Extension
UNIVERSITY OF WISCONSIN–MADISON

Preliminary Forage Recommendations for Grazing Solar Sites

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While there are several successful examples of sheep grazing solar sites across Wisconsin, a key question remains: **what forages do well in between and under solar panels?** There are two approaches to vegetating solar grazing sites: **forages selected for nutritional quality and growth** and therefore for sheep production, or **pollinator plantings** composed of warm season grasses and native forbs. In this second path, sheep grazing acts as a form of vegetation management; however, the lower forage quality and production limit the agricultural production from these sites.

This factsheet focuses on maximizing agricultural production on solar sites. Specifically, which perennial forage species are shade-tolerant, low growing, and able to provide good quality feed for sheep? While there is currently a lack of research on the topic for the Upper Midwest, this fact sheet provides prospective and current solar graziers with some guidance on appropriate forage species for several soil types and climate zones in Wisconsin, should developers seek input or allow the grazier to direct vegetation of the site.

Pictured above: Meadow fescue

Shaded for Sheep

While planting pollinator habitat is the most popular form of vegetation in solar sites, grazing solar sites is growing in popularity. Not all graziers have the opportunity to influence the vegetation selection for solar sites, but for those who do, there is little to no guidance on forages suitable for the shade and height tolerances of solar panels that also provide the quality necessary for optimizing livestock production in Wisconsin. Shading from the panels helps regulate soil temperatures and retain soil moisture during the summer when conditions tend to be hot and dry. Shading will also influence the type of vegetation that grows, impact forage quality, and potentially reduce the summer slump traditionally seen with cool-season grasses. The following recommendations are based on general knowledge of forage production and conditions at solar sites and are in the process of being investigated at sites in Wisconsin.

Cool-season grasses are the foundation of improved pastures for livestock in Wisconsin because of their ability to provide superior forage quality and quantity in our climate. Combining growth habits of bunchgrasses that typically provide the bulk of pasture biomass, and sod-forming grasses that fill in bare ground and combat weeds, can provide a complementary forage base with good production and quality potential.

Bunchgrass

Orchardgrass and **meadow fescue** are two popular cool-season grasses for Wisconsin pastures, and both have potential in solar grazing systems. They are shade tolerant and often possess high forage quality in shaded environments. Orchardgrass may have greater yield potential than meadow fescue, but it matures faster and does not maintain forage quality and palatability as long as meadow fescue. Late-maturing varieties of orchardgrass are available and recommended. Orchardgrass is suited for well-drained conditions and is

more competitive, whereas meadow fescue is not drought tolerant but can persist in poorly drained soils. Both species produce well under well-managed grazing systems. If planted together, sheep will preferentially graze meadow fescue until it has thinned out of the stand, resulting in orchardgrass dominating. Other shade-tolerant, nutritious bunchgrasses include festulolium and perennial ryegrass. Perennial ryegrass tends not to persist for more than 3 to 5 years in Wisconsin, but it establishes quickly.

It is expected that these grasses will not produce as well in the deeper shade of fixed tilt panels as they will in the variable light penetration of single-axis trackers seen in newer utility-scale projects. Regardless of the panel racking, the key to utilizing these grasses within solar sites is ensuring that they are grazed in a timely manner as they both can reach up to 4 feet in height, potentially shading lower edges of panels and reducing energy output if not grazed or mown. erum quis re as nia volorum nonseria cus volupta tquodipidit ape

Sod-Forming Grasses

Sheep and cows are unlikely to willingly graze potential invasive and undesirable species like Canada thistle. Integrating a sod-forming grass will help to cover bare ground and suppress weeds. **Kentucky bluegrass** is a ubiquitous cool season, sod-forming grass that spreads quickly, tolerates heavy grazing and shade, and is highly palatable. While its yield potential and drought tolerance are not great, shade from solar panels may create conditions that allow Kentucky bluegrass to produce longer into summer. Unlike orchardgrass and meadow fescue, which can tolerate acidic soils, Kentucky bluegrass requires pH between 6.0-7.5.

Legumes

Pictured above: Red clover

Legumes provide nitrogen for pasture grasses and protein for grazing animals, which is especially important for lactating animals. Legumes can lead to an increased risk of bloat in grazing animals if comprising more than 50% of the dry matter in the forage. Popular legumes in Wisconsin include red clover and alfalfa. **Red clover** tolerates shade, low pH, and wet soils better than alfalfa and maintains its quality longer. While it does not tolerate drought or persist as well as alfalfa, it readily reseeds itself when allowed to mature. Because of its shade tolerance, red clover performs better in pasture mixes than alfalfa. If red clover begins to thin out of the stand, it is easily re-established by frost seeding with a broadcaster at 4-8 lbs/acre during the spring freeze-thaw cycles.

Rates and Ratios

Pasture mixes are often drilled at 20-25 lbs/acre, planted ¼ to ½ inch deep, broadcasted and then rolled. A sample mix at 25 lbs/acre may contain:

Species	%	Lbs/acre
Meadow fescue or orchardgrass	60	15
Kentucky bluegrass	16	4
Red clover	24	6

Establishment

Solar panel installation will often occur before vegetation establishment, especially when grading is deemed necessary. Pasture establishment is best in the early spring or late summer/early fall, with the latter being preferred because of the reduced weed competition.

If construction is completed outside of those time windows, a **cover crop** might be necessary to outcompete potential weeds before permanent vegetation establishment, and it can also provide grazing potential. If construction is planned to start mid-summer, a spring planting of oats can increase trafficability of the site and keep weeds at bay until a late summer planting. Pearl millet, sudangrass, and sorghum-sudangrass hybrids are all options for summer cover crop plantings to outcompete weeds before a late summer pasture establishment. However, these summer cover crops can grow in excess of 7-8 feet, potentially shading panels, so they should not be planted unless there are plans for grazing or mowing the site in the first summer. Non-grass species such as kale or turnips provide a lower growing option but may not be as competitive with weeds as grasses. Other cover crops, such as a winter cereal like rye or triticale will not produce a seed head without vernalization but will likely encounter leaf rust in late summer and could act as a "green bridge" for the pathogen to affect the pasture planting later.

If establishing the permanent vegetation following a summer cover crop, the covers will likely have to either be intensively grazed or mowed to prevent them from outcompeting the pasture or terminated prior to planting by herbicide or tillage. In any case, the permanent vegetation should be drilled between rows of panels for best establishment and broadcasted underneath the panels. If broadcast seeding, plant just prior to rains and/or roll the seeding to ensure good seed-to-soil contact.

Toxic Plants

While sheep will normally avoid most of the toxic plants common in pollinator mixes or that emerge in pastures, proper management is needed to prevent their ingestion. Even if a pollinator mix is planted outside of the solar array or the area intended for grazing, toxic plants planted right up to fence lines might still be within reach for sheep.

Utilize proper grazing management to minimize risk of sheep needing to graze on toxic species such as milkweed, buttercup, St. John's wort, and white snakeroot. Visit this page for a more complete list of common toxic plants for livestock in Wisconsin.

The disturbed nature of solar sites can also foster an environment for non-native toxic plants like deadly nightshade. Identification of unknown plants is important for safe grazing. If the infestation is severe, unpalatable and toxic species should be managed by mechanical mowing or herbicide application.

Selecting the right forage for solar grazing is only one of many steps to making agrivoltaics work. Other factors to address when considering this practice include:

- Agreements with the utility about access, internal fencing, and handling facilities
- Arrangements for providing water and potentially feeding supplemental grain
- Management of vegetation the sheep do not graze – and management to protect desired vegetation
- Safety issues (ewes casting against poles, risk of damaging solar infrastructure, etc.)
- Parasite management and other normal management considerations for grazing sheep include bloat and nutritional needs of different life stages.

Solar grazing is new to the upper Midwest, and we have much to learn about this promising practice. Farmers can seek information and share their experiences through networks such as the American Solar Grazing Association, GrassWorks, and local grazing groups, as well as NRCS and Extension.

Related Resources

Scan QR code to view **"Common Poisonous Plants of Concern for Wisconsin's Livestock"** or view online at go.wisc.edu/PoisonousPlantsforLivestock

American Solar Grazing Assocation
solargrazing.org

USDA NRCS
nrcs.usda.gov/conservation-basics/conservation-by-state/wisconsin

GrassWorks, Inc.
grassworks.org
Find a local grazing network:
grassworks.org/resources/grazing-networks

UW-Madison Extension
go.wisc.edu/ExtensionGrazing
go.wisc.edu/ExtensionSmallRuminants