SOIL AMENDMENTS IN ALFALFA PRODUCTION

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Soil amendments mean many things to many people. To me they are materials intended to change the chemical or physical properties of the soil. They may change both the physical and chemical properties and some may even add plant nutrients.

By state laws, or the lack of state laws almost anything can qualify as a soil amendment. If you look over the collection of sales brochures which have come across my desk in the last 25 years almost anything does. Soil amendments are not required to be registered by the California Department of Food and Agriculture. This is both good and bad. But this makes it a classic case of Caveat Emptor - let the buyer beware

I don't want to leave the impression that soil amendments are all bad - some of them are very useful to correct specific problems.

Sulfur and sulfur bearing compounds definitely have a place in many areas of California where alfalfa is grown.

Elemental sulfur can effectively reclaim alkali or sodic soils -- that is, those soils which have an excessive amount of exchangeable sodium. In order to be effective sulfur must be incorporated into the top several inches of a moist soil which is warm (60^{o} F or more). More details of these processes are discussed in detail in the Proceedings of the 1975 Alfalfa Symposium.

Except in rare instances elemental sulfur should not be added to soil which does not contain free lime because the soil could become excessively acid. Alfalfa, as you know, enjoys a soil which is slightly on the alkaline side. Continued use of sulfur on a non-calcareous (without lime) soil may make the soil so acidic that the rhyzobial bacteria which live on the alfalfa roots and make nitrogen available to the plants cannot function. I have actually found a few soils which have been made excessively acid because of the misuse of sulfur.

Gypsum (calcium sulfate) is also widely used to correct alkali soils. Gypsum can be broadcast on top of the soil and be carried down with rain or irrigation water - but it works faster if it is mixed into the soil. Gypsum will not harm the foliage, is not toxic, and will not materially affect the soil reaction -- that is the acidity or alkalinity of the soil -- once the excessive sodium has been replaced.

Sulfuric acid can be used on calcareous soils to reclaim alkali. It can also make a non-calcareous soil acidic. It does not need to be incorporated in the soil but it cannot be applied to growing plants without serious damage to the foliage. It is fast and effective and works at any season. Since it is dangerous to handle it should only be applied by a fully qualified person. Cost may also be a consideration in using sulfuric acid.

Lime-sulfur and ammonium polysulfide have also been used to reclaim alkali but they must be used in amounts which are prohibitively expensive.

Some of these sulfur bearing compounds are also added to irrigation water to improve the rate of water penetration or added periodically to the soil to correct the damage done to the soil by poor quality irrigation water.

Gypsum may be added to water to increase its calcium content and to precipitate any soluble carbonates in the water. Some river waters have a very low salt content. Low salt waters penetrate soils slowly. The addition of gypsum to these waters can and does improve the rate of infiltration. Gypsum is not a cure-all for poor water penetration and should not be used without careful evaluation.

Sulfuric acid or sulfur dioxide from tanks or sulfur burners has been used in irrigation water to reduce or completely eliminate the carbonate and bicarbonate content of the water in the hopes of improving the infiltration rate. The adjusted sodium absorption ratio is lowered when the carbonates are reduced or eliminated so it should work. Sid Kite, Farm Advisor, Kings County, and I measured the infiltration rates in a non-calcareous soil in each irrigation over a two year period. We have not been able to see significant increase in rate of infiltration. Perhaps a calcareous soil would have shown us some improvement.

Lime-sulfur and ammonium polysulfide at 20 gallons per acre per irrigation also showed us no improvement in rates of infiltration on a non-calcareous soil.

Elemental sulfur was not tried because we had no lime in the soil. The only treatment we tried that increased the infiltration rate was 3000 pounds per acre of gypsum applied in the furrows of sugar beets at lay-by. This improvement was measurable for only one irrigation -- all subsequent irrigations were no better than the untreated water, sulfuric acid at two rates, lime-sulfur or ammonium polysulfide.

It appears that if a grower has low calcium-high bicarbonate water, the only reasonable approach is to apply gypsum periodically to the soil to reverse the damage done to the soil by this poor quality water.

Alfalfa and other legumes often respond to the addition of sulfur as a nutrient. All of these sulfur bearing soil amendments will satisfy the plant's need for sulfur. In this case, however, they should be considered to be fertilizers and not soil amendments.

So much for sulfur and alkali soils -- what about acid soils?

In California excessively acid soils are rarely found. We do find some in high rainfall areas, in sandy soils where high rates of acid forming fertilizer or sulfur has been used. Many peat soils are also excessively acidic.

There should be no concern about acid soils as long as the pH of a saturated paste o: the soil is 6.0 or higher. If the pH is 5.5 or below you should consider using lime as a soil amendment to reduce the acidity.

There are several common forms of lime available -- all of them will do the job. Shell meal, limestone, or sugar beet lime all contain 85 to 100% calcium carbonate. Dolomite is a natural deposit of calcium-magnesium carbonate.

Whatever form you may use, it should be finely divided. It must be well mixed with the top several inches of the soil. It should not be used as a top dressing because lime is not sufficiently soluble in water to be effective.

Before you buy any lime be sure you really need it. I've seen many cases where unscrupulous or poorly informed salesmen have hustled growers into buying lime. It is sad to report that these hustlers are aided and abetted by apparently legitimate laboratories.

Bulky organic materials such as manure, composts, and crop residues are also useful in improving soil tilth. To be truly effective they must be used in tremendous quantities. Because they are in short supply they are not usually practical to use except for a small acreage.

In addition to these bonefide soil amendments, there are a host of other materials which come on the market -- stay for a short while and pass out of the picture.

Things like enzymes, organic catalysts, vitamins, bacterial inocculation, one celled algae -- all claimed to increase the microbial activity of the soil. Humic acids, fermented liquid manures, seaweed, and various types of crushed rock are all intended to improve tilth or nutrients.

Some more imaginative soil conditioners which have been on the market are charged copper wires or large permanent magnets buried in the soil to enhance plant growth. (These electronic gadgets are equally effective in keeping insects and rodents away).

Also available is calcined clay and some coal-like materials. These may have some desirable properties but such tremendous amounts must be applied as to make their use impractical.

Many of these materials are passed off as "fertilizer substitutes". This is tragic. Scientists studying plant nutrition have repeatedly found that these types of materials have essentially no economic value. That leads me and most of my colleagues to believe they are quacks. Quackery is a serious problem in California agriculture. These charlatans make a living from growers who will try a ton or a drum or two to see if it works. I know several of my farmer friends who have done just that.

All of these products use the same unfounded sales pitch -- "Commercial fertilizers have ruined the soil, killed the life in the soil, poisoned our food and increased the susceptibility of crops and livestock to diseases and insects. They are also ruining your health -- and you know that food doesn't taste like it used to.

"This new product has just been discovered and will rebuild soils, reduce or eliminate the need for poisonous fertilizers, control insects, diseases, and improve the quality of food. This product is so effective that a little goes a long way."

The sales pitch generally uses scientific terms and quotes bonefide scientists out of context. At the same time they attack agricultural scientists because they have not found any real evidence to support their fantastic claims. Because they don't get support from the scientific community they fall back on testimonials.

Growers who are taken in by the testimonials and buy some of these things find they don't work as claimed and quit buying them. Sales drop off and the promotion scheme moves to a new area.

I am happy to observe that in over 35 years as a soil surveyor and a Farm Advisor, I have yet to see one of these "fertilizer substitutes" survive very long. However, during the few years each one is around they do relieve growers of much cash that could better be invested at the gaming tables in Las Vegas.