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Determining Grazing Readiness

for Native and Tame Pastures

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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 over winter and during greenup. 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 date. This may be the right decision some years, but each year is different with respect to 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 both 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, will also vary from year to year.

Plant Development

It is important to understand the difference between plant development and plant growth 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. It is obvious that there is a correlation between development and growth. However, 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.

Development Stage Scales

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

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green needlegrass is shown in Figures 1 and 2. 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.

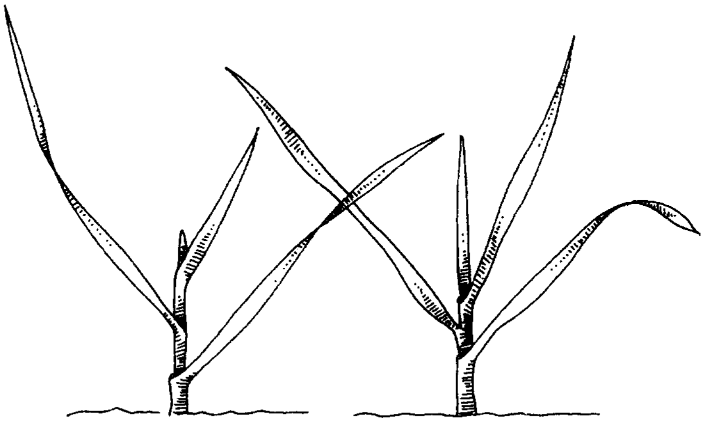

Figure 1. This is a grass plant that has three fully developed leaves so the Haun growth stage is 3.0. For crested wheatgrass this stage requires an accumulation of 443 GDD.

Figure 2. This is a grass plant that has three fully developed leaves and the fourth 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 1209 GDD.

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 GDD. For any calendar day the number of GDD for that day is the average of the hourly minimum and hourly maximum temperature in the same 24-hour period minus the base temperature. The equation for calculation is:

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

where GDD = 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

Accumulating Growing Degree-Days

The daily GDD are summed to determine the total GDD accumulated from initiation of spring growth to any other date. As a point of reference, the number of GDD accumulated at Bismarck from April 1 to June 30 for years 1951 to 1980 are presented in Table 1. The date to start recording temperatures for calculating GDD to determine development stage of perennial forage grasses is quite different than for cereals. In cereals, emergence dates are easily determined, but in perennial grasses, the time that

Table 1. The daily GDD calculated from the average daily temperature for the 1951-1980 period at Bismarck, ND. GDD was 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**	**1047.5**	**2011.5**

growth and development begins in the spring is less obvious. Research at Mandan determined that the time to start accumulating GDD 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 GDD on May 5. Since we started recording GDD on April 1 and the average daily air temperature exceeded 32 F for five consecutive days, we can add all GDD from April 1 to May 6 (6.0 + 7.0 + 7.5 ... + 19.0 + 18.5). The total GDD for this time period is 452 GDD. At 452 GDD, needle-and-thread is in the Haun stage 1.5 and crested wheatgrass 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 halfway point in readiness (see section on "Growing Degree-Days and Grazing Readiness" for more detail on leafy development and grazing readiness).

Growing Degree-Days and Grazing Readiness

The GDD needed to produce each leaf on some common tame and native forage grasses determined from regression analysis of accumulated GDD 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 1209 GDD to reach Haun stage 3.5. It is best to calculate GDD from actual weather data as described earlier, but for this example we can use the GDD from Table 1. From Table 1, which is based on the 1950-1981 period, we see by summing GDD that 1209 GDD 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 base temperature.

The tame cool-season grasses require fewer GDD 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 GDD to reach Haun stage 3 (3-leaf stage) which occurred on May 6, intermediate wheatgrass needed 675 GDD (May 17), and seeded Rodan western wheatgrass needed 535 GDD (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	1037	1209	1382
Needleandthread	290	580	869	1014	1159
Prairie Junegrass	216	432	648	756	864
Western Wheatgrass	297	603	954	1170	1386
Blue Grama	423	711	1062	1296	1530
	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 2 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 3 leaf stage recommended for beginning grazing of cool-season grasses.

The recommended growth stage for beginning grazing on both tame and native pastures is the 3 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. Since dev-elopment stage will vary depending on the year, the GDD approach is more precise for selecting the proper date to begin grazing.

Record Keeping

The GDD method requires the following record keeping to determine plant development stage. (1) Record the daily maximum and minimum temperatures and calculate the daily GDD. Temperatures can usually be obtained from weather reports on the local radio station or from newspapers (record keeping sheet supplied). (2) Determine the starting date for calculating GDD, 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 GDD are accumulated for that day. This date will normally be about April 1 in southern and April 10 in northern North Dakota. (3) Accumulate the GDD for each day from the starting date. (4) Use Table 2 to determine the GDD 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) We also recommend that managers 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 GDD accumulated to that date, managers will better understand the relationship between GDD and grazing readiness.

Conclusion

Using the GDD approach to determine grazing readiness, you have minimized the guess work 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.

RECORD KEEPING TABLE. Use to record the daily GDD calculated from the average daily temperature for the your area. GDD is calculated using 32 F as the base temperature.

Day	April	May	June
	------------ GDD ------------		
1			
2			
3			
4			
5			
6			
7			
8			
9			
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11			
12			
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25			
26			
27			
28			
29			
30			
31			
Total			

(Make extra copies of form for later years)

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