TECHNIQUES OF JUNIPER GRAFTING

PHILIP M. HALL[1]
Sneed Nursery Co.
Oklahoma City, Oklahoma

Grafting upright junipers is a year-round operation. While the actual grafting is done in Oklahoma only in the winter from about December 15 through March 1, there are many other items requiring attention throughout the year to produce the final product.

Understock. The first step is to build a good supply of understock. We use both *Thuja orientalis* and *Juniperus chinensis* 'Hetzii' as understock for upright junipers. *Thuja orientalis*, more popularly called biota, understock is grown from seed in open beds for 2 to 3 years. Seed is sown in early to mid-spring at a high density. In the fall of the following year we undercut the seed bed and selectively harvest the seedlings of a size acceptable for grafting. Oversize seedlings are discarded and undersize plants are left in the bed for one more year. After harvesting, the roots are trimmed back just enough to allow easy potting in a 3-inch round clay pot. We use these larger pots with *Thuja* in order to give more room to the plants when set in a bed of peat moss. In the past we have had difficulty with *Thuja* having a foliage blight when packed too tightly under conditions of high humidity.

Juniperus chinensis 'Hetzii' is started from cuttings taken during the winter months. In Oklahoma, the most acceptable time is between November 15 and March 1, when the stock plants are in a dormant condition. For understock applications it is very important to impress upon the cutting crew the kind and size of cuttings which should be taken. The correct stem diameter is the most critical factor in selecting cuttings, with the optimum diameter being about 4 mm to 7 mm at a distance of 5 to 6 cm from the base of the cutting. On vigorously growing stock plants this diameter will usually be 20 to 25 cm from the apex of each growing terminal. An important factor concerning rapid and vigorous rooting is selection of cuttings from the current season's growth. Stock plants which are weak or growing under unfavorable conditions often have the acceptable diameter well back on 2 year old wood. In general, cuttings from 2-year-old wood should be avoided due to increased difficulty of rooting; however heel cuttings, which include just a small portion of old wood at the base, are quite acceptable and, according to some sources, preferable. When cuttings are taken from the stock plants, we then strip the foliage off the basal 3

[1] Presented by Eddie Spears, Spears Tree Farm, Tahlequah, Oklahoma.

inches and bundle them in groups of 25 with the bases matched. The entire bundle is then topped to give the cutting an overall length of 6 to 8 inches. The bundles are brought to a cool, dark storage room, immersed in a disinfectant solution and placed on wire racks. We mist the cuttings once or twice per day until they are stuck in the rooting beds.

We root most of our Juniperus chinensis 'Hetzii' in ground beds under quonset type structures with a rooting medium of sand, peat and bark. Previous to sticking, the beds are sterilized with methyl bromide. The cuttings are stuck on 1-1/2 inch centers using a nail board to insure consistant and accurate spacing. This spacing yields about 35,000 cuttings in a 6′ by 96′ bed. We stick the cuttings about 3/4 inch deep or just deep enough to hold the unrooted cutting upright during a hand watering. Just prior to sticking, the basal end of the cuttings is given a 5 second dip in a solution of 5000 ppm IBA in 50% water and 50% isopropanol. Misting is clock controlled but usually changed daily depending on weather conditions. Every 2 to 3 weeks until rooting takes place, the cuttings are drenched with Banrot or Benlate. In 9 to 12 weeks the cuttings begin to root and new top growth becomes noticeable. At this point we begin to use a 20-20-20 water soluble fertilizer on a biweekly basis. Once rooted, the cuttings can be hardened off from the mist rather quickly in just 1 to 2 weeks. The cuttings are maintained in the ground beds through the summer. For us, the best time to pot the rooted cuttings begins toward the end of September and preferably ends by the first of November. In the harvesting operation, the beds are heavily watered and the cuttings carefully dug with as little disturbance to the roots as possible. After trimming the roots back to a length of 3 to 4 inches, the cuttings are potted in 2-1/4 × 2-1/4 × 3 inch plastic pots and placed in a shade house to be maintained until root establishment. The potted understock plants are left ouside until about November 15 or until they have been through one or two good frosts. In a relatively dormant condition, they are then transferred to the glasshouse where they are brought into an actively growing state with a maintenance schedule of moderate water, moderate fertilizer applications, and one or two drenches with Banrot. The day prior to grafting, the group of plants to be used are given a very heavy watering since, if all goes correctly, they will not be hand watered again for about 8 weeks.

Labor. At our nursery the actual grafting operation usually begins about December 15 and ends about March 1. A well synchronized operation is an absolute necessity for juniper grafting, both from a cultural point of view and from an economic point of view, so it is very important to maintain a work force of just the right number of people. Since the output of each

worker may vary greatly, it is good for the propagator to have some idea of each individual's potential in order to schedule the labor properly. In general, the best experienced scion makers can be expected to produce about 2500 to 3000 scions per 8 hour day, while our best grafters will produce an average of 1200 grafts per day. On the other hand, inexperienced workers can be expected to produce about 1000 scions per day or 600 to 700 grafts per day after a 2-week learning period. Therefore, the decisions regarding placement of labor must depend on the experience and ability of the individual employees. For our particular grafting operation, the work force usually consists of 1 or 2 scion makers, 2 to 5 grafters, 2 or 3 people to collect scions from the fields, 1 or 2 workers to bring understock to the grafters and set the completed grafts in the beds, and one person to supervise the entire operation and fill in where a need exists.

Grafting technique. The basic technique for making a juniper graft is well known throughout the nursery industry. However, every nursery and, no doubt, every propagator involved in this field has different ideas of the finer points of the operation. Scion material is collected in the field, preferably from young trees which have been sheared 2 years previously but not sheared during the growing season preceding grafting. Due to lack of availability, however, it is often necessary to collect scion material from older trees. The workers try to select material with a diameter closely matching that of the understock and which is of current season's growth. This material, usually 10 to 15 inches in length, is brought to a cutting room, dipped in disinfectant solution and placed on wire racks. They are misted 2 or 3 times per day to keep them in fresh condition. Our policy is to use the material within 3 days of collection even though storage, under proper conditions, could last 2 to 3 weeks.

The scion maker's technique is very important. A good scion will have a longitudinal slice about 30 mm long removed along the inside curve (if a curve exists) of the stem and a similar but slightly shorter (28 mm) parallel slice removed from the outside curve. It is of the utmost importance to leave a strip of undisturbed bark and cambium along each side about 2 to 3 mm wide. Finally, a wedge is made at the basal end starting the cut on the shorter side. We prefer the wedged scion to one that simply tapers along the length of the cut to a point. Ths reduces the amount of very thin material at the basal end that might be more subject to desiccation. A well prepared scion is of great importance in the survival chances of the graft. A poorly made scion almost assures either complete failure to unite or a weak graft union if healing does occur.

Once the scion is properly prepared it goes to the grafter, whose job of making the side graft is equally critical. Starting as low as possible on the stem of the understock, the grafter makes a longitudinal incision about 30 mm long to a depth 1/4 to 1/3 the diameter of the stem. The cut must not be all the way through so that there is a flap. The scion is then inserted into this incision so that the long cut is toward the center of the understock. The flap is brought into contact with the shorter cut of the scion. All this is done while being careful to match scion and understock cambial layers at least on one side of the graft. The grafter then wraps the graft with a budding strip, applying just enough tension to keep scion and understock in close contact. The wrap should spiral down the graft union leaving small gaps between turns and tying off below the union.

The next step is to place the completed graft into a bed where the scion and understock may callus and develop connective vascular tissues. The healing process requires proper maintenance of moisture and temperature around the union. In our case, we place moist peat moss just to the top of the union without burying the foliage where fungus problems might arise. However, we are careful not to leave any of the union uncovered so as to prevent drying which would result in failure to heal.

The facility. With the graft now in place in the healing bed, success or failure depends upon the facility and its proper maintenance. Three essential factors — moisture, temperature and light intensity — are critical in the healing of a well made graft. It is in view of these factors and their interdependence upon one another that the facility must be designed and maintained.

The method of moisture control has changed drastically with the advent of mist systems. Our grafting beds were built long before mist systems were in general use; and hence controlling moisture was more a matter of keeping water in rather than adding water to compensate for losses. Our beds were built to a depth of about 24 inches, which allowed placement of glass frames or, more recently, plastic tents over the plants. This created an enclosed environment with nearly 100% humidity and virtually no water loss. The system had two major drawbacks: high humidity coupled with high temperature around the foliage encouraged disease problems; labor costs were high because of the need for frequent aeration by lifting the glass frames or rolling back the plastic tent. With the automatic mist system the deep beds are not absolutely necessary but are probably helpful in cutting down on drying air currents. The question of how much water to apply with mist no doubt varies greatly among propagators involved in juniper grafting. Of

course, the amount applied must be considered along with the other two critical factors of temperature and light intensity. Some propagators apply water liberally to keep the graft union constantly wet, especially when using a well drained packing medium. In our case, the peat moss packing medium has a large water holding capacity; therefore, our philosophy is to apply as little mist as possible without allowing the peat or the foliage to dry out. On a cloudy winter day, for example, the clock might be set for 20 or 30 minute intervals with 3 to 4 second bursts. On a bright day, misting might be increased to 12 to 15 minute intervals with 5 second bursts. No steadfast rule for misting can be relied upon, and during the critical healing time I consider my first and foremost duty to be checking the moisture conditions in the beds hourly and adjusting the mist clock according to needs.

The heat source for the greenhouse is a gas-fired boiler. Steam mains run overhead down the center of each section of the greenhouse. At the far end, the main branches and steam lines run beneath the raised benches and back to a common return for recycling. We are great believers in the benefits of bottom heat for grafting applications. In fact, we believe that bottom heat is the only important source of heat in our system. We much prefer the foliage to remain cool in the 50 to 65°F range, while the graft union is in the 75 to 85°F range. We do not want the tops to get so cold as to curtail metabolic activity, but the 50 to 65°F range provides ample metabolism and discourages excessive transpiration. Our experience shows that heat is quite important for healing of the graft union. Early during the past grafting season we noticed a distinct temperature gradient from one end of a bed to the other. The cooler end was substantially slower to callus and had a greater loss percentage. To correct this gradient, plastic skirts were placed around the grafting beds with ventilation holes at the warmer end. After some experimentation we obtained a reasonably consistent bed temperature along the length. Bed temperature is maintained by a thermostat with the probe inserted directly into the peat moss at graft union level.

The third factor critical to the facility is light intensity. My experience indicates that high light intensities are, in our system, detrimental. With high light there follows higher air temperatures and increased transpiration. More mist is then needed, which increases chances of disease problems. Our best success has been with a shading just dense enough that shadows are not cast even on a bright day. As is obvious, the three factors of moisture, light and temperature cannot be dealt with separately. Any alteration of one factor requires a reassessment of the other two.

Post Healing Treatment. The easier cultivars (most of the *Juniperus scopulorum* cultivars) usually show callus in 7 to 14 days. Time for complete healing is variable, but in 6 to 8 weeks the callus starts to turn a dull brown color indicating the onset of lignification and formation of vascular connections. New growth from the scion preceded by a "spring" color change is also noticeable at this point. The hardening off procedure may then begin and should last 10 days to 2 weeks with gradual reduction of mist and increased hand watering. Constant random sampling is necessary to decide when to cut back the understock. This is done only after considerable lignification when the unions seem physically strong. We cut back the understock all at once rather than in steps because, quite frankly, we have seen no cultural advantages in the latter, more labor intensive method. The cut is made with a pair of sharp clippers at an angle in order to avoid a pronounced stub which might be subject to infection. In the same operation, the budding strips are removed and replaced with a thin piece of masking tape. The union is still tender and could be broken if handled too roughly. The cut back grafts are then reset in the beds and maintained on a water and fertilizer schedule until shipping time in mid-May.

FIELD PROPAGATION OF SEEDLINGS IN MIDDLE TENNESSEE

MICHAEL HOBBS

Warren County Nursery, Inc.
McMinnville, Tennessee 37110

Seed beds. The term "seed bed" implies the preparation and cultivation of seedlings en mass, closely spaced, and cultivated intensively in a confined area. This practice is not generally carried out in this region except under greenhouse or hothouse conditions in the propagation of evergreen liners. Most seed propagation in this area is, and has traditionally been, the row type of cultivation, which differs very little from the other types of nursery cultivation.

Seed sources. The seeds used for propagation of the liners and understock used in this area come from several sources. The wild collected seeds are the oaks, dogwoods, maples and many others. There are more plant species native to the McMinnville area than in the Great Smoky Mountains, which explains why the Tennessee nursery industry originated in this area. The seeds are harvested at the proper time of the year by people commonly known as "seed collectors." The collectors are usually older people who are capable of knowing the differ-