

d) In ring culture, capillary benching, growing bags.

e) Mushroom casing additives.

f) Sewage sludge compost additive where it absorbs excess water and improves air flow, thus enhancing composting. It is also useful in the final product as an amendment.

**Inorganic Comparisons**—No discussion of perlite would be complete without at least passing reference to the other most common inorganic amendments that it is often used in conjunction with or in lieu of. One of the salient features of perlite is its high total porosity, i.e. the total available for occupation by water and air. This is largely so because the inner air space of perlite is not entirely occupied, while the inner air space of sand, pumice and polystyrene (despite their radically different densities) are relatively more solid or occupied. With respect to total porosity, only coarse vermiculite (with 80% + and with air space of 43%) and peat (with 80% +) have more than coarse perlite (with 70% +, and air space of 60%) while sand varies from 30 to 45%. Perlite holds 2 to 4 times its dry weight of water while sand and polystyrene hold considerably less, whereas peat and vermiculite hold far more.

## **TOP-WORKING (WINTER-FIELD GRAFTING)**

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One of the methods of propagation used at Carlton Plants is that of top-working or winter-field grafting. This technique is used in combination with other methods of propagation to develop a unique style of tree. This style or form is characterized by having a clean straight trunk to a specific height, then a burst of limbs and foliage from that point. A select group of plants lend themselves to top-working, specifically those with a compact globular form and those that are weeping. Other advantages to top-working are to circumvent the problems of poor bud take and slow growth rates of some cultivars.

**Cultivars.** Current production levels consist of about twenty cultivars totaling 50,000 plants. The majority of this production is in flowering cherries with the remainder being globular and pendulus forms of ornamental tree, (See Table 1).

**Materials.** The grafting process requires some basic tools and supplies. Those used at Carlton consist of a good knife, sharpening stone, leather strap, hand pruners, and pouch to carry scionwood. Other supplies include 1 in. wide paint brush, tree tar, 1 in. wide

**Table 1.** Explanation of various rootstock, interstem and graft combinations used

Scion cultivar	Rootstock/ interstem	Schedule	Graft Height	Graft Type
<i>Acer platanoides</i> 'Globosum'	<i>Acer platanoides</i>	2	6'	cleft
<i>Caragana arbores-</i> <i>cens</i> var. <i>pendula</i>	<i>Caragana arborescens</i>	2	3'	cleft
<i>Caragana arbores-</i> <i>cens</i> 'Walker'	<i>Caragana arborescens</i>	2	3'	cleft
<i>Cercidiphyllum</i> <i>japonicum</i> 'Pendulum'	<i>Cercidiphyllum</i> <i>japonicum</i>	2	5'	cleft
<i>Corylus avellana</i> 'Contorta'	<i>Corylus avellana</i>	2	3'	cleft
<i>Laburnum alpinum</i> forma <i>pendulum</i>	<i>Laburnum anagyroides</i>	2	4' & 5'	cleft
<i>Malus</i> 'Coralburst'	<i>Malus pumila</i>	2	3'	cleft
<i>Malus</i> 'Sargen Tina'	interstem-white flower crabapple	2	4'	cleft
<i>Morus alba</i> 'Pendula'	<i>Morus alba</i>	2	4' & 5'	cleft
<i>Prunus</i> × <i>cistena</i>	<i>Prunus cerasifera</i> Mgro-29C interstem- <i>P. cerasifera</i> 'Newport'	2	3, 4½, 5½	cleft whip or tongue
<i>Prunus</i> 'Accolade'	<i>Prunus avium</i>	2	6'	cleft
<i>Prunus</i> × <i>yedoensis</i> 'Akebono'	<i>Prunus avium</i>	2	6'	and/ or
<i>Prunus serrulata</i> 'Shirotae' ['Mount Fuji']	<i>Prunus avium</i>	2	6'	whip & tongue
<i>Prunus serrulata</i> 'Shirofugen'	<i>Prunus avium</i>	2	6'	"
<i>Prunus serrulata</i> 'Kwanzan'	<i>Prunus avium</i>	2	6'	"
<i>Prunus</i> 'Snow Fountain'®	<i>Prunus avium</i>	2	4½'	"
<i>Prunus subhirtella</i> 'Autumnalis'	<i>Prunus avium</i>	2	6'	"
<i>Prunus subhirtella</i> 'Pendula'	<i>Prunus avium</i>	2	3' & 5½'	"
<i>Prunus</i> × <i>yedoensis</i> 'Yoshino'	<i>Prunus avium</i>	2	6'	"
<i>Robinia pseudo-</i> <i>acacia</i> 'Umbraculifera'	<i>Robinia pseudoacacia</i>	1	6'	cleft
<i>Salix caprea</i> 'Pendula'	<i>Salix caprea</i>	1	4' & 5'	cleft
<i>Syringa meyeri</i>	<i>Syringa reticulata</i>	2	3'	cleft
<i>Ulmus glabra</i> 'Camperdown'	<i>Ulmus pumila</i>	1	base, 5½'	bark, cleft
<i>Wisteria sinensis</i> (purple, blue, pink, white)	<i>Wisteria sinensis</i>	1, 2	base, 5½'	cleft

surveyors' tape, and a 6 ft. tape measure.

**Scion Orchards.** Carlton maintains an extensive scion orchard or mother block for the production of high quality budding and grafting wood. These orchards are severely pruned once a year in fall or winter to concentrate growth for the following season. Fertilization takes place in the spring with ammonium nitrate at about 400 lb. per acre. Sprays for insects and disease are applied throughout the season. Irrigation is withheld in the fall on established trees to allow the wood to mature properly.

**Scionwood.** Scionwood is collected about December 15th. Working with this date allows time for collection prior to our coldest weather, a time when damage to the buds can occur.

Wood is always selected from current season's growth. Shoots are cut long (3 ft.) to prevent dehydration which occurs with small sticks. The caliper of most scions is in the range of  $\frac{1}{4}$  to  $\frac{1}{2}$  in. in diameter. One should review the size of the rootstocks to be grafted in order to select the proper size of scionwood.

Once cut, the limbs are brought into a building where they are graded, counted, packaged, and labeled for storage.

The bundles of wood are either wrapped in butchers' paper or placed in poly bags for storage.

The quantity of scions is estimated and registered, then the packages are placed in a cooler for storage at 36°F.

**Rootstocks and Interstems.** When choosing the rootstock and/or interstem, consideration must be given to compatibility and hardiness. Table 1 shows the rootstock that is used with each scion cultivar. Producing the rootstock/interstem to be top-worked is handled two ways on two different schedules.

**One-Year Schedule. . . .**

The seedling or rooted cutting is planted out in April and May. Once the plant has established roots and has started to grow, the plant is cut back to a single bud or shoot. The plant concentrates all its energy into a single stem which grows rapidly. The plant is staked and then tied throughout the season. Nitrogen fertilizer is applied in mid-July. The plants are cultivated and irrigated and continue growing. The growth obtained varies with each cultivar; however, 5 to 6-foot plants can be obtained in one season. See Table 1 for growing schedule for each rootstock and interstem.

**Two-Year Schedule. . . .**

On this schedule, the seedling or rooted cutting is again spring-planted. The plant is irrigated and cultivated through the summer. In August some rootstocks (such as *Prunus* and *Malus*) are budded. In about 30 days, the bud bands are cut and the bud lays dormant until the following spring. The remaining rootstocks not handled in this manner are allowed to continue growing untouched to build roots and caliper. In March of the following season, the tops of the rootstocks are cut back to a bud. At this point, the plants are staked,



tied, and maintained as in the one-year schedule. The rootstocks go dormant in fall and are untouched until time of grafting the next year.

**Timing.** The grafting is done February 15th through March 15th. Some regrafting is done about April 1st. At this time, there is activity within the plant but no growth is apparent. Grafting is only done on dry days.

**Grafting heights.** The height at which the various cultivars are grafted is dictated by factors such as growth rate, eventual use, aesthetics, and customer demand. Grafting heights for each cultivar are listed in Table 1.

**The top-working process.** To streamline the process, 3 workers are used as a team. They start with one person cutting the tops off of the rootstocks at the desired height and removing any side limbs. Cull plants are also removed at this time. The other two workers sort through the scionwood and cut scions, usually 6 to 8 in. long from the bundle of long whips taken from storage. The scions are put into a pouch which the grafter wears at his waist. The three workers take their place in a row with the grafter in front. The grafter first makes the cuts on the scion, leaving 4 to 6 buds per stick. The appropriate cut is then made on the top of the rootstock and the scion inserted to match the cambium layers.

The second worker's job is to wrap the graft union. This is done using a strip of 1 in. wide surveyors tape. The wrap is started on the rootstock and worked up about 1 in. onto the scion, then tied off. The third person paints the top of the scion and the area just above the tape on the scion. This is done with a 1 in. wide paint brush and tree wound tar. This process is repeated some 600 to 800 times a day for each crew. Three basic grafts are used depending on the cultivars. They are the cleft, whip and tongue, and bark grafts. Table 1. indicates the graft used for each cultivar.

**Aftercare.** The grafts are watched for signs of growth. Buds usually start to swell in 4 to 6 weeks. Those that appear dry and shriveled may be regrafted. By mid-April buds break and begin growing on both rootstock and scion. All shoots on the rootstock are removed except for about 4 to 6 just below the graft. These are called pullers and are left in place to help nourish the plant until the scion is established. They are removed when about 6 to 8 in. long.

The tape is left in place for 3 to 4 months to give support to the graft union. It is removed by cutting with a sharp knife.

The plants are fertilized twice and cultivated and irrigated on a regular basis throughout the season. Some balancing of the limbs is necessary to make a full and balanced canopy.

**Finished product.** The trees will have taken on shape and character by season's end. They are dug from the soil bareroot and brought to the warehouse for grading, storage and eventual shipment.