THE MAYWAY MAILER

August 2013

Quality Matters

Chinese Herbs & Pesticides

By Skye Sturgeon, DAOM (candidate)
Quality Assurance Manager, Mayway, USA

Just over five weeks ago, various Chinese Herbal Medicine groups on the web lit up in response to a report by Greenpeace East Asia regarding pesticides in Chinese herbs. Mayway was notified about this issue by our UK affiliate early morning on Monday, the 24th of June and we have continued to receive telephone and email inquiries from concerned practitioners. We have contacted our suppliers, manufacturers, and consultants in China about this issue. Their responses are included in this article as well as the actions that Mayway is going to take in response to this problem. (See Sidebar for basic information about pesticides.)

In case you did not see the Greenpeace report, titled "Chinese Herbs: Elixir of Health or Toxic Cocktail", it can be accessed here: http://www.greenpeace.org/international/en/press/releases/Exposed-toxic-pesticides-cocktail-revealed-in-traditional-Chinese-herbs/ There is a link at the bottom of the page that takes you to the official report. Another related report from Greenpeace describes the results of sample testing in seven countries including the US, Canada, France Germany, Italy, Netherlands, and the UK. (See: http://www.greenpeace.org/eastasia/campaigns/food-agriculture/Chinese-Herbs-Elixir-of-Health/?gpi-blog where there is a link under the column on the right titled, "Take Action". Click on "Read the full international report".

The AAAOM Herbal Medicine Advisory Consortium has also been discussing this issue. One of the members of the HMAC, Eric Brand, alerted the group to a Harvard study, "Heavy Metal and Pesticide Content in Commonly Prescribed Individual Raw Chinese Herbal Medicines" that was released in 2011. This study can be accessed here: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3163780/. The Harvard study also cites several other studies that concern the presence of pesticide residues and heavy metals in Chinese herbs.

Field of *Bo he*/mint

The issue is real and Mayway is appreciative of Greenpeace's raising the alarm, but it is more complicated than either Greenpeace's or Harvard's studies show. The Harvard study is based on older data and their sampling algorithm creates an under-reporting bias because the study team monitored the herbs from seed to processing, after which they were tested. Mayway has received reports that some herbs are treated with fumigants and pesticides after "traditional" processing. Additionally, the Harvard study gathered samples from *dao di* or traditional growing areas that our contacts tell us are less likely to be grown with pesticides. Interestingly, the Harvard study found that many so-called, wild-crafted herbs were also contaminated with pesticides (presumably from wind drift or water-borne transfer, although this is unknown.) Greenpeace's samples are, at least, from actual commercially available herbs. However, Greenpeace's data over-reports in that their samples are from common, high sales volume herbs and from the largest and therefore highest volume suppliers who are the most likely to use intensive, mono-culture practices, including extensive pesticide use.

Why are pesticides being used on Chinese herbs?

One should understand that Chinese herbs are both wild-crafted, that is to say, gathered, and cultivated. Herbs are cultivated for several reasons. Firstly, demand for herbs has led to a situation where the collection of herbs in the wild has become unsustainable and has threatened some herbs with extinction. Mu xiang is listed as CITES I and is restricted in international trade. Since mu xiang is cultivated in the People's Republic of China (PRC), it is considered CITES II under this circumstance and is available only by special export and import permits.

Secondly, certain Chinese herbs are big business in China. The demand for many herbs has risen to the extent that they have become agricultural commodities. Ju hua, jin yin hua, and gou qi zi are good examples of herbs that are grown in vast mono-culture fields. This is simply industrial agriculture with all of the familiar concomitant practices associated with this scale of cultivation, including multiple pesticide use. Herbs that are derived from fruit are particularly subject to pesticide application.

Thirdly, Chinese herbs are a significant source of income for many people in China. Individual farmers and their families, cooperatives, and small villages depend on the cultivation of herbs. They are grown mixed in with crops that provide food for personal consumption and for resale. Pesticides are used to protect this investment in their livelihood and food supply. Even if pesticides are not directly applied to the herbs, cross contamination can occur and many times, entire fields are treated with anti-nematode pesticides before planting. An additional factor is that the widespread growing of herbs outside of the *dao di* regions has led to farmers using intensive agricultural methods to facilitate the adaptation of the herbs to alien growing conditions.

Greenpeace's information and conclusions reflect China's, and for that matter, the world's, overall current situation of agriculture that is necessary to feed the planet's burgeoning population. However, Chinese herbs are only one part of agriculture and by focusing on the situation of ju hua, tian qi and gou qi zi, the report gives the extremely serious and somewhat exaggerated impression that the whole Chinese herb industry abuses pesticide use. Tian qi and gou qi zi are special cases, and without the use of pesticides there would essentially be crop failure.

The number of herbs with this type of situation compared to all Chinese herbs is relatively small. The 2010 *Pharmacopoeia of the People's Republic of China* (PPRC) contains 616 medicines, including 490 plant-based herbs and 6 fungi. Of these 496, 175 are cultivated. Of the 175 cultivated herbs, not all require pesticides. A considerable number require none or little use of pesticides. Pesticide use depends on the plants own characteristics and the climatic conditions during planting; when the weather is cool, rainfall and temperature appropriate, pest incidence is low. On the contrary, drought, excessively rainy weather, or high temperatures bring a high chance of pests and diseases.

There are 35 herbs commonly requiring frequent use of pesticides. There are an additional 14 that require prolonged, high-dose, multiple varieties of pesticides. (See Sidebar for lists of herbs that are commonly treated with pesticides.) Those requiring pesticides make up 9.9% of the total 496. Thus, the vast majority of Chinese herbal medicines are likely to be free of significant pesticide residues.

As for the use of banned pesticides, due to the wide geographic dispersion of Chinese agriculture, poor management, and the low level of knowledge regarding pesticides by common farmers, it must be admitted that this situation is occurring. Some farmers may use banned pesticides when planting, especially if the local area has pest problems. Sometimes they use pesticides prophylactically at the suggestion of a local chemical dealer or farm agent. The solution to this problem requires education, the development of relevant laws, and especially, the strengthening of government enforcement.

Most herbs have pesticide residues that are detected in low amounts, but many of the detected pesticides are not registered (that is to say, banned) for use in the United States. However, FDA has determined action limits for 10 of these pesticides regarding them as unavoidable pesticides such as organochlorine residues that persist in the environment (e.g., DDT), even if their use has been discontinued.

What Greenpeace is calling for
"Ecological farming is the cure"

(See: (http://www.greenpeace.org/international/en/campaigns/agriculture/solution-ecological-farming/) I include the next five paragraphs excerpted from their website.

> "An important first step is an immediate reduction of chemical pesticides in agriculture, working towards a total elimination. Chemical intensive agricultural is a global problem affecting many countries and requires the immediate address of public authorities around the world.
>
> However to truly end our chemical pesticide addiction once and for all, the global agricultural industry must undergo a paradigm shift towards Ecological Farming, which includes dedicating more financial support by the public authorities from all over the world. Healing Chinese herbs will require facing the deep, systemic failure of chemical intensive agriculture, not simply treating the symptoms.
> Ecological farming ensures healthy food for today and tomorrow, protects soil, water and climate and promotes biodiversity. Unlike industrial agriculture, it does not contaminate the environment with genetic engineering, chemical pesticides and synthetic fertilizers. And equally as important, it is for the people, siding with small-scale farmers and local communities.
>
> Greenpeace is urging governments to implement more stringent controls and monitoring systems for pesticides residues in food products, carry out clear pesticides reduction programs and divert financial funding towards more ecological farming practices, in particular; non-chemical alternatives to control pests. Greenpeace campaigns to raise global awareness and strive towards a pesticide-free future for all. In doing so, we can heal Chinese herbs and free global agriculture from chemical addiction.
>
> Greenpeace is calling on the Chinese herbs companies to publicly disclose all pesticides used in the production of their products and to provide a timeline aimed at reducing their usage."

While Greenpeace's call for Ecological Farming is worthy of aspiration, let us examine what policies and regulations are already in place.

The PRC Ministry of Agriculture regulations for pesticide use

The Chinese Ministry of Agriculture Announcement numbers 194, 199, 322, and 1586 clearly specifies the banned and the restricted pesticides which may not be used within China. The State list of pesticides banned or restricted for use by production operations on vegetables, fruit, tea, and herbal materials:

1. Prohibits the use of 33 pesticides:
Methamidophos, parathion, monocrotophos, benzene hexachloride (BHC or 666, more accurately named hexachlorocyclohexane), dichlorodiphenyltrichloroethane (DDT), toxaphene, fenamiphos, chlordimeform, nitrofen, aldrin, dieldrin, N,N-methylene-bis (MATDA), mercury preparations, Cadusafos, tetramine, silatrane, Sulfotep, coumaphos, calcium phosphide, magnesium phosphide, zinc phosphide, arsenic, lead type, organic fluoride, ammonium phosphate, fluoroacetamide fonofos , thiophanate-methyl cyclophosphamide, dibromoethane, dibromochloropropane (DBCP), fluorine, sodium acetate, methyl parathion, and terbufos.
2. Restricts the use of 17 pesticides:
Phorate, methyl isofenphos, demeton, carbofuran, Metolcarb, Ethoprophos, Phosfolan, chlorine Triazophos banned in vegetables, fruit, tea, and Chinese herbal medicine;
Omethoate banned in cabbage and citrus trees;
Dicofol, fenvalerate, endosulfan banned in tea;
Butanehydrazide banned in peanuts;
Isocarbophos, methomyl banned in citrus trees;
Methyl bromide banned in strawberries and cucumbers;
Fipronil, banned from sale and use except as a sanitizing agent, and for the treatment of corn seed coating.

Of course, there are many other pesticides that are banned or restricted in other countries including the US. It should be noted that, even with these regulations in place, the use of pesticides is a decision of individual farmers. Enforcement is difficult, if not actually non-existent, and compliance becomes a voluntary decision of the grower.

Pesticide testing requirements for Chinese herbs

The problem is that the above pesticide-use regulations treats Chinese herbs as agricultural products, but Chinese herbs in yin pian (prepared "pieces", i.e. medicinal) form are regulated by the 2010 PPRC. The 2010 Chinese Pharmacopoeia contains a total of 616 varieties of Chinese herbs (excluding supplements) and there are only pesticide testing requirements for gan cao (licorice) and huang qi (astragalus), with testing limited to BHC, DDT, and pentachloronitrobenzene (PCNB). On October 25, 2012 the National Pharmacopoeia Committee posted a draft memorandum to require Panax ginseng and American ginseng (raw herbs and yin pian) pesticide residue testing and limits: "limits for total BHC= NMT (not more than) 0.2ppm ; total DDT= NMT 0.2ppm; PCNB= NMT 0.1ppm; hexachlorobenzene NMT 0.1ppm; heptachlor NMT 0.05ppm; aldrin NMT 0.05ppm; chlordane NMT 0.1ppm." The draft has not been formally implemented, but the public comment period has passed and it is expected to be finalized this year. Also, there is no pesticide testing requirement for finished products (patent medicines) in the PPRC.

The testing methods in Appendix IX Q of the 2012 PPRC provides for the quantitative analysis of 18 pesticides representing organochlorines, organophosphorus, and pyrethrin pesticides. (A method for carbamate pesticides is not defined.) The method employs a separate determination for each class and uses gas chromatography (GC) only. A mixed reference standard for each class, in serial dilution, must be used with each test. Reportedly, certified reference standards are difficult to obtain in the PRC.

These pesticide testing requirements are rather limited and inadequate in providing information that the users of Chinese herbs would like to know.

Good Agricultural Practices

The term *Good Agricultural Practices* (GAP) can refer to any collection of specific methods, which when applied to agriculture, produce results that are in harmony with the values of the proponents of those practices. "Good" will depend on the standards you are applying. The Food and Agriculture Organization (FAO) of the United Nations has been the primary proponent of GAP, although many member states have created their own versions.

The goals of GAP have been designed to produce safe and healthy food and non-food agricultural products, while taking into account economic, social, and environmental sustainability. The principles are applied through sustainable agricultural methods, such as integrated pest management (IPM) (See Sidebar for more information about IPM), integrated fertilizer management and conservation agriculture.

GAP applications are being developed by governments, NGOs (non-governmental organizations), and the private sector to meet farmers needs and specific requirements. However, many think these applications are only rarely made in a holistic or coordinated way and the practices do remain voluntary.

ChinaGAP Certification

In responding to concerns about food safety in the international market, advancing the standardization level of agricultural production, improving agricultural products quality and making growing and breeding enterprises adapted to the international good agricultural practice system standards, ChinaGAP was implemented on May 1st 2006.

ChinaGAP standards are constituted to encourage decreasing usage of agricultural chemical products and medications, preserve agricultural sustainable development, ensure a system of production that protects the safety of primary agricultural products, increase food quality, and engender the safety confidence of consumers. After China entered into WTO, enterprises became aware that GAP certification has been the important condition of agricultural products for import and export. Products with GAP certification are much more acceptable and competitive in both local and foreign markets.

Unfortunately, ChinaGAP has scarcely been adopted in the PRC except for model agricultural cooperatives and large agribusinesses, and even then, only in a few instances. Generally, farmers consider such requirements onerous and expensive to implement.

Good Agricultural and Collection Practices related to herbs

In addition to the GAPs discussed above there are specific protocols and policies that have been developed specifically for medicinal herbs. First, there is the "WHO Guidelines for Good Agricultural and Collection Practice for Medicinal Plants" (GGACP) (2003) (see: http://apps.who.int/medicinedocs/en/d/Js4928e/). With this document WHO has developed a series of technical guidelines relating to the quality control of herbal medicines, providing a detailed description of the techniques and measures required for the appropriate cultivation and collection of medicinal plants and for the recording and documentation of necessary data and information during their processing.

The relevant section regarding pesticides states,

> "Any agrochemicals used to promote the growth of or to protect medicinal plants should be kept to a minimum, and applied only when no alternative measures are available. Integrated pest management should be followed where appropriate. When necessary, only approved pesticides and herbicides should be applied at the minimum effective level, in accordance with the labeling and/or package insert instructions of the individual product and the regulatory requirements that apply for the grower and the end-user countries. Only qualified staff using approved equipment should carry out pesticide and herbicide applications. All applications should be documented. The minimum interval between such treatments and harvest should be consistent with the labeling and/or package insert instructions of the plant protection product, and such treatments should be carried out in consultation and with the by agreement of the buyer of the medicinal plants or medicinal plant materials. Growers and producers should comply with maximum pesticide and herbicide residue limits, as stipulated by local, regional and/or national regulatory authorities of both the growers' and the end-users' countries and/or regions. International agreements such as the International Plant Protection Convention and Codex Alimentarius should also be consulted on pesticide use and residues."

In 2006, the American Herbal Products Association and the American Herbal Pharmacopoeia published a similar, perhaps more rigorous, document, "Good Agricultural and Collection Practice for Herbal Raw Materials" (see: http://www.ahpa.org/portals/0/pdfs/06_1208_AHPA-AHP_GACP.pdf). This document's stance on pesticides reiterates the WHO position:

> "Pesticide use. If pesticides, herbicides, insecticides, or fungicides, whether from natural or synthetic sources, are used on a crop, properly trained personnel should apply these at the minimum effective rates. Only those chemicals that have been approved for use on the specific crop may be applied, and application levels must ensure that established tolerance levels for the crop are not exceeded. Application and storage of such products must be in accordance with label recommendations and all regulations."

Included in the WHO guidelines in Annex 1 is a decree by the PRC State Administration of Pharmaceutical Supervision that was implemented in June 2002. The title of this document is "Good Agricultural Practice for Traditional Chinese Medicinal Materials". Article 16 states,

> "Comprehensive prevention and control strategies should be used against diseases and insect pests which affect medicinal herbs. If it is necessary to apply pesticides, the smallest effective dosage should be used and highly effective, low-toxicity and low-residue pesticides should be selected in accordance with the provisions of the Regulations for Pesticide Management in the People's Republic of China, so as to reduce pesticide residue and pollution by heavy metals, and protect the ecological environment."
>
> However, as noted in the WHO document, "Despite such guidelines, there is still considerable disparity between knowledge and implementation. For example, it is a difficult task to train farmers and other relevant persons as producers, handlers and processors of medicinal plant materials. While pharmaceutical and other companies are striving to meet the requirements for the quality control of herbal medicines, they cannot force farmers, producers, handlers and processors to follow good agricultural and collection practices for medicinal plants."

Limitations and complications of pesticide testing

Herbs are among the most difficult vegetable products to analyze. Their extracts contain a large number of natural products that can potentially interfere with pesticide analysis. Current analytical methods target only a subset of possible pesticide compounds. Whether for food, herb, or environmental samples, analyses are often complicated by the presence of co-extracted naturally-occurring chemicals. Even after several stages of sample cleanup prior to analysis, it can be difficult to detect trace levels of contaminants in the presence of the remaining matrix.

For time and cost efficiency, multi-residue analyses (MRAs) are used to "screen" for most pesticides. Traditionally, these methods have relied upon gas chromatography (GC) with various element-selective detectors to locate pesticides in the complex mix of chemicals. Liquid chromatography (LC) is used for those compounds that are not amenable to GC. Since screening is a qualitative analysis only, GC with mass spectral detection (GC/MS) has been widely used for confirmation and quantitation of suspected hits. Today, more and more pesticide laboratories are relying upon LC with mass spectral detection (LC/MS) and GC/MS as their primary analytical tools. Still, most MRAs are target compound methods that look for a small subset of the possible pesticides. Importantly, any compound not on the target list is likely to be missed by these MRAs.

Additionally, there are over 700 registered and over 600 "banned" pesticides in use all over the world. Mayway has first-hand experience with three orders of raw herbs that have been detained by FDA this year because of pesticide residues of unregistered chemicals present in excess of maximum residue limits (MRL). (An added complication is that few pesticides have been registered with the FDA for Chinese herbs.) In some cases, the pesticides found were scarcely appropriate for the herb upon which they were used and were also banned for such use in the US.

Mayway's testing did not pick up these pesticides. They are not listed in the Pharmacopeia of the PRC nor were they a part of the typical multi-residue analysis (MRA) employed by many US testing labs, which typically screen for 190-240 pesticides. The United States Pharmacopeia (USP) describes a pesticide testing method for about 100 pesticides. The FDA-published "Luke Method" screens for less than 200 pesticides. A modification of the Luke Method is the testing method employed by many US Chinese herb importing companies and obviously does not represent a comprehensive screen of all of the possible pesticides that may be used. The FDA in its Pesticide Analytical Manual describes the multiple methods that are necessary to screen for pesticides in complex matrices. (See http://www.fda.gov/Food/FoodScienceResearch/LaboratoryMethods/ucm2006955.htm)

As in so many aspects of business, one gets what one is willing to pay for. Pesticide screening costs in the range of $370-650 per herb per batch, depending on how many pesticides are being screened, the methodology being used, and the minimum detection limit of the method. A quantitative analysis of positive hit for an individual pesticide run with a serially diluted reference standard could cost an additional $400-650. Notably, "not detected" (ND) does not mean the absence of a particular or any number of pesticides, but rather it means that it is below the detection limit of the method used or that the method is not optimal in finding that chemical. If based on a multi-residue analysis, the claim that an herb is "pesticide tested" or "pesticide free", implying that it does not contain pesticides is inaccurate. The pesticides tested for are "not detected".

Furthermore, and importantly, testing does not prevent the use of pesticides. Testing provides some knowledge but it is not a remedy. Given these difficulties in determining pesticide levels, one might ask why not simply insist on organic Chinese herbs?

About "organic" Chinese herbs

Mayway has been asked numerous times by practitioners why we don't provide organic Chinese herbs. Mayway has thoroughly investigated the possibility of acquiring organic herbs from China for many years. Can't we get "our" farmers to grow herbs organically? The answer is that some most certainly do, but it is not as simple as that.

Let me propose a definition for organic herbs. Organic herbs are herbs that are produced using methods of organic farming – that is, a form of agriculture that relies on techniques such as crop rotation, green manure, compost and biological pest control. Organic farming may use certain fertilizers and pesticides but excludes or strictly limits the use of manufactured (synthetic) fertilizers, pesticides (which include herbicides, insecticides and fungicides), plant growth regulators, food additives, genetically modified organisms, or human sewage sludge. Organic herbs are also not processed using irradiation, industrial solvents, or chemical food additives.

In the US, organic farming is certified by the United States Department of Agriculture (USDA) under the National Organic Program (NOP). The NOP authorizes 84 organic certification agencies in the US. (For a list, see: http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5100382) A product cannot simply be declared organic, no matter how it is grown. The certification process is supposed to consider soil, water, air (drift), and adjacent crops and farms in addition to handling, processing, and storage. The organic designation must hold the organic integrity of the product from farm to market. Each year, in the US, one of the USDA-accredited certifying agencies verifies that each organic operation is complying with the USDA organic regulations. This includes an on-site inspection, which can be either announced or unannounced. Additionally, at least 5 percent of certified organic operations' products are tested for residues of prohibited substances (such as synthetic pesticides) every year.

"Organic" herbs from China are problematic. Although it is certainly plausible that there are authentic organic herbs being cultivated in China, the real issue is certification. The Cornucopia Institute has been raising the alarm for years regarding numerous claims of fraudulent organic products from China. See: Cornucopia: http://www.cornucopia.org/2011/02/usda-uncovers-plot-to-import-fake-chinese-organic-food/.

One Chinese herb importer in the US claims that some of their herbs are organic, even labeling their packaging with the USDA NOP logo. Also displayed is the logo of California Certified Organic Farmers (CCOF). A search of the 2012 List of certified USDA organic operations (http://apps.ams.usda.gov/nop/) reveals that this company is certified organic for its handling operations in the US and not for its crops. CCOF has confirmed this limited designation and admitted that it does not conduct certification in the PRC. The quality of these herbs may be high; they may have no detectable pesticides; they may even be organically grown, but the herbs are not certified organic.

Mayway has contacted Ecocert (www.ecocert.com/en/), perhaps the largest organic certification body in the world and who has offices in five cities in the PRC, regarding the possibility of certifying some of our organic herbs. As mentioned above, to ensure the integrity of organic herbs from farm to market, it would require certification of the farmer, processor, and every step in the distribution chain. (For instance, Mayway has discovered that in some areas of China aluminum phosphide, a source of phosphine gas, is commonly used to fumigate entire warehouses of already processed herbs.) The cost for this certification is $5000 per herb per year for each step in the chain. Assuming only one "middle-man" distributor, this would add $15,000 to each batch of each herb. This would add $25-50 to Mayway's cost for each bag of herbs that could be certified organic. We think this

cost is unsustainable, exorbitant, and we believe our customers would find it unacceptable. In addition, many growers are unwilling to take the risk of a loss of yield from their farms and are afraid of a loss of income. They ask us if we are willing to pay more for organic herbs and if we are willing to guarantee their harvest.

There are laudable efforts to grow organic Chinese herbs underway in the US. See: High Falls Garden: http://www.localherbs.org./ (over 100 Chinese herbs are available) and Chinese Medicinal Herb Farm: http://chinesemedicinalherbfarm.com/. However, the number of varieties and the amount of each herb that is available is limited. Their main focus is educational and not commercial. Additionally, the herbs from these US growers are raw herbs and have not been traditionally processed into yin pian.

What action is Mayway going to take?

Mayway thinks that since Chinese herbs are medicinal products, that they should be held to a higher level of quality over agriculture, even though food is consumed by everyone, in much larger amounts, and over a longer term. If Chinese herbs are being prescribed for therapeutic purposes, then they should not be contaminated with neurotoxins, metabolic enzyme or endocrine disruptors, or carcinogens.

Mayway is going to respond to this issue on several fronts. First, we have identified a laboratory in the US that tests for over 415 pesticides according to the EU Phamacopoeia. Currently, we are conducting testing on every batch of herbs that we have in inventory that are among those that require "multiple pesticides with large doses" (See list in Sidebar) to determine the actual level of pesticide residue on these herbs. If any of these herbs prove to be contaminated with toxic pesticides, we will stop selling that batch of the herb, recall the entire batch from which it came, and look for an uncontaminated source.

Second, we are going to test our inventory of the 35 herbs that pesticides are used relatively often and take the same action with these herbs that was described above.

Third, we are going to test for pesticide residues in our herbs, which are soon to be harvested, before they leave China. We intend to reject any batch contaminated with pesticide levels greater than the FDA's MRLs.

Mayway has noted that in the above mentioned PRC State Administration of Pharmaceutical Supervision's Good Agricultural Practice for Traditional Chinese Medicinal Materials Article 53, the following:

> "There should be detailed records kept of the entire production process for each kind of traditional Chinese medicinal material, with photographs or pictures when necessary. The records should include (along with other data):
> (2) Production techniques and processes:
> 1.0 The planting time, quantity and area of medicinal herbs; the growth of seedlings, transplantation, the kind of fertilizer used, and the time, amount and method of its use; the type of pesticide used – including insecticides, fungicides and herbicides – and the amount, time and method of its use.

Consequently, next spring or during the next planting cycle, we are going to require the farmers from whom we receive cultivated herbs, extensive documentation regarding their cultivation practices. The WHO GGACP document provides, in Annex 5, a model document which Mayway is going to adapt and disseminate through our consultants and agronomists in China. Then, we are going to test each batch for pesticide residues using the EU Pharmacopoeia protocol. Again, Mayway will reject any herb that contains pesticide levels greater than the FDA's MRLs.

This issue is evolving here at Mayway. We are committed to continue to provide the highest quality Chinese herbal products that are authentic, unadulterated, and uncontaminated. The patients of Chinese herbal practitioners deserve a true "elixir of health" and not a "toxic cocktail."

Bio: Skye Sturgeon, DAOM (candidate) is the Quality Assurance Manager and Special Consultant for Mayway, USA. Skye is a core faculty member at the American College of Traditional Chinese Medicine where he is also enrolled in ACTCM's doctoral program. Previously, Skye was president of the Acupuncture & Integrative Medicine College, Berkeley. Before making Chinese medicine his career choice, Skye was a clinical biochemist and toxicologist.

What is a pesticide?

A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests. Additionally, under United States law, a pesticide is also any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.

According to The BCPC Pesticide Manual, more than 700 pesticides are currently approved for use around the world. About 600 more were used in the past, but are either banned or no longer marketed. However, in spite of their discontinuance, some of these still persist in the environment where they may bio-accumulate in the flora and fauna. Many pesticides or their degradation products can be found at trace levels in food, herbs, and beverages; in soil, water, and air; in aquatic and terrestrial flora and fauna; and in human blood, adipose tissue, and breast milk. The World Health Organization has classified pesticides into five groups based upon their acute toxicity to humans. The categories range from "Acutely Hazardous" to those that are "Unlikely to Present Acute Hazard in Normal Use." Certain pesticides are classified as persistent organic pollutants (POPs), carcinogens, teratogens, or endocrine disrupters.

What is a pest?

Pesticides are often referred to according to the type of pest they control.

Pests are living organisms that occur where they are not wanted or that cause damage to crops or humans or other animals. Examples include: insects; mice, nematodes, and other animals; unwanted plants (so-called weeds); fungi; and microorganisms such as bacteria and viruses, and prions.

Types of pesticides according to the type of pests

Algicides: Control algae in lakes, canals, swimming pools, water tanks, and other sites.
Antifouling agents: Kill or repel organisms that attach to underwater surfaces, such as boat bottoms.
Antimicrobials: Kill microorganisms (such as bacteria and viruses).
Attractants: Chemicals such as pheromones that attract pests (for example, to lure an insect or rodent to a trap).
Biopesticides: pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals.
Disinfectants and sanitizers: Kill or inactivate disease-producing microorganisms on inanimate objects.
Fungicides: Kill fungi (including blights, mildews, molds, and rusts).
Fumigants: Produce gas or vapor intended to destroy pests in buildings or soil. The use of sulfur dioxide to treat Chinese herbs is one example.
Herbicides: Kill weeds and other plants that grow where they are not wanted.
Insecticides: Kill insects and other arthropods.
Miticides (also called acaricides): Kill mites that feed on plants and animals.
Microbial pesticides: Microorganisms that kill, inhibit, or out-compete pests, including insects or other microorganisms.
Molluscicides: Kill snails and slugs.
Nematicides: Kill nematodes (microscopic, worm-like organisms that feed on plant roots).
Pheromones: Biochemicals used to disrupt the mating behavior of insects.
Repellents: Repel pests, including insects (such as mosquitoes) and birds.
Rodenticides: Control mice and other rodents.

Major Categories of Chemical Pesticides

Organophosphate Pesticides - They were developed during the early 19th century, but their effects on insects, which are similar to their effects on humans, were discovered in 1932. These pesticides affect the nervous system by disrupting the enzyme that regulates acetylcholine, a neurotransmitter. This action allows acetylcholine to transfer nerve impulses indefinitely and causing a variety of symptoms such as weakness or paralysis. Organophosphates are quite toxic to vertebrates. Most organophosphates are insecticides. Some are very poisonous (they were used in World War II as nerve agents). However, they usually are not persistent in the environment.

Carbamate Pesticides also affect the nervous system by disrupting an enzyme that regulates acetylcholine, a neurotransmitter. The enzyme effects are usually reversible. They are considered less toxic than organophosphates. There are several subgroups within the carbamates.

Organochlorine Insecticides They operate by disrupting the sodium/potassium balance of the nerve fiber, forcing the nerve to transmit continuously. Their toxicities vary greatly, but they have been phased out because of their persistence and potential to bioaccumulate. They were commonly used in the past, but many have been removed from the market due to their health and environmental effects and their persistence (e.g. DDT and chlordane).
(continued on next page)

Pyrethroid Pesticides were developed as a synthetic version of the naturally occurring pesticide pyrethrin, which is found in chrysanthemums. They have been modified to increase their stability in the environment. Some synthetic pyrethroids are toxic to the nervous system. Pyrethoid pesticides act to keep the sodium channels found in membranes in their open state, which means that the nerves cannot repolarize, leaving the axonal membrane permanently depolarized, thereby paralyzing the organism.

What is Integrated Pest Management?

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.

The IPM approach can be applied to both agricultural and non-agricultural settings, such as the home, garden, and workplace. IPM takes advantage of all appropriate pest management options including, but not limited to, the judicious use of pesticides. In contrast, *organic* food production applies many of the same concepts as IPM but limits the use of pesticides to those that are produced from natural sources, as opposed to synthetic chemicals.

IPM is not a single pest control method but, rather, a series of pest management evaluations, decisions and controls. In practicing IPM, growers who are aware of the potential for pest infestation follow a four-tiered approach. The four steps include:

1. **Set Action Thresholds**
Before taking any pest control action, IPM first sets an action threshold, a point at which pest populations or environmental conditions indicate that pest control action must be taken. The sighting of a single pest does not always mean control is needed. The level at which pests will either become an economic threat is critical to guide future pest control decisions.

2. **Monitor and Identify Pests**
Not all insects, weeds, and other living organisms require control. Many organisms are innocuous, and some are even beneficial. IPM programs work to monitor for pests and identify them accurately, so that appropriate control decisions can be made in conjunction with action thresholds. This monitoring and identification removes the possibility that pesticides will be used when they are not really needed or that the wrong kind of pesticide will be used.

3. **Prevention**
As a first line of pest control, IPM programs work to manage the crop, lawn, or indoor space to prevent pests from becoming a threat. In an agricultural crop, this may mean using cultural methods, such as rotating between different crops, selecting pest-resistant varieties, and planting pest-free rootstock. These control methods can be very effective and cost-efficient and present little to no risk to people or the environment.

4. **Control**
Once monitoring, identification, and action thresholds indicate that pest control is required, and preventive methods are no longer effective or available, IPM programs then evaluate the proper control method both for effectiveness and risk. Effective, less risky pest controls are chosen first, including highly targeted chemicals, such as pheromones to disrupt pest mating; mechanical control, such as trapping or weeding; or biological such as beneficial insects that eat or parasitize target pests. If further monitoring, identifications and action thresholds indicate that less risky controls are not working, then additional pest control methods would be employed, such as targeted spraying of pesticides. Broadcast spraying of non-specific pesticides is a last resort.

What are other sources of exposure to pesticides in the United States?

While the presence of pesticides in Chinese herbs is troubling, this exposure is insignificant when compared to other sources of exposure.

1. The growth of organic food in the US is phenomenal, yet, according to the Organic Consumers Association (www.organicconsumers.org/), 98% of the food consumed in the US is not organically grown. Choosing to buy organic is helpful, but food consumed outside of the home is rarely organically grown. Conventionally grown food commonly is accompanied by pesticide residues.

2. Many household products are pesticides. All of these common products are considered pesticides:
- Cockroach sprays and baits
- Insect repellents for personal use.
- Rat and other rodent poisons.
- Flea and tick sprays, powders, and pet collars.

• Kitchen, laundry, and bath disinfectants and sanitizers.
• Products that kill mold and mildew.
• Some lawn and garden products, such as weed killers.
• Some swimming pool chemicals.

3. Air and water-borne chemicals. This especially true in agricultural areas. Run-off from agricultural chemical use contaminates the water table and finds its way into wells and municipal water supplies. Air-borne pesticides can be disseminated for miles from where they are applied. The Harvard study found higher levels in many "wild-crafted" herbs, which were presumably contaminated from nearby agricultural pesticide use, than in many "cultivated" varieties.

4. Soil, from prior pesticide use. Some pesticides remain bio-active in soil for years. DDT has a half-life of up to 30 years. Even after four half-lives, four percent of a compound will remain. DDT was banned for agricultural use by the Stockholm Convention in 2004, but is still allowed for mosquito control. India is the largest producer of DDT and China ceased to manufacture DDT in 2007. It is still being used for agriculture in India, Korea, (and by Mayway's testing) China, and elsewhere. Many foods grown in California contained detectable amounts of DDT in edible portions of vegetables that come into contact with soil 12 and 24 years after the banning of its use.

List of herbs commonly treated with multiple pesticides and with large doses

Bai zhu (Atractylodes macrocephala rhizome)
Chen pi (Citrus reticulata peel)
Dang gui (Angelica sinensis root)
Da suan (Bulbus Allii Sativi)
Gou qi zi (Lycium barbarum fruit)
Hei zhi ma (Sesamum indicum seed)
Jin yin hua (Lonicera japonica flower)
Jiu cai zi (Allium tuberosum seed)
Qing pi (Citrus reticulata peel- immature)
Ren shen (Panax ginseng root)
Ren shen ye (Panax ginseng leaf)
San qi (Panax notoginseng root)
Shan zha (Crataegus pinnatifida fruit)
Shan zha ye (Crataegus pinnatifida leaf)

List of herbs on which pesticides may be used relatively often

Bai bian dou (Dolichos lablab seed)
Bai he (Lilium brownii bulb)
Bai shao (Paeonia lactiflora root)
Bai zhi (Angelica dahurica root)
Ban lan gen (Isatis indigotica root)
Bei sha shen (Glehnia littoralis root)
Bu gu zhi (Psoralea corylifolia fruit)
Da qing ye (Isatis indigotica leaf)
Dang shen (Codonopsis pilosula root)
Gan jiang (Zingiber officinale rhizome)
Gao liang jiang (Alpinia officinarum rhizome)
Hei dou yi (Lu dou yi) (Glycinis max skin)
Hua ju hong (Citrus reticulata exocarp)
Huang lian (Coptis chinensis rhizome)
Huang qi (Astragalus membranaceus root)
Jie geng (Platycodon grandiflorum root)
Ju he (Citrus reticulata seed)
Ju hong (Citrus reticulata rubrum exocarp)
Ju hua (Chrysanthemum morifolium flower)
Long yan rou (Dimocarpus longan aril)
Mu dan pi (Paeonia suffruticosa root-bark)
Mu gua (Chaenomeles speciosa fruit)
Niu xi (Achyranthes bidentata root)
Pi pa ye (Eriobotrya japonica leaf)
Ren dong teng (Lonicera japonica stem)
Sheng di huang (Rehmannia glutinosa root)
Sheng jiang (Zingiber officinale rhizome)
Shu di huang (Rehmannia glutinosa root)
Tao ren (Prunus persica seed)
Tian nan xing (Arisaema erubescens rhizome)