

FREQUENTLY ASKED QUESTIONS ABOUT HANDLING FLOODED PRODUCE

Originally published by the University of Vermont Extension- September 2011
Revised in March 2016

Flood waters are likely to contain contaminants from upstream farms and rural septic systems, urban lawns and roadways, industrial sites and/or overflow from municipal sewage systems. Contaminants may include raw manure or feces, agricultural chemicals, fuel, heavy metals or other chemical contaminants. Microbial pathogens that could be in flood waters include bacteria, viruses, and parasites. It only takes a small amount of some pathogen to make people (particularly the young, old, pregnant or immune-compromised) very sick.

The Federal Food Drug and Cosmetic Act states that food that is grown, held or packed under unsanitary conditions where it may have become contaminated with filth is considered adulterated and is not to enter the human or animal food supply.

<http://www.gpo.gov/fdsys/pkg/USCODE-2010-title21/html/USCODE-2010-title21-chap9-subchapIV-sec342.htm>

Under this law, the U.S. Food and Drug Administration (FDA) has stated that any crops where the edible portion was in contact with flood waters must be discarded, destroyed or tilled into the soil. This applies to both above ground crops and root crops. Under this law, if a farmer sells food that is later identified as being the cause of a food borne illness outbreak, that farmer is criminally liable.

The FDA's most recent (October 2011) notice to growers and others in the food industry who have been affected by floods and hurricanes provides guidance in determining when foods where the edible portion has NOT contacted flood waters can be reconditioned for human use.

<http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/EmergencyResponse/ucm287808.htm>

This advice is more challenging to interpret because it does not provide specific guidelines. Rather, it states that:

Disposition of crops in proximity to, or exposed to a lesser degree of flooding, where the edible portion of the crop has NOT come in contact with flood waters, may need to be evaluated on a case-by-case basis. Factors to consider in the evaluation include:

- *What is the source of flood waters and are there potential upstream contributors of human pathogens and/or chemical contaminants?*
- *Type of crop and stage of growth, e.g., is the edible portion of the crop developing? How far above the ground does the lowest edible portion grow?*
- *Were conditions such that the crop may have been exposed to prolonged periods of moisture and stress which could foster fungal growth, and possibly, development of mycotoxins?*

Based on this information we have divided the information in this FAQ into two sections: 1) questions where the FDA's stance is clear and 2) questions where the FDA's guidance is more broad and difficult to interpret.

The information in this document reflects our best effort to interpret federal food safety guidance and related scientific research, and to translate this into practical management options. However, growers are fully responsible for their own management decisions, for the quality and safety of the food they sell, and for compliance with all applicable laws and regulations.

WHERE THE FDA STANCE IS CLEAR

1. Does flooded produce have to be discarded?

Yes, if the edible portion has come in contact with flood waters the produce must be discarded due to the high risk of contamination from chemicals and microbial pathogens in flood water.

2. My field of carrots/potatoes/parsnips/other root crop is still young and several months from harvest, can I sell the crop?

No. The FDA is clear that any edible portion of a crop that comes in contact with flood water may not be sold, even if you leave it in the ground afterwards for a long time. There is evidence that potatoes can uptake pathogens through their lenticels and carrots can take them up through their crowns.

3. I had a planting of leafy greens (lettuces, spinach, Swiss chard, etc.) that did not germinate before the flood but now that the waters have receded it has emerged and looks great. Can I sell it?

No, this is a high risk. As they grow, the leaves will be in contact with flooded soil as this crop grows and thus could get contaminated with soil-borne chemical and/or microbial contaminants such as *E. coli*, *Salmonella*, etc. from wastes that were in flood water. Once attached, washing even with disinfectants cannot remove the pathogens.

4. Can I peel and/or cook flooded produce (particularly root crops and winter squash) and then sell it?

No. Although peeling and cooking will greatly reduce the microbial load, and will reduce some of the surface chemical contamination, any flooded produce – regardless of how it is processed - is still considered adulterated by the FDA and not allowed for sale. Unfortunately, because of the uncertainty as to the type and extent of microbial and chemical contaminants, further processing does not necessarily provide an assurance of safety. If there is contamination on the outside peel of the product, it would be hard to prevent some cross-contamination occurring with the flesh during the peeling process.

5. There was a lot of water standing on my field after the storm but it was just rainwater; it did not come from a river, stream or other surface water. Can I sell my produce?

Yes. Pooled water from rainwater alone is not considered to be flood water and the produce should be ok for sale. However, if there is evidence of contamination due to significant runoff from an adjacent area where livestock, manure, or compost are kept, then the produce may be contaminated if it was in contact with the contaminated water and should not be sold for human consumption.

6. My crop was flooded but I have tested it for bacteria after treating it with a chlorine sanitizer and the results show it is not contaminated, is it legal to sell?

No. Neither post-harvest cleansing of flooded crops, nor testing of flooded produce is accepted by FDA as a means of ensuring the safety of flooded produce for human consumption. This is partially because the produce could also be contaminated with unknown chemicals that are more difficult to test for, and partly because the microbial contaminants may not be evenly distributed throughout the field.

7. I have a buyer that says if I provide a test showing my produce is not contaminated with *E.coli* he will purchase it. Can I sell it to him?

No. Produce buyers must follow the law, too. Further, *E.coli* is not the only contaminant of concern in flooded produce. Testing for microbial pathogens in this situation cannot ensure the safety of the produce, as there are too many pathogens that can cause food borne illness to test for feasibly. Pathogens are often deposited unevenly on fields in flood situations, and it is not possible to take enough of these tests to have any reasonable certainty that all the food is safe for sale.

8. Can flooded produce be fed to livestock?

No. Upstream farms, sewage treatment plants, industrial plants, hazardous waste sites, etc. means that floodwaters almost always will contain contaminants which can stay on the produce and this can harm livestock health if consumed. The FDA is also concerned about residues from some contaminants being transferred to animal products for human consumption (meat, milk and eggs).

9. Can I replant my greenhouse this fall to a crop of salad greens even though it flooded in the summer?

No. You should not replant flooded soils in greenhouses to leafy greens. There is just too much risk of microbial contamination from the soils getting onto these crops that are low to the ground. In general, you should avoid planting any crops consumed raw this fall. A reasonable way to reduce the risk of contamination would be to build raised beds at least 6 inches high, and bring in non-flooded soil/compost to fill them, then avoid cross contamination from soil in greenhouse walkways by covering them with landscape fabric or straw, etc.

10. What about other perennial crops that were under flood waters but that I won't be harvesting until next year, such as Echinacea, burdock, or other herbs grown for their roots?

Crops that have been exposed to flooded soils are deemed adulterated by the FDA. Even though these crops will not be harvested for quite a while, that is the law. We do not know whether, or to what extent, these crops may take up pathogens or chemical contaminants. If they are internalized by crop tissues then waiting until the next season and allowing a winter to pass before harvesting will not avoid contamination of the crop.

11. What kind of soil tests should I do before I plant again?

Biological contaminants (those that are carbon-based) will break down over time in the soil, and it is difficult to conduct meaningful tests for these due to their variety and spatial distribution. Heavy metals, however, will not break down over time, and can be tested for more easily using traditional soil sampling methods. You can contact the KSU Soil testing lab in Manhattan at 785-532-6101 (<http://www.agronomy.k-state.edu/services/soiltesting/>) or the MU Soil and Plant Testing lab in Columbia at 573-882-0623 (<http://soilplantlab.missouri.edu/soil/>) for more information on their testing services.

12. My field has large depositions of silt and debris. Do I need to remove this, test it, or can I till it in?

Large debris in your fields should be removed, but the silt deposited by flood water and smaller debris do not need to be removed. Soils should be allowed to dry sufficiently and then tilled to at least six inches deep before planting crops. Adding compost or other organic matter when tilling will be beneficial to the soil's biological activity, which can promote decomposition of some contaminants. To protect the soil from erosion after tilling, it is advisable to plant a cover crop, which will also stimulate biological activity. In the fall, consider planting small grains such as oats or winter rye with or without hairy vetch for adding nitrogen.

13. Should I test my water?

If your wellhead was submerged under flood water, your well water should be retested to ensure that it is potable. Only potable water should be used to wash produce after harvest. In Kansas, you can contact either your local health department, a local sanitarian, or a Kansas Department of Health and Environment District Office for assistance and before collecting any well samples <http://www.kdheks.gov/waterwell/>. In Missouri, contact the State Public Health Lab: <http://health.mo.gov/lab/privatedrinkingwater.php>. Private certified labs are also available for water testing: <http://dnr.mo.gov/env/wpp/labs/microbiological.htm>.

14. What precautions should I take during clean-up?

Workers should wear protective clothing such as rubber boots, rubber gloves and an N-95 respirator mask when working in fields that were flooded. Mark the highest locations that flood waters reached using flags, etc. FDA recommends leaving a 30 foot buffer between flooded areas of fields and areas with crops to be harvested for human consumption; this is to accommodate a generous turn-around distance for equipment to prevent crop

contact with flooded soil to avoid cross-contamination. Try to minimize dust and tracking dirt and sediment from flooded areas into non-flooded areas (such as packing sheds) as much as possible to reduce the chances of cross-contamination.

15. My fields sometimes flood in the spring, but some springs they don't. Now that I know I have to destroy flooded crops - what should I plant in areas that are likely to flood? I don't want good land that may or may not flood go to waste.

Avoid planting root crops, leafy greens and any other crops that are ready-to-eat (normally not cooked) and any crops that grow very close to the ground. Instead, consider planting taller crops such as sunflowers or sweet corn or even fruit trees; non-edible cash crops such as biofuel crops: corn, sunflowers, or canola are an option if you have the equipment to harvest them and necessary processing equipment and a market to sell them.

16. How does flooding affect the organic certification of my land?

You will need to discuss this with your organic certifier. The organic regulations require that "prohibited substances" cannot be applied to land for at least three years prior to harvesting an organic crop. Floodwaters could contain many potential contaminants that would be considered "prohibited substances". Fortunately, the volume of water during flooding events often dilutes the contaminants. In most cases, low levels of contaminants would be considered unavoidable residual environmental contaminants and would not affect the certification of the land. However, there are instances where prohibited residues would be of greater concern and farmers should contact their organic certifier to discuss next steps. If your farm is directly downstream from a source of concentrated prohibited substances, for example, a sewage treatment facility, or if there is evidence of contamination, for example an oily residue on your fields or an empty propane tank, the organic certifier may decide to test for likely contaminants and continued certification of the affected field will be based on the outcome of the tests and on-site inspection. Note that if your wellhead was submerged, your water should be retested to ensure that it is potable. Only potable water should be used to wash organic produce. You will need to provide your organic certifier with a copy of your completed water test.

WHERE THE FDA DOES NOT GIVE CLEAR GUIDANCE

Choosing to harvest crops under the following conditions appears to be allowed by the FDA but there is still a risk of contamination. It is up to the grower to decide if the level of risk is low enough to grow and harvest food crops. No one wants to be responsible for making anyone ill. Growers should carefully consider the level of risk associated with harvesting a crop near flooded areas or one that is grown in flooded soils after the waters recede.

A food borne illness event associated with Kansas or Missouri produce and even the potential lack of consumer confidence from the uncertainty of the safety of potentially flooded produce would have serious ramifications for growers throughout both states. If you do choose to harvest crops in situations described below, keep records of what factors you considered when making that decision and the steps you took to avoid cross-contamination.

17. If the edible portion of a crop was above the flood water can it be sold?

Yes but only if the risk is low. Growers will have to make their own case-by-case analysis of this situation. (See the FDA's notice to growers about the safety of food affected by hurricanes and flooding <http://www.fda.gov/food/recallsoutbreaksemergencies/emergencies/ucm112723.htm>)

Although the edible portion of the plant may not have been in direct contact with flood water, there is still risk of it becoming contaminated. Contaminants that remain on the stem can be transferred to the flower or fruit, or contaminants in the soil may be splashed up onto the fruit. The risk of cross-contamination through

indirect

sources is of particular concern in that the produce can become contaminated during the harvest or post-harvest handling process if it comes in contact with contaminated water, soil on hands, or other contact surfaces. Because fruits and vegetables have irregular surfaces, once contaminants become attached to the cracks and crevices on the surface of produce, it is not considered possible to disinfect the edible portion.

Questions to consider to assess the level of risk include:

- a) Are you confident that there are no major sources of contamination upstream (see description below for how to assess sources of contamination)?
- b) Were the flood waters only a few inches up on the plant and the plant is tall (For example, sweet corn, tall staked tomatoes, tree fruit and other crops where the edible portion is high on the plant and could be well above flood water even though the soil surface was flooded)?
- c) Is there any evidence of splashing of flood water onto the crop?

18. How can I determine if there were sources of contamination upstream of my field(s)?

To assess potential upstream sources of contamination, several things should be considered such as the location of malfunctioning wastewater treatment facilities, manure storages, potentially damaged septic systems, or hazardous waste sites in the watershed upstream of your farm.

19. If the edible portion of a crop had not yet formed, can I leave the flooded crop in place and sell it later?

This may be possible for some crops. If soils were flooded, edible portions will be developing in the window where pathogens might still be present (some can persist in the soil or on plants for months) and the risk of cross-contamination occurring during harvesting or handling is still there. The risks of food borne illness are greatest with any crops that might be eaten raw. With potatoes and winter squashes: if the edible part had not formed but there is reason to suspect the soil is contaminated and the edible portion of the crop will eventually come in contact with the soil once it appears, then the FDA is clear that the product should not be harvested and consumed. However, these crops, because they are cooked by consumers, have less risk than other types of crops that will be allowed to develop after a flood. Questions to consider when evaluating the crop can include: upstream sources of potential contamination, the time it took flood waters to recede, time it took the field to dry out, and the time until harvest. In general, the longer that the crop has been exposed to the sun and drying conditions, the better.

Fruiting plants that were in contact with flood waters but had no fruit on them at the time (tomatoes, beans, peas, peppers, etc.) or other plants with edible portions that had not yet formed at the time of flooding (broccoli, cabbage, Brussels sprouts etc.), may be allowed to form the edible part and then harvested after you have considered the above questions. However, do not sell these crops *if the heads had started to form prior to the flood* and were exposed to flood water as contaminants can get trapped within the folds of the heads and persist.

Kale and similar crops that can regrow new edible portions after flooding may be harvested if all leaves that might have come in contact with the flood waters are removed and then new growth that is harvested is triple washed and rinsed with a disinfectant (see below for information on how to disinfect produce). Keep in mind however, that sanitizer in the wash water will not remove the contaminants once they have attached to the produce.

All crops harvested as described above should be triple washed using a disinfectant prior to sale, even if you do not normally wash them.

20. I have parsley growing on black plastic that was flooded. If I mow off the plants and allow them to regrow is it

OK to harvest and sell them?

Only if you are sure that the parsley has not come in contact with flooded soil. In other words, the plastic must not have flooded soil or sediment remaining on top of it, and the holes in the plastic must be small enough to prevent soil splashing up during rain, etc. Parsley, cilantro and other herbs grow low to the ground and have a lot of leaf surface area to which soil can cling. If you have any doubt about soil getting onto the parsley leaves, then the crop should not be sold, especially since it is often eaten raw. Cilantro, which has a similar growth form to parsley, has tested positive in the past for pathogenic E.coli on tests conducted by the USDA-AMS Microbiological Data Program. <http://www.ams.usda.gov/AMSV1.0/mdp> .

I had flood water come into the wheel tracks of my field but the raised beds of crops/hills of potatoes were above the flood level, can I sell my produce?

It depends. Above ground crops that did not contact the water can be sold. Water permeates the soil in a fan shape and could move from the wheel tracks into some parts of the raised beds, potentially contacting the potatoes. If any edible portion of root crops or crops that lie on the surface (e.g. melons) came in contact with contaminated flood water or soil that could be contaminated, that would prohibit their sale.

21. How should I treat the crops that did not come in contact with flood water?

If a crop is anywhere near flooded soils, take extra precautions to avoid cross contamination from soil contact, blowing dust, and equipment such as dirty bins. After harvest, thoroughly rinse off any soil on the produce with potable water, and then triple rinse (i.e. put through three separate baths) in a solution of 150 ppm chlorine (sodium hypochlorite), or Sanidate® at the highest labeled rate (0.5 fl. oz/10 gal. water). *Rinsing in water with disinfectant will not disinfect produce if the pathogens have already been internalized in the produce or have attached to the surface of the fruit or vegetable.* The purpose of disinfectant in rinse water is to reduce the microbial load in the water to avoid cross-contamination. Disinfectants must be used properly to be effective. Excess organic matter and soil in the wash water, or an improper pH of the wash water will reduce the efficacy of the disinfectant.

Amount of sodium hypochlorite (chlorine) to add to wash water for 150 PPM		
Sodium hypochlorite, 5.25%		
Target PPM	Teaspoon chlorine /5 gallons water	Cup chlorine /50 gallons water
150	11	2.25
Sodium hypochlorite 12.75%		
150	4.5	1

- If you are using chlorine, check the wash water pH with pH test strips and adjust the pH to between 6 and 7.
- If washing tomatoes, peppers or eggplants, etc. the temperature of the water should be no more than 10 degrees cooler than the produce to prevent the crop drawing in water, potentially contaminating the flesh.
- Use test strips to monitor the level of the disinfectant often. Test strips for pH and Chlorine levels (one option): <http://www.sanitationtools.com/Search/Results?Term=pH+test+strips>

22. When can I replant my flooded field to edible crops? It is up to the farmer to decide when the risk is low enough to replant. The following can help reduce risk when replanting: allow the soil to dry out, till thoroughly, and allow some time for the population of microbial pathogens to decline before planting the next human food crop. The longer you can wait, the better, and it is not advisable to plant without a waiting period. Keep in mind that the USDA GAPs food safety practices as well as the organic standards require waiting several months after the application of raw manure, and if your fields were exposed to raw manure or

feces in flood waters then that can be considered a similar situation. A minimum of several weeks waiting before planting is a good idea given that some research studies have found that pathogens in soil may decline significantly during this time. But again, if a high level of biological or chemical contaminants is suspected, as with extreme flooding conditions that breached many septic systems, it is prudent to wait longer to allow time for the carbon-based contaminants to be decomposed.

Current industry guidance recommends 60 days, with shorter times possible based on the growers assessment of their field and flood conditions. Mixing in well-made compost will help stimulate biological activity and decomposition. Where you can, it will further reduce risk to sow a cover crop such as oats or winter rye and wait to plant human food crops until the following season.

23. What kinds of edible crops can I replant on soils that have been recently flooded?

Avoid planting any leafy greens, carrots, and other crops that might be eaten raw, directly into flooded soils. These crops pose a relatively high risk, as described above. If you have greenhouses or high tunnels that you normally use for growing such crops, an alternative would be to build raised beds at least 6 inches high and fill them with soil and compost that has not been flooded. With garlic and root crops for next year's harvest it is still a good idea to wait as long as possible to plant these crops, allowing microbial pathogen populations to decline, since there is some evidence that crops can internalize pathogens from the soil. While microbial pathogens will decline over time, keep in mind that chemical contaminants may persist.

24. Can I use wooden bins that have been in contact with flood water to store unflooded produce?

It is not advisable, as wooden bins have porous surfaces that can retain soil and harbor microbes; this creates concern about cross-contamination from contact between clean produce and contaminants that may be on the surface of the bins. However, to greatly reduce risk, you can insert a clean poly bin liner after power washing the wooden surfaces and sanitizing with a 150 ppm chlorine solution. Bin liners are available from several companies that sell harvest supplies.

This information was compiled in 2011 by: Ginger Nickerson, Vern Grubinger, Londa Nwadike and Lynn Blevins, [University of Vermont Extension](#).

Updated by: Londa Nwadike, Ph.D, Kansas State University/ University of Missouri Extension Food Safety Specialist
2201 W. Innovation Dr
Olathe, KS 66061
tel: 913-307-7391
email: lnwadike@ksu.edu
www.ksre.ksu.edu/foodsafety/

105 East 5th St, Suite 200
Kansas City, MO 64106
tel: 816-482-5850
email: nwadikel@missouri.edu
missourifamilies.org/foodsafety/

University of Missouri, Lincoln University, U.S. Department of Agriculture and Local Extension Councils Cooperating. MU Extension is an equal opportunity/ada institution.

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

Kansas State University, County Extension Councils, Extension Districts, and U.S. Department of Agriculture Cooperating. K-State Research and Extension is an equal opportunity provider and employer.