

Manual for Northern Herb Growers

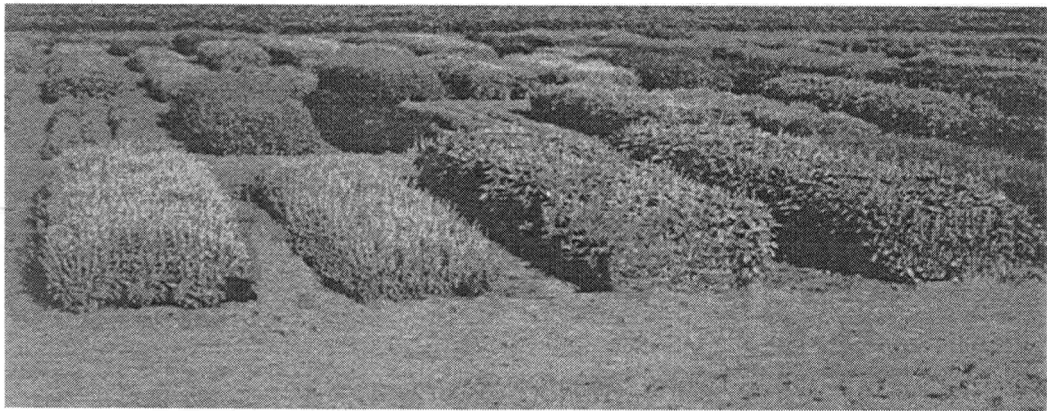
Seija Hälvä and Lyle E. Craker



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Warning and Disclaimer

Neither the authors nor the publisher recommend or assume any responsibility for identified uses of plants within this book, including medicinal uses. All recommendations are detailed and described according to the best available information and neither the authors nor the publisher can assume any responsibility for misapplications, changes, or crop failures associated with using this book.

Preface

Interest in growing herbs has increased rapidly in the last decade as individuals have become more aware of the aromas, flavors, and health benefits associated with these plants. In addition, the wide variety of plant material and adaptability of these plants to growth in the home garden and field has encouraged both novice and experienced grower to plant a few herbs. From these beginnings have come a number of questions, especially from northern areas, on methods for cultivating herbs to ensure high yields of quality plant material.

Numerous herbs thrive in North America and Europe. The abundant light, warm growing temperatures, and available water supplies promote the growth in a number of herbs. Of course, the cold winter temperatures and the limited growing season impose some restrictions on the types of herbs which can be grown and significantly increase the need for good management. Annuals need to be started early in the season to complete the growth cycle before the first winter frost appears. Cold-sensitive perennials need to be mulched or brought indoors for protection from freezing temperatures. Soil fertility, pH, and moisture must be adjusted to support vigorous, early growth. Weeds and other pests must be controlled.

This manual contains the essential information for growing and managing herbs in northern locations. The first section introduces concepts related to producing herbs and details key areas in management decisions. The second section provides horticultural guidance for specific herbs. An appendix includes suggestions on seeding and potential problems along with other useful hints for producing a better crop. In all sections, advice on propagating, pest control, harvesting, and other aspects of herb cultivation is offered as a start for the beginner and a review for the accomplished. Diagrams and tables have been used to amplify procedures and reasoning.

We trust this growers manual will provide the herb novice and professional with methods for producing superior herb crops. While extensive scientific research related to some species is lacking, we have mixed that available with our personal knowledge on growing these plants. We hope this manual will encourage you to start and to expand your production of herbs.

Seija Hälvä
Lyle E. Craker

Dedication

To the growers of our food, to the educators of our children, and to the blessings of our families.

Acknowledgements

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Section I. Growing Herbs

Manual for Northern Herb Growers

Introduction

Herbs represent a wide variety of plants used for culinary and medicinal purposes. As a group of plants, these species are valued for their characteristic aromas, flavors, and healing properties. Historical records indicate the use of herbs since prehistoric times. By the ninth century, herb gardens were flourishing in Europe. Early settlers and pioneers moving across the United States established “kitchen” herb gardens (located for convenience just outside the kitchen door) as a source of flavorings, dyes, pest repellents, deodorants, and medicine. The first pharmacies in America were stocked with extracts and elixirs prepared from herbs. Today, interest in growing herbs ranges from individuals attracted to herbs as a gardening hobby to commercial enterprises searching for new investment opportunities.

The aromas, tastes, and pharmaceutical properties associated with herbs result from the collection of chemicals in the plant. These chemicals, mostly within the essential oil (sometimes known as the volatile oil), are synthesized in the plant during the course of metabolism. Depending on the plant species, the essential oil and constituent chemicals can be located in leaves, stems, flowers, seeds, roots, or throughout the plant. In commercial practice, the essential oil is sometimes removed from the plant tissue by distillation or solvent extraction and then used in place of the whole herb in food preparations, cosmetics, and pharmaceutical products. The essential oil from a single herb may consist of more than 100 separate, chemical compounds, all of which may subtly contribute to aroma, taste, and medicinal properties.

Almost anyone can successfully grow herbs. A window sill or a small garden plot and a few gardening tools are usually sufficient for producing enough herbs for home use throughout the year. A grower interested in sustained, commercial production of herbs will require a larger field or greenhouse space and some investment in equipment and management. Producing high yielding, quality herbs for home consumption or the marketplace, however, is eased by an understanding of the plants and associated horticultural practices.

Herbs, as with other crop plants, need adequate light, water, and soil nutrients. In addition, consideration must be given to the soil pH, temperature, pests, and other environmental variables. Plant spacing within the row and between rows must be fixed close enough to ensure maximum capture of sunlight by the leaves, but distant enough to prevent excessive competition for resources that could result in a decrease in quality and yield. The soil in the plant bed must be properly prepared and the seed must be planted to the correct depth. Fertilizers and irrigation water may be needed during the growing season to maintain vigorous growth and development. The harvest must be correctly timed to maximize yields and assure that harvestable fractions are in peak condition. Fresh market plant materials must be kept fresh and dried market material must be dried and stored under the conditions that maintain characteristic flavors and aroma.

The objective of most herb growers is the production of high yields of quality plant material. As in other fields, such results will come from good planning, good management, and attention to details.

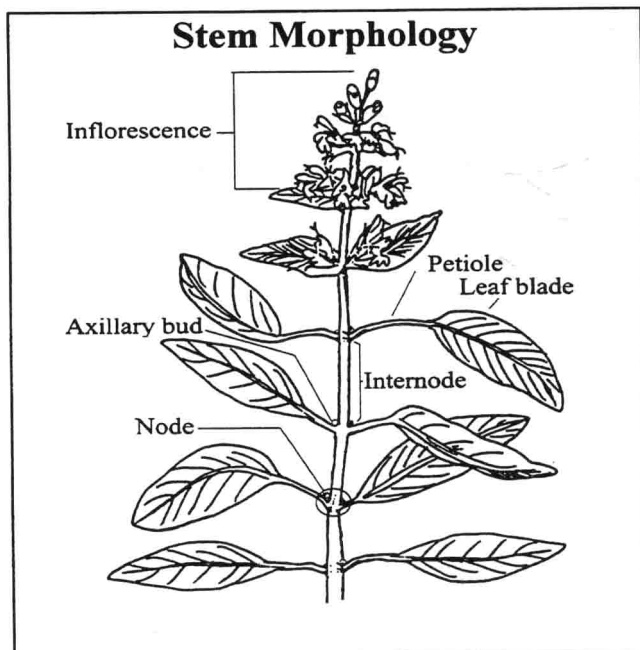
Planning

Planning is the first step in successful herb growing. The level of planning required for growing a field or garden of herbs depends upon the purpose, scale, and experience of the grower. Being aware of the growth environment and intended use of the herbs should make growing the plants easier and produce a better crop. Before committing to large scale, professional cultivation of fresh or dried herbs, marketing opportunities should be considered. Unlike some other crops, ready, open markets do not exist for all herbs and sales of large quantities of an herb may be difficult. Growers should probably explore local, national, and international markets before deciding on which species to grow and what level of sales could be expected. Buyers frequently want to examine production samples before contracting for future purchases.

For those individuals interested in growing herbs as a hobby or as a few garden plants, these species can be grown everywhere from an indoor window sill to a small garden patch. Some of the more cold sensitive perennial herbs such as lemon balm, rosemary, and lavender may be grown indoors as houseplants in northern conditions and moved outdoors in the summer. For home use, fresh material can be picked from the plant as needed. Herbs can also be readily used as bedding plants and for other ornamental purposes.

Plant descriptions

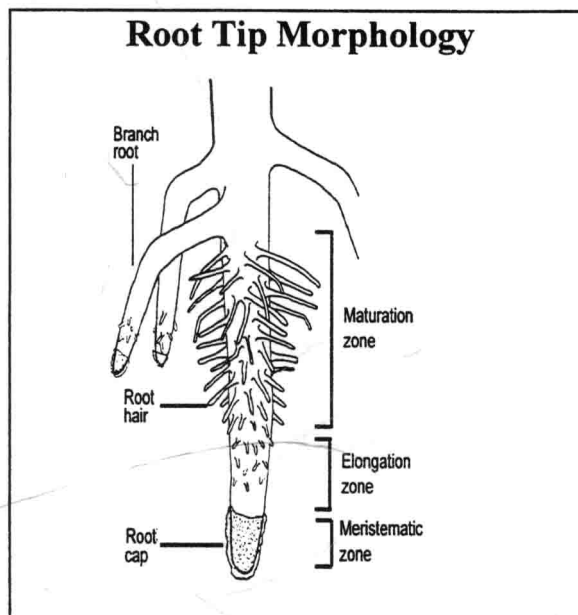
* Familiarity with the size, shape, and color of herbs helps in identifying plants, discerning



abnormal growth and development patterns, and recognizing quality plant material. A growing herb can be easily divided into two parts: a portion below soil surface and a portion above the soil surface. The portion below the soil surface consists primarily of roots and rhizomes, important for plant anchorage, nutrient and water absorption, and food storage. The portion above the soil level consists primarily of stem, leaf, and floral tissue, important in growth, photosynthesis, and reproduction. Although fundamentally and functionally similar among herbs, each of these structures, is characteristically different for different herbs. For example, the roots of horseradish are strongly geotropic and thickened with a few small side roots. In contrast, the roots of peppermint are smaller with numerous side branches.

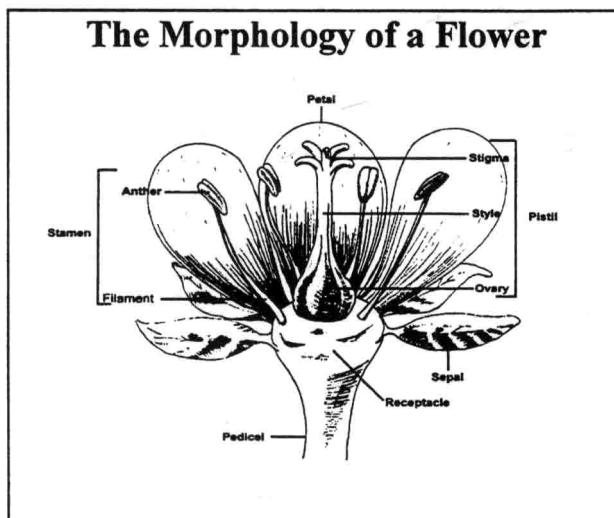
Growing Herbs

As a physical structure, the root secures the plant in place and supports the upper portion of the plant. Water and nutrients are absorbed by the root through root hairs, the small, thread-like structures which develop near the tip of the roots. Carbohydrates synthesized in the leaf are frequently stored in roots in the form of sugar or starch and are the food reserve for plant regrowth in the spring or after a harvest. Rhizomes are horizontal, underground stems with buds from which new plants can develop. A well developed root system is necessary for vigorous plant growth and injury to roots or rhizomes from plant pests, transplanting operations, or cultivation practices can severely limit plant development and yield.



The aesthetic and commercial value of an herb frequently depends upon the shape, color, and size of the vegetative and reproductive parts of the plant material, especially for those herbs where the leaves, stems and/or flowers contain the aromatic constituents for which the plant is valued. In addition, a lush, green foliage generally indicates a healthy, vigorously growing herb. Herbs under physical or biological stress frequently become a light or yellowish green color, a change in appearance that could occur due to stress on the plant roots or foliage.

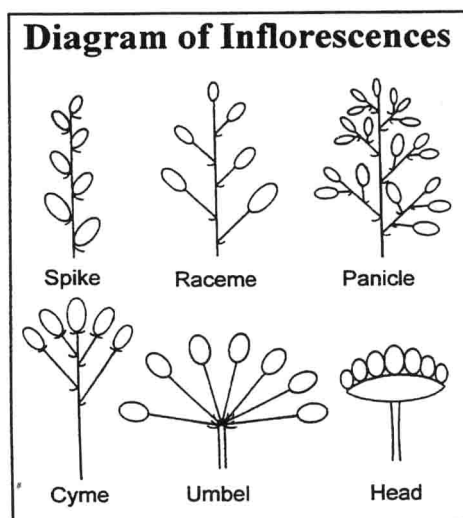
In the culture of herbs, decisions related to planting densities, row widths, weed control, and fertilizer applications are based on the size of the roots and foliage. For example, recommended plant spacings are designed around the plant architecture so that the foliage intercepts 95 percent of the available sunlight striking the field. Thus, herbs with smaller leaves or fewer tillers are planted closer together than herbs with a larger physical structure. Spacing plants too close together results in mutual shading of leaves from the sun and a decrease in plant growth. Sunlight supplies the energy for the photosynthesis that supports plant growth.



Flowers on herbs range from the simple and inconspicuous to the large and elaborate. In each case, the flower consists of reproductive parts (stamens and pistil) and accessory parts (petals, sepals, and receptacle). The stamens produce pollen (male component) and the pistil produces eggs (female component). During pollination, usually by wind or insects, the pollen is transferred from the anthers (a portion of stamen containing the pollen) to the upper surface of the pistil (stigma) where the pollen grains germinate and grow through the style (portion of pistil)

to the egg cells in the ovary (portion of pistil containing the eggs). A fusion of the male nuclei (in the pollen) and the female nuclei (in the egg) result in the zygote which upon growth and cell division becomes an embryo. The embryo and other supportive tissues are collectively known as the seed.

Distinctive arrangements of flowers, inflorescences, are observed on different taxonomic groups of plants. The type of inflorescence is one of the variables used in the classification and naming of plants. For example, flowers of the Apiaceae family are borne in umbels. An inflorescence generally develops at the terminal tip of the plant, but additional inflorescences can grow from axillary buds.



The number of seeds formed within each flower depends upon the number of egg cells fertilized and the environment. Flowers are genetically programmed to contain a limited number of eggs and a lack of water, light, nutrients, or other stresses will frequently reduce this number or induce abortion of developing embryos. Seed size is also affected by the environment and an environmental stress during seed filling (the storage of food reserves in the seed) can result in smaller seeds. Large, well-filled seeds are preferred since a large food reserve in the seed adds to seed weight (yield) and provides more energy for germination and emergence of seeded crops. In many herbs, seeds that do form are easily lost due to shattering (the process where seeds abscise from the flower when mature) and thus are

unavailable for harvest. Shattering, which is a valuable characteristic in wild plants that need to shed and widely distribute seed for development of future plant populations, is a detriment in crop plants where the seed needs to be collected at harvest.

Planting site

The potential of any herb to grow depends upon the availability of resources and the limitations of the planting site. Most herbs should be planted in a well-drained soil in a warm, sunny location. Yet, tolerances to temperature, light levels, nutrition, pH, drought, and other stresses differ among herbs. Some herbs may grow better at a particular site than others. Generally, the greatest limitation to growth in northern areas is cool temperatures and a short growing season. For example, cool spring weather slows seed germination enabling fungi to attack and destroy the seed before the plant can become established. Short growing seasons frequently prevent full development of the herb due to frosts which kill the plant tissue in the fall before growth is completed.

Planting sites should be disease and weed free, possess ample soil nutrients for growing the plants, and have a soil pH that has been adjusted to that required by the selected herb. The availability of irrigation water and field access for cultivating and harvesting equipment are also important considerations. Fields on southern slopes and with darker soils tend to become warm

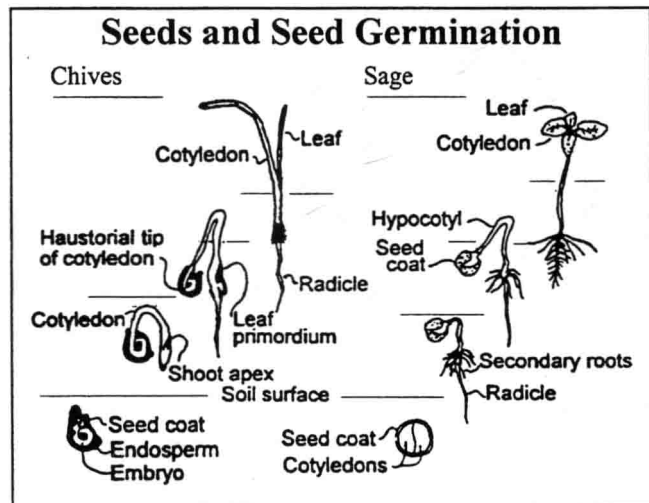
earlier in the spring than other locations, enabling earlier planting and thus an extension of the growing season. Having a planting site close to markets and transportation outlets can reduce the expenses associated with handling, processing, and selling of herbal products. Since many herbs and herb extracts are used in food products, planting sites where the soil contains heavy metals or organic wastes that could contaminate the plant material should be avoided. Heavy clay soils are generally not suitable for herb production.

Herbs grow best in a finely prepared soil. In preparation for planting, fields should be plowed or cultivated as an initial step for controlling weeds and disposing of plant residues. Secondary tillage operations with fine tooth harrows are usually necessary to smooth and level the seed bed. Raised beds, on which many herbs grow very well, can be constructed using a lister or similar device.

Propagation

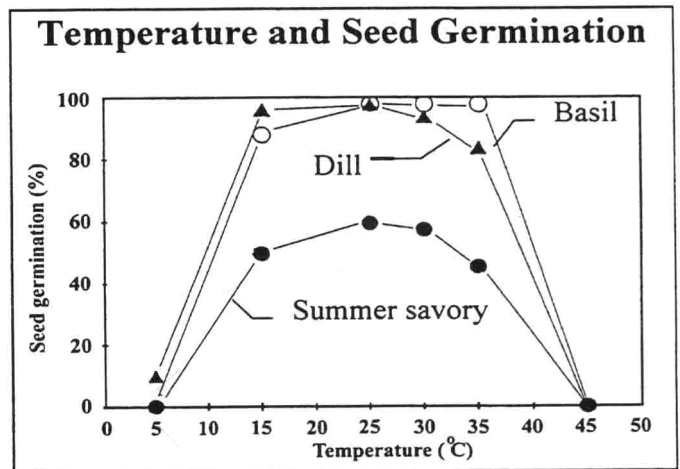
Most herbs can be propagated by seed or vegetative cuttings. The choice of propagation method generally depends upon the plant material and whether facilities for making, rooting, and holding cuttings are available. Annuals (plants that complete the growth cycle in one growing season) and biennials (plants that complete the growth cycle in two growing seasons) are usually started from seeds. Perennials (plants that continue growing over several growing seasons) are frequently started from seeds or from cuttings. Cuttings may be made from root, stem, or leaf tissue, depending upon the herb.

The seeds that result from the sexual reproduction process in plants represent the new generation of the plant. Each viable seed (a seed that will germinate and produce a new plant) consists of three parts, the embryo (the new plant), food reserves (generally starch or oil used as an energy source by the seedling until photosynthesis can begin), and a seed coat (protective wrapping around the seed). Most herb seeds are relatively small as compared with other crop plants and have very limited food reserves. This low food reserve means that the seeds must be planted shallow so that the available food reserves are sufficient to support seedling emergence.



Unfortunately, seeds planted near the surface of the soil are often exposed to a water stress that will inhibit germination. On warm, sunny days, the top layer of soil can dry rapidly and the seeds may lack moisture at critical times in the germination process. In dry conditions, fields should be irrigated or seeds should be started in greenhouses or seeding beds to ensure good germination and emergence and then transplanted to the field. As a "rule of thumb" herb seeds are usually planted at a depth equal to two to three times the seed diameter.

Good plants result from good seed selection. Using only the best quality seed with a high germination percentage will result in more vigorous germination and emergence. The seed should be free of weed seeds, properly identified as to plant type and variety, suitable for your locality, and adapted to the desired rate of planting. Seeds that are broken, diseased, insect- or rodent-damaged, over-heated during drying, or small for the type of herb may not germinate nor emerge. Large, plump, undamaged seeds generally germinate faster, emerge earlier, and produce the most vigorous seedlings. In addition, larger seeds can be planted deeper in the soil to help prevent the seed from being subjected to any drought stress during germination.



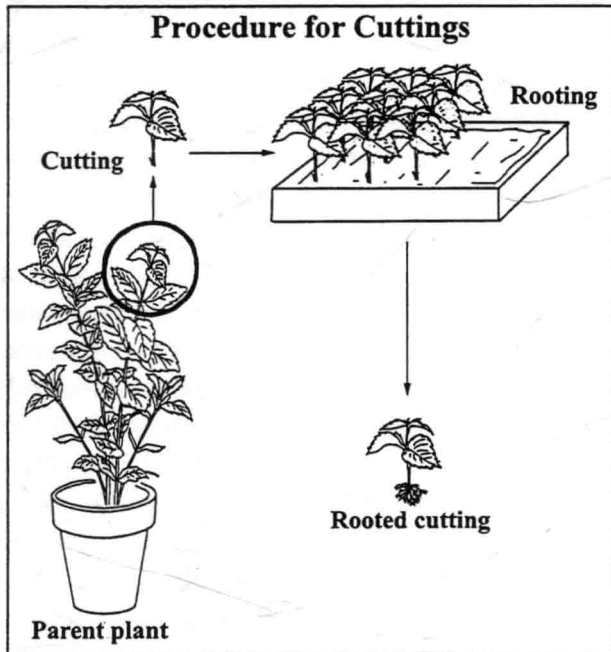
The seeding rate should be adjusted to provide the desired number of plants per unit land area. Plants with seeds that germinate poorly, because of the type of plant or because of damaged seed, should be seeded at a higher rate to account for the poor germination. In some instances, a high seeding rate may be used and the plants subsequently thinned to establish a good stand. To germinate, the seed must imbibe water, overcome any dormancy (due to such factors as the need for cold temperatures, light, or aging), and initiate metabolism of food reserves. Germination occurs when the seed has adequate water and when the temperature is within the correct range. In general, yields are maximized by using as much of the growing season as possible. Annuals should be seeded in the spring, as early as the plant will tolerate the cool weather and/or late frosts associated with this time of year. Cold-susceptible, summer annuals should be seeded in late spring after the danger of frost has passed. Plantings should be timed so that a large leaf area is available to intercept sunlight during the longest days of the year.

Dividing, making vegetative cuttings, and tissue culture are methods of getting new plants without using seed. Since most plant tissues have the ability to regenerate a new plant when placed in the appropriate environment, populations of plants can be rapidly propagated from pieces of a stock plant. In addition, the new plants will be genetically identical to the original stock plant, a property that is very important when the original plant has especially desirable characteristics. Propagating plants from cuttings can ensure continuation of unique plants that may have special types of oil, uncommon foliage, disease resistance, or other useful traits.

In dividing, clumps of plants are dug or removed from pots and the clump then broken apart or divided into sections, with roots and foliage in each section, that can be replanted as new plants. In vegetative cuttings, a piece of the plant is cut from the original plant and placed under moist conditions. New roots grow from stem and leaf cuttings and new stems grow from root cuttings. The cutting with both roots and foliage can be planted as a new plant. In tissue culture, individual or a very small group of plant cells are removed from a stock plant under sterile

conditions and placed on nutrient media for generation of roots and foliar tissue. Subsequently, the new plants can be removed from the media and planted.

With cuttings, the plant tissue must be kept moist during the rooting process since the ability of the tissue to absorb water is very limited. Root cuttings may be covered in wet sand or other rooting media. The bottom cut end of stem and leaf cuttings are usually inserted into rooting media for support of the tissue and to help keep the tissue moist. A mist system which sprays water on the cuttings every few minutes will also keep the tissue moist and the plant cells alive. Frequently, new cuttings are covered with plastic to maintain high relative humidity around the



plant material. Air circulating around the cuttings will help prevent disease infections. Air must also penetrate the rooting media since the tissue needs oxygen for the living processes involved in growing new roots. Cuttings may be taken from almost any annual, biennial, or perennial plant tissue. New roots form on the cutting in about 10 days for herbaceous plants and about 20 days for woody plants. Herbs reproduced by dividing will have injured root systems. Therefore, these plants should be thoroughly watered to ensure adequate moisture until new roots develop. Cuttings and divisions are made from stock plants and, in most instances, these stock plants will need to be maintained in a greenhouse so fresh material is available as needed for making cuttings.

Good herb crops can be grown from seed, cuttings, and divisions. The propagation method of choice depends upon the herb and the availability of greenhouse space. Seeds are easily stored and can be planted directly in the field. Cuttings and divisions require stock plants and must be transplanted. In short growing seasons, the yields of herbs grown from seeds may be reduced because the plant will not have sufficient growing time to mature. Herbs from cuttings and divisions have established root systems and some growth when transplanted to the field, thus enabling these plants to make full use of the early part of the growing season. Using cuttings and divisions allows a more accurate placement of seedlings in rows with none of the problems associated with failure of seeds to germinate. Space and labor, however, must be available to maintain stock plants, make the cuttings and divisions, and grow the transplants. Cuttings and divisions do allow for the reproduction of genetically identical plant material.

Fertilization

For herbs to grow and develop, soil nutrients need to be absorbed by roots and translocated throughout the plant. These nutrients, whether originating from soil parent material, decaying organic matter, or added fertilizers, function in plant structural and metabolic systems, making

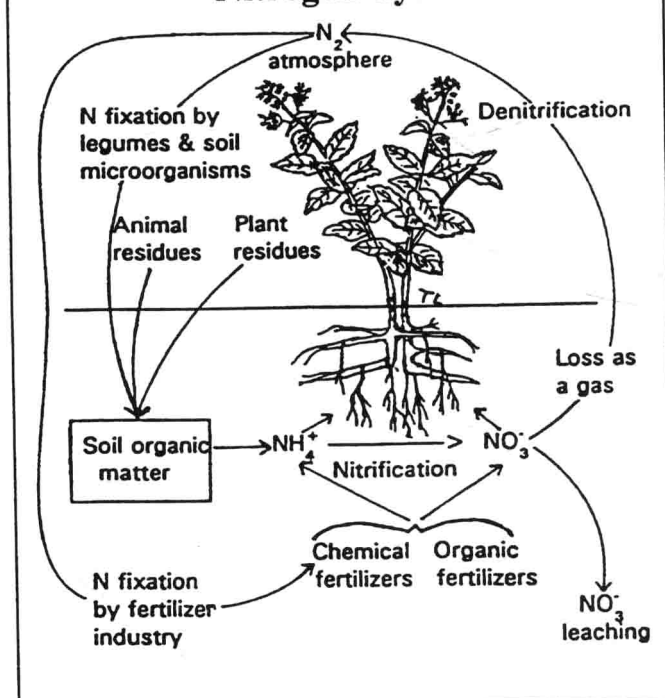
Sources of Organic Nitrogen

Fertilizer	Quantity needed per acre for 50 lb of available nitrogen
Dried blood	400 lb
Seed meals (soybean, cotton seed)	900 lb
Alfalfa meal	2.2 tons
Poultry manure	2.4 tons
Dried cow manure (commercial grade)	2.5 tons
Green manure crop (fresh alfalfa)	6.5 tons
Farm manure (large animal with bedding)	10 tons
Compost	10 tons

growth and development of the herb possible. The full yield potential of an herb is only obtained when the soil contains sufficient nutrients to support vigorous growth throughout the life cycle of the plant. Since soils frequently are deficient in one or more essential nutrients, the missing minerals must be supplied by fertilization.

In developing a fertilization program, the grower must decide how much fertilizer to apply and which fertilizer to use. No universal guidelines on fertilizer application are available since soils differ in fertility and different herbs have different nutrient requirements. Soil tests, plant analyses, previous experience, field history, and advice from others with experience in growing the herb are all very useful in determining the type and quantity of fertilizer to apply. Both organic and manufactured fertilizers may be used to supply essential nutrients to herbs, but from personal choice and market demand most herb growers choose to produce organically grown plant material.

Nitrogen Cycle



The availability of any soil nutrient for uptake by an herb is influenced by the level and solubility of minerals in the soil. For many nutrients, solubility is affected by soil pH. At a soil pH 6 to 7, a balance of nutrients are available to the plants. At a soil pH 5.5 or less, concentrations of some nutrients, such as iron and manganese, become more soluble in soil water. The increase in these elements at a low pH may be toxic to the herb and can reduce the availability of other nutrients.

Organic fertilizers need to undergo mineralization or weathering to release the nutrients into the soil water. The rate of mineralization depends upon the organic material and environmental conditions. To