We have received reports of some forages, including cover crops that were planted in later summer, having very high concentrations of ash. Ash in forages is comprised of minerals contained within the plant (for example, potassium, calcium, magnesium, and copper) and soil contamination that was either splashed onto the surface of the plant while in the field or was picked up during harvest. On average cool season grasses such as orchardgrass or fescue harvested as hay or silage have about 7-9% ash and legumes such as alfalfa harvested as hay or silage average 10-12% ash. Generally mineral concentrations decrease as plants mature and is greater in forages grown in soils that contain high concentrations of available potassium (luxury consumption). These factors will change plant ash concentrations but generally by only a few percentage points.

On the other hand, harvest practices and soil conditions at harvest can increase ash concentrations by 5 to more than 15 percentage points with only small changes occurring in major mineral concentrations. Soil contamination can greatly increase concentrations of trace minerals especially iron, manganese, and aluminum. A study from the University of Delaware evaluated the composition of corn silage that was harvested after severe flooding caused by Hurricane Irene. Normal corn silage has about 5% ash but some samples from flooded corn had concentrations exceeding 20%. Iron averages about 250 mg/kg (ppm) in normal corn silage but silage made from flooded corn averaged about 2500 mg/kg. Concentration of aluminum averaged more than 5 times higher in flood-damaged corn silage compared with normal silage.

With the exception of potassium and sulfur, high concentrations of intrinsic minerals (those contained within the plant) in forages are not an issue; however mineral supplementation should be adjusted based on the mineral concentration in the forages. Forages with high concentrations of potassium reduce magnesium absorption and increase the risk for grass tetany. Additional magnesium should be fed in that situation. High potassium forages also increases the risk of milk fever when fed to dry dairy cows. In that situation, inclusion rates of the high potassium forage should be limited if possible or anionic diets should be fed prepartum. Forages with high concentrations of sulfur can interfere with copper and selenium absorption. In that situation, additional copper and selenium should be fed (within FDA regulations for Se) and high bioavailability sources should be used.

More problematic are forages with high concentrations of ash caused by soil contamination. Several problems can occur:

1. Ash has no energy. If everything else is equal as ash concentration increases energy concentration decreases linearly.
2. The high concentrations of trace minerals (iron, copper and maybe aluminum) can be toxic to rumen bacteria which will reduce fiber digestibility. This will reduce the energy value of the forage and can reduce feed intake.
3. If soil is high in clay, this will greatly reduce absorption of copper and zinc which are required nutrient for cattle and sheep.
4. Total dietary iron concentrations greater than about 500 ppm can be toxic to animals; however, the iron in soil-contaminated forage is mostly iron oxide (rust) which has very poor bioavailability and low toxicity. Increasing dietary vitamin E to about 1000 IU/day (based on dairy cow experiments) helps alleviate some of the issues associated with high iron. Because of low

bioavailability, high iron from forages is unlikely to cause direct toxicity to cows, but an experiment conducted at North Carolina State University found that iron from soil that was mixed with forage and then ensiled had increased bioavailability as storage time increased. This is likely because of the effect silage acidity had on the iron. As silage storage time increases, high iron silage may become more of an issue. This will not occur with high iron hay.

5. Probably the greatest potential risk of high ash forages is ruminal or abomasal impaction. The soil particles that the animal consumes can settle out in the rumen or abomasum (the gastric stomach) filling up the organ and eventually blocking passage of digesta. Clinical signs include lethargy, inappetence, constipation and eventually death. Upon necropsy the abomasum will be filled with soil particles. This is a bigger problem with dense soil particles such as sand. Lighter soil particles can flow through the digestive system.

The first step in evaluating ash in forages is to determine whether the elevated ash is intrinsic (inside the plant) or from soil contamination. Forages with less than about 250 ppm iron usually do not have much soil contamination but as iron increases above that level, ash contamination from soil is likely. If your forages have substantial ash concentration and high iron, the forage should be diluted with low ash feeds and mineral supplementation may need to be modified.

However, we do not know how much ash is too much. A case study from Saskatchewan found absomasal impaction in some beef cows that consumed forage with about 15% ash and 9000 ppm iron (normal ash in the forage would be about 8% and iron would be around 300 ppm). In a survey, 40% of the farmers that fed the flooded corn silage described above reported some animal health effects (there was no control so we do not know how many farmers not feeding the flood damaged corn silage would have reported health issues).

Because definitive data are not available on toxic ash levels, producers should be very cautious about feeding forages with more than 4 or 5% increased ash when it comprises the total diet. Forages with more than about 13 or 14% ash (assuming it is soil contamination as indicated by very high iron) should probably be diluted with feeds not contaminated with soil.

References/other information:

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