## *The Little Bugs In and Around Us*

*by Glenn I. Teves, County Extension Agent, UH CTAHR CES*

In the beginning, the Earth had no air in its atmosphere. Then, the smallest forms of life evolved and inhabited every niche on earth. They started producing air, which was a waste product of their respiratory system. When we came along; we fit right in because we survived on oxygen, breathing it in and breathing out carbon dioxide. Most plants took in carbon dioxide and gave off oxygen. We became part of one big happy family, and the ultimate example of mutual symbiosis.

But survival of fittest was in play, and the weak ones or those not well adapted to the niches available wouldn't survive, as the strong ones dominated. If there were too many of them, they too would die off from too much competition for important food and niche resources. Imbalances, or changes in the environment, would favor one species over another. The yin and yang of this existence dictated that there would be opposition in all things, and dark side was established when the bad guys, such as killing viruses caused epidemics, and continue to evolve, with new ones still being discovered today. That's the whole concept of survival of fittest, and how we live and die today.

The word for today is 'MICROBES'. Our bodies contain more microbes, in pounds, than the weight of our brain, and we're just starting to understand a little about them. When we're born, we're coated with microbes to protect us to endure in our new 'dirty' environment. For babies born by C-section, they're more susceptible to diseases and bad microbes in this 'dirty world' because they haven't been inoculated with these protective microbes originating from their mother.

Microbes are the IN thing not only in research and development, but also in farming. We've come to the realization that we know very little about these microscopic animals, many of which are vital to our existence. Just recently, a researcher at UH was awarded a $10 million grant to study microbes in the ocean, but we still know very little about the ones of the land.

In water remediation projects, through the use of microbes, we can take dirty water and run them through aerobic and anaerobic tanks in which microbes will strip the dirty water of all nutrients and microorganisms. What comes out in the end is clean and clear water, ready for reuse. This is the wave of the future.

More recently, farmers in Hawaii have been learning how to grow microbes. The Korean system of growing Indigenous Micro-Organisms or IMO's is taking the islands by storm, but there are many naysayers who comment that you cannot get something from nothing. Once you understand some of mechanisms of these microbes, and

*Won Bok and Lettuce Seedlings*

what they can do, then maybe you can understand how they can make something from something. Microbes have many different food sources, including each other or other's waste products. Even university types are questioning this stuff, short of even saying this is 'snake oil'. Well, another saying I've grown to understand is, "You never know if you never go." In other words, you cannot close your mind to this stuff until you see the results. Seeing is believing, and there's some interesting stuff happening here.

Michael Duponte, my counterpart at Hilo Extension Service, has taken the lead in this area, and spent over a month in Korea seeing this system in action and is a zealous convert to this type of farming. For example, in a special swine pen system, microbes are sprayed to a layered litter system in a swine pen and as a result, there's no odor or flies. The litter system absorbs waste and odor through layers of organic matter, including logs under finer litter, and requires little water because you don't have to shoot down the pens daily.

This system starts with the collection of indigenous microorganisms on your farm, growing them out, and combining vital food to help them grow and flourish. The next step is to put them in your farm environment to grow and become part of your farm system to help your crops grow. You have to create the ideal environment for them to grow; too much water and they will drown.

Based on my limited knowledge of them, some microbes can extend the root systems of plants or produce vital nutrients, because it already happens in nature with micorrhyza, a fungus that scavenges for phosphorus by attaching to, and extending the root system of plants. Rhizobia is bacteria that attaches to roots of legumes such as beans and sunn hemp, and converts nitrogen from the air into ammonia that plants can break down and utilize for free. By having these microbes working for you, you can minimize your farm inputs. We'll be talking more and more about microbes, and hopefully we'll have a class on how to grow them real soon.

Organic matter is the raw material that becomes the engine for growing plants, while nitrogen becomes fuel for the engine. Recently, the Makakuoha Cooperative, composed of some of our beginning farmers received a USDA Rural Business Enterprise grant to purchase a truck and trailer to haul green waste out of the land fill and onto farms. This is exciting and it will allow

them to build their soils on the homestead to levels of productivity never imagined, and we could only dream of. These indigenous microbes will be part of the equation to speed up this conversion of organic waste and nitrogen into plant food and high quality plant media.

Conducting field demonstrations on Molokai will allow everyone to see for themselves. Science is based on experimental design by conducting side-by-side controlled trials. It's been a challenge conducting trials on this system since so many factors and microbes are at play, but this needs to be done to determine effects on crop growth and also on yield.

Just recently, the Kohala Center wrote another grant for Makakuoha Cooperative that was approved to train beginning farmers to produce compost utilizing this system and to grow indigenous microorganisms. The USDA Socially Disadvantaged Small Farmer Grant is intended to build capacity of the cooperative and to help them implement their strategic plan. These include creating compost to improve crop production, developing an equipment service, and also developing a processing facility to comply with federal food safety requirements. If you're interested in being involved, contact Tubz Kalipi or Tony and Kapua Lauifi. We need more production to feed into this system, and I'm hearing of a handful of you starting up. This is great, and the timing couldn't be better. Just look at the price and quality of vegetables in the stores, and you know it's the time to grow your own.

Dr. Norman Arancon is a member of the agriculture faculty at UH-Hilo and has teamed up with Dr. Ted Radovich of UH Manoa to better understand the effects of worm castings and juices produced by these worms on germinating seeds, seedlings, and plant growth. I met with him recently, and he believes that the positive effects of these compounds on plant growth are the result of plant hormones. There are many types of hormones effecting root and shoot growth, as well as stem elongation. By better understanding the effects of these plant hormones, and stimulating the growth of combinations of these hormones, we may be able to provide plants with a balanced combination of hormones to replace some fertilizer inputs. This is exciting stuff!

***Natural Systems***

When growing a new crop, it's important to find out about the natural habitat of the crop; where it comes from and how it grows. Avocado is a good example. Here's a section from the book, 'The Avocado, Botany, Production, and Uses': *"Avocado is indigenous to the cloud (highland) and lowland forests of Mexico and Central America where it has adapted to soils with abundant organic litter that provide a well-aerated substrate, rich in microorganisms and with a high water-holding capacity. Under these conditions a dense mat of 'feeder' roots develops to exploit the*

*supply of nutrients released from the decaying vegetation and to take up water to meet tree requirements for growth. The litter zone also provides a buffer between air/soil interface, moderating the impact of atmospheric changes on the root environment, thereby protecting the fleshy roots from dessication and large changes in temperature."*

This vital information tells you what kind of environment avocado likes to live in. We take them out of this environment and create a monoculture, with fertilizers and pesticides to reduce production costs, and we wonder why we run into problems such root rot, *Phytopthora cinnamomi* or salt burn. But if you want to grow great avocadoes for say, your lifetime, you will need to keep it as close to its natural environment as you can. This applies to each and every crop that you grow. Stress creates problems that manifest itself as disease, weak plants, poor post-harvest quality product, and premature death. Mimicking the natural systems that the plant evolved in will assure better long-term growth.

***Organic Farming Systems***

Organic systems focus largely on soil building as the solution to many production problems. The mantra, "The key to disease control is to grow a healthy plant" holds true and this is achieved by creating healthy soil. Many people want to grow organically, but they don't understand the system. You cannot just stick a seed in the ground without building the soil first. Overall, Hoolehua soil is low in organic matter, so you have to build it up big time. It's also low in phosphorus, magnesium, calcium, and the pH needs to be raised a bit. Like a bank account, you have to put in before you can withdraw, and you have to build up all of these. And just because you put it in doesn't mean it's available for your use right now.

Carbon, nitrogen, and microbes are the key components in the production of compost, fuel for organic farming systems. Conversion to plant food is slow since nitrogen in nature is in short supply, is slowly released, and becomes the food for microbes to breakdown carbon, usually in the form of green waste or mulch. Mulch includes plant materials from lawn or garden waste, or even large trees. A great source of carbon is invasive trees such as Christmas Berry and Formosa Koa, and even Guinea grass, among many others, because you can't use it for anything else except a bon fire.

The main problem is there's usually too much carbon and insufficient nitrogen, resulting in few microbes to break things down. There are ratios you try to achieve in order to create the ideal breakdown time, such as C:N ratios of 20-25:1, but in most instances you have ratios of 100, 200, or even 500:1, much more carbon than nitrogen. As a result, change is slow and this can be good or bad; good if you want a sustained release of nutrients and bad if you need more nutrients than the system can presently produce. Recent studies have

*Carrot Seeds ready for harvest*

shown only 70% of the blood & bone that organic farmers on Molokai use will be available to crops 90 days after application.

So where's the nitrogen? Another source of nitrogen is storms in which lightning will create a chemical reaction to produce nitrogen, but in the bigger scheme of things, this is rare. The main organic sources include fish, blood, and feather meal. Cotton meal is a good source of nitrogen, but is either genetically modified (GM) or contains a lot of pesticides, so it usually doesn't fit into the organic scheme of things. If we have sufficient nitrogen available, we would have the start of an ideal organic system. As an example, I look to Squanto for sage advice that he shared with first pilgrims. Dig a hole, add a fish, and plant corn. This is basic but not far from the path we should be taking.

Nutrients are just one of the key components of the system. Economics will always come into play unless you're just growing for your family. How much will it cost to produce this organic matter, and what about transportation costs, which are usually prohibitive for many of the things we try to do? Some farmers are really on top of their costs, and it's almost second nature for them. It will always come down to, "Should I be doing this or could I be making more money doing something else? Farming is long-term and can be a source of steady, long-term income, but it might not be the only source of income for your family.

There are many other positives or intangible benefits of embracing an organic system, including a healthy environment, and pono land stewardship. When I was young, ranching was something that kept me out of trouble. When my friends were having a good time, I was fixing fences, rounding up cattle, or catching the loose ones. Keeping the family together and busily engaged is important, especially in this unpredictable, dirty world out there.

### *Making Fertilizer*

There's a proposal floating around to build a high-tech incinerator at the Molokai land fill to convert rubbish into urea fertilizer. The system can convert one pound of rubbish into 2 pounds of urea. Sounds far-fetched, but I was reviewing the plans and its already being done in other parts of the U.S. Rubbish is burned at 5000 degrees Centigrade or 9000 degrees Fahrenheit, and the gases, including ammonia, are captured and converted into urea. This system creates less pollution than the existing Maui Electric Powerplant in Pala'au. A good question is will this urea

be considered organic since it's created without petroleum? Probably not, because it's a concentrated fertilizer, and all approved organic fertilizers are not concentrated.

### *Hybrid Farming Systems*

Today, the word 'hybrid' is used most frequently to describe cutting-edge automobiles. The Toyota Prius Hybrid is a combination of an electric car and gas consuming combustion engine. This wasn't always the way we used this word. In the past, it meant crossing two inbred plant varieties to create a uniform plant, an F1hybrid. Creating a hybrid involved crossing two plants with unique attributes and combining these attributes into one plant. Attributes include heat-tolerance, disease and nematode resistance, higher nutrient content, and also unique colors. Active breeding for hybrids have been taking place for several decades, starting with corn and tomatoes. These vegetables were hybridized to combine the best of both parents to produce a super plant, and have increased productivity beyond our imagination.

Recently, I heard the word used in a unique way. On the two ends of the farming spectrum, there's conventional farming and organic farming, but there's a new kid in town, the hybrid. The hybrid is designed to utilize the best of both worlds. I'm still trying to understand this system but I was probably involved with it for a while. What are examples of hybrid systems? The best example I can think of is using urea fertilizer to make compost. By doing so, you can accelerate the production of compost for your farm. So what's the down side? You probably will have to use more compost since you're going to burn it up or consume it faster. Another example is using conventional fertilizer in an otherwise organic system with no pesticides. I like this system because I still have lots of leftover fertilizer from 10 years ago that I have to use up, and fertilizer is getting to be very expensive, and almost prohibitive.

In such a system, I would think that the use of pesticides is the last resort. In many systems we've worked on and developed over the last 25 years, pesticides were a fallback position. Integrated Pest Management was in full swing on Molokai in the mid 1980's and this involved monitoring pests and setting thresholds for spraying. We would count insects on leaves each week to first determine if we had to spray at all. This was determined by establishing 'economic thresholds'.

At what level of insect populations were the insects impacting yields? We had to collect a lot of data on each insect before we were able to set standards, and still we had to fine tune them. We were able to figure out watermelon insect levels. The biggest problem is when insects carried viruses, there would be zero-tolerance because the virus could spread like wildfire and wipe out the entire crop.

There may also be some adjustments that need to be made in the hybrid

system, including the selection of varieties adapted to your system, maybe not, but you will need to fine-tune the whole system nonetheless. When you change one piece, you usually have a ripple or domino effect, so more adjustments need to be made. I see benefits from the soil side, but how far to the 'dark side' do you go before it's not a hybrid system anymore? Weeds are the number labor challenge, so tillage is critical. In small farms, it's even more difficult because sometimes the only machine is 'you'. Do you use herbicides to control weeds? This is the new frontier, because I think organic foods are going to get very expensive, and many of us will not be able to afford them. So what are we willing to live with or without?

In the next issue, we'll discuss conventional farming systems. With the recent issues on Kauai related to pesticide drift and exposure, discussing Molokai's recent past in this same area helps us to understand so we don't repeat the mistakes of the past. We need to progress as a people and not only focus on the economic bottom-line, but move to the next level of the quadruple bottom line-***Profit, Planet, People, Purpose***. If not, then something is really wrong with us and we're really not progressing. More next time…