

Assessing On-Farm Produce Safety Risks: Pre-Plant Stage

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Overview

As consumption of fresh fruits and vegetables in the United States has increased, so have foodborne disease outbreaks and recalls associated with fresh produce (Callejón 2015; Painter 2013). In addition to compliance with regulations such as the Food Safety Modernization Act (FSMA) Produce Safety Rule, the marketplace has become stiffer in terms of on-farm produce safety requirements. Growers selling to larger buyer channels and institutions are often required to obtain Good Agricultural Practices (GAP) food safety certification. While growers selling through direct market channels including farmers markets and roadside stands do not typically need certification, they may have on-farm produce safety standards to achieve. Regardless of the market outlet channel and/or size of the farm, the potential for produce contamination exists. Thus, understanding on-farm produce safety risks is essential for all farms who grow, harvest, pack, hold and/or ship fruits and vegetables. Identifying risks that may be associated on your farm during the pre-plant stage is the third step to developing and implementing best practices to reduce those risks and reduce potential produce contamination. This publication is the third in a series of seven factsheets to assist you in creating a food safety program (Figure 1).

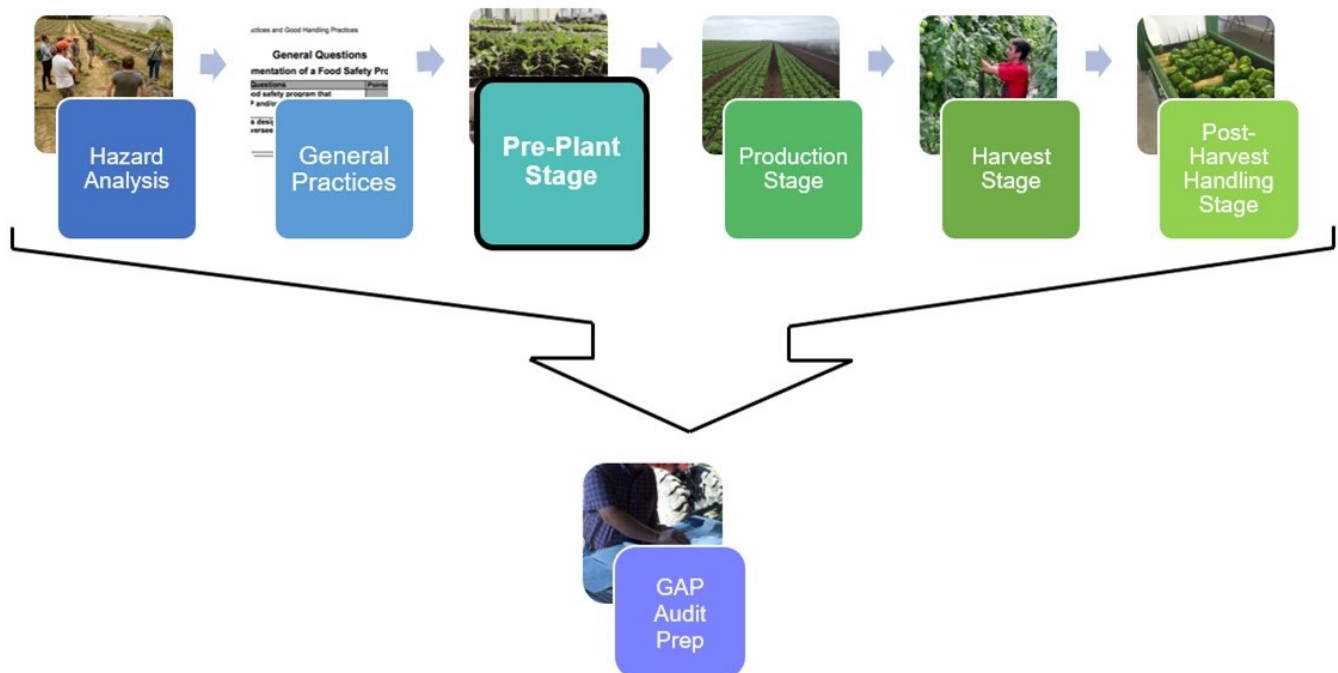


Figure 1. This series is designed to provide produce operators with the knowledge and tools to develop and implement Good Agricultural Practices (GAP). The final publication provides guidance for tying all the pieces together in preparation for a third-party food safety audit.

Pre-Plant Stage

Before planting it is important that physical, chemical, and biological hazards on and around the farm and in materials used in production are identified. Materials and the growing environment can be contaminated any time before, during, and after production. Assessing potential contamination events before beginning production (growing activities) is important to prevent potential product contamination. Utilizing the farm sketch created in the first step (Hazard Analysis) of this series (Bardsley et al. 2021a), assess the potential risks from (a) prior and current usage of the farm land and structures, (b) adjacent land areas surrounding the farm, (c) the source or condition of each plant material (i.e., seeds, tubers, transplants, rootstock, etc.) and how each plant material will be started (i.e., plastic seed flats, containers, direct sowing, bare root seedlings), and (d) any specific crop characteristics.

History and Current Farmland Use Patterns

As a grower you probably know your current farm conditions better than anyone else. You understand factors in the field prior to planting that will help facilitate crop growth and yield. Along with these factors, it is also important to understand potential food safety hazards associated with the field and/or the protected culture production areas. A helpful way to identify hazards and assess risk is to use the farm sketch, along with any supporting maps showing production fields, greenhouses/high tunnels, barns, buildings, portable sanitation units, septic systems, manure storage areas, compost production areas, livestock/dairy facilities, and wells, springs, and surface water sources. Other helpful documents include soil, drainage, and topography maps, as well as farm production records or histories. If you are unsure of the farm's history (for example, it has been recently purchased), you may try speaking with previous landowners or your nearby neighbors, and/or searching land records to help fill in historical land-use gaps.

Consider the previous uses of the farmland and determine if any subsequent practices may present a potential risk for contamination. Knowing how long the farm has been in agricultural production, and what type, is very important. For example, if the farm was once used for poultry production where poultry were housed in structures that are now no longer present, there may be arsenic-based feed additive residuals (used to kill parasites) in the soil (Hileman 2007). As another example, prior to 1950 apples were widely grown in Virginia and North Carolina with lead arsenate used as the primary insecticide for controlling codling moth. This resulted in lead and arsenic accumulation and contamination of the soil (Schooley et al. 2008). It is important to investigate previous animals raised or prior crops grown to identify any risky production practices such as the above two examples. The land may have once been used for other non-agricultural purposes that pose current-day risks: land used for dumping, waste disposal, manufacturing, or any other use that represents a potential source of contamination (Figure 2).

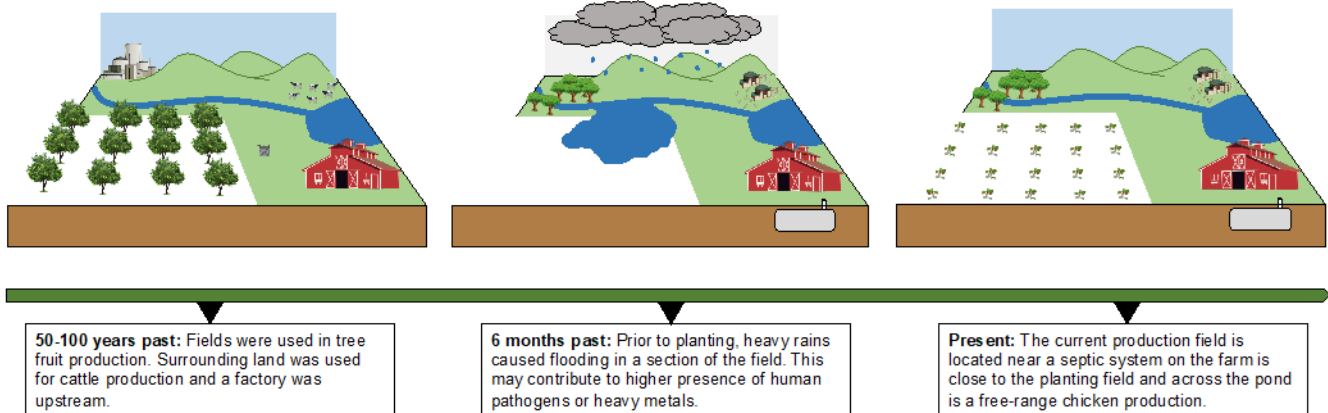


Figure 2. Current and previous land use timelines can be used to identify risks that could contribute to potential product contamination. For instance, the current land is near a septic system and a free-range chicken operation. Six months prior heavy rains led to flooding in the section of the field. 50-100 years past the land was used for tree fruit production and a factory was upstream from the farm which may have contributed to chemical contamination in the field and water.

As you work through this process, use your documentation of the current and past land uses to create a written history of the farm. In addition to documenting past land uses, make sure to also include any extreme weather events that have occurred, such as flooding or heavy rain fall from hurricanes or major storms. Flooding has been associated with an increased presence of human pathogens, harmful heavy metals, and other chemical contaminants in the soil (Produce Safety Alliance 2018). If flooding has occurred in growing areas, soil testing for heavy metals and other possible contaminants should be considered.

Along with the land use history, assessment of the current use and condition of the farm should be documented. Confirming water sources are protected from contamination is key to maintaining produce safety and minimizing potential product contamination events. Water sources (e.g., well, surface, and spring) should be assessed for any potential sources of contamination. For example, for wells, inspect the overall construction of the well, its siting, and the integrity of the well cap. It is also important to think about the physical placement of any livestock rearing and/or manure storage piles in relation to production areas, as evidence suggests close proximity to animal operations may increase contamination events (Bihn et al. 2014). Additionally, if compost is made on the farm or purchased from a buyer, make sure to consider prevention of any runoff and leaching into production fields or areas. The condition of septic systems and their proximity to produce fields and water sources may also contribute to contamination events. For example, septic leach fields should not be located near produce fields to avoid potential contamination to the crops and or damage to your septic system from unwanted plant roots.

Finally, the physical condition and structural integrity of all farm-related structures should be assessed. This includes (a) production facilities such as greenhouses, high tunnels, hoop houses, or any other forms of protected agriculture, (b) packing areas such as simple pole barns, enclosed buildings, or actual packing houses, (c) storage structures such as chemical and pesticide cabinets, sheds, box storage, and (d) cooling facilities such as cold rooms. Additionally, remember to think about potential animal intrusion, such as birds, rodents, and snakes, among other creatures. Lastly, in the case of packing lines and other equipment, while it is possible to retrofit old, used machinery, sometimes it is cost-prohibitive to do so, especially to ensure refabricated equipment meets acceptable food safety criteria.

Adjacent Land Use Considerations

Activities occurring on land surrounding your farm and adjacent to produce fields is also important and may greatly influence food safety. On the sketch and/or map of your farm, specify uses of the surrounding landscape. If produce fields are located near sewage treatment facilities, waste material landfills, or animal operations there may be potential risk for contamination due to leaching, runoff or other situations/factors. For example, if an animal operation is adjacent or near the farm the following questions should be considered:

- What type of animal operation is it and are the animals contained (e.g. a free-range grazing vs concentrated feedlot or facility)?
- Is it a large-scale, concentrated, or small-scale animal operation (e.g. How many animals are there in a given area)?
- How far are animal production and/or grazing areas from produce fields?
- Can animals accessing the surrounding area pose a risk of runoff contamination to your production water sources or into produce fields (e.g., Are the animals uphill from produce fields)?
- Are there physical barriers such as berms, grass buffer strips, or ditches that may help to reduce the risk of field contamination?

Plant Material Sourcing and Use

Understanding possible hazards that may pose a risk to any plant material (i.e. seeds, transplants, bulbs, tubers, and rootstocks) prior to planting is important. This includes being able to document where plant materials are sourced and how the plant material will be used for propagation (if applicable), as well as how the plant materials have been handled by the vendor before and during shipment. These factors are important for traceability, but they are also necessary for resolving any issues related to plant material province, quality, and viability. Once received, plant materials should be stored under optimal conditions for that crop prior to planting (Maynard and Hochmuth 2007; Wyenandt et al. 2020). For example, if starting seeds in flats or plug containers, it is important to make sure the flats and containers are clean and not a potential source of contamination. Attention should also be given to the soil media and how it has been stored before filling flats or pots. If any pre-plant fertilizer is used, it should also be stored properly to avoid cross-contamination. More information will be discussed about plant production chemicals in “Assessing On-Farm Produce Safety Risks: Production Stage” (Vallotton et al. 2021a) in this series.

Crop Characteristics

An important consideration at the pre-plant stage also includes plant morphology and anatomy, or the external and internal characteristics of the crop plant. It can be especially important to identify the parts of the plant that will be harvested for food when evaluating risks (Figure 3). Is the harvested portion above ground or below ground? If it is below ground, is the food typically eaten raw or cooked (e.g., carrots versus potatoes)? If the harvested portion is above ground, does it grow on the ground directly (e.g., summer squash, winter squash, onions), or is it aboveground (e.g., staked tomatoes, apple trees)? Are each of these types of produce eaten raw or are they cooked? You should also consider the susceptibility of the fruit or vegetable for infiltration of microorganisms. There is research to support internalization of human pathogens through the roots, stomata, or blossoms. You should also determine if the crop surface poses any additional risks. For example, some cantaloupe has a netted rind, which may promote attachment of microorganisms. It may be helpful to reach out to your local extension agent or specialist to discuss your crops and the latest research on those crops in regards to food safety.



Figure 3. (a) Both carrots and potatoes are grown underground; however, carrots may be eaten either raw or cooked whereas potatoes are typically cooked. (b) Onions, tomatoes, and apples are eaten as both raw and cooked; however, onions come into direct contact with the soil, whereas tomatoes and apples are aboveground. In all cases, it is a good idea to consider the potential risks for each crop at pre-plant, production, harvest, and post-harvest stages.

On-Farm Produce Safety Pre-Plant Stage Checklist

Use the list of items below as a guide to tasks that should be completed as a part of your on-farm food safety program. Once each task is conducted, check off that item. For items that do not apply to your operation, write N/A next to the item.

- Reflect on each crop you will be growing during the season.
- Note any specific risks known to be associated with the crop, such as a netted rind, stem scars on fruit, or if it is a higher risk crop in terms of related outbreaks.
- Determine what plant material will you be using for plant propagation: seeds, transplants, bulbs, tubers, or rootstocks.
- Think about how the plant material will be labeled and stored prior to planting, for instance, in a cooler or protected storage space.
- If starting seeds and transplants, establish written protocols for the use of new and used seed flats and containers, cleaning, sanitizing, and disposal of used soil media.
- Consider where unused soil media and related materials will be stored, and where propagation tasks will take place to avoid cross-contamination.
- Conduct a land history assessment for all production, packing, washing, and storage areas by investigating all previous land uses.
- Survey previous farming activities (such as crops or animals raised), pesticide usage and storage, the integrity of water and septic systems, and use of any structures and facilities.
- Consider previous non-farm uses of the land, such as any industrial activities.
- Investigate historical weather events such as floods that have occurred on the land.
- Identify any low-lying areas prone to flooding or standing water.
- Perform a current land use assessment of on-farm and adjacent neighboring land areas.
- Identify any areas that pose a risk of potential run-off from concentrated livestock, grazing, or manure storage.
- Identify any current activities that pose contamination hazards such as dumping of chemicals, waste disposal, or manufacturing.
- Ensure current structures and facilities are physically intact and functioning.
- If new facilities are being installed, (greenhouses, high tunnels, packing lines, coolers), consider design modifications that will satisfy specific food safety needs. This might include layouts for greater water access, floor drains, temperature control options, etc.
- Document your land history and land use assessments, keeping records of any notes and materials collected.

Name

Signature

Date

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