

Sudan/Sorghum Forage Management

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Sudan/Sorghum forages have many desirable features as an annual forage option in Iowa:

- Rapid growth and quick recovery after grazing or cutting
- Tolerance of drought and high temperatures
- Highly palatable and nutritious forage
- Few insect and disease problems
- Usually do not require herbicides
- High carrying capacity when rotationally grazed

Sudan/Sorghum forages are generally classified into three major groups:

- sudangrass and hybrid sudangrass
- sorghum-sudan hybrids (crosses between sorghum and sudangrass)
- forage sorghum

Forage Selection for Livestock

All Sudan/Sorghum forages are good choices for dairy and beef cattle feed. The choice of forage will be heavily dependent on seasonal needs and intended harvest management @ silage, pasture, green-chop, etc.

Sudangrass and sudangrass hybrids should probably be the first choice over sorghum-sudan hybrids for sheep pasture. Research has shown lamb gains on pasture to be higher with sudangrass than with sorghum-sudan crosses¹.

Occasionally there are reports of *Cystitis Syndrome* in horses grazing sorghum-sudan crosses. This is an infection of the urinary tract (inflamed urinary bladder). The concern is reduced when the forage is harvested as hay. *Cystitis Syndrome* has never been reported to occur in horses grazing sudangrasses¹, and is not a concern with ruminant animals.

Table 1. Estimated Nutrient Composition (DM-dry matter, CP-crude protein, ADF-acid detergent fiber, NDF-neutral detergent fiber, TDN-total digestible nutrients, Ca-calcium, P-phosphorus.²

| Forage | DM | CP | ADF | NDF | TDN | Ca | P |
|-------------------------|-----------|--------------------------|-----|-----|-----|------|------|
| | % , as is | ----- % , DM basis ----- | | | | | |
| Forage sorghum | | | | | | | |
| silage, dough stage | 28 | 6.0 | -- | -- | 55 | 0.29 | 0.26 |
| Sorghum-sudangrass | | | | | | | |
| fresh, early vegetative | 18 | 16.8 | 29 | 55 | 70 | 0.43 | 0.41 |
| fresh, mid-bloom | 23 | 8.8 | 40 | 65 | 63 | 0.43 | 0.36 |
| hay, full bloom | 91 | 8.0 | 42 | 68 | 57 | 0.55 | 0.30 |
| silage | 28 | 10.8 | 42 | 68 | 56 | 0.46 | 0.21 |
| Corn | | | | | | | |
| silage, well eared | 33 | 8.1 | 28 | 51 | 70 | 0.23 | 0.22 |

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Planting Date, Depth, & Row Width

Soil temperature for sudan/sorghum forages should be warmer than for that of corn. The soil should average 65°F or more in the upper 4 inches to ensure rapid germination and emergence. Planting dates in Iowa typically range from mid-May to mid-June. Consider staggered planting dates to gain flexibility with stage of maturity for grazing or green-chop harvest.

Planting technique should provide for uniform seed distribution, proper seed depth, and good seed-to-soil contact. Seed-to-soil contact is best achieved by planting into a firm, moist soil environment and using a press-wheel attachment on the row-planter or drill, or

using a cultipacker following the drill or broadcast operation.

Seed should be planted at a depth of 0.75 to 1 inch in fine textured soils, and up to 1.75 inches in sandy soils. Slightly deeper planting is sometimes appropriate to reach moisture.

Optimum row spacing can vary depending on the purpose of the forage. Limited research has suggested using narrow row spacing (@ 6 to 12 inches) for hay harvest, and wider row spacing (18 to 20 inches) for grazing livestock. The narrow row spacing usually improves forage yield while the wider row spacing reduces trampling waste by grazing livestock.

Table 2. Seeding rates for the sudan/sorghum forages.

| Forage | Planting rate | Planting method | Row width |
|----------------------------------|--|--------------------|--------------|
| | --- lbs/A --- | | -- inches -- |
| Sudangrass and hybrid sudangrass | 25-35 ^a | broadcast | --- |
| | 20-30 ^a | drill | 8 |
| | 10-15 | drill | 20-30 |
| Sorghum x sudan hybrids | same as for sudangrass and hybrid sudangrass | | |
| Forage sorghum | 8-10 | row-plant or drill | 30 |

^a Use the higher seeding rate for hay production. Higher plant populations reduce stem diameter for better dry-down.

Harvest Management

Tables 3 and 4 list typical dry matter (DM) yields and animal unit days (AUD) for sudan/sorghum forages. This information assumes good management practices and a favorable environment.

Grazing management -- An animal unit (AU) equals 1,000 lbs of livestock. An animal unit day (AUD) equals the number of grazing days in one season for one animal unit per acre. A full-season sudangrass or sorghum-sudan hybrid grazing season is approximately July 1 through November with a typical seasonal forage distribution of:

| Month | July | Aug. | Sept. | Oct. | Nov. |
|-----------------------|------|------|-------|------|------|
| Seasonal distribution | 35 | 35 | 15 | 5 | 5 |

Subdivide pastures to graze rotationally for maximum production. Stocking rates of 4 to 6 AUs per acre will provide for more uniform and efficient utilization of forage. Do not graze before plants reach an appropriate height (Table 3) to avoid potential problems with prussic acid. Leave 6 to 8 inches of stubble for rapid regrowth and tiller development. If forage height gets too tall for efficient grazing (@ 40 to 50 inches), consider green-chopping or ensiling the forage.

Hay, silage and green-chop management -- Harvest in the late-vegetative stage or at 30 to 36 inches in height for optimum yield and quality. At this height, 15% CP and 63% TDN are common. Crude protein and TDN have been shown to decrease significantly with increasing maturity down to 6 to 7% CP and 54% TDN by dough stage.

Table 3. Suggested Rotational Grazing Management Summary.

| Forage | Days from planting to first grazing | Stocking rate and rotation | Days rest to allow regrowth | Rotational grazing |
|----------------------------------|-------------------------------------|--|---------------------------------|--------------------|
| | | | -- AU/A -- | -- AUD -- |
| Sudangrass and hybrid sudangrass | 18 inch height about 35 days | 4-5 AU/A graze to 6-8 inches grazed in 7-10 days | 18 inch height about 21 days | 130-150 |
| Sorghum-sudan hybrid | 24-30 inch height about 40 days | 5-6 AU/A graze to 6-8 inches grazed in 7-10 days | 24-30 inch height about 25 days | 160-180 |

Hay -- harvest is difficult with sudangrass and sorghum-sudan hybrids. Cut the crop at a 30 to 36- inch height. Leave 6 to 8 inches stubble height for best regrowth and aeration of the cut forage swaths. Condition using more roller pressure than for conventional hays. Drive in a low gear and run the engine at maximum governed speed. Create as wide and fluffy a windrow as possible. Do not windrow until all plants on the top of the windrow are dry enough for baling. It can take an entire week of sunny weather to cure the forage for hay harvest. The prussic acid content in forage decreases as much as 75% while curing and is very rarely hazardous when fed to livestock.

Haylage -- harvest is suggested at heights similar to or taller than for hay harvest. Hay harvest is

recommended at lower heights to assist dry-down and maintain high quality. Thus while a seasonal hay management system may be planned as a 3-cut system at a 30 to 36-inch tall harvest height, a seasonal haylage system may be planned as a 2-cut system at boot-stage of maturity. Wilt forage to 50 to 60% moisture before harvest.

Green-chop -- forage is usually safer than the same material used for pasture because it is not selectively consumed. Stem tissue dilutes the higher concentrations of prussic acid in the leaves. However, because of the potential for prussic acid to be produced in chopped forage, only chop as much forage as the cattle will consume in 4 to 5 hours.

Table 4. Suggested Hay, Haylage, Green-chop, or Silage Harvest Management Summary.

| Forage | Cutting management | Days from planting to first harvest | | Estimated DM yield - Tons/A - |
|----------------------------------|---------------------------------|--|-------------|----------------------------------|
| | | hay, haylage, green-chop | silage | |
| Sudangrass and hybrid sudangrass | cut 2-3 times | 2.5 feet tall ~ 45 days from planting ~ 25 days regrowth | | 3-6 |
| | cut at dough stage | | 80-90 days | 4-6 |
| Sorghum-sudan | cut 2-3 times | 3 feet tall ~ 30 days regrowth | | 4-7 |
| | cut at dough stage | | 80-100 days | 5-7 |
| Forage sorghum | cut at mid- to hard dough stage | | 90-110 days | 7-9 |

Never harvest a load of green-chop and let it sit on the wagon overnight. Stagger the planting dates to gain flexibility with harvest maturity.

Silage -- harvest of forage sorghum at a mid- to hard dough stage. Chop into 3/8 to 1/2 inch lengths when the crop is 65 to 70% moisture (mid- to hard dough stage). Use a finer chop at lower moistures to ensure firm packing. Prussic acid levels in the silo are expected to be low and not present a hazard as long as it is not fed within 3 to 4 weeks of ensiling. Immature or drought stressed plants may build up higher levels of prussic acid. In this case, it is suggested to allow 6 to 8 weeks of ensiled storage before use.

Soil pH and Fertility

Sudan/sorghum forages grow well in soil pH levels between 6.0 and 7.5. Typical nitrogen recommendations for sudangrass or sorghum-sudan hybrids under multiple cutting management would be 80 lbs of N per acre preplant and 40 to 60 lbs of N per acre after each cutting. For forage sorghum, apply between 100 and 150 lbs of N per acre preplant. Remember to take N credit from manure and rotations of forage legumes and soybeans.

Weed Management

Delay planting until soil temperatures are warm enough for early weed control by tillage. With the

quick emergence and growth of sudan/sorghum forages, herbicides are not usually needed. Rowed sudan/sorghum crops can be cultivated if needed.

Atrazine can be used to control annual grass and broadleaf weeds in forage sorghum and sorghum-sudan hybrids as preplant, preemergence, or postemergence. Atrazine is not registered for use on sudangrass. Atrazine may be applied up to 2 lbs per acre on fine textured soils with at least 1.5% organic matter. However, some crop injury may occur at this rate. Do not use atrazine on sandy soils. Postemergence treatments with atrazine should be made before weeds are 1.5 inches tall. If an emulsifiable oil is used with atrazine, use no more than 1.2 lbs per acre, and use before broadleaf weeds are 4 to 6 inches tall. Do not graze or harvest for 21 days following application.

2,4-D amine or ester may be used for broadleaf weeds on all sudan/sorghum forages when these crops are 4 to 12 inches tall. Use 2,4-D amine at 0.25 to 0.50 lb per acre or 2,4-D ester at 0.16 to 0.33 lb per acre. Do not graze or harvest for 14 days following application.

Feeding Concerns

Prussic Acid Poisoning -- Sudan/sorghum plants contain a cyanogenic glycoside called dhurrin. When plant tissue containing dhurrin is damaged (chopped, trampled, chewed, wilted, frozen) two fermentation enzymes in the plant hydrolyze the dhurrin into the hydrocyanic acid (HCN), also called prussic acid. At high levels, HCN can be toxic to livestock (Table 5).

Table 5. Safe Limits of HCN Concentration in Forage.^{3,4}

| Relative degree of toxicity | <u>Concentration of HCN in dry forage</u> | | <u>Concentration of HCN in fresh forage</u> | |
|-----------------------------|---|----------------------|---|---------------|
| | ppm | mg HCN/100 gm | ppm | mg HCN/100 gm |
| Very low | -- | 0-25 (0-0.025%) | -- | -- |
| Low | 0-500 | 25-50 (0.025-0.050%) | <150 | <15 |
| Medium (potential) | 500-700 | 50-75 (0.050-0.075%) | 150-200 | 15-20 |
| High (dangerous) | >750 | >75 (>0.750%) | >200 | >20 |

Factors that Affect HCN Levels in Sudan/Sorghum Forages:

Harvest recommendations under the "Harvest Management" section of this publication include managing potential HCN in feed.

- **Species** -- Generally, sudangrass contains about 40% less HCN potential than sorghums. Usually, sorghum-sudangrass hybrids are slightly higher in HCN potential than sudangrass.
- **Plant parts** -- Leaves normally contain higher levels of HCN than stems, and upper leaves contain higher levels of HCN than lower leaves.
- **Suckers** -- Tillers have higher HCN potential because they consist mostly of leaves.
- **Maturity** -- As the plant matures, the total portion of stem increases in the plant and the HCN potential decreases. However, if animals are allowed to selectively graze, the poisoning hazard in pastures decreases only slightly.
- **Fertilizer** -- HCN potential is usually higher when heavy applications of nitrogen fertilizer are made and the soils are deficient in phosphorus and potassium. Apply P and K according to soil test and split apply N to decrease potential problems.
- **Frost** -- Free HCN accumulates in frozen tissue within a few hours after thawing and wilting. A light frost (above 30°F) may just damage the tops of plants. Delay grazing or harvest a few days after frost to allow the HCN to dissipate from the plant tops. Livestock can be returned to the pasture as long as the sudan/sorghum forages are at the appropriate grazing height (Table 3).

Sometimes a light frost enhances development of young shoots from the base of the plants. If this occurs, delay grazing since these new shoots may be high in HCN. Ideally, wait for the new shoots to reach proper grazing height, however, it is more likely that a complete killing frost (28°F or

less) would occur first. Once a complete killing frost occurs, the plants should not be grazed for at least one-week (wait until the frosted tissue is cured and dry).

If haying the forage, the curing process decreases HCN levels by as much as 75%, removing nearly all of the feeding concern. However, haying these forages this late in the season is nearly impossible. If ensiling the forage, harvest at a proper moisture for the storage structure used to ensure proper fermentation. The fermentation process removes some of the HCN potential. Normally, 4 weeks of fermentation is sufficient before feeding the silage. However, if immature plants were harvested, leave the forage ferment for at least 8 weeks before feeding.

- **Drought** -- During severe drought, stressed plants are stunted, increasing the total portion of leaf tissue and HCN potential. With a drought-ending rain, rapid regrowth could also contain higher HCN potential, so allow for sufficient plant height before grazing or harvest.

Nitrate Poisoning -- Accumulation of high nitrate levels in sudan/sorghum forages is usually related to stressful growing conditions such as drought. High nitrogen fertilization rates combined with stress could increase the potential problem.

Unlike HCN, concentrations of nitrates are highest in the lower stem tissue. Leaving the recommended 6 to 8 inches of stubble when grazed or harvested encourages rapid regrowth and reduces the amount of nitrate potential in these feeds.

If harvesting a drought-stressed crop, such as forage sorghum, leave a higher stubble height (10 to 12 inches) to avoid the possible high nitrate levels in the lower stalk. The nitrate content of cured hay is stable, so avoid haying a drought stressed crop. Proper ensiling of these forages will reduce nitrate concentrations by 40 to 60%, however poor ensiling (poor fermentation) may not reduce nitrate levels. Forages suspected of high nitrate levels should be tested by a laboratory.

Table 6. Guidelines for Nitrate in Feedstuffs⁵

| Nitrate (NO ₃) concentration ¹ | | Comments |
|---|-----------------|---|
| (%) | ppm | |
| 0.00 - 0.44 | 0 - 4,400 | This level is considered safe to feed under all conditions. |
| 0.44 - 0.66 | 4,400 - 6,600 | This level should be safe to feed to non-pregnant animals under all conditions. It may be best to limit its use for pregnant animals to 50% of the total ration on a dry basis. |
| 0.66 - 0.88 | 6,600 - 8,800 | Feeds safely fed if limited to 50% of the total dry matter in the ration. |
| 0.88 - 1.54 | 8,800 - 15,400 | Feeds should be limited to about 35 to 40% of the total dry matter in the ration. Feeds containing over 0.88% nitrate should not be used for pregnant animals. |
| 1.54 - 1.76 | 15,400 - 17,600 | Feeds should be limited to 25% of total dry matter in ration. Do not use for pregnant animals. |
| over 1.76 | over 17,600 | Feeds are potentially toxic. Do not feed. |

¹NO₃ concentration, ppm ÷ 4.4 = NO₃-N concentration, ppm

References

1. Wheaton, N.H. *Sudangrasses and Other Crops for Temporary Forage*. University of Missouri.
2. National Research Council, *Nutrient Requirements of Dairy Cattle*, Sixth Addition, 1989.
3. Boyd et al. 1938. *Agronomy Journal*.
4. Burns and Wedin. 1964. *Agronomy Journal*.
5. Faulkner, D.B. and M.F. Hutjens. 1989. *Nitrates in Livestock Feed* from the American Society of Animal Science symposium on nitrate toxicity.