

Factors affecting NSC levels in grass

Genetic potential

Everyone keeps asking what kind of grass is safer? Well I wish it was just as simple as planting a different kind of grass. While genetic potential for high carbs is definitely something we want to avoid, I cannot recommend any kind of grass that might be safe for a laminitic horse to graze free choice in all environmental conditions. Genetic potential deserves it's own page, so go here to learn more: [Kinds of Safer Grass](#)

Time of day

Levels of NSC will be lowest from about 3 AM to 10 AM. NSC peaks in afternoon, and will start to decline after the sun goes down. Therefore the best time to graze fat or laminitic horses is very early morning. Someone needs to invent a gate opener with a timer for those who like to sleep late. Mine go out at 5 AM for 2 to 3 hours.

Temperature

Nighttime temperatures of less than about 40F (5C) will cause sugar and fructan levels to increase significantly. The duration of the lower temperature will have a direct bearing on the amount of sugars leftover from the day before. A week of nights with freezing temperatures and sunny days can double the NSC content of grass.

Sunlight

Intensity of sunlight has a direct affect on carb synthesis in plants, and is a really huge factor in NSC content. Cloudy weather or shade will reduce the amount of NSC.[Ciaverella abstract] [21] An overcast, drizzly day may keep NSC levels from increasing from morning levels throughout the whole day. A grove of fast growing trees around a 'health spa paddock' would keep sugar levels lower. Check out this cool site that measures solar radiation in the US for consideration of solar energy use. <http://www.nrel.gov/gis/solar.html> If you scroll down to where it says:

"Direct Normal Solar Radiation (Two-Axis Tracking Concentrator)—Static Maps " you can find out where and when the sun shines most in the United States. Here's the annual total map: http://www.nrel.gov/gis/images/us_csp_annual_may2004.jpg That dark red square in south central Colorado is me. Check out the monthly data, and you can see where laminitis associated with grazing is most likely to occur. See why we have much more problems in the Intermountain West and southwestern regions. I would love to see an epidemiological study on laminitis and colic in horses on pasture done utilizing some of this type of weather data. Notice the cloudy regions in the northeastern region of the US. While this data is for average climate over time, remember: weather happens. Even if you live in a cloudier region, don't get complacent. If/when you get a long stretch of sunny weather, especially coupled with cool night temperatures, watch your laminitis prone horses closely, and limit access to grass if they start to pork out or get sore footed.

Fertility

Nutrient deficiency is another kind of stress. Nitrogen and phosphorus deficiency are well documented as triggers for NSC increase in grass. Here's an analogy: think of the plant as a factory that makes fiber and protein as end products. The factory uses mainly water, sugar, nitrogen, phosphorus as raw materials to make these finished goods. Photosynthesis will keep making sugar as long as the sun is shining. But, if one of the essential components is missing, the other raw materials pile up in inventory. Hence, when nitrogen is deficient, growth slows, sugar piles up, and fructan forms. I know a lot of people don't believe me on this, so here's some links to abstracts:

<http://www.blackwell-synergy.com/links/doi/10.1046/j.1469-8137.2004.00990.x/abs/>

<http://www.blackwell-synergy.com/links/doi/10.1046/j.1469-8137.1997.00712.x/abs/>

<http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=34844>

Some caveats: overfertilization may extend the period when grass stays green with active photosynthesis. into late fall. Then freezing temperatures can cause accumulation of NSC and especially fructan that might not have occurred if grass if the grass had gone dormant . Take soil samples, calibrate your fertilizer applicator, and KNOW how much you need and are putting on.

Because fertilization may dramatically increase the amount of grass available, the amount of NSC per acre of pasture will increase, even though the concentration of individual mouthfuls of grass is decreased. If a horse with free choice pasture was having its intake controlled by the amount of grass present, I can see where fertilization might then provide an opportunity for over eating. But for those of us controlling our horses intake by limiting access to grass, or by use of a grazing muzzle, it makes more sense to provide enough fertilizer for optimum growth thereby decreasing the NSC content of the grass available.

Irrigation

Drought stress may increase NSC concentration in some grass species. [\[Volaire abstract\]](#) Using the same analogy as above: if the factory shuts down due to lack of water, the sugar (raw materials) pile up in inventory. I keep hearing farriers and veterinarians recommending not to irrigate pastures for laminitic horses, and it makes absolutely no sense to plant scientists. Increased water concentration in grass does not founder horses. In some species, drought stress cause dramatic increases in fructan concentration, which allows for rapid regrowth after the first drought breaking rain.

<http://www.plantphysiol.org/cgi/content/full/132/4/2218>

<http://www.blackwell-synergy.com/links/doi/10.1046/j.1469-8137.1999.00388.x>

<https://www.ajol.info/viewarticle.php?id=7976&jid=118>

Stage of Growth

Generally speaking, new short grass is low in sugar, and the concentration increases with higher leaf area, concentrates in the elongating head, peaks at flowering, then declines with maturity, other factors being equal, which they generally aren't. This concept has gotten us in trouble, so I feel the need to elaborate on this point. The reason this gets a little tricky is because we have to be careful to note if we are talking about average NSC concentration in the whole plant, or parts of the plant. First we have to understand the concept of 'source' and 'sink'. We generally think of leaves as being the 'source' of the NSC, because that's where they are made. The growth point and developing head are considered the 'sink' because that's where the NSC is most needed. The growth point can contain up to 40% of the dry weight as sugar and starch. But when a plant is re-growing from stubble, the new leaves may actually be a sink, utilizing carbs that were stored in the plant base until such time that the leaf area is large enough to start making more carbs than it is using for its growth. This is why if we look at data for 'total' plant carbs, this period of initial growth will be lower overall. Then when the grass gets 6-8 inches tall, depending on the kind of grass, it's gets strong enough to start making the amount of carb necessary to form seed heads. The elongating shoot will become the sink, drawing sugars from the leaves. At this stage, the stem will have more sugars than the leaves. The generation of the emerging reproductive organs, the flower and later seeds, is the highest priority sink. This portion of the plant has the highest sugars, and is why it is so common to see horses grazing selectively on newly emerged heads. These new heads can test 4X higher than grass leaves in tiller stage, and are horse candy. I believe this is the reason why we continue to see grass founder even after the nighttime temperatures warm. As seeds mature, the sugars are converted to starch, which is less soluble than sugar and fructan, therefore is a more stable, long-term form of storage carb. Hay cut in this mature stage of growth will be the lowest in sugar content overall. From this stage on, in a grass that has not been grazed or cut, the overall % of sugar declines, unless stressful environmental conditions occur, which could increase NSC in any green tissue. In a study conducted in cooperation with USDA, we found that environmental conditions were more important than stage of growth as a factor in NSC, and especially fructan content, of oat hay. Leaving mature, 'standing' hay for later use may be an option, but also eliminates a couple of months of productive grazing time late spring and early summer.

Regrowth from mowing after heading is lower in NSC than the initial growth. This makes sense from the standpoint of plant physiology. The plant has put most of its strength (carbs) into reproduction, and will be weakened (depleted of carbs) if this is removed. This is why specialists in rotational grazing recommend that regrowth not be grazed until the plant is back to 6-8 inches tall, when it has enough leaf area to be back in 'source' mode, rather than 'sink'.

Cutting

Cutting makes no difference to NSC content. Sometimes people confuse 'cutting' with maturity. Late cutting means late in the season. Late maturity means hay that is cut when the forage is past its prime; with fully developed seeds. If you have a choice of cuttings, the most likely candidate for low NSC content, (don't guess, test!) would be the cutting that grew quickly, and was not subjected to environmental stress. Avoid hay cut under drought stress, or that might have been frosted the week before cutting.