickly, plus the conditions within the propagation environment became much less favorable for rooting. As a result, propagation success for cuttings taken after mid-May 1998 was much lower than for 1997. Crapemyrtle are generally considered as easy to root from cuttings. However, once the heat triggered plants to flower, rooting slowed, overall rooting success declined, and the growth of any resulting liner plants decreased (Whitcomb, 1978).

9) Air pruning of roots of cuttings is beneficial. Containers designed for air pruning allows root manipulation and increased root branching without open wounds or abrupt loss of roots. As roots are guided into openings, the tip of the root desiccates and eventually dies. When a root apex is air-pruned, more lateral branching occurs just as when a twig or branch is pruned (Hathaway and Whitcomb, 1977; Threadgill and Whitcomb, 1982; Whitcomb and Williams, 1984; Whitcomb, 1989). This benefit may be in part due to a more extensive lateral root system and the greater nutrient absorption capacity of younger roots (Shiyu et al., 1998). In some cases, air pruning and perhaps improved aeration have led to significant improvement in overall rooting. The yield of useful Leyland cypress liners was 15% higher in the air-root-pruning RootMaker® container compared to the conventional containers during a 2-year growing season study in Alabama (Tilt 1998, pers. commun.).

10) Rooting Hormones—A Mixed Bag: Sometimes Helpful, Sometimes Not Needed. In general, the softer the tissue, the less auxins are needed (Whitcomb, 1997). Semihardwood and hardwood cuttings have minimal terminal bud activity, thus adding a hormone generally aids rooting by speeding up the rooting process and improving root development. However, most softwood cuttings benefit little, if any, from the use of auxins because of the activity of the soft tissues and the natural production of auxins (Davis and Whitcomb, 1975; Glenn et al., 1976; Hickman et al., 1982; Ward and Whitcomb, 1979; Whitcomb, 1975; Whitcomb, 1978; Whitcomb, 1984). Remember — it is not how many cuttings you stick that is important, rather how many cuttings end up as useful plants and in the shortest production time.

LITERATURE CITED

Bean, R.R. and **C.E. Whitcomb.** 1975. Effects of single or multiple cuttings per container and fertilizer levels on appearance, production time, and landscape performance of woody ornamentals. Okl. St. U. Ag. Exp. Sta. Rpt. P-724:33-36.

Bisher, M. and **C.E. Whitcomb.** 1975. Response of woody ornamental liners to fertilization, propagation pot size, and holding time. Florida Nurseryman 9(27):9,10.

Bowlin, B.F. and **C.E. Whitcomb.** 1980. Effects of container size during propagation on rooting and subsequent growth of tam junipers. Okla. St. U. Ag. Exp. Sta.. Rpt. P-803:65-67

Carney, M. and **C.E. Whitcomb.** 1983. Effects of two slow-release fertilizers on the propagation and subsequent growth of three woody plants. J. Environ. Hort. 1:55-58.

Davis, R.E. and **C.E. Whitcomb.** 1975. Rooting cuttings of crimson pygmy barberry. Okla. St. U. Ag. Exp. Sta. Rpt. P-724:46-47.

Diver, S. and **C.E. Whitcomb.** 1981. Effects of dolomite, Micromax, and propagation medium on the rooting and subsequent growth of pyracantha and juniper. Okla. St. U. Ag. Exp. Sta. Rpt. P-818:21-23.

Glenn, R., C. Hagan, and **C.E. Whitcomb.** 1976. Effects of Osmocote in the rooting medium and auxin levels on rooting and subsequent growth of cuttings. Florida Nurseryman. 21(3):30,40.

Hall, G.C. and **C.E. Whitcomb.** 1974. Rooting of juniper cuttings utilizing antitranspirants as a replacement for mist. Okla. St. U. Ag. Exp. Sta. Report P-704:44-46.

Hathaway, R.D. and **C.E. Whitcomb.** 1977. Propagation of grapes in containers. Okla. St. U. Ag. Exp. Sta. Rpt. P-760:36-37.

Hickman, G., B. Appleton, and **C.E. Whitcomb.** 1982. Vegetative propagation and evaluation of five *Ulmus parvifolia* selections. Okla. St. U. Ag. Exp. Sta. Rpt. P-829:16-18.

Murray, D.P. and **C.E. Whitcomb.** 1973. Maximizing rooting of bottlebrush cuttings. Florida Nurseryman.18:13, 35.

Richards, D. and **C.E. Whitcomb.** 1980. Effects of nutrition during propagation and date of planting out on quality of nursery stock. Okla.. St. U. Ag. Exp. Sta. Rpt. P-803:42-45.

Shiyu, G., W. Ran, and **R. Koenig.** 1998. Integrated root system age in relation to plant nutrient uptake activity. Agron. J. 90:505-510.

Threadgill, C.C. and **C.E. Whitcomb.** 1982. Effects of container depth, diameter, and media on the rooting of cuttings. Okla. St. U. Ag. Exp. Rpt. P-829:31-33.

Threadgill, C.C., C.E. Whitcomb, and **R. McNew.** 1985. Effects of propagation container dimensions and media on growth of four nursery crops. J. Environ. Hort. 3:126-131.

Tilt, K. 1998. Dept. of Horticulture, Auburn Univ., Auburn, Al. 36849.

Ward, J.D. and **C.E. Whitcomb.** 1979. Nutrition of Japanese holly during propagation and production. J. Amer. Soc. Hort. Sci. 104:523-526.

Whitcomb, C.E. 1973. Nutritional management of juniper and holly stock plants in containers and field. Okla. St. U. Ag. Exp. Sta. Rpt. P-691:6-7.

Whitcomb, C.E. 1974. Effects of pot size on rooting of juniper cuttings. Am. Nurs. 139:15, 73-75.

Whitcomb, C.E. 1975. Asexual propagation of hybrid elms. Okla. Sta. U. Ag. Exp. Sta. Rpt. P-724:41-42.

Whitcomb, C.E. 1977. A solar greenhouse for propagation. Comb Proc. Intl. Plant Prop Soc. 27:394-397.

Whitcomb, C.E. 1978 Propagating Woody plants from cuttings. Okla. Ag. Exp. Sta. Tech Bulletin B-733. Okla. St. U., Stillwater, OK.

Whitcomb, C.E. 1980. The carryover effect from micronutrients in container production. Okla. St. Univ. Ag. Exp. Sta. Rpt. P-803:49-54.

Whitcomb, C.E. 1981. Effect of micronutrient nutrition during propagation on container plant production. Comb Proc. Intl. Plant Prop. Soc. 30:468-473.

Whitcomb, C.E. 1983. Rooting cuttings under a wet tent. Comb Proc. Intl. Plant Prop. Soc. 32:450-454.

Whitcomb, C.E. 1984. Propagating trees from cuttings. Proc. Southern Nurseryman Res. Conf. 19:200-201.

Whitcomb, C.E. 1985. A propagation technique for difficult to root species. Proc. Southern Nurseryman Res. Conf. 30:241-244.

Whitcomb, C.E. 1985. Water quality and plant production in containers. Comb Proc. Intl. Plant Prop. Soc. 35:672-677.

Whitcomb, C.E. 1988. Calcium, magnesium, and irrigation water. Comb Proc. Intl. Plant Prop. Soc. 38:425-529.

Whitcomb, C.E. 1989. Roots for the future. Comb Proc. Intl. Plant Prop. Soc. 39:170-174.

Whitcomb, C.E. 1991. Effects of water quality and water management on the growth of container nursery stock. Comb Proc. Intl. Plant Prop. Soc. 41:492-496.

Whitcomb, C.E. 1997. High light with moderated temperatures aids the rooting of softwood cuttings. Comb Proc. Intl. Plant Prop. Soc. 47:403-406.

Whitcomb, C.E. and **L.T. Davis, Jr.** 1970. Propagation of leafy cuttings without mist. Florida Nurseryman 15:7, 36.

Whitcomb, C.E., J. Gibson, and **A. Storjohann.** 1978. Effects of Osmocote in rooting media. Amer. Nurseryman 147(7):11, 66-68.

Whitcomb, C.E., A. Storjohann, and **W. Warde.** 1981. Micromax — micronutrients for improved plant growth. Comb Proc. Intl. Plant Prop. Soc. 30:462-467.

Whitcomb, C.E. and **J.D. Williams.** 1984. A container to stimulate root-branching. Proc. Southern Nurseryman Res. Conf. 29:34-35.