

it available. It forms a large majestic rounded tree at maturity and has this thick, heavy polished foliage, one of the most beautiful ever-green trees I have seen.

MR. HILL: In what zone will it grow?

MR. FLEMER: There is a lot at Greenbrier. They have quite a patch at Norfolk. That is Zone VII or VIII. I don't think it will take it to the National Arboretum. Do you know, Ray?

MR. RAY BRUSH: I would like to make a remark about this. Capitol University got hold of it somehow from the South about eight or ten years ago. At the present time we have a tree at the American Bureau College at Temple in Amhurst. It has gone through two winters. Although it loses its foliage, it sprouts out the following spring and grows.

MODERATOR ROLLER: Thank you, gentlemen, for a very interesting discussion.

The next subject on the program for this afternoon was to have been Propagation of *Kalmia* by Means of Seeds, but John Ravenstein is on a trek to Europe, so we are going to make up a little time right here and call on Jack Hill for a discussion of Propagation of *Juniperus chinensis* in the Greenhouse and Mist Bed.

MR. JOHN B. HILL: I can't let this opportunity go past after the discussion on oaks. A hybridist by the name of Samuel Hovenstein wrote in a spoofing way a little poem and concluded with his theory that oaks were noble and eternal as compared to the wreckage of man's transient nature with these words of counsel: "Before the world goes up in smoke, ladies, get yourself with oak."

Now to get into this subject of the propagation of the chinensis group.

## THE PROPAGATION OF JUNIPERUS CHINENSIS IN GREENHOUSE & MISTBED

JOHN B. HILL  
*D. Hill Nursery Company*  
*Dundee, Illinois*

As I approach this group of experienced and knowledgeable propagators, I wish it understood that I do so without any burden of vanity or overconfidence. The broad subject of propagating the various cultivars of *Juniperus chinensis* is, at once, so broad and widespread in its practical application that I feel it most useful to avoid frequent reference to the research of other workers and, rather, confine my remarks so that they apply to our experiences and observations made in Dundee. The published research is readily available to all.

Hasty examination of earliest records finds that there is reference to the rooting of *Juniperus chinensis* by cuttage in the Orient and England during the 18th century. Very little is said of the actual technique and equipment employed, but the strong inference in these

early reports indicate that even then the idea was considered neither novel nor new.

For the benefit of those in this audience who have not yet encountered the problems typical of rooting the "more difficult" varieties, most of the currently popular cultivars of *Juniperus chinensis* can be effectively reproduced by graftage without unusual difficulties. There is apparently a far greater variation in the willingness of this specie to root as cuttings, than to heal as a grafting scion. Since our operation is entirely commercial in nature, we tend to do very little "pure research," but always seek empirical and practical procedures for handling those varieties which are currently most desirable. Thus, emphasis and the best focused observations are always made relative to the varieties leading the sales list. A good example of the focus, to which I refer, can be found with the familiar cultivar — Sargent's Green Chinese Juniper. It is not difficult to recall a period some ten or fifteen years ago when this variety was nowhere near as popular as today and, therefore, since it was to be propagated in only small quantities, did not receive anything like the attention that it does today, relative to rooting percentages, quickness of rooting and all the other factors that enter into determining the commercial feasibility in a propagation project. We have made attempts in Dundee to correlate the apparent ease of rooting with some cultivars to the difficulties experienced with others on a basis of plant growth characteristics. It quickly becomes apparent that the typically multistemmed and low-growing forms root far more easily than do those displaying a distinct arborescent or tree-like growth habit. Thus, where there appears to be no commercial feasibility in attempting to root *Juniperus chinensis Iowa*, there can be no question at all about the ability of any good propagator to produce the familiar *Juniperus chinensis pfitzer*.

It might be interesting to trace for a moment the evolution of the propagational practices at D. Hill, since our records go back with accuracy to the early years of this century. The first efforts at rooting selections of *Juniperus chinensis* were made with a cold frame facility. In this type of operation, the cuttings were typically stuck in outdoor, glass-covered frame, just before growth commenced in the Spring. In our latitude, this would place the period of taking during the last week of April and the first two weeks in May. No record was made of experiments of various types of cuttings, but simply notes made of the varieties, quantities and time of making. The accepted procedure for that method of propagation was to insert the cuttings during the bracketing dates given above, and their removal from the cold frame was not scheduled until the next year: just before the bed was prepared to receive the next batch of cuttings. No record is given of the time when the first rooting became apparent, but it is inferred that these cuttings were kept under shaded glass, outdoors, for the entire period, with only very casual mention made of "arising and watering." These old records gained back from the years 1902-1910 reveal that percentages were not very good. . . . The record of *Juniperus chinensis procumbens* made in the year 1908 finds that 400



cuttings were inserted into the cold frame on July 14th, and the bed was covered tightly on December 6th, and the cuttings were found to be dead and disposed of on April 24th of the next year.

Percentages improved appreciably when fresh horse manure was included in these outside, glass-covered, rooting frames, for now they were actually hot beds. Records made between 1910 and 1916 frequently find that percentages in excess of 60% were enjoyed with *Juniperus chinensis procumbens* and another variety, simply listed as *Juniperus chinensis*. Time of taking, sticking and removal were all identical with the procedure described previously.

The first pair of actual propagation greenhouses were erected in Dundee in 1914, and the first efforts in rooting cuttings of the *Juniperus chinensis* species were made by "direct benching." This first two or three years were not very successful, and I suspect that these failures trace to the inability of the persons in charge to maintain adequate temperatures and humidities, thus the procedure was developed whereby cuttings were taken during the summer dormant period—late June to early July — and stuck in flats which were then placed in an outdoor hotbed over four to six inches of fresh manure. These flats, with the cuttings intact, were then brought into the greenhouse in the late fall, and actually rooted in the greenhouse itself. It is doubtful whether any rooting took place in the hotbed, but, except for the tremendous amounts of labor involved in moving these flats, this system offered considerable flexibility, in that individual flats of cuttings or even whole lots of cuttings in flats could be "reflatted" and thus the limited space in the greenhouses used to maximum advantage. As a usual thing, the cuttings that rooted over the first winter were "flatted off" sometime during the next growing season for subsequent culture in flats up to two or three years before they were bedded out in the Fall. This method of combining a hotbed pre-conditioned with a greenhouse was developed fully between 1917 and 1954.

During 1954-55 our method of handling Juniper cuttings was changed once more back to the direct-benching method. This was under the guidance of Mr. Jim Wells, and we are still following this direct-benching method on all but the so called "difficult varieties." At the present time, therefore, we are going direct from the field grown stock plants to the bench with most varieties in the early Fall of each year. Our present program has come to recognize the desirability of rapid handling on all varieties of *chinensis* and we, therefore, actually make the cuttings themselves right in the field, treat them with a chosen hormone, and have them in the greenhouse rooting bench in well under 30 minutes. We try never to let batches of these cuttings accumulate for there seems to be a rather strong correlation between total percentage of rooting and rapid handling.

The method which we are using on those varieties considered to be more difficult to root, and I will use *Juniperus chinensis Maney* as an example, calls for taking short, tip cuttings in late July and "pre-conditioning" in an outdoor mist bed for 8 to 10 weeks. Although this method produces problems in handling, it does appear to

enable rooting percentages that are sufficiently high to render the method commercially feasible. This method of pre-conditioning in an outdoor mist bed has evolved after rudimentary trials ranging from allowing the initial superin layer to form in the air, to the familiar system of lifting and re-sticking Fall made cuttings after 4 to 6 weeks in the bench. At the present time, we appear to be getting much better results with Maney Juniper handled in the way described. This cultivar has the decided tendency to develop a large, vigorous callous and then refuse to differentiate this abundant parenchyma into roots. Pre-conditioning these cuttings in the mist bed during the summer and then re-sticking into a greenhouse bench during the month of October gives adequate rooting percentages in a reasonable length of time. It is not at all unusual to find 15 to 20 percent of these tip cuttings lightly rooted after 8 to 10 weeks in the mist frame and those found rooted are potted off immediately. The remainder display none of the heavy callous so typical of the cuttings directly benched in the Fall and thus are easy to handle during the re-sticking process. At the present level of observation and experiment, there appears to be no special advantage to re-applying a chosen hormone nor removing whatever callous has formed in the mist bed. We simply sort out the rooted from the unrooted and handle the latter quickly while re-inserting it into a regular greenhouse bench.

There is strong feeling that the apparent advantages in this system of handling do not trace nearly so much to any magical quality of the mist but rather to the time that these cuttings are taken . . . late June through early August. It is suspected that a good propagating greenhouse, adequately equipped with fan and pad cooling will probably do a better job than the mist, since after 8 or 10 weeks in the mist type facility, there is evidence of severe foliar leeching, which results in partial defoliation and rather unsightly cuttings. Perhaps one day Dr. Hess will have perfected that greatly sought "black box" into which a sample cutting may be inserted and the cofactors determined by a direct read-out scale on the top of the box!!

Since we do not yet have this wonderful device of the future, let me describe quickly several techniques that we have found useful in addition to dispelling several beliefs which we had and are perhaps even now prevalently held elsewhere. . . .

There appears to be no difference whatsoever in the rooting percentages obtained with cuttings which include "the heel" and those severed with a sharp knife on either an oblique or straight-across cut. All varieties of *Juniperus chinensis* appear to root best when the growing tip is left intact. Thus, what we call "tip cuttings" give us a better percentage than "butt cuttings." It is typical that the cutting including the greenest wood also requires a greater strength of hormone application than older and more mature wood but with an additional variation shown in that identical cuttings taken in July and September, find the former requiring a greater hormone concentration. Thus, the greener and softer the cutting, the stronger hormone required.

Our present method of applying hormone in dry form may be



worth commenting upon—because our cuttings are always field made and gathered into oriented bunches, counted and of approximately equal length, we dip the entire bunch of cuttings for “swish treatment” into Morton Chemical’s Panogen, diluted one to twenty thousand and then insert the butt end of the bunched cuttings into the top of a small polyethylene bag containing a very small quantity of the dry hormone. When the bottom of this bag is shaken vigorously, we appear to obtain quite an even coating of the hormone powder on the moist ends of these cuttings. The above described method would seem to give us more uniform results than the standard dipping and tapping method, while also enabling the advantage of handling the cuttings in substantial multiples.

In keeping with recent findings by Dr. Chadwick and Dr. Reisch, we are unable to correlate any improvement in rooting with wounding. We are, therefore, not now, practicing the technique of wounding on any cuttings of any kind.

Since our commercial production aim is, of course, to get the individual plant off and going as an individual at the earliest possible date, we like to lift each batch of cuttings from the greenhouse rooting bench at the earliest reasonable date. We have discovered that considerable time can be saved by re-sticking those cuttings which were not rooted in bunches rather than singly. We are not sure just why cuttings thus lifted and re-inserted appear to exhibit a marked tendency to root quickly when gathered in bunches of ten to twenty; the effect is plainly evident nonetheless. It might be that the factor of bench aeration is contributing to this effect and to this end. I should also like to point out that our present method of sticking all cuttings specifies the use of a peg board rather than the more familiar method of opening a slit and then “pounding” the cuttings in. The rooting sand currently in use is of medium coarseness . . . about the consistency of coarse coffee grounds and thus is probably quite well aerated at all times. I presume that most members are familiar with our over-all bench management program, which does not call for the changing of sand but rather for steam sterilizing between each batch of cuttings. If at all possible, we also like to re-steam before any cuttings are re-stuck, thus eliminating the possibility of pathogen carry-over from one bench to another.

In summary, it is felt that the most important factors in the achieving of good Chinese Juniper rooting percentages are:

1. Rapidity of handling from parent plant to bench.
2. Maintenance of cool bench temperatures for the first 4 to 6 weeks — 58 to 62 degrees Fahrenheit.
3. Maintenance of adequate humidity in the rooting environment without excessive wetting of the cutting tops.
4. Willingness to undertake the labor of lifting the cutting batch for pot processing those ready, and re-sticking those cuttings which appear to be in good condition but not yet rooted.
5. Careful selection and maintenance of disease and insect-free stock plants.

Most selections of *Juniperus chinensis* are not truly difficult to propagate, but the task for all of us will be measurably lessened when Charles Hess produces that wonderful "black box."

Thank You.

MODERATOR ROLLER: Are there any questions?

MR. JAMES WELLS: Jack, I am interested in this question of wounding, and whereas, I can agree and did say in my paper that wounding has never actually rooted a plant, I believe, nevertheless, it has a very definite effect upon the quality of the root system and the number of points of attachment now. Do you find, say in taking the standard juniper pfitzer that you are getting the same quality of rooting without wounding as you did with it?

MR. HILL: Jim, I believe yes, and I believe if your tests on wounding were carried out under consistent conditions over a long enough period you would find where wounding might have a particular advantage under a particular set of conditions. Again, I refer to pfitzer and normal conditions. I find wounding is pretty much a waste of time.

MR. HOOGENDOORN: Did I understand you correctly that you use sand for your juniper cuttings?

MR. HILL: Yes, we use sand entirely for junipers.

MR. HOOGENDOORN: Have you ever experimented with peat and perlite?

MR. HILL: Peat and perlite, peat and sand, and peat and Turface — that is the name of the Canadian silt-clay. The sand seems to work best.

MR. HOOGENDOORN: Did I understand you to say you never cut your tips back?

MR. HILL: Not until rooting has taken place. We wish to develop character. After the rooting and growing, then we remove the tip, but not before.

MR. HOOGENDOORN: Don't you get a long cutting then?

MR. HILL: No, on these chinese we tend to use a short tip for we want greener than usual wood. We take the cutting I would say a maximum of five inches, probably averaging something more like four. On the horizontal we take a long branch and cut it up into pieces, but that is just for the chinensis.

MODERATOR ROLLER: At this time we have *New Plants: Their Propagation and Adaptation* — by A. F. Dodge, Regional Plant Introduction Station, Ames, Iowa. Mr. Dodge.