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Volume 3 Number 6 March 2018

Preventing Chilling Injury of Greenhouse and Vertical Farm Grown Basil

Demand for year-round and locally produced fresh-cut and potted culinary herbs such as basil (*Ocimum basilicum* L.) has been increasing rapidly in recent years. Greenhouse growers and indoor vertical farms are benefiting from this demand (Figure 1) by expanding production and products (Figure 2). However, a major challenge for producers, distributors, packers, and exporters of fresh-cut and potted basil, shiso or beefsteak plant (*Perilla frutescens* var. *crispa*), and some oregano (*Origanum*) species is chilling injury especially during winter months. Most other commonly used fresh-cut herbs marketed in clam shells can be stored at temperatures between 32 to 36 °F (0 to 2 °C) without injury. Since basil is native to tropical regions, is it susceptible to chilling injury at temperatures below 54 °F (12 °C) during transport, distribution, storage, and marketing in the retail environment. Therefore, 54 °F is generally the recommended temperature for storage and shipment of most basil cultivars.



Figure 1. Hydroponic nutrient film technique (NFT) greenhouse basil production.

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Visual symptoms of chilling injury in basil can vary by cultivar, with some growers indicating that sweet basil is the least sensitive.

Interveinal brown spot or discoloration of leaves and sometimes browning of the stem is often followed by wilting, epinasty, loss of glossy appearance (Figures 3, 4, 5, and 6) and aroma. Leaf abscission of older leaves typically occurs a few days after exposure to warmer temperatures and can be attributed to chilling-induced ethylene production (Figure 5).

To complicate matters even more, it has been reported that greenhouse produced basil is prone to *Botrytis cinerea* when there is excess humidity in the packaging and storage temperature are above 54 °F.

A review of the literature indicates that researchers around the world have explored a wide variety of treatments and technique to prevent or reduce chilling injury of basil with success. Recent research has shown that the time of day that ornamental cuttings such as euphorbia and lantana are harvested influences their post-harvest life. Aharoni et al (2010) reported that harvesting sweet basil at 8 AM (2 hours after sunrise) resulted in severe leaf browning, decay, and abscission after 5 days at 54 °F plus 2 days at 63 °F (17 °C). However, harvesting basil at 4 PM resulted in reduced browning, decay, and abscission after exposure to the above chilling temperatures. Previous work conducted at Michigan State University by Lange and Cameron (1994 and 1997) indicates that shelf life of sweet basil stored at temperatures at or above 50 °F (10 °C) improved when harvested during the afternoon. They conclude that a possible solution to large losses caused by chilling injury might be to harvest in the late



Figure 2. Typical packaging of potted greenhouse or vertical farm produced herbs. Potted herbs are then marketed in grocery store produce departments.



Figure 3. Characteristic chilling injury symptom of brown discolorations (top left) on cut basil in a plastic clam shell. The clam shells were not in the display cooler with the other cut herbs.



Figure 4. Chilling injury symptoms of potted basil in a garden center. Photo: Christopher Currey, Iowa State University.



Figure 5. Young potted basil after exposure to 3 days of 43 °F in a cooler, followed by 3 days at 72 °F. Notice yellowing and brown discoloration of bottom leaves. Photo: Jennifer Boldt, USDA-ARS.



Figure 6. Chilling injury of potted basil in a grocery store produce department with an air temperature set point of 50 °F.

afternoon or early evening and then store chilling-sensitive leafy crops for 1 day at 50 °F before refrigerated shipment at 41 °F. It has also been reported that increased resistance to chilling injury of afternoon-harvested basil can be correlated to a 10-fold accumulation of carbohydrates such as starch.

Another study by Aharoni et al (2010) showed that chilling injury severity of cut basil harvested in the morning was reduced by up to 42% by exposing the packages to humidified air (96 to 98%) at an air temperature of 100 to 104 °F (38 to 40 °C) for 4 hours prior to exposure to storage temperatures of 48 °F (9 °C).

To summarize, chilling injury may be avoided by storing and shipping fresh cut and potted basil at or above 54 °F (12 °C). Basil harvested in the afternoon will have a better post-harvest life than plants harvested in the morning. Finally, if you are not able to ship basil at temperatures above 50 °F, condition plants for one day at 50 °F before shipping. As with all research, growers are advised to conduct their own trials before implementing large scale changes as your growing conditions can impact results.

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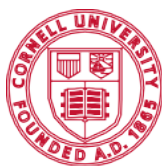
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