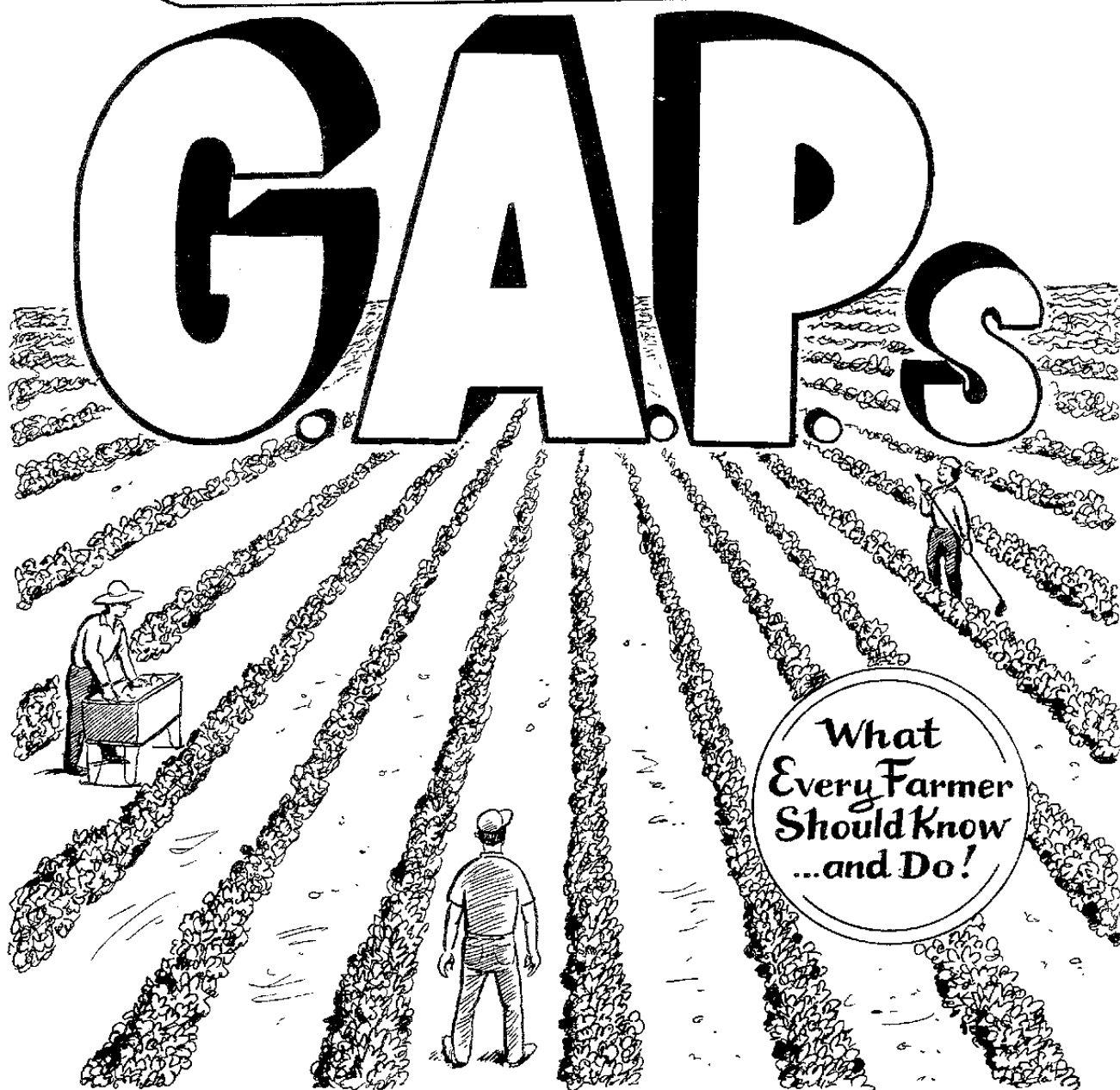




Illustrated Guide to Growing Safe Produce on Your Farm

Good Agricultural Practices



The National Sustainable Agriculture Information Service, ATTRA (www.attra.ncat.org), was developed and is managed by the National Center for Appropriate Technology (NCAT). The project is funded through a cooperative agreement with the United States Department of Agriculture's Rural Business-Cooperative Service. Visit the NCAT website (www.ncat.org/sarc_current.php) for more information on our other sustainable agriculture and energy projects.



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United States
Department of
Agriculture

National Institute
of Food and
Agriculture

Contents

The Importance of Food Safety	2
Pathogens: The Bad Bacteria that Cause Disease.....	2
Proper Handwashing Technique	11
Biodiversity and Food Safety on the Farm	11
Resources	12
Food Safety and Good Agricultural Practices (GAPs).....	12
Ready for an Audit?.....	13
Specific NOP Regulations for Composted Manures	14
Soil and Compost Resources.....	14
Water and Irrigation Resources	16
Analytical and Testing Services.....	16
Other Useful Resources.....	18
Sample Record Keeping Form for Compost/ Manure Application and for Compost Production	19

The Importance of Food Safety

Farmers play an important role in preventing food-borne illnesses through their use of good agricultural and management practices. There are many ways that farmers can reduce the risk of contamination of their produce, such as:

- The proper use (and disposal) of water,
- Proper compost and application of manure,
- Good hygiene habits from the workers in the farm,
- Regular equipment checkup and maintenance,
- Proper sanitation of processing surfaces and transportation vehicles,
- Accurate record keeping.

With these practices, a farmer is not only contributing to a better and safer food system, but also creating more consumer confidence about the farmer's product and farm while reducing the potential liabilities from a food-borne outbreak.

Pathogens: The Bad Bacteria that Cause Disease

Humans, animals and plants all co-evolved with bacteria that are considered normal, and even necessary, residents of our skin, mucosal membranes, and digestive tract, and, in the case of plants, their roots and leaves. These bacteria are benign inhabitants—they don't cause disease. Pathogens are bacteria that are not normally present in humans, animals or plants, and when they show up, they can cause disease. The good agricultural practices described in this publication were developed to reduce their presence in fresh produce, decreasing the likelihood of disease outbreaks.

The most common bacteria that cause illness are:

Campylobacter

Campylobacter is the most common cause of bacterial food-borne illness. The Centers for Disease Control estimate that 2.4 million persons are affected each year (www.cdc.gov/nczved/divisions/dfbmd/diseases/campylobacter/technical.html). It is commonly found in the intestines of warm-blooded birds and mammals. Food is the most common vehicle for the spread of *campylobacter*, and produce may be contaminated by animal feces in the fields where raw fruits and vegetables are grown. Most human illness is caused by one species, *Campylobacter jejuni*, and the disease is characterized by symptoms such as diarrhea (often bloody), abdominal cramps, and fever. The illness lasts one week.

Salmonella

Salmonella is a bacterium that causes the disease salmonellosis, with roughly 40,000 cases reported annually in the U.S. These bacteria, which live in the intestinal tract of mammals and birds, are usually transmitted to humans by eating food contaminated with animal feces, including food contaminated by food handlers who didn't use a proper handwashing technique. The disease is characterized by diarrhea (sometimes bloody), fever, and abdominal cramps. *Salmonella* infections can occasionally be localized, or become systemic by entering the blood.

Escherichia coli (E. coli)

E. coli are a large and diverse group of bacteria. Experts think that there might be about 70,000 infections in the U.S. annually with *E. coli* O157, a particularly dangerous "Shiga toxin-producing" *E. coli*, or STEC. STEC live in the guts of ruminant animals, including cattle, goats, sheep, deer, and elk, but have also been found in pigs and chickens. The major source for human illness is cattle. Infection starts when food contaminated with human or animal feces is eaten. *E. coli* most commonly cause diarrhea.

Related ATTRA publications

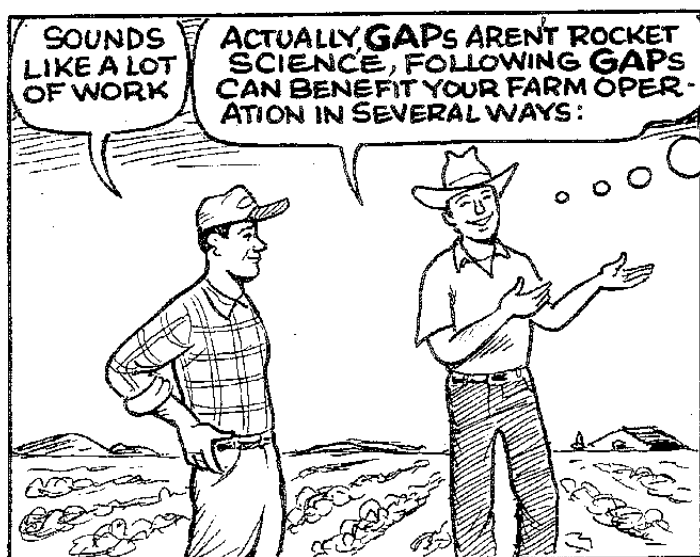
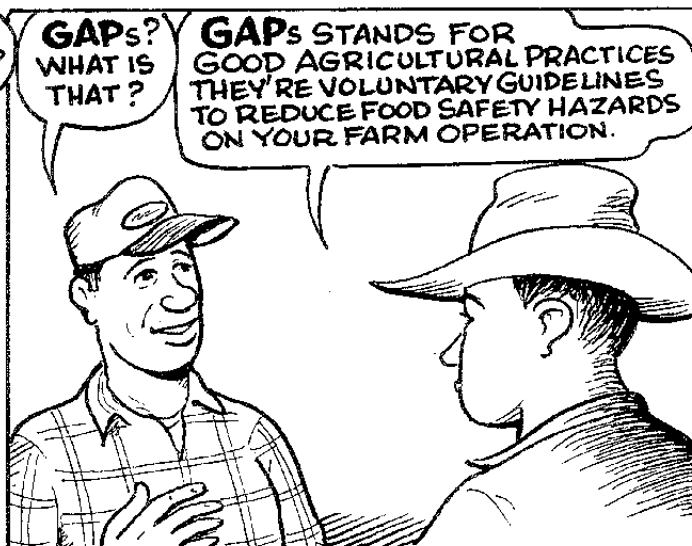
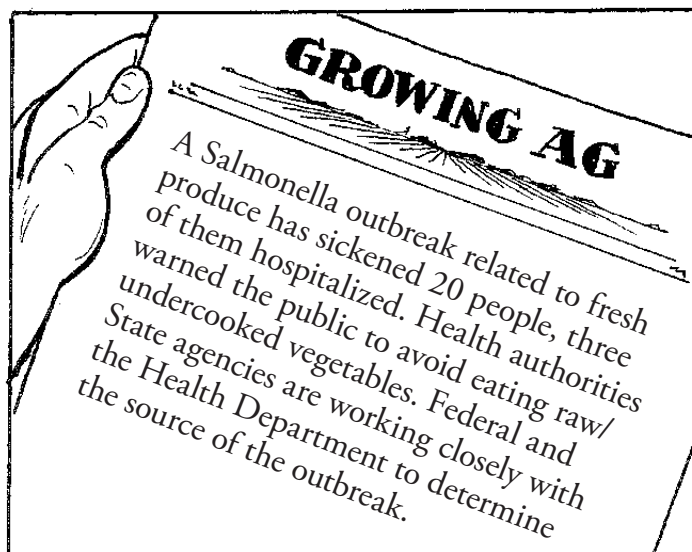
Publications available from ATTRA by phone (1-800-346-9140) or Web (www.attra.ncat.org)

Start a Farm in the City: Has information about urban soils and mitigating contaminated soil.

New Markets for Your Crops: Outlines some approaches to finding new markets, some of which might require a GAPs plan.

Protecting Water Quality on Organic Farms: Overview of practices to support good water quality on your farm.

Farmscaping to Enhance Biological Control: Includes discussion of approaches to developing hedgerows, which can act as buffers to protect crops from contamination.



...AND I HAVE ALL MY GOOD PRACTICES WRITTEN DOWN ON PAPER READY TO SHOW TO ANY FARMERS' MARKET MANAGER OR WHOLESALE BUYER



SOME BENEFITS OF HAVING A **GAPs** OR FOOD SAFETY PROGRAM FOR YOUR FARM ARE:

- Reduces the risk of produce contamination and contributes to a safer product.
- Allows easier access to markets concerned about food safety issues.
- In case of a food safety issue in your area, good records can prove your safety practices and avoid or reduce liability.

MAYBE I SHOULD HAVE A **GAPs** PLAN

THANKS PETE I'LL SEE YOU TOMORROW

I CAN GIVE YOU A TOUR OF MY FARM TOMORROW SO YOU CAN SEE HOW IT WORKS

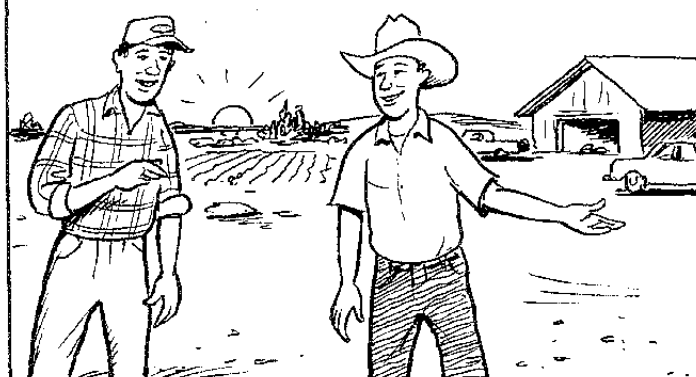


NEXT MORNING SAM VISITS PETE ON HIS FARM

HEY PETE

WHAT'S UP SAM...READY TO SEE HOW WE WORK **GAPs** INTO OUR OPERATION?

SURE



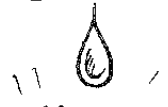
IT'S ALL ABOUT REDUCING THE RISK OF DANGEROUS GERMS THAT CAN CONTAMINATE OUR CROPS



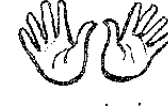
THERE ARE FOUR BASIC APPROACHES TO **GAPs**:



CLEAN SOIL: Minimize human pathogens in the soil.



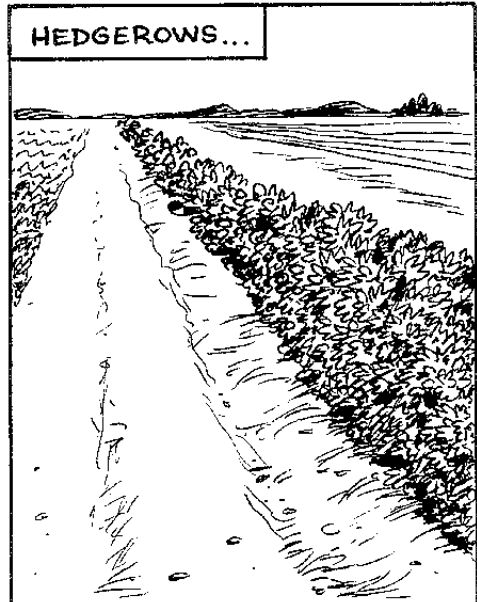
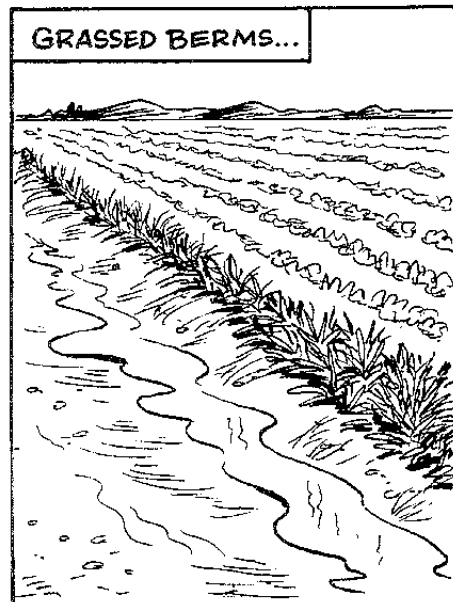
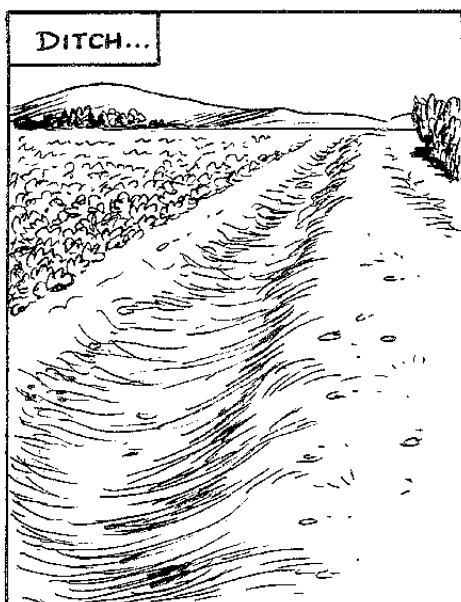
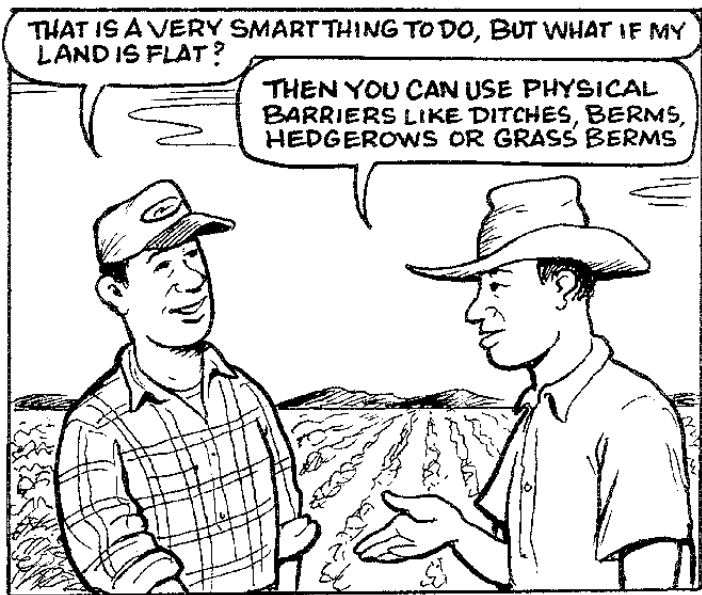
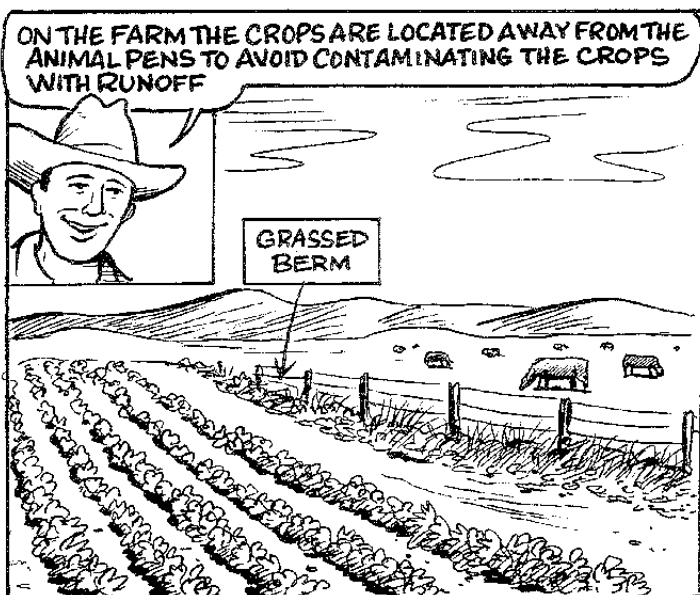
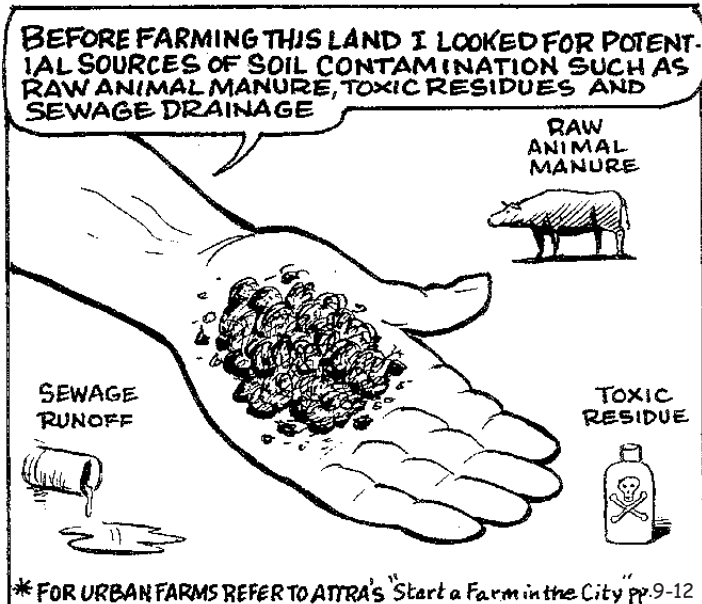
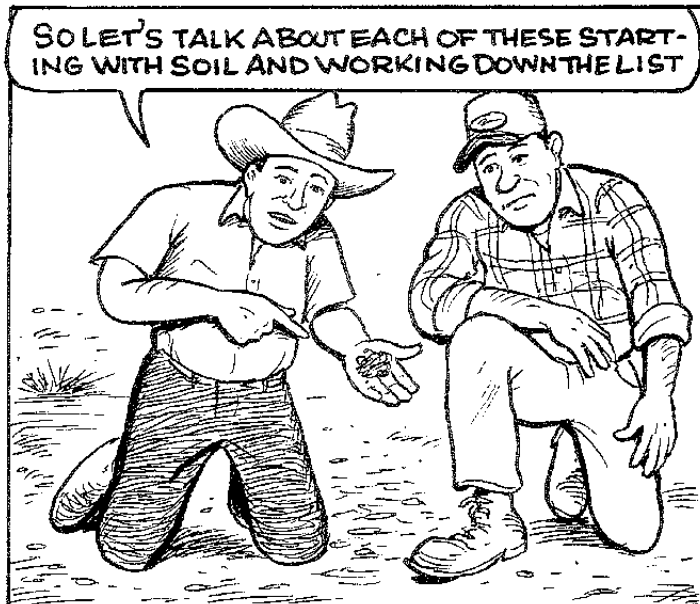
CLEAN WATER: Water quality should match its intended use. For example, water used for washing and processing should be of drinkable quality.

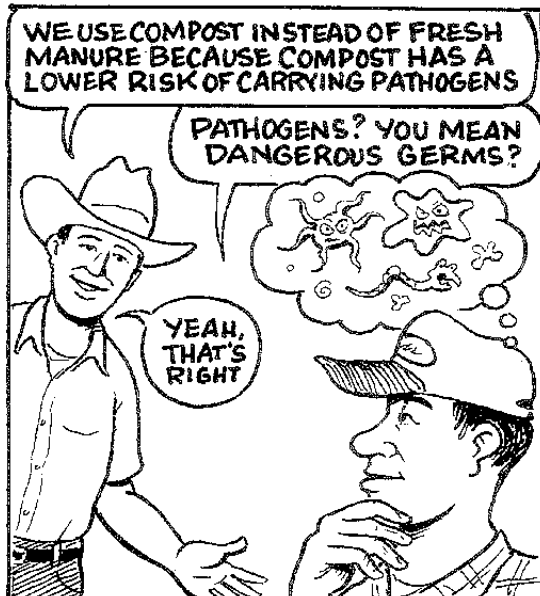


CLEAN HANDS: Workers should use good personal hygiene in the field and in the packing house.



CLEAN SURFACES: Proper washing and sanitation of working surfaces, packing bins, transportation vehicles, etc.

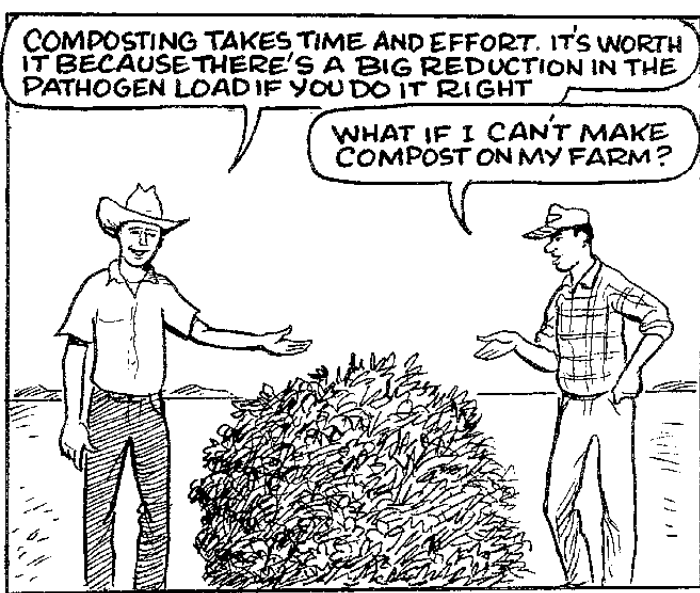
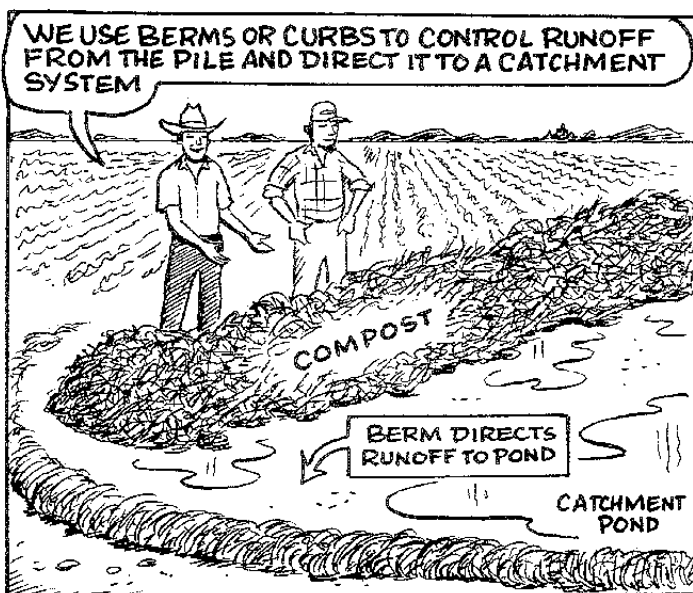




LET ME GO THROUGH THE BASICS:

- The manure composting pile is located a safe distance away from the fields and water sources.
- We store manure in windrows located on a slightly sloped surface.
- We turn the pile regularly to secure aeration and high temperatures within the compost pile.

We maximize the time between manure or compost application and harvest, to minimize risk of contaminating edible parts of the plant.



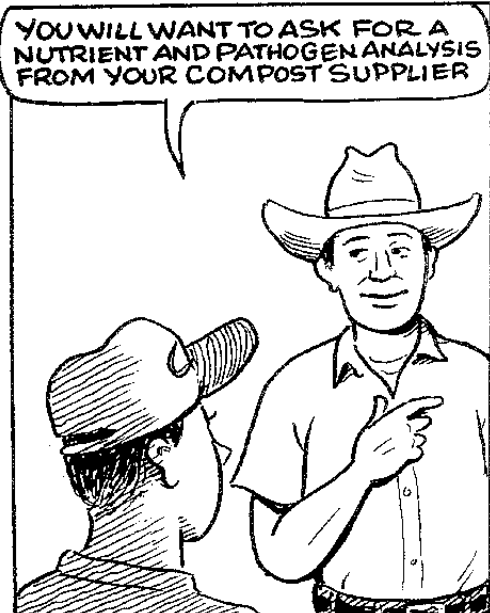
YOU CAN USUALLY BUY COMPOST. WHEN BUYING COMPOST OFF-FARM, IT'S IMPORTANT TO CONSIDER:

Delivery rates

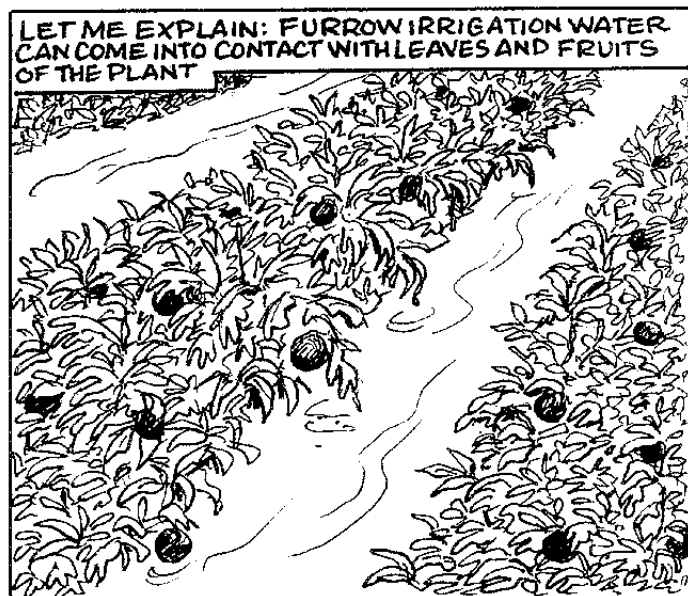
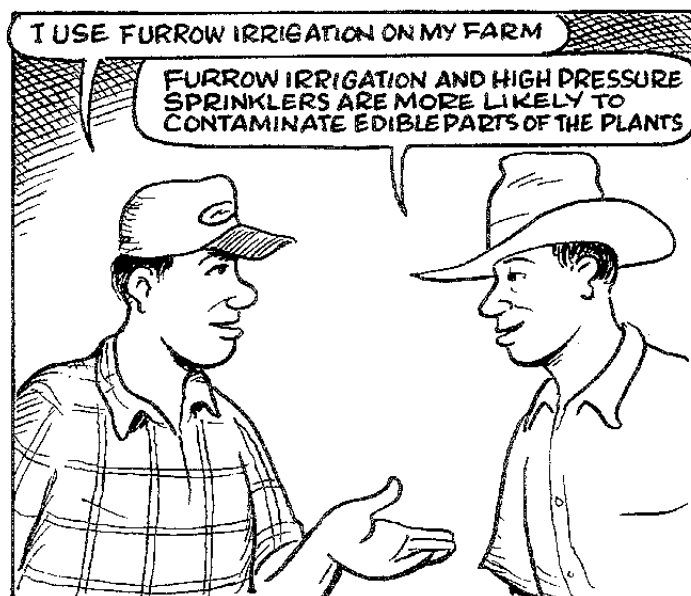
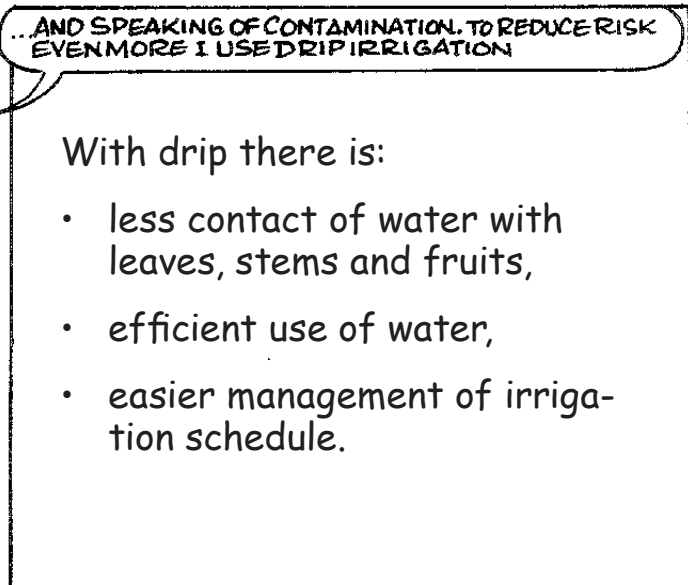
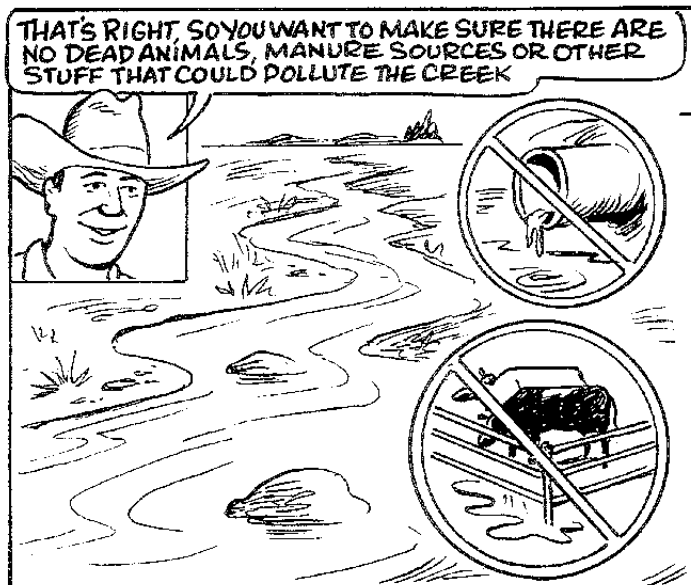
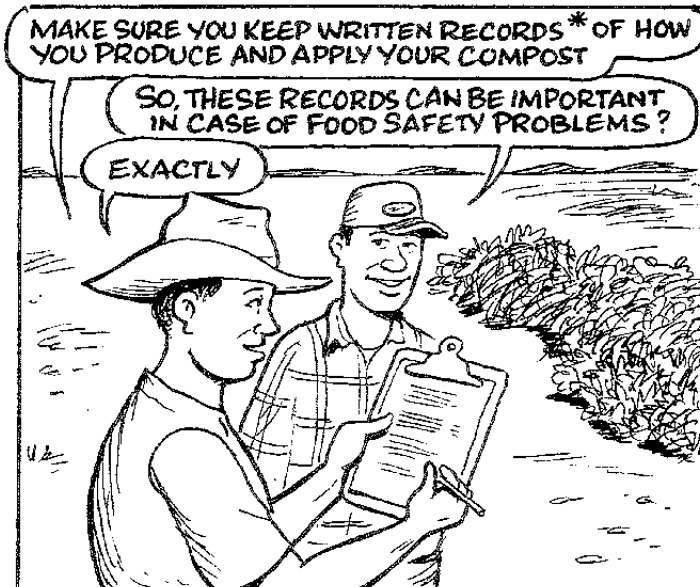
The source of the compost

The nutrient content

The pathogen load

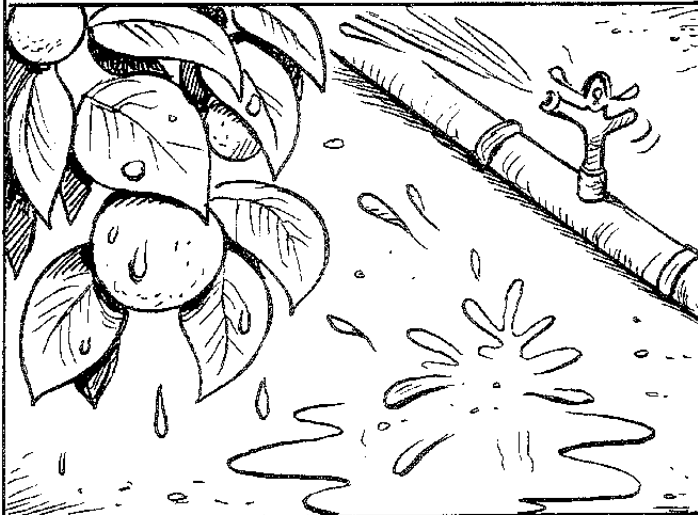


See page 16 for a list of testing laboratories



*See page 19 for manure and compost application and production record keeping documents and see page 14 for specific National Organic Program regulations for composted manures

AS FOR HIGH PRESSURE SPRINKLERS, SPRINKLER DROPS SPLASH DIRT ONTO THE LEAVES AND FRUITS.



AND FOR ANY FOLIAR SPRAYS, I USE WATER THAT'S SAFE TO DRINK.

WHERE DO YOU GET THAT WATER FROM?

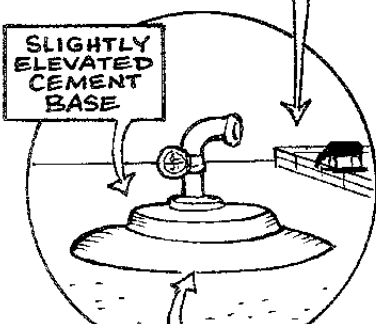
THAT'S A DEEP SUBJECT ~ WE USE WELL WATER



...AND TO MAKE SURE MY WELL WATER IS CLEAN MY WELL IS:

LOCATED AWAY FROM ANIMAL PENS

SLIGHTLY ELEVATED CEMENT BASE



NO CRACKS IN BASE OR TOP TO PREVENT CONTAMINATION FROM SURFACE WATER.

THIS IS ALSO THE WATER MY WORKERS USE TO WASH THEIR HANDS, WHICH BRINGS US TO CLEAN HANDS AND SANITATION



HOW DO YOU GET YOUR WORKERS TO FOLLOW GAPs?

I TRAIN MY WORKERS ABOUT THE IMPORTANCE OF GOOD HYGIENE AND HOW IT RELATES TO FOOD SAFETY

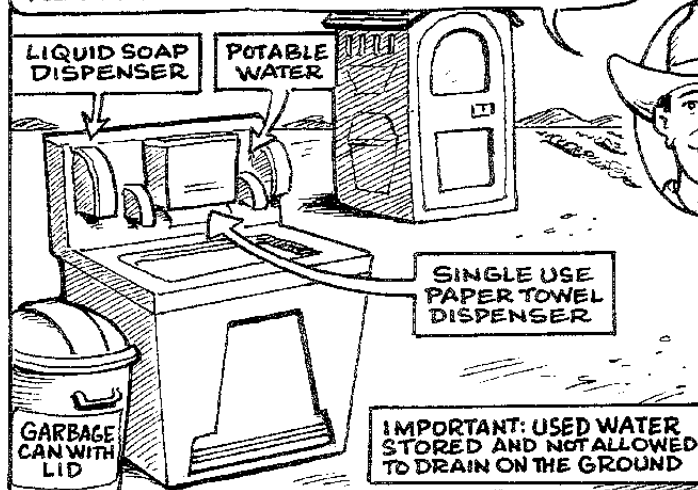


IMPORTANT POINTS TO EMPHASIZE AT WORKER FOOD SAFETY WORKSHOPS ARE:

- Make sure workers understand the connection between microbial risks, personal hygiene, food contamination, and how GAPs reduce these risks.
- The importance of reporting illness.
- The importance of simple practices such as keeping produce crates off the soil, and
- Hand washing after toilet use, eating, taking breaks, etc.
- Teach a proper and effective hand washing technique. **

** for a proper hand washing technique, refer to page 11

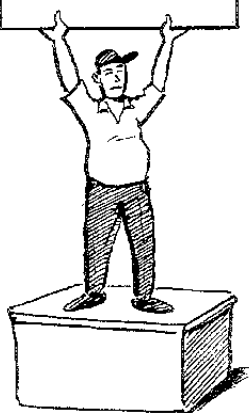
I ALSO PROVIDE EASY ACCESS FOR ALL MY WORKERS TO CLEAN PORTABLE BATHROOMS AND HANDWASHING STATIONS AND I KEEP RECORDS OF ITS CLEANING SCHEDULE



AND LAST, BUT NOT LEAST: CLEAN SURFACES I HAVE A STANDARD PROCEDURE TO CLEAN AND PROTECT ALL BINS AND HARVEST AID EQUIPMENT



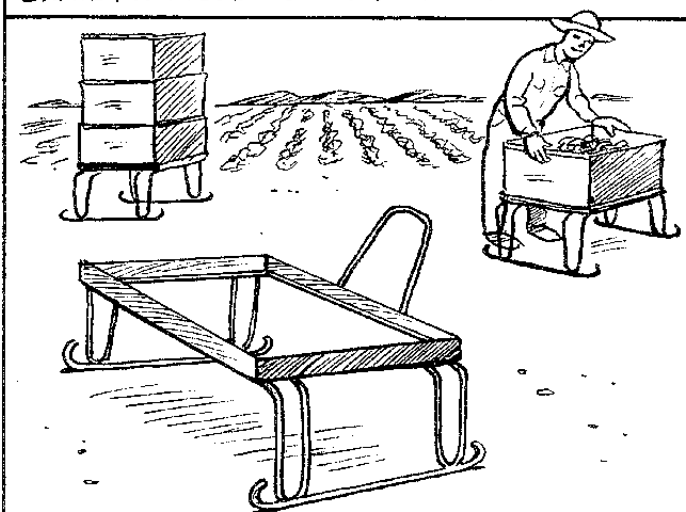
NEVER STAND ON BINS



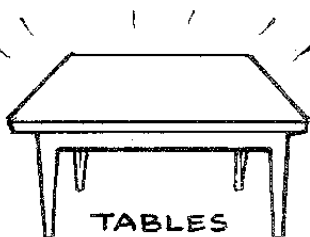
AVOID STACKING CRATES AND CONTAINERS AFTER THEY HAVE BEEN IN CONTACT WITH SOIL



ONE OF MY WORKERS CAME UP WITH A CLEVER SOLUTION: A STAND THAT KEEPS THE HARVEST CRATE FROM COMING INTO CONTACT WITH THE SOIL



OTHER FARM EQUIPMENT THAT IS USUALLY NEGLECTED, BUT SHOULD ALSO BE ROUTINELY CLEANED AND SANITIZED INCLUDES:



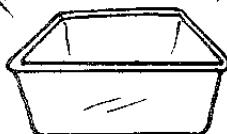
TABLES



PERSONAL HAND TOOLS



BUCKETS



PRODUCE WASH BIN

INSIDE THE PACKING HOUSE CONSIDER THESE RISK MANAGEMENT PRACTICES:

- The packing facilities and equipment should be clean and sanitized at the end of each day.
- All food scraps, grains, and culls should be removed to avoid attracting pests.
- There should not be any animals or pests present in the packing house.





Proper Handwashing Technique

- Wet hands with clean, warm water, apply soap, and work up a lather.
- Rub hands together for at least 20 seconds.
- Clean under the nails and between the fingers.
- Rub fingertips of each hand in suds on palm of opposite hand.
- Rinse under clean, running water.
- Dry hands with a single-use towel.

From *Food Safety Begins on the Farm: A Grower's Guide*.
Cornell University.

Biodiversity and Food Safety on the Farm

Biodiversity is the number and variety of organisms found within a specified geographic location. Biodiversity is important to sustain farm ecosystems because biodiverse soils function better than non-biodiverse soils—they have superior ability to absorb and hold water, are less prone to wind and water erosion, and, through interactions between soil organisms and the plant, biodiverse soils make available a wider range of nutrients to the plant than non-biodiverse soils. A biodiverse farm also retains many checks and balances against outbreaks of pests. Conversely, lack of biodiversity and lack of habitat for beneficial organisms can lead to overuse of pesticides, which is a food safety concern. However, a few species of animals on the farm can present food safety risks if adequate measures are not adopted. The following table lists animal species, the food safety risk they represent to your crops, and actions farmers should take to avoid contamination of produce.

Relative Risk to Unprocessed Produce from Animal Presence		
Domestic Animals	Food Safety Risk	What a Farmer Can Do
Cattle	Very High	• Prevent contamination of cropland, and water sources used for crop management, with pasture and rangeland runoff. • Use grasses and vegetable buffers between crops and grazing lands. • Rest grazing areas at least a week prior to irrigation. • Filter runoff through wetlands. • Avoid feeding on confined areas, use healthy pastures. • Use certified compost or make sure farm-made compost is adequately managed. • Use hedgerows or windbreaks to avoid possible dust containing manure blowing into crops.
Non-Domestic Animals	Food Safety Risk	What a Farmer Can Do
Feral pigs	Moderately Low	• Monitor fields for feral pig intrusion. Define no-harvest zone if fecal matter is identified. • Hunt the pigs or install hog wire fence. • Removing habitat doesn't work.
Wildlife	Food Safety Risk	What a Farmer Can Do
Deer	Low	• Use inexpensive feeding attractants away from crops. • If high deer activity: discourage animals with loud noises, motion sensors, food attractants, and fencing as last resource. • Do not remove habitat that protects water quality.
Rodents	Moderate	• Don't grow crops eaten raw near concentrated cow manure.
Field Rodents	Low	• Removing habitat that filters pathogens in water is counterproductive.
Birds near cattle operations or polluted areas	Low	• Do not plant or at least do not harvest in areas where birds consistently perch directly over planted beds.
Amphibians and reptiles	Low	• Make sure that nearby riparian areas are not unnaturally depleted of water during the crop season. Conserve habitat.
Insects	Low	• Do not grow crops eaten raw next to areas of concentrated cow manure. • Do not harvest crops impacted by high populations of flies close to harvest.
Abstract from Summary Table: Relative Risk to Unprocessed Produce from Animal Presence. Prepared by Wild Farm Alliance. www.wildfarmalliance.org . Obtained from: "Your Farm" Family Farm. Good Agricultural Practices "gaps" and Standard Operating Procedures "sops" Community Alliance with Family Farmers, www.caff.org/policy/GAPsJuly52010.pdf		

Resources

Food Safety and Good Agricultural Practices (GAPs)

Several universities and extension services have publications and resources regarding food safety and GAPs. Some of them are listed below:

Iowa State University. University Extension Publications:

On-Farm Food Safety: Guide to Good Agricultural Practices (GAPs)

Learn how to develop a food safety plan on the farm that documents your risk reduction efforts.

<https://www.extension.iastate.edu/store/ListItems.aspx?Keyword=Good%20Agricultural%20Practices>
www.extension.iastate.edu/Publications/PM1974a.pdf

On-Farm Food Safety: Guide to Food Handling

Details of safe food handling habits related to health, hygiene, and handwashing for all farm workers.

<https://www.extension.iastate.edu/store/ListItems.aspx?Keyword=guide%20to%20food%20handling>
www.extension.iastate.edu/Publications/PM1974B.pdf

On-Farm Food Safety: Guide to Cleaning and Sanitizing

Suggested checklists, standard procedures, and schedules to document proper on-farm cleaning and sanitizing practices.

www.extension.iastate.edu/store/ListItems.aspx?Keyword=guide%20to%20cleaning%20and%20sanitizing
www.extension.iastate.edu/Publications/PM1974C.pdf

Cornell University Department of Food Science

Several resources and publications available online.

GAPsNET

Good Agricultural Practices Network for Education and Training. The website shows GAPs-related events provided by the National GAPs Program collaborators.

www.gaps.cornell.edu

Food Safety Begins on the Farm: A Grower's Guide

Good Agricultural Practices for Fruits and Vegetables

<http://sfp.ucdavis.edu/pubs/articles/foodsafetybeginsonthefarm.pdf>

Minimize Pathogen Contamination During Production and Harvest of Fresh Produce

www.wcmorris.com/gap/files/cornell_foodsafe.pdf

National GAPs Educational Materials

www.gaps.cornell.edu/rks.html

Commercial On-Farm Food Safety Practices

New Mexico State University and University of Hawaii, Manoa. Dr Willis Fedio & Jim Hollyer.

This website offers a general view to commercial farmers of the best on-farm food safety practices.

<http://gaps.nmsu.edu/welcome.html>

If you need more information about this website and its content, please e-mail:

Dr Willis Fedio Ph.D.,

Microbiologist

New Mexico State University, Physical Science Laboratory,
wfedio@psl.nmsu.edu

Jim Hollyer,

University of Hawaii,

hollyer@hawaii.edu

There is also a 25 min. DVD video available titled *Closing the GAPs: Utilizing Good Agricultural Practices* that demonstrates the Good Agricultural Practices.

Cost: only shipping and handling fees apply

To order or for more information please contact:

College of Agricultural and Home Economics

Box 30003, MSC 3AI

New Mexico State University

Las Cruces, NM 88003-8003

Or call:

575-646-5368 or toll free: 1-888-750-4156

vstudio@nmsu.edu

The Joint Institute for Food Safety and Applied Nutrition (JIFSAN) has a Good Agricultural Practices manual available online for free at:

www.jifsan.umd.edu/training/gaps_manual.php

The U.S. Food and Drug Administration (FDA) has a variety of guidance documents online regarding food.

Guidance for Industry: Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables.

October 26, 1998.

This U.S. Food and Drug Administration (FDA) guide provides assistance to U.S. and foreign produce industry in enhancing the safety of domestic and imported produce by addressing common areas of concern in growing, harvesting, sorting, packing, and distribution of fresh produce.

Available online at: www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/ProduceandPlanProducts/ucm064574.htm

Contact information:

Office of Food and Safety.

U.S. Food and Drug Administration,

5100 Paint Branch Parkway

College Park, MD 20740

301-436-1700

Also, the FDA offers specific documents on crops:

Guides to Minimize Microbial Food Safety Hazards of:

Leafy Greens: <http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/ProduceandPlanProducts/ucm174200.htm>

Melons: <http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/ProduceandPlanProducts/ucm174171.htm>

Tomatoes: <http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/ProduceandPlanProducts/ucm173902.htm>

The New Crops Opportunity Center, from the University of Kentucky Department of Agriculture, provides production and marketing information on new crops and value added versions of current crops. They have a good introductory publication about Good Agricultural Practices: www.uky.edu/Ag/NewCrops/introsheets/gap.pdf

For more information, contact:

Christy Cassidy
Coordinator, New Crop Opportunity Center
N-318 Agricultural Science Center
University of Kentucky
Lexington, KY 40546-0091
859-257-1477
newcrops@uky.edu

Farm Food Safety. On-farm Food Safety from Penn State University. The web page shows you a four-step process to safer farm practices, with different resources from publications, training material and videos. There is also information on training and workshops.
<http://foodsafety.psu.edu/gaps>

Rhode Island Food Safety Education. URI Cooperative Extension. Includes information on Rhode Island's Good Agricultural Practices Grower Certification Program.
www.uri.edu/ce/ecf/food/grow.html

Kentucky Department of Agriculture: Good Agricultural Practices Educational Resources. A variety of resources from different sources can be found in this website regarding self audits, third party audits, general information, good agricultural practices, microbial contamination, training manuals for farm workers, and also product specific publications (tomatoes, peaches, lemons, etc.) Available on the Web at:
www.kyagr.com/marketing/GAPResources.htm

North Carolina Market Ready. Fresh Produce Safety. NC Cooperative Extension Fresh Produce Safety – Field to Family is one of the core educational focus areas of NC Market Ready program. Developed for NC Cooperative Extension personnel and NC growers and consumers, the

Fresh Produce Safety portal, contains valuable resources and materials, including information on Good Agricultural Practices (GAPs), traceability, training materials, cost share opportunities and more. Visit this portal at: www.ncsu.edu/enterprises/ncfreshproducesafety.

National Good Food Network

The National Good Food Network is bringing together people from all parts of the rapidly emerging good food system – producers, buyers, distributors, advocates, investors and funders – to create a community dedicated to scaling up good food sourcing and access. The webpage has a variety of resources including publications, news and webinars.
www.ngfn.org

Ready for an Audit?

The retail and food service industries are implementing the fresh produce audit verification program in order to verify that farms are producing fruits and vegetables in the safest possible way. These audits are performed by third parties to verify that specific good agricultural practices are being followed.

The Agricultural Marketing Service, together with state departments of agriculture, offers a program based on voluntary audits that confirms adherence to the recommendations made in the Food and Drug Administration's *Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables*. If you are interested in this program, please contact:

Kenneth S. Petersen
Audit Programs Coordinator
Fresh Products Branch
1400 Independence Avenue SW
Room 1661, Stop 0240
Washington, DC 20250-0240
Phone: 202-720-4560
FAX: 202-720-8871
ken.petersen@usda.gov

Steve Thomas
California Department of Food and Agriculture
Program Supervisor
CA Fed-State Inspection Service
165 East Tulare
Dinuba, CA 93618
Phone: 559-595-8000
stthomas@cdfa.ca.gov

There are also self audits available on the Internet:

UC Good Agricultural Practices offers GAP self audits which allow you to assess the GAPs in use in your business. You can answer the self audit online or print the self audit for your use. The complete document is available for download.
http://groups.ucanr.org/UC_GAPs/GAP_Self-Audits

Penn State GAP Self Audit. This Food Safety self audit is based on the USDA Good Agricultural Practices and Good Handling Practices Verification Program Audit Matrix. http://foodsafety.psu.edu/gaps/Checklist_with_Points2.pdf

Grading, Certification and Verification. The Agricultural Marketing Service (USDA) offers a listing of participating companies that perform third-party audits for the retail and food service industry to verify that their suppliers are in conformance to specific agricultural best practices. www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateN&page=GAPGHPAuditVerificationProgram

The Kentucky Department of Agriculture lists in its website self-audit resources (from Cornell University) as well as third-party audit resources. www.kyagr.com/marketing/GAPResources.htm

The NC Market Ready program also has audits available (self audits and third-party audits) and food safety plans essential to obtain GAPs certification. http://ncsu.edu/enterprises/ncfreshproducesafety/?page_id=2347

What will you do if a food-borne illness is suspected to come from your farm?

The best way to protect yourself is to have proper documentation. A personal food safety manual for your farm is like “insurance” that shows the application of good practices. The **University of Massachusetts Extension** has a Good Agricultural Practices Food Safety Manual available online for free that can be used as a template for your farm. The manual is available at: www.umassextension.org/nutrition/index.php/programs/food-safety/programs/good-agricultural-practices/gap-manual

For more information on GAPs and help in setting up a Food Safety Plan at your farm, contact:
David Nyachuba
dgn@nutrition.umass.edu
413-545-0552

or
Rich Bonanno
rbonanno@umext.umass.edu
978-361-5650

The **Kentucky Department of Agriculture** also has a compilation of farm manuals available from different resources to download or click from their website: www.kyagr.com/marketing/GAPResources.htm

Fresh Produce Safety Plan for Field Practices (NC Market Ready). Consumers and retailers are demanding accountability when it comes to producing, buying and selling fresh produce. Developing, implementing and auditing a

food safety plan are essential steps in obtaining Good Agricultural Practices (GAPs) certification. NC Market Ready has a compilation of resources useful in this area: http://ncsu.edu/enterprises/ncfreshproducesafety/?page_id=2383

Specific NOP regulations for composted manures:

Policy

“Processed manure may be used as a supplement to a soil building program without a specific interval between application and harvest. As always, producers are expected to comply with all applicable requirements of the NOP regulations with respect to soil quality, including ensuring the soil is enhanced and maintained through proper stewardship.

Processed manure products must be treated so that all portions of the product, without causing combustion, reach a minimum temperature of either 150° F (66° C) for at least one hour or 165° F (74° C), and are dried to a maximum moisture level of 12%; or an equivalent heating and drying process could be used. In determining the acceptability of an equivalent process, processed manure products should not contain more than 1x10³ (1,000) MPN (Most Probable Number) fecal coliform per gram of processed manure sampled and not contain more than 3 MPN Salmonella per 4 gram sample of processed manure.”

The NOP document master list is available on the Web at: www.ams.usda.gov/nop/NoticesPolicies/MasterList.html

And specific regulations for processed animal manures: www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELP-RDC5062127

Soil and Compost:

ATTRA Publications

All these publications are available online on our ATTRA website: <http://attra.ncat.org> or by calling and requesting a free copy at: 800-346-9140.

Alternative Soil Testing Laboratories

This resource list provides a range of soil testing labs and supplies that support the special analytical needs of farmers using organic or sustainable production methods. <http://attra.ncat.org/attra-pub/summaries/summary.php?pub=285>

Biodynamic Farming and Compost Preparation

Biodynamic agriculture was the first ecological farming system to arise in response to commercial fertilizers and specialized agriculture after the turn of the century, yet it remains largely unknown to the modern farmer and land-grant university system. The contribution of biodynamics to organic

agriculture is significant, however, and warrants more attention. This publication provides an overview of biodynamic farming and includes additional details and resources on the specialized practice of biodynamic composting.

<http://attra.ncat.org/attra-pub/summaries/summary.php?pub=290>

Farm Scale Composting Resource List

This resource list offers readings, links, associations, software, periodicals and bibliographies on composting at an individual farm scale.

<http://attra.ncat.org/attra-pub/summaries/summary.php?pub=287>

Manures for Organic Crop Production

Livestock manures are an important resource for sustainable and organic vegetable crop production. This publication discusses the problems and challenges associated with using both raw and composted manures and some of the solutions. Because it is a similar material with related concerns, guano is also dealt with in this document. Restrictions on the use of raw manure in organic farming are also discussed.

<http://attra.ncat.org/attra-pub/summaries/summary.php?pub=182>

Notes on Compost Teas

This publication offers a brief discussion of compost teas compared with compost extracts, describes some methods and equipment for compost tea production, and introduces the soil foodweb concept. A list of laboratories that analyze compost tea is provided, along with an annotated list of key literature and links to resources on the Web.

<http://attra.ncat.org/attra-pub/summaries/summary.php?pub=125>

Soil Management: National Organic Program Regulations

The National Organic Program Rule, §205.203, Soil Fertility and Crop Nutrient Management Practice Standard, does not define specific land practices that producers must use. But it does identify general soil management and environmental protection objectives. From these objectives, producers and the organic certifiers they work with must determine whether specific farming practices meet the NOP criteria. This publication provides management guidelines for meeting, and measurable parameters for monitoring, these objectives. It also discusses why these objectives are essential for maintaining sustainable, organic production systems.

<http://attra.ncat.org/attra-pub/summaries/summary.php?pub=180>

Other Soil and Compost Resources

BioCycle: Journal of Composting and Organics Recycling

Advancing composting, organics recycling, and renewable energy.

Available online at: www.jgpress.com/biocyclus.htm

Compost Science and Utilization

An online site with different resources for composting science and use.

www.jgpress.com/compostscience/index.html

Composting at Home

A factsheet from the Ohio State University Extension. Available online at: <http://ohioline.osu.edu/com-fact/0001.html>

Cornell Composting

This website is maintained by the Cornell Waste Management Institute and provides access to a variety of composting educational materials and programs developed at Cornell University.

<http://compost.css.cornell.edu/index.html>

Also available, the On-Farm Composting Handbook: http://compost.css.cornell.edu/OnFarmHandbook/onfarm_TOC.html

Farmer Information Fact Sheets: Composting

A set of simple procedures for making compost on the land, from grass cuttings and using water hyacinth.

<http://lecoport.org/perl/lecoport15.pl?SearchType=slideshowView&slideshowId=92&checkRequired=Y>

US Composting Council (USCC)

The USCC is a national, nonprofit trade and professional organization promoting the recycling of organic materials through composting. The USCC is the only national organization committed to the advancement of the composting industry.

www.compostingcouncil.org

Agricultural Composting Basics

From the Ministry of Agriculture, Food and Rural Affairs, Ontario. A very comprehensive factsheet available online at: www.omafr.gov.on.ca/english/engineer/facts/05-023.htm#site

eXtension

An interactive learning environment with diverse publications on topics such as agriculture. They have a search engine to locate Extension offices near you. A good article on manure and compost utilization is available online:

Manure and Compost Utilization on Fruit and Vegetable Crops

www.extension.org/pages/Manure_and_Compost_Utilization_on_Fruit_and_Vegetable_Crops

Also, **Making and Using Compost in Organic Agriculture** www.extension.org/article/18567

Water and Irrigation:

ATTRA Publications

All these publications are available online at our ATTRA website: <http://attra.ncat.org> or by calling and requesting a free copy at 800-346-9140.

Energy Saving Tips for Irrigators

This publication describes ways that irrigators can save energy to reduce irrigation costs. It describes recommended irrigation system installations, explains how utilities charge their irrigation customers for electricity, and describes common causes of wasted energy, as well as common energy-saving hardware improvements. It also includes a do-it-yourself method to estimate the efficiency of electrically powered irrigation systems. A listing of references and resources follows the narrative.

<http://attra.ncat.org/attra-pub/summaries/summary.php?pub=119>

Maintaining Irrigation Pumps, Motors, and Engines

This publication explains how to maintain irrigation pumps, motors, and engines for peak efficiency. The publication includes descriptions and diagrams of recommended installations, checklists for maintenance tasks, and a troubleshooting guide. Each system component is treated separately and maintenance tasks are broken down by how frequently they need to be done.

<http://attra.ncat.org/attra-pub/summaries/summary.php?pub=112>

Measuring and Conserving Irrigation Water

This publication describes how to find the net water application rate for any irrigation system. It further explains how to calculate the number of hours the system should be operated, describes several ways to measure flowing water in an open channel or pipeline, and offers suggestions for irrigating with limited water supplies.

<http://attra.ncat.org/attra-pub/summaries/summary.php?pub=332>

Protecting Water Quality on Organic Farms

While organic farms tend to have less nitrogen leaching, better nutrient holding ability, and less runoff and erosion, there can still be environmental concerns related to organic farming, in the areas of the transition period from conventional to organic, in nutrient management planning practices and from improper storage of manure or compost materials. This publication discusses strategies for preventing water pollution by addressing those concerns.

<http://attra.ncat.org/attra-pub/summaries/summary.php?pub=114>

Irrigation (Power Point presentation)

Sustainable irrigation practices and methods for protecting soil and water quality when using irrigation

http://attra.ncat.org/downloads/water_quality/irrigation.pdf

Other Water and Irrigation Resources

National Institute of Food and Agriculture: Water

American communities and rural areas depend on a safe and reliable water supply. The science and management of water requires consideration of the quantity and quality of water resources and the land management activities that affect these water resources. Through research, education and extension, NIFA water programs provide basic knowledge, application and learning opportunities needed to address agricultural water quality and quantity issues.

www.csrees.usda.gov/water.cfm

Water: Laws, Regulations, Policy, Guidance and Legislation. US EPA

Laws and regulations, policy and Guidance documents, and legislation, US EPA Department of Water.

www.epa.gov/OW/laws.html

NRCS Water Quality and Water Quantity

The NRCS West National Technology Support Center hosts a team of technical specialists that cover a broad range of water quality and quantity issues. Each of nine disciplines provides information, data, software, and support contacts.

www.wsi.nrcs.usda.gov/products/W2Q/W2Q_home.html

The Farm Water Quality Planning Program is a coordinated effort by the University of California Division of Agriculture and Natural Resources, whose goal is to improve water quality education to the irrigated agriculture industry in California.

<http://groups.ucanr.org/signup/index.cfm>

The National Water Program has the mission of creating and disseminating knowledge that insures a safe and reliable source of water of the appropriate quality to meet the needs of food and fiber production, human health, use and economic growth, maintenance and protection of natural environmental systems.

www.usawaterquality.org

Disinfecting a Domestic Well with Shock Chlorination

This New Mexico State University publication talks about shock chlorination as a disinfection treatment recommended when a domestic drinking water system is contaminated with bacteria. Contamination can occur when the well is installed.

http://aces.nmsu.edu/pubs/_m/m-115.pdf

Analytical and Testing Services

Alternative Soil Testing Laboratories

This resource from ATTRA provides a range of soil testing laboratories and supplies that support the special analytical needs of farmers using organic or sustainable production methods.

<http://attra.ncat.org/attra-pub/summaries/summary.php?pub=285>

The US Composting Council lists a group of STA (Soil Testing Assurance) labs that provide analytical services for STA participants and use TMECC (Test Methods for Evaluation of Compost and Composting).

www.compostingcouncil.org/programs/stallabs.php

Other Agricultural Analytical Laboratories by region:

North Central Region

(Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin)

Universal Analytical Laboratories

891 Eighth Street
Carlyle, IL 62231
Phone: 618-594-2627
Fax: 618-594-2637
ualab@ualab.com

GMS Laboratories

They perform soil tests, including heavy metals, and compost. Different tests available. Contact information:

P.O. Box 61
23877 E 00 North Road
Cropsey, IL 61731
Phone: 309-377-2851
Fax: 309-377-2017
gmslab83@gmslab.com
www.gmslab/pages/home

Olsen's Agricultural Laboratory

210 East 1st Street
McCook, NE 69001
Phone: 308-345-3670
Fax: 308-345-7880
www.olsenlab.com/default.aspx

Northeast region

(Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Washington D.C., West Virginia)

Agricultural Analytical Services Lab

Wide range of services including soil (heavy metals), manure and compost, water, plant tissue, and others. Contact information:

Penn State University
Tower Rd.
University Park, PA 16802
Phone: 814-863-0841
Fax: 814-863-4540
aaslab@psu.edu
www.aasl.psu.edu

UVM Agricultural and Soil Testing Laboratories

Provides soil (including heavy metals), manure and compost testing. Contact information:

Agricultural and Environmental Testing Lab
Jeffords Hall, Room 262
63 Carrigan Drive
University of Vermont
Burlington, VT 05405-1737
Phone: 802-656-3030
Fax: 802-656-0285
Joel.Tilley@uvm.edu / dross@uvm.edu
www.uvm.edu/pss/ag_testing

Analytical Laboratory and Maine Soil Testing Service

5722 Deering Hall
Orono, ME 04469-5722
Phone: 207-581-3591
Fax: 207-581-3597
<http://lanlab.umesci.maine.edu>

South Region

(Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, Puerto Rico, US Virgin Islands)

Waters Agricultural Laboratories Inc.

Soil analysis (including heavy metals), water analysis and other services relevant to agriculture. Located in Georgia and Kentucky. Contact information:

257 Newton Rd.
P.O. Box 382
Camilla, GA 31713
or
2101 Calhoun Rd.
Highway 81
Owensboro, KY 42301
Phone: 229-336-7213
Fax: 229-336-7967
info@watersag.com
www.watersag.com/frame.htm

Soil, Water and Forage Analytical Laboratory

045 Agricultural Hall
Stillwater, OK 74078
Phone: 405-744-6630
Fax: 405-744-9575
soiltesting@okstate.edu
www.soiltesting.okstate.edu/index.htm

A&L Eastern Laboratories, Inc.

7621 Whitepine Rd.
Richmond, VA 23237
Phone: 804-743-9401
Fax: 804-271-6446
office@al-labs-eastern.com
<http://al-labs-eastern.com/index.html>

A&L Plains Laboratories

A&L Plains Agricultural Laboratory
Lubbock, TX 79408-1590
Phone: 806-763-4278
Fax: 806-763-2762
www.al-labs-plains.com

West Region

(Alaska, Washington, Oregon, California, Hawaii, Montana, Idaho, Nevada, Utah, Arizona, Wyoming, Colorado, New Mexico)

D&D Agricultural Laboratory, Inc.

Specializing in soil, plant and water analysis
Contact information:
5750 E. Shields Ave., Suite 104
Fresno, CA 93727
Phone: 559-348-1818

Dellavalle Laboratory, Inc.

Provide soil, water, plant tissue, manure analysis, with others. Also consultant services. Contact information:
1910 W. McKinley Ave., Suite #110
Fresno, CA 93728
Phone: 800-228-9896 / 559-233-6129
www.dellavallelab.com/index.html

Waterlab Corp

2603 12th Street SE
Salem, OR 97302
Phone: 503-363-0473
Fax: 503-363-8900
<http://waterlabcorp.com/index.php>

Other Useful Resources:

The United States Environmental Protection Agency (EPA) helps you find environmental information about the area where you live, regarding possible contamination in water, soil and air. The website is: www.epa.gov/epahome/whereyoulive.htm. The EPA also offers a list of environmental agencies by state: www.epa.gov/epahome/state.htm

The EPA has a very complete and informative Web page on compost: www.epa.gov/epawaste/conserve/rrr/composting/index.htm

Keeping Feces on the Farm. Science Now.

This article reveals the advantage of spray irrigation compared to older flood irrigation techniques. Spray irrigation appears to reduce transport of pathogens into drinking water wells. This is especially a concern for livestock farming operations, which are increasingly worried about liability from *E. coli* and similar cases of infection.

<http://news.sciencemag.org/sciencenow/2010/06/keeping-feces-on-the-farm.html>

Best On-Farm Food Safety Practices: Documenting Trace-Back and Trace-Forward of Harvested Produce

Helpful publication from the College of Tropical Agriculture and Human Resources, University of Manoa at Hawaii. This document gives a good description of a traceback system, mostly oriented for a larger farm, but the principles are the same. www.ctahr.hawaii.edu/oc/freepubs/pdf/FST-36.pdf

Sample Record Keeping Form for Compost/Manure Application and for Compost Production

Manure Applications log

From: *National GAPs Education Materials, Cornell University Department of Food Science:*
www.gaps.cornell.edu/rks.html

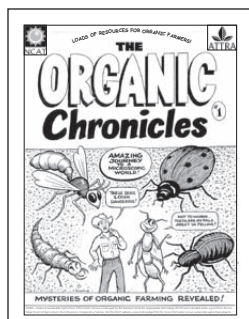
Name of operation:							
Please see the food safety plan for overall manure application procedures							
Date	Field Applied	Rate	Incorporated (Yes or No)	Supplier	Crop Planted (Type and Date)	Crop Harvested (Date)	Initials
Reviewed By:					Title:		
Date:							

Compost Production Record

From: *Organic Market Farm Documentation Series. ATTRA.* <http://attra.ncat.org/attra-pub/PDF/marketforms.pdf>

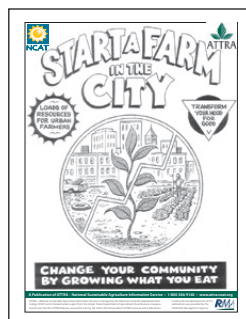
Compost Production Record		
A record of on-farm compost production practices.		
Farm Name:		Production Year:
Compost Pile, Windrow, or Unit I.D.:		Date Started:
Compost Production Method Used (circle one): windrow in-vessel static aerated pile		
Feedstocks Used (including inoculants): (see other side for approximate C:N ratios of common feedstocks)		Estimated C/N Ratio:
Dates	Temperature	Turned?

Other publications in ATTRA's Illustrated Series of publications



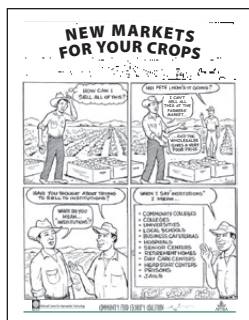
The Organic Chronicles

- Available in English, Hmong, and Spanish



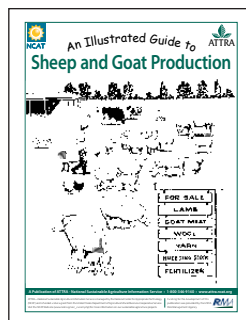
Start a Farm in the City

- Available in English and Spanish



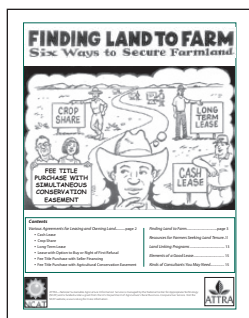
New Markets for Your Crops

- Available in English and Spanish, and as an audio download in Spanish



Illustrated Guide to Sheep and Goat Production

- Available in English, Hmong, and Spanish



Finding Land to Farm

- Available in English and Spanish



Organic IPM Field Guide

- Available in English and Spanish

Illustrated Guide to Growing Safe Produce on Your Farm: GAPS

By Pamela Wolfe and Rex Dufour
NCAT Agriculture Specialists
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Robert Armstrong, Illustrations
Karen Van Epen, Editor
Robyn Metzger, Production

This publication is available on the Web at:
www.attra.ncat.org/attra-pub/PDF/foodsafety.pdf

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