Organic Soil Fertility Management

By Klaas and Mary-Howell Martens

William Albrecht noticed that both cattle and people from some parts of the country were much stronger and healthier than those in other regions. Similar observations were made by Andre Viosin in France, Sir Albert Howard and Lady Eve Balfour in England, and many others around the world. Great breeding herds of cattle and horses seemed to be numerous in some regions while other regions constantly imported new breeding stock. Disease outbreaks seemed to be much more frequent and severe in some areas while others were often "missed" and remained mostly healthy at the same time.

Sir Albert caused quite a stir when he announced that he had let his healthy stock come in close contact with cattle who had brucellosis and that his cows had remained perfectly healthy. Many people responded to him by saying that his claim was "impossible".

These pioneers of organic agriculture believed that the relative health and vigor (or lack of it) of these people and animals began in the soil that produced the food that they ate. The soils that produced the healthiest animals all had very generous amounts and similar proportions of the key minerals calcium, magnesium, potassium, phosphorous, sulfur, iron, manganese, zinc, boron, copper, etc. The soils were also well supplied with humus.

What can we do if our farm is not one of these lucky locations, naturally blessed with the right proportion of nutrients, or what if the natural fertility has been depleted? How can we improve our soil health, thereby improving animal and human health at the same time?

Enhancing Microbial Activity

The vitality and constitution of the soil is in its life, or its microbial and small animal activity. We must provide the conditions that nurture a healthy diversity of soil life and allow it to thrive. This includes providing sufficient food, air, water, and a favorable environment, while eliminating factors that affect the soil life negatively.

Microbes require organic matter for food, but not all organic matter is created the same. Elevating soil carbon alone is not the goal - the added organic matter must be of the right type. Some of the least productive soils we have worked with have excessively high organic matter, but it tends to be very inactive. Would we feed our children, or our cattle, old dry hard woody material? No doubt they would object! We must supplement the soil with high quality organic matter that will break down easily, readily providing nutrients to the microbes and turning into humus that will feed the plants.

Microbes need to have a good balanced supply of minerals. This is one reason that soil testing is so important - to give you an indication whether there are mineral imbalances and deficiencies. Not only are plants responsive to mineral imbalances, so are microbes. When there are severe mineral imbalances, this can lead to a shift in microbe populations to a predominance of pathogenic and detrimental ones.

Microbes also need sufficient soil air, water, and gas exchange. These conditions depend on good drainage and soil structure. You need to consider drainage on a large scale - is tiling or other erosion control needed to provide better surface and subsurface drainage? These need to be corrected as soon as possible. Microbial activity, mineral balance and organic matter will improve soil physical conditions on a more internal level through stable aggregation, changes in soil chemistry, and reduced erosion and leaching. The overall result will be a soil that better holds the right amount of air and water, with sufficient movement to get rid of wastes.

We also have to eliminate factors that damage soil life. Pesticides are the obvious problem here, but another thing that really hurts soil life is high levels of mineral salts. These can come from synthetic fertilizers, but they can also come from excessive manure, especially anaerobic liquid manure. Even compost, if over-used, can lead to a "salty" soil. These conditions depress microbial activity, damage soil structure and tend to favor certain types of weeds, such as lambsquarters, pigweed, and velvetleaf.

Balancing Mineral Nutrients

Dr. Albrecht observed that certain proportions of major cations were consistent among the most productive soils. After testing many soils throughout his career, he recognized that the best soils tended to contain roughly 68% calcium saturation, 12% magnesium, 3% potassium, and 5-10% other basic cations such as sodium, and 5-10% hydrogen. This proportion of calcium and magnesium seemed to give the soil excellent internal drainage, and air and water movement. These proportions are affected by soil physical makeup - sandier soils need higher levels of magnesium and other minerals relative to the calcium to meet the nutrient needs of the crop and retain water. Clay soils might need less magnesium and lower saturations of some of the other minerals. Albrecht also observed that the absolute mineral proportions are less critical on soils with high organic matter and good microbial activity.

It is important to recognize that mineral nutrients need to be in balance with each other. Due to interactions between minerals, excesses of one nutrient may lead to deficiencies in others. Plants grown in soils with extremely high phosphorus levels can show zinc deficiency symptoms because the zinc present in the soil will be tied up. A deficiency in boron can make it difficult for a plant to obtain enough potassium. Very high nitrogen will prevent adequate uptake of potassium and copper. Such mineral imbalances can lead to stunted or abnormal plant growth, increased insect and disease pressure, and changes in weed potential. Animals eating crops grown in imbalanced soils tend to have metabolic problems, either from getting too much or too little of necessary nutrients from their feed.

If a soil test indicates a mineral deficiency, organic farmers have a number of options to correct the situation. You

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should first find out what approved materials are available locally and economically. Limestone is readily available in most regions, but you should look carefully at the calcium and magnesium content of the lime - if your soils are already high in magnesium, you probably don't want to add more and should request Hi-Cal lime. If magnesium is low, then dolomitic lime might be a better choice. If wood ash is available locally, this is often a very economical source of calcium and potassium with phosphorus and trace elements in smaller amounts.

Poultry manure or compost is not only high in nitrogen, it also adds a lot of phosphorus, potassium, calcium, magnesium, sulfur and many trace elements. Turkey manure is similar, but is higher in copper, which if you need it, this would probably be your best source. Gypsum is available in some regions and adds calcium and sulfur. Granite dust is great for trace elements and contains a slow release form of potassium.

With fertilizer, the idea that "if a little is good, a lot is better" is seldom correct. Nature does not like rapid changes and it is important to realize that you can overuse even good materials if not careful. Many organic farmers overapply manure, especially if they use it as their primary nitrogen source, and can end up with unhealthy levels of potassium and phosphorus. These lead to sick cows, sick plants and weed problems. It is also possible to overapply lime, resulting tied-up phosphorus and potassium and lower yields. We feel that it is generally best to correct soil deficiencies slowly.

When you make a change in mineral level, it will often take several years for that change to show fully in the plants and animals. It can take 3-5 years before the full effect of liming is seen. The plants, and therefore the organic matter, will also slowly react to the mineral changes, further extending the effect.

Well-made compost is an excellent source of the mineral nutrients, organic matter and microbial diversity, plus it becomes a microbial inoculant of the soil. This is especially the case with the Biodynamic preps when they are put into the manure. Composting also stabilizes nutrients to make them less leachable. Composted materials will not compete with crops for nutrients in the soil like uncomposted materials can do. We also have the opportunity to enhance compost by adding materials like rock dust, gypsum, and even clay. These materials, when properly put into a compost pile, can reduce loss of nutrients in the composting process, and the minerals they contain will become more readily available once they have been composted.

In Conclusion

One problem we see on many conventional farms is that they are "leaky". Excessive "luxury" levels of synthetic fertilizers are applied, leading to very high levels of soluble minerals in the soil that are easily lost through leaching and erosion. Synthetic nitrogen fertilizers dissolve calcium and magnesium that then leaches at higher rates, requiring more frequent liming. Extremely high levels of soluble nutrients destroy soil life, which leads to further deterioration of soil structure, loss of nutrients and physical compaction.

On an organic farm, we're striving to keep sufficient fertility available to the crops while keeping it on the farm. A rainforest is one of the most productive ecosystems on earth. Despite enormously high rain fall, the minerals are not lost because they are held in biological forms and recycled rapidly. It should be our goal on organic farms to simulate this type of system. In order to do this, we have to pay close attention to both the biological and chemical needs of the soil, knowing that soil health depends on the balance and interaction between both.

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