

What is flooding?

By definition, flooding is the flowing or overflowing of a field with water outside a grower's control (6, 9*). (**Numbers refer to the information's resource, numbered on p.3.*)

Why is flooding an issue?

In addition to physical damage flooding may cause a field/crops/farm, flood water may also be contaminated with sewage, chemicals, heavy metals, microorganisms of public health significance, and other contaminants. Flood water poses a contamination risk to produce that it may come in contact with. Pooled water (such as puddles), while not considered flooding, may also pose a risk to crops (6, 9).

Determine the extent of the flooding. Did the flood water contact the edible portion of the crop?

Yes: This produce is considered adulterated and must be destroyed (10).

No: Grower should evaluate the safety of the crop, consideration should be on a case by case basis, accounting for unique circumstances; not every field on a farm may have been affected in the same way by the flooding. Take into account:

- The flood water: Where did it come from (river, irrigation canal, drainage ditch)? What might be in the water considering upstream events or facilities? Was there a nearby catastrophe (e.g., chemical spill)? Did the flood water carry unfinished compost/BSAAO onto the field?
- Crop type and growth stage: Has the edible portion of the crop developed yet? What is the potential for splashing like? Would the lowest portion of the edible part be subject to splashing from the flood waters? Can the crop be harvested without cross-contamination? Internalization potential should also be considered.
- Degree and duration of exposure: How long did it flood? How long before the water receded? How quickly did the field dry out? What is the risk of fungal growth and the potential for mycotoxin development (grains are particularly susceptible to molding)? (2, 6, 7)

In addition to the crops, equipment and buildings may have been contaminated/affected by the flooding. Equipment should be properly cleaned and sanitized before being used again.

Preparing to Replant Flooded Fields

Before replanting a field should be:

- Dry enough to allow for it to be worked safely, taking into consideration soil compaction that may occur.
- "Cleaned" – Flooding may have caused soil erosion or sediment deposits to collect unevenly, making it necessary to redistribute soil/sediment evenly or level the land to allow for replanting. Cover crops may be planted to help with soil erosion and to improve the soil structure after a flood. Trash or other debris deposited by the flooding may be present in the field and should be removed (1, 4, 6, 8).

- Assess the field's safety, considering:
 - Field history and crop selection
 - Time interval between flooding, planting, and harvest
 - The source of the floodwaters and potential contamination events
 - Sufficient drying time for the field to be reworked
 - Soil sampling and testing (1, 4, 6, 8)
- In cases where chemical or radiological hazards were associated with flood waters, a re-entry based on biological hazards may not be adequate to ensure the safety of the field before replanting occurs. In these cases, testing or other assessment may be necessary before replanting.

The FDA does not have a minimum required wait time between flooding and replanting. However state and local agencies, such as CA LGMA; and Western Growers, recommend a 30-60 day wait time before replanting (3, 5, 6).

Testing

In some cases, testing may allow for wait times to be reduced (5). Soil testing resources for growers include:

- [List of soil testing labs \(Fresno, Madera, Merced, Stanislaus\)](#)
- [UCCE list of agricultural analysis labs](#)
- [Plant and soil labs in Central and Southern CA](#)
- [Plant and soil labs in Northern and Central CA](#)

Additional Controls

Growers may wish to consider additional controls to protect their produce (6).

The FDA recommends:

- Separation of affected and unaffected crops
 - If the edible portion of a crop came in contact with flood waters, it should be destroyed in such a manner that it does not pose a food safety or contamination risk to other crops. If a grower has yet to determine the exposure or contamination status of a crop, that crop should be kept separate from unaffected crops to prevent contamination. Growers may wish to clearly identify which crops have been exposed to flood waters to prevent cross contamination.
- Cross contamination prevention between fields
 - Equipment should be adequately cleaned and sanitized before moving between a flooded field and an unaffected field. Similarly, PPE should be worn by personnel in flooded fields, and should be discarded or thoroughly cleaned and sanitized before moving to an unaffected field.
- Buffer zone
 - A 30-foot buffer zone allows for equipment to turn in the field without contaminating an adjacent, unaffected field/crop.

- Well water/well head check
 - Well heads that may have been submerged under flood waters may have been exposed to contaminants. It is recommended to check water quality after a flooding event has occurred. Extension Offices, as well as local and state agencies may be a valuable resource for growers when determining the condition of their well/water source.

Resources

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<https://crops.extension.iastate.edu/cropnews/2011/06/flooding-and-stored-grain>
3. "Commodity Specific Food Safety Guidelines for the Production, Harvest, Post-harvest, and Value Added Unit Operations of Green Onions." Western Growers Trade Association, 2010.
<https://www.wga.com/sites/default/files/Green%20Onions%20GAPs%20-%20February%202010.pdf>
4. "Flooded Crops: Food Safety and Crop Loss Issues." *Center for Agriculture, Food, and the Environment*, University of Massachusetts, 26 Oct. 2016.
<https://ag.umass.edu/vegetable/fact-sheets/flooded-crops-food-safety-crop-loss-issues>
5. "Flooding Fact Sheet." LGMA, 2023.
https://lgma-assets.sfo2.digitaloceanspaces.com/downloads/Flooding-Fact-Sheet_Jan-2023.pdf
6. "Guidance on Safety of Flood-Affected Food Crops." *Guidance for Industry: Evaluating the Safety of Flood-Affected Food Crops for Human Consumption*, FDA, 2011.
<https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-evaluating-safety-flood-affected-food-crops-human-consumption>
7. "Potential for Infiltration, Survival, and Growth of Human Pathogens within Fruits and Vegetables." *Potential for Infiltration, Survival, and Growth of Human Pathogens within Fruits and Vegetables*, FDA, 2009.
<https://www.fda.gov/food/hazard-analysis-critical-control-point-haccp/potential-infiltration-survival-and-growth-human-pathogens-within-fruits-and-vegetables>
8. "Repairing Flood-Damaged Farm Fields." University of Massachusetts, Sept. 2011.
https://ag.umass.edu/sites/ag.umass.edu/files/pdf-doc-ppt/ISU-UNL_Post-Flood_Field_Repairs_Fact_Sheet.pdf
9. Schweiger, J. "Gardening After a Flood." University of California Cooperative Extension.
<https://cesantaclara.ucanr.edu/files/259468.pdf>
10. "Title 21 Chapter 9 Subchapter IV Sec. 342 Adulterated Food." *U.S.C. Title 21 - Food and Drugs*, 2011.
<https://www.govinfo.gov/content/pkg/USCODE-2011-title21/html/USCODE-2011-title21-chap9-subchapIV-sec342.htm>