PLANT PROPAGATION PRACTICES

James S. Wells

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To my wife Cecil

whose comradeship and loyal support has made all things possible, this book is affectionately dedicated

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Introduction

THE selection and propagation of plants is one of the oldest works of mankind. Plant collecting expeditions were organized and sent to the farthest points of the known world by the Egyptians 5,000 years before the birth of Christ, and intensive plant selection and propagation was an integral part of Chinese culture long before western civilization as we know it came into being. Through the centuries of man's slow advances from primeval ignorance, his close attention to all kinds of plants has been maintained, first from sheer necessity, and later from a desire to surround himself with beautiful things. During the Middle Ages, the art of plant production had already achieved a high degree of excellence and complexity, but had not been organized on a proper scientific basis. The extraordinary lengths to which growers went during this period and later to grow special plants makes strange reading today. I recently came upon a most extraordinary recipe for a compost devised by Isaac Emmerton, a grower of auriculas, who published his methods in 1815.

Convinced that auriculas needed a rich compost he came up with "three parts of goose dung steeped in bullock's blood, three parts of sugar-bakers scum and two parts of fine yellow loam to which a small amount of sand might be added as required." The dung and the blood were put into a pit and left to putrefy. In six weeks or so when the mass had solidified it was dug out and mixed with the sugar-baker's scum and loam. The mixture was then exposed to the sun and air for two years, and the heap broken down and raked through each month. At the end of this time it was considered ready to use.

Horticultural knowledge has advanced in 140 years, particularly in the past quarter century, yet nothing has been learned that has changed the basic principles of good growing. Science has presented a number of excellent tools, which can greatly increase efficiency, but in order to use them properly and to the maximum advantage, a thorough grounding in horticulture through practical experience must be acquired. There is no substitute.

It was my good fortune to be brought up by my father who was a plantsman of the "old school." He started work at the age of twelve, working six days a week from 6 A.M. to 6 P.M. and cycling six miles each way to his work. Such were the conditions of his day and he thought nothing of it, but in the course of his long apprenticeship he learned the real fundamentals of plant growth, and as I became old enough to take an interest in what he was growing, he began to try to instill in me some of his knowledge. I was not too apt a pupil, but any skill that I may have in my chosen work I owe directly to my father. And it was he who prodded a most unwilling son to try to put into words some of the things we were doing.

It is now botn a duty and a pleasure for me to try to record some of the points which have seemed of value in my daily work. The notes presented here are not intended to provide a complete review of all methods of plant propagation. The purpose has been to simplify and to present a brief introduction to some of the more important fundamental principles which govern plant propagation. Any single aspect could be the subject for a book, but I have tried to bring out some of the practical details which seem important for the young grower seeking help with his immediate problems. The exchange of information in this way is vital to our craft. Therefore, I would be delighted to hear from any grower anywhere, giving of his experiences, particularly should they differ with the ideas recorded here.

In writing this book, I have received constructive help and criticism from so many people that it is impossible for me to name them all individually, but I would like especially to thank Dr. Wendell H. Camp for his assistance in writing Chapter 4. Much of the material of this book has appeared as articles in "The American Nurseryman," and I wish to record my appreciation to Mr. F. R. Kilner, not only for his permission to republish, but for his unfailing support and wise counsel. The photographs which can add so much to a book of this kind were produced at The Seabrook Farms Co., Bridgeton, New Jersey by Mr. Edward Taubert and Mr. Robert McClelland whose patience in attempting to portray what I had in mind was unending. Finally, I wish to acknowledge my sincere appreciation to Mr. C. F. Seabrook for his unselfish support of my experimental work, and his sympathetic understanding of the problems with which we worked.

J. S. W.

Dundee, Illinois
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PART 1

Setting Up and Equipping a Propagating Unit

THE young nurseryman who has recently decided to do some of his own plant propagation is immediately faced with a number of important questions. Is the site suitable, and if not, how can it be made so? What is the best site? What equipment is needed? Perhaps he does not have too much capital and wants to start in a modest way. How can this be done without wasting effort, time, and money? Is it possible to start propagating with simple equipment and add to it as means and needs increase? What is an ideal propagating unit?

To these and many other interrelated questions an attempt is made to give an answer in this section, with the usual conditions of the young nurseryman borne in mind at all times. Apart from these immediate questions, some of the wider aspects of soil conservation, its place in the planning of the good grower, and its value and importance in plant propagation are considered. To some people, soil conservation may seem somewhat remote from plant propagation, yet it should not be, because it is the very essence of this work.

Often growers use such a book as this to dip into as the need arises and, if they are not right on the threshold of building a frame and a greenhouse, that section will be left to read at some later date when they think they will have more time (and that never happens). But it will be best to read this book straight through the first time. It will then be more readily understood and of greater value in daily work.

NOTE: Numbers in parentheses refer to the appendix.

CHAPTER 1

Choosing the Site

THE choice of a site for the nursery and propagating department is one of the most important matters which confront the would-be grower, for upon the wisdom of his choice may rest the difference between failure and success.

ASPECT

No matter what the purpose may be, the points to watch are the same. At the head of the list is aspect. Aspect means the lie of the land in relation to adjacent land areas and prevailing wind, and also in relation to trees, buildings, and other factors which may affect the climate. The ideal aspect would be an almost level area having not more than a one per cent slope to the south. It should be protected on the north by a good belt of trees and at any other point from which strong, cold winds can be expected. It should be reasonably high with perhaps slightly higher land to the north but with lower areas to the south. While these conditions would be ideal, there are few of us who can pick and choose to this extent. Many a fine nursery and propagating house is situated on a north or west slope, and one I saw near Pittsburgh was perched on what seemed to be the side of a mountain. Yet excellent plants were produced there.

But if there is a choice, it is wise to exercise it and to know just what to look for and why.

Land Drainage. The lie of the land in relation to surrounding land areas is important on two counts: land drainage and air drainage. If there are high areas above your fields, it follows that water must drain down to you. Therefore, land drainage must be adequate. The local office of the soil conservation service can be of help. (1) They will have the whole area plotted, and will be able to tell just how much seepage of water you can expect and how much runoff may follow a flash flood. Both points bear directly upon the well-being of your land and plants. There is hardly a piece of land which cannot be drained and made usable, given sufficient money, but drainage of waterlogged land, and protection of land from flash floods coming from a large watershed above, can be a costly business.

Rainfall and runoff and, above all, ditches, waterways, and outfalls should be checked on your land and on your neighbor's both above and below you. It may appear at first sight that land drainage is adequate by the natural ditches and valleys in which flash floods are carried, but it is not wise to assume that this is so. Even natural drainage can become clogged and virtually useless, requiring much expensive work with draglines and heavy drainage equipment to ensure efficient operation. Clear drainage channels are essential to points below your land, because the farther down the natural drainage area you go, the larger the amount of water which has to be dealt with, and the more efficient the drainage system must be.

Air Drainage. Allied with land drainage is the question of air drainage. Hot air rises and cold air drops to take its place. This rise and fall of air and the flow of cold air to the lowest point is what produces those frost pockets which are usually difficult to cure. Some frost pockets are created by thoughtless planting of thick hedges and windbreaks across the natural path of air drainage. A thick hedge, a brick wall, or any other obstruction to the even flow of the cold air along the surface of the ground will result in a frost pocket. Many an orchard has been changed from miserable failure to regular production simply by cutting a good wide hole in the boundary hedge at the lowest point of the land. This allows the cold air to drain out as it falls to ground level and pass on before settling down to freeze. It should be remembered that still, calm air will freeze first; moving air much later. So, a piece of land at the bottom of a valley is to be avoided, no matter how well protected it may seem. In fact, any piece of land which is completely surrounded by high land, high trees, high buildings, or anything which might stop the flow of cold air to lower areas should not be considered. Thus, the losses which may follow the first fall frost can be eliminated, and heating bills will be materially reduced.

These points are important in producing young stock in heated greenhouses, but they are of minor interest only where propagation is to be carried out in the open land, as with fruit trees or roses which are propagated by budding during the summer months.

Windbreaks. Some protection from prevailing winds is desirable, likewise protection at those points from which occasional stinging cold winter rains and wind may come. A good belt of trees is an ideal windbreak, and it is good business to plant one if natural protection is not available. Many of the pines such as *Pinus sylvestris, Pinus strobus,* and the common Christmas tree, *Picea abies* (Norway spruce), are excellent for this purpose, and plantings will grow into a first-class windbreak in ten years or less. But if protection can be had naturally, it is better and less expensive. Protection of this kind is particularly valuable in conserving heat. It is not so much the intense, still cold but rather the penetrating chilling winds that blow through every crack and crevice of the house taking away heat and running up fuel bills. From this point alone, it is well worthwhile to take full advantage of all natural protection from the elements for the saving is constant and considerable over the years.

One point of warning here in regard to wind. It is virtually impossible to stop wind. It can be deflected, or its force changed for a time, but to stop it completely is impossible. The design and planting of a windbreak should aim at providing a defense in depth and should filter rather than block the wind. A broad belt of trees or shrubs, planted in well-spaced, staggered rows will do this admirably, reducing the velocity of the wind, calming and tempering its effect both upon plants and greenhouses. It is possible to so arrange these shelter belts as to create a relatively calm oasis, when outside a full gale may be raging. Part of my boyhood was spent on the Scilly Islands which are situated 40 miles out in the Atlantic off the west coast of England. I well remember the fierce westerly Atlantic gales, for never a year passed without winds of 90 miles per hour or more being registered. Yet these islands, being in an almost frost-free climate, are particularly suited to the production of early flowers, mainly daffodils and narcissus. These are raised in small rectangular areas of land on the side of the hills called "gardens" and, for protection, each garden is surrounded by a thick hedge of *Escallonia macrantha,* a shrub not hardy in many sections of the United States. As a result, the flowers came through the early spring gales without damage, for no matter how wild the weather, the hedges which were 10 to 12 feet high and 5 to 6 feet thick filtered the wind so successfully that it was almost calm and still inside. But the principle is to *filter,* not to *stop*. Where solid screens were erected as a trial on the islands, they were promptly blown down with the first full gale.

Elevation. Height above sea level should also be considered in regard to aspect, for it will affect the climate—particularly in the winter. The higher the elevation, the more severe the weather can be. Closeness to the sea or any large mass of water will tend to temper extremes of temperature. It is well known how much more temperate is the climate within ten miles of the seacoast, and this is due to the fact that water absorbs heat from the sun during the summer, thus cooling the hot days, and releases this heat slowly through the winter. Any fairly large spread of water will do much the same. The flourishing nursery industry which developed in Ohio, Pennsylvania, and New York along the coast of Lake Erie, shows this principle put to practical use.

SOIL

No amount of good soil can overcome an inherent fault due to poor land drainage or inadequacy in any of the other major points of aspect. Good land must be correctly placed to be of real value.

But if these points are checked and found in order, soil itself must be considered for what manner of soil it is, and how it can be expected to grow the intended crops. If the soil is extremely heavy, it is difficult, if not impossible, to get a good tilth for a seedbed or for planting out young material and both the cost and complexity of daily operations will be immeasurably increased. If the soil is highly alkaline, costly and difficult alterations will have to be made before it can be used for any of the normal propagation practices. Since soil condition is one of the most important factors in all phases of plant growth, it is necessary to know and understand just what particular soil condition each plant requires. It may well be that as the stock develops, it will not be so critical as to the soil conditions in which it finds itself, but in the young stage, from seedling or rooted cutting onwards for two or three years, exact control of soil condition is necessary for the proper development of lining-out stock. It therefore follows that a good, sound, medium loam will require less alteration to meet the particular requirements of any group of plants, with a consequent lessening in work and operating costs. A "medium" soil, such as a sassafras or a gault loam, in good heart, which has been well treated in the past is a good choice. Such a soil cannot help but grow good plants.

Conservation. Here again government services are freely available for the asking. (1) Practically all the main growing areas in this country have now been mapped from the air by the soil conservation service of the U.S.D.A., and all farms and fields are clearly shown. The different types of soil in each locality have been plotted onto these maps so that it is possible to obtain exact, up-to-date information on the composition and growing power of the soil in particular fields. Alternatively, if the land is already in use, then this information, coupled with soil tests, makes it possible to decide just what the land needs to bring it back to a state of full fertility or to keep it there. Remember, good soil is capital just like money in the bank. It can be used wisely, so that it brings in regular dividends, or it can be used wastefully leading to eventual bankruptcy and ruin.

How much fertility is lost when one B&B crop is removed from a piece of land? On a crop of five- to six-year taxus, an inch to an inch and a half of topsoil will probably be removed. On an acre of ground this represents a loss of about 150 tons. Soil scientists estimate that it takes ten

1 Soil Conservation. *(Top)* It is a capital loss when the land looks like this. *(Bottom)* The return of common sense. Long slopes broken up by well constructed and well protected terraces.

thousand years to make an inch of topsoil—and that ten thousand years' production can be depleted in seven. "What of it?" one might say, "there's plenty more underneath." Yes, I suppose there is, but it was that type of selfish thinking which produced the dust bowls of the Midwest.

In using land, no matter for what purpose, it is part of your debt to the people who came before you to leave the land in a better condition than you found it. How is this possible when an inch and a half of topsoil is taken away every seven years? This inch and a half of topsoil can just about be balanced by proper methods of husbandry and soil rebuilding if there is no loss from other sources. Wind and water erosion are capable of removing about half as much topsoil per year as are removed in crops. Therefore, since topsoil is vital for livelihood, it should not be lost by careless handling and disregard of the natural laws of soil conservation.

In nature, soil is very carefully conserved and is not allowed to waste. This is true at almost all levels of soil fertility Where growing conditions are extremely severe, nature has provided groups of plants adapted to grow under the particular conditions. All grades of crops, from light to heavy, including trees, shrubs, grass, and other herbage, hold the topsoil in place and prevent the rapid rushing of surface water across the land after a heavy rain. The rain is held at the point where it falls, and slowly soaks into the ground to form a natural reservoir which can be drawn upon later by the plants. Some water will percolate into the hidden depths of the earth and find its way by underground rivers to other areas where it may come forth and feed the recognized waterways which carry off the surplus. But by far the greater part of the rain water is held where it falls, immediately beneath the plants. Nature has created a balance between the destructive elements and the needs of the earth by covering the soil with plant growth.

Along comes the nurseryman, the lumberman, or the builder and strips the ground of its trees, bulldozes off the stumps, tears up the herbage, creates vast fields for mechanized operations, destroys the natural watersheds. We have fields of perhaps hundreds or thousands of acres. Heavy flash floods fall upon this land and instead of the water being held in place, it rushes to the lowest point, carrying crops, topsoil, fertilizer, and the farmer's bank account with it.

How can the dismal scene depicted here be rectified? The answer lies in the application of modern soil conservation principles to your growing operations. The basic principle of soil conservation is control, particularly control of water as it is deposited on the land. This control should be applied in a number of ways.

There is the excellent control provided by natural vegetation. In removing this vegetation and preparing the land for an "unnatural" form of cropping this control is removed and the land opened to a wide array of abnormal conditions. This natural control has to be replaced artificially. The long gradual slopes must be broken up into sections by terraces which halt the flow of water, reduce its velocity and carry it in an orderly manner from your land.

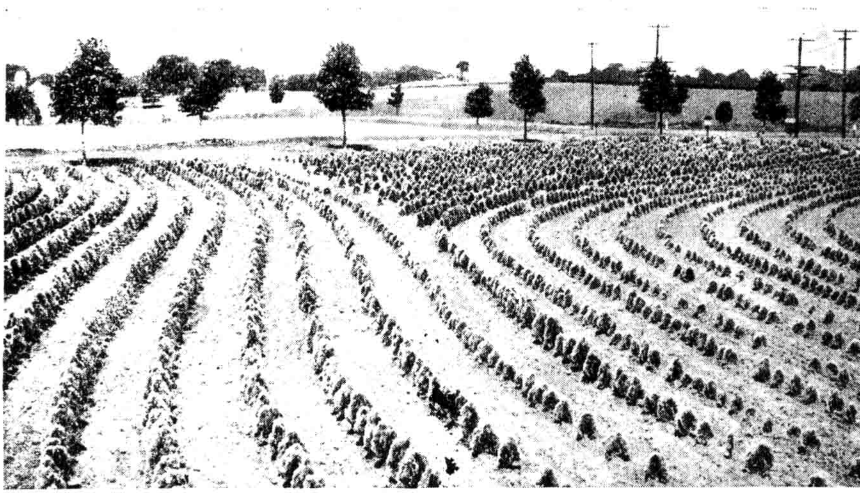
It would be ideal, of course, if soil conservation methods could be arranged to ensure that very little water would be carried off. That was how nature managed it before man upset things. But that is no longer possible; there must be a compromise. At times the water will fall more rapidly than our land can absorb it, and this surface water must be carried off in such a way that it does not take along our topsoil, our fertilizer, and our livelihood. Proper planning allows for the worst conditions which may be experienced in a ten-year period. By carefully measuring the area under consideration and by referring to the weather records, a plan may be made for the maximum amount of water which may be expected.

Terraces are designed to take the flow of water gently away from the land. They are constructed with a gentle fall across the slope and sown to permanent grass. This resists erosion and, if properly cared for with occasional fertilizing, liming, and mowing, will protect the land indefinitely. The flow of water follows these terraces until it comes to the natural point on the land where it would run downhill into the valley and thence into a river or other natural runoff system. At this point, a waterway can be constructed which is a wide strip of grass onto which the terraces from either side can deposit their surplus water. This strip carries the water down to the lowest point of your land in an orderly manner, and with the protection of good grass, the loss of topsoil is negligible.

As soon as the terraces and waterways have been constructed and sown to grass, the land is ready for planting.

Contour Planting. It is useless to terrace a field and, when planting nursery stock, to ignore the contour principles which fixed the site of the terrace. The plants themselves have to be planted on contour and to many a grower whose idea of good growing is a straight line, contour planting is just plain crazy.

We should therefore examine the advantages of contour planting. Each row really duplicates in a minor key the terraces which are already constructed. With cultivation along the row a small ridge is thrown up along the line of plants and this acts as its own small terrace. Falling rain is trapped on each row and held right around the roots of the plants. Unless the volume is excessive, it will have time to sink into the ground instead of rushing off. This is the heart of soil conservation. Time is the essence of the problem. Soil will absorb only so much water in so much time. A heavy fall of two or three inches of rain in an hour will be way



2 Contour Planting. This *Thuja orientalis nana* was set out by a single-row tractor-drawn planting machine. Four men handled 33,000 plants in one day.

beyond the capacity of any cultivated soil to absorb. Some water is bound to run off. That cannot be avoided, but when normal rainfall comes and the water falls on properly protected and contour-planted land, each drop is given more time to be absorbed into the ground because it is held in place by the contour rows and terraces. On uncontrolled land each drop of water immediately begins to move sideways instead of downwards and, joining with its neighbors, very shortly produces a gushing stream. This is not possible under normal conditions on contoured land for, even though puddles may form, the water eventually is absorbed into the ground.

Rebuilding Soil Structure and Fertility. If the land is fresh to nursery stock, then probably no rebuilding is necessary. It should be in good condition if it has been growing general farm crops, and all that is required is construction of the necessary terraces and waterways to protect it properly. If, however, your land has had nursery stock on it or has been heavily cropped in any way, the rebuilding of natural fertility will need a fair expenditure of money and much intensive work.

Soil conservation does not stop with the terrace or the contour row.