

# Early Growth and Development of Wheat in Northeast Oregon

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**E**arly growth and development in cereal plants follow a regular, predictable pattern. Accumulated heat is the driving force behind development.

If you know to what temperatures your crop has been exposed, you can predict development and compare your predictions against field observations. Differences between predicted and observed development are due to stress and can be used as a tool to evaluate the quality of growing conditions in a field.

The purpose of this publication is to provide background information about early development of cereals and to give you specific information about expected wheat development patterns based on historic weather data.

## Calculating growing degree days

Growing degree days (GDD) are the units used to measure heat accumulation over time. You will need to calculate how many GDD have accumulated since you planted your crop in order to compare your crop's development against predictions.

Table 1.—Sample GDD calculation.

Day	Max F Temp.	Min F Temp.	Average Temp. (°F) (Max T + Min T)/2	Average Temp. (°C) = Daily GDD	Cumulative GDD
1	72	48	60	16	16
2	78	45	62	17	33
3	69	43	56	13	46
4	73	45	59	15	61
5	75	46	60	16	77
6	74	49	62	17	94

GDD = (Max T + Min T)/2. Centigrade degree days are used for prediction purposes. Since wheat will grow at 0°C, any average temperature above freezing counts toward the degree day accumulation.

Table 1 shows a sample calculation of GDD. The process is as follows:

1. For each day since planting, add together the maximum temperature and the minimum temperature and divide this total by 2. The result is the day's average temperature (column 4).
2. If this average temperature is in Fahrenheit, convert it to

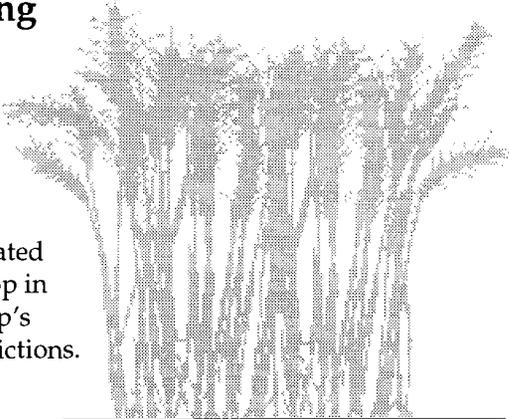
centigrade (column 5). To convert to centigrade, subtract 32 from the Fahrenheit temperature and then multiply by 0.55. For example:

$$50^{\circ}\text{F} - 32 = 18$$

$$18 \times 0.55 = 10^{\circ}\text{C}$$

The centigrade average temperature is the number of GDD accumulated for that day. (If the average temperature is below freezing, give it a GDD value of zero.)

3. To find the number of degree days that have passed since planting, add together the average centigrade temperatures for each day after the crop was seeded (column 6).



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Figure 1 shows a typical accumulation of degree days for a winter wheat growing season in LaGrande, OR, based on data taken from 1948 through 1991.

### Typical development pattern

It takes about 80 degree days for a seed to germinate and about 100 degree days for a plant to emerge from a depth of 2 inches (50 GDD per inch). Therefore, it takes a total of 180 degree days just to get the first leaf out of the ground.

If you plant a wheat crop in moist soil and find that no plants have emerged by the time 250 GDD have accumulated since planting, you should examine the field and the planted seed. There may be problems that will require reseeding.

It takes about 100 degree days for each leaf to extend. If you look at a plant with 5½ leaves on the main stem, you know that it has been about 550 degree days since the plant emerged.

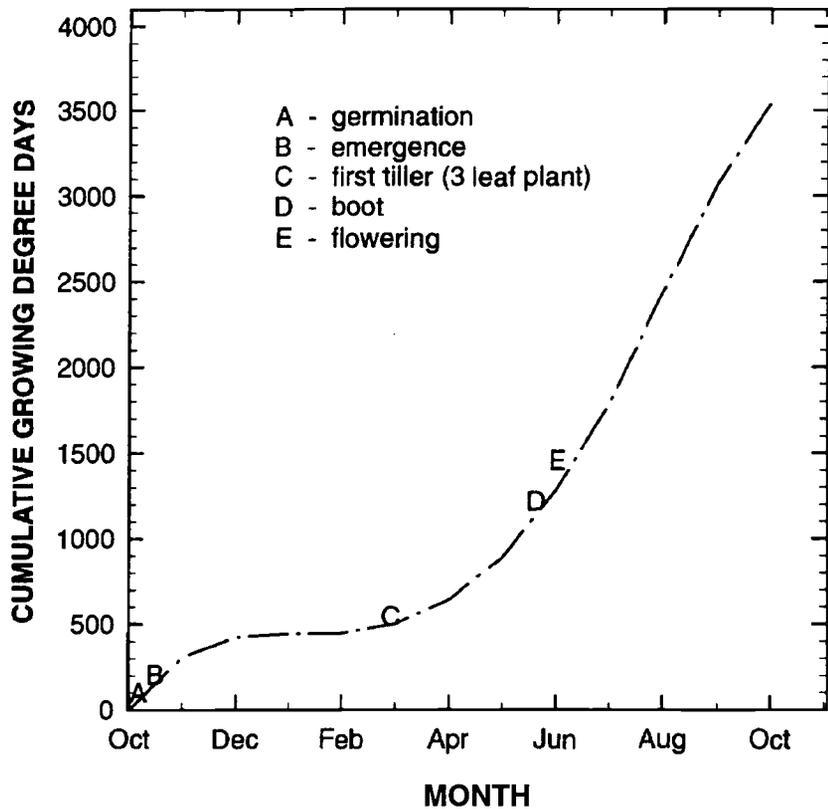


Figure 1.—Historical average (1948–1991) GDD accumulation for LaGrande, Oregon and approximate times wheat plants will reach specific growth stages at this location.

Table 2.—Relationship between GDD and wheat plant development.

GDD (Centigrade; 0° base)		Plant Growth Stage	Number of Main Stem Leaves Present	Tillers Present
From Planting	From Emergence			
0	—	—	—	—
80	—	Germination complete	—	—
180	0	Emergence complete	—	—
280	100	First leaf fully developed	1	—
380	200	Second leaf fully developed	2	—
480	300	Third leaf fully developed	3	T0
580	400	Fourth leaf fully developed	4	T0, T1
680	500	Fifth leaf fully developed	5	T0, T1, T2
780	600	Sixth leaf fully developed	6	T0, T1, T2, T3
1,200	1,020	Boot stage		
1,400	1,220	Flowering stage		

The table assumes that seeds were planted 2 inches deep and that it takes 100 GDD for each leaf to grow out. The actual number of GDD required for each leaf can vary from 75 to 120, but 100 generally works well.

Tiller development also is heat driven, but tillers do not appear until well after their parent leaf has extended. In fact, a tiller is not produced at a node until the third leaf above it appears. Use Table 2 to determine approximate plant growth stage, leaf number, and tiller number. In this table, T0 refers to the coleoptile tiller, T1 to the tiller developing from the first leaf, etc.

Using historic weather data (Figure 1) and the fact that 1,400 GDD are required to reach the flowering stage, we can say that winter wheat planted in early October at LaGrande likely will flower in early June.

Now look at Figure 2. While the average flowering date is early June, year-to-year fluctuations at a location are common. Flowering at LaGrande can occur in early May in a warm year (1991-1992) and in mid- to late-June in a cool year (1984-1985).

Observed fluctuations in flowering across locations also can be explained by differences in GDD accumulation. Average weather data (Figure 3) tell us that a 40-day difference in flowering date is the normal difference between Pendleton and Enterprise.

Armed with information about accumulated GDD in your area and knowledge of plant development patterns, you should be able to walk into any early growth cereal field and "read" the plants. Your reading will tell you what has happened and what is happening to the plants in that field.

This information can be a powerful management tool. For example, if you know that 700 GDD have accumulated since you planted a crop, and you assume 80 GDD for germination and 100 for emergence, then your crop has had 520 GDD available

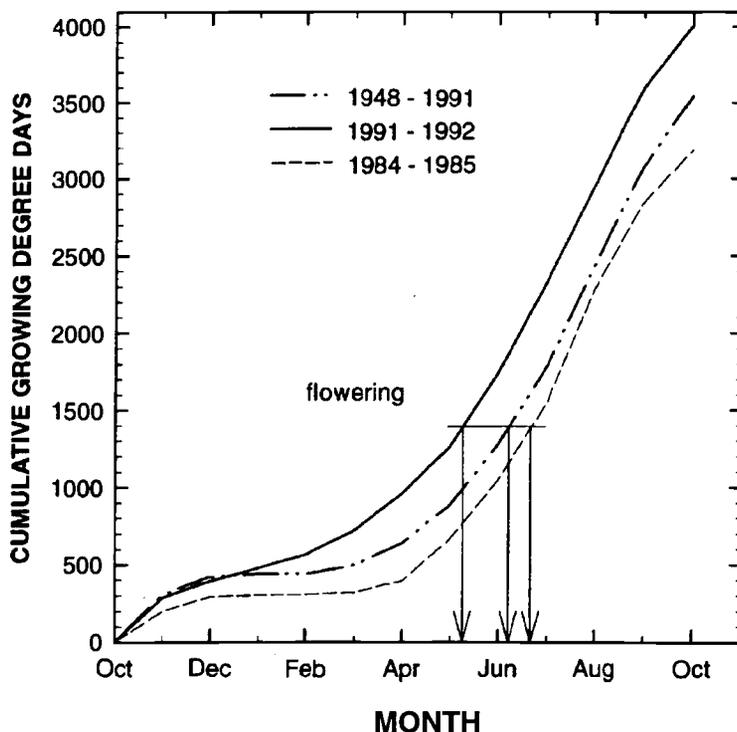


Figure 2.—Historical average (1948-1991) growing degree day accumulation for LaGrande, OR and accumulations for a warm (1991-1992) and cool (1984-1985) year.

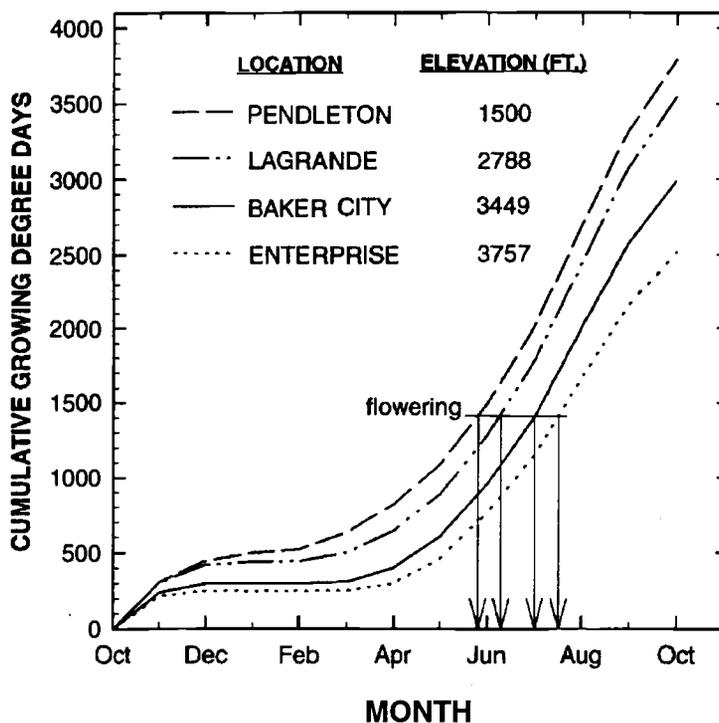


Figure 3.—Historical average (more than 30 years) GDD accumulation for four sites in northeast Oregon and anticipated flowering date at each site.

for leaf development. If conditions in the field have not limited growth, five leaves should be present on the main stem, and the T0, T1, and T2 tillers should be present (Table 2). If one or several of these structures is

missing, then you know some stress has occurred and can try to determine the cause. If possible, eliminating this stress in the future may lead to greater plant productivity.

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