Propagating and Growing French Tarragon

Artemisia dracunculus (L.) var. *sativa*

Charles E. Voigt
University of Illinois at Urbana-Champaign

Botany and History

French tarragon, *Artemisia dracunculus* (L.) var. *sativa*, is a perennial herb from the family Asteraceae (Compositae), native to southern Russia in the area of the Caspian Sea (Bailey, 1961; Bailey and Bailey, 1976; McCormick, 1990). The plant bears lanceolate, alternate, entire leaves on a plant 45-75 centimeters high (Hemphill and Hemphill, 1983). Under certain conditions, the plant bears small, greenish-white, sterile flowers in terminal panicles. Under typical north temperate zone conditions (central Illinois) these are seldom seen (Hylton, 1976; Kowalchik and Hylton, 1987). Because this plant does not produce viable seeds, it must be maintained using asexual propagation (Hartmann and Kester, 1983).

Botanic nomenclature of this plant can be confusing, since what is apparently taxonomically correct is still rarely seen in popular literature. *Artemisia dracunculus* (L.), according to *Hortus Third* (Bailey and Bailey, 1976), is the correct name for Russian tarragon, and *Artemisia dracunculus* (L.) var. *sativa* is correct for the useful form, French tarragon. This makes botanic sense, since, according to Dr. Arthur Tucker, Delaware State University taxonomist, French tarragon (2n = 36) is a sterile chromosomal derivative of Russian tarragon (2n = 90) (Sutton, Humphries, and Hopkinson, 1985; Tucker, 1995).

By far the most commonly published nomenclature, however, remains *A. dracunculoides* for Russian and *A. dracunculus* for French tarragon. To add to the confusion, still other references only mention *A. dracunculus* but do not differentiate taxonomically between French and Russian tarragon. In this instance, perhaps the best course of action for the non-botanist is to be aware that the confusion exists, and that the French tarragon, which can only be propagated by asexual means (no seeds), is the high quality plant that is desired, regardless of what taxonomic nomenclature may be ascribed to it by a given reference (Voigt, 1995; Clark, 1997).

Its use was recorded by the Greeks about 500 B.C. (Anderson, 1976; Hylton, 1976; Sutton, Humphries, and Hopkinson, 1985). The plant is also reported to have been cultivated by Charlemagne throughout his empire (McCormick, 1990). Some historians think tarragon really originated in Asia and invading Mongols brought it to Spain in the mid 1100's. In Spain it was called "taragoncia", from the Arabic "tarkhun" (Keville, 1991). It was introduced into England in the early 16th century, and brought to North America by the Dutch around 1650. During his lifetime, Thomas Jefferson distributed starts of this plant to his gardening friends (Kowalchik and Hylton, 1987; McCormick, 1990)

The botanic species name, *dracunculus*, is derived from the French word *esdragon*, or little dragon, presumably because the fleshy roots resemble a tangle of snakes (Loewenfeld, 1964; Simmons, 1968; Hylton, 1976; Kowalchik and Hylton, 1987; Weiss and Weiss, 1992). The Greek "drakon" (Kruger, 1993) and the Arabic "tarkhum" or "tarkhun" as well as the Italian "dragoncello" also refer to this same dragon or serpent-like quality of the roots (Lathrop, 1981; Keville, 1991).

In medicinal lore, plants with serpentine roots were given credit for treating snakebite (Kruger, 1976). At this time, the venom of snakes was assumed to be carried in their tongues. Since tarragon numbs the tongue, it was thought that it could numb the tongue of the viper and counteract its venom (Kowalchik and Hylton, 1987).

Chemistry

The chemical numbing agent in French tarragon is a substance called estragole (methyl clavicol or paraallyl anisole). It is present in fresh tarragon, but is very volatile and quickly evaporates when the plant is dried (Lima, 1986). This is a big reason why fresh tarragon is so much more desirable than dried, which is sometimes described as tasting like "hay" (Clark, 1997). The numbing agent in tarragon is so effective; it was once given to numb the tongue before taking nasty tasting medicine (Fox, 1970; Foster, 1971; Bremness, 1988). In distilled, concentrated form, estragole may be carcinogenic (McCormick, 1990).

Culinary Uses

French tarragon is extremely popular as a culinary herb because its licorice or anise flavor adds a unique taste to sauces and main dishes (Fox, 1970; Clark, 1997). Since the fresh product contains 10 times the flavor components of the dried, sources of fresh tarragon are desirable through as much of the year as possible. While it is most closely identified with French cooking, this herb is widely used in Europe, Asia, and North Africa, particularly in areas surrounding the Mediterranean Sea (McCormick, 1990).

The numbing effect of tarragon negates the "fishy" character of seafood, making it a popular choice for these dishes. Authentic Bernaise sauce requires fresh tarragon (Hylton, 1976). Despite being adapted to culture over much of North America, the primary production areas remain in France. The United States is a net importer of this herb (Miller, 1985).

Propagation

French tarragon does not produce viable seed, while Russian tarragon does (Fox, 1970). Consequently, purchased tarragon seed will, of necessity, be the Russian variety, which is a taller (to 150 centimeters), coarser, weedy plant. This Russian pretender normally produces almost no fragrant oil and is essentially worthless, except as a wreath base, somewhat similar to Sweet Annie, *Artemisia annua*, but without the strong scent (Owen, 1978). It is probable that there is an ancient botanical connection between Russian and French tarragon, since it is unlikely that a non-seeding plant would develop and survive, except under cultivation and selection.

The result of this development of a non-seeding plant is that French tarragon must be reproduced vegetatively, without seeds (Hartmann and Kester, 1983). Vegetative propagation differs from seed propagation in that vegetative plant parts, such as stems, roots, bulbs, and leaves are used, rather than seed (Adriance and Brison, 1955). Traditionally, this has been done by dividing existing plants (Lammerink, 1985). This method is still highly satisfactory for home garden production, and for small-scale commercial production of the fresh herb. Actually, division is highly advisable every 2 to 4 years to keep plants healthy and productive (Anderson, 1967; Wrensch, 1992; Hopkinson, Miske, Parsons, and Shimizu, 1994). For large-scale commercial field production, division may not produce enough plants fast enough, so stem tip cuttings are also used when crown buds do not supply enough plants (Hemphill and Hemphill, 1983). A cutting may be defined as any vegetative plant part which, when detached from the parent, is capable of regenerating the missing organ or organs. An herbaceous cutting is defined as a portion of a soft, succulent plant used for the purpose of reproduction (Hottes, 1922; Stoutemyer, 1954; Mahlstede, 1957). Plants, which reproduce readily from herbaceous stem tip cuttings, produce large numbers of new plants from a few stock plants. The process is inexpensive, rapid, simple, and does not require specialized techniques like grafting or budding (Hartmann and Kester, 1983). Due to the necessity of asexual reproduction, French tarragon remains a premium-priced herb plant.

Prior to 1990, the rooting success of softwood stem tip cuttings of French tarragon was reported as spotty at best (Miller, 1989). Herbaceous cuttings are usually soft, tender, and succulent and require special attention with regard to temperature and moisture (Adriance and Brison, 1955). A wash with a dilute solution of sodium hypochlorite may remove dirt and disease spores from cutting material (Quinn, 1987).

On the basis of some recent propagation research and grower success, the following guidelines have been developed to achieve more consistent results in propagating tarragon by stem tip cuttings. First, the condition of the stock plants varies seasonally, and according to their treatment. If the plant material is growing vigorously, with abundant, soft, succulent growth, rooting seems to be maximized (Kains and McQuesten, 1942). If stock plant growth is slowed, either by stress or by approaching seasonal dormancy, rooting success will rapidly deteriorate. In order to obtain high quality plants in the shortest possible time, cuttings must root quickly and abundantly. Propagation should then be planned to avoid the natural dormant season and conditions, which tend to stunt or stop lush growth (Wells, 1955; Hartmann and Kester, 1983; Moe and Andersen, 1988).

The second factor, which seems to be critical, is avoiding desiccation of cutting material from the time it is severed from the mother plant until it is stuck in the rooting medium under mist. It is desirable to take cuttings in the early morning when fully turgid, then handle them in a way which minimizes loss of turgor (Hartmann and Kester, 1983). Some form of mist or fog system is always advisable, since this succulent plant material loses water so rapidly after detachment. Wilting can be prevented by carrying the cuttings in a closed container lined with wet paper towels or newspaper (Free, 1957). It seems to take a particularly short time in this species to reach a point where some of the leaf tissue loses the ability to recover full hydration, and dead tissue results, which provides for easy disease access under the moist conditions on the mist bench (Voigt and Vandemark, 1993). A problem with mist is that mineral nutrients can be leached from cutting material if it takes too long to root. This can lead to signs of mineral deficiency or even tissue necrosis (Blazich, 1988).

Development of intermittent mist systems in the late 1930's and early 1940's allowed the rooting of cuttings of previously impossible plants (Blazich, 1988; Loach, 1988). Leaves sprayed intermittently are effectively cooled through evaporation of this thin film of water. It is important to maintain not less than 92% relative humidity around the cuttings being misted (Wells, 1955). Water loss is retarded, leaf temperature is lowered by evaporative cooling, and the cuttings can tolerate higher levels of irradiance, in turn increasing photosynthesis (Welch, 1970; Hartmann and Kester, 1983; Loach, 1988). Misting allows cuttings with a high leaf: stem ratio to be used, which is good, since there is more photosynthetic activity in the leaves (Welch, 1979). Leafy cuttings should be rooted in an environment that is conducive to photosynthesis (Davis, 1988).

Misting with indoor air temperature water (21 to 24°C.) rather than ground temperature water (11 to 13°C.) will speed rooting of cuttings. If soluble salts are a problem in the water supply, a water treatment method such as a reverse osmosis system will enhance performance of the cuttings (Biernacki, 1993). The minimum amount of water necessary to maintain cutting turgor must be applied to prevent leaching, waterlogging, and excessive cooling of the rooting medium. Application of too much water via mist also aggravates the effects of hard water, sometimes creating pH difficulties (Welch, 1970). Especially in cooler weather, bottom heat on the propagating bench (about 24° C.) will also speed rooting, thus cutting down the time under mist (Welch, 1970). It seems that the shorter the mist period, the stronger the cuttings remain and the more likely they are to survive and grow vigorously (Wells, 1955).

While verbal reports from a successful grower and propagator of this plant encouraged the use of a rooting hormone (Woods Rooting Compound) composed of a 2:1 mix of IBA (indole-3-butyric acid) and NAA (naphthalene acetic acid) applied at approximately 750 parts per million in an ethanol and water solution (Biernacki, 1993), preliminary work done on this project by the author at the University of Illinois has shown that cutting material harvested from stock plants in prime condition and handled as described above roots quickly and successfully without additional hormone treatments. If cutting material is less than ideal, then addition of a moderate amount of a rooting hormone may substitute for some of that prime condition (Voigt and Vandemark, 1993).

Cuttings will root in a variety of media. Sharp sand alone yields adequate results, but is physically heavy and hard to handle. Vermiculite, perlite, and sphagnum peat moss all also work fairly well, too, as rooting media. Best results have been achieved when 50:50 mixes, by volume, of milled sphagnum peat with either perlite or vermiculite are used. (Hartmann and Kester, 1983) This mix has the added advantage of adapting fairly well as a medium for the early growth of the newly rooted plants. For this reason, most greenhouse peat-lite soil mixes should prove adequate for excellent rooting and subsequent growth (Voigt, 1995).

To start propagation in late winter for early spring planting or plant sales, stock plants should be carefully handled to induce strong growth by late winter. This usually amounts to placing the dormant plants in unheated poly houses in fall, where a chilling requirement can be met, and then, after the first of the year, bringing them into the moderately warm greenhouse where the plants can break dormancy and grow vigorously. In areas of low winter light intensity, supplemental lighting to provide additional irradiance and a 16-hour light period will increase this early growth (Bassuk, 1986). In areas without dependable winter chilling outdoors, stock plants may be refrigerated, or given a long-day treatment to help break dormancy.

Dormancy

In a study of dormancy and how it affects the ability of crown buds to root and grow, field plants showing above-ground dormancy yielded buds that rooted and grew well, even in early October. The type of growth from these early season buds was interesting because they formed rosettes of growth of a type that tarragon plants in this latitude never form naturally. After November 30, this growth form did not appear and plants elongated immediately upon breaking dormancy. Earlier propagated rosette plants also broke and grew at about this time. These crown divisions grew and survived best without supplemental mist application (Voigt and Vandemark, 1993).

An interesting sidebar to this research was that, although division seems like a method of propagation, which is too slow to yield many plants, preliminary observations, and unpublished data actually showed that a fairly high number of divisions can be obtained. In these studies, two-year-old field-grown plants commonly yielded 50 or more crown bud divisions, which rooted and grew relatively easily (Voigt and Vandemark, 1993). Issues such as contamination with soil-borne pathogens may be another limiting factor in using division for commercial propagation of French tarragon (Quinn, 1987).

Tissue Culture

Tissue culture has been used in some studies to propagate French tarragon, with some success. Both severed leaves and stem tips with leaves removed have been successfully cloned in this manner. Both systems had a high yield of subcultured plants which rooted easily with the application of hormone to the culture medium. These plantlets then needed mist or other high-humidity treatment to acclimate to conditions out of the tissue culture system (Garland and Stoltz, 1980; Sutton, Humphries, and Hopkinson, 1985; Mackay and Kitto, 1988).

Tissue culture seems ideal for producing large numbers of plants quickly, but remains a relatively expensive system. Plants produced in tissue culture are usually relatively disease-free. There may also be a rejuvenating effect on the plants, giving them greater vigor after the tissue culture process. For whatever reason, tissue culture of French tarragon has not yet become a commercially successful venture.

Plants in tissue culture sometimes, under certain conditions, show a tendency to exhibit genetic changes called somaclonal variation. Since French tarragon does not form true seeds and cannot, therefore, actively be bred by conventional means, this process may actually afford a chance to select new genetic types. At present, no one is trying to breed French tarragon cultivars through somaclonal variation in tissue cultured plants, but the possibility is intriguing.

Hardiness

Although it is often listed as a "somewhat tender" perennial plant, French tarragon is actually hardy to around -35° C. What typically kills the plants is excess moisture during the winter dormant period. The fleshy roots are particularly susceptible to water standing on the crown of the plant during this time (Loewenfeld, 1964; Foster, 1971). Plants can tolerate a wide range of yearly rainfall, from 20-135 centimeters per year, provided heavy rains are not concentrated during the dormant season. Tarragon will survive soil pH readings of 4.9 to 7.5, although a near-neutral 6.9 is optimal (McCormick, 1990).

Culture

Well-drained soil is the number one requisite of a good growing site for French tarragon (Wrensch, 1992; Hopkinson, Miske, Parsons, and Shimizu, 1994). This would come, ideally, from natural soil conditions in the area, but native soils can be amended and cultural practices employed which will allow production in most soils. Raised beds or ridge culture are particularly desirable in areas of heavy soils and poor natural internal soil drainage. Compost, peat, or other organic soil amendments will improve soil aeration and drainage. Adding a small amount of sand may actually make conditions worse in fine-textured, tight soils (Voigt, 1995).

For best production of high quality tarragon, moderate or better soil fertility needs to be maintained. A fertilizer program similar to a good vegetable garden maintenance level is usually adequate, except in particularly poor soils. A summer mulch to cool the soil and keep the leaves clean may be effective, though winter mulch may keep the crowns too wet and actually encourage winter kill. Irrigation may be necessary to maintain high quality late into the season. In late summer and early fall, dormancy begins to develop and production rapidly declines (Voigt, 1995).

To establish field production of French tarragon, cuttings should be rooted in late winter, grown on into the spring, then be hardened and planted in the field. If greenhouse space is not available, established plants in the field can be divided in early spring, as soon as the crowns can be dug. In the field, space plants or divisions 30 to 45 centimeters apart in rows 75 to 120 centimeters apart, or space plants 30 to 45 centimeters apart in all directions in intensive beds. Heavy wet soils should be avoided, if possible (Bailey, 1930). There should be a moderate harvest the first summer and a full harvest in the second, third, and possibly fourth summers (Voigt, 1995).

After three or four years, plantings should be divided or replaced, because crowding, perennial weed invasion, and normal attrition of plants will begin to make inroads in production. A system where 1/3 of the total required production area is planted each year, with individual plantings destroyed or divided after the fourth year might work well in equalizing production over time. It would be assumed that the sum of the smaller first and fourth year harvest, combined, would equal the full production level of the 2 and 3 year old plantings (Foster, 1971).

Harvesting

Begin harvest of about 1/3 of shoot growth starting as soon as plants have fully expanded leaves in mid spring. Cut material should be cleaned, if necessary, and then packaged immediately to slow wilting, which begins as soon as tips are severed from the plant. The remainder of the plant will be reinvigorated by the harvest and will branch and regrow to provide multiple harvests throughout the season. Plants should be cut back frequently during the growing season to keep fresh new growth coming (Simmons, 1968; Bassuk, 1986; Wrensch, 1992). As dormancy begins in early fall, harvest should stop, mainly because quality rapidly deteriorates. It is best not to shear off the unsightly brown tops in the fall, as this may lower plant hardiness through the winter.

Summary

In summary, French tarragon is a very popular herb which is of much higher quality in the fresh state than when dried. Since it is a plant which produces no viable seed, it must be propagated vegetatively. It seems that the difficulty of this process may have been over-emphasized in the past.

The simplest method is division, which, in a home garden situation, can be as simple as digging up the clump and chopping it into quarters with a spade, then replanting these divisions for a 4:1 yield of new plants. While division can yield a surprisingly high number of new plants if done in a more meticulous way, some situations require a still higher plant yield even more quickly.

Stem tip cuttings from stock plants in the proper condition have been shown to root very easily, often without the addition of rooting hormone. Proper handling of cutting material and an effective mist rooting facility greatly enhance success. Seasonal changes in the plant lead to a period when growth slows or stops, and during this period, rooting is effectively impossible. Cold treatment will break this dormancy, and long day treatments will, to some extent, substitute for the cold treatment (Bassuk, 1986). Finally, tissue culture may hold promise in the future, either as a propagation method or as a breeding tool.

French tarragon is a plant which does not produce viable seeds and must be propagated by asexual means. While division and stem tip cuttings have been used with fair success in its propagation, the speed of reproduction was often inadequate to meet commercial demands. Although stem tip cuttings are usually an efficient means to produce large quantities of new plants from a limited supply of stock plants, results with this particular herb plant, prior to the start of this project, were often inconsistent and unsatisfactory. The work in this thesis was undertaken to gain a better understanding of French tarragon and to develop a more effective, dependable method for its propagation. Statistical analasis of all data, throughout, was completed using Fischer's Protected LSD.

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