ECHO® Development Notes

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Pest Prevention: The Foundation of Integrated Pest Management

By Stacy Swartz

When the topic of agricultural pest management is mentioned, most people think first about monitoring for pests or intervening to reduce pests: scouting, pest identification, and/or application of pesticides are some specific practices. However, prevention is an often-overlooked key strategy that farmers can use to minimize the likelihood of pest problems. This article will explore the role of prevention in a pest management plan.

INTRODUCTION

What is a pest?

An agricultural pest is any organism or infectious agent that causes stress or damage to a desired plant or plant product. For example, a weed is a pest if it competes with a crop for resources, causing the crop stress it otherwise would not have. Infectious bacteria, fungi, and viruses cause diseases and are therefore pests. These small pests are transferred from one plant to another through water, through the air, by insects, or by larger animals (including humans). The most familiar pests are insects, ranging in size from the small whitefly to large swarms of locusts. Larger pests such as birds, mice, and rabbits can also cause damage in the field.

Some pests affect agricultural products in storage, such as cereal and pulse grains (Sallam, 1999; Manandhar *et al.*, 2018). However, this article will focus on preventive pest management in the field. In the remainder of this article, the term 'pest' will refer only to agricultural pests that affect crops in the field.

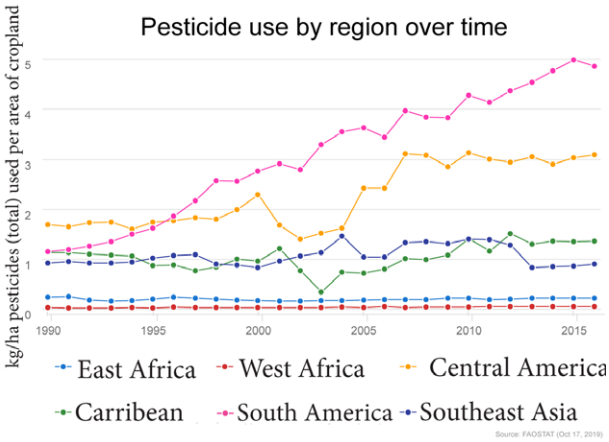

Figure 1. Total pesticide use by region of the tropics over time. *Source*: FAOSTAT 2019

A brief history of pesticides

Throughout history and across cultures, farmers have used a variety of resources, strategies, and practices to manage in-field insect pressures. Naturally-derived compounds (e.g. sulfur) have been used as pesticides for thousands of years. By contrast, synthetic pesticides have only been produced and used since the 1940s.

Trends in the Global North: The combination of the Industrial Revolution and the Green Revolution in the Global North allowed for the relatively rapid spread and broad use of synthetic pesticides without consideration for human or environmental health. Concerns associated with pesticide use emerged in the 1960s, leading to the establishment of protection agencies. Now, pesticides are largely controlled by governmental regulations that vary among countries, but that generally aim to protect farm workers, pesticide handlers, and the environment.

Trends in the Global South: In the Global South, the access, use, and regulation of synthetic pesticides has varied over time and among regions. Figure 1 illustrates some recent trends in pesticide use by region. Pesticide use in South and Central America has increased over the past three decades, while other regions of the tropics have remained roughly the same (FAOSTAT, 2019; Schreinemachers and Tipraqsa, 2012). Up to 25% of countries in the Global South lack pesticide regulations and (where such regulations exist) their enforcement. This is due to insufficient resources, lack of incentives for enforcement, limited environmental standards, and lack of cohesion between relevant departments (Phung *et al.*, 2012; Schreinemachers and Tipraqsa, 2012; Kegode, 2019). Often farmers are not sufficiently educated about how to properly mix and handle pesticides, dispose of pesticide containers, and use personal protection equipment. In an

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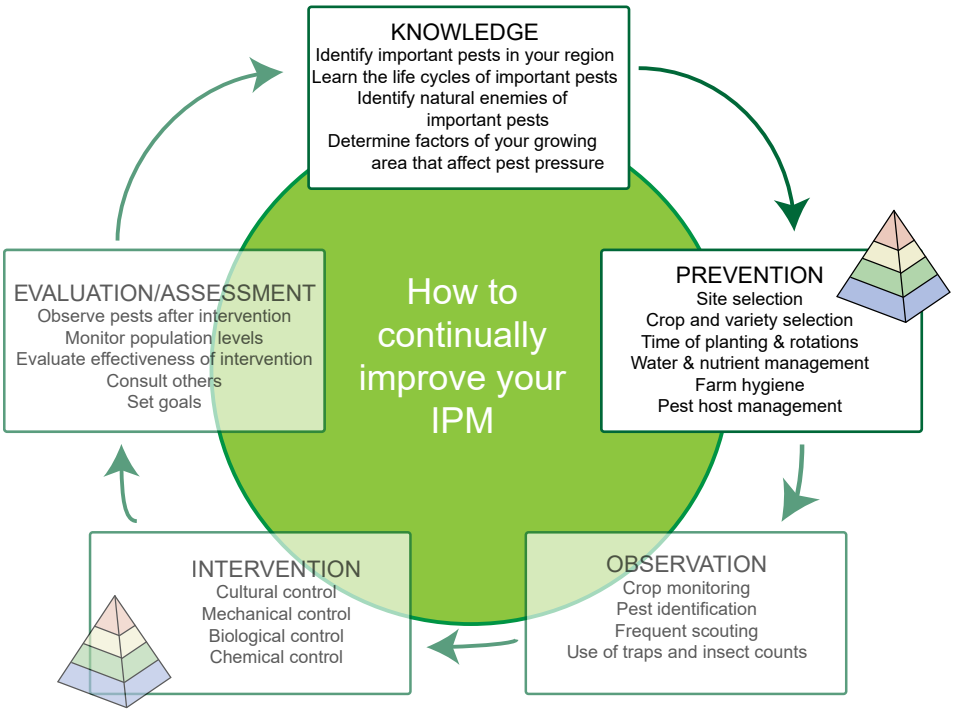

Figure 2. Stages of an example IPM cycle. Planning can start at any stage of the cycle, and the order of stages is flexible. The pyramid icon indicates stages that include strategies for pest prevention or suppression. Some "Prevention" stage strategies are described in this article and are illustrated in figure 5. *Source*: Adapted from farmbiosecurity, Creative Commons Attribution 3.0 license

effort to unify international standards of pesticide management and to reduce some of the negative effects of regulatory gaps, the FAO and WHO jointly released The International Code of Conduct on Pesticide Management.

Concerns in pest management

Pesticides have become a vital part of sustained food production to meet the needs of a growing global population. However, widespread pesticide use poses concerns to human health, the environment, and long-term sustainability. As an example, the process of pests becoming resistant to pesticides reduces the long-term effectiveness of those pesticides.

Climate change, the introduction of new pests, and several other factors have increased pest pressures in the tropics, where food insecurity is already a major concern. Pests contribute greatly to crop loss, and farmers in resource-limited regions experience some of the most significant effects (Chakraborty and Newton, 2011). For example, over the past three years in East Africa, the combined drought and fall armyworm infestation resulted in maize crop losses of up to 100% for some farmers (FAO, 2017; Sisay *et al.,* 2019).

The current global situation calls for a multi-pronged approach to pest management. To be widely applicable, this approach must provide farmers with options to control pests at various scales of production (from small farms to very large operations) with a diversity of resources. Integrated pest management (IPM), a strategy based on farmer innovations, is highly adaptable to specific contexts and reduces dependency on pesticides while still recognizing their use. IPM has gained traction since 1989; in particular, Farmer Field Schools (FFS) have effectively educated farmers about IPM (Peshin *et al.,* 2009).

IPM focuses on the larger system and aims for long-term prevention of pests using a combination of techniques and controls. An individual farmer's IPM plan should constantly improve as it cycles, as shown in figure 2. The rest of this article will address the knowledge and prevention aspects of the cycle.

KNOWLEDGE

Learning is useful at any time in a continually improving IPM strategy, but can be especially advantageous when beginning an IPM plan. Obtaining some of the important information may require community collaboration.

Identify important pests in the region

Seasonal insect pressure can change from year to year, due to the introduction of new pests from global trade and/or from the abiotic spread of pests and disease. Still, it is important to record pests that farmers regularly see during different growing seasons; this will help you understand which pests are common, and when they tend to arrive each season.

Learn the life cycles of important pests

Pests' lifespans and life cycles vary greatly. You should be able to identify common pests in many different life stages, such as egg, larva, nymph, pupa, or adult (Figure 3). If you can recognize stages in pests' life cycles, you will be better able to intervene, because some interventions are only effective at certain life stages. Information such as lifespan and/or the presence of a winged stage allows you to estimate the potential rate of spread and/or mobility of the pest population.

Identify natural enemies of important pests

Natural enemies of pests may live in the environment and already help control the pest population naturally. Some natural enemies are well-known (Figure 4), while others can be determined by carefully observing interactions between pests and other species. Once you know of natural

Figure 3. Cowpea bruchid (*Callosobruchus maculatus*) eggs (left) and adults (right). On the cowpea seed, you can also see a hole where one of the larva emerged. *Source*: Tim Motis

Figure 4. Ladybug (*Harmonia* sp.), an insect pest predator. The larva in the left photo is feeding on aphids. The right photo shows an adult ladybug. Both were on sorghum leaves at ECHO in Florida. *Source*: Tim Motis

enemies, you can record their relative abundance before and during the growing season.

Determine factors in the growing area that affect pest pressure

Pay attention to factors in the growing area that affect pest pressure. These may be environmental, such as trends observed in the field during and after the growing season. They may also include cultural, economic, political, and social dynamics. Here are some examples of questions to think about and discuss at a community level:

- **Does everyone plant at the same time?** Some pests only affect crops during specific windows of plant development. If all farmers in a region plant a crop at the same time, hypothetically they will all experience similar pest pressure. However, if one farmer's crop is behind everyone else's, that farmer may experience significantly more pest pressure.
- **Is it socially and culturally acceptable to apply pesticides in the region?** If the government restricts use of certain pesticides, farmers should follow regulations and guidelines set by local authorities. If certain pesticide applications are somehow socially unacceptable, farmers should make sure that the community is aware of their IPM plan so that the community can respond in whatever way they feel most comfortable. For example, if a farmer is applying pesticides on crops next to a school, the community may express that this should be done when students are not in school for a certain amount of time. The community may also ask the farmer to put up a hedgerow between his field and the school. Does the community have expressed goals for pest management?
- **What management options are feasible, given the available resources?** List pest management techniques that are currently used, and record their efficacy (recognizing that this will probably be subjective). What quantities of time, resources, and effort are currently invested in pest management? A lack of resources may limit the number of sustainable and feasible pest management techniques.

Knowledge is an important piece of an IPM strategy. It empowers farmers by increasing awareness of pest traits and helping to shift farmers' mindsets, so that they proactively focus on prevention of pest problems rather than reactively waiting to see and treat problems that might arrive.

PREVENTION

Pest prevention (sometimes called pest avoidance) is the deliberate minimization of the potential for pests to be present in the field. Preventative measures are the foundation of IPM, minimizing risks of crop damage. Among all pest control methods (e.g. biological, physical, cultural and chemical), some techniques are preventative while others are suppressive (Figure 5). Preventative techniques create unfavorable conditions for pests, for example by limiting pests' access to water, food sources, or shelter. Suppressive techniques kill or trap pests, reducing existing populations. This section focuses only on preventative methods.

Prevention principles and examples

Select crops or varieties best able to resist pests

Crops differ in their natural defenses against pests, and so do individual crop varieties. Plants actively defend themselves against pests in several ways.

Non-preference plants have some trait (e.g. color, odor, toxicity, or texture) that makes them undesirable to pests. For example, various bean species have trichomes (specific plant hairs) that trap insects or deter them from landing on or laying eggs on leaves. As another example,

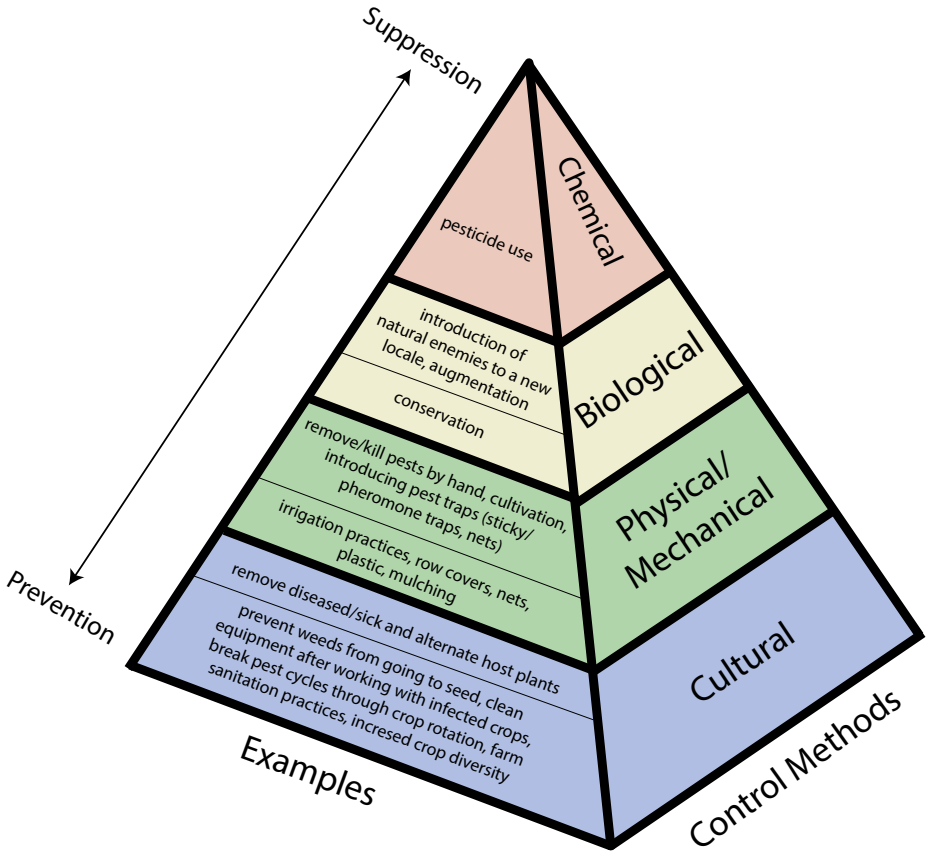

Figure 5. Control method categories and examples. Examples that are preventative techniques are in the base of each box, while suppressive examples are in the top of each box. *Source*: Stacy Swartz

some plants do not taste good or are toxic, which deters pests from eating them (at least the second time).

Resistant plants respond to pest damage in ways that reduce the amount of damage that the pest can cause. Many resistant cultivars have been developed through crop selection. The International Rice Research Institute has successfully developed various resistant cultivars. Breeding programs for sorghum have led to host-plant resistance for management of sorghum midge, green bug, mites, aphids and head caterpillars (Sharma, 1993). The International Institute of Tropical Agriculture has developed cassava varieties that are resistant to cassava mosaic disease and cassava brown streak disease (Hahn *et al.,* 1980).

Tolerant plants are more likely to remain relatively healthy and to maintain yield after pests damage them. They can fight off diseases and/or heal after damage has already been done. Crop breeders often select for the trait of tolerance in crops. Tomatoes and cucumber have varying levels of tolerance to viral infections of tomato yellow leaf curl virus and cucumber mosaic virus, respectively (Pagán and García-Arenal, 2018).

Maintain plant resilience to pests/disease

The health of propagation material contributes to the establishment of a successful crop. Make sure the seed you collect and save is fully developed and mature. **Select healthy seed/propagation material** that is free of disease, is viable (alive), and has high vigor (is strong). Some diseases spread through infected propagation material such as cuttings. Throughout the growing season, monitor plants for resistance or tolerance, flag those that exhibit higher resistance, and save propagation material from those specific plants.

When plants have access to the resources they need, they can often fight off pests and diseases. When they lack necessary resources, they become weak and are unable to recover as quickly. To minimize these risks, **plant on time, at the right spacing, and meet crop water and nutrient demands**. This may require split application of inputs (e.g. manure or compost) a few times throughout the growing season, to provide crops with enough nutrients to thrive at different stages of development.

Practice farm sanitation

Pests sometimes remain and multiply on non-crop plants such as weeds that grow among crops. You can help control pest populations by **reducing or disrupting pest habitat around the crop**. Remove volunteer/weed plants that create habitat for pests, and plants or plant residues that are diseased. Good farm sanitation also includes **cleaning equipment after working around infected plants**. If you use pruners on infected crops, make sure to sterilize the tool (using heat, isopropyl alcohol, or vinegar) before using it on crops that are not infected, to reduce transfer of disease.

Rotate crops (over time and/or spatially)

Crops in the same family tend to be sensitive to similar pests and diseases. Crop rotation over time and/or space can break the life cycle of a pest by removing the crop host that the pest needs to survive. One option is to **rotate a specific field through crops that are sensitive to different pests, over time** (Figure 6A). Crops that deter or kill pests can be included in crop rotation schedules; for example, you can rotate crops that are susceptible to nematodes with any number of nematode-suppressing crops (see *EDN* 75 for some possibilities).

In areas where more than one crop is grown at a time, you can **rotate blocks of crops spatially over time** (Figure 6B). Switching host crop plants from one location to another will help reduce pest populations over time.

You may want to plant crops with an awareness of when insect pest populations are likely to become a problem. If a particular pest goes dormant for a time (due to cold or dry weather), and you **plant ahead of pest emergence**, plants can get a head start and gain strength before pests are abundant. However, note that if farmers in your region plant at varying times, some farmers' crops may experience greater pest pressure because they have planted asynchronously. Be aware of how decisions such as planting time are made at the individual and community levels.

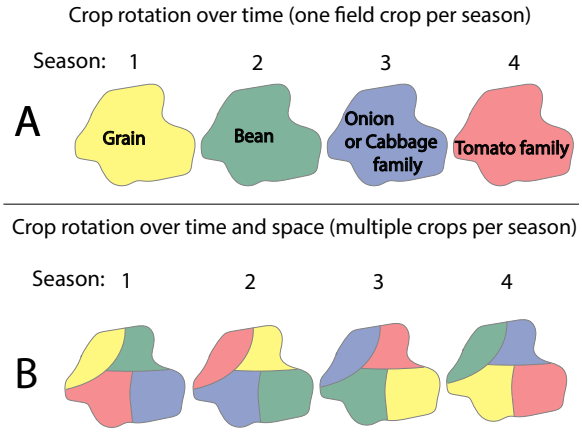

Figure 6. Examples of crop rotations over time (four consecutive seasons/years are illustrated in A) or over space and time (B; colors in B correspond to crop examples in A). *Source*: Stacy Swartz

Design to divert or minimize pests (habitat management)

Arguably, the most sustainable ways to prevent pest problems over the long term are linked to habitat management. This approach includes designing systems in ways that either divert pests away from agronomic crops or increase favorable conditions for pests' natural enemies. Almost all of the methods and techniques around habitat management will **increase a system's overall plant diversity**. Gurr *et al.* (2003) explain how plant diversity helps with pest management while also keeping inputs low. The authors also describe how the benefits of diversity in agricultural systems go beyond pest management.

Conserving native areas around crops can help prevent pests in several ways. Native plants house beneficial insects that prey on pests or outcompete them for resources. Hedgerows around crops can also visually or physically block the entrance of some pests.

Sometimes a farmer plants a **trap crop** on the outer perimeter of the plot. A trap crop is a preferred host plant for a pest that also affects a primary crop; by planting it around the perimeter, the pest is led away from the field crop to infest the trap crop instead. On some trap crops, pests cannot complete their life cycle, so farmers do not need to manage the trap crop. In other situations, to break a pest insect's life cycle, farmers harvest and then destroy trap crops, either by feeding the plant material to animals or by burning it.

Farmers can **intercrop fields with companion plants**. Companion plants benefit crops in several different ways. Some deter pests to which cash crops are susceptible or sensitive. One example is marigold, which can reduce a number of pests in various crops (for

more information about marigolds, see *EDN* 132). Other companion plants attract natural predators of pests.

The "Push-Pull" approach for pest control simultaneously incorporates trap crops and companion plants. The International Centre of Insect Physiology and Ecology and the Kenya Agricultural Research Institute system developed the system, described in *EDN* 116.

CONCLUSION

Smallholder farmers in the tropics face increasingly overwhelming hurdles. Population growth, a volatile global climate, and the need for long-term productivity make sustainable food production challenging. Integrated pest management is a platform to equip farmers with diverse decision-making skills. When farmers focus on knowledge and preventative measures, they begin to feel in control of their production, and their mindset about pest management changes from reactionary to preparatory.

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ECHOES FROM OUR NETWORK

Nutrition Education in the Context of Community Agriculture Programs

ECHO shares information to help farmers grow food more effectively, with minimal purchased inputs. However, unless training is also given around nutrition, farmers and their families will not benefit optimally from changes that are made. At the November 2017 ECHO International Agriculture Conference, Kathy Bryson shared ideas for how to integrate practical nutrition education into community agriculture programs. Bryson is the International Training Director at SIFAT (Servants in Faith and Technology), and works in Central America. Information from her talk is summarized below. You can watch Bryson's presentation on www.ECHOcommunity.org; a pdf of the presentation is also available.

Global significance of malnutrition

Globally, one in three people suffer from malnutrition. Malnutrition takes a number of different forms, including stunting (being shorter than average), wasting (being thinner than average), and being overweight. Wasting is an obvious form of malnutrition, affecting about 8% of children globally. However, hidden hunger and micronutrient deficiencies are much more prevalent, affecting about 50% of children globally. In fact, economists at the 2012 Copenhagen Consensus declared micronutrient interventions the most cost-effective way to address the world's biggest challenges. Vitamin A deficiency affects a third of children between 6 months and 5 years of age, including almost half of children in sub-Saharan Africa (48%) and Asia (44%). Vitamin A helps strengthen the immune system in the body, so supplementation can help reduce the number of deaths from infectious diseases. (Malnutrition and infection exacerbate each other; if you are malnourished, you will be more susceptible to infections. Similarly, if you suffer from an infection, you may have a decreased appetite and/or your body may have a more difficult time absorbing nutrients, increasing your risk of malnutrition.) Iron deficiency anemia, which causes a person to lack energy, is even more prevalent than vitamin A deficiency. Iodine deficiency can result in mental retardation.

Learning by doing through family gardens

One specific way to connect agriculture with nutrition is to promote nutrient-dense family gardens, which are often planted outside the house. The vegetables and fruits are easy to access and can be regularly incorporated into meals, directly impacting a family's nutrition.

Concepts to communicate

An agriculture program should be planned to include elements that relate to feeding children. The first 1000 days of a child's life are critical; nutrition in the womb and during the first two years of life will impact the rest of that individual's life. A pregnant woman needs to eat a sufficient quantity and variety of foods to support her baby's growth in the womb. Where possible, newborn babies

should be exclusively breastfed for the first six months and then continue nursing with complementary foods. This involves support from the woman's family, but also from others in the community. If you introduce a community agriculture program, you may need to look for creative ways to allow for women's involvement that also enable them to breastfeed. When introducing gardens, encourage the planting and consumption of nutrient dense foods. Also consider food preparation and processing techniques: preserve seasonal produce, and look for ways to make nutrients more bioavailable (e.g. by adding oil to foods rich in Vitamin A). Finally, observe how water is supplied and used in the community. Many diseases are spread through contaminated water--mosquitoes that carry malaria breed where there is standing water; parasites often have part of their life cycle in water; and microscopic bacteria and parasites can be present even in water that looks clean.

Bryson also shared a list of her top 12 messages to promote good child nutrition (some of which were explained in more detail in previous paragraphs):

1. Promote exclusive breastfeeding for the first six months of a child's life.
2. Add complementary foods (weaning foods) after six months.
3. Feed young children small meals, but feed them often.
4. Feed children a mixture of Go, Grow and Glow foods. *Go* foods give energy (i.e. carbohydrates), *Grow* foods help build muscle (protein and fats), and *Glow* foods contain essential micronutrients (vegetables and fruits). One way to ensure that children eat a variety of foods is to make their plate colorful.
5. Promote preservation of seasonal fruits and vegetables.
6. Encourage proper handwashing and sanitation.
7. Deworm children every six months by giving them a 400-g albendazole tablet.
8. Feed children extra when they are recovering from sickness. A good rule of thumb is to feed an extra meal for each day they have been sick.
9. Vaccinate against major childhood diseases.
10. Learn how to treat diarrhea using oral rehydration solution. Kathy shared that oral rehydration therapy (ORT) saves more lives than antibiotics! One simple recipe is 6 tsp sugar and ½ tsp salt in 1 liter of water.
11. Promote growth monitoring of children under five. Regularly plotting weight on a growth chart can help spot problems before a child becomes badly malnourished. Chart examples;

    A growth chart that can be printed (for ages 1-5)
    An interactive growth chart (for ages 2-20)

12. Use fuel-efficient cookstoves, to reduce the amount of smoke in the kitchen.

FROM ECHO'S SEED BANK

New Lima Bean (*Phaseolus lunatus*) Cultivars Available

By Cody Kiefer

Without equal, *Phaseolus lunatus* reigned supreme as my favorite childhood "vegetable." I celebrated every time my grandmother graced her table with this popular staple of the southern United States—always accompanied by golden cornbread, of course. Known as "butter bean" in the US South, my grandmother certainly knew the secrets to eliciting the creamy texture responsible for this common name. Undoubtedly, between bites of beans and bread, I had not pondered the global significance of this particular legume.

Originating in Central and South America, post-Columbian Spaniards introduced *P. lunatus* to Asia via the Philippines, and its voyage to Africa was a direct result of the transatlantic slave trade. As much of the export of *P. lunatus* originated from ports in Peru's capital, it adopted the common name, "lima bean."

A dietary dynamo, lima beans are low in fat and high in protein and dietary fiber. Myriad cultures have adopted its use, and have similarly created myriad methods to prepare it. Young pods are boiled or fried as a vegetable delicacy, mature seeds may be harvested while still fresh or allowed to dry in-pod, and leaves and stems are often used as livestock fodder. Dried seeds can be boiled and reconstituted for typical bean soups or stews or pounded into flour for various porridge and bread applications. As with most beans, adequate cooking is necessary to eliminate antinutrients.

Figure 7. Clockwise, from top left: *P. lunatus* 'Haba' vines demonstrating vigorous growth; 'Haba' cultivar seeds, white with purple mottling; 'Humidity Resistant' seed pods on vine; and 'Humidity Resistant' seeds. *Source*: Seed photos, Cody Kiefer; others, Holly Sobetski

A nitrogen-fixing legume, lima bean belongs to the Fabaceae family, and thus shares many similar characteristics with its cousins: trifoliate leaves, papilionaceous (butterfly-shaped) flowers, pod-borne seeds, and nodulating roots. Numerous cultivars of *P. lunatus* exist, and are often categorized as vining or bush types. The ECHO Global Seed Bank has historically offered four cultivars, and has recently added two new strains: 'Haba' and 'Humidity Resistant.'

Former ECHO staff member, and long-time ECHO friend, Brad Ward, noted the advantages of a locally available *P. lunatus* strain while working in the Dominican Republic. Drawn to its productivity in poor soils and harsh climates, Brad provided the ECHO Global Seed Bank with a supply of seeds, where it was dubbed 'Haba.' Plants are vining-type, day-neutral, and bear white seeds with purple mottling (Figure 7). Leaves of this cultivar are trifoliate and distinctly pointed; seed pods are green. 'Haba' is robust, high-yielding, and requires minimal maintenance. Brad also shared that cooks in the Dominican Republic found this strain flavorful.

Dr. John Bishop similarly donated seed from a lima specimen noted for its tolerance of hot, humid conditions. For most cultivars of *P. lunatus*, heat stress significantly decreases yield; however, the 'Humidity Resistant' strain provided by Dr. Bishop has shown an ability to withstand such conditions and maintain high yields. This is another vining-type cultivar. Pods are dark purple and bear black seeds (Figure 7).

Common pests and diseases of lima bean include web blight (*Rhizoctonia solani*), fusarium root rot (*Fusarium solani*), downy mildew (*Phytophthora phaseoli*), root-knot nematodes, and aphids. To reduce pest and disease pressure, apply IPM techniques mentioned earlier in this issue of *EDN*.

We encourage active development workers to take advantage of our 10 free trial seed packets offer (limited to two packets per cultivar/variety) and explore the potential of these two cultivars to bolster your work. Trial seeds can be used to evaluate new species that may help to diversify food crop options, improve soil fertility, provide useful farm products and generate income for small scale farmers. Give these selections a try, and let us know how they perform for you!

For more information on cultivation of *P. lunatus*, refer to our Plant Information Sheets on ECHOcommunity.org.

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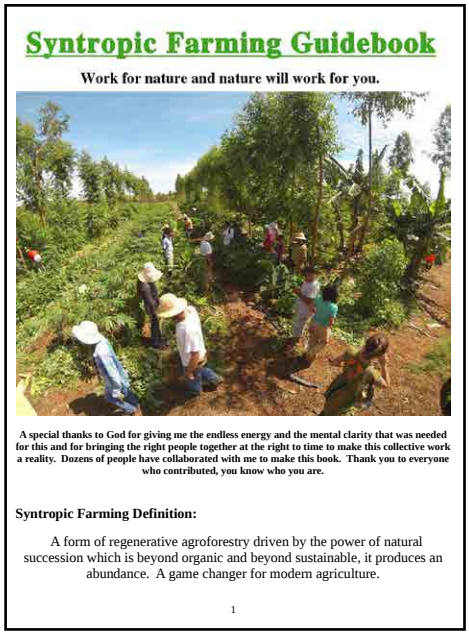
BOOKS, WEB SITES, AND OTHER RESOURCES

Syntropic Farming Guidebook by Roger Gietzen

Reviewed by Dawn Berkelaar

ECHO has an extensive network of agricultural experts working in diverse areas of production and development. Many members contribute to our various publications and resources, often writing or contributing to our existing documents.


Syntropic Farming Guidebook

Work for nature and nature will work for you.

A special thanks to God for giving me the endless energy and the mental clarity that was needed for this and for bringing the right people together at the right to time to make this collective work a reality. Dozens of people have collaborated with me to make this book. Thank you to everyone who contributed, you know who you are.

Syntropic Farming Definition:

A form of regenerative agroforestry driven by the power of natural succession which is beyond organic and beyond sustainable, it produces an abundance. A game changer for modern agriculture.

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Some provide self-developed resources for us to share with the rest of our network. One such document is *Syntropic Farming Guidebook*, written by Roger Gietzen. Gietzen shared about syntropic farming in an evening session at ECHO's 2018 International Agriculture Conference. He recently completed this guidebook and gave permission for us to post it on ECHOcommunity.org.

Gietzen begins by introducing the concept and principles of syntropic farming. Syntropic farming, developed by Ernst Götsch in Brazil, is an agroforestry approach designed to mimic a forest in several very specific ways. First, plants are densely placed to maximize both horizontal and vertical space, similar to the various strata found in a forest. This enables the system to capture as much of the sun's energy as possible.

Second, plants and trees are carefully chosen with a process of succession in mind; some of the initial plants will grow and die relatively quickly, while others will grow slowly and steadily over many years. As the system matures, the mix of plants and trees will become more diverse and more productive. Some plants are grown only for the biomass they produce; other plants, while also producing biomass, are primarily grown for their fruits or other harvestable parts.

Intense pruning is a unique aspect of syntropic farming (overstory species are sometimes pruned, removing up to 95% of biomass!). Prunings are used as mulch and provide many benefits such as suppressing weeds, feeding soil microorganisms, and aiding in temperature and water management. According to Götsch, extensive pruning at strategic times also accelerates growth. He hypothesizes that when plants are pruned during their growing stage, they release plant growth hormones into the system that encourage nearby plants to grow more quickly.

Syntropic farming is an attempt to produce food and/or cash crops, and at the same time to rehabilitate and regenerate the land. The promises of syntropic farming are many: large yields; multiple income streams; optimal use of land; no need for external inputs; improved soil quality; minimal weeding; plant resilience due to biodiversity; and better water management, both in extreme wet and dry times. Gietzen tells the story of Götsch's cacao farm, showing that an established syntropic system can sustain high productivity with a level of labor that is comparable to that needed to manage a conventional farm. However, syntropic farming can be

complicated to understand and apply. It requires in-depth knowledge of biological processes, access to many different kinds of seeds, and careful management.

In the second section of his guidebook, Gietzen gives a practical example of what it might look like to implement syntropic farming. He shares detailed, specific planting schemes illustrating one way to apply syntropic farming on existing farmland. The plans were developed specifically for Haiti, but much of the content would apply elsewhere in the tropics. Many of the trees mentioned in Gietzen's guidebook are native to Haiti; some are described in *Bwa Yo: Important trees of Haiti*, a book by Joel Timyan. [Table 8.3 in an article called "Mimicking Nature," referred to at the end of this article, shares other potential combinations of trees and crops that will likely grow well together and that could be considered for a syntropic agriculture system.]

In a book chapter called "Mimicking Nature," Katherine J. Young describes syntropic agriculture as one kind of successional agroforestry system (SAFS). Her review is helpful for understanding both the potential and the challenges of this unique approach to agroforestry. The profiled SAFS farms are impressive (Götsch's farm among them), but the challenges are real. As mentioned, management requires a high level of knowledge. Little research exists to validate claims about SAFS. Labor requirements are intense for the first five to ten years of growth. Another challenge is that marketing can be difficult when a farm yields a wide variety of crops, but none on a large scale [that said, this could be a real benefit for a smallholder subsistence farm]. Young concludes, "Nevertheless, despite these current limitations, SAFS show great promise as an innovative approach to increase agro-biodiversity, regenerate severely disturbed agricultural landscapes, diversify harvest yields, and reduce ecological and economic risks associated with conventional agricultural systems."

Syntropic Farming Guidebook is available on www.ECHOcommunity.org in multiple languages. You can watch a short video about Götsch and syntropic farming here.

Reference:

Young, K. J. 2017. Mimicking Nature: A review of successional agroforestry systems as an analogue to natural regeneration of secondary forest stands. Chapter 8 in: *Integrating Landscapes: Agroforestry for biodiversity conservation and food sovereignty* p. 179-209.

UPCOMING EVENTS

ECHO Florida Events:

Location: ECHO Global Farm, USA

26th Annual International Agriculture Conference
November 19 - 21, 2019

Dear ECHO Network Members,

The ECHO International Agriculture Conference is fast approaching. We are looking forward to many wonderful hands-on workshops, plenary presentations, and evening talks by delegates with great experiences, and oppurtunities for attendees to network.

This year we will be hosting an Appropriate Technology Fair. The fair will highlight a wide range of technologies appropriate for rural agriculture communities. You will be able to see the technologies and meet the organizations and practitioners using them around the world.

We are also honored to have Roland Bunch back in Florida at the ECHO Global Farm. He will share about his work and experiences with cover crops throughout Africa and Latin America. At the conference there will be opportunity to speak with Roland about the updated version of his book *Restoring the Soil*, and to get your own copy signed by him.

ECHO East Africa Events:

Best Practices Improving Nutrition and Sustainable Agriculture in Highland Areas
November 26 - 28, 2019
Hilltop hotel in Kigali-Remera (TENTATIVE), Rwanda

Best Practices to Improve Nutrition and Livelihoods in Pastoralist Areas
March 2 - 4, 2020
Uganda

PLEASE NOTE: At ECHO we are always striving to be more effective. Do you have ideas that could help others, or have you experimented with an idea you read about in *EDN*? What did or did not work for you? Please let us know the results!