Growing Vegetables

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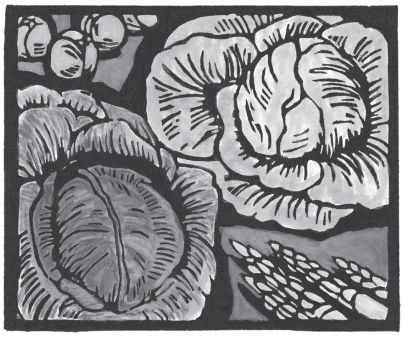

THE COMPLETE GUIDE TO ORGANIC GARDENING

6TH EDITION

Steve Solomon

SASQUATCH BOOKS
SEATTLE

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Introduction

There seems to be but three ways for a nation to acquire wealth. The first is by war, as the Romans did in plundering their conquered neighbors. This is robbery. The second is by commerce, which is generally cheating. The third is by agriculture, the only honest way; wherein man receives a real increase of the seed thrown into the ground in a kind of continual miracle.

—Benjamin Franklin

In your hands is a handbook for year-round vegetable growing in the maritime Northwest. It covers the at-home production of most types of garden food, with information on just about every regional aspect of vegetable gardening. It is as complete and as simple as I can make it.

Why I Write This Book

Please observe that I say "write," not "wrote." That's because I've been steadily revising this book since I began the first edition in 1979. This one in your hands is the sixth edition, revised in 2007. The second through fifth editions demanded complete rewrites because each time I had learned too much to merely adjust the old structure. This one, the sixth edition, required but a bit of tweaking and a major revision of how I recommend the growing of asparagus.

My intention behind writing every one of these six versions has been that fresh, homegrown vegetables will become a major part of your family's food supply. You're about to learn how to grow a full array of vegetables, not only during the heat of midsummer, but all year round.

Twenty-nine years ago I homesteaded in Oregon because I believed in self-sufficient living. Self-sufficiency is still my personal solution to a lot of the world's problems and many of my own. It seems to me that as people become more responsible for their physical survival—and there is nothing more essential to surviving than eating—they begin to have a more positive attitude about life in general. They're less dependent on a complex system that is entirely out of their control.

A self-sufficient person becomes "independence minded." The Oregon countryside is still dotted with large vegetable gardens; consequently, independence-minded is how many old-time Oregonians describe both themselves and the unique culture of the state. Washington State isn't much different.

Although independence-mindedness is a spiritual state, I'd also like you to enjoy a higher level of physical well-being, because I find it far more pleasant to be among healthy people. Having a feeling of well-being lets us throw back our shoulders, move confidently through life, and assert our independence. To enjoy solid health, we need to make a substantial part of our total food intake fresh vegetable food. But most North Americans have neither great vegetables nor strong health. The best way to change your diet in the direction of health is not to force yourself because someone told you to change, and certainly not to change by fighting your own bad habits and cravings. The best way to reform yourself is simple—experience the pleasures and wonderful tastes of fresh garden vegetables. Given a few years to work on a person, the garden will effortlessly change the gardener's preferences. I know this works because I've been through this change myself.

Growing Vegetables West of the Cascades has always been constructed a little differently than most other gardening guides. It advocates thinking for oneself. It explains the basic processes that happen in growing food and then puts you in a position to decide for yourself exactly what to do. In that sense I see my book as being very Oregonian.

This book must, of economic necessity, be a regional book. My publisher believes that the cover price would far exceed the market's tolerance, and the book's size would scare away too many bookstore browsers, if I (I) tried to include all of the specialized information

needed to succeed west of the Cascades *and* (2) also made this book into a complete, scientifically accurate general guide to gardening. As a result, I've had to concentrate on point 1 at the expense of point 2.

This restriction will mainly affect the novice. If you already know enough to succeed at growing vegetables in another climate, my book will be all you'll probably need. New gardeners, however, may want to find other sources of information about the general procedures for using raised beds, preparing the soil, making compost, and the many other gardening minutiae commonly called the techniques of gardening. Well, dear novice, the public library is full of nationally distributed garden books. Following the varietal advice, soil management systems, and planting schedules in a book targeted at the East often won't reveal the potential of our climate and will often lead to failure, but the general information in them can be very valuable.

Why We Need a Regional Gardening Book

Most gardening books published in the United States and Canada are actually very regional, although this is often not directly mentioned. They maximize profit by addressing the area of greatest population—that part of North America east of the Cascade Range.

Gardening west of the Cascades is very different. Our winters are mild and rainy, and our summer days are rarely hot; even our midsummer nights are usually too cool for short-sleeved shirts. We also have a perverse pattern of rainfall. We get a lot of moisture in winter when our gardens don't need it, but it rains little or not at all in summer when they do.

If we adjust to our climate, we can grow fresh food year round. If we act as though we were gardening in the East, we will have fresh food for only a few months a year. The Americans who first settled the Oregon Territory gardened as though they were still living in Ohio. This seems ironic because the first colonial settlers were British gardeners from a maritime climate just like ours. But by the time these British had become Americans and then settled the continent, they'd forgotten not only that they were once British, but also how they used to farm and garden.

Had the native tribes of the Oregon Territory been gardeners like the natives of the East Coast, the first Anglo-Americans arriving here might have acquired appropriate agricultural technology, which is exactly what happened to the British in Massachusetts Bay Colony two centuries earlier. But the tribes on this coast were living quite comfortably by hunting and gathering, and gardening not at all. So the new arrivals continued to farm and garden here—especially garden—as though they were back in Ohio, which sort of worked but was far from optimal.

This situation persisted in Oregon and Washington until we started to smarten up in the late 1970s. Cascadia then resembled a Third World backwater, exporting lumber,

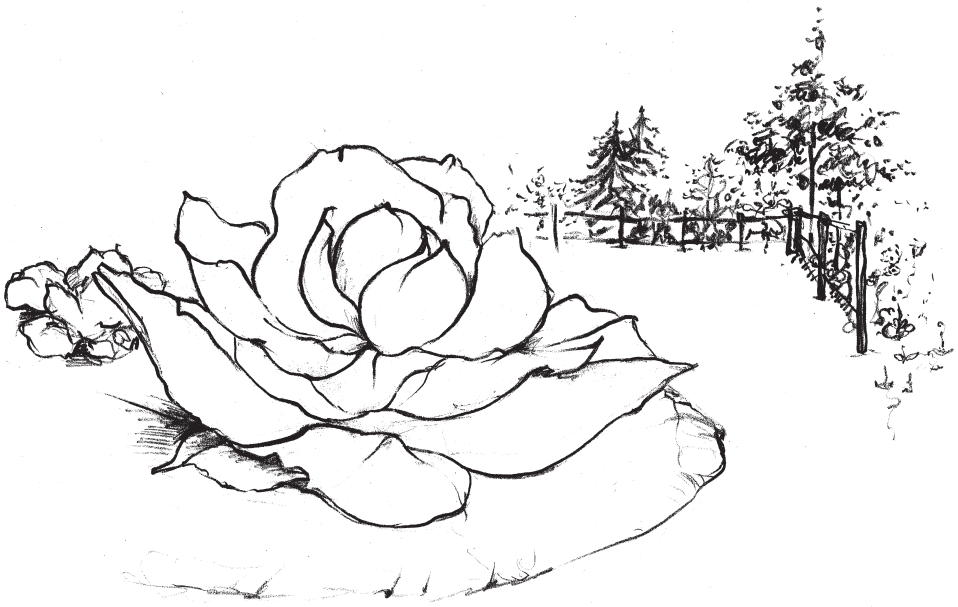
livestock, and fruit to the rest of the United States. Like other Third World countries, we depended on imported technology. We learned to garden from books describing techniques that worked in the East, and we bought our seeds from catalogs of eastern companies selling varieties that worked well where summers were hot and humid but that often did not grow as promised for us. And little in these catalogs helped us take advantage of the opportunities presented by our mild winters.

I do not know exactly how all of the diverse threads of change were woven together in Seattle or who to credit for what. Perhaps one reason that Seattle was the center of the new gardening movement was its proximity to *British* Columbia, where British seeds and British gardening books were available. The Canadians had done a much better job of adapting to their part of the Cascadia Bioregion than the Americans had. I do know, though, that toward the end of the 1970s a group centered around an active community garden in Seattle began to experiment with winter cropping. One of their number, Binda Colebrook, then wrote what I found to be a mind-expanding book called *Winter Gardening in the Maritime Northwest*.

Since then things have become a lot easier for the region's vegetable gardeners. We now have the knowledge to make full use of the climate. We have regional seed companies whose ethics and quality are world-class. And you have this book and Binda's book to introduce you to all of the possibilities.

I have always made myself as available as I could to help people. If you wish to contact me, write to me care of Sasquatch Books, or send e-mail to stsolomo@soilandhealth.org.

Chapter 1 Basics



The agriculturalist is the servant of the plant.

—Louise Howard, wife and research partner of
Sir Albert Howard until her death in India in about 1932

Prior to 1870 most Americans grew up on family farms with a hoe and shovel in their hands. My generation grew up quite differently, knowing everything about automobiles. The next knew the television schedules; the current one knows computers.

My generation was guided toward a university education, which meant a healthy dollop of high school sciences, including plant biology and basic inorganic chemistry. These sciences and university-level geology did more to make me appreciate what was happening around me than anything I was taught about history or social life. I owe my teachers a debt of gratitude for this knowledge. But because we gardeners need to develop an even greater understanding than is found in a science class or textbook, I wrote this chapter to open your eyes, mind, and heart.

Please Be a Plant

The way to understand another being is to put on their boots and walk in them. So I'm going to ask you to assume the viewpoint of a wild plant and then the viewpoint of a garden vegetable.

Sure, plants have viewpoints! All living things do. Dogs and cats have dog and cat awarenesses. Some people are quite good at understanding animal awarenesses. Others lack this ability; these folks are the ones whom dogs growl at and cats scratch. Similarly, some people seem to have green thumbs. For others, every plant they tend sickens and dies.

I think, however, that most "brown-thumbedness" is caused by ignorance and can be cured by gaining a little insight. Rote instruction that offers steps to be followed blindly is not nearly as effective as insight. The Latinos have a few wonderful words that illustrate this concept. *Instruido*—often said with slight disdain—means someone who displays pride after having been well instructed. Those who are *instruido* can *seem* knowledgeable. They have learned the proper buzzwords and can parrot the trendy concepts, but they don't really have wisdom. The innately wise person is *educado*. And the best sort of educated being, the sort that gets the most respect in Latin America, is one who is *autodidactico*, meaning someone who is self-teaching, self-motivated, self-directed. Latinos also understand that most *autodidacticos* can barely stand being in a classroom.

I don't want my efforts to turn out *instruidos*; the universities and agricultural schools do more than enough of that already. So I am asking you to take the little bits of data and the strange and perhaps slightly funny viewpoints I provide about plants and try them on for size. Look around and see if what I suggest fits what you observe going on.

A plant has awareness and knows things, but it does not think. If you doubt this, I suggest you read *The Secret Life of Plants*, listed in the bibliography at the end of this book. Plants make an effort to survive just like we do, but unlike some animals, especially humans, plants seem to have no individual awareness. A plant is no more uniquely "one being" than a skin cell on your thumb is. Plants participate in a group consciousness composed of all of the same sort of plants in the area. Thus, all of the fir trees of the maritime Northwest might share one consciousness. To this group, enhanced survival of the whole is the common goal.

Plant awareness is so different from ours that to know it you have to just "see" it. One way to do this is by spending some time leaning on your hoe and just being with the plants in your garden. You can also get it by hugging trees in the forest or meditating on hillsides. I prefer hoe-leaning, though I've done some of the others too. I've come to some remarkable understandings while hoe-leaning; once I became the symphylans undermining my trial ground and saw in one flash of insight how to manage them. I share this with you in Chapter 4.

There's no shortage of books on how to meditate, but none as far as I know mention hoe-leaning. Here's how to do it. While working in the garden, when your muscles become

a bit tired or sore, you put the working end of the hoe on the soil, hold the handle near the top with both hands for a bit of a prop, rest it against your shoulder and/or cheek, and, while supporting some of your weight on the tool and leaning slightly forward, stare off into space or at some part of your garden and *don't think*. Then, when you do resume thinking, don't try to force yourself to stop, which is what people who meditate do—just resume hoeing. Don't let anyone call this laziness; hoeleaning is a vital gardening chore, equally as important as hoe sharpening.

What I've discovered from my own hoeleaning is that plants are trying to be universal conquerors, engaged in a stiff competition for the control of light, soil resources, and space, in much the same way that people play a Japanese board game called Go. Plants attempt to own the space around them by getting there first and then by preventing their competitors from squeezing in around them. Because domination is their purpose, plants throw off a great deal of variations so that the one seedling with just the right stuff can succeed against all the others. Plants play this out by sowing dozens, hundreds, thousands of their own seeds in a small area and then letting their offspring have at the battle, competing with each other and with the progeny of other species. The victor's progeny will then be more likely to have the right stuff.

Most species are highly variable. To see this, take a close look at a patch of fir trees. Walk among them. Notice that one tree is bushy with long, well-developed side branches while another is taller and slender. One fir has dark green needles, another blue-green; one has long spaces between each whorl of side branches going up the trunk, another a short interstem. And although you can't see it, one has a deeply penetrating root system and another's roots are shallow and extend widely. The variations go on and on, in bark thickness and texture, in needle shape, and in the odor of, amount of, and thickness of sap. The closer you look the more differences you'll find. Yet all are Douglas firs. And all are competing with one another and with every other species for control of that forest.

There is very little "live and let live" in this game of competition by survival strategy. A thicket of firs starts out in a sunny spot. Gradually they shade out the grasses, berries, broom, and other herbs. Once the trees control all of the resources, their competition with one another makes the whole patch of trees grow taller faster. Those few that are able to overtop their competitors capture all of the light and thus kill off the shorter trees. A few end up owning all of the water and nutrition and get all of the light. Obviously, the game favors the taller-growing trees with fewer side branches.

So why do the firs keep on making trees that have a great deal of side-branch development? I imagine that it's because when trees with long and thick side branches grow at the edge of a forest (or alone in a clearing) they can shade a lot of ground, kill off the grasses and other low-growing herbs, and control that space better.

Similar battles go on in any site where a plant is capable of growing. In fact, in every natural setting, the plant already growing in

a spot must be the one that is best suited to be there. This is proved by the fact that it is already there. If another plant were better suited to own that spot, it would already be there instead of the one that is there. How's that for logic?

Every kind of plant has a unique winning strategy. Young trees make no seeds for many years but first direct their energy to growing tall and strong. Once they have overtopped everything and control their space, they make jillions of seeds that can, because of the height at which they're released, travel long distances before sowing themselves. A fierce competitor like wild lettuce rapidly spreads a dense mulch of its own leaves over the low-growing competition, starving them for light, while it uses the light it collects to make and store up food in its fleshy, juicy core. Then the lettuce suddenly bolts, puts up a tall seed stalk that overtops any competition remaining around it, and, with that big reserve of food in storage, rapidly makes seeds that blow away in the wind.

Some vines can wriggle into any bit of light missed by a competitor or climb over the competition, while their big leaves rapidly fill in and dominate that spot. Biennials sprout in the cool of early autumn when other species can't grow, store up food during the sunnier days of winter and early spring, and use that food reserve to shoot up a tall seed stalk later in spring, way ahead of competitors that sprout in the spring. Biennials are especially well suited to our climate because their survival strategy matches the seasonal rains, starting out when the rains begin in autumn and making seed as the soil dries out the next summer.

Admiring the strategy each vegetable family uses allows the gardener to better assist them. In fact the word "cultivation" might be defined as creating a more ideal situation for a given sort of plant. And that's the whole of gardening in a nutshell. In Chapter 9, I categorize vegetables by their basic familial survival strategy because we cultivate (help) each group in its own unique way.

Weeding

Most wild plants are vigorous enough to dominate infertile soil and survive heavy competition. Wild plants develop tough stems and leaves. Bitter, unpalatable flavors and often spiny leaves and stalks discourage would-be grazing animals, as do assorted unpleasant or poisonous chemical contents. We can't eat many of them. Wild plants make large numbers of small, hard seeds that are broadcast widely, but people prefer to eat large, tender, fat seeds.

Vegetables once were wild plants too, but now have been changed by people. I understand plant domestication as an eternal contract whereby we humans promise to nurture a wild plant and protect it and its progeny from competition. In exchange the wild plant changes itself to suit us, the creators of its new environment. This contractual relationship was brilliantly exploited by a nineteenth-century American plant breeder named Luther Burbank—an *autodidactico* if ever there was one.

Burbank wrote that whenever he cultivated a wild plant in his garden it immediately grew to many times its wild size. We gardeners have all noticed this: Any weed that grows unhindered in our gardens becomes huge and wildly outdoes our weak and puny vegetables. Burbank also noticed that the wild plants he wanted to change seemed to "know" that they were being taken care of, because within a few generations, the plants would cooperate by trying to become what Burbank wanted them to be, even if that meant they became weak and unable to compete well. He said that this happened because the plant was trying to please its protector.

Burbank's system of plant breeding involved first studying all of the members of a potentially useful wild family to see what desirable characteristics already existed and then visualizing—strongly, clearly, and continuously—a recombination of those traits into exactly what he wanted that family to become. If Burbank kept his visualization in mind as he crossed and recrossed the various species that constituted the family, and in each generation propagated only those individual plants that contained ever more of the traits he wanted, the species would eventually become exactly what he envisioned.

Burbank's method sounds very primitive compared to the scientific mathematical procedures developed by his contemporary, Austrian botanist Gregor Mendel, and currently used by all plant breeders. Interestingly, Burbank said that he understood Mendelian genetics and believed that they worked, but that he personally preferred not to be a statistician. A more intuitive system better suited Burbank's genius.

Other changes inevitably occur over time when a wild plant is cultivated. Root systems become less extensive because crops are fertilized, perhaps watered, and certainly protected from competition by weeding and by thinning surrounding plants. A portion of the plant's energy can then be redirected away from making roots and toward producing thicker, juicier leaves, pods, or stems; larger flowers; bigger, sweeter fruit; and tastier seeds. Because vegetables don't have to compete, they can be inbred, which can emphasize desirable traits and uniformity, but at the expense of vigor.

Having become weak, vegetables cannot survive untended by a gardener. The successful gardener's unavoidable task must then be to create much better growing conditions than are found in wild fields.

PLANT SPACING AND WEEDING

The most popular and most widely taught gardening system uses raised beds laid out so that the vegetables are spaced as close together as possible. This method, known as intensive gardening, became standard practice during the 1970s, as population growth squeezed more and more gardeners into smaller and smaller backyards. It seemed the perfect solution to the postage stamp backyard. These days people look only at the pluses of intensive gardening, but some aspects of this method are not so desirable.

The intensive method's main promise is getting the most food possible from the least space. However, the wide raised beds it depends on are prepared and laid out so as to

require a great deal of hand work, especially bent-over hand weeding. That's because it is possible to get quite a few more plants into a given space that has been laid out in beehive-like hexagons than into one patterned in traditional long rows. It is possible to increase the yield a bit more by placing plants so close together that a long-handled hoe can't work between them. And it is possible to harvest even a bit more if some seedlings are started in small pots and then transplanted into any gaps formed by the harvest of other plants. One plant comes out and plop, another goes in immediately. This technique seems very efficient. And while it is true that by harmoniously orchestrating your plantings you can increase your harvest by half, there is a price—and that is a lot more by-hand, with-fingers, bent-over work.

I started out gardening this way, and I know the system intimately. But when I began conducting a half-acre test plot for Territorial Seed Company in 1980, I set out not to grow food but to harvest information. The trial varieties had to be arranged in well-separated, far-apart rows so that careful observations could be made of each and every plant. Growing vegetables in this way turned out to have unexpected benefits. I discovered quicker ways to do garden work, and some of the species that I gave lots of elbow room became much larger, seemed healthier, and yielded longer and more. Consequently, a major theme that pops up in this book is a dialogue about "extensive versus intensive."

It is a lot less work to weed standing upright with a lightweight, sharp, long-handled hoe than it is to weed bent over with dull fingers. But it is not possible to hoe between vegetable rows unless they are at least a foot apart. So for small-sized vegetables I lay out raised beds in short, straight rows at least I foot apart, the rows running across the width of the bed. I don't use hexagonal patterns. In this book you will not find any recommendations for spacing of less than a foot between rows. And I am sure that once you discover the joy of a sharp hoe, you will rarely pull a weed by hand.

Working humusy soil atop a raised bed with a sharp, light, well-designed hoe does not take much time or effort. My current vegetable garden is about 65 by 70 feet, more than four times the average-size garden. During late spring and early summer, when everything, including the weeds, is growing its fastest, I can keep rows, hills, beds, and paths virtually free of weeds in about two hours a week. Later in the summer, weeding takes even less time because growth rates for all plants slow down. Allowing the paths to get a bit weedy also stops winter erosion.

Types of Weeds

It is not necessary to get rid of every single weed in the garden—only most of them. I have a priority system, and I recommend it to you. One type of weed I do not allow to exist at all, anywhere, ever, is grasses.

GRASSES

Grasses have highly invasive, dense root systems. Although low-growing grasses may not

compete for light, their aggressive roots rob the soil of most of the available nutrients and water, stunting nearby vegetables. Grasses have a strong ability to grow rapidly in shade, and many types multiply through underground runners, forming big masses that are very hard to remove gently. Established clumps of grass neither hoe out nor pull out easily by hand, and getting them out by yanking or chopping can damage delicate vegetable roots nearby, so it is essential that you destroy grasses before they become established. Make a regular weekly patrol of the garden. In a single week no grass plant is going to grow very large. If, when hoeing, you try to expose the roots to the air and sun, the plant is almost certain to die. If it somehow reroots, this weakened plant is much less likely to survive when you hoe again. The only time I bother to pull grass by hand is when some has eluded me for a few weeks and formed a clump. If it is very close to a vegetable (and it usually is, because that is how I overlooked it in the previous weeding), I try to loosen it gradually and pull it gently by hand so as not to upset the vegetable the grass clump is trying to strangle.

Even grasses growing in paths should be removed. Otherwise, they'll form a tough sod and will soon be invading the beds.

Some people are terrified of grasses that propagate through underground runners, calling them witch grass or twitch or couch or cooch. Or worse names. This sort of grass isn't really so bad. If once a week you cut off twitch ½ inch below the soil line, getting every little bit of it that shows to the light, the food reserves stored below will gradually become depleted and the plant will eventually die. It might take you a couple of months of repeated weekly hoeing to accomplish this. You can also get rid of horseradish, blackberries (even wild ones), comfrey, and any other very persistent plant that puts up big, fast-growing sprouts from food-storing roots in exactly the same way. The key is a *sharp* hoe and enough room between your vegetables to wield it.

PERNICIOUS WEEDS

Certain weeds are very hard to eradicate because they grow quickly and/or spread through underground runners and/or make huge quantities of seeds that spread widely. Included in this group are thistles, morning glory, and nightshade. Sometimes I feel like including sheep's sorrel in this group, too. These weeds should not be permitted to make seed in or anywhere near the garden. It is wise to mow a swath 25 to 50 feet wide around country gardens once a month to reduce the number of weed seeds blown into the garden. Incidentally, thistle stalks store so much water that once the plant has flowered it can still make viable seeds after it has been cut down. So either cut them well before the blooms form or, if it is too late, chop the stalks into short pieces and make sure they're lying in the sun. Also be sure to cut off the stalk below the soil line to kill the growing point, or they'll resprout from the roots. Again, the key is a sharp hoe.

OTHER WEEDS

Even though your rows are at least a foot apart, a month or two after emergence the

fast-growing vegetables form a leaf canopy that hinders hoeing. The shade of this canopy will strongly suppress any new weeds that sprout. But a few will sprout and grow anyway. Any weed in the garden that begins to peek through the crop leaf canopy should be pulled. There won't be many emerging, and they'll yank easily from the uncompacted soil.

I should also mention that toward the end of the summer I largely stop weeding except around overwintering crops (especially alliums). I stop fighting everything—everything, that is, but grasses. There are several reasons for this. One, the weeds growing at that time of year are not going to make seeds until next spring, and I will hoe them out before that happens. Two, weeds in fall and winter grow slowly, while in most cases the vegetables are way ahead of them. Three, I would like the garden to go through the winter covered with as much green as possible to reduce compaction from winter rains, prevent erosion, and leave the soil as loose as possible next spring. Weeds will do this job as well as any green manure I'd intentionally sow.

Thinning

It doesn't do much good to reduce weed competition if the vegetables compete among themselves. To grow properly, each vegetable needs a minimum of space. To grow its very best, each vegetable needs as much unoccupied space as it can possibly use at its full development. Crowded radishes will not bulb at all. Crowded carrots mostly develop tops. Densely packed bush beans set small, often tough, and frequently misshapen pods that take a long time to pick. Crowded tomatoes, zucchini, and cucumbers stop setting fruit.

I wish it were possible to produce a packet of seeds, every one of which would germinate and become a perfect plant. Then it would be possible to sow one seed where each mature plant was desired—and there would be no thinning. But alas, this is not the nature of vegetable seed. This brings to mind the old legend about Squanto teaching the Pilgrims how to grow corn: Make a hill of loose soil, dig a hole in it, put in a dead fish and cover it deeply, and plant four corn seeds well above the fish—one for the worm, one for the crow, one to rot, and one to grow. But if the one don't rot or the crow don't come, there's thinnin' to be done.

I've met gardeners who just cannot thin out crowded seedlings. It seems like murdering children to them. I entreat you, gentlest of persons, to reconsider the nature of plants. Thinning seedlings is not like drowning unwanted kittens. *Vegetables don't mind being thinned.* They actually like it. They know that you are helping them by thinning them out. They understand that the gardener has to plant several seeds to get a single plant established because they do the very same thing themselves on a much larger scale. Wild plants sow a hundred times more seeds than a gardener will sow to get a single plant that grows to maturity. And they thin themselves out in far less gentle ways than the gardener will do it.

Here are two examples from nature that

illustrate what I mean. Observe the natural propagation of any member of the cabbage family, collectively known as coles. Coles are mainly biennials. After overwintering, they shoot up flowering stalks covered with enormous sprays of yellow or white flowers; each flower then becomes a skinny seed pod an inch or two long containing half a dozen or so seeds. These pods mature and dry out in the heat and drought of midsummer. Some seeds fall to earth from pods that split quickly; these may sprout with the next rain and get a jumpstart on the competition. But if the summer proves hot and dry, these early releases may well die off. Seeds held more securely within the pod are protected from the first rains of late summer; these sprout only after the whole pod falls to earth and gets thoroughly soaked, when soil conditions have become nice and moist in autumn. Often all of the seeds within a single pod sprout at once, splitting it open with their germination, and come up as a little cluster. All of this variation is good, just as Darwin says in Genesis.

Most likely, all of the seeds within a single pod are the result of a visit by a single bee, but each seed might be parented by a pollen grain from a different plant. Thus every seed in the pod may also be different. Brassica seeds are tiny and the seedlings weak and small, but coming up in a clump they combine their force to push through the soil on top of them, so a cluster of seedlings may emerge where a single seed would fail to grow. Each seedling in this clump competes for water, nutrients, and light. The single most vigorous one eventually dominates the space, and the others die off. The winner is best suited to reproduce. A wild cabbage may produce ten thousand seeds to have but one survive to produce seeds next year.

Or take a member of the cucurbit family. A wild cucumber or wild melon makes quite a few fruits, each full of seeds. After the fruit dries out, these all sprout in one huge cluster. Like the brassica pod, the seed within that single fruit was probably pollinated by a single bee bringing pollen from hither and yon. Consequently, the many seedlings are all different. The one that dominates the area is the one that grows to produce more seed next year. All the others die, mainly of starvation, and they die young.

I hope that's sufficient argument to convince you, gentle readers, that thinning agrees with nature's plan.

As a general rule it's wise to sow extra seeds and, after emergence, thin them in three gradual steps over three to five weeks. This ensures a stand even if germination is low, bad weather slows early growth, and you lose a lot of seedlings to insects, slugs, or diseases. Another general rule is that the bigger the seed, the more certain the germination and the fewer seeds you need to sow for each plant wanted. I always sow two to four large seeds (corn, beans, squash, melons, cucumbers, radishes) and four to six small seeds for every final plant I want. I make an exception for those very spendy hybrids that are priced by the seed; these are usually so vigorous and so uniform that it is enough to sow only two or three seeds for each plant desired.

Immediately after they emerge, the survivors should be thinned a bit, but only where so

much seed was dropped that clusters of seedlings appear. During their first week some of the weaker seedlings will thin themselves out for you, by falling prey to damping-off diseases and insects. In most species the first true leaf should develop in another week. Then it's time to thin the stand to about ½ to 1 inch apart, with big seeds at least an inch apart.

With open-pollinated varieties, by the end of two weeks the more vigorous individuals will stand above the others. At this point, pull out the weakest seedlings to give the stronger ones more unencumbered growing room. Should a rare and remarkably vigorous plant appear, pull it out too. This one is probably an unintended intervariety cross-pollination. It'll grow like gangbusters, but what a cabbage-kale or zucchini-pumpkin cross finally produces may be very disappointing.

Guiding these thinning steps is the intention that vegetable seedlings should never, ever be allowed to compete with one another for light, water, and nutrients. I can't stress this enough. When you sowed those seeds, you undertook to maintain the terms of a contractual agreement we humans made with that species long ago when it agreed to become our vegetable and we agreed to prevent it from having to compete. If you don't fulfill your end of the bargain, the vegetables won't be able to do their best.

Once the little plants are "established" (by this I mean that they have three true leaves and are growing well), they are pretty immune to sudden loss from insect or disease, and they can be thinned to the desired final spacing.

The Facts of Light

Gardening with grace involves participating as vegetables respond to those things (factors) that control their behavior. Throughout the rest of this book, I use the scientific word "factor" to describe this. A "factor" is simply something that influences or determines what happens.

I've already discussed some of the factors that determine plant growth, such as competition and spacing. Eventually I go over most of them, and eventually you'll see how these factors interact. Then you'll be a pro.

To paraphrase Louise Howard, gardening consists mainly of being a servant to the plant. Our job as servant is to adjust plant growth factors toward the plant's ideal. We can do a great deal to improve soil moisture, soil nutrient levels, competition, the quantity of air, and organic matter in the soil. We usually cannot afford to change air temperature or overall light levels.

People living in temperate climates all notice that the "force" of the sun changes with the seasons. However, they may not notice how much these changes affect plant growth. Since my garden is my year-round produce counter, I have become as responsive to changes in light levels as my plants are. I feel the sun's force in my bones and on my skin; the sun's force tells me what do just as it does with the wild plants.

In about mid-February a bit of strength returns to the sun. After this date the hardiest of vegetables begin to grow slowly. Bulbs come

up. And unless the spring seems unusually harsh, on around March first I begin sowing peas, radishes, broad beans, and other leafy greens like lettuce, mustards, and spinach. I also thoroughly weed and side-dress (fertilize) any overwintered onion family crops because just as their relatives the ornamental bulbs do, alliums resume growth at this time. Were I to sow or fertilize earlier, even if the weather cooperated with a few sunny, warm days, and they germinated, the little plants just couldn't grow. And although *I* may want to start gardening and *I* need to do some planting after a long winter of spending too much time indoors, if the weather of early March is not conducive to planting I have learned after many years of frustration and self-induced failures that there is little reason to rush out and put in seeds. The growth rates of early March are so slow that something started several weeks later will mature only a few days later.

By early April the sun has become forceful. Species that store sugar can now grow, so I sow beets, onions, and carrots. Even though these can often germinate under plastic five or six weeks sooner, they'll barely grow before April because there's not enough solar energy. By mid-April the sun begins to feel much stronger—when it shines. I can start those popular tropical vegetable species that in our temperate region must be started indoors. They'll be ready to put outside about mid-May. If I started them sooner indoors and set them out in a heated greenhouse when they were too big for an indoor environment they just would become spindly from low light levels, grow too slowly, and probably have disease problems. A few more weeks pass, and the sun feels extremely strong. I can begin to sow those semitropical vegetable species that we direct-seed outdoors, like beans and corn—unprotected if I live where there is no more frost danger, under plastic if there is still danger of frost.

I sow most autumn and winter crops before midsummer, while several months of strong sun remain. By August, I start species that will overwinter and be harvested in the spring, so they will gain some size but won't become too big before October's low light levels check their growth, because smaller (but still substantial) plants are more tolerant of frost and rain than are big ones.

About early September, while the juicer is cranking out "V-7" and real fresh prune juice by the gallon and I go into sugar shock every morning from the melons, my whole body begins to mourn the loss of summer. That may seem strange when the summer garden is at its peak. But not only does it become difficult to get a suntan after August, the flavor of our delicious garden fruit has already started to decline. Plants need strong solar energy to make the excess sugars and other flavoring substances that give garden fruit that special taste. Powered by less force, the tomatoes lose their richness, eggplants and peppers get smaller and become relatively tasteless, and melons aren't disgustingly sweet anymore, while their vines begin to look scruffy and soon succumb to powdery mildew. This leaf disease also affects the other cucurbits. First the cucumbers and melons go, and even if there is no rain or heavy dew, by the end of the month, the squash go too. The cause of powdery mildew

seems to be rain or heavy morning dews, higher daytime humidity and chillier nights. The real cause is overall plant weakness from lack of light energy.

Since we eat mainly from the garden, these losses seem okay because by then we've had our fill of fruit anyway. I'm always glad to switch my diet away from sugars and toward more salads and other leafy greens, and starchy root crops.

Even if frost hasn't taken them yet, by the middle of October the tomatoes can no longer ripen fruit, and all of the tropicals and semitropicals succumb to molds and mildews. Putting a plastic tunnel over them will retard this by a few weeks, but not for long. There just isn't enough light energy for tropicals.

Under winter's weak light, only a very few ultravigorous species are able to grow any new leaves. A few more very hardy ones will barely maintain the leaves they've already made. Winter conditions don't provide enough light for accumulating surpluses, so plants cannot enlarge storage roots, form seed, or make and ripen fruit. Thus, winter gardens must of necessity consist largely of very hardy leafy greens and root crops that hold in cold storage under the soil.

West of the Cascades, where winters consist of day after day of cloudy skies and low light levels, protecting fruiting vegetables in greenhouses does not solve the problem of light deprivation. Even though they are warm and relieved of the stress of repairing the ravages of endless rain beating on their leaves, light-weakened greenhouse plants make flavorless fruit, set it very sparsely, and ripen it very slowly. The only way to have good-tasting tomatoes, peppers, zucchini, cucumbers, and the like from November through March is to provide intense artificial light.

LIGHT INTENSITY AND GROWTH RATES

If you want tender, sweet young lettuce salads every day, all summer, through the autumn, and as long into winter as possible, allow me to guide your thoughts for a few paragraphs.

The last section underlined the fact that as light intensity changes with the seasons, the speed at which plants grow changes. However, there's more to this concept, which when you grasp the idea, will give you a better supply of salad greens or radishes or whatever other fast-growing cut-once-and-be-finished-with-it vegetable you choose to grow.

At first glance it seems that many kinds of plants start out growing slowly and then pick up more and more speed as they get bigger. Actually, they often don't. From mid-April through August, the months when the sun's energy is quite strong, many plant species grow at a fairly uniform rate, but the amount gained in each period of time increases geometrically—1-2-4-8-16-32-64-128. Plants grow much as bacteria or yeasts do, by splitting their cells, two for one. A plant makes a leaf. That leaf gathers sunlight, water, and nutrients and makes enough food to support the leaf itself and some extra. The extra allows the plant to make new cells, which make food, which make extra. One leaf makes two, the two make two more each, or four; the four leaves double and make eight. This goes on

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