
Use Garden Beds for Super-Soft Soil

The use of growing areas reduces the problems of soil compaction, giving you a more productive garden and less work.

RAY WOLF

GARDENS ARE CHANGING. All across the country, gardeners are rapidly putting to use a new type of gardening that disdains neat rows all lined up like little tin soldiers. These new style gardens feature growing areas, the planting of four or five "rows" within one row.

The reason behind the shift in garden layout is simple. It's easier and more productive to garden in what are termed growing beds than it is to garden by the old-style row method. The new mode goes under many names, with each school of thought having its own unique methodology. Yet they all boil down to the same basic design of not planting in individual rows, but grouping your plantings together into blocks or beds anywhere from 18 inches to six feet wide.

Although gardeners' reasons for switching to beds are varied, the main benefit they all receive — whether they know it or not — is improved soil structure. While advocates of growing beds will point to the many advantages of beds, far and away the thing they do best is prevent soil compaction within a plant's root zone, allowing for optimum growth.

Dr. Albert Trowse of the USDA's National Tillage Machinery Labora-

tory points out that we have bred specialized varieties for higher yields, and many people offer optimum fertilization to the plants, yet they grow them in compacted soil. "That's like running a thoroughbred race horse on a pony ride. With proper soil structure and no compaction, you'll have a real racetrack for those hybrids to run on," he said.

"Wherever you have cultivated soil, it is vulnerable to plow pan," Trowse claimed. In a garden undergoing constant cultivation, the potential is much greater.

A plow pan is formed by the compaction of finely pulverized (cultivated) soil particles into a thin, nearly impervious strata. This strata is a very effective barrier to root growth and to moisture travel. Plow pans form at the deepest level of cultivation, where pulverized particles get compressed against uncultivated soil.

PATHS LEAD TO MOST COMPACTION

Paths are the part of the garden subject to the most compaction, as they receive the most traffic. The overall effect of planting in beds is that the number of paths is decreased, as is the area of the garden subject to compaction. In a traditional gar-

den, you have a small strip of planting area, the row, with wider bands of compacted soil on either side, the paths. The photo (p. 68) shows the effect of compacted soil on root development of a one-month-old corn plant. The area was subsoiled, with traffic allowed on one side of the plant, and no traffic on the other side.

It doesn't take a genius to see that the side without traffic is far superior to the trafficked. In a garden of growing beds, the number of plants subjected to root-zone compaction is greatly reduced, as four or five rows of plants are put into one bed — instead of five rows flanked by six paths.

When talking about soil compac-

tion in the garden, Dr. Trowse is quick to note that it doesn't take massive tractors to create plow pans. In studies in India and Poland of fields that have never been mechanically farmed, Dr. Trowse has found compaction problems as bad as anything he has seen on large mechanical farms in this country.

He explained that the more you cultivate soil, the more vulnerable to compaction it will be. "A well-cultivated garden soil may need as little as 3½ pounds of pressure per square inch to form a plow pan. People walking flat-footed create about 5½ pounds of pressure, more than enough for compaction," he pointed out. "When they get up on their toes, the balls of

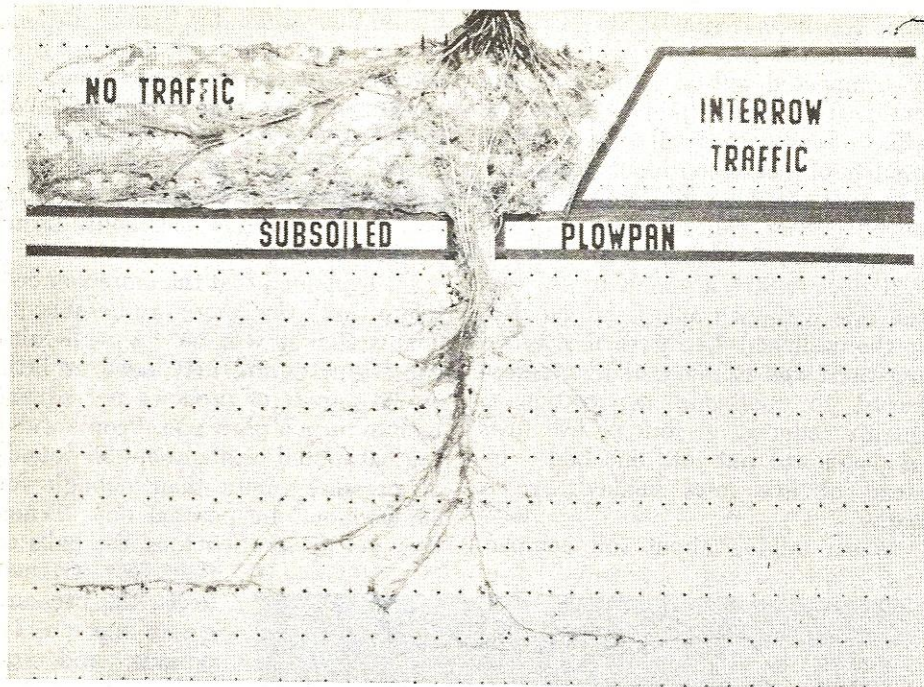
their feet, or their heels, the pressure goes up to 15 pounds, and you really have compaction," he added.

So what's a gardener to do? Dr. Trowse recommends that once you cultivate the growing area, stay completely off it. That's best done by using growing beds.

To see how detrimental a plow pan can be, let's



Once the permanent bed is constructed, walk no more on the growing areas! By avoiding compaction, you'll benefit from increased yields.



In this photo of a one-month-old corn plant by the National Tillage Machinery Laboratory, the top right area has been trafficked, and has very little root growth, while the side with no traffic has a good root system. The small subsoiled area allows the root system to penetrate the plow pan and make additional root growth.

assume you have a well-tilled garden, with a plow pan about one foot deep. The only water the plants can effectively use is what is in the area above the compaction. In a sandy soil, one cubic foot can generally hold about $\frac{1}{2}$ inch of available water, while soil high in organic matter can hold as much as $1\frac{1}{2}$ inches of water. Garden plants use an average of about $\frac{2}{10}$ of an inch of water a day.

When you figure that plant roots can grow an average of $2\frac{1}{2}$ inches a day, and the root systems of almost all plants can go as deep as six feet, you can calculate the amount of available water in an area without a plow pan, as compared to that with a plow pan. With a one-foot-deep plow pan, anywhere from $\frac{1}{2}$ to $1\frac{1}{2}$ inches of water would be available to the plant, or from three to seven days' worth. However, if the plant can reach the entire

six feet with its roots, you have an effective water supply that will last from 15 to 45 days.

With that information in mind, Dr. Trowse compared gardening with a plow pan and compacted pathways to gardening in a window box. "If you have a one-foot-deep plow pan, a plant has only one foot of growing depth, when it optimally could use up to six feet," he points out.

Dr. Trowse continued his explanation of the dangers of a plow pan by examining the effect of inadequate moisture and nutrients on a plant. "A plant will put out as many as 14,000 new feeder roots each day. It's up to these feeder roots to gather the water and nutrients the plant needs. If the feeder roots are getting enough water and nutrients, the plant can operate at 100 percent and make maximum use of sunlight," he explained.

"However, if these roots cannot get enough water or nutrients, if they are restricted to a one-foot growing area, the plant will not operate at peak efficiency," he said. He emphasized that "this is well before any visual signs of wilting would set in."

The detrimental effect of a plow pan can reduce a plant's operating efficiency anywhere from 25 to 50 percent according to Dr. Trowse. "And you don't need the classic rock-hard plow pan to stop the growth of feeder roots," he added.

GETTING RID OF COMPACTED SOIL

Thus, the challenge is to decide if you do have a compaction problem in your garden, what to do about getting rid of it and not cause another to form. Next time you get a good rain, wait three or four days, then go into the garden with a pointed metal rod. Slowly push the rod into the soil, and you will feel any levels of compaction before the rod hits the subsoil. The other option is to wait until the soil dries, and dig a soil profile from the surface to the subsoil.

If you find you have a plow pan, there are several things you can do. You can subsoil the area and plant a vigorous grass, then let it grow without any traffic on it for two or three years, and let the roots strengthen the soil to reduce future compaction worries. However, if you want to keep the garden area in production, you can break up the plow pan mechanically through deep cultivation. On farms, massive chisel plow-type equipment is pulled through fields with compaction problems. But in the garden, it normally must be done by hand or tiller.

One alternative is to sink a pickax or spading fork as deep as you can wherever you will be planting, as all you have to do is pierce the plow pan in the area below the plant. The other option is to either till or dig through the plow pan. Experiments at the Tillage Machinery Lab have

shown that the L-shaped tines of a rotary tiller tend to spank the ground at the bottom of their stroke to form what Dr. Trowse considers "less than ideal conditions." On rotary tillers with the L part removed from the tine, leaving a straight knife effect, results were much better, reducing plow-pan formation.

Dr. Trowse cautions that "If you're not willing to change your cultural practices to prevent future compaction, don't subsoil. What man tries to improve upon is normally where all the trouble is." However, he added, "If you subsoil and then don't walk on the growing beds, you'll have a superior garden."

Although breaking up a plow pan may be hard work, preventing one is not. Simply put, plow pans are formed in the very shadow of cultivation. Meaning that if you walk or ride over the soil after you cultivate it, you will be compacting soil everywhere you step. The more you walk, the more complete and impervious this barrier becomes.

The solution is to mark off the areas you will be growing in, then stay off them and limit your movement to established paths. In the USDA's work, the establishment of permanent paths to control traffic in large fields is the main answer to compaction problems. Between the areas of compaction, growing beds are formed with very good soil structure where test yields have reached three times the national average. You can do the same in your garden by establishing permanent growing beds and permanent paths. If you can't establish permanent areas, be sure at least to stay off the growing beds once established each year.

MORE BENEFITS TO GROWING BEDS

In addition to improvement in soil structure, growing beds offer a host of other advantages. By concentrating your water and fertilizing only on

areas to be planted to crops, you'll average a 40-percent reduction in the amount of ground under care. Besides, the improved soil structure allows plants to use the water and nutrients you supply much more efficiently.

Perhaps the best-known advantage of a growing bed is what is termed a "living mulch." The concept is that by planting rows close together, as the plants mature, the leaves will overlap. That provides very good shade cover for the soil, both reducing water loss and greatly reducing weed-seed germination. If you've ever stood in the middle of a mature forest on a hot summer day, you can appreciate this shading effect.

In a standard row garden, each and every plant stands alone in the row, with rows starkly separated from each other. With growing beds, the plants' foliage forms a much denser canopy. This increased leaf mass makes for much more efficient use of available

solar energy. Dr. Eugene P. Odum, professor of zoology at University of Georgia, has written that scientists have consistently found that maximum broad-leaf crop production is achieved when the leaf surface equals four to five times the surface area of the garden. There is no way you can reach this level with standard row spacings.

What Odum's work means is that row gardens do not use all the solar energy that is available to plants. Compounding the problem of not using all the sunshine, plants standing



Planting beds lend themselves to trickle irrigation systems. Water is piped to the entire bed at once, with feeder lines in the paths.

alone use much more water than do those growing in a thick stand. Wind has a strong drying effect on both plants and soil. For example, a staked tomato plant that stands up in the air may need twice as much moisture as one allowed to run along the soil, due to increased transpiration when exposed to the wind. In a growing bed, only the two end rows would be exposed to the increased drying effects, while the middle rows would be well protected.

Another area of gardening that greatly favors growing beds is the idea of companion planting. (See page 56.) In beds, the beneficial effects of mixed cropping are much more pronounced than in row gardens. With growing beds, short-season crops can be planted along with long-season crops in the same bed. The short-season varieties will benefit from the other crop, yet be harvested before crowding ever becomes a problem. Growing beds are ideal for combining companion planting with succession planting for maximum yields.

As your season starts to wind down, it is very easy to put small portable cold-frame-type devices over an entire growing bed to preserve your harvest longer into the year without wasting precious cold-frame space on paths. By making all your beds uniform in size, cold frames and shading devices will be completely interchangeable.

It's hard to understand how the tradition of individual rows got started, for horticulturists have long known that plants grow best when closely grouped. Almost all gardening throughout history has used some form of bed configuration, except in the last 70 to 80 years. Perhaps the shift from beds to rows was done to mimic large-scale agriculture as it shifted over to mechanical means of cultivation. How ironic that now the USDA is looking at large-scale use of growing beds for field crops, while gardeners are still using rows.

PLAN A BED GARDEN

To plan a bed garden, there are only a few things you must remember. First, don't make your beds too wide. You should be able to reach the middle of the bed from either side, so you won't have to walk on the soil.

To figure out plant spacings, just use the spacing given on the seed packet for plant distance within the row, and ignore the advice about how far apart to put the rows. If a head of lettuce can have additional heads growing 12 inches away from it to the north and south, it can also have heads 12 inches away from it to the east and west. By improving your soil structure and avoiding compaction, you will have more vertical root growth in place of horizontal root growth, allowing more plants to be closer together.

If you are gardening an area that has a soil-compacting problem, try to work the soil in the growing beds as deeply as you can, without disturbing the soil stratification too much. Again, once you have worked the soil, stay off it.

If you are preparing your garden with a tiller or a shovel, cultivate only the area you will be planting. Once the soil has been worked, gently rake the sides of the growing bed toward the middle, to give about six inches of sloped side on each side of the bed. If you cultivate an area four feet wide, you should have a planting space about three feet wide left. In this area you can plant as many rows of plants as you wish, or you can use a matrix planting pattern, using octagonal spacings instead of straight rows. However, for beginners, it is best to stick to rows — spaced closely together.

Some beds should be four to five feet wide, while others may only be wide enough to support a double row of a climbing or sprawling vegetable. Generally, the smaller the vegetable, the better it does in beds.