



Cornell University

## **DEALING WITH FLOODED VEGETABLE FIELDS**

**Steve Reiners**

**Associate Professor in Horticultural Sciences**

**Cornell University**

Record breaking rains in parts of New York State have left many vegetable growers in dire straits. What had been shaping up to be an excellent season has quickly turned into a nightmare with crops under water in many locations. Growers have been asking many questions as to what they can do in the short and long term. The following are recommendations pulled from many sources including Michigan State University, Ohio State University, Texas A and M, Florida State University, as well as Cornell.

### **FLOODS AND FOOD SAFETY**

There are two types of flooding. The first is more typical and occurs after a heavy downpour when fields become saturated and water pools on the soil surface. This type of flooding can reduce yields and even kill plants but usually will not result in contamination of produce with human pathogens. The second type of flooding is more severe and seen less often. Standing water in fields that is runoff from stream/river overflows will more likely be contaminated with human pathogens. Unless flooding was light and there is no danger of bacterial contamination from floodwater, do not use fruits and vegetables that were ready for harvest at the time of flooding. Some fruits and vegetables are more susceptible than others to bacterial contamination.

Leafy vegetables (such as lettuce, cabbage, mustard, kale, collards, spinach, and Swiss chard) along with strawberries were at or near harvest and more likely to be contaminated. Silt and other contaminants may be imbedded in the leaves, petioles, stems, or other natural openings of fleshy structures and can be difficult to remove. Do not use if mature when flooded.

Root, bulb, and tuber crops such as beets, carrots, radishes, turnips, onions, and potatoes are less susceptible to bacterial contamination. With the exception of radish, most of these crops should not be near harvest. Produce with a protected fruit or impervious outer skin such as peas, melons, eggplant, sweet corn, or winter squash may be contaminated on the surface.

It is extremely important that produce be properly washed to reduce contamination. To control postharvest losses, it is recommended that produce be washed in chlorinated water before storage or shipping (see table below). The wash temperature should be about 10°F warmer than the produce temperature to ensure that decay organisms are not sucked into the tissue. Since chlorine is most effective at a slightly acidic pH, it is important that wash water is buffered to adjust the pH to between 6 and 7.

Chlorine in the wash water is often inactivated when the wash water becomes dirty. Use filtering devices to remove soil and organic material, and check the chlorine concentration often. Produce should be subjected to the chlorinated wash from one to ten minutes. After it is removed, allow it to drain for several minutes before packing. **NOTE:** Leafy vegetables at or near harvest that were flooded with stream/river overflows should not be harvested or consumed. Chlorinated wash water will not eliminate likely human pathogens on their surface.

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Amount of sodium hypochlorite to add to wash water for 50-150 PPM dilution.

Target PPM	ml/L	tsp/5 gal	cup/50 gallons
<b>Sodium Hypochlorite, 5.25%</b>			
50	1.0	3.66	0.75
75	1.4	5.5	1
100	1.9	7.25	1.5
125	2.4	9	2
150	2.9	11	2.25
<b>Sodium Hypochlorite, 12.75%</b>			
50	0.4	1.5	0.33
75	0.6	2.25	0.5
100	0.8	3	0.66
125	1.0	3.75	0.8
150	1.2	4.5	1

## PLANT SURVIVAL UNDER WATER

Many growers have asked how long a crop can live once it is flooded and what may be the effect on yield. There has not been much work done on vegetable crops but we may learn some lessons from field corn and soybeans. In field corn, measurable short term reductions for root and leaf growth rates begin immediately within 1-12 hours, but tend to recover quickly, 2-3 days after the water has drained. Most of our sweet corn was at least twelve inches tall which means the growing point is well above the soil line, which improves the chance of survival. If flooding in corn lasts less than 48 hours, crop injury should be limited. Look for new leaf growth 3 to 5 days after water drains from the field.

Even if flooding doesn't kill corn plants outright, it may have a long-term negative impact on crop performance. Excess moisture during the early vegetative stages retards root development.

When six-inch corn was flooded for 24, 48 and 72 h corn yields were reduced 18, 22, and 32% at a low N fertilizer level. At a high N level, these reductions ranged from 19 to 14 % one year and <5% in another year. When corn at a height of 30 inches was flooded for 24 and 96 h, yields were reduced 14 to 30%. With a high level of N in the soil, very little yield reduction occurred even with 96 h of flooding. When flooded near silking, no reduction in yield occurred at a high N level, but yield reductions up to 16% occurred with 96 h of flooding at the low level of N.

In soybeans, studies showed yield losses of 20% when soybean fields were flooded for greater than 2 days, but it should be noted they still had a yield.

In vegetable crops, we should expect to see similar trends. Flooding of a short duration, less than 48 hours should have a minor impact on yield. Flooding for 48 to 72 hours may result in more significant yield losses. The two most important things growers can do to aid recovery is 1) as soon as the soil can be worked, till the soil to break up sealed surfaces and allow air to enter the soil, and 2) sidedress with nitrogen, up to 50 pounds of N per acre, perhaps during the tillage operation or, if conditions do not allow for soil applications, apply a foliar application (see below). **Please note**, many plant diseases will be much worse following flooding rains. It is important that growers closely monitor their crops and manage these diseases.

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## FLOODING AND SOIL FERTILITY

That "gasping" sound you hear in some vegetable fields is the plant roots trying to get some oxygen. Many of the vegetable plants in fields across parts of New York have an off-green or yellowish color. These plants are suffering from a complex of nutrient deficiencies, nitrogen, phosphorus, potassium and perhaps others, even though the soil contains adequate amounts. But the main deficient element is oxygen. Plant roots need oxygen to take up nutrients and water to utilize the photosynthate from the tops and to grow. With the heavy rains we have had, soils are near saturation; that is, nearly all of the pore space is filled with water, leaving little room for air. Ideally, for good root growth 50 percent of the pore space should be filled with air. As soils drain, air is drawn into the soil, but when it rains, the water forces the air out of the pores. As is obvious to all, what is needed now is several rain-free days so the soils can drain and draw in air to stimulate root growth.

Unfortunately, the flooded fields often develop a hard surface layer that prevents air from entering. Any tillage that can be done to break that seal will be beneficial. Once the plant roots get adequate oxygen they will begin to grow and take up the nutrients present in the soil.

Plants can absorb nutrients through their leaves. Spraying the plants with nitrogen, phosphorus and potassium can help plants through stress periods. Use a low salt liquid fertilizer to supply 4 to 5 lb nitrogen, 1 lb phosphate ( $P_2O_5$ ) and 1 lb potash ( $K_2O$ ) per acre. Since nitrogen is the key nutrient to supply, spraying with urea-ammonium nitrate (28 % N solution) alone can be helpful. These can be sprayed by aerial or ground application. Use 5 to 20 gallons of water per acre. The higher gallons per acre generally provide better coverage. However, before investing money in trying to salvage root crops check to be sure that the main root that develops into the marketable product is still healthy. Flooded fields often kill the large tap root resulting in a fibrous root and an unmarketable product. This is especially true for fresh market carrots.

Tests were conducted in Florida to determine the effectiveness of different foliar fertilizers in recovering flood-damaged vegetable crops and found that potassium nitrate performed the best, urea the second best, and calcium nitrate the third. See table below for details.

Nitrogen fertilizer application information.

<b>Fertilizer</b>	<b>Formula</b>	<b>N%</b>	<b>Application* (lb/100 gal)</b>	<b>Rate (gal/ac)</b>
Potassium nitrate	$KNO_3$	13	15	50-100
Urea	$CO(NH_2)_2$	46	9	50-100
Calcium nitrate	$Ca(NO_3)_2$	12	35	50-100

\*Pounds of product, not pounds of N

## WHAT TO PLANT NOW?

Even assuming fields could be worked and planted today, it is too late to replant many vegetables. At best, we are looking at only 80 to 90 days before a likely frost. Crops that should not be replanted now include processing beets, carrots, pumpkin, winter squash, melons eggplant, onions, peppers, potatoes, and tomatoes. It is probably too late for sweet corn. Crops that could be planted for a fall harvest include snap beans, fresh market beets, broccoli, cauliflower, cucumbers, summer squash, zucchini, leafy crops (lettuce, spinach, etc.), and radishes. Detailed information on these crops is available in the 2006 Cornell Vegetable Guidelines, available on the web at <http://www.nysaes.cornell.edu/recommends/>.

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Before planting, growers need to take a step back and think this through. Just because a crop can be planted does not mean it should be. Do you have the proper equipment to grow the crop? Any experience with the crop? Are you aware of the crop's potential pests and what to look for in terms of damage? Do you have the chemicals needed to control these pests? Was a herbicide used in a field this spring that could cause injury in a newly planted crop? Perhaps most importantly, how will you market the crop? Don't spend two or three thousand dollars to grow a crop only to have no market at the end. Work the numbers. Will you be better off with a partial payment from crop insurance and possibly disaster relief from the federal government rather than losing more money with an unfamiliar crop?

There are some cover crop options that growers may want to consider for their flooded fields. Rather than let productive fields go to weeds for a season, use the opportunity to plant a cover crop or green manure. Many growers are familiar with cover crops planted in the fall. But this year you can plant a crop that you may not have had the opportunity to use previously. Some of our most productive cover crops can be planted in the summer. Choose from crops that are effective at reducing weeds, minimizing pathogens, supplying nitrogen and phosphorus or generally improving overall soil health. Choices include;

## **Non-legumes**

### **Sudangrass or sorghum-sudan hybrids**

Seeding rate – 30-50 lb/Acre

Seeding time – late spring through August 1

Culture and Benefits – Heat loving annual. Apply supplemental nitrogen to encourage growth (especially in soils where N has been leached). Mow when three feet tall to encourage greater rooting and manage top growth. Incorporating green prior to frost may suppress some diseases and nematodes. Produces large amounts of organic matter and roots penetrate compacted soils.

### **Buckwheat**

Seeding rate – 60 lb/Acre

Seeding time – Late spring through summer

Culture and Benefits – Warm season annual. Mow or incorporate at early flowering to avoid seed set and subsequent weed problems. Grows rapidly and thrives on poor soils. Two successive buckwheat crops followed by winter rye can effectively reduce weed pressure in a field. Also makes phosphorus more available to subsequent crops.

**Legumes** – Legumes have the ability to fix nitrogen from the air so they are a very valuable as a “free” source of nitrogen. Unfortunately, most legumes do poorly when sown in warm summer weather. There are however, a couple of exceptions.

### **Cowpeas**

Seeding rate – 70 – 100 lb/Acre

Seeding time – Late spring through mid-summer

Culture and Benefits – Heat loving legume. Look for forage cultivars as they will put on more vegetative growth. Before incorporating, mow or roll and incorporate green. Can add 100-150 lbs/A of nitrogen but remember to inoculate seeds with a “cowpea” type inoculant. Adds 1 to 2 tons of dry matter per acre.

### **Annual Alfalfa – Nitro**

Seeding rate – 15 – 20 lb/Acre

Seeding time – Late spring through early summer

Culture and Benefits – Annual alfalfa that normally winter kills. Produces good top growth as well long taproots to break up compacted layers. Be sure to use an inoculant to maximize N fixation.