Wetting Agent Chemicals and Products to Improve Soil Physical Conditions

OSU EXTENSION FACTS

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Many Oklahoma soils display poor physical condition contrasted to the friable soils of the midwest U.S.A. In improvement of physical conditions, a valid goal would be to make Oklahoma soils behave physically as well as those of the midwest.

Some retailers claim their soil amendment materials will improve the physical conditions of midwest soils and by implication will do miracles in Oklahoma soils. It is possible that some day a formulation will be available which will indeed improve Oklahoma soil physical conditions. In the meantime, we can conceive some simple tests which would need to be met to aid us in recognizing this miracle product.

The following characteristics describe poor physical conditions:

a. Soil is hard when dry.
b. Soil shows low permeability to water.
c. Soil surface is slow to wet.

Soils of the midwest generally are better than Oklahoma soils in these regards. This is due largely to the higher organic matter content of the midwest soils. It is well established that frequent tillage, dry conditions, and high temperatures tend to destroy soil organic matter. The presence of organic matter bonds in soils tends to stabilize aggregates in the soil and make the soil resistant to dispersion by water and solutions and, in turn, reduce the strength which the soil achieves when dry. Mineral bonds which occur when organic matter is low can achieve considerably higher strengths. This strength is diminished when the soil wets up and thereby the soil tends to lose aggregation capability and friability.

Let's discuss a few causes of poor physical conditions:

High salt content (particularly sodium salts). To cure such problems think of leaching the excess salts or replacing them with other ions. It is frequently desirable to replace excess sodium with calcium ions. For example, gypsum has proven useful in treating sodium spots in soils.

Low organic matter. Frequent tillage and high temperatures have served to reduce the organic matter content of our Oklahoma soils. An obvious cure is to attempt to increase organic matter by incorporation of vegetation by tillage. Unfortunately, we generally find such additions are quickly oxidized away.

Low porosity. Even though we may find a satisfactory level of porosity and resultant water permeability after a winter of wetting and drying, freezing and thawing, it is common that the permeability of the soil decreases after a few spring rains or irrigations.

Hard soil means high-strength soil. High strength is related both to compaction and low water content. High compaction and low water content means high strength for a given soil. We generally find that presence of a little water can cure the hardness problem. Mulches have aided in this regard. Sometimes tillage can help be reducing compaction effects, but subsequent tillage beneath the previously compacted layer may merely move the compaction zone further down.

Thus, we have not seen much success in dealing with poor soil physical conditions. However, we would expect the miracle soil conditioning agent to be able to significantly modify one or more of these problem conditions. We would need to look for evidence that such was occuring.

Practical Materials

These materials apparently provide some organic matter-type bonds in the soil to replace some of the mineral bonds. Some of these materials (See Soil Water Infiltration, Current Report #2231) have proven successful in this regard. This has been documented in the literature over the past 20 years. Several of these products are reasonably stable in the soil and significant effects persist into the second and third growing seasons. A principal drawback has been the apparent necessity to treat a pulverized dry soil with the material and thoroughly mix the conditioning agent to depths as deep as 6 inches. For crust control, we need only worry about the top half inch or so, but then even the slightest soil disturbance will probably expose some untreated soil.

"Krilium" has been reported as being mixed with the top 6 in. of soil. Concentrations of .05% are common and relief in strength is dramatic. However, to treat 6 inches of soil with even this low percentage would require a 1000 lbs/A which would cost roughly $300. Applications of the material to soils in the midwest, while producing dramatic reductions in strength, commonly produced no effect on yield.

The conditioner Super Slurper has been recently tested at OSU (D. L. Nofziger and P. Hemyari, Agronomy Dept.) and does have fairly dramatic effects on reduction of strength of soils of all textures. In general, the worse the strength problem, the greater the amelioration by Super Slurper. Further research is needed to test the effectiveness of Super Slurper applied in low concentration in bands over the row for reducing surface crusts.

Water Infiltration Effects

The companion article "Soil Water Infiltration", Current Report #2231, lists the factors to which we will want to look to detect improvement by a soil conditioning material. These can be evaluated by merely inspecting a water solution and will give us a good guess as to the probable effect in the soil. Farmers who have heard claims about the effect in the soil may wish to run some tests. It would be important to apply the material to more than one place, for example, strips through a field.

We have tested some materials for ability of water to infiltrate the soil from a post hole. In running these tests we must make sure that the shape of the post hole remains constant through the test and that the soil does not slough off from the walls into the bottom of the hole creating a cavity of different shape. This could give the appearance of a drastic change in water level in the hole.

This effect can be detected by using a yardstick to measure the liquid level from the bottom of the hole and noting the liquid level and the mud level on the stick. Thus, if we started with a 2 ft. hole, we would insert the yardstick to the 2 ft. point and make measurements along the stick when we withdrew it from the hole.

None of the materials that we have tested have improved the water infiltration characteristics of a soil. By infiltration, we mean the ability of a soil profile to receive water from water applied at the surface. Rainfall (and oftentimes, irrigation) is a transient condition where water is applied for a short period of time. The actual infiltration process does not begin until the soil surface becomes wet. If for some reason the soil surface is water repellent, the full effectiveness of a water application is not obtained. This can occur with a heavy dry thatch or in the case of some soils which have had fungal growth at the surface.

Some amendment materials on the market are reported as being biodegradable which, in the long run, is a desirable attribute. However, some of them degrade rapidly (in hours) and would presumably lose their effectiveness at that time. Thus, they would be useless for long-term conditioning effects.

Unusual Conditions Which Demand Unusual Treatments

Non-wettable soils and thatch. If the surface won't wet, water will not infiltrate. In such cases, if we are to get the full benefit of rainfall and irrigation (particularly sprinkler) we may need to insure more rapid wetting. In such cases, it is possible that a wetting agent will achieve greater overall infiltration, particularly if the time required to wet up the surface or the thatch is an appreciable portion of the total water application time. Thus, even though the wetting agent may tend to reduce infiltration rate, the overall accumulation of water in the soil may be greater because of the immediate wetting made possible by the wetting agent.

An indication of this might be to note soil profile wetting after a thunderstorm. If the soil has wet down less than an inch after a one inch rain, some improvement might be effected with wetting agent. If it appears that most of the rain got into the soil, wetting agent may not help. A highly biodegradable material may not be useful here since it might decompose before a rain occured.

Road cuts and mine spoils. It is not unusual for these surfaces to be hard and difficult to wet. Recent studies in Texas have shown that sulfonated compounds may help nonwettable mine spoils to receive water and establish plant cover.

Materials Registered as Penetrants, Spreaders, and Stickers

These can provide essential functions for the application of pesticides, but these functions may not be needed for soils. It could be misleading to market them for soil purposes even though they are legally sold for pesticide adjuvants.

Nutrient Release, Availability and Mobility

Several materials have been advertised as assisting in this process. Indeed some of the literature on Krilium showed a greater effect of fertilizer used in conjunction with Krilium than with fertilizer alone. The researchers believed that the effect was due to better water relations in the soil and better aeration and not due to any particular interaction between the soil conditioner and the fertilizer.

Word of Caution

Soil amendments can be expensive. It is wise not to use a conditioner unless the need for a conditioner is known and its effectiveness has been verified either by bonafide research methods or after you have tested the material on a small plot.

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