R1061

Determining Grazing Readiness for Native and Tame Pastures

Kevin K. Sedivec, Rangeland Management Specialist, NDSU Extension Service

Proper pasture and range management begins early in the spring. A major decision to be made is: When to start grazing?

Starting grazing too early reduces plant leaf area for photosynthesis that is needed to replace carbohydrates depleted during the winter and green-up. Plant vigor is reduced, stands are thinned, total forage production is lowered, and disease, insect and weed infestations are increased.

Pastures and range damaged by grazing too early may take several years of rest before the stand regains productivity. On the other hand, starting grazing too late increases forage loss and waste through trampling or reduced palatability.

Pasture and range managers generally base grazing readiness or time to begin grazing on calendar dates. This may be the right decision some years, but each year is different with respect to the earliness or lateness of spring; the calendar date method may not always coincide with the best time to graze.

We recommend that grazing readiness be based on the development stage of the most common or key grass species in the pasture or range. The recommended plant development stage for beginning spring grazing of native and tame grass species is when the plants have three to four leaves.

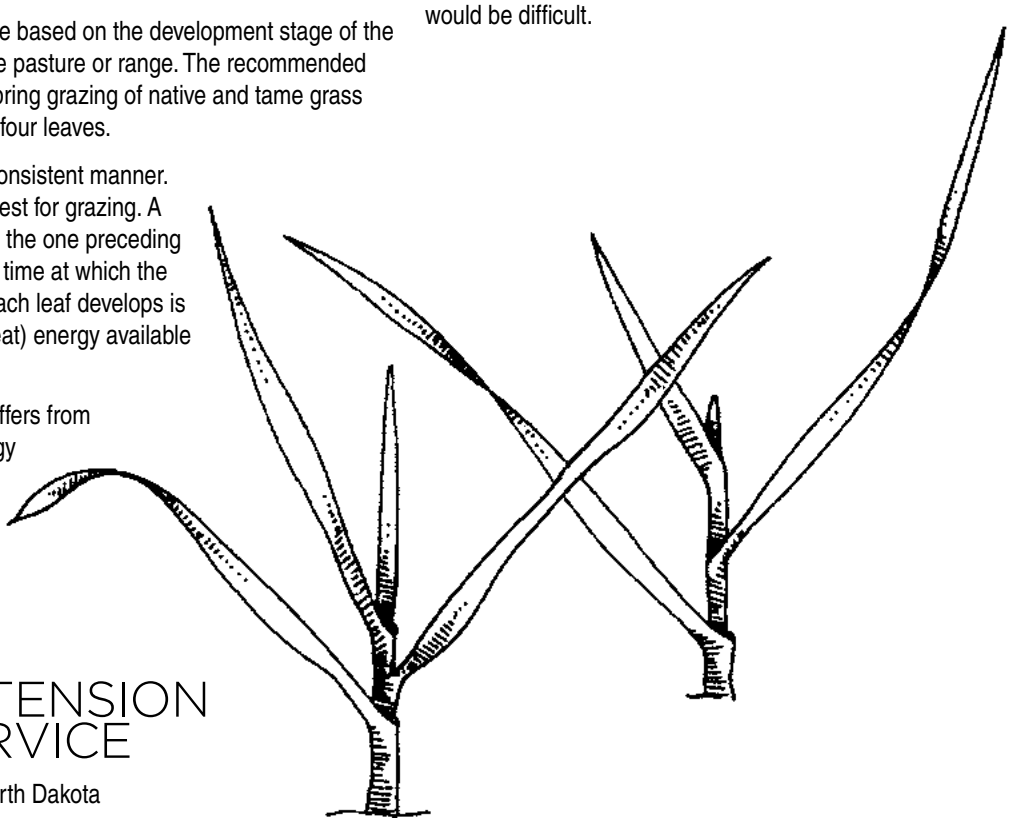
Grass plants develop in an orderly and consistent manner. Leaves are the major plant organ of interest for grazing. A new leaf becomes visible on a plant after the one preceding it is almost fully developed. The calendar time at which the first leaf appears and the rate at which each leaf develops is determined by the amount of thermal (heat) energy available for biological activity.

The air temperature on any spring day differs from year to year, so the amount of heat energy available for plant development for any calendar date, hence development stage, also will vary from year to year.

Plant Development

Understanding the difference between plant development and plant growth is important for determining grazing readiness. Development refers to the formation of plant structures, such as leaves, in an orderly and consistent pattern. Plant growth is the accumulation of forage dry matter or the expansion of leaves and stems.

For determining grazing readiness, we are most interested in the number of leaves formed on the plant. A correlation between development and growth is obvious. Thus, from a management viewpoint, initiating grazing at a specific development stage can be repeated each year, whereas initiating grazing at a specific dry-matter yield would be difficult.



NDSU EXTENSION SERVICE

North Dakota State University, Fargo, North Dakota
Reviewed and reprinted May 2013

Development Stage Scales

The Haun plant development stage scale is being used routinely in North Dakota to determine the plant development stage of cereal crops from emergence to grain harvest for the proper timing of herbicide and fertilizer applications. For determining grazing readiness of grasses, we are interested only in plant vegetative development that occurs prior to head formation.

The Haun (Haun, J.R. 1973.) visual quantification of wheat development (Agron.J. 65:116-119) scale, originally developed for cereals, is an easy-to-use scale that also can be used to determine the development stage of forage grasses. This scale is a numerical expression of the number of leaves produced on a main stem. An example for crested wheatgrass and green needlegrass is shown in Figures 1 and 2.

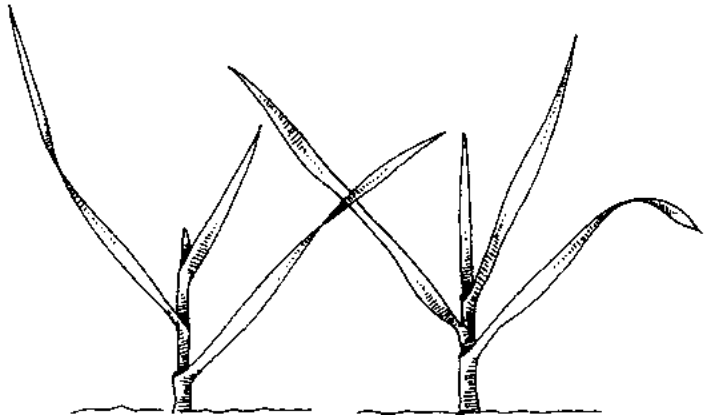


Figure 1. (Left) This is a grass plant that has three fully developed leaves, so the Haun growth stage is 3.0. For crested wheatgrass, this stage requires an accumulation of 443 growing degree days (GDDs).

Figure 2. (Right) This is a grass plant that has three fully developed leaves and the fourth, which is half as long as the third leaf, so the Haun growth stage is 3.5. For green needlegrass, this stage requires an accumulation of 1,209 GDDs.

Most cool-season grass plants produce a maximum of six leaves on stems that are reproductive or produce a head. Plants that remain vegetative will continue to produce leaves if water is available. Fewer than six leaves may be produced if plants are under severe water, nutrient or high-temperature stress.

Calculating Growing Degree Days

Air temperature is the main environmental factor that determines the rate of plant development. Each leaf produced on a stem requires a specific amount of accumulated heat, or heat units. The temperature when plants initiate development, or the base temperature, is 32 degrees Fahrenheit for cool-season and 40 F for warm-season grasses.

The temperature or heat units that a plant needs to accumulate to produce a leaf can be expressed as growing degree days, or GDDs. For any calendar day, the number of GDDs for that day is the average of the hourly minimum and hourly maximum temperature in the same 24-hour period minus the base temperature.

Accumulating Growing Degree Days

The daily GDDs are totaled to determine the total GDDs accumulated from the initiation of spring growth to any other date. As a point of reference, the number of GDDs accumulated at Bismarck from April 1 to June 30 for 1951 to 1980 are presented in Table 1.

The date to start recording temperatures for calculating GDDs to determine development stage of perennial forage grasses is quite different than for cereals. In cereals, emergence dates are determined easily, but in perennial grasses, the time that growth and development begins in the spring is less obvious.

Research at Mandan determined that the time to start accumulating GDDs is on the first day after March 15 that the average daily air temperature (daily maximum + daily minimum ÷ 2) exceeded 32 F for five consecutive days.

To show how to use Table 1, let's calculate the GDDs on May 5. Because we started recording GDDs on April 1 and the average daily air temperature exceeded 32 F for five consecutive days, we can add all GDDs from April 1 to May 6 (6.0 + 7.0 + 7.5 ... + 19.0 + 18.5). The total GDDs for this time period is 452.

At 452 GDDs, needle-and-thread is in the Haun stage 1.5 and crested wheatgrass is approaching Haun stage 3.0 on May 6. Based on range readiness, the crested wheatgrass is ready to be grazed on May 6, but the needle-and-thread is just reaching the half-way point in readiness (see section on "Growing Degree Days and Grazing Readiness" for more detail on leafy development and grazing readiness).

The equation for calculating GDDs is:

$$\text{GDDs} = \frac{\text{T max} + \text{T min}}{2} - \text{T base}$$

where GDDs = growing degree days

T max = daily maximum temperature
T min = daily minimum temperature
T base = 32 F for cool-season and
40 F for warm-season grasses

Table 1. The daily GDDs calculated from the average daily temperature for the 1951-1980 period at Bismarck, N.D. GDDs were calculated using 32 F as the base temperature.

Day	April	May	June
	- - - - - - - - - -	GDD	- - - - - - - - - -
1	6.0	17.0	28.5
2	7.0	18.0	29.0
3	7.5	18.0	30.0
4	8.0	18.0	30.0
5	8.5	19.0	30.5
6	8.5	18.5	31.0
7	9.0	19.0	31.5
8	10.0	19.0	31.5
9	10.0	19.0	31.0
10	10.0	19.5	31.5
11	10.5	20.5	32.0
12	11.0	21.5	32.0
13	11.5	22.0	32.0
14	11.5	22.5	32.0
15	11.5	23.5	32.0
16	11.5	24.0	32.5
17	12.0	24.0	32.0
18	13.0	24.0	32.0
19	12.5	24.5	31.5
20	12.0	25.0	32.0
21	12.5	25.0	32.5
22	13.0	26.0	32.5
23	13.0	26.0	33.0
24	13.0	26.0	33.5
25	13.5	26.0	33.5
26	14.0	26.5	34.5
27	15.0	26.5	35.0
28	15.0	26.5	35.0
29	16.0	26.0	35.0
30	16.5	26.5	35.0
31		27.0	
Total	**343.0**	**1,047.5**	**2,011.5**

Growing Degree Days and Grazing Readiness

The GDDs needed to produce each leaf on some common tame and native forage grasses determined from regression analysis of accumulated GDDs and Haun stage are shown in Table 2.

To show how to determine the date to begin grazing, we need to select an indicator grass such as green needlegrass at Haun development stage 3.5 (3.5-leaf stage). From Table 2, we see that green needlegrass requires 1,209 GDDs to reach Haun stage 3.5. Calculating GDDs from actual weather data as described earlier is best, but for this example, we can use the GDDs from Table 1.

From Table 1, which is based on the 1950-1981 period, we see by totaling the GDDs that 1,209 GDDs would be accumulated by June 6. Therefore, from this example, using green needlegrass as the key grass on which to base our decision, grazing could start about June 6.

The date when using other native grasses as key grasses to reach Haun stage 3.5 would be needle-and-thread, May 30; prairie Junegrass, May 20; and western wheatgrass, June 1. Blue grama, a warm-season grass, reached Haun stage 3.5 on June 30, using 40 F as the base temperature.

The tame cool-season grasses require fewer GDDs to form a leaf and, therefore, can be grazed earlier than the native grasses. Using Table 2 and following the same procedures as above, Nordan crested wheatgrass requires 443 GDDs to reach Haun stage 3 (three-leaf stage), which occurred on May 6; intermediate wheatgrass needed 675 GDDs (May 17;, and seeded Rodan western wheatgrass needed 535 GDDs (May 11). The difference observed between native prairie western wheatgrass and seeded Rodan western wheatgrass is due to selection by plant breeders for early development in Rodan.

Table 2. Growing degree days required for some native and tame grasses to develop to Haun stages 1 through 5.

	Native Range Grasses in Mixed Prairie Haun Development Stage*				
Grass	**1**	**2**	**3**	**3.5**	**4**
Green Needlegrass	346	691	1,037	1,209	1,382
Needle-and-thread	290	580	869	1,014	1,159
Prairie Junegrass	216	432	648	756	864
Western Wheatgrass	297	603	954	1,170	1,386
Blue Grama	423	711	1,062	1,296	1,530
	Grasses Seeded in Pure Stands				
Nordan Crested Wheatgrass	148	295	443	516	590
Intermediate Wheatgrass	225	450	675	787	900
Rodan Western Wheatgrass	178	356	535	624	713

*A Haun stage of 3 is defined as a plant that has two fully developed and collared leaves. The third leaf, when extended, would be as long as the second leaf. This stage is about equivalent to the three-leaf stage recommended for beginning grazing of cool-season grasses.

The recommended growth stage for beginning grazing on tame and native pastures is the three- and 3.5-leaf stage, respectively, which coincides with Haun stages 3 and 3.5, respectively, (Figure 1 and Figure 2).

Based on the calendar date method, the recommended date for beginning grazing in southern North Dakota has been early May for tame pastures and late May to early June for native pastures. Because the development stage will vary depending on the year, the GDD approach is more precise for selecting the proper date to begin grazing.

Recordkeeping

The GDD method requires the following recordkeeping to determine plant development stage:

1. Record the daily maximum and minimum temperatures and calculate the daily GDDs. Temperatures usually can be obtained from weather reports on the local radio station or from newspapers (recordkeeping sheet supplied).
2. Determine the starting date for calculating GDDs, which is the first day after March 15 that the average daily air temperature (daily maximum + daily minimum ÷ 2) exceeds 32 F for five consecutive days. If the average daily temperature is less than 32 F, no GDDs are accumulated for that day. This date normally will be about April 1 in southern and April 10 in northern North Dakota.
3. Accumulate the GDDs for each day from the starting date.
4. Use Table 2 to determine the GDDs required for the key species to reach Haun stage 3 (tame) or 3.5 (native); at this stage, the pasture is ready for grazing.
5. Visit the pasture about every week during this period to become more familiar with grass development. By counting the number of leaves and determining the Haun stage, and by making comparisons to the GDDs accumulated to that date, managers will better understand the relationship between GDDs and grazing readiness.

Conclusion

By using the GDD approach to determine grazing readiness, you have minimized the guesswork about when grazing can begin on any pasture. If grazing starts at the proper development stage, the plants will be more tolerant of grazing stress and will maintain the higher vigor needed to continue forage production during the grazing season and in following years. As the spring season varies from year to year, and grazing readiness varies year to year, the GDD approach will help you determine the best date to begin grazing.

Source:

Frank, A.B., J.D. Berdahl and R.E. Barker. 1985. Morphological development and water use in clonal lines of four forage grasses. Crop Sci. 25:339-344.

Frank, A.B., and L. Hofmann. 1989. Relationship among grazing management, growing degree-days, and morphological development for native grasses on the northern Great Plains. J. Range Manage. 42:199-202.

Frank, A.B., and R.E. Ries. 1990. Effect of soil water and nitrogen on morphological development of crested and western wheatgrass. J.Range Mange. 43:255-258.

This publication was authored by Kevin K. Sedivec, rangeland management specialist, NDSU; Albert B. Frank, plant physiologist, Agricultural Research Service, U.S. Department of Agriculture, Mandan, N.D.; and Lenat Hofmann, research agronomist, Agricultural Research Service, USDA, Mandan, 1993.

RECORDKEEPING TABLE

Use to record the daily GDDs calculated from the average daily temperature for the your area. GDDs are calculated using 32 F as the base temperature.

Day	April	May	June
	- - - - - - - - - - - - - GDD - - - - - - - - - - - - -		
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
9	_____	_____	_____
10	_____	_____	_____
11	_____	_____	_____
12	_____	_____	_____
13	_____	_____	_____
14	_____	_____	_____
15	_____	_____	_____
16	_____	_____	_____
17	_____	_____	_____
18	_____	_____	_____
19	_____	_____	_____
20	_____	_____	_____
21	_____	_____	_____
22	_____	_____	_____
23	_____	_____	_____
24	_____	_____	_____
25	_____	_____	_____
26	_____	_____	_____
27	_____	_____	_____
28	_____	_____	_____
29	_____	_____	_____
30	_____	_____	_____
31	_____	_____	_____
Total	_____	_____	_____

(Make extra copies of form for later years)

For more information on this and other topics, see www.ag.ndsu.edu

500-5-13