Planning Annual Forage Systems

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With continued strong demand for summer pasture, some producers are looking at cropland alternatives to produce grazing forage. This typically involves planting cool- or warm-season forages and in many cases, double-cropping annuals. An important challenge in these systems is getting an extended, continuous period with available forage to be grazed. This can be achieved through using a combination of warm- and cool-season annuals.

Graze annual forage at proper height or stage of growth.

Species Selection and Management

There are numerous cool- and warm-season annuals that can be used for forage. Cool- and warm-season species should be planted separately, but mixtures of several cool-season species could be planted, and similarly, mixtures of different warm-season species could be used.

Warm-Season Annual Grasses

Warm-season annual grasses can be planted in late spring or early summer to provide mid and late summer grazing or stockpiled and used for winter grazing. Sudangrass is a rapidly growing warm-season grass, with good regrowth potential. It usually contains lower levels of prussic acid than sorghum-sudangrass hybrids, but it is also slightly lower yielding.

Sorghum-sudangrass hybrids resemble sudangrass, but the hybrids are taller, have larger stems and leaves, and generally produce higher yields. However, it has a slower regrowth rate and is more likely to contain toxic levels of prussic acid. It can also become coarse and unpalatable if allowed to become too mature before grazing.

Pearl millet is another annual grass that could be grown for supplemental forage. It tends to have smaller stems and is leafier than the other grasses and it does not produce prussic acid. However, it has less regrowth potential than other summer annuals.

For more information on selection and management of warm-season (summer) annual grasses, see NebGuide G2183, Summer Annual Forage Grasses (PDF version, 341KB).

Cool-Season Annual Grasses

Spring small grain cereal grasses such as oats, spring triticale, spring barley, and spring wheat can be planted in early spring to provide late spring and early summer grazing or planted in mid

or late summer to provide fall grazing. They will not survive over winter and thus, no spring grazing.

Generally, winter small grain varieties will not produce as much fall growth as spring small grain varieties. Winter small grains can be planted in the fall to provide earlier spring grazing than spring varieties planted in early spring.

Brassicas

Brassicas (turnips, kale, rape, etc.) can be high-yielding and high-quality. Due to their ability to scavenge nitrogen, they tend to have relatively high protein content. It is recommended that they be mixed with small grains for grazing. The most common use is for fall or winter grazing, but they can be planted in the early spring with spring small grains. Most brassicas have a high energy content even when mature. This quality is maintained later into winter than the small grains.

For more information on summer/fall planting of cool-season annuals, see NebGuide G2262, Annual Cool-Season Forages for Late-Fall or Early-Spring Double-Crop (PDF version, 1.1MB).

Fertilization

Annual forages must be fertilized to reach their yield potential. However, fertilizer application should be according to soil test recommendations. With warm-season annual grasses, nitrogen (N) is most often the limiting nutrient. Typically, 50 to 60 lbs. N per acre is needed at establishment. Additional nitrogen may be needed after the first grazing or haying to promote regrowth. Adequate rainfall or irrigation and favorable temperatures are needed with additional N fertilization to reduce nitrate risk. For cool-season annuals 50 to 60 lbs. N per acre is typically needed.

Irrigation

In central and western Nebraska, irrigation will increase yields and improve the reliability of forage production. More information on irrigation management for forage production can be found in NebGuide G2012, Forage Production with Limited Irrigation (PDF version, 860KB).

System Development

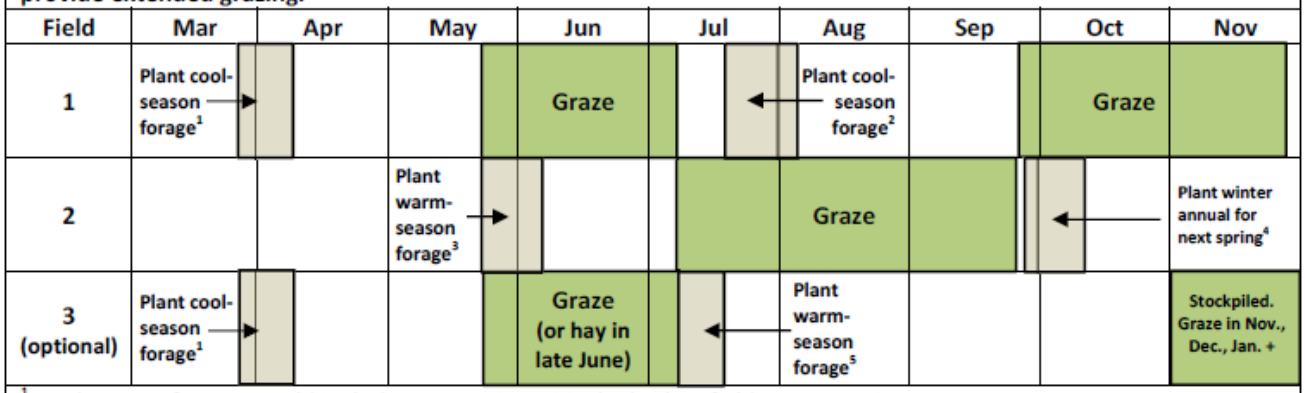
Timing of planting is critical when trying to have an extended, continuous period with forage that can be grazed. Systems A and B (Tables 1 and 2, page 3) provide examples of suggested planting times and potential grazing periods for annual forages using multiple fields in the system. On these calendar tables, possible planting time windows are identified (tan shaded) that would result in the potential grazing periods (green shaded). Adequate moisture and other weather conditions are assumed.

System A can be used for starting an annual forage system in the spring and could be transitioned to System B with planting a winter annual in the fall when grazing the warm-season forage was complete.

With any of these plans, it is necessary to have access to additional forage resources such as a hay and an area to drylot feed or nearby permanent pasture where cattle could be moved if any number of circumstances caused a shortage in the amount of forage needed to continue grazing on the planted fields. Similarly, for each of the forage types, additional acres could be planted as a reserve for forage shortages and harvested for hay if not needed for grazing.

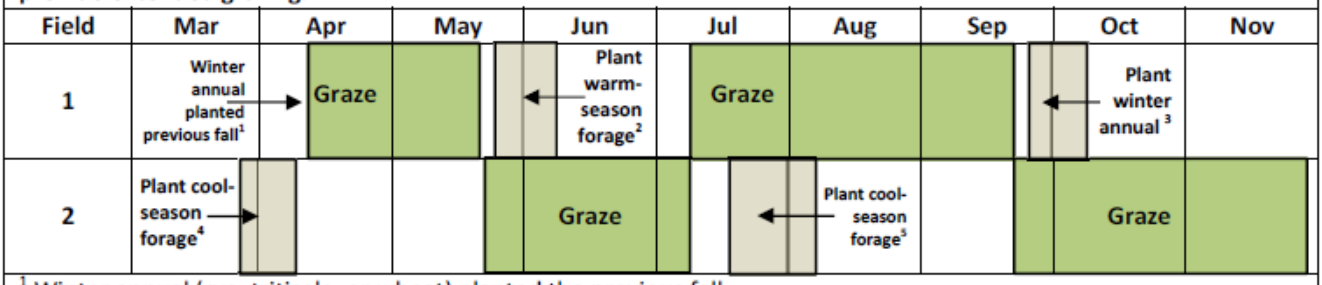
For each of the example systems, corn residue could be fed during the winter if available. If corn residue was not used or available, Table 1 includes an optional third field that could be planted to a small grain cereal in the spring, then harvested for hay or grazed until late June. A warm-season annual would then be planted and grazed as winter stockpile. An alternative to utilizing this as winter stockpile is to windrow it in September and directly graze the windrows during the winter months. More information on this management practice can be found in NebGuide G1616, Windrow Grazing (PDF version, 623KB).

Table 1. System A: example of approximate planting and grazing periods of double-cropped annual forages to provide extended grazing.



[1] Cool-season forages could include oats, spring triticale, barley, field peas, or mixtures.
[2] Cool-season forages could include oats, spring triticale, barley, field peas, turnips, radishes, or mixtures.
[3] Warm-season forages could include sudangrass, pearl millet, sorghum-sudangrass hybrids, corn, soybeans, sunflowers, or mixtures.
[4] Plant winter annual (rye, triticale, or wheat) for the following spring.
[5] Warm-season forages could include sudangrass, pearl millet, sorghum-sudangrass hybrids, corn, soybeans, sunflowers, or mixtures. These acres would be stockpiled for grazing during the winter months.

Table 2. System B: example of approximate planting and grazing periods of double-cropped annual forages to provide extended grazing.



[1] Winter annual (rye, triticale, or wheat) planted the previous fall.
[2] Warm-season forages could include sudangrass, pearl millet, sorghum-sudangrass hybrids, corn, soybeans, sunflowers, or mixtures.
[3] Plant winter annual (rye, triticale, or wheat) for the following spring.
[4] Cool-season forages could include oats, spring triticale, barley, field peas, or mixtures.
[5] Cool-season forages could include oats, spring triticale, barley, field peas, turnips, radishes, or mixtures.

Grazing Efficiency and Grazing Management

Another key factor associated with annual forages is grazing efficiency, which refers to the percent of the forage actually consumed by the grazing animal. With grazing, factors such as stage of growth when grazing starts, grazing or rotation strategy, palatability of the forage, and trampling losses all affect grazing efficiency. In addition, grazing interrupts plant growth which could affect potential forage production. In general, grazing efficiency is lower for the taller growing warm-season annual forages than for cool season species, especially if grazing is occurring when they are relatively mature.

The targeted height to begin grazing depends on the species. For small grains, grazing can begin when they are 6 to 8 inches tall. With sudangrass, grazing can begin at about 18 inches in height. Since sorghum-sudangrass hybrids usually contain prussic acid, grazing should not begin until plants are at least 20 to 24 inches tall. Pearl millet can be grazed when it is 12 to 15 inches tall.

It is a good idea to divide fields into three or more smaller paddocks of a size that permits animals to graze a paddock to the targeted end height within 7 to 10 days. For most warm-season grasses the target residual height to allow good regrowth is 8 inches. For most cool-season small grains, the target residual height is about 4 inches. More information on grazing management of warm-season (summer) annual grasses can be found in NebGuide G2183, Summer Annual Forage Grasses (PDF version, 341KB).

Carrying Capacity and Stocking Rates

Another crucial part of planning annual forage systems is to estimate what the livestock carrying capacity will be. This in turn, will help determine the number of acres of each of the forage types that need to be planted. Production of different annual forages will vary with several factors such as species, growing conditions, planting date, irrigation, and fertilizer management. Spring-planted small grain cereals or winter annuals commonly yield about 2 to 3 tons/acre. Warm-season annuals typically produce 3 to 5 or more tons/acre. Production from mid- to late-summer planted small grain cereal monocultures or mixtures with brassicas can range from 1 to 3 tons/acre with the higher yields related to earlier planting.

Potential hay yield and stocking rates estimates provide starting points for estimating carrying capacity for cool- and warm-season annual forage systems (Tables 3, 4, and 5 - page 5). Using a planned grazing rotation with several paddocks, a grazing efficiency of 40% for warm-season and 50% for cool-season annual grasses may be attained. Grazing efficiency may be higher during the fall if plants have completed a significant portion of their growth when grazing begins.

Table 3. Approximate stocking rates for early-spring planted cool-season annual forages (oats, spring triticale, barley, field peas, or mixtures) or fall-planted winter annuals (rye, triticale or wheat) grazed in spring. Based on a range of potential hay yields and a grazing efficiency of 50%.[1]

			Cow-calf pairs per acre[2]	
Potential hay yield (Tons/acre)	AUM/acre[3]	AUD/acre[3]	for 1 month	for 1.5 months
1.5	1.92	58	1.28	0.85
2.5	3.21	96	2.14	1.42
3.5	4.49	135	2.99	1.99

[1] Typical grazing period would be late May through early July.
[2] To convert cow-calf pairs per acre to yearlings (600 to 800 lb.) per acre, multiply by 2. A cow-calf pair is assumed to be 1.5 AU (1500 lb.)
[3] AUM = animal unit month; AUD = animal unit day.

Table 4. Approximate stocking rates for mid- to late-summer planted cool-season annual forages (oats, spring triticale and barley, field peas, turnips, radishes, or mixtures) based on a range of potential hay yields and a grazing efficiency of 50%.[1]

			Cow-calf pairs per acre[2]	
Potential hay yield (Tons/acre)	AUM/acre[3]	AUD/acre[3]	for 1 month	for 2 months
1.5	1.92	58	1.28	0.64
2.5	3.21	96	2.14	1.07
3.5	4.49	135	2.99	1.50

[1] Typical grazing period would be October and November. It is possible that grazing efficiency may be higher during the fall graze-out period as plants have completed a significant portion of their growth when grazing begins.
[2] To convert cow-calf pairs per acre to yearlings (600 – 800 lb.) per acre, multiply by 2. To convert to weaned calves (500 lb.), multiply by 3. A cow-calf pair is assumed to be 1.5 AU (1500 lb.)
[3] AUM = animal unit month; AUD = animal unit day.

Table 5. Approximate stocking rates for early-summer planted warm-season annual forages (sudangrass, pearl millet, sorghum-sudangrass hybrids, corn, or mixtures) based on a range of potential hay yields and a grazing efficiency of 40%.[1]

			Cow-calf pairs per acre[2]		
Potential hay yield (Tons/acre)	AUM/acre[3]	AUD/acre[3]	for 1 month	for 2 months	for 3 months
2	2.05	62	1.37	0.68	0.46
3	3.08	92	2.05	1.03	0.68
4	4.10	123	2.74	1.37	0.91
5	5.13	154	3.42	1.71	1.14

[1] Typical grazing period would be July, August, or September, or as stockpiled forage after killing frost.
[2] To convert cow-calf pairs per acre to yearlings (600 – 800 lb.) per acre, multiply by 2. A cow-calf pair is assumed to be 1.5 AU (1500 lb.)
[3] AUM = animal unit month; AUD = animal unit day.

To estimate the number of acres needed of each of the forage types for a planned system, divide the total number of head by the carrying capacity estimates. Table 6 provides an example of these calculations following the System A plan illustrated in Table 1 (page 3).

Table 6. An example to estimate acres required for a 100 cow-calf pairs using System A (Table 1).

Field	Forage type	Grazing period	Estimated cow-calf pairs per acre	Calculation	Estimated acres needed
1	Early-spring planted cool-season forage	Late-May to early July (1.5 months)	1.42	100 pairs divided by 1.42	70
2	Late-May to early June planted warm-season forage	Early July through September (3 months)	0.91	100 pairs divided by 0.91	110
1	July to early-August planted cool-season forage	October and November (2.0 months)	1.07	100 pairs divided by 1.07	93
2	Early-October planted winter annual	Mid-April through May of next year (3 months)	1.42	100 pairs divided by 1.42	70

Potential Forage-related Cattle Disorders

Prussic-acid poisoning can occur with sudangrass and sorghum-sudangrass hybrids. However, certain varieties of sudangrass or sorghum-sudangrass hybrids are known to be lower in prussic acid potential than others. Therefore, it is best to select varieties that are known to have low potential for the production of prussic acid and not begin grazing until plants have reached target height of 18 to 24 inches. When grazing in late fall, care must be taken to remove cattle from prussic-acid producing species before frost. Grazing can resume 10 days after a hard-killing frost. For more information see NebGuide G2184, Cyanide Poisoning (PDF version, 463KB).

Nitrate poisoning can be an issue with all annual grasses, as well as with brassicas, and usually occurs when high rates of nitrogen fertilizer are used in one application or when factors such as detrimental weather interfere with plant growth. For more information, see NebGuide G1779, Nitrates in Livestock Feeding (PDF version, 319KB).

When grazing small grains in the spring or fall, grass tetany is a concern for lactating cows. Feeding a free-choice mineral that has 12 to15 percent magnesium with a target intake of 3 to 4 ounces/d will reduce the incidence of grass tetany.

Despite the potential for forage toxicity, both the summer and winter annual forages offer opportunities for economical forage production.

Cost of Forage Production

Table 7 provides an example of a system following the plan illustrated in System A (Table 1) with an estimate of costs for producing the forage. Table 8 (page 8) provides an example of a system following the plan illustrated in System B (Table 2, page 3). The system in Table 7 requires more land per pair but has less input costs compared to the system in Table 8.

Current pasture rental prices in the center part of Nebraska average $62/pair/month and ranges from $48 to $83/pair/month. Current pasture rental rates are at high enough levels to suggest there may be an opportunity to use annual forage systems economically. However, this will vary significantly across regions and specific operations. Thus, producers need to take a serious look at their own situation before incorporating this sort of change into their operation.

Table 7. Estimated forage costs for annual forage system in central Nebraska. Includes 100 cow/calf pairs on 175 to 230 acres and grazing from mid-May through mid-November (180 days of grazing).

	Spring cool-season	**Summer warm-season**	**Fall cool-season**
	Field 1	Field 2	Field 1
Forage (seeding rate, lb/ac)	Oats (100)	Sudangrass (20)	Oats (60)/Turnip (3)
Acres/pair	0.63 to 1.0	0.87 to 1.2	0.63 to 1.0
Plant date	mid-March	mid-May	mid-July
Grazing start date	early-May	mid-July	early-October
Tons of forage produced	2.0 to 3.0	3.0 to 4.0	2.0 to 3.0
Grazing efficiency, %	50	40	50
Days of grazing	45-50	70-80	45-50
Nitrogen, lbs/ac	40	60	40
Irrigation, inch/ac	3	7	6
Costs			
Seed, $/ac	$30.00	$36.00	$23.40
Seeding, $/ac	$12.00	$12.00	$12.00
Fertilizer (N @ $0.58/lb), $/ac	$23.20	$46.40	$23.20
Irrigation (pivot $7.80/inch), $/ac	$23.40	$54.60	$46.80
Forage cost, $/ac	$83.60	$149.00	$98.10
Forage cost, $/pair/month	$42 - $63	$55- $72	$40 - $61
System forage cost, $/pair/mo.	$45 - $64		
Property tax ($60/ac), $/pair/mo.	$17 - $23		

Table 8. Estimated forage costs for annual forage system in central Nebraska. Includes 100 cow/calf pairs on 135-195 acres and grazing from early April through October (200 days of grazing).				
	Fall planted winter annual	**Spring cool-season**	**Summer warm-season**	**Fall cool-season**
	Field 1	Field 2	Field 1	Field 2
Forage (seeding rate, lb/ac)	Rye (100)	Oats (100)	Sudangrass (20)	Oats (60)/Turnip (3)
Acres/pair	0.73-1.07	0.60-0.88	0.73-1.07	0.60 - 0.88
Plant date	late-Sept.	mid-March	late-May	mid-July
Grazing start date	early-April	late-May	mid-July	mid-Sept.
Tons of forage produced	2.0-3.0	2.0-3.0	3.0-4.0	2.0-3.0
Grazing efficiency, %	50	50	40	50
Days of grazing	40-55	45-50	60-70	45-55
Nitrogen, lbs/ac	40	40	80	40
Irrigation, inch/ac	3	3	7	6
Costs				
Seed, $/ac	$25.00	$25.00	$36.00	$20.10
Seeding, $/ac	$12.00	$12.00	$12.00	$12.00
Fertilizer (N @ $0.58/lb), $/ac	$23.20	$23.20	$46.40	$34.80
Irrigation (pivot $7.80/inch), $/ac	$23.40	$23.40	$54.60	$23.40
Forage cost, $/ac	$83.60	$99.20	$149.00	$98.10
Forage cost, $/pair/month	$33 - $49	$43 - $49	$54 - $80	$41 - 60
System forage cost, $/pair/mo.	$41 - $62			
Property tax ($60/ac), $/pair/mo.	$12 - 17			

UNL Beef website: http://beef.unl.edu/planning-annual-forage-systems