

MANAGING STRESS

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"Every test in our life makes us bitter or better. Every problem comes to break us or make us. The choice is ours whether we become victim or victor"
Kahlil Gibran

Stress is the basis of many ailments in our lives, and also in the lives of plants, and sometimes we don't see the whole web and its threads.



Tip-burn on lettuce is physiological stress caused by a combination of nutrients, water, and high temperatures.

Part of understanding stress is identifying its component parts in order to get to the root of the problem. The word 'stress' conjures up all kinds of feelings and images related to both plants and animals, including us. One definition of stress includes the following:

*"Physiological or biological **stress** is an organism's response to a stressor such as an environmental condition or a stimulus. Stress is a body's method of*

reacting to a challenge. According to the stressful event, the body's way to respond to stress is by sympathetic nervous system activation which results in the fight-or-flight response. In humans, stress typically describes a negative condition or a positive condition that can have an impact on a person's mental and physical well-being."

It's been said that the 'fight or flight response' brought us to where we are today in surviving the minute by minute stimuli which cause us to act and do. If the dinosaur indeed adapted to climatic change, we probably wouldn't be around today except for the smaller versions of humans such as dwarfs or menehune who were able to avoid detection.

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We can learn wisdom from the great words of Benjamin Franklin, the man, not the store who said, "Early to bed, early to rise, makes a man healthy, wealthy and wise."



Under extreme heat and water stress, Chinese Rose Beetles can riddle Banana leaves, although it's not one of the most preferred hosts.

In this sage advice, old Ben shares many important concepts of life, of getting into a routine by following a stable and predictable regimen each day as a way to minimize stress. When old Ben came up with this saying, electricity and night lights weren't in existence yet, so this was one way of saving on kerosene or wood.

Another aspect of this sage advice was taking advantage of a sunny day by putting in a full day's work. It was about being industrious, productive, and busily engaged. In this way, old Ben could invent many things, and also have a better understanding of electricity. He became an author, printer, political theorist, politician, postmaster, scientist, inventor, civic activist, statesman, and diplomat. It was all in a day's work, and he surely needed a good night's rest to minimize stress, and be reinvigorated, and ready to conquer the world the next day.

Today, we not only deal with stresses that affect our sense of touch, sound, smell, and feel, but also our emotions. Our mind-body connection is something

that's grown even more complex, because the more we learn the more realize we know very little.

Exploring the human psyche can get so exasperating and take you off the beaten path to the point where you can lose yourself in yourself.

Plants are easier to work with because they don't answer back or give you 'attitude', or get 'physical'. Compare the human definition of stress with a definition of plant stress:

"Stress' in plants can be defined as any external factor that negatively influences plant growth, productivity, reproductive capacity or survival. This includes a wide range of factors which can be broadly divided into two main categories: abiotic or environmental stress factors, and biotic or biological stress factors."



Cabbage Aphids on Cauliflower

One example is low temperatures, which affects not only the plant's metabolic rate, but also the plant's ability to take up nutrients, especially Phosphorus (P). Low temperatures, even in Hawaii, can affect the plant's root system and its ability to take up P in

cold conditions, and we've seen this in alfalfa production on Molokai where plant stems show a purpling, indicating Phosphorus deficiency even when soil Phosphorus is adequate.

Plant stress can take many forms, and I've tried to list some of the most obvious ones: Water – Heat – Cold - Excess Nutrients (toxicity) - Nutrient Shortage – Wind – Disease - Light – Darkness – Pathogen – Physical

The list goes on, but nature is not always 'cut and dry' in its characterization of stress, and combinations of stressors are more the norm. Some create a domino or cascading effect, and more stressors jump into the fray along the way. There are many parameters to stress, as well as steps in the process of managing stress.



Plant stress can affect the supply of agricultural products, leading to temporary shortages

What triggers stress? One determining factor is our sensitivity to stress. Some of us are numb to the things around us, and are not bothered by many things, while others seem to be sensitive to

every little thing the rubs them the wrong way. It's like some of us have an acute sensory system that can detect every moving and non-moving thing.

Day length can affect plants adversely and affect their ability to complete the process of photosynthesis or the conversion of light into energy affecting P uptake and less growth in the process. This process may also predispose plants to more stress such as diseases brought on by low light and low temperature, further stacking plant stress.

One example is Banana Leaf Streak or Sigatoka disease, a foliar disease of banana that, under extreme conditions, can defoliate plants. I've grown banana in two different climates in the Hoolehua Plains, one in the desert at 450 feet elevation with 30 inches of rainfall, and 800 feet elevation with 75 inches of rainfall, and have seen the impacts of Black Leaf Streak. At the higher elevation, Black Leaf Streak seems to be around all the time, and during the winter months the impacts are greater than in the lowlands.

Below ground, root-knot nematodes can affect uptake of nutrients and water in susceptible plant species. This microscopic eelworm creates galls on roots of susceptible plants by their feeding action and also by plant response to this stress. They can be in sync with crop from germination, where plant exudates awaken nematodes to breakfast and feeding time.

Tolerant species may excrete toxins to kill off nematodes, and have built up their defensive mechanisms through centuries of evolving and surviving in proximity to this pest, referred to as co-evolution. Creating high organic matter conditions can create a less than ideal condition for the nematodes and a better condition for competing organisms, such as nematode-trapping fungi.

Plants that didn't evolve with this pest may have a more difficult time surviving in this type of environment. Some plants may have something in their genetic makeup that resists the nematode, such as toxic root exudates, but we can't tell until we flush out their genetic variation by crossing them with themselves and imposing different kinds of stresses on them to see how they respond.

Some tomato varieties can tolerate high populations of root-knot nematodes, for example, but plant resistance to nematodes can sometimes be broken by high soil temperatures.

The phrase 'survival of the fittest' is a moving target in a changing world. Plants that survive well today may not be able to survive in the future with changing climatic conditions. Erratic climatic conditions are especially troublesome because some species cannot adjust to quick pendulum swings of hot and cold, and dry and wet weather in the same week.

However, some plant genera have an arsenal of genes that allow them to adjust to both minute and major

changes in their environment. Again, tomatoes have a vast gene pool with many wild relatives we can be accessed to incorporate resistance into existing commercial cultivars such as salt, disease, and insect tolerance, and also fruit color, size, and shape.



Mealy bugs on Dippig or Saba banana, a favored Filipino banana used to make lumpia.

For some plant genera, it takes generations, decades, or even centuries to make these changes through a rearrangement of genes in response to environmental and physiological changes. In many instances, we may never know what's in a plant's total genetic package because it takes too long according to our timeline.

Understanding the plant's ancestral home can tip you off to the ideal conditions for growth, their seasonal adaptations, their light demands, and their nutritional idiosyncrasies. Where did they come from and what kinds of environmental conditions exist there? What genetic characters from their ancestral home are helpful in their new home, Hawaii?

Sometimes, man creates his own problems by not practicing some of the basic tenets of farming such crop rotation, which is a common problem in Hawaii, driven by the need to survive and to be able to harvest a crop each week of the year.

A good example is papaya production in Hawaii, starting in Waimanalo and Kahuku, and finally Puna and Kapoho. Impatient and desperate, after getting battered due to bad habits, man tries to overcome the problems that he created in the first place, including the ongoing battle with tolerant insects and virulent diseases.

In order to speed up the process of overcoming stress, he uses genetic manipulation by injecting 'new' genes into a plant to protect it from stresses such disease, insects, weeds, cold, heat, water, and more.

Sometimes we question the intent of these processes: is it about money, power and control, or is it really to make the world a better place to live? It's probably all of these, but we cannot separate the good from the evil. Man will only keep doing something if he's gonna to make money or prestige or fame or some other obscure goal.

Science is about reductionism, and may not see how everything is connected in a holistic system for the common good. Money, or the lack of it, can be a very large stressor in life, the BIG trigger, and can make you do things you wouldn't ordinarily do.

We need to keep our stress in check so we can take care of our plant's stress. I return to the sage advice of Ben Franklin as a starting point in our lives, and in also learning to understand the stresses in our plant's lives.



A Healthy Banana Leaf? Edge necrosis (center leaf) is a hint of possible Potassium deficiency.

Many Shades of Orange

Citrus is a family of closely related species, most of which can cross with each other to create new varieties. The main citrus species include Tachibana Orange, Lemon, Mandarin or Tangerine, Indian Wild Orange, Pummelo, Sweet Orange, Sour Orange, and Grapefruit. Grapefruit is believed to be a natural hybrid between pummelo and sweet orange discovered in the Caribbean.

The Sweet Orange is among the most popular citrus, including the common or blonde orange, the sugar orange, the blood orange, and the navel orange. Crosses between species have created tangelo, tangor, tantangelo, lemandarine, calamondin, and many others.

The ancestral home of citrus is widely debated and is believed to be a wide band through Southeast Asia, south of China and east of India, while others believe they originated in Australia, New Guinea, and New Caledonia.

Citrus was cultivated before 300 B.C. and spread throughout Asia, Africa and the Mediterranean through conquests and trading between many civilizations, including Greeks, Romans, and Arabs, creating orchards throughout tropical Asia and Europe. Portuguese and Spanish explorers carried Citrus throughout the New World, including the Americas, on their voyages of exploration and colonization, continuing the creation of new citrus varieties.

Early on, many grew Citrus as a potted ornamental and medicinal plant, considering it inedible due its extremely powerful, almost medicinal fragrance which could penetrate clothes and repel attacks of noxious insects.

Gradually, and through the introduction of sweeter and more complex-flavored fruits, citrus attracted the attention of Europeans who went through great expense in growing these prized fruits in special enclosed areas called orangeries.

Today, we have a better understanding of these unique citrus compounds used as disinfectants and solvents, pesticides, blood thinning agents, cosmetics and perfumes, including oils as Bergamot, Petitgrain and Neroli.

Many new citrus varieties arose from the mutation of a single bud, unique and different from the parent tree. Seeds were also another important source of new varieties. Many Citrus varieties are seedless when planted alone or as one variety, but will produce seeds when planted with other varieties nearby. The deep orange fruit color is enhanced by a wide difference between day and night temperatures.



Tangerines in Oregon? Alan Kapuler's heated greenhouse in Corvallis, Oregon

Some of varieties that do well in Hawaii include Washington Navel Orange, Eureka and Improved Meyer Lemon, Minneola Tangelo, Mexican and Tahitian or Bearrs Lime, Star Ruby Supreme Grapefruit, Nagami and Meiwa Kumquat, and Dancy, Clementine, Satsuma, Fremont, and Fairchild Tangerine.

With the ongoing threat of invasive pests arriving here in potted plants, we may have to rethink our methods of propagating new citrus plants on Molokai, such as grafting varieties that are already on the island, and also planting seeds and cuttings.

Many varieties are grafted to special rootstocks to increase plant vigor and impart disease resistance to trees. Some Citrus species produce seeds identical to their parents, such as Lime, and can be propagated from seed. One recommended method of propagating pummelo is by cuttings.

Excellent reference materials on growing citrus in Hawaii can be found at the University of Hawaii College of Tropical Agriculture and Human Resources website:
<http://www.ctahr.hawaii.edu/site/Info.aspx>

The Path of Least Resistance

You are the master of your own destiny. Many of you were interested in farming because you wanted to change your life or your career path. We live in one of the most beautiful places on this earth, and being able to create a successful business in Hawaii is probably the best thing that could happen to anyone to provide long-term economic security for your family for generations. But it's not easy, and requires major changes in your life.

In life, we get so caught up in problem solving that we don't have time to be pro-active; we just react to life. In the book, *The Path of Least Resistance*, it talks about learning to become a creative force in your life. An important point the book makes is that creating is not problem solving; it's creating the environment so things happen in a positive way, and continue to happen.

I've included quotes from the book to reinforce some of my comments. There are three important insights:

- 1) You go through life taking the path of least resistance: Like water running down a stream, this is how we live our life. *"Energy moves where it is easiest for it to go... You got to where you are in life right now by moving along the path of least resistance... You may try to change the direction of your own flow in certain areas of your life - your eating habits, the way you work, the way you relate to others, the way you treat yourself, the attitudes you have about life, and you may even succeed for a time, but eventually you will find you return to your original behavior and attitudes."*
- 2) The underlying structure of your life determines the path of least resistance: The structures in your life determine your path of least resistance. *"Many continue to live the way they do, often feeling powerless and frustrated. They have attempted to make major changes in their relationships, their careers, their family, their health, and the quality of their lives, only to find themselves, a short time later, back to their old entrenched patterns."* That's why addictions and bad habits are so hard to break. *"They know that there is more to life than what they have experienced, but they don't know how to create it. As long as the structure in your life remains*

unchanged, the greatest tendency is for you to follow the same direction your life has always taken.”

3) You can change the fundamental underlying structures of your life:

Just as engineers can change the path of a river, you can change the structure of your life so you can change the life you want.

“Furthermore, once a new basic structure is in place, the overall thrust of your life, like the power of the river’s current, surges to form the results you truly want. And the direct path to those results becomes the new path of least resistance.”

The guiding principle that emanates from these three insights is this: ***You can learn to recognize the structures at play in your life and change them so that you can create what you really want to create.***

All of you have committed to making this change in your life by investing a substantial amount of time creating a farm. The farm is one vehicle to help create family economic security, but it’s more than that. For some, it will be one of the many vehicles to economic security, while for others it will be the only vehicle.

The fastest growing category in agriculture today is the multiple-income farm family or MIFFS. This is where one member of the family works outside of the farm in order to secure medical

insurance and a reliable income stream, while another farms full-time. This is a very stable model if both sides work well.



The Family Farm – Hoolehua, Molokai Circa 2005

Speaking from experience, it’s important to farm while you’re young and still have the stamina to deliver on your dream. As you age, your dream will still be there, but the ability to execute on that dream will be greatly diminished.

Beginning farmer programs are focused on hands-on experience. The first part of the program has been in learning, not only about agriculture but about life. When you farm, you learn a lot about yourself, your limits and how much energy you can put out. Agriculture is life.

There are many reasons to farm. One is food security. We live in one of the most remote areas in the world, far away from where our food is grown. We import 85-90% of the food we consume, and it’s estimated that we have about seven (7) days of food in Honolulu. If a catastrophe should occur, such as an

earthquake or tsunami, will you be prepared? There's a misconception that we're in a better situation to survive on Molokai because we have lots of food on the land and in the ocean.

The problem is we need to gather the food first, and this takes energy, either human power or a vehicle that requires diesel and gasoline so we can drive to the ocean, drive our boat out to the fishing site, or drive our truck to where the deer or pig might be.

After this, we need to drive home, prepare the food, and store it. The last step requires electricity unless we're drying food with the sun. By farming, we would be part of the solution, and it means preparing for the unpredictable and the unforeseen. You can live in a dream world, it's just the dream, but the nightmare may occur at any moment.

Those who will succeed in farming are those who are not willing to take NO for an answer, and are willing to make major changes in their lives to put farming high on their list of priorities. They will question many things and not take it at face value. It will really come down to how bad you want to farm.

Many people cannot do this. There will be times when you don't feel like going out there to weed or harvest, that you feel sick and are just not motivated. If you expect to succeed, you will need to overcome these 'down times'.

The farm will depend on your energy to make it happen, because you are the driver of the farm. Part of succeeding is realizing what you're getting into before you get into it, with both eyes wide open. As you gain more knowledge, you will be able to make the right decisions and put in energy where it counts.

You will come up with innovations that increase productivity and output. But in the end, you will want to get more out of it than you put into it, and this is possible if you think and do things strategically. Knowledge is power, but you need to turn your knowledge into energy to execute consistently.

There are ways to plan your farm out where it doesn't become stressful and it's not a situation where the farm controls you. This can happen very easily when the bar is raised too high, and your goals become difficult to attain.

While it's great to set your goals a little 'out there', it cannot be totally beyond your reach. You can easily frustrate yourself by doing this and can lose motivation. Setting small goals and achieving them gives energy to your work, and you'll want to do more. Again, this is where planning comes in.

Knowing what to expect each day is part of the equation, and something farmers want to attain because it makes life predictable. At the same time, you have to be ready for obstacles and not be derailed by them.

I still remember Hiene and Becky Mokuau, pioneer Molokai homestead farmers sharing their story with me, and their humble beginnings are inspiring. They started farming with a car, a DeSoto, to pull the plow because they didn't have money to buy equipment or credit to access money.

As they grew, they received assistance from the UH Extension Service and USDA Soil Conservation Service to help them refine their system because no one was growing sweetpotato on a commercial scale of say 10-20 acres. They refined their sweetpotato production to an art form by mechanizing, utilizing a tobacco transplanter to plant cuttings or 'lau' and a sugar beet digger to dig potatoes.



Becky and Hiene Mokuau planting sweetpotato slips or 'lau' with a tobacco transplanter, Circa mid-1970's

They had to overcome the fact that the pineapple companies didn't want the homesteaders to farm on their own because it would frustrate their plan of farming these lands and making the homesteaders their laborers. These

companies controlled the wharf, the barge, and the crane that loaded everything onto the barge. They would tell Hiene and Becky there was no space on the barge for their sweetpotatoes in an attempt to derail their efforts.

They continued to persist and persevere. Hiene got involved in his homestead community, and was one of the founders of the Hikiola Cooperative to help market homestead farm products, to bring in much needed farm supplies, and to extend production credit to farmers.

This was in 1976 when the first of two pineapple companies closed their operations, most of it on Hawaiian Home Lands, and homesteaders were trying to plan ahead for the day when lands would return to them and they would have to '*cultivate their lands on their own behalf*', quoting from the Hawaiian Homes Act.

Planning what to do each day was one of the hardest strategies to work out, and in organizing the farm, and Hiene mentioned that it took them about ten years before they knew what task they were going to focus each day.

After they figured out the whole system, each day was set aside for a different function, including field preparation, planting, weeding, harvesting, packing, and shipping, but you also had to plan

for those ‘rainy’ days when the work calendar had to be modified.

Knowing what to expect tomorrow can make things easier today, and you can plan accordingly. I started working with them in 1981, and they became my *kupuna* or elders, providing me with an accelerated version of farming and life, helping me to keep focused and even scolding me when I tried to work every day of the week to catch up on things.

If you live in a rainy place, and you stopped working every time it rained, you wouldn’t get much done. Rain and other unexpected happenings can throw you ‘off schedule’, but the key is how you react to the unexpected.

You can react with a ‘woe is me’ attitude or you can say ‘whatever’ and adjust your schedule to take care of other issues that still result in a forward movement of the farm. Moving from a point of chaos to a point of stability is always a good thing. Or you can be a dinosaur and refuse to change.

Innovation is a trait that must be acquired. Some have it and others don’t. Some will be happy with the way things are going, while others are ‘hungry’, always trying to be on the cutting edge; a new crop variety, a new packaging idea, a new marketing concept, or a new product.

All of this costs money, and some ideas may not pan out, but having this trait is a

good thing. Some farmers are happy with where they are, and don’t want to change, and this is OK if you have a stable system in order and are satisfied with what you’re doing.

Others realize that in farming they need to be lifelong learners. New ideas can charge us up, and produce new found energy to move forward. Learning the basics, then taking it to the next level through innovation is what we expect each beginning farmer to do.

Getting to the Seed

Farmers are constantly looking for a competitive advantage or ‘edge’ to put them ahead of the farm game. Having access to the latest technology and finding which ones are ‘appropriate’ and will fit your farm system is the key.

One way of staying ahead of the curve is by conducting on-farm crop variety trials. Identifying new varieties that might be better adapted to your environmental conditions, seasons, and farm system than your present varieties is one way to maximizing your production system.

A global economy gives us access to seeds from many areas of the world, and finding the right variety can increase yields and quality with no increase in inputs, including fertilizer and amendments. In fact, the right cultivar may require less fertilizer.

Identifying Varieties

The first step is identifying varieties or cultivars adapted to our area. Some seed companies go through great detail in describing cultivars, while others only have a brief description that's more like hype with very little objective information.



Growing Squash Seed – Anna Peach of Squash and Awe, Lalamilo, Waimea, Big Island

One way of seeking out more information about a cultivar is by identifying the source of the seed. If you're not buying a widely available variety, the chances of getting accurate information, such as disease resistance and adaptability, may be even difficult.

Climatic conditions play an important role in which cultivar will excel. Seeds for tropical conditions must be adapted to warm night conditions, and hot-humid days. With the variable weather we have throughout the state, a variety that does well in Kona may not do well in Molokai.

Also, many varieties developed for temperate conditions focus on cold tolerance and earliness since many of these areas have a short growing season, but there are certain temperate varieties with broad adaptation, and can be planted in both tropical and temperate area, as well as high input and organic systems, but the only way of knowing for sure is by conducting on-farm trials and growing them side-by-side with a variety you're very familiar with.

Seed Producers vs Seed Stores

There are as many different types of seed companies and seed stores as there are seeds, with varied business and philosophical models, so it's hard to describe all the different types of seed-related companies.

There are even some employee-owned companies. Many companies producing seeds are not the companies selling seeds to farmers, and are similar to farmers selling to wholesalers who are selling to retailers in a marketing system. A schematic of this plethora of seed systems would make you dizzy.

The seed industry has undergone a wave of consolidation through the purchase of smaller seed companies by larger ones, and this move is being led by large multi-national pharmaceutical and pesticide companies such as Monsanto, Syngenta, Mycogen, Pioneer, BASF, Bayer, and others.

Many of these corporations started in pesticides, and morphed into a combination of genetic modification and pesticides as a new direction.



Monsanto Corn Fields – Kualapu'u, Molokai

Many of these companies see their future in genetic manipulation and patenting seeds into order to create residual, long-term income. It's about corporate survival, but others perceive it as way of controlling food and society.

There are concerns related the infiltration and manipulation of government creating an unfair playing field, and raising more questions about pesticide and food safety, as well as environmental health. Evolution in the control of seeds started with the government growing seeds as part of the land grant mission, to a global free market. These large seed corporations usually sell to retail and wholesale seed stores or companies, and may not sell directly to farmers.

Seed Stores

Many seed stores sell both retail and wholesale, and buy all their seed from other companies and are more like a retail store since they have no seed production system. They may know little if anything about the seed they're

selling, and may even hire a call center to take their calls and answer questions. There are some who grow some of their seed and also buy from others in order to provide a wide assortment of seed to accommodate the needs of their clientele.

It's my experience after growing my own seed that there's a lot of junk seed out there, small-sized seed with poor germination, and a relatively short shelf-life compared to well cared from and well grown seed. Cost is always a factor, but so is having the seed when you need it, especially with the potential of storms wiping out concentrated plantings of seed in areas such as Southeast Asia and South America.



Beefy Resilient Beans bred by Carol Deppe of Oregon for resilience and genetic diversity in changing weather conditions

Seed Production Systems

The large companies have traditionally focused on large-scale, high-yield, high-input farming systems. Under low input systems, many of these cultivars may not fare well because they're evaluated

and selected under conventional, high-input systems.

Reviewing the websites of these seeds companies will give specific information on cultivars. However, the recent purchases of many small companies by large multinational seed companies have given them access to a large collection of seeds adapted to a wide range of global conditions.

The type of farming system you have developed will determine in large part what kind of seed you should be seeking.



Harvesting lettuce seed selected for tip-burn and bolt-tolerance – Molokai Summer 2014

Organic Seed

On the other side of the spectrum are the organic and sustainable seed companies that can be considered the alter-ego of the large seed companies. They focus on organic aspects of seed breeding, such as creating low-input varieties or ones that may not be as uniform, and are more genetically diverse to allow for changing conditions.

Developing open-pollinated lines with great diversity also allows farmers to

make selections and save their own seeds, thereby controlling not only the quality of seed but also availability. Many organic farmers value control over their seeds as a form of independence and a better handle over their farming system.

Organic seeds are produced in organic systems without the use of synthetic and petroleum-based chemicals. Also, the use of genetically modified seed is not an option in an organic system. Pollen contamination from nearby production utilizing genetically-modified seed is becoming an increasing problem especially in areas with large production of genetically modified crops, and organic corn and beet seed production nearby.

Organic farming systems require farmers to purchase seeds that are produced organically. This system of farming is more holistic, and focuses on soil management more than yields. Matching the cultivar to the organic farming system is key, especially a farming system that may involve high organic matter, slow-release organic fertilizers, and the cultivation of microbes.

Disease Resistance

Another aspect in identifying adapted cultivars is an understanding of crop diseases prevalent in your farm area because the cost of disease control can be prohibitive or there may be no cost-effective method of control. Some

cultivars are bred for resistance to diseases.

A good example are tomatoes, some of which may have resistance to several diseases and also pests, including spider mites, root-knot nematodes, Bacterial Wilt, Fusarium and Alternaria fungus, Tobacco Mosaic, Spotted Wilt Virus, and Tomato Yellow Leaf Curl Virus. Planting disease-resistant varieties are a cost effective way of controlling diseases, and becoming an important trend for all types of growers.

Market and Use Considerations

Market considerations play into the variety of seed to be purchased. One example is carrots. If you selling baby carrots, selecting a cultivar that colors early, has strong tops for ease of harvest when young, and is flavorful when young is very important.

Shelf-life is very important, especially if shipping the product over long distances. If selling to the local fresh market or a nearby farmer's market, shelf life may not be important, and other considerations may be priorities, such as excellent taste or eye appeal.

Mixing different colors of the same size product may increase the marketability of your products. Examples include a mix of purple, white, yellow, orange, and red carrots, or orange, white, and purple cauliflower, or yellow, orange, red, and purple grape tomatoes.

Market preferences will dictate the selection of varieties. What does your

clientele demand? One way of finding out is by having a taste or preference test of varieties from your field trial, and evaluating your clientele responses. Creating an evaluation sheet will help you collect relevant information. Sometimes, exposing them to new colors and varieties may open doors to the production of new varieties.



Summer 2014 Lettuce Variety Trials for Heat-Tolerance – Manoa X Leopard F3

Field Trials

Field trials can be as technical or as simple as you want to make it. However, minimizing the variables in your field plot is important so what you're seeing is actually the result of the cultivar and not wind or shade or uneven irrigation or fertilization.

One way of minimizing these variables is by replication and randomization. Replication involves placing the same variety in different parts of the field to

minimize the effects of wind or shading or irrigation.

The number of replications will determine how many times a variety is planted in different places in a field, while randomization involves removing human bias from trial design to randomly plant cultivars in different areas of the field.

An easy way to first design a layout of the field that's similar to how you grow your crop. Be sure to add border rows so all varieties have plants on all sides of them. The next thing is to number pieces of paper, one for each cultivar. Put the numbers in a hat, and pull out numbers from a hat. Write down the numbers in the sequence you pull out.

This takes the human bias to favor one cultivar and put it in more favorable areas of the field, since humans seem to screw things up without even trying. A minimum of three replications should be conducted, but if the field is quite variable in soil or slope, more replications are recommended.

It's important to maintain your farming system, such as spacing, fertilization, watering scheme's etc. Any changes may influence the outcome of your trials. At the same time, understanding what the results of the trial mean is important.

One example or statement of results is this: "The tomato variety Kalohi had the highest total yield, highest marketable yield, and highest percentage of Grade A fruit in my growing system in this

climate on my farm when sown on April 10 and transplanted on May 1, 2014."

Your results may mean more than that, depending on the amount of data you collected, but it doesn't mean it will be the best variety when planted on May 1 in any area on any island. This trial may be a starting point in identifying the most adapted variety to your area, but is not an end all.



Taste Evaluations for organic Endive varieties, Organic Seed Alliance 2014 Annual Conference, Corvallis, Oregon

The problem with trial results is that they usually produce more questions than answers. There are other variables that may be more important, such as taste, fertilizer efficiency or how it performs in a low input or even a drought system.

Creating a real-life environment for your trials is a good start because it's a cruel world out there and you want your varieties to have the resilience to run the gauntlet of possible production conditions.

It may be difficult to determine when to start collecting yield data if varieties

