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How Can You Reduce Flooding Damage to Vegetable Crops? [1]

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Flooding is the major risk to fresh vegetable production in south Florida, especially in the south Dade County area. Although most soils are normally well drained, low-lying areas are often prone to flooding during periods of high rainfall. In Miami-Dade County, agriculture losses from flooding as a result of rainfall (13.9") in December 2000 were estimated at 13 million dollars. In October 1999, vegetable crop losses due to hurricane Irene were estimated to be about 77 million dollars, with nearly 19,000 acres damaged by floods.

Several management practices have been reported to help crops partially or entirely overcome flood damage. For example, the application of nitrogen (N) fertilizers overcomes N deficiency, while natural or synthetic hormones are used to correct hormone imbalances, and the addition of fungicides help control soil-borne pathogens. We recently conducted a flooding experiment with bush bean, cowpea, and sweet corn. This article recommends some practices to alleviate flooding damage of vegetables.

Nitrogen fertilizers effectively enhance crop recovery

Because of reduced root activity, flooding causes a significant decrease in N content and the rate of N accumulation in plants. Plant-available N in soils is also very low because of leaching or runoff. Yellowing of leaves due to loss of chlorophyll from leaves within two to three days of waterlogging is probably attributed to N deficiency. Thus, a strategic use of N fertilizer after flooding may alleviate N deficiency and enhance crop recovery from flooding. Growers should apply fertilizers as soon as soils become dry enough for tractor operation. Foliar application of liquid fertilizers is more effective than broadcasting dry fertilizer because of root damage due to flooding. Many kinds of N fertilizers can be used for crops after flooding. Recently we tested several fertilizers for their effectiveness 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 1 for application information. A regular granular dry fertilizer, such as 10N-10P_2O_5-10K_2O, also can be

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used for flooded crops, but it is not as effective as foliar and liquid fertilizers.

Growth regulators have little effect on crop recovery

Various plant growth regulators have been associated with alleviation of waterlogging damages, but there is a dearth of information available on their effects on waterlogged crops. Spraying shoots with a synthetic cytokinin (6-benzylaminopurine [BAP]) has been reported to reduce flooding damage by improvements in leaf extension and retard premature loss of chlorophyll in older leaves. This was related to application of BAP compensating for the restricted transport of natural cytokinin from the root system, affecting metabolism of gibberellins, and adversely affecting the inhibitory action of abscisic acid on growth. However, our study with six growth regulators showed no effects on sweet corn and cowpea recovery from flooding. See Table 2 for application rates used in this study. Some growth regulators even inhibited crop recovery by affecting photosynthesis and evapotranspiration.

Fungicides may not affect crop recovery

Flooding increases the severity of diseases. The symptoms of diseased roots are discoloration, rotting of the root, and the premature death of the plant. The damage reduces the ability of the root systems to obtain mineral nutrients or perform other functions essential to the shoot. Two common diseases, Phytophthora and Pythium, cause greatest damage to roots in poorly drained soil. Application of fungicides probably reduces the incidence of disease in waterlogged plants and thereby increases plant tolerance to flooding. However, we tested two fungicides (Ridomil and Bravo 720) in our flooding experiment, and neither chemical had a significant effect on plant growth. See Table 2 for application rates used in this experiment.

Table 1. Nitrogen fertilizer application information.

Fertilizer	Formula	N%	Application (lb/100 gal)	Rate (gal/ac)
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

Table 2. Growth regulators and fungicides were tested for sweet corn and cowpea.

Chemicals	Type	Rate
Progibb	Growth regulator	50 ppm
6-Benzylaminopurine	Synthetic cytokinin	10 ppm
Trigger	Synthetic cytokinin	8 oz/100 gal
Auxigrow	Growth regulator	4 oz/gal
Fulvic acid	Growth regulator	1 quart/100 gal
Ethaphon	Growth regulator	100 ppm
Ridomil	Fungicide	16 oz/100 gal
Bravo720	Fungicide	1 quart/100 gal