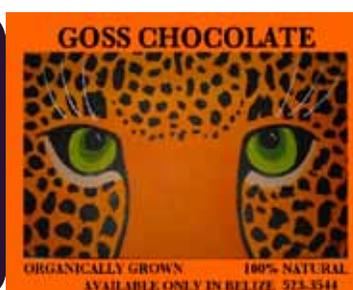
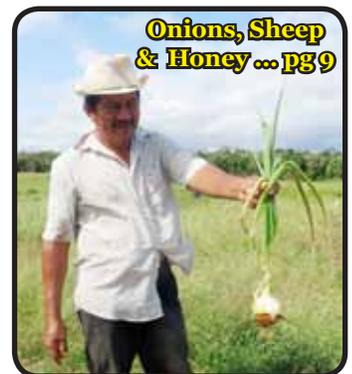


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WEED CONTROL PROGRAM FOR PASTURES

Edwin Gomez¹, Wilbert Ramclam², Art Plett³

INTRODUCTION

Weeds have been known to compete with crops for water, light, space and soil nutrients (J.D.Green *et al* 2006) thus reducing production. According to Penn State Extension Agronomy Facts 62, Weeds can be classified into three main groups (3). *Annuals*¹, these complete their life cycle within a year and reproduce only by seeds. *Biennial*² weeds live during two growing seasons (2 years) and reproduce only by seeds also. *Perennial*³ weeds live for more than two (2) years and reproduce by vegetative structure and seeds.

A trial was conducted to control weeds in pastures at Spanish Lookout, Cayo District, Belize C.A. from the 10th August to the 12th September 2016 in collaboration with Mr. Art Plett.

OBJECTIVE

1. Evaluate herbicide mixture to control both annual and perennial weeds. 2. Develop a cost per acre analysis. 3. Evaluate weed control after eight (8) days of application. 4. Re-entry period for animal grazing.

METHODS

Select a problematic pastured area with weeds. 2. Division of applied and control blocks 3. Calibration of application equipment 4. Application of recommended herbicide dosages based on product technical sheet 5. Record application date and inspection dates.

HERBICIDE COST ANALYSIS

(Table 1.1) Herbicide Trial cost analysis for 20 litres pump mixture

PRODUCT	ACTIVE	PRES	DOSAGE	C/U	C/PUMP
Tribel 48 EC (CC)	Triclopyr	1000	35	\$ 47.03	\$ 1.65
Elimina 60 SL (CC)	2-4-D	1000	135	\$ 8.09	\$ 1.09
Dash 37.5 EC (CC)	Metyl Oleato-P.	1000	20	\$ 6.00	\$ 0.12
AMS (lbs)	21-0-0+24S	110	0.5	\$ 35.00	\$ 0.16
TOTAL					\$ 3.02

RESULTS:

Application date August 10th, 2016



Eight days after application August 17, 2016



CONCLUSIONS

- Selected herbicide mixture in table 1.1 effectively controlled both annual and perennial weeds in graze area, no damage was done to the pasture.
- Estimated cost per acre for recommended herbicides in Table 1.1 \$18.12 Belize dollars.
- Re-entry period for: Elimina 60 SL, lactating 7 days, beef 0 days, Tribel 48 EC, 0 days for beef and lactating cattle.

Feasting in the Wake of Destruction Meals Prepared By Earl By Deborah Harder

Many of the trials and seeming disasters we experience can actually yield valuable fruits in our lives, for example, patience and wisdom. However, this spiritual principle is much easier to state in words than to live out in reality when we face disappointments of life. Our recent experience with Hurricane Earl reminded us of this truth and helped us to consider it, on a very small scale, for the storm did not damage anything truly important to us: our lives, the lives of our loved ones, or even significant amounts of property. We were thankful that God spared Belize reasonably well.



As on many Belizean plantations, Hurricane Earl uprooted a few trees and banana plants at our place, and brought an abrupt end to the mango harvest, blowing down most of the immature mangoes. Our corn crop, like most of the neighbors, was mostly flattened; however, two months later, we were amazed to see how the corn continued to mature and produced a surprisingly good harvest, praise to God. Just after the storm we of little faith felt quite dejected when we saw some stalks were completely broken off. I brought the baby cobs home to use whole as a vegetable. Sliced into attractive "stars" and combined with thin slices of baby green bananas from broken off banana stalks they made a nice curry. I called it Hurricane Curry. I used the leftovers to make Hurricane Samosas, which you can make using a pastry of equal parts corn meal, cassava flour and cassava starch like pie crust dough, rolling it into balls, pressing each one into a tortilla press and filling with curry mixture, folding into a half moon shape, sealing the edges, removing from the plastic lining of the press, brushing with butter or oil and baking until golden brown.

As for all the green mangoes that blew down, we gathered them up the next day, hoping that many would still ripen; however most were too damaged from the night on the wet ground. In my last article, on using mangoes, I mentioned in passing that green mangoes can be cooked as a vegetable. However I admit this remark was not based on personal experience or research, sloppy journalism at best. My neighbors were first to try cooking with the green mangoes Earl blew down, and sent over some excellent patties made from half green mangoes and half potatoes. I couldn't guess the mystery ingredients; but when I found out, I was inspired to try Hurricane Patties, made of equal parts of cooked smashed green bananas and green mangoes. Mixed with egg, onion, salt and pepper, cassava flour and a little curry powder, then fried on both sides, they were quite palatable. Next came Hurricane Custard, made like pumpkin. Hurricane Soup featured green mango shredded instead of cabbage in our usual Russian cabbage borscht recipe. This soup includes tomato juice, which combines well with green mango because of its slightly sour flavor. My family thought it was cabbage, though soon when they heard the names of the new creations I could no longer stump them. The final member of our body of hurricane foods was heart of palm, harvested from the young coconut tree that blew over. Heart of palm is known as "poor man's cabbage" but is truly a delicacy. Nestled in the crown of any palm, it cannot be harvested without destroying the tree, but when this is done by

choice or necessity it yields a large amount of excellent vegetable food. It can be eaten raw, either cut into sticks or shredded into a salad, or cooked in any way cabbage is used.

We have so much to be thankful for; especially we should thank God that Hurricane Earl was so mild and didn't do more damage or destroy many reliable fruit trees. In some places where trees were uprooted, it just created more sunlight and space to plant other, more valuable fruit trees. We thought our half acre plot of corn was all destroyed, but to our amazement it pollinated from its prone position and we ate plenty of green corn and tamalitos, and harvested two big wagon loads of ripe corn. We felt very small and unworthy of the blessing of the crop despite the storm. As my husband said, we can see over and over again how the Lord blesses us with an abundance of harvest, and blessings completely undeserved, showing His love and care for us despite disasters, which at times may be needed for our learning.

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TO THE EDITOR

Dear Editor,

According to the Mennonites and some Belizeans that live in the Barton Creek area hunters are responsible for decades of destructive fires that have been set there. They set fires so they can come back a few weeks later and easily see and shoot animals. After the tall tiger fern is burnt off young grass sprouts appear and some animals enjoy eating them.

To help solve this apparently country-wide problem the government needs to change the laws so penalties are severe for trespassing and arson. Then these very ignorant people may think twice about going on other people's land and setting fires. Perhaps the threat of a 10 year prison sentence would go a long way to help stop all the illegal logging as well.

This year a fire was set on the other side of Barton Creek directly across from our property. It was so dry that a spark from it ignited the trees beside the creek on our side. It burned about 2000 square feet and killed all the young trees. Had it been drier one foolish person's criminal actions could have destroyed an entire forest along a beautiful creek.

People need to understand that there are microscopic fungi, bacteria and worms in the soil that are responsible for plant fertility and root nutrient uptake. Every time the land is burned more of these micro-organisms die and the land is less capable of supporting life. Also, the soil on a burnt hill is washed away more easily by the rain. If the fires continue, all we will be left with is barren, rocky hills like they have in Iraq and other countries where humans burned the land too many times. Too many people setting too many fires all over the planet is insane, destructive behavior. It must stop.

The tiger fern we have in Belize is a pioneer plant that helps re-grow forests. It is highly flammable in the dry season and needs to be protected and cared for. Since Belize parades itself on the world stage as an eco-tourist destination it seems more than reasonable that the government should have strict laws in place to help protect recovering forests. Such laws will attract more tourists.

At this point the unconscious behavior of humanity is destroying the planet with fire, genetically modified organisms, chemical sprays, nuclear power plants, toxic dumping and countless other destructive practices. How can people think that growing food with poisonous chemicals is a good idea? They all get washed into the oceans and poison life there too. If people knew how toxic the oceans are the seafood industry would cease to exist. We need to find our way back to organic farming. In less than a century we have made a huge mess. Change is desperately needed before the destruction becomes irreversible.

The correct course of action is to take impeccable, loving care of our planet. I believe all people on the planet desperately need to hear and fully understand this. What do you believe? If you care about your children and grandchildren the answer is obvious, is it not? I was in shock when I first heard that Belize has what some people call the "smoke season". This must stop. We cannot continue burning the earth if we want it to continue to support life.

Brad Simon
Email: bradsimon40@yahoo.ca.

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Going Biological Large-Scale Carbon-Smart Corn Down the Wormhole

Customizing Biological Methods for Large-Scale Farming

By David Yarrow

At the end of 2015 I talked to Missouri bootheel farmer David “JR” Bollinger about his experiences growing corn, soybeans and milo using carbon-smart farming principles and practices. In his first year fully committed to biological agriculture, Bollinger cut conventional fertilizers by 50 percent and applied blends of biocarbons, minerals and microbes. Soils, plants and yields are all showing positive results.



Bollinger is the fourth generation to farm on 3,500 acres in the southeast Missouri Delta, with the family’s main crops being corn, soybeans, wheat and milo.

“In 2012, I first dabbled in biological farming on a reclaimed coal mine,” he said. “A gentleman with microbial products first tickled my brain about dead soil. He challenged me to find an earthworm. I went looking, and ... none. I noticed there wasn’t much life. The soil looked like moon dust, vacant of life.”

DIRT IS INERT; SOIL IS ALIVE

More than mineral dust, soil is created by living organisms. Soil isn’t only made by microbes; soil is made up of microbes and the living matrix and infrastructure they create to support their invisible communities.

“I sprayed his microbe mix of bacteria, fungi and humate at 1 gallon per acre on 50 acres,” said Bollinger. “That year was the big drought with three rains the whole year; 80 percent loss on the 1,000 acres. But 50 acres where I applied microbes actually had a good crop.”

He questioned why soils are so lifeless.

“Because of the kind of person I am, I started digging in, and wow! I’m fortunate to live in a time when I can dig as far as I want. Why is this? Why is that? So many different layers of life.

I tinkered with mixes under gro-lites in my basement to see what products do. In test pots, I saw effects and benefits. You can say I went down the wormhole.”

Bollinger now considers earthworms to be very valuable farming partners.

“When you dig into what earthworms do, they’re fascinating. As a kid, I took them for granted as fish bait. Now I see all their benefits — the tunnels they make, their movements in soil, their functions. They’re key to good, healthy soil. If you have worms, you have healthy soil.”

New research reveals earthworms are farmers, too. They pull plant biomass into their tunnels, not to eat, but as a soft lining for the growth of bacteria and fungi. Later, a worm returns to graze this fuzzy film of mycelium and microbes. Worms farm their tunnels to cultivate microbes, and thus spread them underground. One ton of earthworms per acre are a primary workforce to convert biomass into fertility and growth.

TEST PLOTS

Urged by positive results and research, Bollinger advocated changes in the family farm’s operations. Bollinger, Sr. was skeptical of new products and cautious about spending money on them.

“I started talking to Dad about biological farming,” said the younger Bollinger. “We started to use different methods. We started small. We didn’t do it all at once. We did test plots for two years. We applied microbes to 1,000 acres of corn and reduced fertilizer on part. We noticed our plants grew bigger and better, and we didn’t have to water as much.”

Bollinger said after June harvest, they usually burned stubble and planted beans.

“Burning stubble gives away goodies worms and microbes need. So, we did a no-till second crop with microbes and saw more results. We were young at this type of farming. We didn’t know what we were doing, but we were seeing benefits. Every time you see a benefit, human nature is to keep doing that.”

ADDING MORE ACRES

In 2015 Bollinger decided to transition more acres to sustainable farming methods.

“I stuck my head in books, read up on bacteria, fungi, mycorrhizae, cover crops, kelp, fish meal, biochar and humates — the whole smorgasbord. I saw benefits from microbes, so what can I do for microbes? ... I dug into what makes their lives better, like conservation tillage. I see it as ‘farming microbes’ versus applying a chemical. I dug into new products. When we applied biologicals, all of a sudden plants are thriving. A side result is our soil is improving. Now that I had confidence in biological methods, I wanted to apply this on all our acreage.”

Going Biological...Continued on page 15

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Agricultural Sector Damages from Hurricane Earl

Extracted from the Report by The Ministry of Agriculture, Fisheries, Forestry, the Environment and Sustainable Development



Overall, 1200 farmers were directly affected by Hurricane Earl which ripped through Belize overnight August 3 and into the next day. The information below reflects only actual produce lost in the producing stage (does not include future losses anticipated from out-of-season fruit trees), using farm-gate prices unless otherwise specified. Additionally some losses of infrastructure are detailed. All prices are in Bz dollars.

Citrus: Losses in Stann Creek and Cayo districts were mainly due to fruit drop, tree loss and damages to housing and other farm infrastructures. Of the 38,000 acres in citrus production, fruit loss amounted to 641,654 boxes of fruit (519,731 boxes of oranges valued at \$11,634,700; 121,923 boxes of grapefruit valued at \$1,791,166) for an estimated total fruit loss of \$13,425,861. Tree losses for oranges: 12,556 trees valued at \$35 per tree, amounted to \$439,460. Tree losses for grapefruit: 1,156 trees valued at \$40 per tree, totaled \$46,240. Total tree loss was \$439,460. Total immediate citrus loss was \$13,911,566. Additional future fruit drop is anticipated as a delayed response to the wind damage and foliar loss to the trees.



Corn: National acreage under corn cultivation for 2015 was estimated at 42,064 acres. Mechanized commercial production of yellow and white corn is concentrated in Cayo District (Spanish Lookout, Banana Bank and Cotton Tree/More Tomorrow areas), in Orange Walk District (Indian Creek/Shipyard) and in Corozal District (Little Belize). At the time of this damage survey, it was not possible to discern if the corn kernels were already pollinated. Corn appearing as healthy may still not produce if they were not pollinated prior to the storm. The estimated corn loss was estimated to be 26,674.5 acres at a value of \$34,998,802 using valuation of \$1,312/acre. Acreage losses by district are as follows: Belize – 59.5 acres; Cayo – 21,000 acres; Corozal – 825 acres; Orange Walk – 4,510 acres; and Stann Creek – 280 acres. The ministry survey of 595 total corn farmers, including large and small, sustained losses from the hurricane. By district these were: Belize – 7 farmers; Cayo – 262 farmers; Corozal – 60 farmers; Orange Walk – 130 farmers and Stann Creek – 136 farmers. The Stann Creek District which has the most milpa farmers countrywide (78 farmers) was predicted to feel the most significant effects in terms of food security and income generation.



Bananas: The banana industry was impacted due to strong winds experienced in the Stann Creek District, especially in the northern farms of South Stann Creek and with relatively minor damage to the southern farms around Bladen. The losses on approximately 1,107 acres is due to:



A. Direct losses (shot plants), the value of hanging fruit that had been produced by the plant but not yet harvested and B. Indirect losses, the value of fruit that had not yet been produced but the plants damaged (unshot). As is the norm, it is assumed that the extent of the damage in unshot plants will approximate to the same degree as that in shot plants for a combined estimated loss

of \$13,249,798. C. Additional costs of \$1,734,483 for labour and inputs to restore farms to full production, which may be achieved by March 2017. Ministry notes that it has been determined that there are sufficient export volumes to justify the [banana shipping] vessel calling on Belize, although the volume has been significantly reduced. Also noted was that the replanting must occur within a 3 week period to salvage existing planting materials. Delays mean additional losses and require importation of new plants.

Sugarcane: There were minimal losses due to wind damage of stand-over cane in the north, where approximately 288 acres sustained losses valued at \$316,800. However, in the Cayo District, Santander Sugar sustained significant losses due to wind damage and standing water from storm and flood waters. An estimated 50,000 tons of cane will be lost, valued at \$2 M and additional losses from damaged roads, machinery and buildings are estimated at \$450,000.



Vegetables and Fruit: Approximately 250 farmers, mainly in Belize, Cayo and Orange Walk Districts sustained significant damage from wind and water logging on their tomatoes, sweet peppers, watermelon, cabbage, cantaloupes and papaya crops. The socio-economic impacts to them are significant as many are highly dependent on these commodities for their livelihood. In addition to the product losses, the program to introduce vegetable cultivation under protected covered structures was severely impacted by the destruction from winds to these tropical greenhouses. These must be urgently replaced as they allow farmers to grow with the appropriate irrigation and a minimal use of pesticides in the controlled environment. Total estimated losses in this category are 252.57 acres at \$6,330,603.



Covered Structures: Estimated value of damages for 103 protected covered structures belonging to 61 farmers is \$717,650.

Chickens and Chicken Barns: Cayo and Stann Creek suffered losses of chickens totaling \$100,000, and losses of chicken barns totaling \$555,000.



The total cumulative estimated loss for the agricultural sector is \$76,698,712.

Resources Required to Recover and Rebound

Corn: The estimated amount needed to recover the corn losses of 26,674.5 acres is \$3,532,815. Figuring requirements for 99 milpa acres, seed cost of \$12,375 and fertilizer cost of \$12,474 total \$24,849; requirements for 26,575.5 acres of mechanized corn (seed costs of \$159,453 and fertilizer cost of \$3,348,513) the total is \$3,532,815 for recovery.

Vegetables: Farmers visited expressed needs for seeds and fertilizer in order to recover. Based on the estimated acreage lost, the total cost for seeds, \$179,564, and fertilizers, \$31,823, is \$211,388.

Covered Structures: In order to rebuild the covered structures, UV plastic, anti-viral netting, PVC pipe for roof frames and lumber are needed. The figures for these were not tabulated at press time.

Citrus: The industry's needs can be classified into two categories: orchard management and orchard replanting. It's estimated that \$19,187,531 is required for orchard maintenance. The immediate requirement is \$6,079,485 to fertilize and drench young trees and

for weed control. In September the industry required \$2,287,530 for Asian Citrus Psyllid (ACP) control and foliar fertilization. In November 2016, the industry will require \$3,674,144 for granular fertilizers. In April 2017 the industry will require \$2,287,530 for ACP control and foliar fertilization. In June 2017 the industry will require \$4,858,842 for granular fertilizers.

Growers need to take the sanitary measures required to remove fallen or uprooted trees, fruit from affected groves and weed control. In areas that were flooded and for the newly planted trees, root drenching with fungicide is an immediate requirement to prevent root rot. To protect and keep the crop that remains on the trees, growers must have applied an immediate round of granular fertilizer to replace the leaves lost from the trees. As the trees begin to flush and replace leaves, trees need to be sprayed to control the ACP that spread the Huanglongbing (HLB), also known as citrus greening disease, as the ACP are attracted to the new leaves. In those areas around Caves Branch where Citrus Leprosis is present, an insecticide/miticide must be applied to control the mites that are the vector of this disease and also for control of the ACP. In addition to the extra round of fertilization that is immediately required to replace leaves and hold remaining fruit on the trees, growers also need to fertilize in November 2016 and June 2017, as well as do additional ACP control sprays that coincide with the phenology and timing of leaf flushing of the trees in the industry in September 2016 and April 2017.

Orchard Rehabilitation: The industry requires an estimated \$39 M in funding to replant 6,500 acres over the next 4 years at \$6,000 per acre. To change the economics of producing citrus and improving competitiveness and returns it is essential that replanting incorporate (1) better land preparation than before including subsoiling and drainage, (2) increased planting densities (to 165 trees/acre for oranges and 100 trees/acre for grapefruit) and (3) adoption of the four-pronged HLB control program: control of ACP, planting only certified citrus nursery trees, removal of old and sick uneconomic trees and implementation of holistic nutrition programmes.

Recommendations: Industry stakeholders are convinced that a framework allowing financial institutions to re-amortize loans and restructure is essential to enable growers to take the measures required to maintain the current crop. This requires flexibility from the Central Bank and the banking sector. Further, industry stakeholders recommend a two-year moratorium on land tax payments, duty-free diesel during harvesting season, and reimbursement of GST within 30 days.

Citrus Products of Belize (CPBL) is anticipating an increase in juice prices and the fruit prices paid to growers should increase. CPBL is considering paying growers 75% for the first payment to assist with the recovery, but this requires some flexibility from Central Bank to enable this cash flow. Nurseries require approximately \$400,000 for repairs. They also require assistance: restructuring with creditors. The outlook for citrus is for increased market prices in both the short to medium term. The Belize citrus industry has an inventory of old trees with an average age in excess of 20 years. This stock needs to be replaced urgently for the industry to remain competitive and to reduce susceptibility to damages caused by events like Earl due to the already low throughput at the processing plant. Additionally, the industry must protect its market interest in CARICOM to prevent Brazilian products to be brought into CARICOM because CPBL cannot supply. This could result in the industry losing its 35% tax barrier advantage as some countries in the region are already challenging Belize's protection.

Macro-economic Effects of Hurricane Earl

Corn: The national production of yellow corn was 146,385,913 pounds for 2014 and 135,043,110 for 2015. Approximately 53,000 acres of corn are planted on a yearly basis (mechanized plus milpa); from this total 26,674.5 acres or 120 M lbs equal to \$34,998,802 were reported as a loss due to the hurricane. The losses in corn will trigger a ripple effect on the wider economy in terms of loss in foreign exchange due to a decrease in exports and feed for the industries of poultry, swine and cattle.



As a result of the losses, an increase in corn prices and increase in by-products, for example, the price of meats, is expected. Corn is a staple crop considered a main contributor to food security.

Vegetables: Approximately 250 farmers with 255 acres under vegetable production in Orange Walk, Belize and Cayo suffered an estimated loss of \$5,352,880. This represents a total loss of 41% of output value when compared to 2015 vegetable production figures. Available production supply for the months of August, September, October and November have been affected, creating a shortage of these in the local market. Farm gate prices will increase while supply will decrease due to the losses experienced in this sector. This limited supply may require importation of these commodities to satisfy the local demand. This sector has the capacity to recover in a period of four months if the capital is made available.



Banana Industry: Belize's banana growers overcame the previous challenges of the dry weather of El Nino (mid 2015 to mid 2016) and the disease Black Sigatoka and still averaged \$88 M per year in export earnings during 2012-2015. During these years of production loss, extra investments still had to be made for disease control and drainage works. Hurricane Earl has resulted in a value loss of \$14.9 M, equivalent to a 17% reduction in that annual \$88M. In addition to the immediate economic loss the industry has to compete for limited foreign exchange; it has to purchase imported inputs of fertilizer and agrochemicals needed to maintain the health of surviving banana trees. Temporary field workers (approx. 250) are needed to be brought into the country to prune damaged trees and clear destroyed trees. These efforts could result in a promising recovery after 8-9 months when the replaced trees begin production (April, May 2017). Presently there still is strong global market demand. Our industry's competitors are currently under threats, such as the Panama disease in Asia and the effects of La Nina in South America. The challenging market conditions around the world will aid Belizean growers to recover any lost market share in their niche markets.



Citrus Industry: The preliminary forecast for citrus fruit processing after the hurricane for the 2016/2017 year is 3,565,237 boxes of fruit (3,327,858 of oranges and 237,379 of grapefruit). Compared to 2015/2016 this is a slight increase of 2.5% or 80,106 boxes of oranges and a forecasted decrease of 36% or 133,585 boxes of grapefruit. Overall the forecast projects a slight decrease of 1.5% compared to the 3,618,716 boxes of fruit processed in 2015/2016. The citrus industry projects a total revenue of \$84.9M for 2016/2017 (\$80.9 for oranges and \$4.M for grapefruit) inclusive of by-products. This is an increase of 8.2% compared to revenue of \$78.4 M achieved in 2015/2016. However, this projection assumes that growers will have access to inputs such as fertilizers and pesticides to apply to wind-battered orchards in order to facilitate a fast recovery of plants.



BEYOND THE BACKYARD

Tomatillos...The Taste of Mexico

By Jenny Wildman



I was horrified when I first heard that some of my favorite vegetables, potatoes, aubergines (eggplant), tomatoes, and all peppers are part of the extensive nightshade family, Solanaceae, most of which can be toxic

to humans. As children we were taught to avoid the pernicious deadly nightshade (Bella Donna) and thinking of anything as mildly related was somewhat unnerving. This is the plant dwale that contains poisonous alkaloids responsible for witches flying, murder and mayhem, delirium and death. Yet it was historically an important ingredient in medicine and still today is used in some pharmaceuticals.

One branch of the nightshade family is *Physalis* which translated means bladder, as their common characteristic is the fruit being encased in a papery husk (the calyx). Some are ornamental as with *Physalis alkekengi*, the bright orange Chinese lantern. Others like *Physalis peruviana*, Cape gooseberry, ground cherry or golden berry, are both decorative and edible and affectionately called "love in a cage." The tomatillo (little tomato) *Physalis philadelphica* or *Physalis ixocarpa* is an essential ingredient to Mexican and Guatemalan cooking best known for salsa verde which graces every table. The tomatillo, miltomatil, or Mexican husk tomato is related to

the tomato and was once generally more popular in this region. Often touted as an important food of the Aztecs and Maya that originated in Mexico, excavations in Teotihuacan, Mexico evidence its use from 900 BC - 1540 AD . However it is possible that the Conquistadors of the New World brought the tomatillo seeds to Mexico from further south as in 2013 a 52 million year old fossilized tomatillo was unearthed in Laguna del Hunco, Argentina suggesting an earlier origin. Spain lost its interest in the little green fruit as the red tomato gained popularity there. Although successfully grown in many countries the fruit/vegetable did not muster up much interest by the consumers and again commercial growing declined.

Mexico has been a loyal supporter of their heritage ingredient and now the culinary demands of the immigrants have introduced new tastes to the USA and Canada where tortillas and tacos have become every day fare and chilies and tomatillos have spiced up the American palette. High demand in California has made El Forno the tomatillo capital of USA. I am pleased that they are gaining renewed interest throughout the world but wondering why they are sadly lacking locally, considering that we do have many residents who immigrated from neighboring countries. I am forced to resort to bottles and cans which pale in comparison to fresh fruits. In some states of Mexico there are wild varieties that are gaining recognition as they are harvested and taken to market.

Tomatillos are easy to grow from seed, need full sun in well-drained soil, not overly demanding and start producing abundantly in about 100 days. Small-scale production could be an excellent fresh retail item increasing our gastronomic offerings. Tests show that an individual plant can produce 200 fruits in a season. They are staked much like tomatoes, spreading about five feet wide and five feet tall, fairly pest-resistant but are not self-fertilizing so you need more than one plant. Dill and fennel are not good companion plants as they contain a type of oil that seeps into the soil, which can cause the tomatillo to get root rot. Basil, cilantro and parsley are great companion plants warding off unwanted visitors and marigolds are good at attracting pollinators. The husk tomato is an annual and comes in colours ranging from green to yellow and dark purple. Only the fruit is eaten as the rest of the plant is poisonous. Some are more sour, others sweeter and fruitier. Unlike the tomato the flesh of the tomatillo is firm and dense. The taste is acidic and can be eaten raw or cooked in soups and stews. It is often added to cut the heat of the hot capsicum and makes a delicious accompaniment to pork dishes.

The husk and the sticky coating on the fruit help protect it whilst growing. They are ready to pick when the husk begins to burst. The husk is discarded although it does have some use infused in tamales but "when in doubt throw it out". Wash off the sticky fruit and it is now ready to use. The fruit can last in the refrigerator for two weeks and can also be frozen. The health benefits of eating tomatillos are numerous; they contain antibacterial and phytochemicals that effectively tackle inflammation and some cancers. Positive ingredients include: fiber, vitamins A, C and K, niacin, potassium, manganese, iron, and magnesium, within a low calorie tasty fruit. Many of the sauces, such as salsa verde and guacamole, are made with raw fruit but roasting and blanching brings out their flavor. This taste is unique and really does not have a substitute ingredient.

Finally, save some seeds! Squeeze some seeds into a glass container and set aside for 3 days and the jelly-like covering will begin to rot and mould. Now add water and stir. The good seeds will sink; the others will float to the top and can be poured off. Keep flushing until you have only clean seeds. Spread them out onto a glass tray to dry for about a week and a half. They can last for years but make sure you label them and give some to your friends so we can all begin to grow and enjoy tomatillos.

For recipes and information you would like to share please email jenniferjanewildman@gmail.com

Picture on this page courtesy Kayo Wildman



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“PROMOTING AGRIBUSINESS DEVELOPMENT IN NORTHERN BELIZE”

Onions, Sheep, and Honey A Winning Combination

By Sergio Omar Gomez



In an effort to minimize the economic impact to northern Belizean farmers by the loss of their preferential sugarcane market, the Food and Agriculture Organization (FAO) of the United Nations in collaboration with the Ministry of Agriculture launched a 30 month project in January 2015. The project, “Promoting Agribusiness Development in Northern Belize” has been funded by the European Union. The economic diversification into growing onions, raising sheep, and making honey encompasses micro, small and medium enterprises in northern Belize. The three-pronged approach is aimed at reducing poverty and improving livelihood opportunities for the rural population in Corozal and Orange Walk and includes 150 onion producers, 100 beekeepers and 100 sheep farmers.

Onion production:

Dr. Jerome Thomas, FAO Representative in Jamaica, The Bahamas and Belize says that the farmers who are being exposed to the value chain approach are learning about all the stakeholders that operate within the industry from input suppliers to the final market consumers. Farmers from San Carlos, Orange Walk and Patchakan, Corozal were trained in best practices in onion production, harvesting and post-harvesting which led to reduction in the cost of production and increases in the farmer’s income. Based on the success of that group of 28 farmers, project leaders are getting ready to host more field schools in Corozal and Orange Walk where onions thrive. There’s plenty of room for expansion. The size of the fresh onion market in Belize is estimated at 108,000 lbs per week, or approximately 5,616,000 lbs per year. Varieties of large healthy red, white and yellow onions produced in northern Belize were on display at World Food Day. In preparation for the new onion season, an



onion storage unit has been designed and will be constructed based on previous consultations with a post-harvest expert from Trinidad. The unit will be built in San Carlos, Orange Walk and will be ready for the next harvest season. The storage unit will allow the supply of onions to be extended to a year-round product of Belize.

Sheep raising:

According to a study by Martin and Manzano in 2010, approximately 800,000 hectares or about 38 % of Belize’s total land area is considered potentially suitable for farming and raising livestock. However, only 9.7%



of the land (about 78,000 hectares) is used for agricultural practices. The FAO project is increasing that percentage not only for onion production but also sheep farms. In preparation for the importation of 25 ewes and 5 purebred Katadin rams from Yucatan, Mexico, sheep farmers in Corozal and Orange Walk were trained how to improve their pastures and forage bank to maximize nutrition for their sheep. The Yo Creek Agriculture Station serves as a demonstration unit for showcasing the best pasture and forage management and sheep husbandry practices and giving farmers the opportunity to observe how the entire system works and how to replicate the system at their farms.

Honey production: Farmers as well as extension officers are learning about beekeeping and honey production. Mr. Franklin



Perez of Costa Rica is conducting an in-depth practical course on beekeeping, hive management, good honey manufacturing practices and essential equipment, value-added products, and traceability. In addition to learning new beekeeping technologies, the beekeepers are being supplied with training equipment, hive tools and equipment and flowering plants in an effort to boost the industry and increase local honey production.

By the end of the project in June, 2017, farmers in other regions will also benefit from the training in northern Belize as the extension officers and oversight committees expand their scope.

Editor’s Note: Sergio Omar Gomez is the National Value Chain Coordinator for the FAO’s agribusiness development projects in northern Belize. He may be reached at <sersgiomar.gomez@fao.org> or at + 501-631-3389.

Industrial Hemp Medicine for the Soil By Karin Westdyk



Since the 1800s people traveled for miles to a dairy farm in Taranto Italy. It was famous for producing some of the best cheeses and dairy products in the country. But in 2008 the farm was ordered to destroy all its animals because tests showed that they were no longer fit for human consumption. They were contaminated with nickel, lead and other toxic substances emitted from a nearby steel mill. Farmer Vincenzo Fornaro had to decide whether to abandon his

farm or stay. He decided to stay and face the huge task of cleaning his soil. After much research, he gained permission to plant industrial hemp to absorb the toxic substances from the soil and neutralize them. Other farmers followed suit and today there are over 100 farmers in the area planting hemp to clean up their land. The planting of industrial hemp in the region has also brought new investments to the area. The first hemp processing plant in southern Italy transforms the hemp used to clean the soil into fiber to make shoes, bags, clothing and construction materials.

Hemp was also widely used for environmental rehabilitation in the Ukraine after the 1986 Chernobyl nuclear disaster. After planting a variety of plants around Chernobyl to help leach the radiation from the soil, hemp was found to be the most effective phytoremediation* plant used. It was subsequently planted widely throughout surrounding communities where radiation levels were abnormally high.

Since the Fukushima nuclear accident in 2011, scientists are not only finding radioactive emissions and toxic metals concentrated in the soil, plants, and animals of Japan, but also along the entire west coast of the North American continent – from Canada to Mexico. Industrial hemp may well be the only solution for sopping up radiation from these contaminated soils. Many plant scientists are claiming that hemp could benefit hundreds of thousands of sites throughout the world containing soils and ecosystems damaged by human intervention.

It is important that we also find ways to deal with heavy metal pollutants left on agricultural land by the use of petroleum based chemical pesticides and fertilizers. According to Chemik International, a scientific journal for engineers in the chemical industry (CHEMIK 2014, 68, 10, 837–842), cadmium, found in phosphate fertilizers, is considered extremely toxic and mutagenic. It is known to cause kidney and bone disease as well as anemia. Along with other heavy metals, it is easily absorbed from the soil into plants we consume -- especially into large leafed vegetables, as well as tobacco.

Traditional treatments for heavy metal contaminated soils are technologically challenging. Whether done on-site, or removed and treated off-site, these methods have proven to be prohibitively expensive, requiring many steps and lots of labor. Thus, many sites are simply abandoned and left unfixed and not only useless, but also posing a health risk as contaminated soils leach into ground water. Industrial hemp has demonstrated its ability to break down and filter cadmium and other heavy metals left by chemical fertilizers and pesticides.

Without impacting plant growth, yield or quality of fiber, contaminants left in the soil are absorbed and stored in the deep roots of hemp, which can reach 8 feet below ground. Knowing that hemp can be used to extract the toxic substances in soil is itself an amazing discovery. But, as an added benefit, the stems and seeds can be turned into biodiesel fuels, industrial lubricants and varnishes, insulation, construction materials, paper, plasticized or composited materials and more. Yet, due to disinformation and confusion surrounding industrial hemp, growing it is still prohibited in most places.

The efforts of organizations such as the Hemp Industries Association (HIA), a non-profit trade association representing businesses, farmers, researchers and investors working with industrial hemp, are helping to change attitudes about the maligned plant. Their mission is to educate the public about the exceptional attributes of hemp products, and their task has been to facilitate the exchange of information and technology between hemp agriculturists, processors, manufacturers, distributors and retailers, and to advocate and support socially responsible and environmentally sound business practices. Organizations with similar missions are the **European Industrial Hemp Association (EIHA)**, the USA-based National Hemp Association, the Australian-based Industrial Hemp Association NSW and the Victoria Industrial Hemp Association, The Canadian Hemp Trade Alliance, and the International Hemp Association, to name a few.

As a proven, valuable tool in the fight to repair human-inflicted damage to our soils and ecosystems, hemp could potentially benefit soils damaged by petroleum-based synthetic chemicals throughout Central America, where they have been heavily marketed and over-used. As is so often the case, restrictions on hemp cultivation due to disinformation, misunderstanding, and confusing it with marijuana (Industrial hemp is not psychoactive.) precludes any large-scale operations from being implemented, and the contaminated sites are largely left unremediated, leaving food crops, soil, and water contaminated.

However, this could change, with growing widespread recognition of Article 28 of the 1961 United Nations Single Convention Treaty, an international treaty designed to prohibit production and supply of specific drugs worldwide. Article 28 clearly exempts industrial hemp from these regulations stating, "This Convention shall not apply to the cultivation of the cannabis plant exclusively for industrial purposes (fibre and seed) or horticultural purposes." Article 27 of The Vienna Convention governing the law of treaties acceded to by Belize in 1981, stipulates that local governments cannot impose laws that would impede or restrict adherence to provisions of any UN convention or treaty. Twenty-seven countries are now growing industrial hemp with impunity largely due to Article 28 of the Single Convention Treaty and Article 27 of the Vienna Convention.

Recognizing that industrial hemp is not the same as marijuana is key to the future of a plant that has enormous environmental, economic, health, and commercial potential.

In the next issues, we will further explore other uses of industrial hemp including medicine, food, and construction materials. Our previous issue contains an article on biofuels from hemp plus the history of its prohibition.

**Phytoremediation is a process that takes advantage of the fact that green plants can extract and concentrate certain elements within their bio-system. Some plants can grow in metal-laden soils, extract certain metals through their roots, and accumulate them in their tissues without being damaged. In this way, pollutants are either removed from the soil and groundwater or rendered harmless. This complex filtering system would prove to be effective in extracting pollutants and leaving only the natural, fresh soil.*

World Food Day

By Gary Ramirez



On 16 October 1945, 42 countries assembled in Quebec, Canada, to create the Food and Agriculture Organization of the United Nations (FAO). Their goal was to free humanity from hunger and malnutrition, and to effectively manage the global

food. FAO celebrates World Food Day each year on 16 October to commemorate the founding of the organization in 1945. Events are organized in over 150 countries across the world, making it one of the most celebrated days of the UN calendar. These events promote worldwide awareness and action for those who suffer from hunger and for the need to ensure food security and nutritious diets for all.

In Belize, World Food Day activities are coordinated by the Ministry of Agriculture in collaboration with its partners in development such as Ministry of Health, Ministry of Education, Pan American Health Organization (PAHO) etc. Planning and preparation for the event is usually coordinated by the World Food Day committee and the one day fair is held typically on the campus of a selected high school or educational institution. In recent years, the event was hosted by Independence High School in Independence village (2013), ITVET Belize City (2014), Mopan Technical High School in Benque Viejo Del Carmen (2015).

This year, however, the annual World Food Day fair was held at the National Agriculture and Trade Showgrounds (NATS) in Belmopan as part of the ministry's effort to expand the use of the showgrounds and highlight recent investments and developments such as the highly popular NATS garden/training center. The event was held on Friday October 14, 2016 under the theme "Climate is changing; food and agriculture must too".

In keeping with the Ministry of Agriculture's support to youth in agriculture, field visits were conducted to a number of schools in the Belmopan area to identify possible areas for collaboration and assistance with either establishing or improving their school gardens. This type of assistance is usually granted to the World Food Day host institution but since this year's celebration was scheduled to be held at the show grounds, representatives of the Ministry of Agriculture in early October conducted evaluations of selected schools to be a part of the project.

Based on the evaluations, a project proposal was developed and approved to assist five schools: Our Lady of Guadeloupe High School, Belmopan Baptist High School, Belmopan Comprehensive School, El Shaddai Primary School, and the National 4H Youth Development Center. The project includes establishing climate-smart agriculture (covered structures, rainwater harvesting, open field irrigation and fertigation systems, etc.), gardens in line with the theme of this year's World Food Day celebration. Memorandums of understanding (MoUs) between the Ministry of Agriculture and the five participating schools were signed during the World Food Day opening ceremonies. In addition to the Bz\$19,679.14 to be invested, the MOUs also include technical support which will be provided to the schools for the next 12 months to facilitate the sustainability of the project. Procurement of material and supplies are currently underway and physical implementation of the project is expected to start by October 24, 2016.

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BEL-CAR Updates

Following 2 years with challenging drought conditions, western Belize's prospective 2016 corn harvests on roughly 30,000 acres looked bright with expectations for restoration of prior corn inventories which had enabled regular exports. Hurricane Earl's arrival, on August 3rd dashed those plans. The biggest surprise of the storm was that the winds which hit the coast at 60-80 mph and normally decrease as they pass over land, apparently gained strength. Several Spanish Lookout farmers felt that winds on their farms exceeded 100 mph. The Spanish Lookout Community Office shortly after the storm estimated an approximately Bz\$20 M loss in row crops. Barton Ramie, the most fertile belt in Spanish Lookout along the Belize River, was 40% flooded and what was not flooded was wind damaged. At Kitty Bank an even higher percentage of cropland was flooded. When flooding is brief (less than 5 or 6 hours), the corn quality is likely reduced to #2, but is still usable for animal feed. Corn underwater longer is not salvageable. Corn planted along the Sibun River, close to the former Hummingbird Hershey operation, were some of the first planted and were close to harvest time when the storm hit. Corn there which was knocked down remained down resulting in a stretched out harvest time from the normal 4 days to over 2 weeks. Expected yields of over 50-60 bags/acre were cut in half. By mid-October, Bel-Car's estimate of western corn loss was about 50% - including quantitative and quality losses.

Bel-Car continues to search for a new hybrid corn variety to replace the favored but discontinued Pioneer dark yellow seed used for local and exported corn meal. A good 'cornmeal corn' yields 68 to 72% of cornmeal, while others may yield only 45% cornmeal. The balance is a lower priced by-product used for animal feed. That seed unavailability is why the 'A' quality yellow corn on our centerfold prices page has been listed as N/A (not available) since August 2014. Farmers are excited about a new variety that has had limited testing in Belize. To date, BAHA has approved it only for trials but are in process of a full risk analysis. Farmers are hoping for a positive decision which would allow its importation for widespread commercial use in the 2017 corn season.

Bel-Car remains positive that the balance (approximately 70%) of local black eye peas will be sold before the 2017 bean harvest. Madagascar's unusually high yields and high quality of their 2016 black eye peas has had a negative effect on other export-minded producers such as Belize.

Spanish Lookout Community Office on Poultry

The Spanish Lookout Community Office reported at least 12 poultry barns, all newer buildings, lost their roofs. They attributed the losses on newer buildings to the nails going into the boards holding the rafters which accumulated rust over time resulting in an adhesive effect. Also, many roofs were constructed with nails rather than screws. On the Sunday following Earl, a small narrow tornado passed through some of Spanish Lookout, popping roof screws again, and in at least one case picking up and smashing a sheep barn through a wall. For the chickens inside the poultry barns, young chicks suffered the highest losses. In some cases where the roof remained, horizontal rain and cold temperatures created a fatal combination for birds without full feathers. Ministry of Agriculture (MAFFESD) reported a loss of \$550,000 in chicken barns and \$100,000 in live chicken losses for Cayo District. These losses are assumed to be mainly in Spanish Lookout where the poultry industry is centered.



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Chicken Breast	4.95			7.88	2.99
Chicken Legs	3.30			2.93	2.67
White Sugar	1.10				0.84

History of John Deere By Julian Thiessen



The humble beginnings of John Deere, the leading manufacturer in the agricultural industry, date back to the early 1800's. According to *Brittanica, 2015*, John Deere, the founder of the company, was born in 1804, in Vermont, and became an apprentice to a blacksmith at a very young age. He was a hard worker and known as a perfectionist. He once stated, "I will never put my name on a product that does not have in it the best that is in me"

Eventually he opened up his own blacksmith shop; however to find more income to provide for his family he left Vermont and settled in Illinois where he did repairs as a blacksmith for the local pioneers.

It was in Illinois where he saw pioneers struggle with their wooden and cast iron plows as they tried to plow the heavy and sticky soil in the area. John Deere decided to fashion himself a steel plow out of a broken saw blade which turned out to be the first self-scouring steel plow. The dirt didn't have to be scraped off the blades; the plow made farming for the pioneers more efficient. This helped revolutionize farming for these pioneers and the popularity of this innovative plow grew.

In time John Deere imported steel from England and began larger scale manufacturing. (Gale Encyclopedia of US Economic History, 2000)



John Deere suffered a tragedy when his oldest son died from a flu epidemic. His younger son, Charles Deere, finished his school and came back to help out with the family business. John Deere brought Charles on board and together they formed an innovative team. In 1868 the Deere Company was incorporated and in 1876 the ever-popular leaping deer was trademarked. Charles Deere, an astute business man, came up with the idea to go directly to the farmers to find out what they needed. The close interaction with farmers led to diversification and continued innovation and to John Deere, Inc. becoming the

world's leading supplier of farm equipment. Today John Deere is a multi-billion dollar company with over 67,000 employees but still strives to honor the legacy of John Deere, the perfectionist.



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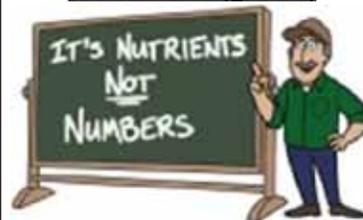
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Going Biological...Continued from page 5

DETERMINATION & INGENUITY

On March 28, 2015, I met Bollinger at Missouri University Bradford Research Farm where I was teaching at a biochar symposium sponsored by Phil Blom of Terra Char. The evening before, Bollinger quizzed me all through dinner. The next day, after I taught two hours, he had a steady stream of questions.

He had made his choice and set his course. Bollinger did his homework to use biologicals in large-scale operations. His first corn planting was 1,000 acres. He had to answer his own questions, follow his own strategy, design his own equipment and use his own resources. He knew that no off-the-shelf solutions exist. His burden was to make this work — and convince his father. In his heart and gut, Bollinger knew a biological path is key to 21st century farming. I visited Bollinger on his farm after Thanksgiving to hear about his progress.

First, Bollinger showed me an impressive assembly of equipment, made to operate as a unit to deposit precise, narrow bands of biological nutrients. With extensive equipment knowledge and savvy mechanical expertise, he built apparatuses to perform a miracle on near-lifeless soil: instantly install the foundation of a healthy soil food web. Bollinger's genius isn't just building complicated machinery. Rather, he figured out how to mix nutrients precisely in the root zone with minimum disturbance. Emerging seeds find nutrients and symbiotic fungi all around budding roots.

"These products don't exist on the market," said Bollinger.

We know biochar, trace elements and microbes are potent in soil — individually, but much more so when mixed together. Can carbon-smart, microbe-friendly soil stewardship be integrated into commercial farming? Can this be easy, economical and feasible for large-scale farmers?

"At front, hanging on the tractor, two yellow side-saddle tanks hold liquid nutrients and microbes," said Bollinger. "We inject this as a band 4-inch off-center. We stagger-step fertilizer in bands to chase roots to grow outward. Liquids include anything from fertilizer to fish meal. We tried different products, all kinds of goodies: humates, humic acid, sea minerals, microbes, fish meal and biochar powder. I wanted to give everything a fair shot in our conventional way and gradually introduce biologicals."

Most of the microbes that Bollinger applied were in liquid form. One lab-brewed blend contains 16 bacteria and nine fungi with support nutrients like humates and trace elements, including free-living nitrogen-cycling bacteria and phosphate-dissolving fungi. The goal is to get them under the surface, in moist, cool soil with nutrients and metabolites, to assure they proliferate.

FEED SOIL MICROBES, NOT PLANTS

Biochar, however, isn't a fertilizer or nutrient and doesn't break down in soil — maybe 3 percent — but greatly boosts fertilizer efficiency. Char is shelter, not food. Microbes don't eat this super-stable biocarbon; they live in it. Burnt biomass is community infrastructure to house microbes with plumbing for water, thin-film wiring for power and nutrient shopping malls. Biochar also curbs nutrient leaching and outgas.

"Montag is our dry fertilizer cart," said Bollinger. "We get a blend that meets the needs of our soil test. We mix in anything from biochar fines to crab meal, shrimp meal, SEA-90, humates. The Dawn unit does an excel-lent job mixing fertilizer, char — anything that goes through the hose — and incorporates them into soil."

Bollinger said that with precise strip-till application and biological amendments he had the confidence to cut dry fertilizer use in half.

"We reduced our liquid fertilization as well. We didn't see any lag. If anything, we saw a boost."

Dry ingredients are agitated and sucked by vacuum hose to injectors on Dawn cultivators and land in soil. Biochar and biologicals were supplied by Terra Char, a 3-year-old biocarbon business near Columbia, Missouri. Owner Phil Blom delivered a semi-load of biochar for Bollinger's soils, plus minerals, microbes and metabolite. Blom offered guidance and support throughout the growing season.



DAWN CULTIVATORS

Behind the tractor ride 16 Dawn cultivators, each with injectors for dry, then liquid amendments.

"I use Dawn because we have sandy ground," said Bollinger. "Its waffle blades are more vertical till, not deep tillage. It moves residue out of the way, so it's easy to plant through. I don't deep till, like with shanks, since this makes a trench that fertilizer tends to go into and increases leaching."

Bollinger said one side gets dry fertilizer and then, a few inches off center, the liquid band is applied, allowing for precise nutrient placement. Soil between rows isn't disturbed.

"Dawn keeps soil within the unit. Eventually, dirt hits it, flies up where dry and liquid lines come in. Then it hits the lead edge of a disc blade that fills up, then turns it, like mixing potting soil with your hand. Dawn fluffs soil to make a seedbed. Soil warms quicker in spring to speed up planting dates. It's a perfect tool to closely place fertilizers. I love how Dawn handles residue and keeps it confined."

The last part of each Dawn unit are "swirlers" — two rolling wheels with inward-facing fingers that lift and stir soil to mix ingredients and aerate soil in 4-inch slots. The rig's main benefit is that it can concentrate nutrients and inoculants in soil where seeds will germinate, not broadcast wide, but thin, across the field. Bollinger gently injects his microbes in a dark, moist subsurface world, not exposed to hot sun and dry wind. Precision placement and blending assures close proximity of nutrients for fast-acting effects.

Going Biological...Continued on page 16

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STRIP-TILL



Tillage degrades soil, burns out carbon and disrupts microbes. Why burn fuel tilling if worms pull biomass into their tunnels? Let worms do the work.

"I call this 'strip-till,' or 'conservation till' because we do a percent of tillage," said Bollinger. "Each year, 20 percent of a field is tilled in 6-inch wide strips, to leave a nice mat of residue on 80 percent to suppress weeds. When we irrigate, or get rain, covered soil stays moist longer under thick residue. Residue was gone by end of July. I was fascinated to see how heavy, thick residue disappeared quickly. I call this 'carbon-smart' or 'biological' farming. It's a hybrid — combining both traditional and modern. In my life, traditional became NPK, herbicides, lots of tillage and all."

Strip-till bands are spaced 30 inches apart. Each year, guided by GPS, Bollinger will move his rig over a few inches to inject another band of biochar plus inoculants, minerals and nutrients. In five years, he will deposit this mix all over his field and will need to use very little chemical fertilizer. Meanwhile, Bollinger is assured steady income, larger yields, higher crop quality and improving fertility as soil regenerates.

SEED STARTER

Bollinger described another biological application at planting: "We also drench with a seed starter. We apply biological nutrients in furrow, right on top of seeds. As soon as a seed kicks out of its tiny nursery sack, I want it in a happy environment. It's another stair-step to optimize germination and seed growth. I only use biological products on top of seed. Later, we sidedress 8 inches off the row — another stair-step. At each stage of growth, we key in nutrients before it needs them, to sit there waiting. We use a lubricant such as talc to help seeds flow and not lodge. This year, we used very fine, 40-micron biochar powder and mycorrhizal inoculant as lubricants. We get beneficial fungi and biocarbon right by the seed, in direct contact. Spores definitely stick to char particles. How much good it did, I don't know, but it can't hurt. I know our seed germination was off the charts this year."

The seed on the farm is non-GMO. "We've grown non-GMO corn about 15 years; never got into GMO corn. Our soybeans are non-GMO. We don't believe in GMOs, and getting premiums for non-GMO kept us on the train. Now, later in life, I see the effects GMOs have. Farmers who grow GMOs must use herbicide, and weeds are now becoming resistant. So I'm proud we grow non-GMO crops. To feed grain to cattle, I feel non-GMO is better."

Until nutrients are abundant and soil is fully mature, soil nutrients must be supplemented by seed treatment, foliar feeding, root drenches and sidedressings. The most critical extra feeding is starter food to wake up embryos and stimulate root growth.

Bollinger used a Terra Char formula to blend biochar powder with kelp, humic acid and bacteria. Spores of endo-mycorrhizae initiate symbiosis with infant roots. Fishmeal is amino acid nitrogen for emerging embryo and colonizing microbes. SEA-90 unrefined sea minerals offers complete trace elements with alkaline charge in balanced, fully soluble form. SEA-90 is a fast-acting "igniter" to jumpstart soil biology, which then digests rock into new soil. The same full-spectrum minerals are in other

sea products, each packed in different chemistry: kelp (carbon), fishmeal (amino acids), shrimp meal (protein), crab meal (chitin).

SIGNS OF HEALTHY CORN

"I planted a typical population of 34,000," said Bollinger. "Years past, I planted 28 to 30,000. In strong or weak parts of a field, my planter can change populations. This corn was 33,500 to 34,000. Typically, seed companies tell you to push population up until you get tip back — corn will grow, but not produce complete ears. My corn had full ears with no tip back. Should I increase population more? I don't know, but greater population definitely didn't stress plants."

The corn came up very uniform with nearly 100 percent germination. "What was really interesting was the health of plants when they came up. Often corn comes up in its early stage yellow. You see purpling in inclement, wet conditions — phosphorus deficiency. I didn't see any, and we didn't apply in-furrow fertilizer other than pre-planting strip-till. Phosphorus was in dry fertilizer. In the past, we put phosphorus right in furrow. This year all we did was add mycorrhizal fungi, which find and move phosphorus in soil. Did it have an effect that quickly? I don't know, but we didn't have purple corn."

In early June, I received a photo of Bollinger in head-high corn. I couldn't see his face, but I knew he was smiling. His corn was 16 inches taller than his neighbors', with thicker, longer leaves that were distinctly darker green. His corn had more chlorophyll making more sugar to grow faster. Bollinger knew he made the right choice to go carbon-smart and grow biologically.

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3-Day Introductory II Kinsey/Albrecht Soil Fertility Workshop for Crops & Pasture Course Instructor: Neal Kinsey

Feb 27-March 1, 2017 at the Conference Room at
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(Follow-up course to Neal's Intro I course given at
UBCF in 2015 & 2016)

- Day 1 - Micronutrient Considerations**
Specifics about cobalt, molybdenum, boron, iron, manganese, copper & zinc
 - Day 2 - Micronutrients and N-P-K-S**
chlorides, selenium and silicon testing
 - Day 3 - Finish N-P-K-S** plus sodium and magnesium. Calcium as time allows
- Specifics with actual examples from soil tests**
This is the farmers' favorite course!

The cost for the 3-day course is \$600. Bz D, which includes course notebook, lunches and refreshments at morning and afternoon breaks. For registration contact: David Thiessen of Thiessen's Liquid Fertilizer at **670-4817** or email: thiessenliquid@gmail.com

"The corn, for its early stage, was taller than it should be," he said. "You can see in photos, healthy corn has a glossy, waxy look. See how wide the leaves are. And inner veins all consistent color. Not much striping that shows deficiencies. It's just a healthy plant — as healthy as corn gets."

Early on, the corn had wider, longer leaves.

"You can go in a field and tell if life is going on, or if it's hanging onto life. Times of stress, like going without rain, are hard on people. You know it stresses plants. But this year, our plants weren't stressed the way they should have been. A few fields, some non-irrigated sand, never had a bad day. They held on until it rained."

Bollinger's shaded soil needs no herbicide, like conventional no-till. Yet, three growing cycles are needed to mature soil's full digestive power to rapidly recycle crop biomass.

CHEAP LABOR

"I was on hands and knees crawling through the crop, looking at soil and plants, at different bugs, different insects, different fungi — lots of life in that soil," said Bollinger. "You can see earthworms. Microbes, you can't see. I expected to see mycorrhizae signs in soil after a test I did last winter with seedlings in pots. I overdosed with spores and saw thick white fungal fuzz like snow on the soil. We're dealing with living organisms, and you've got to treat them right, or they won't treat you right."

Bollinger has learned to think holistically. He knows there are no single-shot solutions. His concept of soil stewardship now embraces the whole community of living organisms that inhabit healthy, fertile soil. Fighting pathogens is secondary strategy, after encouraging roots, enlisting microbes as allies and a complete menu of minerals.

On July 4th, Bollinger sent me a photo of nearly ripe ears. I'm not familiar with southern Midwest corn growth, yet this seemed early. I was told that it was unprecedented.

"End of June, corn tassel starts here," said Bollinger. "Sweet corn is earlier. We start to get sweet corn July 4th. Around the 13th, we usually can sweet corn. We planted late, so I didn't expect such early tassels and ears. I'd say the corn was two weeks early."

On July 16th, Bollinger emailed a photo of three ears.

"Ears were 43 long, majority 16 around, many 18. Typical all over the field. In the past, it might be 12 or 14, a few 16s. But this year, 16 was the norm. Two extra rows on each ear add to overall yield."

Corn ears by July 4th fed my faith that Bollinger's 4-inch strips would work, but photos of roots blew a fuse in my imagination. Thick beards of white roots erupted from the base of stalks. I never saw such dense, fine roots. They knew nutrients were there and saturated the zone with roots to suck up the goodies.

In photos, black grains of biochar are visible. Each absorbs eight times its weight in water, adsorbs immense amounts of mineral ions, held loosely, ready for H+ exchange with root or microbe. Biochar's special benefit is to hold anions (nitrogen, phosphorus) as well as cations to keep them near roots.

Bollinger was thrilled by the remarkable roots — and mystified.

"I was scouting for insects the first day I saw roots 6 inches long. Hard to say how long they got, because they twisted and turned, but some grew to 3 feet. This was widespread throughout the field. In fact, the whole 50 acres looked that way — like spaghetti across the field."

They had a wet spring and timely rains at tassel helped.

"Later, we bridged gaps with irrigation. Foliar sprays to put on nutrients help, but aren't a full watering. We used a moisture probe this year to monitor water use. We didn't over-water, but once it got to a certain point, we kept it at that range. Seems like the crop was very efficient with water."

Weed and insect pressure also decreased.

"Residue in middles suppressed weeds. Corn grew so fast, canopy shaded the middles, and weeds didn't grow. Not much bug pressure, either. One zone — a high-sand ridge — a bit more."

Consistently well-nourished plants don't attract pests. If pests do infest, vigorous plants outgrow bug damage. Once during the year, Bollinger sent me a question about an insect pest. I gave him non-toxic remedies to discourage bugs and strengthen plants. He later reported bugs ate the weeds and hardly touched his crop.

BLENDING BIOCHAR

Estimating biochar application rates was difficult. Field conditions, complex calculations, equipment malfunctions, blending uncertainties, changing recipes and other variables made a precise rate for each field elusive. A minimum of 2 percent biocarbon is needed to sustain strong microbe communities, and Certified Organic requires 4-5 percent carbon. I suggest half as super-stable biochar and humus, another 2.5 percent as digestible carbon, like crop stubble, compost, manure, etc. But 2.5 percent biochar tilled in 6 inches is 8 tons per acre — at \$.50 per pound, and \$8,000 per acre, and that is too costly for farmers.

Going Biological...Continued on page 34

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Agriculture Prices at a Glance- \$\$\$\$\$\$ NOVEMBER 2016

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	Czi	1.50-1.70	OW	1.90-2.10	Bze 1.70
750-1100 lbs	L/H	Cy	1.90	SCr	2.00-2.05	Tol 1.50
Weaner steers	L/H	Czi	2.00	OW	2.40	Bze 2.10
"		Cy	N/A	SCr	2.05	Tol 2.10
Breeding heifers		Czi	N/A	OW	2.25	Bze 1.70
"	L	Cy	1.80	SCr	N/A	Tol 1.90
Cull cows	H	Czi	N/A	OW	1.40	Bze 1.20
"	H/L	Cy	1.10	SCr	1.40	Tol 1.50
U.S. CATTLE						
U.S. price - corn fed - 1000-1200 lbs	L	US\$ 1.01150				
U.S. price - feeders 600-800 lbs	L	US\$ 1.21875				
BELIZE HOGS						
Weaner pigs - 25-30 lbs - by the head	L	100.00 80.00				
Butcher pigs 160 - 230 lbs, per lb	L	1.85 1.65				
BELIZE SHEEP						
Butcher lambs - live per lb	S	2.75 2.50				
Mature ewes - live per lb	S	2.00 1.75				
BELIZE CHICKEN						
Wholesale dressed, per lb (Sp Lkt)	S	2.38				
Wholesale dressed, per lb (BI Crk)	S	2.40				
Broilers - live per lb (Sp Lkt)	S	1.22				
Broilers - live per lb (BI Crk)	S	1.24				
Spent hens per 4 lb bird (Sp Lkt)	H	4.50				
Spent hens per 4 lb bird (BI Crk)	S	3.50				
CITRUS						
Oranges per lb solid, est. final	H	2.5929				
Grapefruit per lb solid, est. final	H	2.5498				
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			
Belize yellow corn, bulk (Spanish Lookout)	S	N/A	.2415			
Belize yellow corn, bulk (Blue Creek)	H	.28	N/A			
Yellow corn/local retail (low volume, Sp Lkt)	L	.29				
Belize white corn, (Cayo)	S	.45 (low volume)				
US Corn, #2 yellow	L	US\$3.865 /56 lb bushel				
US organic, #2 yellow corn feed grade	H	US\$7.50-10.00 /56 lb bushel				
Belize soy beans (Spanish Lookout)	H	.50	N/A			
Belize soy beans (Blue Creek)	S	.54	.49			
US soy beans, #2 yellow	L	US\$10.18 /60 lb bushel				
US organic, #1 feed grade soy	H	US\$17.50-19.00 /60 lb bushel				
Belize milo (Spanish Lookout)	S	.20-.21				
Belize milo (Blue Creek)	H	.22				
Red kidney beans (Spanish Lookout)	S	.70	.60-.65			
Red kidney beans (Blue Creek)	S	N/A				
Black eyed peas (Spanish Lookout)	L	.50	.38			
Black eyed peas (Blue Creek)	L	.50	.30			
Paddy rice per pound (Spanish Lookout)	S	.40-.53 farm price, dried				
Paddy rice per pound (Blue Creek)	L	.35-.45 farm price, dried				
HONEY						
Honey, 5 gal (approx 60 lbs)	S	\$150.00 (CQHPC)				
Honey, speciality, 5 gal (approx 60 lbs)	S	\$150.00-250.00 (Cayo)				
SPECIAL FARM ITEMS						
Eggs - tray of 30, farm price	L/H	4.58 (Sp Lkt)	5.70 (Blue Creek)			
WD milk per lb to farmer	L/H	contract .56; non contract .53				
Raw milk (farmer direct sales)	S	8.50 gal (5 gal + 8.00 gal)				
CACAO						
Cacao beans (TCGA & MMC) /lb	S	3.00 dried fermented				
Cacao beans (TCGA & MMC) /lb	S	1.20 wet beans				
US Cacao beans, metric ton	L	US\$ 2,680.12				

Birds of Belize

The Art of Taxidermy Exhibit

By Dr. Stephen Zitzer and Dalena Lesso



The Belize National Institute of Culture and History (NICH) in collaboration with Dr. Stephen Zitzer launched an exhibit at the San Ignacio/Santa Elena House of Culture on Friday evening October 7, 2016 titled *Birds of Belize and the Art of Taxidermy*. The exhibit displays 30 plus bird species native to Belize that were provided by various official Belizean wildlife conservation, protection, healthcare and rehabilitation agencies in cooperation with the Belize Department of Forestry. Dr. Zitzer did all the skinning, stuffing and posing of the specimens, most of which were victims of collisions with vehicles; many died of unknown causes and several were known to have been shot. Additionally, Dr. Zitzer has a permit with the Belize Department of Forestry to legally collect dead animals and to perform taxidermy, but not to collect or kill live specimens. Except for a limited season for a few relatively large game bird species including ocellated turkeys and chachalacas, all birds in Belize are protected including all the species in the exhibit. The exhibit has a relatively high percentage of

species of birds of prey, including nocturnal (active at night) species dominated by owls and diurnal (active in the day) species that includes hawks, falcons, forest-falcons and fish eagles or ospreys. However, their dominance in the exhibit is correlated with the fact that these birds are much more visible and recognizable when they are injured, but the fact they are often hit by vehicles does contribute to the record of their distribution in Belize. The other parts of the



exhibit highlight several species of both fresh and marine aquatic habitats, well-known residents of the mainland including the national bird of Belize, the keel-billed toucan, and several species that are migratory or part-time Belizean residents. Throughout the exhibit, many of the birds have examples of the types of foods they consume including mice, bats, insects and other birds. Each species is also provided with a brief description of its total range, the habitats they prefer, their nesting, behavior and diets and threats to their future existence and possible roles for Belizeans to play to ensure their future in the "Jewel".

Dr. Zitzer combines 40 years of taxidermy work on thousands of specimens, over 50 years as a birdwatcher and artistic talent

to create life-like results. He and his wife, Dalena, spent several hundred hours over the past year and a half preparing the specimens for the exhibit. The ultimate goal of the exhibit is to showcase a small fraction of the incredible bird biodiversity of Belize that needs to be respected and protected in order to maintain a sustainable "Jewel". Consequently, at the



end of the exhibit on 9 November the specimens from the exhibit will be used for ecological and environmental educational purposes by the agencies that supplied the specimens. Dr. Zitzer resides permanently in Belize and will continue to provide taxidermy services when needed.

The exhibit is only possible because of the indispensable and enthusiastic help of Mrs. Lupita Ferguson, director of SISE, San Ignacio, Santa Elena house of culture and history.



The exhibit is available for viewing free to the public through November 9th.



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B A H A

BELIZE AGRICULTURAL HEALTH AUTHORITY

Presentation on Glyphosate to Pesticide Control Board Registration Committee



As a first step in the newly developed policy and procedures for re-registration of pesticides, the August meeting of the Pesticide Control Board Registration Committee (PCBRC) was a session to hear presentations by two groups of petitioners who are recommending a ban on glyphosate. The first group represented six organizations: Sustainable Harvest International (SHI)– Belize, Plenty Belize (PB) and Belize Organic Family Farming (BOFF), Belize Botanic Gardens (BBG), Pro Organic Belize (POB) and Belize Wellness Institute (BWI); the second presentation represented Southeast Watershed Alliance Group (SWAG).

The PCBRC of PCB staff and public sector representatives from Ministry of Agriculture (MAFFESD&CC) R&D Central Farm; MAFFESD&CC Commercial Imports, Central Farm; Plant Health, Belize Agricultural Health Authority (BAHA); Dept. of Environment (DOE); and Ministry of Health (MOH) listened to facts based on scientific, peer-reviewed publications, over 100 of which were given in abstract form to them.

Glyphosate has become one of the most popular herbicides in the world, with use dramatically increasing in recent years. Over 136 metric tons were imported into Belize in 2015. It is sprayed widely and freely in Belize to control weeds: under fences along roadways, in playgrounds, around gardens and walkways, around fields, under trees, and in orchards. It is used by major crop growers as well as home gardeners. It is easy to use and has been advertised as safe by the manufacturers. During the time from 1993 when it was approved for registration in the U.S. and now, data has been emerging that point to many health and environmental consequences resulting from the use of glyphosate formulations. For example, the inert ingredients and additives in the formulations have been shown to be 1000 times more toxic than glyphosate alone, the active ingredient on which past studies concentrated.

The fact that glyphosate was detected at all sample sites monitored for three years in the Maya Mountain Reserve in a study published in 2011 by Kristine Kaiser and the fact that 50 – 75% of aerially sprayed pesticides affect non-target organisms show the extent of potential glyphosate hazards to Belizeans.

The presenters cited many of the studies that link glyphosate formulations either directly or indirectly such as the food chain, vaccinations, and water to health conditions and diseases, some of which were not known until the use of glyphosate became commonplace: diabetes, thyroid and

liver function impairment and cancer, infertility, birth defects, autism, depression, dementia and Alzheimer's, breast cancer, non-Hodgkin's lymphoma, urinary/bladder cancer, gluten intolerance, digestive problems and chronic kidney disease. A study in Sri Lanka that linked chronic kidney disease to the use of glyphosate prompted that country to become the first to ban glyphosate.

When glyphosate formulations affect key species, whole ecosystems are affected – starting with soil. Root colonization and soil populations of the fungus *Fusarium* and selected rhizosphere bacteria greatly increase after glyphosate application. Glyphosate destroys earthworms, degrades soil micro-organisms, binds to essential minerals and organic soil particles and inhibits protein synthesis which leads to cell death in all plants, fungi and many bacteria species. The toxic effect of glyphosate formulations can impact plants and animals directly by exposure to spray or indirectly by changes in the eco-system; chronic effects are caused by long term exposure in the eco-system. Physiological and behavioral effects on birds and honeybees have caused declines in their population. Studies show the negative impact of glyphosate formulations on the ecology of freshwater systems includes micro-organisms, algae, crustaceans, other aquatic invertebrates, fish and amphibians.

The compelling case for banning the use of glyphosate formulations in Belize stresses the need for making Belizeans aware of the toxicity of the herbicide and for farmers and researchers to find a replacement. The PCBRC asked the presenters for their help in the next steps to be taken in the review and re-registration process.

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Successful Cattle Auction at Iguana Creek, Spanish Lookout By Cornie Friesen of JF Brahman Ranch

JF Brahman and KR Ranch jointly hosted a cattle auction at the roadside cattle facilities of Joe Friesen Jr in Iguana Creek, Spanish Lookout on September 10th.



Fifty-seven individuals registered to bid on the livestock. The cattle were sold to 16 different buyers coming from Spanish Lookout, Hummingbird Highway areas, and Lower Barton Creek.

Fifteen Brahman breeding bulls were sold, bringing an average of \$3,833 (3.25 /lb) per bull. The top selling bull, from Menno Reimer's KR Ranch brought \$5,400.

Seven Brahman breeding heifers (pregnant) were sold at an

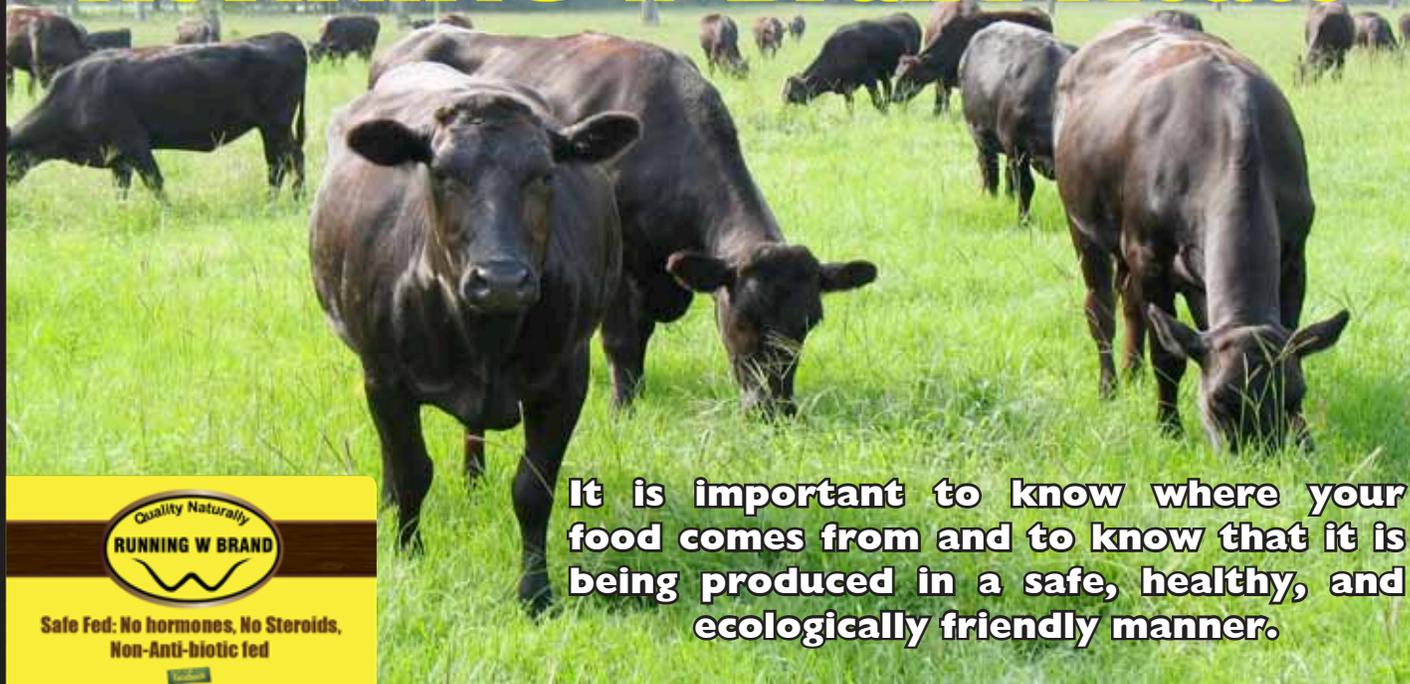
average of \$2,130 (2.15 /lb), and the top price heifer was sold by HD Ranch (Glen Dueck). JF Brahman (Cornie Friesen) sold 8 bulls averaging \$4,038 with their highest price being \$4,800.

The auction drew a crowd of about 250 people coming from Corozal, Blue Creek, Shipyard, the Belize River Valley, Melchor de Mencos (Guatemala), Hummingbird, Bird Walk, Springfield, Lower Barton Creek, Spanish Lookout and surrounding areas of Cayo District. The organizers were very pleased to see so many people come to the event as it was a great opportunity for fellow cattle farmers to meet and discuss their industry.

Although the prices were somewhat lower than last year, the organizers are looking forward positively to the next auction, tentatively scheduled for March, 2017. Prices in general within the industry have declined recently, so it was expected that breeding stock prices would reflect that at this sale. In order for breeders to receive a more fair return for the extra efforts and money invested to produce top quality breeding stock, cattle prices need to increase by about 25%.



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Necessity: The Mother of Invention Corn Reels in Spanish Lookout

When Hurricane Earl belted across the corn fields of Belize it flattened much of the corn. The farmers in Spanish Lookout, using their combines, had serious problems: the combines could not pick up all the corn and the corn clogged the machinery. Daniel Koop, mechanical engineer/entrepreneur



to the rescue! Using an existing design concept he fabricated a *corn reel* to mount on top of the combine header. The corn reel looks like a giant three-dimensional comb with three rows of "teeth" made of round steel tubing that assist the header with picking up and feeding the corn into the combine. The corn reel can be turned on and off with the flick of a switch by the combine driver as required; it is hydraulically driven. It can be raised and lowered during operation or lifted up and out of the way when its function is not needed. Daniel didn't have much time, but his ten busy employees fabricated 11 corn reels, outfitting a third of the combines in Spanish Lookout.

After studying in Manitoba and in Tennessee and earning his master's degree in mechanical engineering Daniel returned to Belize. He has been so busy designing and fabricating modifications to farm implements and solving other mechanical problems that he has not even had a chance to put a sign up in front of his shop on Baltimore Drive.



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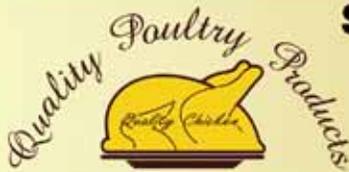
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Cassava and Belizean Food Security

By Johnathan Canton and Gilbert Canton Jr.



Can you imagine driving along one of our major highways and seeing “large tracts of cassava being planted and harvested? Large cassava trucks lined up outside of a cassava factory waiting to be unloaded? The cassava factory producing intermediate and final products, and distribution trucks

busily being loaded to deliver products to supermarkets and other cassava consumption points?” This is precisely what Deep Ford, the regional coordinator of the Food and Agricultural Organization (FAO) for the Caribbean, asked the attendants of the 2014 Regional Conference on Cassava in the Caribbean and Latin America to envision. For many of us this might sound familiar. Indeed, we have seen similar sights associated with the sugar, banana and citrus industries in Belize. So why is there a sudden interest in cassava?

The answer to that question first requires consideration of Belize’s recent trade statistics. In the last decade our import bill has risen approximately 70% to nearly 2 billion Belizean dollars. In comparison, our export earnings are almost four times lower at roughly half a billion Belizean dollars. These alarming figures are not unique to Belize but represent a regional trend in the Caribbean. In fact, according to the FAO, half of the countries in the Caribbean region import greater than 80% of the food consumed. This is increasingly recognized as a threat to both financial and food security in the region. The message from the FAO is and has been clear for a long time – we must find ways to cut down on imports while fostering local production. In this vein the FAO, in conjunction with leaders in the Caribbean community, have recognized the potential of expanding the local production of cassava.

At first mention, the suggestion of expanding the cassava market may seem a bit odd. Indeed, in Belize cassava is viewed as a niche crop that is associated with the Garifuna culture and incorporated into a select few, albeit beloved, recipes. But consider for a moment that cassava is the sixth most important food crop in the world, surpassed only by wheat, rice, corn, potato and barley. Moreover, in excess of 800 million people, mostly in the world’s poorest tropical countries in Africa and Asia, rely on cassava as a staple crop. Also note that the *Manihot spp.* to which cassava (*Manihotesculenta* Crantz) belongs is indigenous to Central and South America. As a result it is perfectly suited to the hot and humid tropics; in fact, it grows poorly if the humidity falls below a critical point. Although traditionally viewed as a heavy feeder, the fertilization requirements of cassava are being revisited and new sustainable practices such as returning crop residues to the soil and intercropping with green manures have significantly reduced such requirements. Further, harvestable cassava tubers can be left in the ground for up to 36 months with minimal detriment to quality introducing a great deal of flexibility and security to the harvest. From an agronomic standpoint then, cassava makes sense.

But, what of marketing? Perhaps the greatest success stories of introducing cassava products into countries where cassava is not a major agricultural crop has been a result of, in a way, not marketing it as a new product at all, but rather introducing

processed cassava into products that already exist. This approach has been showing great promise in the form of composite or blended flours. Brazil, for example, has mandated the blending of 10% cassava flour with wheat flour for bread making. Also, the Barbados-based FAO office, headed by Vermaran Extravour, has had great success at introducing a basic bread recipe with 30-40% of the wheat flour substituted with either grated fresh cassava or cassava flour. In the Workshop on the Integrated Development of Value Added Cassava Products in the Caribbean held by the University of the West Indies and the FAO on October 6th, 2016 representatives from both the government and private sector in Belize had the opportunity to do a sensory sampling of these bread recipes which were found to be not only acceptable but quite pleasing in both taste and texture. This is a significant finding as the FAO, in its analysis of the import bill for the Caribbean region, has identified wheat flour as one of the top ten imports in the region. Indeed, what would Caribbean cuisine be without Jamaican patties, Trinidadian roti and Belizean Johnny cakes? Belize is no exception to the rule. UN comtrade database statistics show wheat imports into the country amounting to approximately US 7 million dollars in 2015. As such, composite flours allow us to reduce our imports of wheat and replace it with locally grown, harvested and processed cassava thus reducing the import bill and creating jobs in the process. The movement has already started in Belize as Anna Howe of Central Farm recently invited bakers from across the country to sample bread made from a cassava-wheat blend in an effort to garner interest. A second example worthy of mention is an initiative dubbed “Project Grow” entailing the use of locally grown and processed cassava in place of imported barley by the Red Stripe brewing company in Jamaica. The project, which receives support from the Caribbean Agricultural Research and Development Institute (CARDI) and the Jamaican government, is expected to create several thousand new jobs while at the same time reduce the import of barley and other raw brewing materials by 20 percent. The outcome of this Red Stripe trial could be of interest to our own Belize Brewing Company.

However, the seamless blending of processed cassava into products that already exist need not be the only approach to expanding the cassava industry in Belize. Cassava chips require less processing than the flour and are of similar texture and appearance to potato chips. In Barbados, the private sector has embraced the FAO initiative and has rolled out various exciting products including cassava cookies and other sweet treats. The increasing worldwide incidence of gluten intolerance is also driving a niche market for gluten-free products – cassava, of course, is gluten-free. Also, the by-products from cassava processing make excellent fodder to be sold to livestock farms.

Belize, with its hot, humid climate, large land-to-population ratio and large tracts of decommissioned agricultural land from other crops such as papaya, is well poised to grow and process cassava. The regional production of cassava here in the Caribbean and Central America, its native land, is still very low relative to Africa and Asia. Will Belize respond to the resources being made available to us by this FAO initiative and increase our own local cassava production? It would certainly create new jobs all along the value chain. From the farmers to the consumers, it seems that we all stand to benefit. So, with that in mind, we end with the message that Deep Ford had for us at the onset of the FAO cassava initiative – Cassava Now!

Editor’s Note: Johnathan Canton was born and raised in the village of Boston in the Belize District. Out of a deep respect for the natural world he pursued a Bachelor’s and later a Doctoral degree in microbiology at the University of Florida. After four productive years as a postdoctoral fellow at the Hospital for Sick Children, he returned home to co-found an organic market garden – Kunahmul Organics. He is committed to bringing healthy, organic and local alternatives to the Belizean market.

Belize Orchid Diversity

By Dr. Stephen Zitzer

Belize is home for more than 300 species of orchid including the national flower of Belize, the black orchid (*Prosthecea cochleata*); many species live in all districts of Belize. The checklist of the vascular plants of Belize, published in 2000, lists 279 species of orchid second to the *Fabaceae*, or legume family, with 295 species found in



Belize White Orchid (*Prosthecea radiata*)

Belize. More recently the *Guide to the Orchids of Belize* by Sayers and Adams, published in 2009 by the Belize Botanical Garden, lists 312 species of orchid including *Pleurothallis duplooyi*, an apparently endemic species, or one that is currently known to occur only in Belize. There is little doubt the list will continue to grow as more plant surveys are conducted in Belize and the existing species genetic relationship are studied and clarified.

Worldwide the orchid family contains between 25,000-30,000 species and is one of the largest plant families on the planet occurring in almost every terrestrial habitat. They are most commonly found growing on trees along with other epiphytic plants, but some species grow on rocks, called lithophytes and many others in soils. Orchids are among the most evolutionarily advanced of plant families, having remarkable specializations for pollination, water uptake and storage, and associations with specific species of fungi and ants for nutritional needs and seed germination.

The defining characteristic of all orchids is the structure of the flowers with the fusion of the male portion of the flower or stamens and the female portion or pistils to form a unique structure called a column or gynostemium. Additionally and a more easily recognized characteristic of most orchids is that one of the three petals in each flower has evolved into beautiful, and sometimes bizarre shapes, called a labellum, which are also often fragrant to attract pollinators in extraordinary complex and specific ways. Orchid fruits, or capsules, are also rather unique in terms of the thousands to millions of tiny seeds they contain, with the vanilla “bean” being the most well-known and commercially cultivated orchid species. Unlike a corn seed that contains a large quantity of store food called the endosperm used to nourish the embryo when it germinates, orchid seeds have

little or no endosperm. Instead, the tiny seeds are wind dispersed and where they land they require contact with specific fungal species to nourish the embryo until it is large enough to begin to photosynthesize. Additionally, most the orchids continue to maintain a symbiotic relationship with its special fungal partner through their lifetime. Most orchids including both epiphytic and terrestrial species develop special root tissue called *velamen* which consists of several layers of dead cells on the root surface that serve a primary role in water uptake and loss. Conversely, the total vegetative diversity of orchids is one of nature’s marvels: species such as *Catasetum integerrimum*, a common species in Belize, grow as large as several meters and weigh as much as a ton, while the diminutive *Specklinia grobyi*, one of the most common orchids in Belize may reach only a few centimeters in diameter and have flowers that are less than 3 mm. long.

In Belize orchids occur in almost all forest and grassland habitats across all six districts and are often abundant in fruit orchards, especially on citrus trees. In general the number of species or diversity of orchids as well as their abundance increases as elevation and precipitation increase, Consequently, Cayo and Toledo districts probably have greater orchid diversity and abundance than the other districts. However, according to the 2009 *Guide to the Orchids of Belize*, “most Belizean orchids are rare and endangered from habitat destruction and illegal collecting”, though no data were used to support the statement. Fortunately, all orchid species are protected in Belize and based on my observations over the past three years, as long as Belize continues to preserve and protect its forests, most orchid species will continue to thrive. The most significant natural challenge facing native orchids is surviving the dry season and in the future many species’ ranges will be potentially and negatively impacted by climate change.

The greatest current threat is land clearing and forest fires. Because only a few orchid species found in Belize’s pine savannas are adapted to natural wildfire, for most other orchid species forest fires are devastating to local orchid populations. Therefore preventing accidental forest fires and limiting the use of fire as a vegetation removal tool are the keys to conserving existing populations of orchids in Belize though, in reality, little is actually known about the ecology of most of the orchids found in Belize. As noted previously most of the orchid species found in Belize also occur in other Central American countries, but because Belize has a much greater percent of forest cover Belize forests may also support some of the healthiest populations of many of the more widespread species. Perhaps they are under-appreciated as they grow and bloom in the dark shadows of forest canopies; nevertheless the orchid diversity and abundance in Belize’s forest are a significant component of overall biodiversity in Belize, an inextricable part of The Jewel.

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The History of Vanilla in Ancient Maya Culture

By Dawn Dean



A drawing of vanilla from the Florentine Codex, 16th Century

Vanilla flourished wild in the damp shade of Central America's lowland forests long before humans discovered its tantalizing aroma and undertook its cultivation. It's possible that the plethora of seemingly wild vanilla found today in southern Belize is vestigial, left behind by the Manché Chol Maya. Before

we get going, it's important to know that 500 years ago, a good cup of chocolate included not only cacao, but also annatto and vanilla. (But no sugar!)

Now let's start with a bit of history.

Hernán Cortés traversed Chol territory in 1525, cutting across what is now the southwest corner of Belize, at the end of a journey from the southern part of what is now the state of Veracruz on the gulf coast of Mexico. His chronicle of the *entrada*, a lengthy letter to Emperor Charles V, includes several references to the cacao he came across in the region. Cortés was well aware of the value placed on cacao by the indigenous peoples he encountered on his travels, having noted in an earlier letter to Charles V that "they use it as money throughout the land and with it buy all they need". He had no idea, however, of the role that cacao would play, together with vanilla and annatto, in sustaining the local economy as the Spanish vied for domination of the Southern Maya Lowlands.

In the 16th and 17th Centuries, the Spanish attempted to subdue, by forced relocation and conversion to Catholicism and by use of the *encomienda* system, the Maya peoples who inhabited the Southern Maya Lowlands, an area made up of the southern parts of Campeche and Quintana Roo in Mexico, the Petén in Guatemala, and Belize. The Itzà, who inhabited the central Petén, determinedly fought this fate and managed to retain their independence until the end of the 17th Century. The Itzà elite consumed, for ritual purposes, great quantities of cacao-based beverages. While they grew a small amount of the three important ingredients for chocolate, cacao (*Theobroma cacao*),

annatto (*Bixa orellana*) and vanilla (*Vanilla planifolia*), it was only enough for local consumption on a small scale. Because of its soil and climate, the central Petén was an inhospitable place for growing cacao.

The Itzà found a way to surmount their shortage of cacao, annatto and vanilla, and simultaneously bolster their own power base by taking control of both the production and trade of cacao, annatto and vanilla in a large area of Mexico and Central America. This control was retained right up until the Itzà succumbed to Spanish domination in 1697.

Another group of Maya, the Chontal Maya of Acalán, which translates as "Place of Canoes", were excellent seafarers, in control of extensive maritime trade routes that stretched east around the Yucatan peninsula and all the way down the coast to the important trading center of Nito on the Gulf of Honduras. They traveled these enormous distances to engage in the trade of luxury goods, including cacao, which they produced, and also feathers, jaguar pelts and slaves. In the wake of the Spanish conquest of the Yucatan, however, their trading activity ceased. The Itzà stepped into the breach and reassembled the Chontal exchange system and resumed use of their trade routes.

Control of this trading system meant that the Itzà were assured an uninterrupted supply of cacao, annatto and vanilla for their personal consumption. It must also have been very lucrative; numerous Maya fled south from the Spanish incursion on the Yucatan to resettle in locations close to Itzà territory, thus creating new outlets for trade. The Itzà went to any means necessary



Elite Maya enjoyment of cacao flavored with vanilla

to maintain their power and control of their extensive trading system and to protect their territory from the advance of the Spanish. They bullied their neighbors, enslaving them, raping

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their women and sacrificing a hapless few who were fool enough to offer aid to the Spanish. In 1630, they viciously attacked the Manché Chol, ultimately inciting the Chol to revolt against Spanish domination. They warred with the Lacandón for control of the Salinas de los Nueve Cerros, the only source of salt in the region. They then used their control of this precious resource to force the Lacandón, and the Manché Chol to exchange their valuable commodities, including cacao, annatto and vanilla, for salt. It is the Manché Chol, who lived south and east of the Petén, with whom our story continues, as much of their territory was within what is present day southern Belize.

With its numerous fertile river valleys, Manché Chol territory was ideally suited to growing cacao. In their orchards, called *pakab* in the Choltí language, the Chol grew great quantities of cacao, annatto and vanilla. In 1620, the Dominican friar Gabriel de Salazar made a circuit around Central America that took him, among other places, the length of Belize, along the shoreline and through Chol territory. Salazar noted the large cacao and annatto orchards in the Chol villages along the coast of Belize: Yaxhal, Paliac, Campin and Tzoité. Chol territory continued, tracing a crescent shape, south and west away from these settlements to the towns of Manché, Chocahau, Yaxhá and Yol (in present day Guatemala). From these villages, the Manché Chol would transport their precious cargo to the Itzà capital of Noh Petén.

It was not only the Itzà who forced the Manché Chol into trade; the Spanish got in on the action too, extorting cacao, annatto and vanilla from the Chol in exchange for overpriced metal tools and other wares. In fact, the Chol, surrounded by the Itzà to the northwest, the Yucatec to the north and the Kek'chi and the Spanish of Verapaz to the southwest, managed to engage in trade with all their neighbors, some forcibly and some voluntarily. This attests to the value of the resources in the possession of the Manché Chol and illustrates that they must have intensively produced cacao, vanilla and annatto in order to be able to supply everyone around them.

In 1689, the Manché Chol were rounded up by the Spanish and forcibly relocated to the Valley of Urrán in the Guatemala highlands. The terrain was absolutely foreign to them; J.E.S. Thompson made the observation that it was like banishing "Sicilians to the remoter highlands of Scotland". It wasn't long before they started to perish. In 1699 it was noted by Marcelo Flores, a Spanish captain, that some Chol still occupied what had been their lands in eastern Guatemala and southern Belize. In 1710 there were only four Manché Chol left in the town of Belén in the Valley of Urran. In Toledo West, the *Chol quink* (Chol man) is still remembered and venerated for his nearly supernatural abilities, by people whose ancestors arrived in southern Belize less than a century ago. This perhaps indicates that the Chol survived much longer than written history records, hidden in their own homes, shrouded by the towering rainforest, slipping into the dark undergrowth, gliding out of sight in rivers known best by them. Whatever the case, their ultimate disappearance meant the loss of their acumen with regard to the cultivation of vanilla.

When the Spanish forcibly relocated the Lacandón in 1695 and defeated the Itzà in 1697, the cacao-based trading network collapsed. With no buyers for their vanilla, and the need to elude capture, the few remaining Chol certainly abandoned their farms. The encroaching bush would have quickly obliterated the annatto. Some cacao would have survived for many years; even today cacao is occasionally found growing near to ancient Mayan settlements in the Columbia River Forest Reserve. But the vanilla, unencumbered by the human need to keep it close to the ground for ease of pollination and harvesting, abandoned by the Chol who planted it, would have proliferated in the moist fertile valleys. Perhaps it is these vanilla plants, mute testimony to the rise and fall of a people, that we find today in southern Belize.

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Marco Figueroa Speaks at POB



POB was fortunate to have cacao expert, Marco Figueroa as the speaker at their monthly meeting on 6th September at Maya Mountain Lodge, Santa Elena, Cayo District.

A native of San Ignacio, Marco attended the Universidad de Zamorano University in Honduras. Marco started in the cacao industry in the 80's with Hummingbird Hershey as Research Manager. Over the decades, Marco has worked for GOB at NARMAP, Programme for Belize, Belize Enterprise for Sustained Technology (BEST), and has managed a cacao operation in Costa Rica. In 2015 he retired after 11 years as the technical advisor for the Toledo Cacao Growers Association (TCGA) and now works at his own diversified farm in the outskirts of San Ignacio when not traveling internationally as a cacao consultant.

Although Toledo is best known for its cacao industry, Marco revealed that there are a few areas in Stann Creek, Cayo and even Orange Walk Districts which are also suitable for growing cacao. *Theobroma cacao* is very particular as to its needs. Almost all the commercial groves are *Theobroma cacao trinitario*. *T. cacao criollo* is the Belizean native species which is increasingly rare today as it is very fragile and susceptible to disease. The *criollo* was crossed with the South American *forestero* many years ago to create the more hardy *trinitario*. About 700 cacao trees, 800 plantain and 136 timber trees fit nicely per hectare and give the cacao a desirable 50% "sprinkle" of sunlight. In addition to a humid tropical climate, it requires 2.5 to 3 feet of fertile topsoil to thrive. It does not tolerate limestone or waterlogged conditions. Cacao lends itself to organic cultivation as it can be grown with considerably fewer chemical inputs than other crops.

Generally cacao trees begin life in a nursery for 4 to 5 months, then are grafted and spend another 2 months there. Grafted trees begin production after 2 to 3 years, and ungrafted begin at about 4 to 5 years. The optimum production stage lasts for about 18 to 25 years, with a decreased production stage for another 20 years after that. Trees over 40 years are considered old. In a traditional system of cultivation, trees yield between 250 to 300 kg/ha of dried fermented beans. Selected grafted trees can yield up to 2000 kg/ha. Generally harvests tend to alternate between higher and lesser yielding years, as many fruit trees do.

Marco commented that the Maya in Belize's South consider their cacao trees sacred, and that it was a difficult task encouraging them to prune their trees. However, pruning cacao trees, as with most plants, stimulates growth and increases fruit production. Keeping them pruned also maintains a more manageable size.

Briefly Marco described the fermentation process which all beans must undergo to attain their typical chocolate flavor. Depending on the variety, fermentation of cacao requires between 6 to 7 days and rarely 8. During this process, the fruit surrounding the beans liquefies, creating "sweating"; these liquids can be saved and used to make cacao vinegar or wine. After the fermentation stage, the beans need slow drying; fast drying can trap acetic acids in the beans, lowering their quality.

Marco recommends more cacao growers for 2 reasons: first, both local and international market demands for our premium cacao keep increasing and second, cacao is a relatively low maintenance environmentally friendly crop. Cacao is currently Belize's largest organic export commodity; it is exported as both certified organic and Fairtrade-certified. Germany is currently Belize's main cacao purchaser. Domestically the main buyers/processers are: Goss Chocolate, Cotton Tree Chocolate, Kakaw and Cirila's who together process about 26,000 lbs. of fermented beans annually.

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POB Pesticide-Free Produce Pick up: Tuesdays, from 1-4 pm at the Express Car Wash across from the San Ignacio Market and beside the French Bakery. There are still a few spots open in the produce co-op for the fall-winter harvest season. Produce is pre-paid by the month. Call Mary at 677-9658 for more information.

Pro-Organic Belize has changed their schedule and will now meet the first THURSDAY of every month. Please note – formerly POB met on the first Tuesday but that has been changed because the new POB produce Co-operative will have its produce pick-up on Tuesdays. POB members and guests meet at noon to order lunch off the menu at Nature's Kitchen Restaurant at Maya Mountain Lodge, ¼ Mile on Cristo Rey Rd, Santa Elena. Speakers commence at 1 pm and business meeting follows the speaker. On Thursday, November 3rd the speaker will be Santiago Juan who will speak on Moringa and food security. December will have a members-only event in lieu of the regular meeting. On Thursday, January 5th, the Ministry of Agriculture's Gary Ramirez, head of the research division at Central Farm, will be the speaker. All are welcome!



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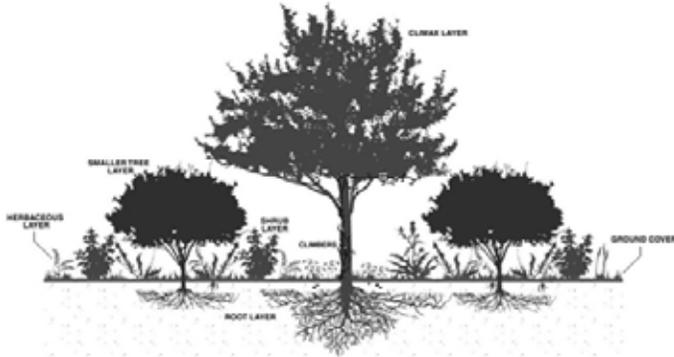
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Ecological Farming

By Taylor Walker



There is a lot of talk these days regarding global climate change, soil loss, and desertification. We as farmers, gardeners, and stewards of the earth can play a major role in slowing and even reversing these catastrophic trends. Thankfully there are many solutions at hand if we use thoughtful techniques and look to the natural environment for ideas and answers.

In nature plants do not grow only in one plane but grow in all dimensions. Most natural terrestrial ecosystems consist of many different species of plants and plant types. Ground covers, vines, herbs, shrubs, understory trees, canopy trees, and emergent canopy trees are all present in a tropical forest. As anyone who has farmed or gardened in Belize surely has witnessed any cleared land left to its devices quickly begins to reforest in a tangle of herbs, vines, and hard tree species. These pioneer species are the first plants to colonize an area after the land is cleared either by farming, overgrazing, or fire. These species are often called weeds. A weed is just a name for a plant in a place that we don't want it or that we have failed to discover its purpose and function.

Each pioneer species has a specific purpose and function. Many stabilize the open topsoil with dense roots; other species can loosen compacted soils with tough penetrating roots. Some species can accumulate minerals from deeper soil levels and make them accessible to shallow rooted species through their growth and decomposition of leaves and branches. One of the most significant categories of pioneer plants is the nitrogen-fixing plants. These plants have natural symbiotic relationships with certain soil-borne bacteria that can absorb atmospheric nitrogen and convert it to a form of nitrogen useful to all plants. The air that we breathe is approximately 70% nitrogen, but this is of little use to plants that rely on this vital nutrient for growth; it must be sequestered by nitrogen fixing species and converted to the plant soluble form of nitrogen. By planting 30% of your canopy or 70% of ground cover/herbaceous plants in nitrogen fixing species most or all nitrogen requirement will be fulfilled. These levels of nitrogen produced are very real and can amount to over 150 pounds of nitrogen per acre per year. This amount is equivalent to over 5000 pounds of chicken manure added per acre per year.

Farmers can take the path of least resistance and plan their farms to replicate this natural succession of species. I always say that you can plant useful herbaceous "weed like" species or spend much of your labor input controlling or removing unwanted wild weeds. Why not spend your time harvesting instead of weeding? By modeling our gardens or farms after natural young forests we are taking proper advantage of the natural cycles and synergies present in a healthy ecosystem. Synergies include nutrient cycling, soil building, erosion control, groundwater recharge, carbon sequestration, evaporative cooling, mineral accumulation, nitrogen fixation, beneficial microbial activity, predatory (pest consuming) organisms, and other diverse symbiotic relationships. By diversifying our gardens and farms

we will provide more consistent year round harvests and avoid the boom or bust dilemma of many single crop systems. Many studies have shown a greater per acre cash return for diverse systems in the long term than conventional systems.

Natural systems often referred to as agro-ecology, agro-forestry, food forests, or regenerative farming are not a new modern idea but have been practiced by cultures throughout the world since the beginning of time. Many of these traditional systems have been abandoned for the quick cash returns provided by conventional commodity farming. But there is still great hope for a bright future. Many damaged landscapes have been healed by regenerative practices. A great example exists in the Loess Plateau in China where millions of acres of desertified land were turned back to beautiful productive farms, waterways, and forests through the dedicated application of regenerative practices. You can see the results for yourself in the documentary *Green Gold* by John D. Liu. Another amazing example is the work of Ernst Gotsch in Brazil. Ernst helped to recover over 2,000 acres of dry deforested land in the Atlantic rainforests through agro-forestry practices. After 30 years of work experts have called Ernst's land the most healthy and biologically diverse section of the Atlantic rainforest; it is producing some the world's most valuable cacao and coffee beans. You can learn more about his work in the free documentary called *Life in Syntropy*. Both of these documentaries are available on Youtube or Vimeo.



Canopy Species or Climax Layer

Enterlobium, Guanacaste, Gliricidia, Madre de Cacao, Leuceana, Inga, BriBri, Quamwood, Cohune, Coconut, Acai Palm, Breadfruit, Tamarind, Mango, Jackfruit, Caimito, Mammee Sapote.

Mid Level or Smaller Trees

Avocado, Canistel, Starfruit, Custard Apple, Soursop, Rollinia, Sweetsop, Guava, Citrus, Sapodilla, Ginap, Rambutan, Mangosteen, Cashew, Allspice, Cinnamon, Craboo, Hogplum, Golden Apple, Jujube (Chinese Plum), Acerola Cherry, Surinam Cherry, Moringa, Cacao.

Shrubs/Herbaceous Layer

Banana, Plantain, Coffee, Pigeon Pea, Cassava, Chaya, Peppers, Pineapple, Cocoyam, Eddo, Gingers, Turmeric, Annual vegetables, Medicinal herbs.

Climbing Vines

Vanilla, Black Pepper, Pitaya, Dragon Fruit, Chayote, Passion Fruit, Yams, Bitter Melon, Luffa, Jicama, Monstera Fruit, Tindora, Grapes, Vining Beans, Gourds.

Groundcovers

Sweet Potato, Perennial Peanut, Desmodium, Tropical Oregano, Longevity Spinach, Ceylon Spinach, Peanut, Beans, Pumpkins, Squash, Melons.

Editor's Note: Pictured above is the author Taylor Walker in home scale, multi-layered garden containing over 250 varieties of fruits and vegetables on a 0.5 acres. Taylor Walker is an ecological designer, and educator, who is in Belize to research and write a book on traditional and modern agro-ecological systems.

AG BRIEFS



The University of Belize College of Agriculture at Central Farm (UBCF) will host prominent soil fertility expert Neal Kinsey for the 3rd time in Belize, on February 27th –March 1st 2017 (the 2016 course was held earlier in Feb 2016). The upcoming course will be a new course to Belize; the 3 day Intro 2 course begins with a day and a half of trace minerals. Workbooks for the new course are available now for paid registrants of the next year's Intro 2 course. All are welcome to attend this course – students, teachers, private sector. Contact David Thiessen at 670-4817 or thiessenliquid@gmail.com. Neal reports that this is “the favorite course” of farmers.



New World screwworm, *Cochliomyia hominivorax*, was confirmed in Key deer on Big Pine Key, Florida in early October 2016, after having been eradicated from Florida over 50 years ago. Belize has been free of the pest since the early 1990's when the USDA and the USA assisted with a biological control program of dropping sterile male flies by air. Prior to that ranchers had to regularly check stock and remove the larval stage of the worm which would bore deep into the animal's flesh. Dogs, wildlife and other warm-blooded mammals were all affected. South America is still plagued with screwworms and the USDA and partners maintain a permanent sterile fly barrier between Panama and Columbia to prevent re-establishment of the fly in Central and North America. South American MERCOSUR countries are currently considering use of the sterile insect biological control, as losses to their livestock industries are in the hundreds of millions of dollars.

Most plant leaf surfaces repel water, so liquids such as pesticides actually bounce off of the leaf surface. A MIT research team found “that only about 2% of pesticide sprays actually stick to the plants, meaning that farmers have to spray many more times the amount of pesticides than they need”. The researchers added electrically charged polymers to the pesticides – half receiving positive charge and half a negative charge, which together create a sticky surface on the leaves for spray retention. Researchers claim that with this new method farmers would need to use only 1/10th of the traditional application amounts (90% reduction) to achieve effective results.



Traditional 'stickers' added to pesticides have been soap-like surfactants which change the leaves' surface tension. However with surfactants

“the speedy droplets bounce off while the surface tension is still changing and the surfactants cause the spray to form smaller droplets which are more easily blown away”, so the improvements are minimal. MIT's new application is being tested now by small farmers in India who use easily adapted backpack sprayers, each with 2 tanks allowing separation of the pesticide into 2 streams. Researchers claim that the charged polymers which are natural and biodegradable can be made locally from low-cost materials. Benefits of this system are less pesticide costs, less environmental pollution and less exposure of farmers to the spray chemicals. https://www.eurekalert.org/pub_releases/2016-08/miot-mpdo83016.php

A Mexican company, Aloe Eco Park has developed an edible aloe-based biofilm to be used on fresh fruits and vegetables to extend shelf life. Aloe has long been known to have anti-fungal and antibacterial properties. The biodegradable product is available in Latin America and the USA. info@aloeecopark.com



Florida's 2016/2017 citrus crop estimate is down to 70 million boxes, a continuous downtrend since the high of 244 M boxes in 1998. Much of the decrease can be attributed to HLB or citrus greening disease. Two strategies for fighting HLB are showing promise at the University of Florida. The first involves use of the CRISPR (clustered regularly interspaced short palindromic repeats) technology, which might eliminate genes that make citrus vulnerable to HLB. Another strategy being tested there uses heat therapy applied by steam treatments to the citrus trees. The steam destroys the bacteria which causes HLB and opens up the plugged phloem so that sap flow is improved and allows the trees to receive nourishment again. Untreated HLB diseased trees show reduced or almost no flushes as the sap's ability to move water and nutrients is effectively blocked by the bacteria. Belize confirmed the presence of HLB in 2009.

Mushrooms as substitute for sugar in chocolate: After 30 years of mycology research, the team at Mycotechnology in Aurora, Colorado discovered a method to reduce up to 66% of a dark chocolate bar's sugar by replacing it with mushrooms, fulfilling their goal “for products to be healthy but also taste great”. Using the roots from the chaga mushroom which grows on birch trees in cold climates, the team creates a 'liquid mushroom', which is then sprayed onto cacao beans and allowed to dry before the chocolate making process begins. In the finished product, the mushroom acts as “a bitterness shield” not allowing the chocolate's bitterness to bind with



For Information on the status of the Iguana Creek Bridge

waters rising or falling, out of water, under water, go to 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	↓ \$9.46 Bz/Gal	↑ \$5.68 Bz/Gal	↑ \$7.88 Bz/Gal
PREMIUM	↓ \$10.02 Bz/Gal	↑ \$6.02 Bz/Gal	↑ \$8.48 Bz/Gal
DIESEL	↓ \$8.57 Bz/Gal	↑ \$5.95 Bz/Gal	↑ \$6.67 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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your taste buds. Sugar is added to chocolate to both reduce bitterness and to sweeten it. Amano Chocolate of Orem, Utah has produced a dark chocolate bar using Mycotechnology's mushroom process.

Environmental and economic factors are driving many researchers to find ways to reduce the use of chemicals in agriculture. **Cambridge Consultants (CC) is working on spray technology which they claim can reduce pesticide (herbicide, insecticide and fungicide) volumes by more than 99%.**



They use microfluidics expertise with machine vision algorithms to enable an **extremely accurate target-type application of chemicals only where they are needed.** They envision their technology being used on large-scale operations. A camera is mounted on the tractor's spray boom and even moving at speeds over 25 mph can look ahead and identify specific targets such as a leaf or a bug, by shape, size and color from a height of up to 50 cm. Then these targets are tracked taking into consideration the movement of the tractor and the camera calibrates for accurately-timed applications from the dispense valve. CC describes their system as similar to skeet shooting, where the droplets must be fired before the boom passes over the target. "The droplet travels at five meters per second and takes one tenth of a second to hit the target. At full speed the target passes under the nozzle in about three milliseconds." CC claims that their system "virtually eliminates drift and run-off" of pesticides. No costs are yet available for this machinery, but the company will be demonstrating this innovative spray system at AgriTechnica in Hanover Germany on November 10-14th. A system enabling 99% reduction of agricultural chemicals is surely to be noticed by farmers wishing to save on input costs as well as by environmentalists and health authorities.

Tecnologias AgriBest, incorporated in 2013 and headquartered near Mexico City, has won first place in the *Cleantech Challenge, Mexico 2016*, from more than 1300 entries. Located close to the prestigious agricultural institutions of Autonomous University Chapingo and the Colegio de Postgraduados, AgriBest has collaborative agreements with both schools to develop technology. **They are working with bacterial strains, entomopathogenic fungi (fungi which work as biological controls for insects) and botanical extracts to create products which benefit crop nutrition and protection.** The botanical extracts are active compounds extracted from plants which have biostimulant or biopesticide effects. The two main effects of AgriBest's system are reducing both chemical fertilizer and pesticide inputs and increasing plant productivity. AgriBest is working with 70 major crops: grains such as corn, beans, wheat and vegetables and fruits for export such as berries, avocados and mangoes. They claim that although many farmers assume the word 'sustainable' means expensive, their systems have proved profitable and outperform the competition. Their website has trial results from 2014 and 2015. AgriBest says of their program: "Producers do not consider it difficult, and as long as they follow the instructions on how to apply each of the 6



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or 7 components, the results are guaranteed." They claim this program can be applied to small, medium and large producers and together with any type of technology, because the underlying principle is always "activating the plant's metabolism to make it more efficient". Although focusing mainly on Mexican customers they plan to expand into Latin America in 2017. www.agribest.com.mx

Jamaica's All Island Banana Growers Association (AIBGA) announced that they will build a banana and plantain processing facility, which will process



up to 50,000 lbs per week. The European Union (EU) is providing 200,000 Euros as funding for the project. Planned products include popular chips as well as flour, pancake mixes, and juices. Jamaica was an exporter of bananas until 2008 but currently imports over \$6M USD of banana products annually. As in Belize, the Jamaican government is promoting value-added production.



An ingredient of grapefruit, nootkatone, has shown promise as a mosquito repellent and an insecticide. Nootkatone is already used as a flavoring and a fragrance in the USA, having GRAS (Generally Regarded As Safe) classification. In addition to

mosquitoes, the CDC (USA's Center for Disease Control) claims that "a single application of a 2% solution of nootkatone will control ticks for up to 42 days at 97% efficacy". Nootkatone kills by blocking receptors on insects' nerve cells for the neurotransmitter called octopamine; insects become hyperactive and "vibrate themselves to death". Humans do not have octopamine but it is compared to adrenaline. Scientists have yet to study any cross-reactions between the receptors for both. To date mosquitoes have not developed a resistance to this chemical so it is viewed as very promising for uses such as in anti-malarial mosquito nets or in insecticidal soaps. Nootkatone is said to break down very quickly

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Ag Briefs...From page 33

so should not cause soil or groundwater contamination. In addition to grapefruit, nootkatone is also found in Alaska's yellow cedar trees.



Toledo company Naledo Belize Inc. exported its fresh turmeric (yellow ginger) paste called *Truly Turmeric* to Canada in August of this year. The paste, used in curries and cooking, is also a healing paste for the skin. The company was created by former Canadian consultant to Belize, Mrs. Umeeda Switlo, and her daughter Nareena. The Switlos plan to hand over the company to a group of Toledo youth.

In 2012 legislation in UK put responsibility on landowners to reduce their use of traditional chemical herbicides. **Weedingtech, a UK company operating in at least 7 European countries, Scandinavia and provinces in Western Canada, offers an herbicide-free alternative which kills weeds within minutes** without harmful active ingredients. Their Foamstream Weed Control works by applying heat in the form of a foam, composed of hot water with natural plant oils, sugars and a wetting agent (surfactant). The foam acts as an insulating blanket keeping the heat on the weed long enough to kill it. This technology appears to be used mainly by contractors for parks, landscapes and other urban and rural weed control at present, and the application equipment commercially available is for those needs. Many are interested to see if the technology will be adapted for use in large scale mechanized agriculture as well. www.weedingtech.com

California date palm tree farmer Jim Parks traveled to Tunisia, North Africa and noticed cattle there feeding on coarse palm fronds. Combining that information with the fact that in many urban areas of the USA the fronds are considered a problem waste item, Parks came up with a plan to create a nutritious livestock feed. Palm fronds can take up to 50 years to biodegrade in a landfill and they are known to interfere with the methane gas processes there. Parks invested over \$500,000 during 3 years, modifying grinders. The fronds are ground up into a hay-like consistency which can be baled, cubed or pelletized. Recycled (waste) Deglet Noor dates, canola meal, wheat middlings (millfeed) and rice bran are all added to the palm hay to make his Sweet Date Feed. The crude protein of the Sweet Date Feed is 16.11%. Using this feed reduces feed costs for local livestock producers. For more information including feed analyses go to www.palmsilage.com



The latest agri-giant proposed merger awaiting regulatory approval is between Bayer, the world's largest supplier of plant protection products (18% of market in 2015) and Monsanto, owner of 26% of the global seed market (2015). Monsanto finally accepted Bayer's \$66 Billion offer in early September. The merger of Dow Chemical and DuPont earlier in 2016 formed the world's second largest agricultural multinational company. What was formerly the big six (BASF, Monsanto, Bayer, Syngenta, Dow and DuPont) are now the big four: BASF, Syngenta/ChemChina, Bayer-Monsanto and DowDuPont Agri. In announcing the Monsanto-Bayer news, Monsanto's CEO said the merger "represents the most compelling value for our shareholders." The National Farmers Union (NFU) concurs that any benefit of the merger will go to the shareholders, not the farmers.

Consolidations have been happening for decades in both row crop and in greenhouse/vegetable industries. Over the past several years Monsanto acquired major European greenhouse vegetable seed breeders, Western Seed, Poloni, Peotec, and DeRuiter, which is their brand for protected (greenhouse) crops. Seminis is Monsanto's brand for open field and unheated protected vegetable crops. Bayer acquired the 5th largest seed breeder, Nunhems, in 2002 gaining Leen de Mos, another Dutch major seed breeder at the same time. In 2015 Bayer acquired Seedworks, the Indian seed breeder for hybrid tomato, chilies, okra and pumpkins. According to freshplaza.com, the combination of Bayer and Monsanto scares most farmers and growers; they are afraid of having no choice left in the future. On the bright side, freshplaza.com reports that the few remaining independent seed companies (Rijk Zwaan, Gautier Semences, Enza Zaden, Axia Seeds, Totam Seeds) are experiencing growth from farmers who prefer to buy seeds from independent companies or family businesses.

Going Biological... Continued from page 17



Bollinger's genius is to concentrate biochar and nutrients in narrow bands, thus cutting rates to hundreds of pounds per acre, slashing annual costs and spreading expenses over several years.

FIRST PLACE MILO

"That cornfield produced 235 bushels," said Bollinger. "The 20-year average for that field is 180 bushels. The crop was easy to grow."

But Bollinger's biggest surprise was his grain sorghum crop.

"One sorghum field made 186 bushels in non-irrigated sand. Normal is 100 bushels; most farms were 120, even irrigated. Believe it or not, my field had irrigation on part, but non-irrigated yielded a few extra bushels."

Yields were good enough to win First Place in Missouri for both irrigated and non-irrigated milo. Continuing to talk numbers, I asked about money saved cutting NPK fertilizer 50 percent versus costs for biochar, biologicals and metabolites.

David, Sr. replied, "Yeah, we got some figures. I'll fine-tune fertilizers — exact amounts we cut back. I'd say close to \$100 an acre cheaper. Maybe not \$100, but way up there." So, 1,000 acres saved near \$100,000 just on fertilizers.

Bollinger said their soybeans show signs of increased health and vitality, and they achieved higher yields.

"Stalk is important in soybeans — usually a little pencil-like stalk," he said. "This year, stalks were like tree trunks. We noticed more lateral branches. Typically, we have a single stem and nodes stretched farther apart. This year, nodes were more stacked, with three or four lateral branches. Every soybean plant I pulled up, rhizobia were always vibrant, pink, bigger in size and more of them than typical, especially on poorer ground. On average, in this ground after wheat soybeans get 35 bushels. We ended in 50 to 55. Also, we cut our soybean population way back to the 80,000 to 100,000 range. Many farms plant up to 180,000 per acre."

Bollinger says his journey to more sustainable farming started because a man challenged him to find an earthworm.

"It tickled me yesterday to walk out in a field, stop in a random spot, dig in-to the soil with two fingers and find an earthworm — then five more. In 2012, I couldn't find a single earthworm."

David Yarrow has taught about and organized sustainable food systems in the northeast United States for more than 30 years. He can be reached at dyarrow5@gmail.com. For more information visit dyarrow.org.

RESOURCES

David Yarrow, TERRA 573-818-4148, dyarrow5@gmail.com, dyarrow.org, Independence, Missouri

JR Bollinger, 573-620-0394, jrbollinger4020@gmail.com, 260 County Hwy 518, Sikeston, MO 63801

Terra Char, Phil Blom, 573-279-2989, terracharinfo@gmail.com, terra-char.com, E. Dripping Springs Rd., Columbia, MO 65202

AgDynamic, Nick Cuchetti & Robert Freeman, 573-838-7030, Malden, Missouri



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