

Soil Health Benefits of Cover Crops

Cover crops seem to be a bit of a hot topic lately, being discussed at two different grower field days at Pine Tree Ranch in the past year, featured in a UC Cooperative Extension field day at the Hansen Research and Education Center, and now being the topic of a second article within a year in *From the Grove*. This is in part because cover crops are a covered practice in the California Department of Food and Agriculture's Healthy Soils grant program (cdfa.ca.gov/oefi/healthsoils).

Alli Fish, community education specialist with UC Cooperative Extension in Ventura County, has done a lot of grower outreach about the healthy soils program (see the California Avocado Society's April 2020 virtual field day handout, californiaavocadosociety.org/seminar-presentations.html). So why does the state of California want to give you money to plant cover crops? In a word, carbon.

California has set some very lofty goals for combating climate change and a primary means of reaching those goals is to sequester carbon. Climate change is too much of a political hot potato to venture into here, but cover crops do a great job of putting carbon into the soil and that, regardless of why you do it, has a wealth of benefits for plants.

A recent article in the journal *Agrosystems, Geosciences and Environment* (<https://bit.ly/3bagezj>) sheds new light on just how beneficial cover crops can be. The research was conducted in corn and soybean fields in four different locations around Virginia using

triticale, vetch, crimson clover, radish, barley, rye and various combinations of those. What was unique about this research was that it specifically focused on the short-term benefits of cover crops — sown in mid- to late-September and terminated in early April — similar to the time that cover crops could be grown during the winter rainy period in California avocado groves.

The researchers found that these cover crops produced an average of one pound of biomass per square foot during the growing period. Despite this biomass, and the fact that cover crops need water to grow like any other plant, the average water content of the soil increased by about 7% with the use of cover crops. This is due to many factors including: the cover crop roots opening up the soil to allow better rain infiltration; the cover crop canopy physically slowing the speed of rainfall and allowing it to fall more gently on the soil surface; and, the cover crops increasing soil organic matter that can hold more moisture.

The cover crop plots also saw a shift of nitrogen from nitrate (NO_3^-) — a highly leachable form of nitrogen — to ammonium (NH_4^+) — a more stable form of nitrogen. The researchers hypothesized that this change was a result of uptake of nitrate by the cover crop and an increase in soil microbial activity resulting in greater nitrogen mineralization. Although the risk of nitrate leaching from avocado groves is minimal, many of the ground water basins in California are impacted by excess ni-

trates, so it is good to know that a relatively simple practice can help to reduce soil nitrate pools, especially leading into the rainy season.

Perhaps most importantly, cover crops increased the bioavailable carbon in the soil by 37% in just over six months in this study. This is important because in the soil carbon is life. Carbon is what soil microbes (bacteria and fungi) feed on. In fact, the researchers found that active microbial biomass increased by 64% in the plots with cover crops compared to those without cover crops. Importantly, the researchers point out that total microbial biomass was not affected by cover cropping, just the active microbial biomass — cover cropping awakened the soil microbes so to speak.

So why are soil microbes such a big deal? Soil microbes are known to affect plant growth in a few ways. First, soil microbes are responsible for the process of nutrient mineralization. Mineralization is the process of converting nutrients from the organic form (bound to carbon and hydrogen) to the inorganic form (plant available).

More importantly for avocados is the role that soil microbial activity plays in plant disease. Many soil microbes are “good guys” and compete against pathogenic microbes. This is why the practice of mulching is recommended for managing phytophthora root rot. The mulch provides a carbon source to wake up the native soil microbial community, which then competes with phytophthora for available resources. Cover crops have



Picture 1. Kamprath Seed's Gill Mix 2018 composed of fall ryegrain, common vetch, radish (daikon), field peas, lacy phacelia, Balansa clover, purple hairy vetch, crimson clover, light Persian clover, and triticale.



Picture 2. Kamprath Seed's Low Profile Beneficial Habitat Blend composed of white clover, Gosse sub-clover, Losa sub-clover, broadleaf trefoil, Persian clover, Antas sub-clover, red clover, phacelia, white yarrow, creeping red fescue, hard fescue, blue flax, alyssum, California poppy, dwarf cone flower and baby's breath.



Picture 3. S&S Seed's Xerces Mix composed of white yarrow, farewell to spring, golden yarrow, California poppy, blue field gilia, common gumplant, sunflower, whitewhorl lupine, baby blue eyes, California phacelia.



Picture 4. S&S Seed's Pine Tree Mix 1 composed of dwarf barley, clammy clover, creeping wild rye, Pacific fescue and yellow-rayed lasthenia.

the same effect and can work synergistically with mulching since mulch is typically applied under the tree canopy and cover cropping is done in the row middles.

On November 26, 2019, a cover crop demonstration was planted at the California Avocado Commission's Pine Tree Ranch demonstration grove in Santa Paula. If you have been to Pine Tree Ranch, you know that the soil is extremely rocky, which made planting the cover crop seed with a seed drill or other mechanical means impractical. Instead, the seed was broadcast and lightly covered with about ½ inch of

compost. Since it was a relatively dry winter until March and this was a demonstration, periodic irrigation was provided to help establish the cover crop.

Four different seed mixes were donated by Kamprath Seeds and S&S Seeds for this demonstration. Each of these different mixes and the plants making them up are shown in the accompanying pictures (photographed on March 31, 2020). We saw no detrimental effects on the trees from any of these cover crop mixes. The more vigorous mixes (pictures 1 and 4) were quite good at suppressing weed growth. Additionally, some cover crop mixes are

good pollinator attractants and may help increase fruit set by increasing pollinator activity in the grove.

Cover crop seed mixes can cost several hundred dollars per acre plus the labor to plant them. However, many of these mixes will reseed if they are allowed to fully mature, so seeding may only need to be done a couple of times to help with initial seed bank establishment.

Cover crops offer many potential benefits for relatively little investment. Have you tried cover crops in your grove? 🍷