

## TALL AND FINE FESCUE: RELATIONSHIP BETWEEN GROWING DEGREE DAYS, DEVELOPMENTAL STAGE, AND NITROGEN ACQUISITION

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The use of growing degree days (GDD) is becoming more widely accepted across the U.S. to compare genotypes and predict the rate of plant development. The technique is simple and does not require complicated plant development staging techniques.

Growing degree day accumulations involve the amount of accumulated heat required for plants to reach a certain stage of plant development; for example, as was seen for tall fescue and fine fescue (Tables 1 and 2). This relationship holds true for most organisms if their growth and development is regulated by temperature (e.g., weeds, insects, pathogens). Thus, management practices that are linked to plant growth stages, such as pesticide, herbicide, or fertilizer applications or even cultivation can be timed based on an accumulated GDD time scale. From year to year, this time scale is much more consistent in predicting plant development than using calendar date.

Table 1. The relationship between accumulated growing degree days (GDD, °C) and fine fescue (cv. Bridgeport) developmental stage. Accumulated GDD corresponding with these calendar dates were calculated starting January 1 and using the centigrade temperature scale. This was recorded in the first seed production year of a spring planted crop. For the year 2000, 228, 440, 678, 979, and 1871 GDD corresponds to 15 February, 20 March, 13 April, 11 May, and 5 July, respectively.

Accumulated Growing Degree Days	Plant Developmental Stage
228	Third-leaf fully expanded - Fourth-leaf emerging
440	Fourth-leaf fully elongated
678	Boot emergence/post-emergence
979	30% Anthesis (flowering)
1871	Seed harvest

Table 2. The relationship between accumulated growing degree days (GDD, °C) and tall fescue (cv. Hounddog) developmental stage. Accumulated GDD corresponding with these calendar dates were calculated starting January 1 and using the centigrade temperature scale. This was recorded in the second seed production year of a spring planted crop. For the year 2000, 186, 312, 517, 825, 1168, and 1688 GDD correspond to 31 January, 29 February, 30 March, 27 April, and 29 June.

Accumulated Growing Degree Days	Plant Developmental Stage
186	Second leaf fully elongated; Third-leaf emerging
312	Third leaf elongated; Fourth-leaf emerging
517	Fourth-leaf elongated
825	Boot emergence
1168	Early stamen emergence
1688	Seed harvest

The determination of GDD is easy. GDD takes into account the average daily temperature accumulations that influence plant development above a certain predetermined base temperature threshold. For temperate grass, I have been using 0°C or 32° F. For each day that the average temperature is one degree above the base temperature, one degree day has accumulated. Due to temperature differences, plant development may vary from year to year and among locations in any given year; basing a crop practice by a particular week on a calendar cannot take these variations into consideration. The calculations of the GDD for a 24-hour period require the following formula:  $\text{Max. temperature} + \text{Min. temperature} / 2 - \text{Base temperature}$  (0 °C or 32° F) = GDD. For example: If on March 3 the maximum temperature is 60 and the minimum temperature is 50° F the GDD for March 3 is  $60^\circ \text{F} + 50^\circ \text{F} / 2 = 55^\circ \text{F}$  and  $55^\circ \text{F} - 50^\circ \text{F} = 5$  GDD. If the average temperature is equal to or less than the base temperature, no degree days are accumulated. For this system to work, the maximum and minimum temperatures need to be taken every day from January 1. For western Oregon I start accumulating GDD beginning January 1 (Table 1 and 2). Early in the season the growing degree days will accumulate slowly; however, as temperatures rise they accumulate faster. Temperature data can be found from a number of sources. One source I often use is the Oregon Climatic Service ([www.ocs.orst.edu](http://www.ocs.orst.edu)).

One practical use for the GDD time scale is with timing of fertilizer N application. For western Oregon, one N application between late winter and mid-spring, which equates to 400 to 900 GDD, has been shown to be sufficient for perennial ryegrass (Griffith and Thomson, 1997c). This is different for earlier growing species such as tall fescue (Figures 1 and 2) and fine fescue (Figures 3 and 4). Both growth and N uptake occur earlier in the season.

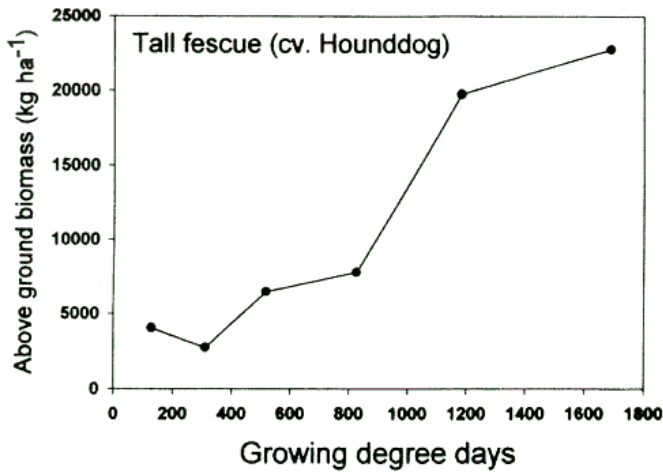


Figure 1. Tall fescue aboveground biomass accumulation, as a function of accumulated growing degree days (GDD), during the second seed production year. Accumulated GDD were calculated beginning January 1 and using the centigrade temperature scale.

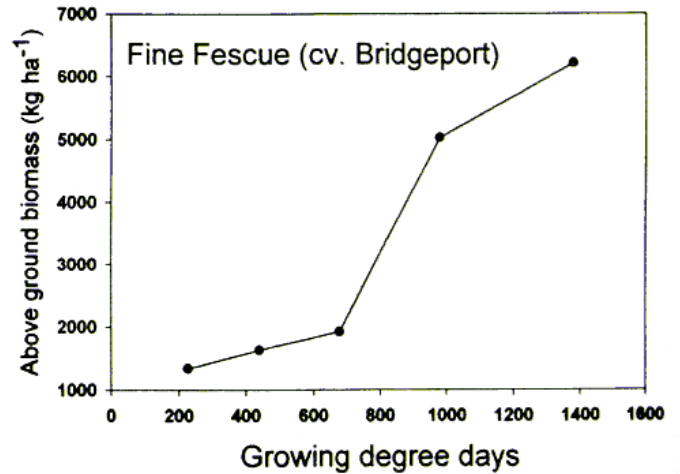


Figure 3. Fine fescue aboveground biomass accumulation, as a function of accumulated growing degree days (GDD), during the first seed production year. Accumulated GDD were calculated beginning January 1 and using the centigrade temperature scale.

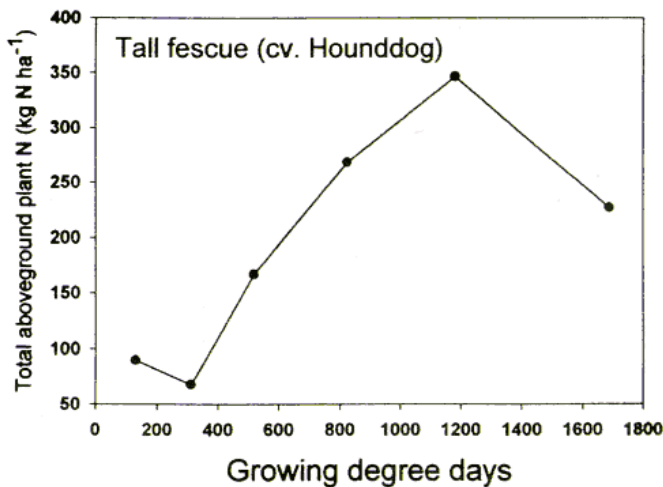


Figure 2. Tall fescue total aboveground plant N accumulation, as a function of accumulated growing degree days (GDD), during the second seed production year. Accumulated GDD were calculated beginning January 1 and using the centigrade temperature scale.

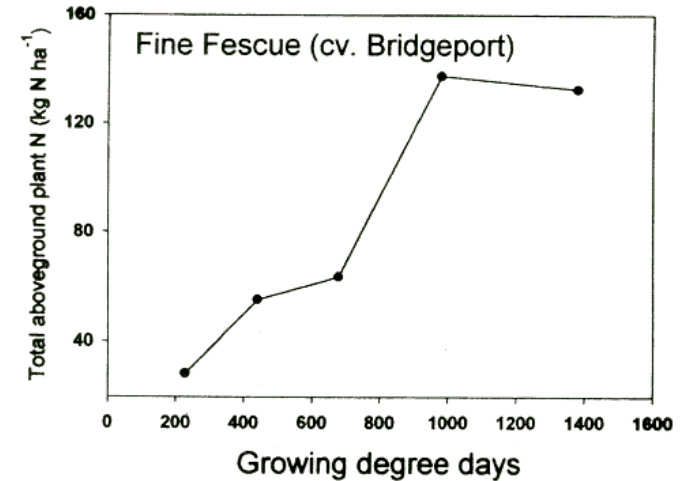


Figure 4. Fine fescue total aboveground plant N accumulation, as a function of accumulated growing degree days (GDD), during the first seed production year. Accumulated GDD were calculated beginning January 1 and using the centigrade temperature scale.

Split N applications in the spring have no seed yield advantage but may be necessary because of equipment constraints due to high fertilizer volumes necessary to meet crop needs. There is usually sufficient mineralized soil N present in the fall to meet fall crop N needs for maximum grass seed yields. Therefore, fall N fertilization is not necessary in western Oregon from a nutritional standpoint. There is some indication that without fall applied N, canopy closure may be retarded and result in less weed suppression between rows.

### **Related References by the Author**

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