

ALLIUM PHYSIOLOGY 101

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Vegetable growers often wish for crops to grow that are undemanding in their requirements, and that provide reliable yields no matter when and how they are grown. Onions and their allies, known as the Alliums, are the fussiest of crops, demanding exact conditions of daylength and temperature for best performance. Here follows a short primer on what makes them tick. The two major important processes in these crops are the formation of bulbs, or bulbing, and the formation of flowers, known as bolting. Both these processes stop the vegetative growth of the plant, so once bulbing or bolting starts, the plant's bulb or number of flower stalks will be proportional to the size of the plant at that time. We will cover these processes separately, and then explain how the plants react to a "typical" growing season.

BULBING: Bulbing is the formation of an enlarged storage structure at the base of the leaves, composed of leaf bases and bulb scales. Bulbs are resting structures that provide food for the plant when it resumes growth after long periods of drought or cold. Since they are the harvested product for which the crop is grown, the factors influencing bulb formation are important to know. In Table 1, those factors are listed, and their influence explained for the main Allium crops.

Table 1. Influence of daylength, temperature and variety on bulb formation in 5 major Allium crops.

Crop	Daylength	Temperature	Variety
Onion	Major	Moderate	Major
Shallot	Major	Moderate	Major
Garlic	Moderate	Major	Major
Leek		No bulbs formed	
Bunching onion		No bulbs formed	

In all the crops that form bulbs, the major stimulating factor is daylength. Under the long daylengths of late spring and summer, bulb formation is initiated. For bulb formation to be concluded, daylength needs to continue to be long enough, otherwise the process stops and goes in reverse, showing up as a thick-necked bulb that does not mature properly. Bulbing is fostered by temperatures that are optimum for growth of the crop in onions and shallots. In garlic, the long days of spring and summer stimulate bulbing, but cold temperatures of winter are essential for bulbs to be formed. That is why garlic is planted in fall; if planting is delayed until spring, no bulbs will form if the cloves that are planted were stored in warm conditions.

In all bulb-forming crops, the choice of variety makes a big difference when bulb formation starts, and what size of bulb is formed. In each major onion-producing area of the country, varieties have been selected to maximize productivity under their specific growing periods. Here in New York, our adapted onion varieties start bulbing at close to the longest day of the year (June 21). In Texas, on the other hand, varieties have been selected to start bulbing under the shorter daylengths of spring, because they

have had all winter to make vegetative growth, and growers want to market an early crop. If such Texas varieties are grown in New York, they would not make much growth before the bulbing process would start, and thus only small bulbs would be formed.

BOLTING: The formation of a flowering stalk and flowers in onions and their relatives is defined as bolting. A bolting plant will not form bulbs, so it is important to prevent flower induction if the purpose of the planting is to produce bulbs. The major trigger for this process is cold temperature (Table 2). The temperature range most effective for flower stalk formation is between 40 and 50 F, but longer periods near freezing can also be effective. Again, the choice of variety makes a big difference in the ease by which an onion can be induced to bolt.

Table 2. The influence of daylength, temperature and variety on bolting and formation of seedstalks in the Alliums.

Crop	Daylength	Temperature	Variety
Onion	Slight	Major	Major
Shallot	Slight	Major	Major
Garlic	Slight	Major	Major
Leek	Slight	Major	Moderate
Bunching onion	Slight	Major	Major

The size of the plant that is subjected to cold conditions is also a factor in bolting. Most onion varieties have a minimum size that must be reached before they can be induced to bolt. Smaller plants are called 'juvenile', while those that are large enough to be stimulated to bolt are 'adult'. That is why, in regions where the onion crop is overwintered, the crop should not be planted too early in fall, to prevent it from reaching the adult state as the cold period arrives. In general, onion varieties that were developed for areas where they will be routinely grown in winter such as Texas, will be more bolting resistant than those grown in the Northeast.

The formation of a seedstalk in garlic is primarily controlled by the variety in this crop. Generally the garlic varieties grown in the Northeast form stalks of varying heights, while those grown in California do not, even if they survive the winter here after fall planting. According to work in England, prolonged cold conditions stimulate bolting and seedstalk formation.