South Dakota State University Extension

How to Test Hay and Forage for Nitrate Levels Using Test Strips

High nitrate levels in hay and forage can pose serious health risks to livestock, particularly pregnant animals and ruminants such as cattle. Environmental conditions including drought stress, frost, cloudy weather, hail damage, or heavy nitrogen fertilization can increase nitrate accumulation in plants. Because nitrate toxicity can lead to reduced performance, illness, or death in livestock, testing forage before feeding is an important management practice.

Nitrate test strips provide producers with a quick, low-cost screening tool to estimate nitrate concentrations in hay or fresh forage. While test strips do not replace laboratory analysis, they can help identify potentially hazardous forage and determine whether additional testing or feeding precautions are needed. Producers who suspect elevated nitrate levels or who receive high strip-test readings should consult a veterinarian, Extension field specialist, or certified forage testing laboratory for assistance interpreting results and developing safe feeding strategies.

The following procedure outlines how to collect, prepare, and test forage samples using nitrate test strips. Careful sample preparation and proper timing during testing will improve the accuracy and consistency of results.

Materials Needed

- Coffee grinder
- Nitrate test strips
- Metal pan
- Portable electronic balance
- 250-mL plastic bottle with cap
- Distilled water
- Paintbrush
- Table knife or spatula
- 100-mL graduated cylinder
- Microwave-safe dish (for fresh forage samples)
- Microwave oven

Safety Notes

- Keep equipment clean between samples to avoid contamination
- Avoid overheating forage during drying because charring can affect results
- Use caution when handling sharp tools and hot containers
- Always confirm results with a commercial laboratory if nitrate toxicity is suspected

Step-By-Step Procedure:

Step 1: Collect a representative Sample

- For Hay:
  - Use a hay probe if available
  - If not using a probe, break apart the bale and collect portions from several locations
  - Cut forage into 1–2-inch pieces

- For fresh forage:
  - Collect the plant portions at ground level
  - Cut into 1–2-inch lengths

Step 2: Dry fresh forage

- Spread forage in a thin layer on a microwave-safe dish
- Place a microwave-safe cup of water in microwave to reduce charring and scorching
- Microwave on high for 2 minutes
- Continue heating in 30-second intervals until dry
- The sample is dry enough when it crumbles easily between your fingers

Step 3: Grind the sample

- Place dry forage loosely into coffee grinder
- Grind using short pulses until the texture resembles coarse sugar or salt
- Use a paintbrush to remove dust and residue
- Repeat until the full sample is ground
- Mix all ground material thoroughly in a metal pan

Step 4: Weigh the sample

- Place the plastic bottle on the electronic balance
- Press the tare button to zero the scale
- Weigh exactly 1.0 gram of ground forage into the bottle

Step 5: Add distilled water

- Before use, test the water with a nitrate strip
  - Dip test strip for 2 seconds
  - Wait for 2 minutes
  - Compare color to chart on test strip bottle
  - No magenta color should appear. If it does, use another water source
- Measure 100 mL of distilled or low-nitrate water
- Add the water to the bottle containing the forage sample

Step 6: Extract the nitrates

- Tightly cap the bottle
- Shake vigorously for 30 seconds
- Let the sample soak for 30 minutes
- Briefly shake again every 10 minutes during soaking period

Step 7: Test the liquid

- Dip a nitrate strip into the liquid for 2 seconds
- Remove and shake off particles
- Wait 1 minute
- Compare strip color to the chart within 10 seconds of color development

Converting Results

Multiply the test strip reading by 100 to determine forage nitrate concentration.

Test Reading (mg/L NO3-)	Forage Nitrate (ppm NO3-)	Interpretation
0	< 1,000	Safe
10	1,000	Generally safe
25	2,500	Use caution with pregnant livestock
50	5,000	Risky, limit intake, dilute ration
100	10,000	Dangerous, avoid feeding free choice
250	25,000	Potentially toxic
500	50,000	Highly toxic

If the strip color is lighter than the 10 mg/L or 1,000-ppm color standard, the forage contains less than 1,000 ppm nitrate. If the strip reads greater than 10 mg/L or 1,000 ppm-color standard, forage should be sent to a laboratory for further analysis. Lab results will come back as NO_3 -N (Nitrate Nitrogen) and safety values will differ from values above.

Interpreting Results

- Low nitrate levels (<1000 ppm or 10 mg/L) generally indicate safe forage
- Moderate to high nitrate levels (1000- 50,000 ppm or 10-250 mg/L) may require dilution or restricted feeding
- Extremely high levels (50,000 ppm or 500 mg/L) can be toxic to livestock

Consult a veterinarian, Extension field specialist, or forage laboratory if elevated nitrate levels are detected.

Tips for Improved Accuracy

- Grind samples consistently
- Mix ground forage thoroughly before testing
- Use clean containers and tools
- Test multiple samples from large forage sources
- Avoid reading strips outside the recommended time window

Learn more at extension.sdstate.edu.

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