FIELD AND FLOWER GARDEN

SOME PRACTICAL HINTS FOR THEIR BETTERMENT

MANY have thought that decreased yields are always due to the exhaustion of certain chemicals from the soil. This is not always the case. In fact, it is seldom that decreased yields are due to the lack of plant food.

Plant origination, the highest type of work with plants, has shown the underlying principles of soils and their use. The results of fifty years' work in getting big results from the soil are here summed up in such a way as to show the underlying principles of crop production.

These principles are applicable on every farm, and may be applied in increasing the yield of any crop.

Years ago farming and gardening were "hit or miss" performances. Farmers tried methods because some one else had used them, and but few of them knew the reasons for any of the operations.

[VOLUME X—CHAPTER IX]
LUTHER BURBANK

In order to understand how to select soils and how to secure the best results from them, one must know the underlying principles of productive ability of soils and the methods used by plants to secure food from them.

Farming is now considered a manufacturing process. As a matter of fact, a farmer uses more kinds of raw materials and produces more kinds of finished products than any other manufacturer. It is just as necessary that he select his raw materials with extreme care as it is that the manufacturer of machinery select the most durable kinds of wood and the strongest kinds of metal.

Farmers have sometimes been criticised for not using more fertilizers but this is not always a just criticism. Fertilizers are valuable in some cases, but often a better physical condition of the soil would make it possible for the plants to secure enough food materials to increase the yield materially without adding fertilizers.

Profit in crops depends upon the location of the crops grown, the use to which the crops are put, and the cost of fertilizing when fertilizing is necessary. There are other things which affect the profits, but these are the underlying factors.

No definite rules can be given about handling the soil, for each one must work out his own practice according to his own conditions.
The Scotch Broom

This is a plant known to the botanist as Cytisus scoparius. The specimen here shown belongs to the variety known as andreanum, and has been described by some botanists as Genista andreana. The plant has become fairly popular in America, and it is a hardy and thrifty shrub, to be recommended for covering barren and exposed surfaces. Mr. Burbank has improved the variety by selective breeding.
LUTHER BURBANK

The value of soil depends upon its texture, the elements it contains, the exposure, location, natural drainage, the availability of the elements required, etc.

A well-drained alluvial soil of fine texture is the most productive with the average crop. Furthermore, it is usually most durable in its productiveness. That is, its valuable qualities continue to manifest themselves year after year.

Other things being equal, a field located in a comparatively level valley or plain is more valuable than one on the side of a hill. Often the soil on the side of the hill is rather thin and there is always the danger of washing. Rains come and carry the most valuable part of the field into the valley below.

Of course, hillside fields are valuable for some crops. In fact, in some cases, where the soil is rich, even better results are obtained on the hills than in the valleys. This is especially true in California and semi-arid sections.

North and east slopes are usually best for late crops, but the south and west slopes are always better for early crops. A slope toward the sun even of only one or two inches to the rod makes a difference in earliness of a week or more. This has been proven by many experiments.

The northern and eastern slopes hold the
ON FIELD AND FLOWER GARDEN

moisture longer but do not warm up so quickly. For this reason they are able to withstand drought better, but never yield as early crops as the southern or western slopes.

A clay sub-soil a foot or more below the surface with a sandy surface layer is the ideal soil for fruit trees. In fact, such a soil is good for most any crop. If the sub-soil slopes sufficiently to drain off surplus water, such a soil will always produce good crops.

CHEMISTRY AND PHYSICS OF THE SOIL

Plants secure their food from the soil through minute hair-like appendages on the roots, known as root hairs. The roots thus serve only as canals. The root hairs collect the food.

Because of the extremely small size of these root hairs it is plainly seen that any food used by the plant must be thoroughly dissolved before being taken up. These root hairs are deciduous like the leaves, and only active to any extent where the leaves are in existence and active. All food taken up by the roots is secured in solution and this makes it necessary to keep the soil properly supplied with moisture.

The presence of the proper chemical elements and moisture, however, is not the only thing that is needed for the root hairs to do their work well. Air must be present in the soil or it will be impos-
An Improved Crown Vetch

This is a useful and attractive perennial shrub, growing in California and in the Southern States, but unfortunately not hardy enough for our Eastern and Northern States. There are several species, giving opportunity for cross-breeding experiments, and it is possible that hardier varieties may be developed.
ON FIELD AND FLOWER GARDEN

sible for the root hairs to secure the necessary food for the plant.

The air in the soil must come from the surface so it is obvious that it is always necessary to keep the surface of the ground in such a condition that it will admit air. Thorough cultivation and deep plowing keep the soil in a loose condition.

In this connection an old English adage copied from The English Ploughman fits in well.

"It is not so tiresome to plow well, sir; your mind is interested."

Knowing that the plant’s roots must have plenty of air, one enjoys stirring the soil deeply for he knows that by this method the crop will be increased.

Cultivation must be frequent because the surface of many soils has a tendency to become rather hard and compact.

We may consider that there are minute tubes leading from the surface down into the soil. When the tops of these tubes are closed by having the soil bake it is easy to see that the supply of air is cut off. Stirring the surface, then, makes a connection with the outside air.

Cultivation also goes far in keeping insects and diseases under control. Many insects’ eggs and larvae and many disease germs are found in the soil. When the field is stirred frequently, these
are brought to the surface and exposed to the hot sun and thousands of them are thus destroyed.

Soil is of a very complex composition, and furthermore it is continually changing. A worm burrows into the soil and in his way replaces and rearranges thousands of soil particles.

As the root hair penetrates among the particles of soil it affects a change.

The passing of moisture from one particle to another makes changes which are of extreme importance from the standpoint of fertility.

Because of this everchanging condition, it is necessary to pay close attention to the cultivation in order to keep the conditions as near uniform as is possible.

A soil that is not given the proper care as to cultivation often holds its valuable food elements like a deposit in a bank that bears no interest.

Every business man knows that it is an extremely bad policy to allow resources to lie idle, but farmers too often do not consider the elements in the soil as resources.

There are three important ways to make available the supply of plant food in the soil: One is by stirring the soil so that the air makes it possible for the root hairs to secure the elements. Another is by supplying sufficient air and moisture so that the elements in the soil will be dissolved.
The Acanthus

This handsome specimen grows in Mr. Burbank's garden at Sebastopol. The plants of this genus are natives of southern Europe, and it has been said that the ornamentation of the Corinthian column was suggested to the ancient architect by leaves of this plant. Some species of acanthus are hardy as far north as New England.
LUTHER BURBANK

And the third is by applying fertilizers which supply the plant foods needed, in an available form.

It does not always follow that when the yield of a certain piece of land is small, that land needs fertilizers. It is very often the case that the poor yield is due to poor seed or shallow culture, or other cause. If great care is taken in selecting seed from the highest yielding fields year after year, one will then know that when the small yield comes it is due to something else.

I do not mean to say that it is not necessary to fertilize, but I do mean to say that very often expensive fertilizers are added when a thorough stirring of the soil, drainage, or irrigation would accomplish the same result.

Soil that is producing fruit crops needs less fertilizing than that producing grain crops. The fruits contain such a large percentage of water that the essential elements of fertility are exhausted from the soil very slowly.

On the other hand, the grain contains a large percentage of the essential elements of soil fertility and it is necessary to add fertilizers to grain fields much more often than to orchards.

Now that the fertilizer manufacturers are under government supervision it is safe to use any good standard fertilizer on the market. Many ex-

[288]
ON FIELD AND FLOWER GARDEN

periments have been conducted to determine the right element in which the soil is lacking and supply that alone.

The analysis of soils has often proven of value, especially in scientific researches, but it is not practical for the average farmer to have a chemical analysis made of his soil to determine what kind of fertilizer should be used.

In practically every case good barnyard manure gives excellent results. In the same way, a fertilizer purchased on the market usually gives the results desired. Because of the complexity of the soil and the complexity of the requirements of the plants so far as different elements are concerned, it is plain to see that it seldom or never happens that any one element is wholly eliminated from the soil at a time.

Sometimes an element which appears to be exhausted from the soil is merely in an unavailable form. The addition of other elements in such a case, although they do not seem to be needed, may produce the required results because they assist the unavailable elements in changing to an available form.

Nitrogen usually has the most immediate and pronounced effect upon crops when it is applied in fertilizers. Nitrogenous fertilizers always produce quicker results, and when it is desired to get
California
Wild Fuchsia

The familiar fuchsias are known as hot house plants in the east, and they seldom attain any great size. But in their native tropical haunts there are some of them that attain tree-like proportions. In California, also, the fuchsia is a shrub growing to a good size, and serving a useful purpose as a permanent lawn decoration.
early crops, these are the ones to use, especially in the early part of the season.

Nitrogen is quite often in the form of ammonia in the fertilizer. Ammonia is very volatile and escapes into the air rapidly if not properly incorporated. A commercial product that has a strong odor indicates that the ammonia is escaping into the air.

Use a fertilizer when it is absolutely necessary, but make sure first that some cheaper process, such as cultivation, irrigation, drainage, or rotation of crops, will not accomplish the same result.

The physical condition of the soil in practically every case is more important than the chemical condition, that is, it has a more direct effect upon the crops.

Increasing Crops by Rotation

Many flower lovers have been dismayed at having a favorite collection of lilies almost entirely destroyed by insects. Such a disappointment can be generally prevented by moving the lily bulbs.

Great fields of grain, and large orchards of valuable fruit trees have produced smaller yields year after year until it was finally impossible to grow a profitable crop at all.

The remedy is rotation.

Each grower must be his own doctor, however. There is no short cut to profitable crop yields.
LUTHER BURBANK

They are obtained by the man who understands the bad effects of growing the same crop on one field year after year, and who knows that these effects can be avoided by making a change in crops.

Every horticulturist and every agriculturist should study what follows carefully. It tells why failures come, and why rotation forestalls such failures.

There are at least four important reasons why rotation of crops is necessary.

In the first place, insects which often gather in great numbers about certain plants are destroyed, or at least their number is reduced when other crops are grown on the land. This is because certain insects are adapted to depend upon certain plants for their nourishment. Lilies and amaryllis are often almost completely destroyed by such insects as mites, small centipedes, wire worms, eel-worms, etc.

Absolutely new, uncultivated soils seldom are troubled. It is mostly in gardens where plants from various quarters are grown that difficulty occurs.

These pests gather around the lower part of the bulb and if the bulbs are left in the same place several years the insects often destroy them completely.
Blossom of Night Blooming Cereus

The improved plant on which this beautiful flower grew is shown in the frontispiece of the present volume. Unfortunately the night blooming cereus is too tender to be grown except as a hot house plant in the colder climates of the eastern states; but it thrives in California, and deserves greater popularity than it has attained.
LUTHER BURBANK

Although this is not generally known it is the common cause for the destruction of lilies. Many have had beautiful lily beds exterminated and have been unable to determine the reason. Sometimes by transferring the bulbs to another location, if thoroughly disinfected before replanting, they can be saved.

If gladiolus bulbs, for instance, are planted in the same place year after year, they do not thrive. Usually there are fewer and fewer bulbs as the seasons progress, rather than more, and those that are produced are much smaller than the bulbs originally planted. The plants are also less vigorous.

The third year the crop is almost a complete failure. It is necessary to practice rotation of crops with gladiolus.

The same thing is more or less true with most other bulbs, as most of them have a bitter poison or protective principle that repels these insects. Some of them, of course, are not quite so susceptible to the ill effects as others.

Various bacterial and fungous diseases also attack plants that are grown in one place year after year. These organisms, although they may not be entirely destructive the first year or two, gradually multiply and become a greater pest from year to year.

[294]
A Beautiful Flowering Cactus

This is the cactus known as Opuntia basilaris, a low spreading form that makes a very striking contrast with the giant spineless opuntias in Mr. Burbank's garden. The present species is too small to be of any value as a forage plant, but its flowers give it high rank as a border plant for the garden.
LUTHER BURBANK

When trouble arises from this source the remedy is to rotate the crops or, in other words, move the crop infested to another location.

Fungal diseases are especially destructive in potato fields. The potato scale, blight, and wart are well-known diseases which can often be wholly or partially controlled by the proper rotation and the planting of uninfected seed.

The third cause for failures is the unfavorable condition of the soil produced by the toxic substances thrown off from the growing plants. Plants, like animals, give off waste matter which is not only useless but poisonous to the plant itself, and often to other plants of similar nature.

These toxic substances are often less poisonous, and in some cases are beneficial, to other crops. It is obvious that when waste products from a certain crop have accumulated in the soil for a number of years, that soil is not as well suited to the crop as formerly. A change of crops practically always results in a more profitable yield because the waste products of the first crop are often not injurious to the second one.

The fourth cause, which is far less common than the others, is exhaustion from the soil of certain elements necessary to plant growth.

It is very seldom indeed that any one of the elements necessary to plant growth is wholly
The Sea-Urchin
Cactus in Bloom

There are several species of sea-urchin cactus, known to the botanists as Echinopsis. The propriety of the name will be obvious to any one who has seen a sea-urchin. The contrast between the stubby stock of the plant and its splendid flower is startling.
absent from any kind of soil. It does happen sometimes, however, that an element is not present in available form. The plant's roots, of course, cannot take up certain elements that are in such a form that they cannot be absorbed. When the supply of material in the form that can be used is exhausted, the plant does not thrive.

Quite often the failure of crops when it can be definitely attributed to the condition of the soil is due to an unfavorable physical condition rather than an unfavorable chemical condition.

Rotation of crops always has an important and essential effect upon the physical condition. When alfalfa, cow peas, clover, or some other legume is grown, the roots grow deeply into the soil and when another crop follows, the fissures or canals opened up by these deep growing roots are used by the roots of the new crop, besides storing considerable nitrogen. In this way it is much easier for the following crop to permeate the soil where there is plenty of moisture. The roots can develop much more quickly and with less effort than if the deep rooting crop had not been grown on the soil before it.

It is quite evident that the addition of barnyard manure has almost as much beneficial effect upon the physical and bacterial condition of the soil as upon its chemical condition.
The Camellia

This shrub was introduced many years ago from Japan, and has attained great popularity. It has double interest in that it is closely related to the shrub the leaves of which furnish the tea of commerce.
LUTHER BURBANK

The effects of rotation are most astonishing as shown by the results attained especially in California when grain follows a corn crop. There is usually fully twice the yield secured from the small grain crop following a crop of corn than when small grain follows a crop of small grain.

No doubt, the cultivation given the corn during the summer has much to do with putting the soil in the proper physical condition for plant growth. This cultivation destroys more of the microscopic organisms which are injurious to plant life, and releases elements which otherwise would be unavailable.

With the present varieties of plants, it will probably always be necessary to practice rotation of crops. But when plants are developed which are resistant to the various conditions which have been mentioned, rotation will perhaps not be so necessary.

Already certain plants have been developed which are resistant to numerous diseases and insects. Varieties of grapes are grown which resist the attacks of phyloera, and apples which are resistant to the attacks of aphis are well known.

Peaches and almonds which are not subject to curl leaf have been developed.

Plums which are not affected by the brownrot and plum pocket are now on the market, also
Cactus Blossom

Although Mr. Burbank's spineless cacti have been developed as forage plants and for their fruit, they deserve a place in any garden for their flowers alone. Not only is the massed effect of these flowers superb, but the individual blossoms are beautiful to the last degree, as this picture testifies.
cherries, pears, walnuts, and perhaps chestnuts, which are resistant to blight.

Because of the value to be secured from crops which need not be rotated, too much emphasis cannot be placed upon the importance of developing new plants for this purpose which are resistant to the various pests.

It will almost always be found that in fields badly affected with some disease or insect there are one or more plants which are not affected as seriously as the rest of the crop. By selecting such plants and perpetuating them by seeds or division, a new variety may eventually be produced that is resistant to the particular disease or insect which caused the damage.

If resistant plants were developed many old field and garden soils which have become worthless for certain plants could be made to produce profitable crops. Such soils are quite often thoroughly infested with numerous insects and diseases and the failure of crops is due more to this than to the lack of proper chemical elements.

It is possible to get resistant varieties of vegetables, grains, flowers, and trees and the process is the same in all cases.

Nature practices rotation of crops in the forest. A forest of hardwood trees is almost always replaced by soft wood trees. After these have grown
Pink Borders

This picture of the residence of one of Mr. Burbank's neighbors at Santa Rosa is introduced as giving a very good illustration of a modest garden that has been made beautiful by use of pinks as border flowers. Such an effect as this may be produced with very small expense, and with a minimum of labor, by selecting any one of a rather large company of border flowers, to meet the conditions of soil and climate of the particular region in which you live. It would be difficult to suggest a way in which a similar expenditure of time and money could insure greater pleasure; and you are benefiting your neighbor and the casual passerby as well as yourself. By making such use as this of even common flowers, you become a public benefactor.
LUTHER BURBANK

on the land for some years, they are replaced by hardwood trees. And so the rotation continues.

This is not intended to be a complete discussion on the rotation of crops. It is the principles which underlie the practice that are of the most fundamental importance.

It is impossible to suggest any definite kinds of rotations which will be applicable under all conditions. Each person must familiarize himself as much as possible with the underlying principles and determine the rotation that is needed under his own special conditions.

[END OF VOLUME X]

—The physical condition of the soil in practically every case, is more important than the chemical condition; that is, it has a more direct effect upon the crops.