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HELPS FOR TEACHERS IN AGRICULTURE

Soils

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The study of "Soils" in the Seventh and Eighth Grades of Indiana schools for the year 1914-15 will cover the following topics: Temperature of Soils; Moisture in Soils; Capillary Water in Soils; Physical Effect of Lime on Soils; Fertility of Soils and Sub-Soils; the Effect of Mulching; Working Wet Soils and Aeration of Soils.

Before taking up these topics, it is suggested that the teacher review with the pupils the work on Soil Types, Weight of Soils, Porosity of Soils, Soil Acidity, Physical Effect of Organic Matter in Soils and Drainage. It will also be necessary for the pupils to secure a quantity of each of the different soils and prepare same for use in the laboratory work as suggested under exercises on Soil Types.

Soil Types

All soils except muck or peat are derived from the breaking down and decomposition of rocks. This breaking clown and decomposition leaves the rock particles of various sizes. When the particles are rather coarse so that they can be easily felt and seen, they are called sand, and a soil made up largely of such particles is called sandy soil. When the particles are so small that they seem like powder, the soil which they make up is called clay or clayey. When fine and coarse particles are about evenly mixed, the soil thus formed is called loam. Muck or peat soils are derived from a decay of plants in swamps or shallow lakes. These soils are the accumulation of ages of growth and decay. The mass of the soil is almost entirely vegetable matter, but it contains more or less of rock particles which have been washed in to the depressions from which the muck has been formed.

There are several agencies which help in the formation of soils. Water is perhaps the most active agent. When it soaks into the rock and is frozen, it has a tendency to break the rock into particles. When it runs over the rock surface or rolls rock particles over each other, there is a wearing away of the rock particles into smaller particles. When ice and snow accumulate into a glacier and move over the surface of the earth there is a grinding and crushing of the rock particles until they are so fine that when the

glacier melts they remain behind as soil. Quick changes of temperature in some parts of the world affect rock particles in such a way as to burst them apart. The throwing out of the dirt from burrows by burrowing animals is also an agency in the formation of soils.

The different kinds of soils mentioned above have different properties of weight, color, temperature, size of particles, power of retaining moisture, etc. These properties are called physical properties. Two words are used in connection with physical properties which should be thoroughly understood. The term "texture" refers to the character of the particles whether they are fine or coarse. The term "structure" refers to the arrangement of these particles in crumbs. In sandy soils there is practically no structure because the particles do not stick together, but in loams and clay soils the particles stick together easily and have crumbs of various sizes. Large crumbs are called clods.

Exercises.—Have pupils secure samples of four particular kinds of soil—sandy, clay, loam, muck.

Other samples should be secured in the community by the teacher if possible and studied in class room for further identification.

Examine with the fingers and note differences in the grittiness of these different types.

Explain the reason for the differences in texture and color.

Study under a hand lens each type and note differences in size, shape and arrangement of particles.

Weight of Soils

Soils are usually spoken of as being "heavy" or "light." These two terms do not refer to the actual weight of the soil in pounds, but to the ease of cultivating. Soils which contain a good deal of sand are called light soils because they are easy to plow and cultivate and never produce clods. Soils which have a large amount of clay material and not much vegetable matter in them are spoken of as heavy soils. These soils, when they are dry, form hard clods and are difficult to plow and cultivate. Light soils, being sandy, usually drain quickly and warm up early in the spring and are adapted to early crops like vegetables. Heavy soils drain more slowly and do not warm up so quickly and are better adapted to summer crops like corn.

In actual weight sandy soils are the heaviest and muck or peat soils lightest. Loams and clay soils are medium weight. Sandy soils often weigh as much as 100 lbs per cubic foot, while garden loam soil will not weigh more than about 70 lbs. The amount of vegetable (organic) matter in the soil not only affects its actual weight but also affects the ease with which it can be tilled. The more organic matter, the lighter its weight and the easier it is tilled.

Exercises.—Weigh a measured quantity of the different types of soil in vessel.

Calculate the weight per cubic foot of each type.
How does the structure of good soil affect the weight?
Explain why sandy soils are considered "light."
What effect does organic matter have on the actual weight of a soil?

Porosity of Soils

If a tumbler be filled with shot, it can easily be seen that there are spaces left between the particles. If shot are of different sizes, the spaces will be different. If the tumbler be filled with shot of various sizes, the nature of the spaces will be still different. These different sized shot may be used to represent the different sized particles that go to make up the soil. When these different sized particles of soil are massed together, there are spaces left between them. These are called pore spaces. Now the pore spaces in the soil are influenced not only by the size of the particles making up the soil, but by the amount of organic matter in the soil and the way in which the soil is compacted. A loose soil will have more pore spaces than a compact soil.

A soil which has large pore spaces takes up rainfall very quickly while one with small pore spaces allows a dashing rain to run off its surface before it can soak it up. It can be seen, therefore, that a sandy soil, which has large pore spaces, will absorb a. rain quickly and let it percolate down through its mass without much resistance, but in the case of a clay soil, the pores are so small that the water cannot enter readily and a great deal of the rainfall will run off the surface and such as does enter the soil will percolate slowly, clue to the small sized pores. Thus it can be seen that a sandy soil does not require much tile draining, while a clay or loam soil will require more drainage.

Exercises.—Remove the bottoms from four quart bottles and make a rack for holding these inverted. Fill each with a given amount of each of the four soils. Add a definite amount of water simultaneously to each of the four bottles and note time necessary for the water to percolate through the soil in each bottle.

Note total amount of water each percolates from the time the first drop falls until dripping ceases.

Compact sand and clay soils in these bottles for a second phase of the exercises and add a definite amount of water as before. Take readings and compare with the first part of the exercise.

Why does the water percolate faster through sand than clay soil?

Does compacting affect the rate of percolation in sand? In clay? Why? What effect does the soil type have upon drainage requirements?

Soil Acidity

(This topic should change places with the topic for December, 1914—Physical Effect of Lime on Soils).

Soils are said to be sour, neutral, or alkaline. The neutral or slightly alkaline condition is the desirable one for practically all

farm crops. Nearly all of the plants that we call legumes will not thrive on soils that are called sour, especially clovers and alfalfa.

It is not easy to explain just how a soil is made sour, but some of the conditions which produce sourness are, lack of drainage, close, compact nature of the soil, continuous cropping, and absence of lime. Many of the muck or peat beds are sour, due to the constant decay of vegetable matter, absence of lime, and lack of aeration.

Whether the soil is sour or not can be determined fairly accurately by the use of the litmus test. Litmus paper can be obtained from the druggist. When blue litmus paper turns to a pinkish color after being in contact with damp soil for a short time, it is a pretty sure indication that the land is acid. To grow clovers and alfalfa successfully, it is desirable that the acidity be removed. This can be done by an application of lime to the land. Crushed or ground limestone is most commonly used for this purpose and under ordinary conditions, an application of 2,000 to 3,000 lbs. per acre is sufficient to correct acidity. It is best to apply this lime to the surface after the land has been plowed and work it in with harrowing and disking.

Exercises.—Take a glass tumbler and fit a circular piece of clean blotting paper in the bottom, lay under this strips of blue and red litmus paper, add a handful of soil from the home field, saturate with fresh rain water. After half an hour note the effect upon the litmus paper by removing the soil and the blotter.

Test samples of the four types of soil in this way.

To another sample of soil prepared in the tumbler for the litmus test in this way, add a sprinkling of lime. What effect does this have on the red litmus paper? Did any of the samples turn the blue litmus red? What does this indicate? How would you correct this condition?

Physical Effect of Organic Matter in Soils

The term organic matter refers to any body which has or has had life. When speaking of the organic matter in relation to soils, we refer to plant bodies. The decay of plant bodies or vegetable matter in the soil is highly beneficial to the physical character of the soil and to the production of crops. Where there is a good deal or organic matter in the soil, the land will plow easily, hold moisture well and be easy to cultivate. The decay of the organic matter also adds plant food to the soil.

Organic matter can be added to the soil in the form of manures from the stables or sheds, or, by plowing under green crops of rye, clover, cowpeas, soy beans, etc., or, by the plowing under of the stubble which remains from a previous crop residue. Perhaps the best method of getting organic matter added to a large area in a uniform way is to plow under a green crop. Few farmers have enough stable manure to cover a large area.

Exercises.—Make a batter of clay soil. To one-half, add one-half as much muck soil. Mix thoroughly. Put a quart of each in

small tin or galvanized troughs and dry thoroughly. Remove from the troughs and note how much more easily the sample containing muck may be crumbled than the sample without the muck soil added.

Repeat exercises, using lime instead of muck. Would it be advisable to add organic matter or lime to heavy clay soils? Why?

Suggest an economic way of introducing organic matter into soil.

Explain the effect of the lime in this exercise.

Drainage

By drainage is meant the removal of the surplus water from the soil. This may be done either by means of open ditches or by means of tile drains. There are several reasons for draining the land.

1. The land is ready for tillage earlier in the spring.
2. Larger yields are produced.
3. The quality of the crop is better.
4. The land is easier plowed and cultivated.

Drainage also affects the temperature, aeration, moisture and available plant food in the soil. Well drained lands have a higher temperature than soils that are not drained, consequently a well drained field can be planted earlier in the spring than an undrained field. Where the land is drained the air has a chance to get into the soil and aerate it. This aeration will furnish better conditions for the growth of the plant roots and helps to make the elements of plant food available. In a drained field the roots of the plants can extend throughout a larger volume of soil and thus come in contact with a larger amount of plant food and moisture and consequently the plants will thrive and withstand dry weather better than on undrained land. The fact that the roots can grow throughout a larger volume of soil enables the plants to have a larger supply of moisture for the dry seasons.

The depth to which land should be drained varies somewhat but it should be drained deep enough so that the roots of the plants may have three feet or more of soil to grow in.

Exercises.—Demonstrate the bad effects of free water on plant growth by planting seeds in soil which in one case is kept saturated with water and in another where only enough water is added to keep the soil nicely moist.

A couple of old tin cans filled with soil will answer very well for this exercise. Punch holes in the bottom of one to afford drainage and leave the other without. In which case do the seeds germinate most readily? After standing for sometime, note the relative conditions in the plant growth. Why these conditions? Explain the effects of drainage.

Temperature of Soils

The germination of seeds is dependent on three conditions: moisture, heat, and air. The temperature of the soil very greatly

influences the germination of seeds as well as the growth of the plants. Some seeds germinate best at a rather high temperature while others germinate best at a lower temperature. The seeds of plants which were tropical in their origin require high temperatures, corn for example. Crops which originated in temperate regions like wheat and oats, germinate at lower temperatures. As a general statement, we may say that a temperature of 85 degrees Fahr. is most favorable for the germination of common seeds. As a matter of fact, however, the temperature in the soil of a field is rarely so high as 85 degrees at planting time. This partly accounts for the fact that the stand of plants is not in proportion to the amount of seed sown, seeds of low vitality not germinating. It-can be demonstrated in the laboratory that wheat and oats will germinate at temperatures of 60 degrees Fahr. quite readily, while corn will scarcely germinate at that temperature and melons not at all. Clover seed will germinate at still lower temperatures. Some of the weed seeds will germinate at a temperature close to freezing.

Several things affect the temperature of the soil:

1. Moisture. When soil is water soaked it will have a low temperature, due to evaporation of the water from the surface of the soil. Also the presence of water keeps the warm air from entering the pores of the soil and warming it.

2. Color. Dark colored soils are warmer than light colored soils, due to the fact that black absorbs heat.

3. Texture. Coarse, sandy soils are warmer than fine clay or loam soils, due to the fact that they are well drained and have large pore spaces for the circulation of the warm air.

4. Slope. Land which slopes to the south is warmer than that which slopes in another direction, due to the fact that it receives the rays of the sun more directly.

5. Compactness. A compact soil will become warmer in the summer months than a less well pulverized soil. This is because a compact soil will conduct heat better and also because it dries out more thoroughly than the well pulverized loose soil.

Land well underdrained and well supplied with organic matter will have a more uniform temperature during the growing season than soils not in such condition because the moisture content will be larger and more uniform. The presence of moisture in the soil has a tendency to keep it cool.

Exercise.—Obtain the temperature of sand, clay and loam soils in the sun.

Note temperature of clay soil covered with lime and clay soil covered with lamp black.

Temperature of loam saturated with water and not drained. Drained.

Temperature of soil with slanting exposure to the sun. With vertical exposure to the sun.

Temperature of the soil with compact surface and with loose surface in both field and school room.

Temperature of clay and sandy soils mixed half and half.
Temperature of clay soil in which decayed vegetable matter has been mixed.
Show the practical bearing of this exercise.

Moisture in Field Soils

In order that a plant may grow well, it needs to have a sufficient supply of moisture. The water makes the cells of the plant turgid. This turgidity keeps the plant erect and thrifty. When plants begin to wilt it is due to the lack of sufficient water in the cells to keep them turgid or completely full. The plant obtains this moisture from the water in the soil. In the soil the water is contained on the surface of the soil particles and in the very small pore spaces between them. The very fine roots of the plant come in contact with this moisture and absorb it and pass it upward to the leaves of the plant. This moisture not only keeps the cells turgid but it also carries the plant food in solution. This plant food is nitrogen, phosphorous, potash, iron, etc. In the leaves these various elements are combined with the carbon which the leaves have taken from the atmosphere, and the various tissues which go to make up the plants are thus formed.

It has been noticed that some plants withstand dry weather better than others. This is due to the fact that they can obtain moisture from the soil where other plants cannot. Also to the fact that they do not use as much moisture as others. Plants which have deep roots, like alfalfa, scarcely ever suffer from dry weather while plants with their roots near the surface, like grass, dry up in a dry period.

It is also true that it is easier for plants to get the moisture which is contained in sandy soils than to get the moisture contained in clay or loam soils. A clay or loam soil may have ten or twelve per cent moisture in it when the plant is wilting, while in a sandy soil when the plant begins to wilt, the moisture may be as low as three or four per cent.

Exercises.—Obtain composite samples (about a pint) of soil to the depth of six inches. Get several pints if possible. Weigh samples of each. Dry and re-weigh. If the samples are dry when taken, moisten before first weighing.

Set plants in half gallon buckets of water. From one strip the foliage, cover the buckets to prevent evaporation. Which uses the most water? How is the water taken up? Would the same result be obtained if moist soil were used instead of water?

Capillary Water in Soils

Water exists in the soil in three conditions:
1. Free, or hydrostatic.
2. Capillary.
3. Invisible, or hygroscopic.

Capillary water is so called because it exists in the very small (capillary) pore spaces of the soil. It not only fills the small

pore spaces but it also covers the surface of the small particles with a thin film of moisture. While the capillary water is thus contained in the soil, free water is that which may exist in the large pore spaces of the soil and is free to drain away if there is opportunity for it to escape, as for example, through tile drains or a gravelly subsoil. Free water does not remain if there is opportunity for it to escape. Capillary water remains until it is used up by plants or carried away by evaporation.

Capillary water moves in the soil by creeping over the surface of the particles. The movement is toward the place of less moisture. Everyone has observed how the oil moves upward in the lamp wick or how the chunk of loaf sugar sucks up water. Both these cases are instances of capillary movement. The action in the soil is similar.

The capillary water in the soil is the only one of the three forms that is useful to plants. It is the moisture which the plant roots absorb and it contains the plant food in solution which the plant uses for building up its tissues. Ordinary soils will hold capillary water to the extent of about 35% of their volume. This percentage of capillary water is more than is good for the growing of plants and seeds. About 15 to 20% of the capillary moisture is best for the growing of plants. Free water in the soil is likely to be harmful because it closes up the large pores of the soil and prevents its aeration and if it has to escape by evaporation it keeps the temperature of the soil reduced.

Exercises.—Demonstrate the capillary rise of water by using sand, clay and loam soils in lamp chimneys or glass tubes, leaving the bottoms resting in an inch of water. In which soil does the water rise most rapidly? Why? In long tubes filled with different soils, in which would the water finally rise the highest? Why?

Explain the capillary rise of water in soils?

Physical Effect of Lime on Soils

Under the natural conditions the soil particles cling together and form crumbs of varying size. It is this crumb structure of the soil which, when it is plowed and cultivated, at proper moisture conditions, makes the soil mellow and easily pulverized. A soil which has good crumb structure is easily drained because the water finds it easy to move downward through the soil to the tile. Of course in sandy soils we find no crumb structure, but most of the loam soils and the better clay soils have a good crumb structure which enables them to permit drainage to good advantage.

Where the soil lacks good crumb structure it is possible to bring about a better condition. Two or three things are necessary to do this.

1. The ground should be plowed and cultivated only when the moisture condition is right. This condition can be determined only by the farmer who is handling the particular soil.

2. The introduction into the soil of organic matter in the form of stable manure or green manure will have a tendency to improve the crumb structure.
3. The application of lime to the land will have a decided effect upon its flocculation. One can observe the effect of lime by taking a teaspoonful of soil and stirring it up thoroughly in a pint of water, then putting in about a teaspoonful of lime and stirring it thoroughly and letting it settle. If observed closely, it can be seen that the particles of soil are settling in little flakes or floccules. The lime has a tendency to bring the individual particles together into little flakes. A similar action takes place in the soil when lime is applied. If lime is applied to the land for the purpose of influencing its granulation, as much as two tons to the acre should be used.

Exercises.—Demonstrate the physical effect of lime on soils by adding a teaspoonful to a pint of clay soil and mixing with water to the consistency of a thick paste. Treat a second pint in the same way but without adding lime. See that both samples are equally wet. Dry and note which sample can be pulverized most easily. Does this result compare with the effect of organic matter on clay? What other value does lime have when applied to soils?

Fertility of Soils and Subsoils

Everyone has observed that where the soil has been thrown out from a deep ditch or excavation, that very few plants grow on it for two or three years, but gradually this soil becomes covered with all the plants that naturally grow in the vicinity. The reason so few plants grew in this soil the first year was because the subsoil was too raw or, in other words, had not become weathered. This raw soil that has been thrown out of the excavation is subsoil. The same result would likely happen in our fields if we were to plow several inches deeper than usual and throw up on the surface three or four inches of the under soil. This under soil contains about as much plant food as the upper soil, especially of those elements we call minerals. It does not contain so much nitrogen. After this subsoil has been subjected to freezing and thawing, its plant food becomes more available and will support plant life.

There is also another factor which influences the productiveness of the subsoil that we have not spoken of heretofore. The subsoil does not contain nearly so many soil bacteria as the upper soil. The presence of these bacteria have a decided effect upon the value of the soil as a place for plants to grow. After the raw soil has been on the surface for a year or two it becomes infested with the bacteria the same as the other top soil and so becomes available for plants. The introduction of organic matter into this subsoil also makes it more useful for plant growing.

The nature of the subsoil very greatly affects drainage. Where the subsoil is hard and compact, the water moves through it very slowly and it takes some time before tile drains become effective

in such soils. In sandy and gravelly subsoils the water moves through very easily and if the sand or gravel layer is very deep, the water may escape so quickly that the upper soil will be the sufferer on account of it.

Exercises.—Obtain a quart each of soil and sub-soil and plant seeds in both. Allow plants to grow for a time. Which produces the largest plant? Use two or three different types of soil and sub-soil if possible.

Study in the field the characteristics of the soil and sub-soil to a depth of two or three feet. Why is the soil darker than the sub-soil? Which is more fertile and why?

The Effect of a Mulch in Preventing Evaporation

A soil mulch is a loose layer of soil an inch or two deep covering the surface. This layer, by reason of its looseness, prevents the movement of capillary water through it. As the capillary water cannot move through this loose layer, there can be no loss from evaporation except such as takes place from the surface of the leaves of the plants growing in the soil. Because of the effectiveness of a mulch in preventing evaporation, farmers are recommended to cultivate their crops in such a way as to produce a loose covering of a couple of inches in depth in order to conserve the moisture in the soil for the use of the plants during the warm and dry months of summer. The best depth of mulch is about two inches. A shallower depth will not hold the moisture so well and to make a deeper mulch will destroy a good many of the roots of the corn or potato plants.

When once a good mulch has been made it will last for ten days or two weeks without being renewed unless there is a shower of rain. The heavy soils need to have the mulch renewed oftener than light soils, because they will establish capillary connection with the under soil quicker. After a shower of rain it will be necessary to renew the mulch because the shower will have compacted down the mulch and established the capillary connection so that evaporation will take place without hindrance.

There is a difference between a dust mulch and a soil mulch. A dust mulch refers to a very fine condition of the soil in a mulch while a soil mulch refers to a condition composed of small clods and crumbs. . The soil mulch in most cases will be more effective than a dust mulch.

It should be noted that moisture may be lost from the soil, not only by evaporation from the surface but also by evaporation from the surface of the leaves of the plants growing in the field. If one stops to consider the large amount of surface presented by all the leaves on the plants growing in the field and remembers that each of these leaves is evaporating some moisture into the air, one can understand that a very large drain is being made on the soil for moisture by the plants alone. Experiments have shown

that a corn plant at tasseling time will evaporate a quart or more of water a day from its leaves, depending upon the atmospheric conditions.

Exercises.—Show the effect of a mulch by filling two flower pots with soil in which seeds are planted. When the plants are two inches high cover the soil in the one pot with a layer of coarse sand or granular dried soil to the depth of one inch. Place in a window and note which requires water first. Care should be taken in adding equal amounts of water to each pot in the beginning.

Fill half gallon buckets or tomato cans with soil. Two with loam, two with clay, two with sand. Saturate the soil in each container. Weigh soil and containers. After soil has become dry enough to Work stir one sample of each to the depth of one inch. Weigh again. Weigh and bestir every other day for a least fourteen days. Record weights and note which samples lose the greatest amount of moisture. What practical value has this exercise?

Working the Soil When Too Wet

Every farmer knows that when he cultivates or plows his land too wet, he produces clods which become very hard. He knows too, that where his land has been plowed or cultivated too wet, the plants do not thrive well. This condition is due to the puddling of the soil by breaking it too wet. Puddling is a condition brought about by handling the soil when there is so much moisture that the particles, instead of sticking together in their natural crumb structure, slip over each other and produce a smeary, sticky mass. When the soil dries, these various masses remain "smeared" together and are very hard and compact. That part of the soil not exposed to the drying of the sun becomes tough and waxy and the roots are unable to penetrate it and when rains come again the water does not soak into the mass readily. Thus it happens that plants growing in such soil are not well supplied with plant food and capillary moisture and become unthrifty. Where soils have been puddled by working too wet, there is very little to be done except to wait for the loosening effect of freezing and thawing. Frequently it takes more than one winter's freezing and thawing to render a soil in good condition again. Where there has been a road or lane through the field, the land is likely to be cloddy in that place for several years after it is plowed up.

Clay and loam soils are damaged most by plowing or cultivating too wet. Sandy soils and peaty soils are not much harmed by being plowed wet.

Soils that are naturally wet should be improved by drainage, the introduction of organic matter, and plowing only when they are in the right moisture condition.

Exercises.—In half a pint of clay soil stir enough water to make a thick paste. To an equal amount of clay soil add just enough water to make the soil crumble nicely when handled. Dry

both in the sun or by the fire. Which can be crumbled most easily after drying? Mix thoroughly equal parts clay and sand. Make a thick paste of one sample. Wet another just enough to make the soil crumble nicely. Dry. Which can be pulverized most easily when dried? Compare samples made of clay and sand with samples having only clay.

This exercise might be repeated using clay and loam.

Explain "puddling" of soils. Note relative damage to clay and sandy soils by plowing or cultivating when wet. What can be done to improve naturally wet soils?

Aeration of Soils

Air is as essential for plants as it is for animals. The oxygen of the air is the element needed. Unless there is oxygen in the soil, seeds will not germinate nor will plants grow after the seeds. have germinated. It is as necessary that air should circulate through the soil to keep it pure as it is that air should circulate through our rooms. The winds blowing across a field have the effect of sucking the old air out of the soil and permitting new air to enter. Tile drains in the soil also greatly assist in the aeration of it.

The presence of air in the soil is also essential to the development of the soil bacteria. Some bacteria live in the absence of air and maintain themselves with oxygen by destroying various compounds in the soil which contain oxygen, but the beneficial soil bacteria need fresh air.

The amount of air in the soil will depend upon the amount of pore space as has been stated in previous lessons. Some of the pore space is filled with capillary moisture and if free water is present, the larger pore spaces are also filled. The more space filled by water the less room there will be for air. Under good condition in the soil the air spaces may amount to 15 or 20% of the volume of the soil.

Soils which are heavy and compact need to be so handled that their aeration will be improved. This improvement can be brought about by drainage, by careful plowing and by the introduction of organic matter in the form of stable manure or green manure, also the flocculation of the soil by liming will improve its aeration.

Exercises.—Demonstrate the need of air for germinating seeds, by planting beans one inch in puddled clay soil and in good loam soil in proper condition to work.

Note difference in rate of germination under both conditions.

Plant seeds in loam soil in mason jars. Seal one tightly and leave the other uncovered and note the growth of plants in each.

Plant seeds in loam soil in tomato cans with and without perforated bottom. When adding water add equal amounts to each. What are the results in the germination of seeds and growth of plants.