

The Secret Behind the Power Of Plant Diversity

It has been observed that a mixture of plants often performs better than a monoculture of the best performing plant in the mix, an observation that defies “common sense”. How does this work? Like so many other hard-to-explain phenomena in agriculture, the secret lies in tiny soil microbes. Soil microbes thrive under many of the same conditions as rumen microbes, so if you want healthy soil microbes, feed them like you would feed a cow: a balanced and diverse diet on a steady basis. This includes carbohydrates, fats, protein, and minerals. We used to think the bulk of microbes in the soil lived by eating crop residue. Now we realize that, in a healthy soil ecosystem, the majority of microbes in the soil live by feeding on the exudates from plant roots.

All plants have root exudates, a nutrient-rich broth that leaks from the roots into the surrounding soil. Scientists have found that plants leak as much as 40% of their energy out of the roots and into the surrounding soil. Each plant species has a unique chemical composition to its exudate. Warm-season grasses, sorghum in particular, have an exudate which is very high in sugar, which provides a huge amount of energy to soil microbes. This is due largely to their very high photosynthetic rate during the long days of summer. Legumes have exudates very high in amino acids, which microbes can use to produce protein. Buckwheat and lupine produce organic acids that make phosphorus more available in the soil, to the benefit of all the microbes in the vicinity. If you have some plants in a mix that release sugars, some plants that release amino acids, and some plants that free up soil minerals, then you get a balanced diet and the microbial population increases dramatically.

At this point, you may be asking, “So what? Why should I care about microbes? I am trying to raise crops (or livestock)? I want plant yield, not microbes.” Have you ever wondered just why plants give off so much of their energy into root exudates? Doesn't it seem suicidal on the part of a plant to just donate such a large percentage of its hard-earned energy to soil microbes? Perhaps it is not so suicidal after all. It has been said, there is no waste in nature. Whether you credit it to a divine plan, or to evolutionary selection, plants that give off high levels of root exudates tend to be more successful than plants that do not. Just as in human interaction, generosity tends to be rewarded. Plants surrounded by healthy, abundant microbial communities are more drought tolerant, are better supplied with plant nutrients, and more resistant to disease; in addition, all this microbial activity increases soil organic matter and improves soil structure.

There is a very good reason we try to create diverse cover crop mixtures containing several plant families, instead of just picking the highest yielding or the “best one”. Plant diversity also provides different root types for better use of soil resources, a layered canopy for better capture of sunlight, better livestock nutrition for grazing, and far lower risk of any one insect or disease taking out the stand.

While there may be some situations in which a monoculture cover crop is the best choice, in general you get far more long-term soil benefit by choosing to plant a diverse mixture of several plant families for your cover crop.