Chile Crop Growth and Development

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Chile (*Capsicum annuum*) production is an important aspect of vegetable crop production systems in the desert Southwest. The *Capsicum annuum* species is the most common group of chiles that we encounter and these chiles are common in our southwestern diet. The New Mexico type chile (aka, Anaheim) is a common crop in the desert Southwest including southeastern Arizona, southern New Mexico, west Texas, and northern Chihuahua, Mexico.

There are five domesticated species of chile peppers. 1) *Capsicum annuum* is probably the most common to us and it includes many common varieties such as bell peppers, wax, cayenne, jalapeños, Thai peppers, chiltepin, and all forms of New Mexico chile. 2) *Capsicum frutescens* includes malagueta, tabasco, piri piri, and Malawian Kambuzi. 3) *Capsicum chinense* includes what many consider the hottest peppers such as the naga, habanero, Datil, and Scotch bonnet. 4) *Capsicum pubescens* includes the South American rocoto peppers. 5) *Capsicum baccatum* includes the South American aji peppers (Guzman and Bosland, 2017). Some examples are shown in Figure 1 and some other chile pepper species as well.

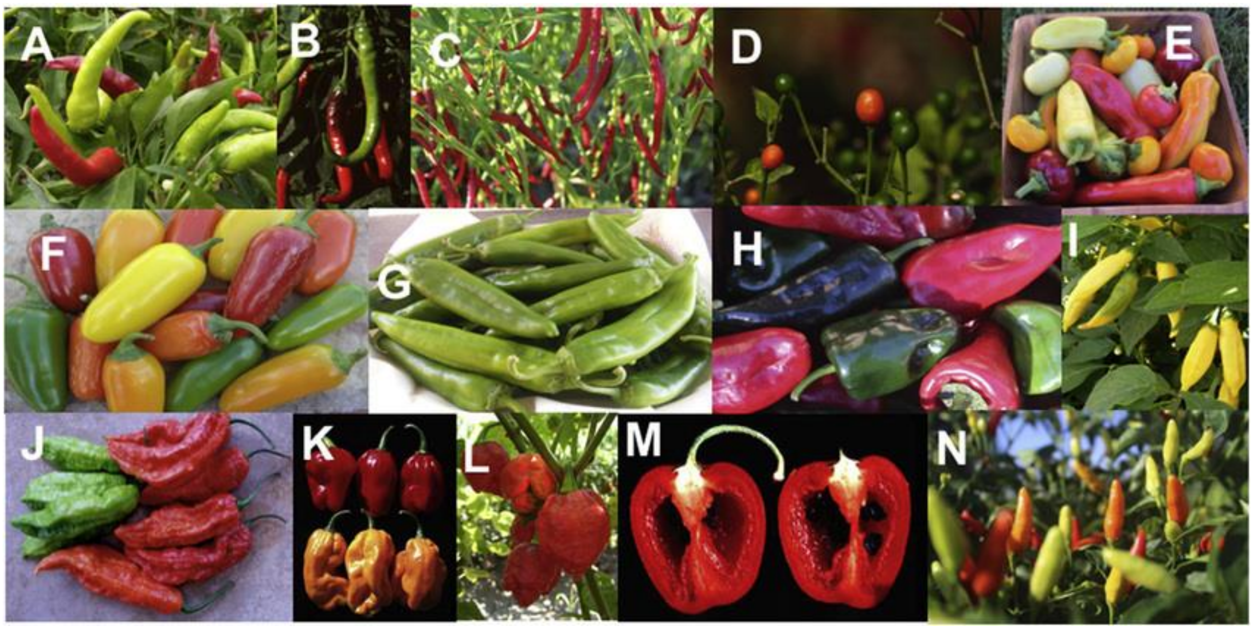

Figure 1. Capsicum annuum pod types include A) Asian, B) Cayenne, C) Chile de Arbol, D) Chiltepin, E) Hungarian Paprika, F) Jalapeño, G) New Mexican, and H) Poblano. A Capsicum baccatum pod type is I) Aji. Capsicum chinense pod types are J) Bhut Jolokia, K) Habanero, and L) Scorpion. A Capsicum pubescens pod type is M) Rocoto and a Capsicum frutescens pod type is N) Tabasco. Source: Guzman and Bosland, 2017.

Crop Phenology

Efficient management of a crop requires an understanding of the basic stages of plant growth in relation to time or age (crop phenology) and basic crop needs. There is a strong phenological relationship with morphological and physiological changes that are taking place and the input requirements important for the crop as the plant develops. As plants change physiologically and morphologically through their various stages of growth, water and nutritional requirements are great examples of crop demand changes that should influence management of the crop in the field.

Heat units (HUs) can be used as a measure of “thermal time” that drives plant development. Thus, HUs can be used as an important management tool for more efficient timing of irrigation and nutrient inputs to crop and pest management strategies. Plants will develop over a range of temperatures which is defined by the lower and upper temperature thresholds for growth (Figures 2 and 3).

Heat unit systems consider the elapsed time that local temperatures fall within the set upper and lower temperature thresholds and thereby provide an estimate of the expected rate of development for the crop. Heat unit systems have largely replaced days after planting in crop phenology models because they consider day-to-day fluctuations in temperature. People still use days after planting to estimate stages of crop development but HUs are more accurate and reliable.

Crop phenology models describe how crop growth and development are impacted by weather and climate and provide an effective way to standardize crop growth and development among different years and across many locations (Baskerville and Emin, 1969; Brown, 1989).

The use of HU-based phenology models is particularly important and applicable in irrigated crop production systems where water is a non-limiting factor. Water stress will alter phenological plant development and it is a major source of variation in crop development models. Accordingly, irrigated systems are more consistent in crop development patterns and HU models can be much more consistent and reliable.

Chiles are a warm season, perennial plant with an indeterminant growth habit that we grow and manage as an annual crop. The fruiting cycle begins at the crown stage of growth and continues until the plant reaches a point of "cut-out" with a hiatus in blooming as the plant works to mature the chile fruit crop that has been developed.

Figure 4 describes the basic phenological baseline for New Mexico – type chile and was developed from field studies conducted in New Mexico and Arizona (Silvertooth et al., 2010 and 2011; Soto et al., 2006; and Soto and Silvertooth, 2007). The use of HUs (86/55 ^{o}F thresholds) are applied in this development model since chiles are a warm season plant (Figures 2 and 3).

Heat units accumulated after planting (HUAP) for any date of planting to the present date can be easily accessed in the Arizona Meteorological Network (AZMET) website.

https://azmet.arizona.edu/

Also, the new HUAP tool for cotton that Dr. Jeremy Weiss, AZMET Director, recently developed can be used for chiles or other warm season crops. The same 86/55 °F thresholds are used and the model does not know what crop you are working with. It is a quick and easy way to calculate HUAP totals for any planting date in 2024.

https://viz.datascience.arizona.edu/azmet/cotton-growth-stages-and-heat-units/

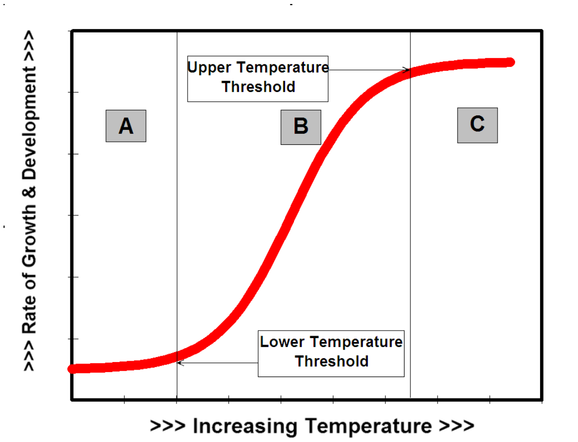

Figure 2. Typical relationship between the rate of plant growth and development and temperature. Growth and development ceases when temperatures decline below the lower temperature threshold (A) or increase above the upper temperature threshold (C). Growth and development increases rapidly when temperatures fall between the lower and upper temperature thresholds (B).

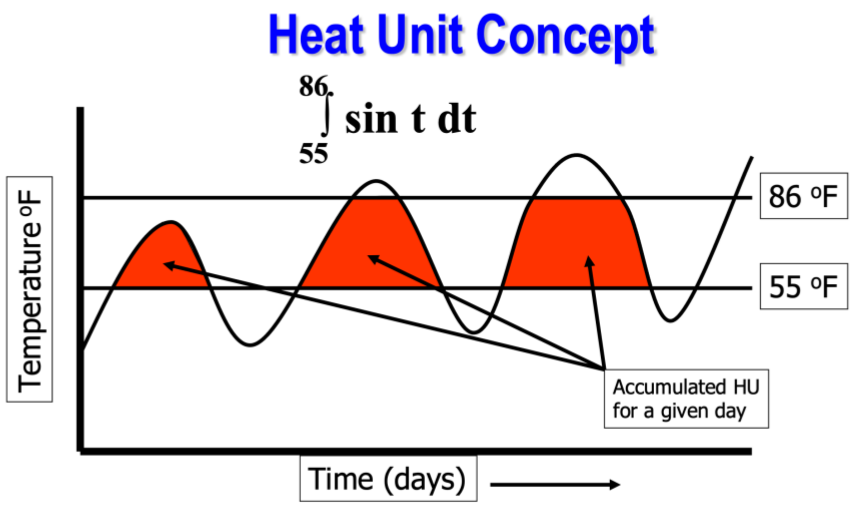

Figure 3. Heat unit calculation with the sine curve method using upper and lower temperature thresholds (Brown, 1989). The 86/55 °F thresholds are used, consistent with most warm season crops.

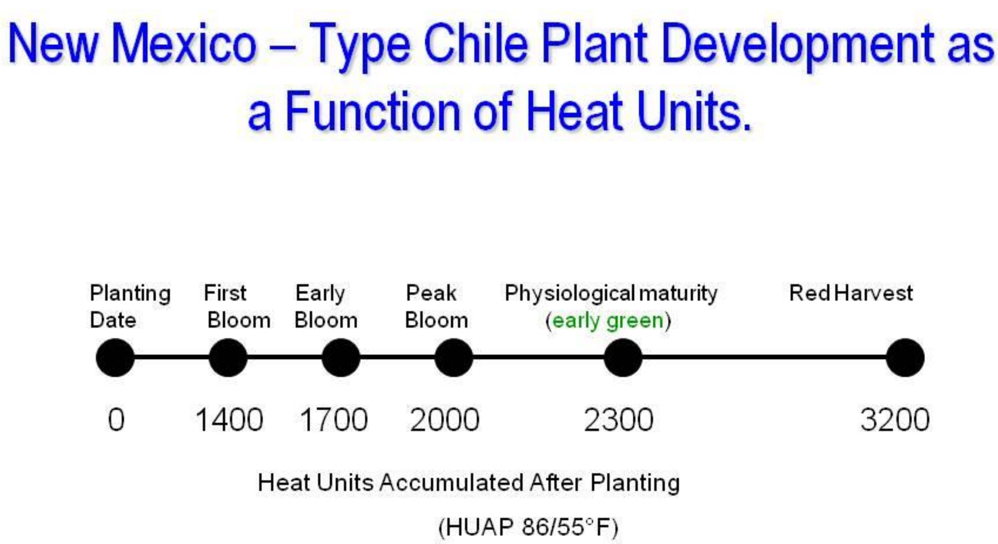

Figure 4. Basic phenological guideline for irrigated New Mexico-type chiles.

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