

# The Belize Ag Report

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Fusarium root rot Photo by John Blarupff



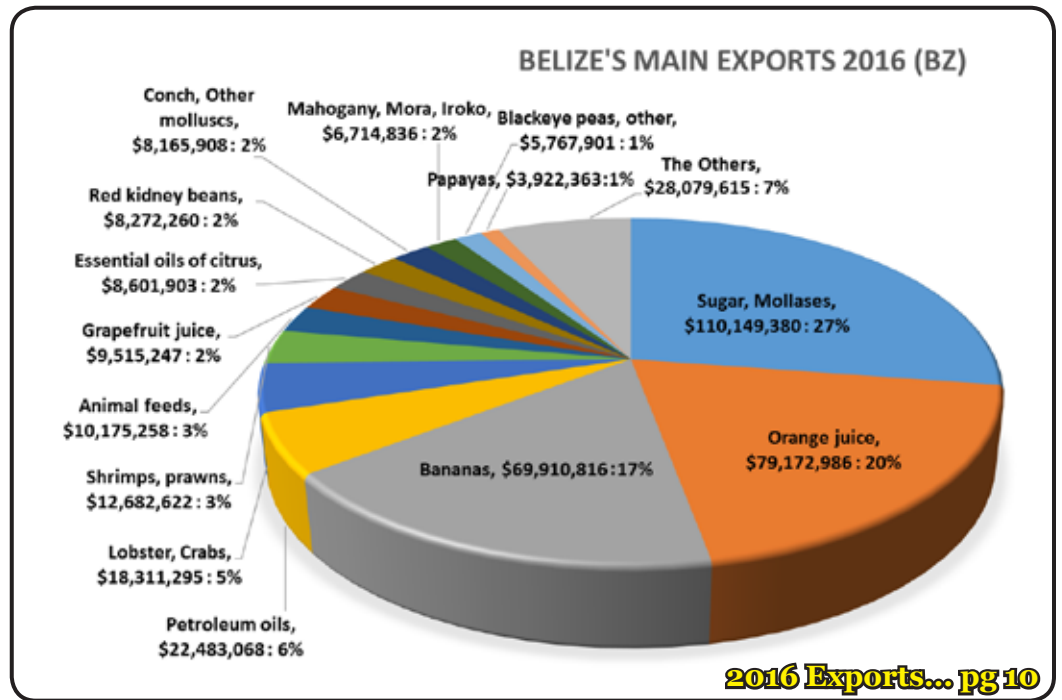
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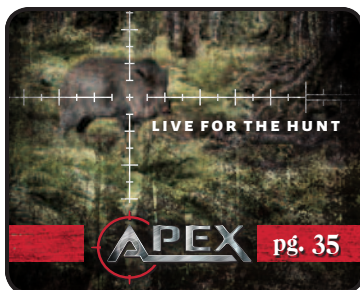
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## Control Postbloom Fruit Drop (PFD) In Citrus Production

Edwin Gomez, Raymond Arnold, David Saravia, Davilmar Avilez

### INTRODUCTION

Postbloom Fruit Drop (PFD) in citrus is caused by a fungus identified as *Colletotrichum acutatum*. Based on Florida Citrus Pest Management Guide, 2016, the fungus affects all species and cultivars of citrus, but severity of the disease varies based on flowering time and precipitation.

Spores of this fungus are produced directly on the surface of infected petals and are dispersed by rain to healthy flowers within 24 hours. Symptoms of the disease are visible in 4 to 5 days after inoculation (N.A. Peters and M. M. Dewney, 2016).

Two models have been developed to determine fungicide application to control PFD: the PFD model and the PFD-FAD system. (Both model descriptions available at University of Florida Web page.)

A fungicide trial was conducted at Barton Creek, Cool Shade, Cayo District to control PFD from 16<sup>th</sup> June, 2017 to 18<sup>th</sup> July, 2017. Area under trial were 15 acres treated and 15 acres as control. Plant rootstock was sour orange, scion Valencia, plant density at 96 plants per acre. Grove age, 25 years.

### OBJECTIVE

1. Apply a Strobilurin in combination with a Triazol fungicide to control Postbloom Fruit Drop (PFD) and improve orange fruit set at flowering. 2. Elaborate an estimated cost benefit analysis after fruit set in treated area to compare with control.

### METHODS

1. Select a problematic area with PFD 2. Choose most significant flowering period of grove. (For this trial, fungicide application was done in June for second flush.) 3. First application done at pinhead previous to flowering with a strobilurin **Regnum 25 EC** at

185 cc per acre 4. Second application to be done 10 to 12 days after the first application, mix a Strobilurin (**Regnum 25 EC**) at 185 CC per acre, combine with a Triazol at 200 cc (**Difecor 25 EC**). For both applications use 300 litres of water per acre, regulate water pH with **Pegador pH** and a sticker **Silkawet 5**. Count fruit set after 20 days of second application in 18 trees in treated area and control area to develop an estimated cost benefit analysis.

### RESULTS AND ANALYSIS

#### COST OF FIRST APPLICATION

APP	PRODUCT	DOSAGE (cc/ acre)	COST/UNIT	COST/ ACRE
1	Regnum 25 EC	185.00	\$ 155.00	\$ 28.68
	Pegador pH	378.00	\$ 18.50	\$ 6.99
	Silkawet	378.00	\$ 6.50	\$ 2.46
	App Cost/Ac	0.00	\$ -	\$ 4.00
<b>TOTAL</b>				<b>\$ 42.13</b>

#### COST OF SECOND APPLICATION

APP	PRODUCT	DOSAGE (cc/ acre)	COST/UNIT	COST/ ACRE
2	Regnum 25 EC	185.0	\$ 155.00	\$ 28.68
	Pegador pH	378.0	\$ 18.50	\$ 6.99
	Silkawet	378	\$ 6.50	\$ 2.46
	Difecor 25 EC	200.0	\$ 75.00	\$ 15.00
	App Cost/Ac	0.0	\$ -	\$ 4.00
<b>TOTAL</b>				<b>\$ 57.13</b>

#### ESTIMATED REVENUE BASED ON FRUIT SET COUNT PER ACRE

TRIALS	AVE/BOX/AC	SALE/PRICE	TOTAL
Treated	105	\$ 14.50	\$1,518.31
Control	34	\$ 14.50	\$ 488.92

#### COST BENEFIT

TRIALS	SALES/ACRE	APP COST	REVENUE
Treated	\$ 1,518.31	\$ 99.25	\$1,419.06
Control	\$ 488.92	\$ -	\$ 488.92
<b>INCOME INCREASE</b>			<b>\$ 930.14</b>

### OBSERVATION/DISCUSSION

1. Estimated yield in treated area accounts three time more compared to control in second flush. (105 boxes per acre /34 boxes per acre equals 3.088) 2. Estimated revenue in treated area sum \$930.14 after deducting application cost and product input cost. 3. Based on results obtained, combination of a Strobilurin with a Triazol is effective to control PFD; the key to positive result is in line with time of application.

# Old Crops Become New Sweet Potato (*Ipomoea Batata*) Part 2 An Underutilized Tropical Root

By Santiago Juan

Sweet potato is a plant grown for its tuberous roots in tropical, subtropical and warm-temperate regions. As mentioned in the last Belize Ag Report, issue 36, sweet potato is cultivated for food in more than 100 countries, sometimes as a staple food but usually as an alternative food. All varieties of sweet potato are a good source of vitamins and minerals. In East Africa, the sweet potato is known as “the protector of children” because it is often the only food that stands between a child’s survival and starvation. A fast-maturing perennial plant, it is grown mainly as an annual. The roots are adventitious, mostly located within the top 25 cm of the soil. Some of the roots produce elongated starch tubers that vary largely in shape, colour and texture depending on the variety. The flesh of the tubers can be white, yellow, orange or purple whereas their skin can be red, purple, brown or white. The stems are creeping slender vines, up to 4m long. The leaves are green or purplish, cordate, palmately veined, borne on long petioles. Sweet potato flowers are white or pale violet; the fruits are round, 1-4 seeded pods containing flattened seeds.



The livestock industry can benefit from sweet potato forage as a source of protein, about 15-30% in the dry matter, but the forage quality depends on the proportion of leaves and stems, the latter containing much less protein than the leaf. Lysine is the main limiting amino acid. Unlike legume forages, it does not contain notable quantities of anti-nutritional factors. The vines are separated from the roots after harvest and provide a nutritive and relished green feed for ruminants. It is a suitable protein supplement for animals receiving low quality forages. Sweet potato can be fed to dairy cows as a supplement to forages such as Guinea grass or sorghum. Sweet potato greens have been successfully fed to dairy cows, sheep, goats, pigs, and rabbits. The economic impact of this is tremendous as it can reduce the farmer’s dependability on high protein-based diets which farmers have to purchase.

I cannot overemphasize the immense potential of the sweet potato as it produces more edible energy on marginal land than any other major food crop. As well as this useful property, it can withstand adverse abiotic and biotic stresses and does not require intensive care. It therefore could potentially contribute to a sound industry in Belize as so many Belizeans are small-to-medium size landowners. An industry around this crop would not be difficult to establish. In difficult financial times in Belize the sweet potato could well be one of our saving crops. The immense industrial value for the extraction of starch and production of animal feed has yet to be explored in our communities. Thus the sweet potato has great potential for enhancing food and nutrition security in Belize. Sweet potato has failed to attract sufficient attention of agricultural researchers throughout the tropics, Belize being no exception to this statement. With greater attention and more collaborative research, there could be considerable improvements in selecting local cultivars and improving husbandry which,

together, would allow it to fulfill a wide range of needs in these areas of the world.

The 1996 World Food Summit definition of food security was adopted to mean “A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”. Based on that definition, sweet potato can fulfill all the aspects of the objectives adopted at that summit nearly 21 years ago, yet in Belize we still see the mass importation of low quality food distributed countrywide.

Added value for farmers comes from a variety of products and ingredients made from sweet potato food including flour, dried chips, juice, bread, noodles, sweets, pectin and leaf powder for smoothies.



Other research can be carried out in the fields of

liquors and anthocyanin pigments in the purple varieties for food colouring and cosmetic industry. Fresh sweet potatoes are baked, boiled, or fried and used in numerous recipes: mashed, pancakes, dumplings, potato salads just to name a few. All the foods which we currently make with the “Irish potato” we can prepare with the sweet potato, without having to import millions of Belize dollars’ worth of potatoes every year. This would not only have tremendous impact on the daily lives of our farmers as additional sales but also to all Belizeans as the foreign exchange would not be needed for the importation of yet another staple.

The flour produced from sweet potatoes could be used in the meat industry as a binder for sausages and meat patties without having to import so much wheat that has many social problems associated with it: not only the monopoly of the wheat flour in the Belize market but also the fact that it is a GMO crop, sprayed with glyphosate that Belizeans have routinely said they would prefer not to have to eat because of the rising problems with gluten intolerance and other diseases that have been linked to glyphosate. The Belizean authorities have little, if any, control over the questionable agricultural husbandry behind the cultivation and handling of the imported wheat crop with herbicides, insecticides and fungicides. Today we do not know what we are eating from the imported processed and unprocessed foods. We read in the press of all the uses of extremely toxic chemicals in the agricultural industry which we end up consuming. This is just another reason for us to focus on crops like the sweet potato which is local to us.

The International Potato Center (CIP) in Peru has the largest sweet potato gene bank in the world, with more than 6,500 wild, traditional and improved varieties. This diversity in the crop is a testament of its immense adaptability in the region.

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## Belmopan Weekend Farmers' Market At National Agriculture and Trade Show Grounds By Sally Thackery



The new pavilions at the Belmopan showgrounds are now open on Saturdays and Sundays for local farmers to sell their products to the public. Opening day, Saturday July 29, was lively and well-attended, by both the public and the market sellers. Big thanks to CEO Jose

Alpuche and Show Grounds Coordinator Gary Ramirez for such a bright vision for this property at the entrance to Belmopan. The entire showgrounds have been cleaned up, mowed, landscaped with beautiful plants and vendor stalls have been colorfully painted. These detailed improvements also include a new entrance gate, bathrooms in all sections and designated parking areas. In addition to fresh vegetables, the market offers dry goods, eco-friendly cleaning products, fruit trees, flowering plants, vegetable plants and fast food vendors. As the market grows throughout the year, other vendors, including live farm animals, will be added.

The Showgrounds are an excellent venue for all types of events, from weddings, family reunions and fundraising parties, to the Belmopan BTIA Tourism Expo which will be held on Saturday 4<sup>th</sup> November in a section adjacent to the market. If you are interested in booking an event or being a market seller on weekends, contact the coordinator at nats@agriculture.gov.bz or call 822-2648.

Thank you also for the beautiful artistic banner welcoming everyone to Belmopan!

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Photos by Sally Thackery.

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**SIRDI EU IPDM Project  
Metarhizium anisopliae Production:  
An Integrated Approach to Control  
Froghopper in Sugarcane.**

**By Jeffy Gomez, Luciano Chi,  
Luis Gongora and Jian Cob**

Froghopper is considered a major pest in sugarcane; every crop cycle it affects sugarcane farmers by increasing control costs while decreasing productivity. The problem is especially serious with the elimination of the preferential market for Belize’s sugar. Hence, it is of great importance to start adapting more environmentally-friendly controls by deterring the use of chemicals and meeting standards set by the Fairtrade market.

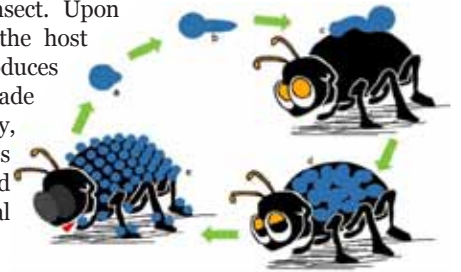
With the assistance of the European Union (EU), the Government of Belize (GOB) and the Sugar Industry Research and Development Institute (SIRDI), the project entitled “Strengthening of Integrated Pest and Disease Management (IPDM) in the Sugar Industry” is being implemented in the northern sugar belt. The aim of the project is to create a competitive and diversified sugar industry that contributes to a sustainable environment for sugar production in Belize. The incorporation of an IPDM program which is based on ecological principles, considering the agro-system as a whole, is to complement and reinforce what farmers have been practicing in their fields. These practices include the on-time application of mechanical, cultural and biological control methods.

The use of a biological agent such as *Metarhizium anisopliae*, presents a “new” and integrated approach to prevent and control froghopper infestation. It has been reported that this biological agent can infect approximately 200 species of insects and arthropods such as termites, ticks and weevils just to mention a few. In contrast, studies have demonstrated that irrational use of pesticides for its control leads to serious environmental and human health problems, as well as pest resistance. The cost of chemical control is approximately up to 80% more expensive compared to a biological control agent.

The recommended dosage application for the metarhizium is determined by the product sporulation count and virulence of which is determined by the laboratory officer at the time of production. Nevertheless, the main objective is for the product to be accessible to all farmers in the northern sugarbelt at a reasonable price, inclusive of the livestock, citrus and organic productive sector. Marketing campaigns have been initiated through SIRDI’s Farmer Field School Program and field days activities complemented with morning talk shows, radio and TV advertisement. The contemplation is for a communication and visibility strategic plan alongside a sustainability plan; a cost benefit analysis is to be performed after the project life cycle.

The process required to obtain an effective biological pesticide such as metarhizium is: collection, isolation, characterization and multiplication. It is crucial to perform this process correctly so as to establish the base for the future development of the fungus. This fundamental step requires developing a complete profile of the entomopathogenic fungus in order to be evaluated as a potential biological agent for its multiplication. *Metarhizium anisopliae*

attacks specific insects initially by attaching its spores, known as conidia, on the cuticle of the insect. It then produces an appressorium and penetrates the insect. Upon successful entry into the host body, it divides and produces hyphal bodies that invade the host tissues. Finally, the fungus emerges from the dead host and produces more conidial spores.



*Figure 1. The general mode of infection of an entomopathogenic fungus: a.) Conidia b.) Germination of conidia c.) Adhesion d.) Penetration and e.) Sporulation of corpse.*

The SIRDI EU IPDM laboratory, which is scheduled to start construction on August

of 2017, is intended to produce biological control agents including the production of *M. anisopliae* for immediate distribution and use by the sugar industry by February 2018. The laboratory will include the following equipped stations: a.) quality control, b.) preparation of substrate, c.) inoculation, d.) incubation, e.) drying, f.) formulation and packaging, and g.) storage. As whole grain, the rice (substrate) is washed, dried and placed on auto-cleavable bags. After sterilization, the rice is cooled down to room temperature and then inoculated with a solution containing the fungus, purified water, sugar, malt, and yeast. The inoculated bags are then placed in the incubation room for 15 days and transferred to the drying room for 7 days after which the rice is washed and the *M. anisopliae* can be applied to the field. Each process requires strict sterile practices and conditions which include the use of face masks, gloves and lab coats. It is important to constantly disinfect the working area with alcohol or sodium hypochlorite solutions.

Finally, sugarcane farmers and all other industries in Belize will have access to the *Metarhizium anisopliae* at an accessible price, since this biological pesticide can also control pests within the poultry, organic production, vegetable and fruits and citrus industries.

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# Biochar Implementation in Agricultural Systems of Belize

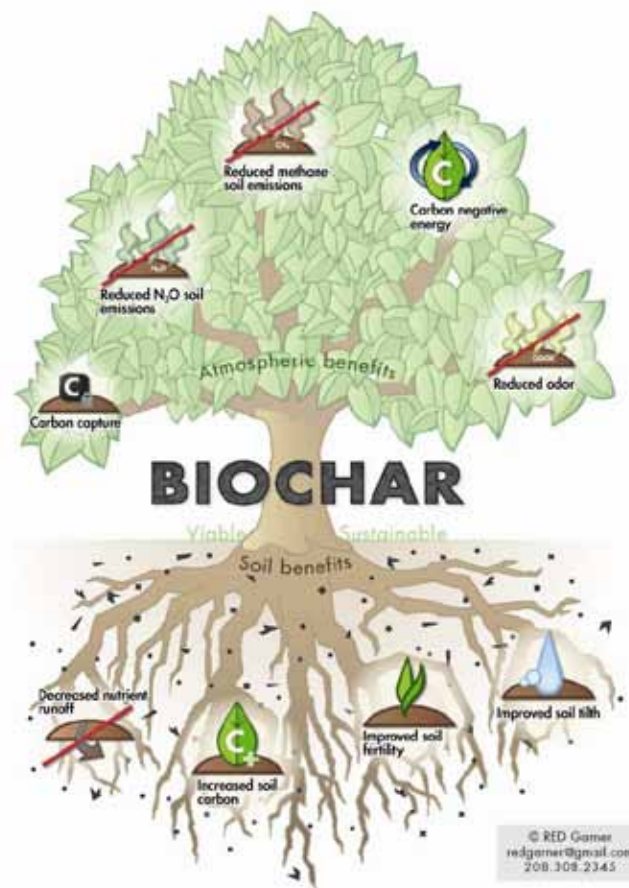
## By Gerardo Ofelio Aldana

In addition to pressures to adapt to climate change, agricultural production demands include innovative and effective solutions to balance both food production and environmental sustainability (Lehmann and Joseph, 2015). Volatility in agricultural commodities, in parallel with population growth, have initiated an alarming concern as to whether the rates of agricultural production will be able to meet its future food demands. Recent years have shown an improvement in agricultural productivity, but future demands are uncertain, especially in light of environmental factors such as climate change (Sands et al., 2014). The climate problem is now extremely large and is drastically affecting our food production systems. What the future needs is solutions that will counteract a myriad of problems all at once. One such solution is biochar. As a potential means to counteract negative environmental effects and satisfy food demand for an ever-increasing population, it is important to understand the effects of biochar implementation within an agricultural system.

Biochar is the production of carbonaceous material derived from the thermochemical conversion of biomass in an environment limited of oxygen (International Biochar Initiative, 2017), and can be used for a myriad of applications supporting agricultural and environmental sustainability (Hale et al., 2015) as shown in Figure 1. Due to its physiochemical structure, biochar has been used to increase agricultural yield, amend infertile soils, reduce leaching of nutrients, store atmospheric carbon within the soil in order to combat negative anthropogenic climate related activities, absorb metallic pollutants, and mitigate pesticide pollution, among other beneficial aspects (Pereira et al., 2011; Millaet et al., 2013; Reid et al., 2013). Though several biochar sources do not easily burn and charcoal is not typically made to address soil fertility issues, nevertheless there is a wide range of biomass that can be used to produce biochar materials of different characteristics, each biochar with its own benefit and impediment. Woody biomass, leaves, crop residues, grass, manure and sludge, amongst other biomasses, can all be converted to biochar via pyrolysis processes.

Agricultural production inadvertently produces large quantities of agricultural waste, which may be a significant burden to environmental management. Agricultural waste disposal techniques such as incineration and landfill disposal are the common methods of waste management; however, these techniques are discouraged since they tend to create more environmental concerns such as leaching and greenhouse gas

Figure 1. Benefits of biochar



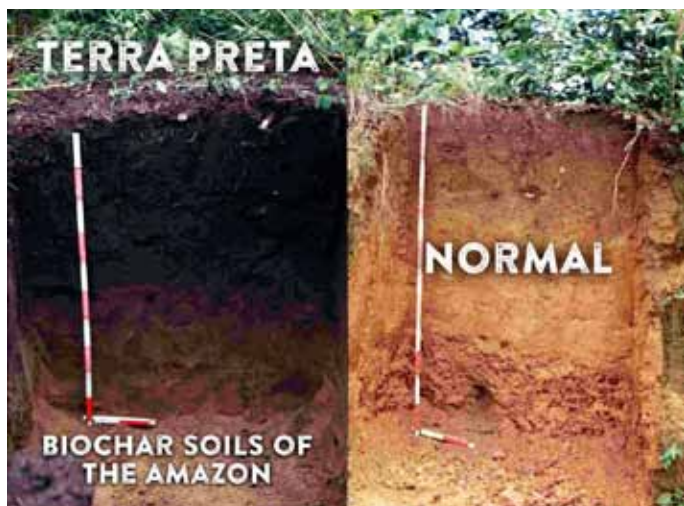
production (Jaria et al., 2017). Rather than incineration and landfill disposal, recycling and converting agricultural waste into biochar opens new futuristic opportunities leading to a zero waste agricultural production system. The addition of biochar to soils has been practiced for several centuries and observed in different traditional agricultural soil management systems around the world. In Belize, studies have found Mayan dark earth characterised as very fine biochar-rich soil containing relict clasts of resistant-burned sediments such as fishbone, conch shells, reef stone, and crab shells. A most striking discovery that greatly contributed and motivated biochar research was the anthropogenic dark earths or Terra Preta de Indio found in Central Amazonia, Brazil. These soils date back to some 8,000 years, and remain high in nutrient and soil organic matter even today, as seen in Figure 2.

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**Figure 2. Pictorial view of Latosol (right) and Terra Preta (left) soil horizon (Anderson and McLaughlin 2009).**



If the widespread use of biochar is to be implemented, the knowledge of biochar and its impacts particularly within soil and agronomic contexts must be well established. Only if the user is confident of positive and cost effective benefits of biochar, when applied at particular rates, will a biochar market emerge. Work on the definition and stability of biochar is ongoing by established research groups and has been initiated in the UK, USA, Australia, New Zealand, Taiwan, and other countries. Several key factors are to be addressed such as better life cycle assessments of pyrolysis biochar systems, better techno-economic cost modelling, better comparative analyses of biochar versus other resource use options, and assessment of land use implications of biochar deployment.

The most commonly used pyrolysis reactors which have reached or nearly reached commercialization are the French/ Lambiotte reactor (<http://www.lambiotte.com/>), rotary drums (<http://www.ethosenergygroup.com/>, <http://techtrade.de/>), and amongst these are the auger reactors, pyrovac design and paddle reactor. In developing countries, the biochar cook stoves have been widely used for the production of biochar. These biomass cook stoves are less complex, low-pollutant emission units designed for domestic cooking and heating using different biomass feedstock, which produce biochar as a by-product (Lehmann and Joseph, 2015). There is a wide range of designs (over 400 types listed in the HEDON database; <http://www.hedon.info/stoves+database>) depending on purpose, scale, fuel used, materials of construction, etc. The Toledo Cacao Grower's Association has produced and utilized biochar for increase in yield of cacao production, while the Maya Mountain Research Farm (<http://www.mmrfbz.org/production/cacao>), has also been producing biochar using biochar cook stoves, as seen in Figure 3.

In a developing country such as Belize, the removal of agrochemical contaminants has been problematic due to the lack of advanced pollution treatment methods; therefore environmental protection agencies seek cost-effective methods for the reduction of pesticide pollution. The application of biochar systems is quite appealing for the reduction of pesticide pollution, since in most developing countries there is a variety of readily available biomaterials such as agricultural and forestry waste for the production of biochar. Mr. Gerardo Ofelio Aldana has been studying the effects of biochar on agricultural soils, reserving key interest upon its effects on heavy metal and pesticide pollution persistency. At present, Mr. Aldana's doctoral research based at

**Figure 3. Biochar cook stove constructed by the Maya Mountain Research Farm in Belize**



Newcastle University, UK, focuses on the interaction of biochar and its effects upon the leaching persistency of pesticides within agricultural soils of Belize. He aims to understand stakeholder's perspectives on the implementation of biochar within agricultural systems of Belize, as well as to provide sound scientific evidence as to whether biochar will be feasible for the attenuation of pesticides from agricultural land, thereby resulting in the protection of Belize's natural and sensitive ecosystems. There is much needed research in order to determine the effects of biochar application upon agricultural yield in agricultural systems of Belize; in order to do this, joint efforts must be established amongst different agricultural stakeholders of Belize.

**Editor's Note:** Gerardo Ofelio Aldana comes from the agriculturally active town of San Ignacio, Cayo, Belize. The beautiful rivers, trees and animals found in his hometown have been Gerardo's utmost inspiration for pursuing a PhD with respect to Agricultural and Environmental Sustainability at Newcastle University, UK. When taking a break from the academic world, Gerardo enjoys singing and playing his guitar while lying in a hammock under a shady tree.



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# BEYOND THE BACKYARD

## Suck Your Way to Health

By Jenny Wildman



I came across an article about a strange fruit that can boost your brain function - something all seniors think of when they cannot remember names or misplace their glasses. The picture was that of the fruit known here as kenep, kinnip or guayo. The deciduous, polygamous kenep tree is part of the soapberry family along with logan, rambutan and lychee, all cousins to the northern chestnut. The scientific

name is *Melicoccus bijugatus* commonly referred to as Spanish lime, quenepa, genip, chennet, talpajocote and mamoncillo from the verb mamar to suck. Kenep trees are native to South America and the Island of Margarita and also found in drier woodlands and gardens of the Caribbean and Central America. The tree is usually grown from seed but is also propagated by grafting and grows to an imposing height. Generally it needs two trees functioning as male and female. You need to choose your location carefully as the tree requires a lot of space and full sun. There are

several different varieties with names like Queen, Montgomery, Jose Paton. There are other melicocci that bear fruit and look very similar, all mainly fruiting from start of the rainy season and here in Belize between June to September.

The fruit is a drupe which grow in bunches. In June I purchased a bag of kenep in San Ignacio market; they were on the smallish side but the ones I purchased on the Hummingbird were large and juicy. When the skin is firm and leathery kenep is ready to harvest and the fruit can keep unrefrigerated for a long time. They market and ship well but if picked too soon will turn black and spoil quickly. Crack open the crisp outer skin to reveal a glorious salmon-to-yellow shimmering pulp which covers one large seed, occasionally two. Take care as it is slippery and can be accidentally swallowed. Pop into the mouth and suck away at the juicy fibrous pulp, a bit sweet, a bit sour, often eaten with salt and chili. Usually it is eaten freshly picked as it is labor intensive to scrape off the flesh to make jams and juices although it is done and very tasty. The seeds can also be lightly roasted for eating and in Colombia they are canned. I roasted some and they taste somewhat like chestnuts crossed with garbanzos.

Bees that feast on the nectar-rich white flowers produce dark fragrant honey. The fruit juice has also been used as indelible ink and dye for clothes. Spilling juice can result in nasty brown stains impossible to remove. The roasted seeds blended with honey make medicine for diarrhea. In fact the list of health benefits from eating the fruit is long due to the many nutrients it contains: fiber, iron, protein, calcium, niacin, vitamins A, B1, B3, B6, B12, C, many essential flavonoids, phosphorous, carotene, lysine and tryptophan which increases serotonin aiding relaxation and curing insomnia. Regular consumption can lower cholesterol, aid digestion, regulate blood pressure, fight off infections, improve skin, remove parasites, prevent kidney stones and urinary infections plus boost the immune system. Oh, yes, I almost forgot, and improve brain function.

It is no wonder that Puerto Ricans turn out to Ponce to celebrate the annual Festival of the Quenepa each August. In Ponce they make a liquor called *bili* by boiling the fruit on the seed, mixing with cane rum, cane sugar, touch of vanilla, pouring the liquid into a plastic container and burying it in the yard for thirty days. It is a much-loved fruit, the taste of summer throughout the Caribbean. Cuba advertises for people to come taste the best mamoncillos every July – October and watch the locals gather the fruit using specially made ladders and picking poles. A lovely sight no doubt.

Other known uses include scattering the leaves on the ground to eliminate ticks and flees. Make a tea by boiling and steeping the leaves and fruits and use for parasites and intestinal problems. For diarrhea roast the seeds then grind into powder, add to boiled water and drink a cup three times a day. The roasted seeds can be made into flour as a substitute for cassava for baking. The heartwood of the tree is used for cabinetry and for building rafts, a shame as this means the end of the tree. Kenep make lovely ornamental roadside trees and great shade. So if this little sucker can do all of that I am definitely planting a few trees as soon as possible as they will take at least five years to bear.

Please send any comments or information you would like to share [jenniferjanewildman@gmail.com](mailto:jenniferjanewildman@gmail.com)

Picture courtesy of Jenny Wildman.



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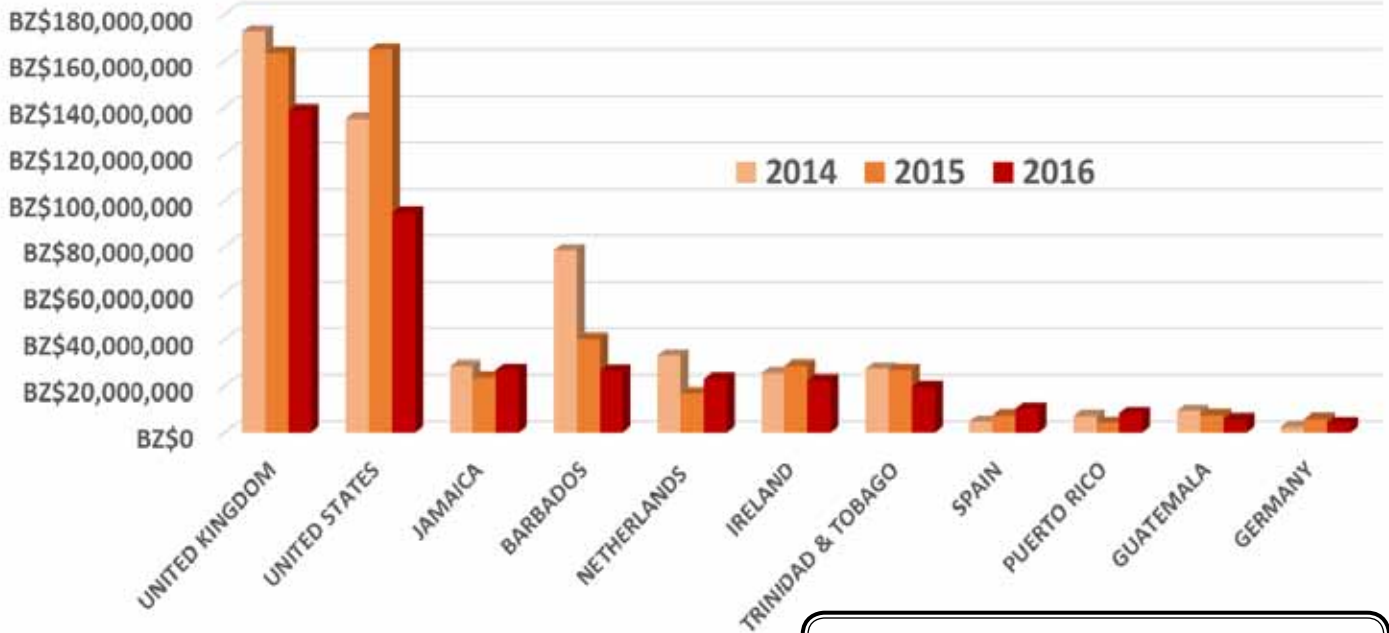
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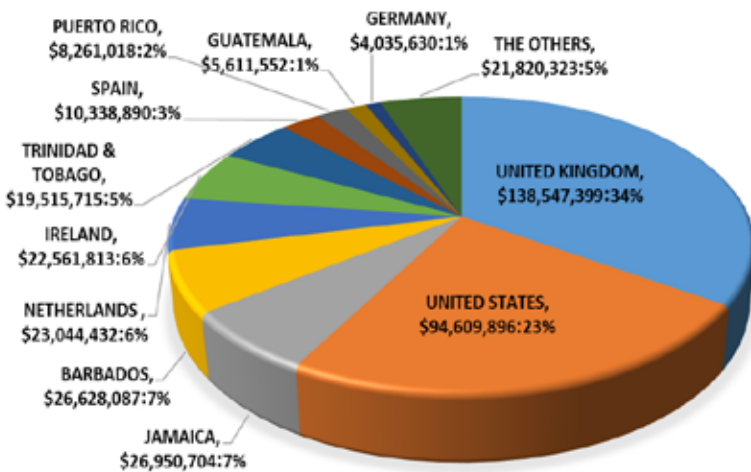
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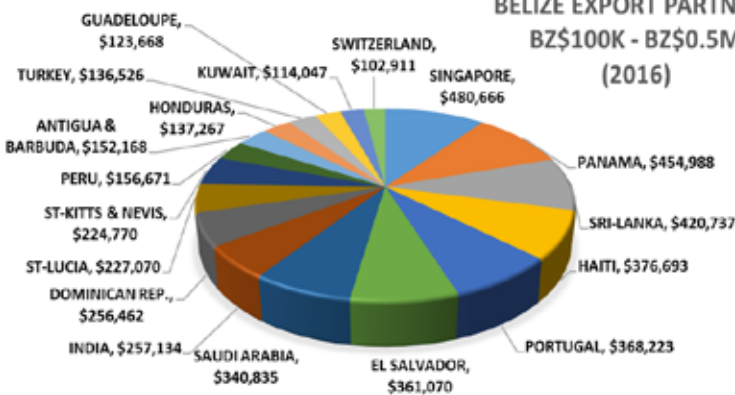
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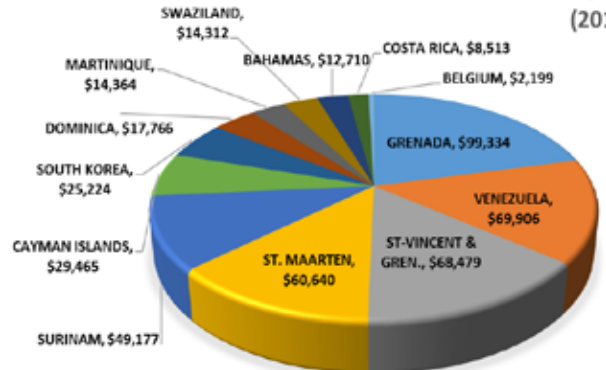
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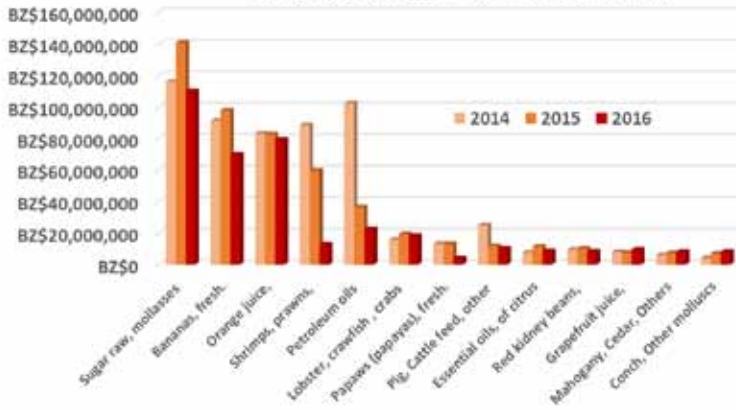
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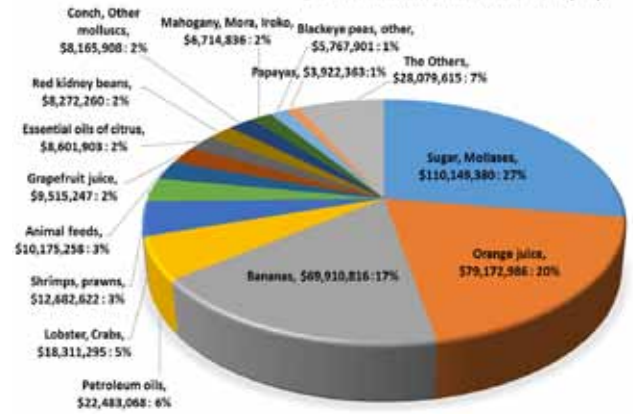
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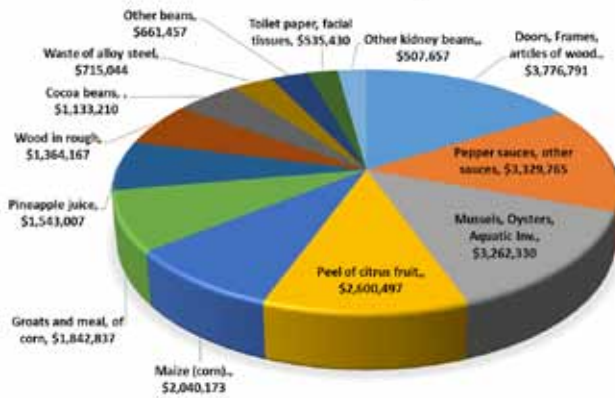
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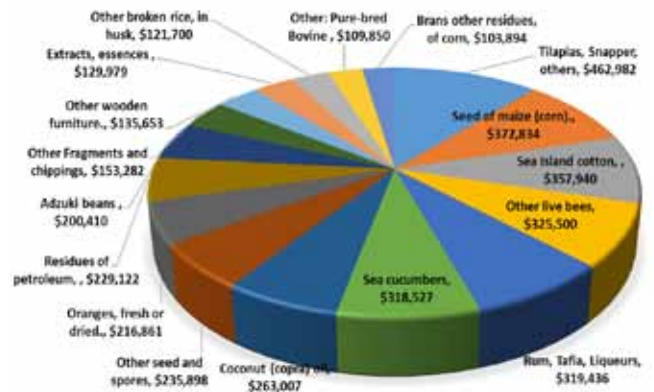
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## Rice Circle R's Contribution to Food Security in Belize

By Jeffrey Magaña



The highest priority for Circle R Products Limited, a farmer-owned business, is food security for Belize. Their newest product, *Dalla Rice*, was recently introduced to provide a 14 oz. packaged of grade A rice for \$1. *Harvest for Kids* is grade A premium rice; *Jade* is grade A; *Ruby*, grade C and *Topaz*, grade D. The *Harvest for Kids* product is named for the socially responsible project it supports. A percentage of the sale of all *Harvest for Kids* rice goes to support Belize Camping Experience in Belize City, summer Bible camps and

work with kids in schools throughout the city. We believe that if our children are inspired today, our country can become a better place. So, remember, if you buy *Harvest for Kids* rice, you are contributing to a worthy cause, not to mention that you are also taking home the best quality rice available in Belize.

There are two (2) growing cycles; dry season and wet season. Records are kept to identify the grain and the farm when rice is delivered and milled. The rice is tested for moisture before it is accepted for milling. Farmers are paid based on quality. All rice is milled to order to ensure freshness.

Circle R was established in Blue Creek, Orange Walk District in 1996 by several farmers who had mutual interest to grow rice and collectively mill and market the rice; it began as a small, 5-person operation milling rice and selling fertilizers and pesticides. Over the years Circle R expanded their operations and number of employees to 70. In the beginning milling was seasonal. Now 26 rice farmers farming approximately 6,200 acres keep the mill running year-round with an annual production of 22,000,000 lbs. of paddy rice; 60,000 lbs. are milled every day.



Currently most of the acres in production are irrigated. After harvest irrigated fields are not used to grow other crops because they are too low for other crops and most fields have flooding risk during the rainy season.

In 2007, the first packaging machine was acquired; in 2016 a second packaging line was added. Circle R products have always been pre-packaged to ensure safe consumer products; each package is labeled and dated. Circle R rice is sold throughout the country.

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# *Fusarium* spp. an Important Disease of Soybeans

By Felix C. Cawich, Agronomist, M.Sc.



Worldwide, soybean is considered an important crop for the production of oil and as a source of protein for people and animals. In addition, it's now being used for biodiesel production. According to the Worldwide Web Foundation (WWF), soybean production has grown 10 times in the last 50 years, covering over one million square kilometres. The increasing production area, like the increase

in yield of monocultivation, has also led to higher presence of disease in soy plantations. Furthermore, the varying climate may favor rapid development of diseases.

### Important Diseases

Diseases originating from different microorganisms can cause blights, cankers, rots, rusts, wilts and others, causing damage to different parts of the plant at any given growth stage (Fig 1.). All growth stages are vulnerable to a disease infection, which may be triggered by existing soil growing conditions, weather, pest occurrence, etc. For example, from VE to V2, plants are susceptible to blights, leaf spots and stem and root rots, all caused by different microorganisms such as *Pythium* spp., *Phytophthora* spp., *Fusarium* spp., *Rhizoctonia* spp., *Phomopsis* spp. As the plant develops, the stages from bloom (R1) to pod fill (R5), are critical times where the appearance of other diseases may include bacterial blight, fusarium wilt, mildews, sudden death syndrome, antrachnose, among others (Paderson, 2009). Some of these are foliar diseases and are obvious to detect, while others damage below ground and go undetected, thus both causing yield reductions.

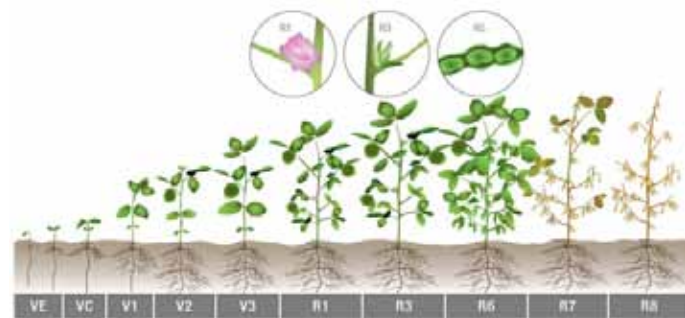


Fig 1. Soybean Growth Stages. (Photo source: University of Illinois, 1999)

Diseases affecting the roots are common every year, causing primarily root rots. The most frequently occurring are root rots caused by different fungi agents like *Phytophthora sojae*, *Rhizoctonia solani*, *Pythium* spp. and *Fusarium* spp.; also the so named charcoal rot caused by *Macrophomina phaseolina* (Diaz, 2012). All are important and require treatment. For purpose of this article, *Fusarium* spp. will be the principal disease discussed.

### *Fusarium* spp.

One of the major diseases attacking soybeans is *Fusarium* spp., which is a widespread, soil-borne pathogen causing diseases such as sudden death syndrome, root rot, crown rot, stalk rot, head blight and scab on cereal and grains (Nelson, 1993; Pedelson, 2010). Different environments may host this fungus, such as soil, roots and aerial plant tissues, plant debris and other organic substrates (Aoki, 2003), where they are capable of surviving for long periods of time, because they have resistant reproductive structures (chlamyospores) that can survive in inadequate conditions for years, remaining dormant until suitable conditions are present. Due to its widespread distribution, the disease can occur in all stages of plant development, from germinating seeds to plant maturity, depending on the host, climatic factors and composition of fusarium species (Mueller, 2010). *Fusarium* may cause disease individually or in complex with other causal disease agents, particularly in response to temperature and humidity (Doohan, 2000). Wet soils and cool temperatures often favor its infection in the early growing season; meanwhile, limiting soil moisture can cause plant stress making it susceptible to infection later in the growing season (Zhang, 2010).

*Fusarium* species, primarily root rot, are favored by cool temperatures and wet soils during early vegetative growth stages, thus affecting younger plants. One of the most important species, causing vast damages in young plants is called *Fusarium oxysporum*, which symptoms may appear as damping off, stunting, decreased vigor, chlorosis and decreased root masses (brown discoloration and/or lesions on the roots), eventually leading to the death of infected plants (Diaz, 2012). The presence of *Fusarium oxysporum* has been confirmed in Belize and it is difficult to differentiate from other diseases or stresses. The absence of a phytopathologic laboratory in the country makes difficult the accurate identification of these phytopathogens.



Fig 2. *Fusarium oxysporum* root rot. (Photos Source: John Bienapfl)

The presence of fusarium species infection has been linked to the soil, seeds and pest infestation. Monocultivation of legumes and persistence of infected plants, increase the damage under optimal environmental conditions. The use of infected seeds is another source of contamination where ten different fusarium species have been isolated, causing a reduction in germination (Pant,

***Fusarium...Continued on page 23***

## Fertility Needed for Growing Pastures and Hay

By Neal Kinsey

When the requirements for life-giving soil fertility to provide abundant plant growth and robust animal health are accurately considered, far too many pastures and hay fields used for livestock production are seriously lacking. Testing the soils in pastures and meadows has sadly proven this to be true far too often, even when only the absolute minimum nutrient content for those soils is considered. To treat your animals right you have to treat your soils right. Anything less and you rob from the total potential of life-giving principles for your soil, the plants grown there, the livestock that consume them and the products that are provided as a result.

When soils are not cared for correctly, it is not just a case of robbing from the soil and reducing the quality of life that needs to be there. Such actions are robbing every aspect of the operation, from the quality of life in that soil all the way up to the quality of life for the stock, the owners, and what is being produced to sell to others. If there is any place where this description should not apply, it should be to those who are caring enough to be known as top livestock producers – those who are there to provide the best and produce the best. From extensive work measuring the initial soil fertility on many types of livestock farms from alpaca, to cows, to goats, to horses, far too often building up the fertility of the soil for producing the best feed and food has not been accomplished.

A large number of farmers and ranchers contact us concerning what fertilizers and soil amendments they should use for growing

good to excellent pasture and hay. Such questions cannot be correctly answered without a soil sample that has been properly analyzed; you can't tell what you need until you know what nutrients you have and don't have! And the soil audit can only provide correct answers when the sample being sent for testing has been taken properly.

When it comes to building soil fertility, here is the place where those concerned with true quality should begin. Take soil tests from permanent pastures and hay meadows to a depth of only four inches. Remember the deeper you sample, the less available the soil nutrients (including micronutrients) will tend to be. Nutrients applied on top of the soil without being worked in will have the most significant effect on the top four inches over the next year. If the soil is to be worked and newly planted to pasture or some type of hay crop, then consider taking a topsoil sample to an average depth of six and three-fourths inches. When soils are worked after fertilization, even two or three inches deep, that is generally sufficient to mix the materials well enough to be utilized throughout the aerobic zone (as deep as a fence post will rot in that soil). If levels of nutrients below this area of prime influence are required, then take a separate subsoil sample to determine whether nutrients are lacking there or not.

Keep in mind that when fertilizer or lime is applied on top of the soil and not worked in, most of the nutrients will remain concentrated in the top few inches during the next growing season. As the plants begin to take up nutrients, if levels are correctly maintained, it is possible to positively affect fertility levels over the next year, which will show up by annually testing that four inch zone. When a grower follows through with fertilizing and testing for three or four years in a row on soils that will not have lime and fertilizer worked into that soil it will become evident as to how important it is that samples should represent only the first four inches as a separate soil sample every year.

When overdone, any fertilizer can contribute to excesses right in the area where the plant is trying to develop its roots to begin growing. Taking a six to eight-inch sample will generally show the soil as needing far more of some nutrients than a sample of the top four inches. The excesses caused by this consequent over-fertilization can become even more serious over years of supplementation.

Although the nitrogen, sulfur and boron will leach downward in the course of the growing season, a portion of the other nutrients will be held in that four-inch "sphere of influence" for much longer. This can affect how much fertilizer you may or may not need for the next crop. Spend your budget on things you need for growth, not on what "might" make a difference. Eventually, due to biological activity - including the plant roots that penetrate deeper down and then die back and decay plus the activity of microbes, earthworms and other life forms – even those nutrients applied on top of the soil will be transported downward and increase the needed levels of fertility to a greater depth in that soil. Although it is a slow process, in working with farmers, ranchers and growers who have done this, we have measured significant changes in the soil to as much as three feet deep (as compared to the control areas that did not receive the nutrients). This program was conducted where the proper fertilizers and liming materials were all applied on top of the soil based specifically on fertility needs as determined by sampling the top four inches and fertilizing accordingly for ten years. The results from multiple sites were increased levels of nutrients and



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increased rooting by as much as 30-50% to a depth of three to four feet.

Considering these results, why should the correct sampling depth be of prime concern for those growing pasture and hay? At times even the most needed fertilizer, if applied in excess, can make one or more other nutrients completely unavailable. This is the real meaning of balance in soil fertility! Excessive applications of any nutrient, no matter what type, will generally adversely affect the availability of one or more of the other needed nutrients (particularly trace elements) that can cause the plants growing there to come up short.

Due to the use of compost and natural materials for fertilizers, deficiencies of micronutrients are too often dismissed as unnecessary for such soils. This can be verified as true on soils in Europe that have received moderate amounts of manures and compost and have been farmed for 500-1000 years. However, most agricultural soils in North and South America have not had the benefit of hundreds of years of such treatments and they show it. When the soils test as lacking in one or more of the trace elements that are shown to be needed, once properly supplied they show up in a positive way concerning the health and vigor of the livestock.

For more on soil testing and other aspects of the soil fertility program we utilize please see our web site, [www.kinseyag.com](http://www.kinseyag.com), or contact us directly for your specific needs. And for those who consider the points made above are of utmost importance, we hope you will consider working with us in order to provide the needs of your soil and the crops to be grown there for benefiting the livestock and people depending on them.



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## Modern Water Wisdom Interview: Author Judith Schwartz Examines Water Management

Reprinted from **ACRES**<sup>USA</sup>, June 2017 • Vol. 47, No. 6

### Interviewed by Tracy Frisch

When writer Judith Schwartz learned that soil carbon is a buffer for climate change, her focus as a journalist took a major turn. She was covering the Slow Money National Gathering in 2010 when Gardener's Supply founder Will Raap stated that over time more CO<sub>2</sub> has gone into the atmosphere from the soil than has been released from burning fossil fuels. She says her first reaction was "Why don't I know this?" Then she thought, "If this is true, can carbon be brought back to the soil?" In the quest that followed, she made the acquaintance of luminaries like Allan Savory, Christine Jones and Gabe Brown and traveled to several continents to see the new soil carbon paradigm in action. Schwartz has the gift of making difficult concepts accessible and appealing to lay readers, and that's exactly what she does in *Cows Save the Planet And Other Improbable Ways of Restoring Soil to Heal the Earth*, which Elizabeth Kolbert called "a surprising, informative, and ultimately hopeful book."

For her most recent project, *Water in Plain Sight: Hope for a Thirsty World*, Schwartz delves into the little-known role the water cycle plays in planetary health, which she illustrates with vivid, empowering stories from around the world. While we might not be able to change the rate of precipitation, as land managers we can directly affect the speed that water flows off our land and the amount of water that the soil is able to absorb. Trees and other vegetation are more than passive bystanders at the mercy of temperature extremes — they can also be powerful influences in regulating the climate.

The week after this interview was recorded, Schwartz travelled to Washington, D.C., to take part in a congressional briefing on soil health and climate change organized by Regeneration International. As a public speaker, educator, researcher and networker, she has become deeply engaged in the broad movement to build soil carbon and restore ecosystems.

ACRES U.S.A. Please explain the title of your book, *Water in Plain Sight*.

JUDITH D. SCHWARTZ. The title plays on the idea that there is water in plain sight if we know where to look. It calls attention to aspects of water that are right before us but we are not seeing. By this I mean how water behaves on a basic level, not anything esoteric.

ACRES U.S.A. How should we reframe the problems of water shortages, runoff and floods?

SCHWARTZ. Once we approach these problems in terms of how water moves across the landscape and through the atmosphere, our understanding shifts. For example, when we frame a lack of water as "drought," our focus is on what water is or isn't coming down from the sky. That leaves us helpless because there's really not much we can do. But if we shift our frame from drought to aridification, then the challenge becomes keeping water in the landscape. That opens up opportunities.

ACRES U.S.A. Could you say anything about flood in that same vein?

SCHWARTZ. Allan Savory has always said that floods are manmade. Again, it has to do with how we manage our land. Is water remaining in the landscape, or is the land incapable of holding that water? If it's the latter, you will get a flood.

ACRES U.S.A. Many people have forgotten, or maybe never were familiar with, what a healthy water cycle looks like. How would you describe its characteristics?

SCHWARTZ. In a healthy water cycle, precipitation remains in the landscape and only leaves the soil through plants or by filtering through the ground into underground water stores. In general, a healthy water cycle ensures there's sufficient water to sustain biodiversity in that particular system.

ACRES U.S.A. Allan Savory's concept of "effective rainfall" ties together many of your examples throughout the book. What do people do to make rainfall more effective?

SCHWARTZ. On a very basic level the key is carbon-rich soil. Often, what is considered a water scarcity problem is really an inability-to-keep-water-on-the-land problem. Carbon is essential here because every gram of soil organic carbon represents 8 grams of water that can be held on the landscape. It's an amazing sponge. When we lose that sponge, we have landscape degradation.

ACRES U.S.A. I still see confusion, even in organic farming circles, between the more persistent soil carbon in humus versus just applying a quantity of compost to the land. They're not going to have the same effect, are they?

SCHWARTZ. There are a couple of ways to understand this. In terms of function, what's important is not the presence of carbon per se, but soil structure, meaning well-aggregated soil to allow for water and airflow. As Christine Jones has pointed out, aggregates form around the roots of plants. Humus is formed within soil aggregates. Adding compost doesn't directly promote aggregation other than, perhaps, helping to create the conditions for aggregates to form. Also, there is a difference between surface, labile carbon and stable carbon deeper in the soil. With added organic matter, the top layer of soil is very biologically active with microbes respiring, releasing CO<sub>2</sub>. This isn't a bad thing since it's rapidly cycling in and out, but to build soil carbon it needs to be drawn down deeper through plants.

ACRES U.S.A. Most likely you wouldn't start with an ample supply of carbon-rich humus in the soil. What have people done to boost the infiltration of rainfall into the soil?

SCHWARTZ. The approach I know most about is holistic planned grazing, in which livestock serve as a tool for large-scale and restoration. In degraded, dryland landscapes — areas that desertify

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most dramatically — planned grazing solves a basic problem in areas with seasonal rainfall: How do you maintain moisture in the soil from the end of one rainy season to the beginning of the next? Indeed, Allan Savory helped us understand that ruminants have always played this role in grassland ecosystems, and therefore sustained these landscapes. One of his particularly useful concepts is the “brittleness scale.” Here in Southern Vermont we have moisture fairly consistently throughout the year. Ours is a “non-brittle” environment. By contrast in Zimbabwe, where Savory is from and the site of the Africa Centre for Holistic Management, there are distinct dry and rainy seasons. This is a “brittle” environment. Brittleness is not a matter of total rainfall, but of distribution of rainfall. Johannesburg, where my husband grew up, has nearly the same average annual rainfall as London. But South Africa is brittle whereas the UK is not. Where a place falls on the brittleness scale provides insight as to how the ecosystem functions. Allan Savory helped us understand that moisture can be maintained in the landscape through the digestive system of ruminants. The animals secrete moisture and nutrients that then can be reincorporated into the soil. They also help break down dead plant matter. Often in agriculture and ecology, we think about birth and growth but not death and decay because they’re not very sexy. In Vermont there’s always moisture to support the microbial and fungal life that break down decaying matter. In dry areas you don’t have that. One of Savory’s core insights is that land can be undergrazed as well as overgrazed. Grazing animals consume and digest — break down — the grasses. They also trample dead plant matter into the soil so microorganisms can act on it. When people look at a landscape, they usually don’t think, “how wonderful that microorganisms are incorporating plant matter into the soil,” though that is what gives it life. That process builds the carbon level, which holds the moisture. With that moisture, the land supports microbial life, which keeps the entire system functioning. Without that it stalls, a story now being written across the planet.

ACRES U.S.A. Do you want to say more about the vicious cycle, where feedback mechanisms make things get worse and worse?

SCHWARTZ. The vicious cycle is driven by the loss of carbon in the soil. This can happen in many ways. If you clear land or heavily till it, you lose soil carbon. Or let’s say land is undergrazed or not grazed at all. When dead plant matter accumulates on the soil surface, it oxidizes. That is, it undergoes chemical decomposition as opposed to biological decomposition by microorganisms. It blots out the sun, hindering new growth. The ground dries out, microorganisms die and you have a biological desert. Savory often gauges landscape health by the space between living plants. When he started the Africa Centre, much of the ground was 90 percent bare. Now, he says, he has to intentionally create bare patches for learning purposes. It is amazing how quickly land heats up when it’s bare. This is where the concept of “land skin temperature” comes in: the soil surface can be significantly hotter than the air temperature. At less than 120°F microorganisms start dying and by 130 degrees, 100 percent of moisture is lost. On hot days, say 100 degrees-plus, you can exceed 140 degrees on bare soil.

ACRES U.S.A. In your book you quote Bruce Ward’s statement about land skin: “If we were to lose our skin, it would hurt like hell.” How do you define land skin?

SCHWARTZ. Bruce Ward was a very beloved teacher of Holistic Management in Australia who passed away a few years ago. He talked about soil as the interface between the body of the earth and the atmosphere, much like our skin is the interface between our body and the air that we move around in. You can also think of it as a membrane that’s protecting the surface.

ACRES U.S.A. What a great image! Another evocative phenomenon is the violence of a raindrop falling.

SCHWARTZ. That was from Alice Outwater’s book *Water: A Natural History*. She describes how raindrops become little bombs detonating upon impact with bare soil. That’s very different from water that gently filters through a tree’s canopy or other vegetation, where it can trickle into the ground and replenish the water table. Raindrops hitting bare soil kind of bounce and they can produce splash erosion that leaves little craters. This reality totally belies our sense of rainfall as a soft, nourishing essence.

ACRES U.S.A. By what process does vegetation moderate soil temperature?

SCHWARTZ. By holding condensation, by covering and shading the soil and by transpiration. I keep on saying “in many ways” because of the built-in redundancy in natural processes. Nothing occurs just for one purpose; rather every process has multiple benefits and effects and multiple ways of reaching the same means of modulation.

ACRES U.S.A. What do you mean by blue water and green water?

SCHWARTZ. “Blue water” is contained in lakes and rivers and bodies of water that are colored blue on a map. “Green water” refers to the water held in the soil. Two-thirds of precipitation becomes green water. Ultimately that is the most important water, as it nourishes most of the vegetation on the planet. In fact, 70 percent of the world’s food is grown in rainfall agriculture. Generally our regulations address blue water, while there’s no protection for green water, despite its enormous significance for maintaining ecological function.

ACRES U.S.A. Doesn’t the same hold for government funding for water, too? It primarily goes for dams and water delivery and removal systems and water and sewage treatment.

SCHWARTZ. Right. There hasn’t been funding to protect green water and educate people on the importance of what the Australian scientist Walter Jehne calls “in-soil reservoirs.”

ACRES U.S.A. Humans are not the only animals that undertake impactful water management projects. Certain wild animals extensively manipulate the land in ways that affect green and blue water, though we typically don’t value their contribution. What happened when we almost completely eradicated the beaver?

SCHWARTZ. We lost our fabulous water engineers. Beavers create wetlands. Their dams slow down the flow of water in wetland areas and keep the water on the land longer. By working with tree limbs, they create meanders that slow down the current. And they create areas of very rich, spongy, peat-like soil.

ACRES U.S.A. What about other keystone species that act as a critical part of water infrastructure?

SCHWARTZ. In the Southwest there are prairie dogs. They create little holes for water to flow through. They also chew on mesquite, and get much of their moisture from eating it. Many millions of dollars have been and continue to be spent to eradicate this woody plant.

ACRES U.S.A. With herbicides?

SCHWARTZ. Yes. But prairie dog colonies not only destroy mesquite, they increase soil moisture and lead to greater biodiversity, conditions unfavorable to mesquite.

ACRES U.S.A. In your book you make a statement about mesquite that grabbed my attention, that when grasses come in the microclimate becomes too humid to support mesquite, and then the mesquite dies.

SCHWARTZ. Absolutely. That trajectory is often ignored when we consider what we call invasive species or weeds. Often, they’re there for a reason. When the conditions conducive to their presence disappear, they naturally retreat. If we merely try to eradicate these unwanted plants, without changing the underlying conditions, we get caught in an ongoing battle we can’t win, like a kind of herbicide arms race.

ACRES U.S.A. The contribution of water management or water to climate change is not widely acknowledged. What should we know about water vapor as a greenhouse gas?

SCHWARTZ. It’s a significant greenhouse gas. There’s more water vapor in the atmosphere than any other, and it traps and transfers more heat.

ACRES U.S.A. Why are you calling for us to use a different narrative about climate change?

SCHWARTZ. I believe the way that we talk about climate change leaves us stuck and interferes with our ability to truly grapple with it. In public discussions, the term climate change is generally assumed to mean

***Water Wisdom... Continued on pg 28***

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# Agriculture Prices at a Glance- \$\$\$\$\$\$ AUGUST 2017

A-B denotes the difference between 1st preference & 2nd preference and sometimes between wholesale & retail and bulk or small amounts. Trend (H) means Higher over last 30 to 60 days (L) Lower (S) Steady. Prices intend on being farm gate in Belize dollars - usually price per lb

BELIZE CATTLE by District - Provided by BLPA						
	T	Dist.	Per lb	Dist.	Per lb	Per lb
Fattened steers	H	Czl	1.85-2.00	OW	2.00-2.20	Bze 1.90-2.15
750-1100 lbs	H	Cy	1.75-1.90	SCr	2.25	Tol 1.75-2.00
Weaner steers	S	Czl	1.95	OW	2.00	Bze N/A
"	S	Cy	1.90	SCr	N/A	Tol 1.50
Breeding heifers	H/S	Czl	1.75	OW	1.70	Bze 1.55
"	L/H	Cy	1.40	SCr	N/A	Tol 1.75
Cull cows	H	Czl	1.55	OW	1.30	Bze 1.25
"	L/H	Cy	1.00-125	SCr	N/A	Tol 1.25
U.S. CATTLE						
U.S. price - corn fed - 1000-1200 lbs	L	US\$ 1.17-1.18				
U.S. price - feeders 600-800 lbs	L	US\$ 1.4605				
BELIZE HOGS						
Weaner pigs - 25-30 lbs - by the head	S	100.00		80.00		
Butcher pigs 160 - 230 lbs, per lb	S	1.85		1.65		
BELIZE SHEEP						
Butcher lambs - live per lb	H	3.00		2.50		
Mature ewes - live per lb	S	2.00		1.75		
BELIZE CHICKEN						
Wholesale dressed, per lb (Sp Lkt)	S	2.32				
Wholesale dressed, per lb (Bl Crk)	L	2.36				
Broilers - live per lb (Sp Lkt)	S	1.14				
Broilers - live per lb (Bl Crk)	L	1.19				
Spent hens - per lb (Sp Lkt)	H	1.70				
Spent hens per 4 lb bird (Bl Crk)	S	3.00				
CITRUS						
Oranges per lb solid, est. final	L	2.5473 (\$15.3095 per box)				
Grapefruit per lb solid, est. final	H	2.7966 (\$11.1865 per box)				
COCONUTS						
Green Coconuts, del'd to Cayo, bulk	S	sm	.40	med	.45	lg .50
Dry Coconuts, del'd to Cayo, bulk	S	.35 - .40				

\*\*\*These prices are the best estimates only from our best sources and simply provide a range to assist buyers and sellers in negotiations.\*\*\*

GRAINS, BEANS & RICE						
	T	A	B	C		
Belize yellow corn, bulk (Spanish Lookout)	L	N/A	N/A	.19		
Belize yellow corn, bulk (Blue Creek)	L	.24	N/A	N/A		
Yellow corn/local retail (low volume, Sp Lkt)	L	\$23.00/100 lb bag				
Belize white corn, bulk (Spanish Lookout)	L	N/A	N/A	.19		
US Corn, #2 yellow	L	US\$3.89/56 lb bushel				
US organic, #2 yellow corn feed grade	S	US\$8.00-9.00 /56 lb bushel				
Belize soy beans (Spanish Lookout)	S	.50 contract	.48 non-contract			
Belize soy beans (Blue Creek)	S	.52	N/A			
US soy beans, #2 yellow	H	US\$10.12 /60 lb bushel				
US organic, #1 feed grade soy	S	US\$17.50-18.20 /60 lb bushel				
Belize milo (Spanish Lookout)	L	.19				
Belize milo (Blue Creek)	L	.20				
Red kidney beans (Spanish Lookout)	H	\$92.00/100 lb bag		N/A	N/A	
Red kidney beans (Blue Creek)	S	N/A				
Black eyed peas (Spanish Lookout)	L	\$68.00/100 lb bag		no price		
Black eyed peas (Blue Creek)	S	.82		undetermined		
Paddy rice per pound (Spanish Lookout)	S	.40-.53 farm price, dried				
Paddy rice per pound (Blue Creek)	L	.40 farm price, dried				
SUGAR/HONEY						
Sugar cane, ton, estimate	H	\$60.55				
Bagasse, per ton	L	\$0.50				
Honey, 5 gal (approx 60 lbs)	S	\$210.00 (CQHPC)				
Honey, specialty, 5 gal (approx 60 lbs)	S	\$210.00-250.00 (Cayo)				
SPECIAL FARM ITEMS						
Eggs - tray of 30, farm price	L/H	4.80 (Sp Lkt)	5.40 (Blue Creek)			
WD milk per lb to farmer	S	contract & non-contract .56				
Raw milk (farmer direct sales)	S	5.00 per half gal				
CACAO						
Cacao beans Organic (MMC) /lb	H	3.50 dried fermented				
Cacao beans Organic (MMC) /lb	L	1.10 wet beans				
US Cacao beans, metric ton (ICCO)	H	US\$ 2,056.65				

# Homemade Health

## WHY AND HOW TO USE

### ESSENTIAL OIL - Part 1

By Marguerite Fly Bevis, RN, BSN

This article, part 1 of a 2 part article on essential oils, describes their basic properties and why they are used. Part 2 will describe how to use them.

Essential oils, the quintessential essence of medicinal plants, have been used by man for therapeutic purposes for thousands of years. They are mentioned in the Bible at least 600 times. Thirty-three different oils are mentioned. Essential oils are the original medicine upon which modern medicine is based. Birch and wintergreen contain salicylic acid, the same component in aspirin but essential oils are easier on the body and present fewer, if any, side effects, whereas modern medicines can have many, some of which can be more dangerous than the illness itself. Plant-based medicines are gentle, working naturally with the body's self-defense mechanisms.

Aromatherapy is so much more than a spa treatment. Research has shown that people who consistently use essential oils have fewer illnesses and when they do get ill, they recover 70% faster than those not using them. The oils contain molecules that are fat-soluble and tiny enough to cross the skin barrier and into the blood-stream. Some are known to cross the brain barrier! The implications for people suffering from neurological disorders are enormous.

Realizing that essential oils are plant-based medicine, we gain new respect and admiration for the myriad therapeutic benefits of each oil. We also realize that they are complicated and must be treated with the same respect as modern medicine when it comes to dosage and application. Understanding the chemistry helps us understand the oil. Each oil is made up of several different chemical compounds, hydrocarbon molecules, and are further classified into their specific chemical families, also called *functional groups*. Functional groups are specific groups of atoms within molecules responsible for the characteristic reactions of each chemical. Members of each functional group exhibit similar chemical reactions.



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#### **Monoterpene Hydrocarbons (Monoterpenes)**

Are found in almost all essential oils, considered the "top note," or first thing you smell

React to air and heat, short shelf life

Are anti-inflammatory, antiseptic, anti-viral and antibacterial, as well as analgesic or stimulating

Stimulate mucous membranes, useful as decongestant

Are therapeutic for respiratory and muscular system

Help support normal information in the DNA of cells

Deeply penetrate, disinfect, and help with respiratory problems

Comprise a widely varied list of benefits

Piney oils (pinene) and citrus oils (limonene) are well-known monoterpenes.

#### **Sesquiterpene Hydrocarbons**

Comprise the largest group of terpenes and present in most essential oils. Good choices for cooling inflammation and soothing pain.

Have a shelf life of six to eight years.

Include heavier oils (middle and base notes)

Can be calming and energizing

Are soothing and calming to irritated skin and tissue

Have the ability to pass through the blood-brain barrier and enter the brain tissue

#### **Monoterpene Alcohols (Monoterpenols)**

Have antiseptic, anti-viral and anti-fungal properties

Relieve stress and promote relaxation

Promote uplifting energizing effect

Examples of monoterpenols are linalool in lavender, citronellol in rose and terpineol in geranium, juniper and tea tree oils

#### **Sesquiterpene Alcohols (Sesquiterpenols)**

Are not as common as monoterpenols

Act as liver and glandular stimulant

Have anti-allergen and anti-inflammatory properties

Are found in sandalwood (alpha-santalol), ginger, rose, patchouli, vetiver, ylang ylang and cedarwood

Work with phenols to clean the receptor sites (proteins located on the surface of each cell)

Are considered to be the base notes in aroma (after-taste)

Generally have grounding, inflammation cooling properties

Have shelf life of six years or longer

#### **Phenols**

Are anti-septic, anti-bacterial, anti-viral and disinfectants

Have anesthetic and analgesic properties

Antioxidant - protect against cellular damage

Have stimulating therapeutic properties

Should be diluted and used for only short periods of time (maximum 10 days)

Can lead to toxicity if used over long periods of time

Are classified as skin and mucous membranes and can cause severe skin reactions

Examples of phenols are cinnamon, clove, thyme, oregano, rosemary, Holy basil

#### **Aldehydes**

Are anti-fungal, anti-inflammatory, disinfectant and sedating, yet uplifting

Comprise the citrus-like fragrance in melissa, lemongrass and citronella oils

Are also found in cumin, eucalyptus, cassia

#### **Ketones**

Are calming and sedating.

Stimulate cell regeneration, promote new tissue growth, liquefy mucus

Examples of ketones include eucalyptus and rosemary; another example is turmerone, found only in turmeric which has been found to balance blood sugar levels and promote normal neural stem cell growth. Use with care during pregnancy, consult with physician before use.

**Esters**

Are formed from alcohols and acids  
 Are highly fragrant and tend to be fruity  
 Are sedating and anti-spasmodic  
 Some have anti-fungal and anti-microbial properties  
 The compound linalyl acetate is found in lavender, bergamot, clary sage, birch, wintergreen, cardamon, ylang ylang, helichrysum, jasmine, and Roman chamomile.

**Oxides**

Are derived from other compounds such as alcohols, terpenes or ketones that have been oxidized  
 Are expectorants  
 Are mildly stimulating  
 Are found in eucalyptus, rosemary, peppermint, cardamon and thyme

**Notable Monoterpenes**

**Black Pepper (*Piper nigrum*)**

There is evidence that pepper has been since at least 2000 B.C. in India. There are references to black pepper in Greek and Roman text. Invigorating when mixed with other oils and inhaled, it is a warm and spicy oil used for sore muscles and joints; it also shows potential for addressing pain and mood health problems. It helps support digestion and circulation, helps reduce food cravings and has been used to help stop smoking. Because it increases sweating and urination, it helps to naturally detoxify bodily

toxins and excess water. Its key compounds are caryophyllene (a sesquiterpene) which contributes the spiciness and has inflammation-cooling abilities, D-limonene, alpha-pinene, and beta-pinene (all monoterpenes). Although it is used topically with a carrier oil on affected muscles or joints, it can be taken internally, only one or two drops added to a smoothie, soup or other savory dishes. It can be an irritant if taken in high doses.

**Ginger (*Cymbopogon nardus*)**

In the 14th Century, ginger was as valuable in trade as a live animal. It was used widely as a tonic for various ailments. The main compounds in ginger are sesquiterpenes, monoterpenes and small amounts of oxides. Ginger is very popular in Chinese medicine because it is a warming oil, in contrast to cooling oils containing menthol. One component, gingerol, has powerful anti-inflammation properties and is also effective for nausea and digestive disorders, joint and chronic pain as well as respiratory problems. It is sometimes referred to as the “oil of empowerment” because it is known to promote feelings of self-confidence and courage. Well known as an effective insect repellent, it should be used diluted in a carrier oil.

**Coriander (*Coriandrum sativum*)**

Coriander oil, steam-distilled from the seeds of the same plant used to make cilantro oil, is excellent for skin irritations, may be used to stimulate appetite and for digestive problems. A study done in 2014 found that coriander was effective against fungal infection of the oral cavity. It also displays antimicrobial activity against all bacteria tested. Coriander pairs well with cilantro oil but should be diluted with a carrier oil before applying topically.




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## Belize: Strengthening Partnerships By Applying “One Health” By Dr. Joe Myers, DVM, BAHA



Medical and veterinary officers from Belize were trained to collaborate using “One Health” strategies in zoonotic and food-borne disease surveillance, diagnosis and preparedness and response, through a comprehensive two-year professional development programme, the One Health Leadership Series (OHLS). The OHLS is part of the regional *One Health, One Caribbean, One Love Project*, implemented by the University of the West Indies (UWI), School of Veterinary Medicine. The One Health project was funded by the European Union (EU) and managed by the ACP Science and Technology Programme (S&T II), in collaboration with the ‘Sanitary and Phytosanitary Measures (SPS) Project’, of the 10th European Development Fund (EDF) Programme coordinated by Inter-American Institute for Cooperation on Agriculture (IICA).

One Health refers to an interdisciplinary approach to minimizing harm and maximizing benefits from the co-management of human, animal and environmental health. This approach is aimed at developing more efficient and effective strategies to address health issues at the human - animal - environment interface.

The OHLS consisted of five, four-day training modules over a period of 2 years:

- (1) Introduction to One Health, (Tobago, November 2014)
- (2) Interconnectivity for Food Safety and Food Security, (Jamaica, June 2015)
- (3) Environment and Health, (Guyana, November 2015)
- (4) Society and Health, (Grenada, June 2016)
- (5) The Way Forward for One Health, (Trinidad, November 2016)

Twenty-nine One Health leaders from Belize and 11 other CARFORUM countries successfully completed the leadership series: Antigua and Barbuda, Barbados, Dominica, Grenada, Guyana, Haiti, Jamaica, St Lucia, St. Vincent and the Grenadines, Suriname and Trinidad and Tobago. Team Belize comprised of Dr. Julio Sabido, Mr. John Bodden, both from the Ministry of Health and Dr. Joe Myers from the Belize Agricultural Health Authority (BAHA). The three J’s were collectively known as “Triple J’s”.

As part of the training, participants were tasked to implement a

locally-relevant One Health project. Team Belize’s initial country project, “Testing for Antimicrobial Residues and Resistance in Poultry Meat in Northern Belize” proved to be too ambitious in relation to the time and project budgetary allocations. Given the bovine paralytic rabies epidemic in Belize, Team Belize decided this provided the perfect opportunity to cement the One Health approach and apply their leadership skills. Team Belize changed gears and embarked on the pertinent One Health project, “Rabies: Outreach and Prevention in Northern Belize” instead.

The overall objective of the Belize’s One Health rabies project was to strengthen partnerships among the Ministries of Health, Agriculture (BAHA) and the Veterinary Association of Belize for effective community outreach by applying a One Health approach for prevention and control of rabies in humans and animals in Belize.

The project was implemented at the local level, the Corozal District, and consisted of 3 main activities.

1. Awareness/sensitization of farmers and the general public about rabies risks;
2. Rabies control: vaccination of susceptible at-risk animals (food animals and companion animal and bat trapping);
3. Epidemiology of the rabies virus including diagnosis.

Customized workshops and trainings were provided to suit the audience or target group and were implemented using a hands-on approach. A major project outcome was the approval to use the Public Health Laboratory in Chetumal, Quintana Roo, Mexico. This enabled results to be obtained rapidly, only three to five days, compared to a month previously. This partnership with the Public Health Lab in Mexico enabled access to other services such as titre checks for medical and veterinary staff and the characterization of the virus.

Belize’s One Health rabies project has wrapped up but the bovine paralytic rabies epidemic continues throughout the country. Lessons learnt, tools developed and skills obtained from project implementation are invaluable strengths gained to face the on-going epidemic. Coming out of the project, the Ministries of Health and Agriculture (BAHA) are strongly committed to working together, maintaining the One Health approach for zoonotic and food-borne diseases.

End note:

*The UWI’s EU/ACP funded One Health One Caribbean One Love’s project partners: IICA, PAHO/WHO, FAO, CIRAD and the Ministries of Agriculture of Grenada, Guyana and St. Kitts and Nevis. The goal of the project was to increase food security, animal health and production in Caribbean countries.*

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**Fusarium...Continued from page 13**



Photo by John Bienapfl

2000). Also, soil containing nematodes that attack legumes may cause root damage, thus allowing them and other fungi to infect plants. Other conditions influencing the development of this disease include soil compaction, crop rotation history, soil pH, herbicide induced stress, iron chlorosis and soil type (Zhang, 2010).

**Management of Fusarium**

Managing fusarium includes different practices. The use of non-infected seed or resistant varieties must be considered. Avoid or minimize spread of disease from infested to non-infested

fields through the use machinery, irrigation equipment, water and contaminated seed. Cultural practices such as planting in well-drained soils, reducing soil compaction, delaying planting and crop rotation (does not include legumes) may help to make conditions less favorable for this pathogen's development (Davis, 2008).The use of fungicidal seed treatment is recommended when there is a history of fungal root problems. The use of biological products, such as *Trichoderma* spp. has proven to reduce fusarium infections (Milanesi, et al 2013). Good management practices are important for minimizing losses from this disease.

For good management of plant diseases, it is most critical to obtain a correct diagnosis!

Note: bibliography of this report can be obtained upon request at [info@danausconsultants.com](mailto:info@danausconsultants.com).



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# Maya Mountain Heirloom Cacao

## What Makes Belizean Cacao So Special? Understanding Genetics of Belize Cacao Beans

By Dan O'Doherty / Minehaha Forman



In the rapidly growing world of specialty craft chocolate, Belize has earned its place among the fine flavored origins of cacao. Known for its unique fruity/caramel flavor, Belizean cacao has won numerous awards in recent years.

Cacao beans originating from Maya villages in the Toledo district of Belize and processed by Maya Mountain Cacao, Ltd (MMC) recently received an heirloom designation from the

Fine Chocolate Industry Association (FCIA). The cacao sample was made into chocolate and blind-tasted by a panel of nine veteran chocolate companies including Guittard, Valrhona, and Felchlin. Panelists universally praised the sample for its overall high quality, as well as its unique and fine flavor attributes.

With so much fanfare around Belizean cacao in specialty chocolate circles, it begs the question: What makes Belize cacao special? As part of the FCIA heirloom designation, MMC partnered with expert cacao agronomist and president of Cacao Services, Inc., Dan O'Doherty, to genotype local trees. "Heirloom status is not dependent on genetic heritage, but part of the designation process is genetic identification. This allows the trees to be recognized and preserved for future generations of cacao growers," writes O'Doherty.

The long-held assumption about Belize cacao genetics was that local trees were predominantly a *Trinitario/Criollo* cross.

However, the results from genotyping show a very different genetic picture. To determine the genetic background of the specific lot of beans that were submitted for heirloom designation, O'Doherty collected leaf samples from individual farms in the villages of San Antonio, Santa Elena, and Pueblo Viejo in the Toledo District. The samples were shipped to the USDA-ARS, where DNA was extracted from the leaves and genotyping was performed. The USDA-ARS has a large database of genotypes from cacao samples collected around the world. By comparing new samples to the database, it is possible to determine the numerous varieties that comprise the population of Belizean cacao.



"A genetic analysis of 50 trees from six different farms in Toledo revealed that only one of the 50 trees could be accurately described as classic *Trinitario* (i.e., *Amelonado x Criollo*), and this tree had less than 25% criollo ancestry. There is no evidence of hybridization of Belizean (ancient) criollo with the modern

hybrid cacao varieties grown by Maya villagers in Belize," O'Doherty writes. ★

But what about those white cacao beans we find on farms all over Toledo and South Stann Creek? It's not uncommon to find white cacao beans in cacao harvested in southern Belize, but according to O'Doherty, not all white beans are related to criollo cacao. While ancient criollo, (notably characterized for its white—instead of purple—beans), exists in remote areas of Belize, criollo did not make a major contribution to the gene pool of Belizean cacao in MMC's genotyping results.

White seeds are not exclusive to criollo cacao; in fact, they may be an indicator of a number of other varieties present in Central America, most notably the *Amelonado* varietal known as *Catongo* that originates from Brazil, according to O'Doherty:

"While there is a small number of pure *Amelonado* trees, the genotyping showed that most Belizean cacao trees are mixed hybrids. In most cases, the results showed that *Amelonado* is the dominant parent type, but upper Amazon *Forastero* types (*Iquitos/Nanay*, *Paranari*, *Ecuadorian Nacional*) are represented in varying degrees. *Trinitario* is also represented in the genetic background of many trees, but in low proportions. Historical and anecdotal reports from farmers suggest that Cadbury and Hershey's introduced commercial cacao hybrids into South and Central Belize during the 1970's and 80's. The native criollo types in Belize are growing in small numbers and in relative isolation from villages. As a result, there has been little opportunity for cross pollination and hybridization between introduced and criollo trees.

"*Amelonado* is a cacao that originates from the lower Amazon basin, and is the traditional variety grown in West Africa, Bahia state in Brazil, and historically on the Atlantic coast of Costa Rica. *Iquitos/Nanay* and *Paranari* populations originate in the upper Amazon basin of Peru. The famous *Nacional* cacao of Ecuador is also technically an upper Amazon type, but has been inbred and domesticated to favor unique and desirable qualities. Aside from several countries in South America where cacao is indigenous, most cacao is typically a blend of several populations. Other than the domesticated criollo varietal, cacao grown in Central America was imported from a limited number of sources. The complex interactions between genetics, climate, and soil—referred to as *terroir*—are still poorly understood at present. However, Belize has several unique factors that may be partly responsible for the excellent and unique flavor of its cacao. For example, the country extends into the northern bounds of commercial cacao cultivation and experiences especially cool weather during winter months. Southern Belize is also known for its unique soils and particularly high levels of rainfall," O'Doherty writes.

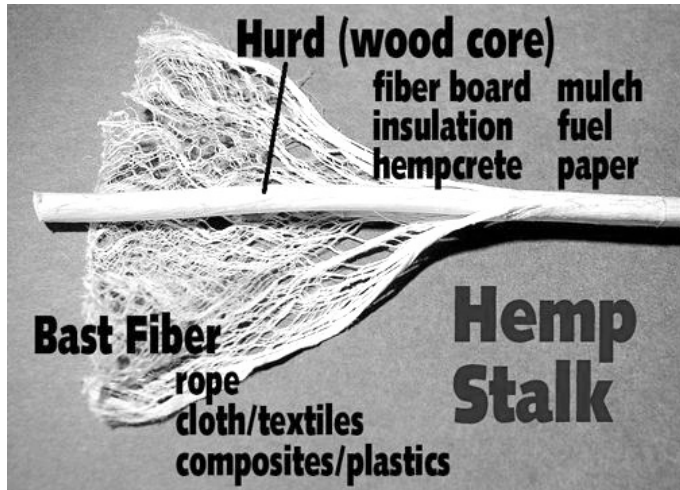
Whether it's the genetics, the *terroir*, or, more likely, a bit of both, Belize has a lot to be proud of in becoming a darling origin of the burgeoning craft chocolate industry.

★ **To view the referenced Belize cacao genetic sequencing charts, go to the online pdf version, pg 37 of Issue 37, found in our Archives.**





## Cannabis Hemp Building Materials By Karin Westdyk



James Savage, a New York business analyst, was greatly disturbed after learning about mold problems making thousands of New Orleans homes uninhabitable after hurricane Katrina, and of the thousands killed in Haiti, crushed by their own homes during an earthquake. He searched for solutions and came up with a material that has been around for thousands of years and started a company to create building materials made from mold resistant, stronger-than-steel cannabis hemp.

### Hempcrete

The outer portion of the hemp stalk has a long history of use for producing paper, fabric, rope and sails (the word *canvas* comes from the word *cannabis*), but Savage discovered that hemp chips made from the woody interior of the cannabis plant combined with water and lime made a very strong rigid material that could be cast into walls, between or around structural supports. Hempcrete walls, when cured and finished, are airtight, yet flexible and breathable, and totally free of toxins and mold. These walls are also insect and fire resistant, and with a high R-value (measurement of insulating power), could eliminate the need for air conditioning in hot climates and greatly reduce heating costs in colder climates. Hemp is strong and vapor permeable, while impermeable to water. It has been projected that houses made from hempcrete could last for 700 years.

### Hemp Plywood

Found to be one of the strongest natural fibers on earth, hemp is an extremely renewable, highly sustainable carbon negative building material and is projected to even replace plywood for building. Trees take upwards of 10 years to grow and we are cutting down 3 to 6 billion trees every year for use in manufacturing. Hemp takes only 4 to 5 months to grow and one acre of hemp can produce as much fiber pulp as the 4 acres of trees, now used to produce the same amount of plywood. In addition, the quality of hemp fiber is far superior to that coming from trees. Fiberboard made from hemp tested at Washington State University demonstrated that it was indeed stronger than steel, could withstand extreme heat and force, as well as resist water.

### Hemp Insulation

Hemp fiber batting insulation is made by bonding hemp fibers into sheets, shaped and cut into various sizes and then installed as semi-rigid batting between structural framing. Hemp "batt" insulation exhibits a higher insulation performance than

traditionally used fiberglass as well as any other insulation materials.

### Hemp Finishes and Stains

Hemp oil wood finishes and stains are excellent alternatives to synthetic petroleum-based polymer coatings. Produced from pressing the oil seed, they are easy to use, make a handsome finish, and are extremely durable. Tests have demonstrated that hemp finishes outperform high-grade commercial wood finishes in resistance and weathering, while containing very low levels of toxic volatile organic compounds making them safer to use.

### Hemp Plaster

One of the main benefits of hemp plaster is that it is easy to apply more thickly and smoothly than conventional lime plasters. It is also well-suited for use in environmentally "green" buildings, as it can be applied directly to a variety of materials such as fiberboard, wood wool board, or straw bale construction. Hemp fibers added to the plaster not only improve the strength and flexibility of the wall, but also increase the insulation value.

Hemp can be used in making practically any building material. In addition to hempcrete, batting insulation, plywood, wood finishes and plaster, hemp can be made into roofing and flooring materials, caulking, paneling, reinforced concrete, spray-on insulation, concrete pipes, bricks, and biodegradable "tougher than steel" plastic composites.

In light of serious climate change predictions and a growing concern about the devastating effects of deforestation on the environment, it makes perfect sense that hemp be explored and developed as an agricultural crop to replace traditional building materials. Industrial hemp could be big business, not only for the building industry, energy industry (see August 2016 issue #33: *Industrial Uses of Hemp*), medical industry (see February 2017 issue #35: *Growing Hemp for Medicine*), and food industry (to be explored in our next issue) but for the farmers who grow it and who would also benefit from its use as a soil amendment (see November 2016 issue #34: *Industrial Hemp: Medicine for the Soil*) and weed killer (see May 2017 issue #36: *Industrial Hemp as Weed Killer*).

As we make the positive essential shift to a future that embraces more sustainable agriculture practices, industrial hemp can lead the way -- creating a win-win situation for the economy and the environment.



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## Nematodes - Friend And Foe

By Mary Loan

Nematodes are non-segmented worms that live everywhere on the planet, including in ice and snow to the depths of the ocean and even in arid deserts. They are most abundant in tropical regions of the world, like Belize. Other names they are known as include: eel worms, thread worms, root knot worms. There are thousands of identified species of nematodes with estimates of about one-half million varieties to be 'discovered', studied and named. Most nematodes are almost invisible to the human eye and are less than 1 mm, or 1/125 of an inch in length. There are generally thousands of nematodes in a handful of soil, over one million in a spadeful, and as many as three billion in the top three inches of soil in an acre. However, some species may grow in length to be twenty-five feet or longer and live as parasites in sperm whales. Some parasites, including pinworms, round worms, Guinea worms and hook worms are a risk to animals and humans.

Many people, especially farmers, cringe when they hear the word nematode. According to online *K-12 News and Views*, it is estimated that nematodes are responsible for fifteen percent of crop loss per year, creating billions of dollars in crop loss worldwide. Nematodes are prolific. Some species carry over twenty-seven million eggs and are capable to lay more than two-hundred thousand in a single day!

Most plant-eating nematodes live in the soil and feed on plant roots. Nematodes have no brain or eyesight but are able to find plant roots. They have a sharp needle-like structure in their mouth which pierces plant roots and sucks the cell contents. This renders plants incapable of water and nutrient absorption, and

causes them to appear weak and sickly and susceptible to disease. Plants most susceptible to root nematode damage include tomatoes, potatoes, peppers, lettuce, corn and carrots.

Nematode damage is evident in the leaves and stems of onions, chrysanthemums, rye and alfalfa.

Entomopathogenic nematodes to the rescue! There are well over thirty species of beneficial nematodes. These carry bacteria capable of destroying the plant-killing nematodes.

Here is how it is done: Entomopathogenic nematodes have a life cycle consisting of egg, four larval stages, and an adult stage. In the third larval stage the 'good guy' nematodes seek a host which is usually insect larvae, including the destructive nematodes. During their feeding the beneficial nematodes kill the larvae by infecting it with bacteria. Death occurs within twenty-four to forty-eight hours. Entomopathogenic nematodes can be purchased and are very safe and effective to use. They are also used to help control caterpillars, cutworms, corn borers, grubs, corn root worms, thrips, weevils, beetles and fungus gnats. These nematodes also help to break down organic matter and aerate the soil.

Other methods of controlling over-population of the bad nematodes include rotating crops, flooding a field, planting marigolds or cover crops, 'solarizing' soil (heating up soil), planting nematode-resistant seeds and plants, adding lots of good organic matter to soil, heavy mulching, dipping seedlings in garlic extract before planting, and incorporating dried garlic leaves using crushed ground marine animal shells chitin. (Fungi eat the chitin, then move on to eat nematodes once the chitin is gone.)

*Nematodes... Continued on pg 27*



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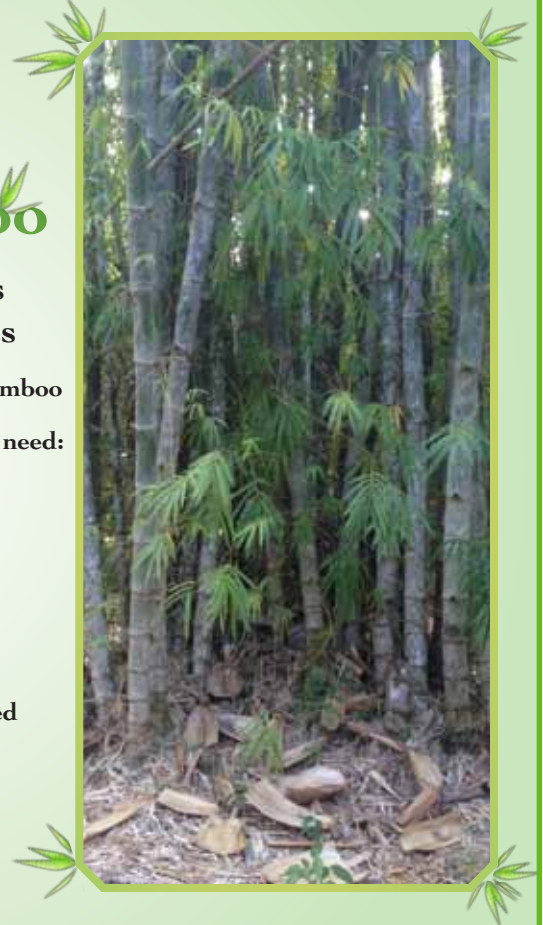
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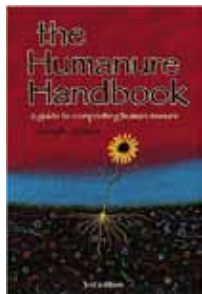
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## The Humanure Handbook

### A review by Chris Harris



This is the book no one would publish. Why? Because it deals in some detail with a subject distasteful to some, uncomfortable to others and “something we just don’t talk about “ to yet more. So the author, Joseph Jenkins, published it himself. And in the process he did us all a big favour.

OK, so what is this “taboo subject”? Well it deals with the subject of the ecological disposal of human waste. At first glance the author’s ideas amount to little more than an advanced view of the “bucket and chuck it” approach used in many rural areas of the world already. But here comes the rub. Jenkins applauds the “bucket” idea, but strongly challenges the “chuck it” aspect. He points out that the amount of such waste disposed of is of critical importance. Just disposal into a so-called septic tank is by no means a complete answer. So what is the alternative?

Jenkins proposes we should follow the practice used extensively in the Far East, which is to recycle human waste as nutrient-rich compost. Again, at first glance this would appear fraught with risk and danger from pathogens etc. However, Jenkins has taken the trouble to research this aspect in some depth. He has shown that properly set up, a humanure compost heap can not only be smell-free, and ultimately free of those dangerous pathogens, but also a source of very useful and fertile material for use in the garden or vegetable plot.

The idea of a clean humanure compost heap depends, of course, on the credibility of the research done, and Jenkins has made an excellent job of challenging conventional prejudices with hard, cold fully-resourced scientific facts. His book takes the reader through the whole idea, even giving designs and “how to” instructions for setting up a humanure system, from very attractive commodes to detailed instructions for the compost heap.

OK, so why? Well a waste system that operates without **any** water usage has to be attractive. Readers might remember from the last issue of Belize Ag Report that domestic toilet flushing is the largest single water usage for most of us. House design and building would be much cheaper without the pipe work needed for waste disposal and sanitary ware. Then, of course, there is the issue of where the piped waste actually goes. How efficient are

### Nematodes... Continued from pg 26

Sometimes farmers apply chemicals called fumigants or nematicides to the soil in an effort to control the damage to their crops. These chemicals are generally very toxic and are hazardous to the health of humans and the environment. Some nematicides have been banned as they easily leach through the soil and contaminate rivers and drinking water for farm animals and humans.

Nematodes have probably been living on planet Earth for its entire existence and will continue to be part of agriculture as part of the balance of nature as a friend and foe of gardeners and farmers world-wide. The nematode *Caenorhabditis elegans* was the first multi-cellular organism to have its DNA fully sequenced. This has led to many breakthroughs in biological and medical sciences and continues to teach us about how a generally small and unnoticeable organism can have an enormous impact on our planet.

septic tanks and field drains? And when pumped out, as septic tanks should be periodically, where does that waste go? And is the effluent really fully de-natured? How do we know pathogens from our waste are not just sinking into the land, possibly polluting aquifers, etc.? And just for the record, four years ago, I had three humanure systems set up at our farm, one for each of our three families. All three work perfectly. Discovering this book was a game changer for us.

*The Humanure Handbook by Joseph Jenkins is published by Joseph Jenkins Inc. and is available from Chelsea Green Publishing PO BOX 428 White River Junction VT 05001*

### Dear Veggie Detective,

Would you please investigate the mystery of the white-centered tomato? Why do some tomatoes have white centers and others are all red and tasty?

Signed,  
Tomato Lover



Dear Tomato Lover,

Your mystery is solved! Tomatoes with white centers have a deficiency in potassium, an element abbreviated as K because phosphorus was assigned the letter P. Basic fertilizers that you buy have three main elements: nitrogen (N), phosphorus (P) and potassium (K) and are designated in 3 numbers which corresponds to these three elements. If your soil doesn’t need N or P you can buy elemental potassium fertilizer. Potassium will give you not only the nice red color on your tomatoes but bigger fruit as well. Your soil needs more than 5% K as a minimum; 6 – 6.5% is better. That is also the amount needed to make the flesh on your peppers thicker. Believe it or not, K is a good weed controller; if K is greater than 7.5% in your soil many different kinds of weeds thrive; so reducing K reduces weeds. I hope the results of this investigation help you to understand the slogan: *Feed the soil and let the soil feed the plant.*”



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## **Water Wisdom... Continued from pg 17**

global warming being caused by excess atmospheric CO<sub>2</sub> due to the burning of fossil fuels. While we absolutely need to stop burning fossil fuels, this narrative is incomplete. And it leaves us feeling powerless because what else can we do about it other than protest pipelines or encourage divestment? However, if we understand climate change as manifestations of distorted carbon, water and energy cycles, we can work to restore the health of those cycles. If you work on restoring the water cycle, you inevitably help restore the carbon cycle. And in addressing the carbon and water cycles, you are helping to rebalance the energy cycle. By energy cycle here I mean the solar energy that strikes the Earth, not fossil fuels. Walter Jehne, a microbiologist with Healthy Soils Australia, has an interesting perspective on the energy cycle. He notes that on average, 342 watts of solar radiation per square meter reach the Earth's surface. But because of how human activity has altered various ecological dynamics, only 339 watts per square meter are being emitted back. To have a stable climate, the amount coming in should equal the amount going out. These are figures from the International Panel on Climate Change.

ACRES U.S.A. So in effect, the Earth is absorbing this amount of energy and that's raising the temperature?

SCHWARTZ. Essentially. The energy differential is only about 3 watts per square meter, which is less than 1 percent of the total amount of solar energy striking the land. Walter asks whether we can work with the water cycle and other natural processes to disperse and re-radiate those 3 watts per square meter. And he points out all the opportunities we have to do so. For example, we can look at transpiration as a cooling mechanism because it consumes energy. For that, all that's needed to promote transpiration is plants. Let's say we have a little patch of bare soil. When the sun hits the exposed ground, that heat is absorbed. It becomes sensible heat — heat you can feel. That is a positive in the energy balance, meaning that we're taking in that heat. Then take a few steps over to a meadow. There the solar radiation falls on plants. Those plants are transpiring water, which uses and disperses solar energy. It's a cooling process, the antithesis of warming up bare soil. That heat becomes latent heat embodied in water vapor.

ACRES U.S.A. Won't that water vapor eventually change phase and become liquid water again?

SCHWARTZ. Right. But it won't necessarily generate heat. It could become water again by condensing into clouds, higher up in the atmosphere.

ACRES U.S.A. Your chapter about how trees make water blew my mind. Could you recount the magnificent story of Rio de Janeiro's historic turnaround from water scarcity to abundance?

SCHWARTZ. In the 1500s when Europeans first arrived in what would become Rio de Janeiro, the mountains around the future city were fully forested. Then, echoing the story of European settlement all over the world, the forests were cut down and the land was exploited and developed. Some people made a heck of a lot of money from the plantations around the city, but over time, the local climate began to change. Streams stopped flowing and other water sources dried up. There was also erosion because the hills did not absorb water well. By the 1800s people were moving away because there wasn't enough water. They were the early harbingers of climate refugees. Fortunately the king at the time believed bringing back the trees would solve the water problem. He enlisted a military officer to handle the reforestation, and thanks to this effort the water did return. This is the renowned Tijuca Forest.

ACRES U.S.A. You draw a stark contrast with Rio and the largest city in all of the Americas, São Paulo.

SCHWARTZ. Sao Paulo is experiencing extraordinary water problems right now, and people are stunned because Brazil has long been considered kind of the Saudi Arabia of water. No one anticipated that it might someday be dry.

ACRES U.S.A. Does this have to do with the deforestation of the Amazon?

SCHWARTZ. Yes, because of the role forests play in cycling moisture. I can say that over the course of writing this book I came to feel that plants run the show to a larger degree than I ever would have thought.

ACRES U.S.A. In *Water in Plain Sight*, you offer astounding facts about the influence of plants on the water cycle. Between 80 and 90 percent of continental atmospheric moisture comes from plants. Wind over forested areas generates more than twice as much rain as wind over cleared areas. Leafy tree canopies produce flows of water vapor more than ten times greater than herbaceous vegetation. How do scientists explain these conclusions?

SCHWARTZ. This is all due to transpiration. We think of plants as recipients of water, but they're also producing, retaining and moving it. The Australian farmer Peter Andrews, who developed Natural Sequence Farming, says: "Plants manage water. And in managing water, they are managing heat." Andrews calls attention to the fact that we have de-vegetated about a quarter of our planet. This means that on a large part of our planet, where vegetation is largely absent, the natural mechanisms that used to regulate moisture and temperature can no longer function.

ACRES U.S.A. I'm trying to picture a quarter of the land surface of the planet being relatively empty of vegetation.

SCHWARTZ. There is the built environment — roads, roofs and concrete. And consider all the degraded areas, particularly as we lose 12 million hectares to desertification each year.

ACRES U.S.A. Often in agriculture, crops are only in the ground for three or four months a year.

SCHWARTZ. They are seasonal deserts, biologically speaking. Fortunately, cover cropping is becoming more common. Going back to desertification, I saw the process occurring with the very large Mennonite farms in Chihuahua, Mexico. The native desert grasslands there are home to many species of birds and other animals, but with so much of that land getting plowed up, large expanses are becoming a biological desert.

ACRES U.S.A. Let's go back to the contributions of trees, which in agriculture, often get short shrift. What are some of the amazing characteristics of trees in relation to the water cycle?

SCHWARTZ. The late Bill Mollison talks about how a tree stands there as a barrel of water. Trees hold water, and water is always moving through trees. They protect the ground from those harsh raindrops and the rays of the sun. They also keep the land from drying out. Trees allow for the slow filtering of water into underground stores. Another way forests are pivotal to the functioning of our ecological systems is their influence on rainfall.

ACRES U.S.A. Is that related to the biotic pump?

SCHWARTZ. This is a theory developed by Russian physicists Anastassia Makarieva and Victor Gorshkov that natural forests act as a "pump" that pulls in moisture. In a forest, the collective transpiration of trees creates an area of low pressure. Since nature always wants to fill a void, this low pressure pulls in moisture from elsewhere, ultimately



from the coastal regions. Water vapor moves all around the Earth, and forests help direct the movement of that moisture by drawing in water vapor. According to the biotic pump theory, this is an important factor in the production of rainfall. Evaporation from the oceans results in a lot of water vapor so coastal rainfall makes sense. The question is, how does rain fall far away from the coast? With the biotic pump, you have a sort of tug-of-war between the oceans and the forests over the moisture. That can explain how you get moisture moving and ultimately falling as precipitation on inland areas.

ACRES U.S.A. That suggests another reason why deforestation is a total disaster.

SCHWARTZ. Absolutely. Deforestation really frightens people who have studied the biotic pump. They recognize how essential transpiration is for normal precipitation patterns and the consequences of interrupting that function.

ACRES U.S.A. Is this one of the reasons that climate in an area can flip so quickly and suddenly become much hotter and drier?

SCHWARTZ. That is the hypothesis as well as something that people are really concerned about. Scientists are finding that the Amazon not only supports local and regional rainfall, but that there are “teleconnections,” so what happens in the Amazon can have effects much farther away, like in the Midwest of the United States. When it comes to water, we all live in the same neighborhood.

ACRES U.S.A. That’s very frightening.

SCHWARTZ. It is. In developing their theory, Makarieva and Gorshkov have been able to watch what’s happening in real time and make sense of it. For example, they associate the unprecedented 2010 fires and heat waves in Russia with the incredible deforestation rate of the Western Russian boreal forests. When something unusual happens, we can inquire about changes in the region that could be factors. We are now seeing droughts in places like Madagascar and Haiti, which once would have been unthinkable. Simply attributing this to climate change

misses the point, as this primarily represents disruption of ecological function.

ACRES U.S.A. Forests in the Rocky Mountains are experiencing massive die-offs. Warmer winters are allowing far greater survival of bark beetles and other tree parasites, and these insect outbreaks are decimating trees. So we’re facing the potential loss of large amounts of forest, with forest fires burning large expanses of trees that are already dead.

SCHWARTZ. This is the vicious circle. Walter Jehne counsels us to rehydrate our landscapes, or else we’re cacti. If we ask how landscapes stay hydrated and what makes them more resilient to fire, then we’ll start finding solutions. Often it comes down to biodiversity. We need the beavers and other herbivores that kept down fire fuel.

ACRES U.S.A. One summer I spent a couple weeks at around 8,000 feet in the uplands of New Mexico. To my utter amazement, beavers were active on this land, which only got 15 inches of rain annually, and they had made lush wetlands.

SCHWARTZ. In Nevada there’s a project initiated by rancher Jon Griggs and biologist Carol Evans to restore the land by working with ranchers on holistic planned grazing. As the land improved, the beaver showed up. Now the land has lush vegetation and sufficient water, even though nearby areas are dry. So let’s pose the question: How can we rehydrate these landscapes? If we focus on attacking this pest or that pest, something always replaces it to fill in the niche. You need to change the underlying circumstances.

ACRES U.S.A. You quote Jan Pokorný’s assertion that our understanding of the role of water and plants in landscape function is the equivalent of medicine before Pasteur.

SCHWARTZ. That statement points to how much more there is to know. The mere fact that water is not a part of our discussions of climate change says to me that we have a very long way to go. The good

*Water Wisdom... Continued on pg 30*



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## ***Water Wisdom... Continued from pg 29***

news is we have all these opportunities to address climate change that are in plain sight.

ACRES U.S.A. In that same vein, policymakers, scientists and even well-read laypeople and climate activists tend to consider trees as carbon sinks and nothing more.

SCHWARTZ. We've gotten in the habit of looking at single metrics and through the lens of single disciplines. Climate science has been dominated by physics, and biology has been left out. Similarly, soil science has been dominated by geology. This is why people believe it takes 500 years to create an inch of topsoil. Again, biology has been left out. And agricultural science has been dominated by chemistry. Now, thanks to publications like Acres U.S.A., biology is being brought in. Bringing biology into any of these discussions is a huge shift.

ACRES U.S.A. Rattan Lal of Ohio State calculates that the world's cultivated soils have lost between 50 and 70 percent of their original carbon. What are the implications of this loss for the water cycle?

SCHWARTZ. It's huge because when you lose the carbon in the soil, much less water can be held in the soil. It also, if indirectly, affects precipitation. You see, water vapor needs something to coalesce around in order to form raindrops. Walter Jehne calls attention to aerosols. We have all this stuff in the atmosphere: ice crystals and salts, and volatile compounds from plants. Then there's particulate matter from combustion, including fossil fuels. And a lot of dust rising from desertified land around the world. The effect of eroding soils is really big and that one we can absolutely do something about. The dust particles tend to be much smaller than condensation nuclei that form raindrops. All of these tiny dust particles and this microdust just sit up there, mingling with water vapor without forming raindrops. And because of what we're doing, the balance is shifting toward these non-water-attracting particles. The Asian brown cloud is one manifestation of this situation. It's pollution that suppresses rainfall, and has diminished annual monsoons by an estimated 30 percent.

ACRES U.S.A. Does the Asian brown cloud hold in heat?

SCHWARTZ. It's complicated. On one hand it holds in heat but it also blocks the sunlight. Some pollution is actually cooling in that it can mask warming effects. It's paradoxical, like the humid droughts that Walter talks about: when it's muggy but there's no rain because the soot and dust particles don't lead to precipitation.

ACRES U.S.A. Amish agricultural consultant John Kempf says that in a really well-functioning, fertile soil environment plants grow faster and require less water to do so.

SCHWARTZ. John talks in terms of the high nutritional level of the plants. He says healthy plants create healthy soil, and healthy soil creates healthy plants. Another virtuous cycle. When plants are growing vigorously they are more effective at photosynthesis, which means more energy to form higher-order nutrients. For example, plants with a high level of nutrition produce more lipids. Kempf refers to the glossy, waxy coat on the foliage of healthy plants. This protective barrier holds in moisture and protects the plant, so it does not need to use its moisture to cool itself and cool the soil. This creates another level of water efficiency. As does living soil, since fungal networks extend a plant's reach to obtain moisture.

ACRES U.S.A. Why do you downplay the benefits of irrigation to address shortfalls in precipitation?

SCHWARTZ. Christine Jones reminds us that every society that has depended on irrigation ultimately fails. Sandra Postel also talks about how irrigation buys time but leads to other problems, such as salinization. If you keep applying water to land, especially in an arid environment, when it evaporates it leaves behind salts. And salinization reduces the quality of water, too.

ACRES U.S.A. Why does the claim that the fastest way to regenerate soil is to grow extraordinarily healthy crops make sense to you?

SCHWARTZ. The healthier the plant, the more carbon that plant can send down into the soil as root exudate. That's another kind of beneficial feedback loop, in that this carbon-based root exudate serves

as currency for trading for nutrients, trace minerals, phosphorus and nitrogen. There's a whole underground barter exchange.

ACRES U.S.A. How did the permaculturists near Big Bend, Texas, collect enough water to overflow a water tank when it hadn't rained in four months?

SCHWARTZ. This is something that took them by tremendous surprise, too. Here they are in an incredibly dry place, where everyone worries about water all the time. Katherine and Markus Ottmers use their barn — the center of operations for all their projects — as a water-collection device. It had two levels of tin roof. In the afternoon, the top one would super heat. Then, at night, cooling breezes laden with invisible moisture would blow in. That temperature differential would cause the moisture to condense, and the water would then flow down a pipe into their water tank. One morning in winter 2012, lo and behold, the water tank overflowed. They checked for blockages and there weren't any. The next morning, Markus woke well before dawn to see what was happening. He was stunned by the rate at which water was flowing into the tank.

ACRES U.S.A. That's remarkable. What have they been doing to create oases on their land?

SCHWARTZ. They used animals to reinvigorate the land so the soil would hold more carbon. Markus worked a lot on managing the flow of water. Sometimes he moved earth on contours with heavy equipment. I remember one spot where we sat that felt very cool. He had created a microclimate that was several degrees cooler than the surrounding area. They also consciously placed plants so they remained in shade until the sun reached a certain angle. That allowed the dew to stay on the plants longer before evaporating in the sun. Marcus made the point that condensation is the most dependable, and therefore the most important, water in the landscape.

ACRES U.S.A. At least in the northeast I don't think we think much about condensation, though I know it can be important in pastures.

SCHWARTZ. People are starting to post various dew-collecting contraptions on my wall on Facebook.

ACRES U.S.A. And you wrote about nets for collecting dew.

SCHWARTZ. Fog nets actually. The placement of plants also isn't something that people think about.

ACRES U.S.A. It's logical that ancient cultures and religions were so clued into dew.

SCHWARTZ. Yes. When I go to synagogue, there's a core prayer that in the winter talks about welcoming the rain, and in the summer welcoming the dew. I had thought of that as a poetic thing, but actually in ancient Israel, people had ways of collecting dew using stones.

ACRES U.S.A. After the desert environment in Texas, you move on to Australia, where you paint an appealing picture of the potential for landscape transformation. You write, "A creek that was a desiccated channel in the 1990s now has clean flowing water throughout the year. More springs are surfacing, and locally endangered species are thriving." How was this impressive regeneration of the land achieved?

SCHWARTZ. Chris Henggeler uses holistic planned grazing. He considers cattle his "middle management" and his plants "lower management." The upper management is the humans, of which there are few on that property. He manages the land so that the microorganisms, which he sees as the workers, can be most effective. He refers to dew as the mini-water cycle and says it's important because if you can keep water on the land and on the surfaces of the plants for longer, that will allow more microbial activity. The expanse of that land is extraordinary. It's the size of the five boroughs of New York and basically under the management of one family, and mostly Chris. He can only focus on certain areas at a time so he has to think strategically. His biggest concern is fire so keeping the landscape hydrated is extremely central. If you can do that, then you minimize the extent of a wildfire.

ACRES U.S.A. Besides keeping the land hydrated — which sounds like a colossal challenge in a hot desert, doesn't he also use cattle to eliminate oxidized vegetation, which would be tinder for fire?

SCHWARTZ. Right. In a natural system, plant-eating animals consume and trample plants, but with the loss of those herbivores in many landscapes, we end up with a void that can be filled by effective management.

ACRES U.S.A. Do you endorse crop insurances as a good hedge for farmers against drought?

SCHWARTZ. I'm not a farmer, so far be it for me to say, "No, take that big risk." But I don't think the crop insurance program as it is now encourages people to manage for drought or to think strategically about water resources.

ACRES U.S.A. I was very struck by your discussion of water and cities. We tend to assume that cities require massive infusions of water from somewhere else, but it turns out that even desert cities squander surprising quantities of water delivered as rainfall.

SCHWARTZ. Cities were designed with the perspective that water is a nuisance in the urban environment. When rain hits all those surfaces of the built environment — roofs, sidewalks, asphalt — it runs off. So you're working to remove what is considered wastewater. At the same time you're bringing in the good water whereas you could make better use of the water that falls onto the urban surfaces.

ACRES U.S.A. Doesn't all this wastewater end up in rivers and eventually the ocean?

SCHWARTZ. Yes, and, of course it's picking up pollutants along the way. In, say, a parking lot, there's leaked oil and all that.

ACRES U.S.A. In a cement jungle, you can't get much aquifer recharge, and you don't get transpiration.

SCHWARTZ. You don't get transpiration, but you do get evaporation. If the water isn't soaking into the ground, it evaporates.

ACRES U.S.A. How does Tucson's rainfall compare to its water needs?

SCHWARTZ. In an average year more rain falls on the surface area of the city than the community uses. But we think we have to get rid of this water and replace it with other water, which is a huge energy drain. Think of a state like California, with all the energy being used to remove water, to bring in water, to send water over the mountains, to deliver water to agriculture, which has been built to depend on imported water.

ACRES U.S.A. How does water scarcity fuel war and other types of conflict?

SCHWARTZ. That's a difficult question because there are lots of factors. But it is worth noting that most conflict areas around the globe are dry lands, and they are lands that are desertifying. Take a place like Syria. Before the uprisings in 2011 there was a multi-year drought. Behind that was desertification, the loss of land function. My husband was in Syria in 2007. At that time there were 1.5 million Iraq refugees — yes, from our war. So you have a situation where people from rural areas are streaming into cities because they can no longer grow food, plus more than a million people displaced by war, plus insufficient rain — or at least insufficient effective rainfall. It's clearly ripe for conflict, even before considering the geopolitical factors. We can rehydrate a lot of these places. Globally I don't think we're paying attention to the degradation of our landscapes. That's partly because the decline happens gradually, and people come to think things have always been this way. It's a collective failure of memory.

ACRES U.S.A. What numbers can you share to give readers a better sense of just how much water we are letting slip away from our land?

SCHWARTZ. Michal Kravcik, who won the Goldman Environmental Prize for his Blue Alternative to a large dam in Slovakia, says more than 700 billion cubic meters of rainwater vanish from the continents each year — water that would previously have remained in the environment. And yet more of the world's surface is being paved over all the time. This leaves less soil that can absorb water and less area to grow trees and other vegetation. This takes us in exactly the

wrong direction. In terms of the water that we waste, Andrew Lipkis of TreePeople says that even in the lowest rainfall year in Los Angeles, over 3,000 gallons of water per person disappeared. Keeping rainfall on the land can be done by very simple means like rain barrels and little swales that pool the water and support trees. And whenever you have trees — or any plants for that matter — they're also pulling up water.

ACRES U.S.A. What lesson can we learn from the celebrated Blue Alternative to Slovakia's mega-dam project?

SCHWARTZ. Often our governments think in terms of large water infrastructure projects because they can understand them. They can figure out which department will budget it, what contractors can be hired, how impressive the ribbon cutting will be and all that. In Slovakia, cities needed more water so a big dam project was conceived. Michal Kravcik and others were concerned that by altering the flow of water, the dam would be detrimental for the environment and several 700-year-old villages would have to be moved, and thus destroyed. The Blue Alternative was a decentralized system that managed the flow of water to make more water available. Volunteers created small water catchments, which collected water and minimized waste. This saved the villages and avoided a large, environmentally destructive project. And cost a fraction of the proposed project.

ACRES U.S.A. Was this done by community people with minimal funding?

SCHWARTZ. Yes. It also gave people meaningful work to do. Many forms of ecological restoration can provide meaningful work for people. This is particularly relevant as degraded landscapes often lack employment because agriculture is failing.

ACRES U.S.A. What are a few of your favorite grassroots solutions?

SCHWARTZ. Rajendra Singh is a doctor who went to the state of Rajasthan, which is a very dry area of India. He realized that the most important thing he could do to enhance the health of the local people would be to help them with water. He worked with them to build very small check dams called johads. Over time the area turned green because these little dams were keeping the water in the landscape. Seven rivers have started flowing again. Singh won the Stockholm Water Prize in 2015. Another thing that I find heartening is the 4 per 1,000 Initiative from the French Agriculture Ministry, which was introduced at COP21 in Paris. It invites nations and other entities to commit to building carbon in agricultural soils at a rate of 0.4 percent per year. That amount was chosen because that, combined with, pledged emissions reductions would halt the annual increase in atmospheric carbon. So that's really powerful and has huge implications for water.

ACRES U.S.A. What makes you most hopeful about the future of water?

SCHWARTZ. The fact that people are beginning to make the connection between carbon, water and climate. At COP21 I attended one of the community-led workshops on water and climate. I met people working on programs to keep water on the land and looking for alternatives to big water infrastructure projects.

ACRES U.S.A. With your book you're trying to bring this message to more people. How else could this message become more widely known?

SCHWARTZ. First of all, just getting people to not be afraid to talk about our big, global challenges. When there's a problem, let's get people to inquire, how would nature solve that problem?

*This interview appears in the June 2017 issue of Acres U.S.A.*

*For more information about Judith D. Schwartz, visit her website. Books by Judith D. Schwartz include: Water in Plain Sight: Hope for a Thirsty World (2016, St. Martin's Press); Cows Save the Planet: And Other Improbable Ways of Restoring Soil to Heal the Earth (2013, Chelsea Green).*

# AG BRIEFS



UB CF announces that the next **Neal Kinsey Soil Fertility 3 day course** will be held the week of August 27<sup>th</sup> (note this has been changed from the dates in the previous Ag Report). This will be a repeat of the very well-received Intro 2 Course given in February. To register, contact David Thiessen at 670-4817 or [thiessenliquid@gmail.com](mailto:thiessenliquid@gmail.com). Limited registration.



**Avocados** reached the highest prices in the US over 19 years early this summer, at \$28 USD/10 kilos, due to lowered yields caused by bad weather and other problems in the main producing countries of Mexico (strikes), Peru (floods), Chile (droughts) and the US (California droughts).



**Avocado as colorant:** Researchers at Penn State, USA, inadvertently discovered that avocado pits, when pulverized, produce very stable and natural food colors, in the ranges from yellow, orange and red. This coloring is said to be more vibrant and stable than other coloring options and is expected to be also very cost effective as it could utilize the large quantities of pits currently tossed out. For more information go to [www.avocolor.com](http://www.avocolor.com)



**Belize citrus estimates for the 2016-2017 crop**, 3.2 m boxes of oranges, even though a decline from the previous year's crop of 3.25 m boxes, was viewed optimistically as 2016 saw an estimated loss of 569k boxes due to Hurricane Earl. Newly planted trees, roughly 2,000 acres, coming into production for the upcoming 2017-2018 season, will increase yields. Local citrus associations, the Citrus Growers Association (CGA) and Belize Citrus Mutual (BCM) made a joint request to Ministry of Agriculture to discuss common industry challenges including HLB management, labor issues and capital availability. Their successful meeting, with representatives of both associations and ministry officials including the Minister of Agriculture Hon. Godwin Hulse was held on 10<sup>th</sup> July, 2017. All parties agreed on a strategic goal to plant 5 million citrus trees in

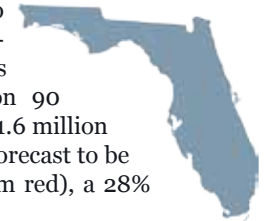
the next 5 years and agreed for the ministry, the associations and the factory to work together to maximize marketing of juice blends locally, regionally and globally.

Regarding the HLB challenge, all parties agreed to the "four pronged approach... (i) the control of the Asian Citrus Psyllid vector that spreads HLB, (ii) the planting of only certified citrus trees, (iii) the removal of sick uneconomic trees and (iv) the implementation of a robust nutrition programme."



**Brazil reported that their exports of orange juice** for the year July 2016 to July 2017, declined 17% from the previous year, to 890,000 tons, a 25 year low. They are anticipating higher yields for the next season especially in the states of Sao Paulo and Minas Gervais. Brazil leads the world in orange juice exports and their top market is the EU.

**Florida citrus production** also continues in a decline, with their 2016-2017 crop 16% down from the previous year. The USDA forecasts 68.7 million 90 pound boxes. Previous year's total was 81.6 million boxes. Florida grapefruit production is forecast to be 7.8 million boxes (1.5 m white and 6.3 m red), a 28% decline from the previous year.



**HLB in China:** According to Mr. Dehua Chen of Yantao Bojie Agriculture Technology Development, 19 provinces have encountered HLB and "compared to other countries, citrus greening disease is more common in China because more chemical fertilizers are used for citrus plants which are planted close together." They suggest better management combining disease prevention with vector control and "replacing herbicides

## For Information on the status of the **Iguana Creek Bridge**

waters rising or falling, out of water, under water, go to [iguanacreekbridge.blogspot.com](http://iguanacreekbridge.blogspot.com)

The Iguana Creek Bridge crosses the Belize River near Black Man Eddy Village, off the George Price (Western) Highway.

## Local and Regional Fuel Prices



	Cayo, Belize	Quintana Roo, Mexico	Peten, Guatemala
REGULAR	↓ \$9.80 Bz/Gal	↑ \$6.88 Bz/Gal	↑ \$8.00 Bz/Gal
PREMIUM	↓ \$10.59 Bz/Gal	↑ \$7.62 Bz/Gal	↓ \$7.69 Bz/Gal
DIESEL	↓ \$8.78 Bz/Gal	↑ \$7.23 Bz/Gal	↑ \$6.46 Bz/Gal



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The EMTs are trained to meet or exceed standards set by BERT and are retested every year. We've also been giving First Aid classes to schools and other organizations.

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like glyphosate with traditional or organic fertilizers and manual weeding.” Since 2003 they have been experimenting with using microbiological fertilizer that “fights against the diseases”. The main product used for that is E-2001, which is imported from the USA.



**New GMO Banana:** After 12 years research, the *Golden Banana* has been developed in Australia and is ready for planting in Uganda. The new variety combines genes from a small Papua New Guinea banana with the Cavendish, to produce a banana with a darker orange color and a higher vitamin A content. Bananas are a major staple in Uganda and this should be in major production there by 2021. The Gates foundation has provided funding.

**Bananas growing in Canada:** Hard to believe, but 2 outside-the-box thinking Canadians are producing bananas, guava and papaya in hoopouses near Auburn, Ontario. They say their fruits are “usually cheaper than the grocery store”, so have found some resistance to their local tropical produce with local stores. They are in discussions to expand or relocate operations in Ontario, or to Quebec and Alberta. Other tropical fruits in experimental phases include passion fruit, pineapple, avocado, mangos and coconuts. For more information contact Canada Banana Farms at [www.facebook.com/canadabanana.ca](http://www.facebook.com/canadabanana.ca).



**Chayote:** Costa Rica, Mexico and the Dominican Republic export cho-cho (*Sechium edule*) to the US in rising amounts. The perennial vine is high in anti-oxidants, iron, manganese, phosphorus, zinc, potassium, copper and in vitamins B1, B2, B6 and C.

Curiously, importers note that fumigation rates have increased greatly “because of the pests or bugs commonly found in chayotes” and then these fumigations diminish the shelf life of the chayote.

**Red pineapple:** A Brazilian company, Botanica Pop Ltda, has announced 2 new varieties of red pineapples, called *Cesar* and *David*. Since then, they have been flooded with local and international requests from both potential purchasers as well as producers. The dark red color derives from the presence of anthocyanin, “which is a strong natural medicinal compound with action against different cancer forms now proven by over 600 indexed scientific publications”. Also these varieties, like other pineapples, contain the healthful enzyme bromelain. The fruit is being promoted as a



premium fruit (unlike the normal pineapple which is considered a commodity fruit) and this will result in a premium price as well. The Brazilian Ministry of Agriculture and local universities are assisting in the development of these cultivars.



**Vinegar For Drought Resistance:**

After studying a new biological pathway that is activated in plants during droughts, scientists at Japan’s RIKEN Center for Sustainable Resource Science (CSRS) found that they could give plants a higher tolerance for drought simply by growing them in vinegar. The HDA6 enzyme essentially functions like a switch activating one of two metabolic pathways: sugar for energy under normal circumstances and acetate during droughts. They treated some Arabidopsis plants with acetic acid and others with water or other organic acids and grew them in drought conditions to compare the results. (The plant is a close relative of cabbage, kale, and cauliflower and is often used in experiments because it readily shows changes). After two weeks, 70 percent of the plants that were treated with the acetic acid survived; nearly all of the other plants had died. The other acids that were used unsuccessfully included hydrochloric acid, butyric acid, formic acid, citric acid and lactic acid.

The same experiment showed increased drought tolerance in maize, wheat and rice when they were grown using acetic acid. They found that the optimum concentration was 40 parts of water to one part of vinegar. This simple technique eliminates the need for transgenic technologies, which means it is not only safer but also much easier to apply around the world.

**Truly local produce:**

An IGA supermarket in the St. Laurent, Quebec, Canada (Montreal area), announced that they are selling 30 varieties of organic produce, which are grown on 25,000 sq. feet of the store’s own roof and will be selling honey from the 8 beehives there. The gardens use water from the store’s own dehumidification system, and will be certified organic by Ecocert Canada. The owners say that growing on their roof is more expensive than other methods, yet they will sell these items at the same prices as other organic produce.



*Briefs... Continued on pg 34*

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**Briefs... Continued from pg 33**



A new report, **the International Greenhouse Vegetable Production Statistics, 2017** edition indicates that about half of the world's vegetable greenhouses are in Asia. Their estimate for the world is 489,214 ha. and by continent is : Europe – 173,561 ha; South America – 12,502 ha; North America – 7,288 ha; Asia – 224,974 ha; Africa – 36,993 ha; Oceania – 2,036 ha; and Antarctica – 0.02 ha (research station). For more information – [www.cuestaroble.com](http://www.cuestaroble.com)

**Indoor Warehouse Farms in US:** In 2015 there were 15 reported warehouse farms, plant factories and rooftop greenhouses in the US, but this has jumped to 56 in midyear 2017.

**Both Arkansas and Missouri's plant boards have put bans on the spraying of dicamba,** with exceptions for use on pastureland.



Dicamba is known for its drifting quality, which makes it very difficult, if not impossible, to control. Farmers who planted GMO dicamba-ready soy or cotton have no damages but neighbors who planted non-resistant varieties have sustained damages on thousands of acres since traditional soy is incredibly sensitive to dicamba. The new dicamba-resistant variety was created to control pigweed (amaranth) which had become resistant to glyphosate (Roundup) as a control.



Food equipment giant Tomra Sorting Solutions has made the **world's largest steam potato peeler** for an un-named potato processor. The 8 meter tall machine can peel more than 143,300 pounds of spuds per hour, which is about 3,000 individual potatoes per 7 seconds. Tomra boasts that it is also 28% more steam-efficient than other peelers of its type.

**Eurofins, one of the world's most respected lab groups, notes that testing for pesticide residues is increasing** as demands for residue-free products rise. They also do pre-harvest tests to advise on the best time for harvesting or the ripeness of a product.



To assist in estimating shelf life, they even have a test which deliberately contaminates a product to see how quickly bacteria develop. They compare their results with maximum residue level (MRL) and acute reference dose (ARfD) values and report that many of their supermarket clients actually

enforce stricter requirements than required by law. They find an average of 5% of produce tested exceeds MRLs, with bell peppers, grapes, strawberries and other soft fruit to be the highest risk. Fresh produce has been residue inspected since 1998, and Eurofins says that “compared to other sectors, the fresh produce sector is a clean business.” Eurofins has labs in 39 countries.

**Banana leaves for food wraps:** A Bolivian woman has started a company processing banana leaves for food wraps, with hopes to reduce use of foil and plastic wraps for food. Both natural and biodegradable, the wraps are catching on in restaurants and butcher shops. They can be used in the cooking process, tolerating grilling, baking, frying and being placed in a fire. The leaves are purchased from the banana farms, then steamed, dried and packed into bags of 10 which sell for the equivalent of \$2.90 Bz\$. The Banana Pack has a 6 month shelf life. Many Belizeans are well acquainted with using banana leaves, and they can sometimes be found loosely packed in our open markets.



**CARDI and the University Of Belize to Collaborate on Knowledge Sharing, Training And Research**



**Activities in the Agricultural Sector:** The Caribbean Agricultural Research and Development Institute (CARDI) and the University of Belize (UB) have signed a memorandum of understanding (MOU) to collaborate in the areas of knowledge sharing, training and capacity building, resource mobilization and research activities geared towards the development of Belize's agricultural sector. The MOU was signed by CARDI's Executive Director, Barton Clarke and the President of the University of Belize, Professor Clement Sankat at the University of Belize, main campus in Belmopan. Present at the signing were CARDI Representative, Omaira Avila Rostant and UB, Central Farm Campus Administrator, Gordon Holder.



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## Cacao Genetic Sequencing *(continues from page 24)*

Regarding the genetic analysis, the first horizontal bar at the top is the Belize genetics sequencing, with the peach color representing Amelonado, the green and red is Upper Amazon Forasteros, yellow is ancient Nacional, and the blue is Criollo. Each vertical color strip within the horizontal bar represents the genetics of a single tree and there were 50 trees tested all showing along the horizontal bar. In order to be fully Trinitario, it would have to be only Amelonado and Criollo which only one of the samples in the first horizontal bar (Belize) of the 50 is Trinitario (cross of Amelonado and Criollo and even that one example is mostly Amelonado-- the peach color vs the blue color).

The second and third horizontal bars going from top to bottom are other countries by comparison to the top bar, which is Belize.

