Animal Housing—Landscaping Overview

Application: used to reduce emissions from buildings and manure storage

Pros

• Size neutral in that the use can be adapted to most any size farm.
• Site aesthetics may influence perceptions of odor emission.

Cons

• May take up to 5 years to become physically effective.
• Uses a significant amount of land.
• Effectiveness is incremental and may be best applied with other methods.
• Care is needed to avoid depositing snow in unwanted areas.

Description

Landscaping may seem like an unusual approach to mitigation of emissions from a livestock facility or manure storage, but trees and shrubs planted near facilities can impact odors, particulate matter and some gases. This landscaping is more formally referred to as vegetative environmental buffers or “VEBs”. Vegetation is normally planted to form a windbreak both upwind and downwind of a livestock building or manure storage.

Methods by which VEBs reduce the effects of emissions, especially odors, from livestock building and manure storage include:

Dilution and Dispersion

Trees and shrubs encourage the emission plume to be stirred and vertically mixed by forcing air over the VEB and through the VEB. Normally, in a well-designed system, about 60 percent of the wind goes up and over the vegetation and about 40 percent goes through the vegetation. This helps to dilute and disperse odors but does not truly reduce emission of other compounds.

Deposition of Odorous Dusts

Due to reduced wind speed created by vegetation upwind of the site, less odor and dust is entrained in the wind because less wind moves over the building or manure storage. Gravitational settling will occur in the “quiet zone” directly downwind of vegetation, settling much like snow during the winter. Particulate matter (dust) is a carrier of odors and, therefore, deposition of dust can reduce odor transmission potential.

Collection and Storage of Compounds within Trees

Trees adsorb odors and gases, particularly ammonia. This is due to a chemical affinity that ammonia has to the waxy coating on tree leaves. Conifers show a better ability to absorb odorous gases and chemicals than deciduous trees. Micro-organisms on plant surfaces also tend to absorb odorous chemicals.

Physical Interception of Particles

Trees are highly effective at intercepting dust and gases. Species with a higher degree of leaf roughness and those with large surface area to mass ratios are the most effective. Therefore, conifers are more effective than deciduous trees plus they have the added benefit of having leaves year-around.

Aesthetics

VEBs can reduce the impact on neighbors by either creating a more natural, aesthetically-pleasing site or obscuring the site so that it is less noticeable. While this is a more abstract benefit, it may in fact reduce odor complaints.

Layout and design of landscaping is critical to proper function and will avoid unintended consequences. Upwind and downwind landscaping are important to create a containment zone. A windbreak causes a “quiet zone” which extends 8 to 10 times the tree height in the downwind direction with reduction of wind speeds in a zone 10 to 25 times the tree height. Upwind, in a zone of 2 to 3 times the tree height, is also a quiet zone. Care should be taken in positioning the windbreak as to avoid dropping snow onto the...
building roof, drifting snow onto drives and around bins, and inhibiting air current necessary for summer natural ventilation (curtain-sided) buildings.

Figure 1 shows an example design from Tyndall and Colletti (2007). In this example three species of trees were used, Red Osier Dogwood, Eastern Red Cedar and Austree Willow, to establish a tiered height for the windbreak. Using multiple species helps to reduce the risk of losing the entire windbreak during a pest/pathogen loss and also allows for more continuous operation since some species are longer-lived than others. Willows and poplars, for instance, have the advantage of rapid growth (5 to 10 ft/yr) to establish the windbreak but they tend to have shorter life spans of 15 to 20 years. These are often used to get quick growth to establish a windbreak early. Shorter species, such as the Red Osier Dogwood which reaches 7 to 9 feet high, are normally placed closest to the barn and fills in the underbrush to help with air flowing through the windbreak rather than over it. The Eastern Red Cedar grows slower than the Austree Willow but will eventually reach heights of 40 to 50 feet and live longer.

In the example, summer winds are predominately from the south/southeast so a higher concentration of trees is north/northwest of the site to filter downwind emission and add turbulence to aid in odor dispersal. Trees on the north are planted with the closest spacing (8 to 10') to act as a filter while the southern trees are spaced further apart to prevent disrupting ventilation air in summer. The trees to the south should be a distance of 10 times the tree height from the building or 300 to 400 feet in the case of Austree Willows. Trees to the north will act as a snow fence during the winter so care should be taken as to not place them so they will drift in unwanted areas. For buildings which do not count on natural ventilation for summer trees may be closer on the south to preserve land area.

Effectiveness

<table>
<thead>
<tr>
<th>Component</th>
<th>Effectiveness</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH3</td>
<td>&lt;50%</td>
<td>Intangible benefits of aesthetics may influence odor concerns</td>
</tr>
<tr>
<td>H2S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odor</td>
<td>6 to 15%</td>
<td></td>
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<tr>
<td>Particulate Matter</td>
<td>&lt;50%</td>
<td></td>
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<tr>
<td>Volatile Organic Compounds (VOC)</td>
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<td></td>
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<tr>
<td>Cost</td>
<td>$</td>
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</tbody>
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Cost Considerations

VEBs have site prep costs, tree establishment costs and long term maintenance. Most of the cost is associated with the initial planting of the trees. Annual maintenance is an important part of maintaining a healthy VEB. Tyndall (2008) estimated the costs for establishing the VEB in Figure 1 as $0.05 per pig produced over a 20 year period. This cost depends on how land cost is factored into the calculation.

More Information

NRCS

Iowa State University
• Vegetative Environmental Buffers. http://www.nrem.iastate.edu/research/veb/
• Farmstead Windbreaks: Planning. https://store.extension.iastate.edu/Product/Farmstead-Windbreaks-Planning
• Farmstead Windbreaks: Establishment, Care and Maintenance. https://store.extension.iastate.edu/Product/Farmstead-Windbreaks-Establishment-Care-and-Maintenance

References