

# Michigan Dairy Review



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## Odor: Give Your Neighbors a Break - A Windbreak

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In 2004 the Michigan Department of Agriculture received 111 Right to Farm complaints covering all resource concerns: air quality, surface water, and ground water (MDA, 2005). Of those complaints, 47% were air quality concerns associated with odors from livestock production. Another 12% were combination complaints, the majority of which were air quality along with surface water resource concerns. According to MDA, nearly 60% of all Right to Farm complaints are filed by neighbors. To maintain amicable community relations, it is in a farmer's best interest to manage odors associated with their production facilities.

Unfortunately, there are few management options for odor control that are both effective and economical. However, one such practice that is readily available not only abates odor complaints, but can improve a farmer's overall environmental image within the community. That practice is establishing

windbreaks or shelterbelts (the term used in the remainder of this article). While establishing a shelterbelt will not totally eliminate odor problems, it does provide an effective management tool that should be considered when developing a farm's odor control practices.

### How Shelterbelts Work

Establishing vegetative shelterbelts has become an accepted odor control practice across the United States (MWPS, 2002, Schmidt, et al., 2004, NRCS-Missouri, 2004). The use of trees and other vegetation to control odor has long been an intuitive practice; however, scientific support of the practice had been lacking until recently. Shelterbelts differ in height, depth, porosity, and tree species but all implement the same principles. Recent investigations have concluded that when designed and implemented properly shelterbelts can be effective in odor reduction through five mechanisms (Schmidt et al., 2002; Leuty, 2004):

**1) Lifting and Mixing.** On windy or breezy days, shelterbelts create turbulence, forcing air movement up and mixing odorous air with fresh air. The resulting dilution of small dust particles and odorous compounds reduces the odor offensiveness prior to it reaching any odor sensitive areas (Figure1).

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**2) Settling of Odorous Particles.** On relatively calm days, shelterbelts may slow air movement. As the wind approaches the vegetative buffer, some of the air will be slowed and pass through the buffer. The remaining wind will be lifted over the buffer in a churning motion resulting in a mixing current on the downwind side of the shelterbelt. Wind passing through, and over the shelterbelt, results in a wind speed reduction extending well beyond the buffer, up to 30 to 50 times the height of the vegetation. Reduced wind speeds allow dust particles and odorous compounds that are attached to them to precipitate out of the wind current.

**3) Filtering of Odorous Particles.** Shelterbelts act as a filtering device in which dust particles are captured on the surfaces of the leaves. For this reason, pines and spruce with their greater total leaf surfaces and year round vegetation are considered excellent filters in established shelterbelts.

**4) Breakdown of Odorous Compounds.** Some odorous compounds, besides dust particles, may adhere to the leaf surfaces where they are broken down by microbial activity (Figure 2). Volatile organic compounds (VOCs) are among the compounds of greatest interest and concern within environmental watch groups and regulatory agencies concerned with air emissions and odors from livestock facilities. Just as the dust particles are filtered out of the air and attach to the leaves of the shelterbelt vegetation, VOCs also adhere to the plants. Research has established that the vegetative buffers will then break down many odor causing VOCs (Tyndall and Colletti, 2000). Since VOCs have affinity for the lipophilic membranes that cover plant leaves and needles, they accumulate on the leaf surfaces. This allows the microorganisms that cover plant surfaces to metabolize and breakdown the VOC's, thereby reducing the odor offensiveness.

**5) Aesthetics.** Some people say "Image is everything", and image has its place in odor control as well. Shelterbelts can improve significantly the aesthetics of the farm by creating a visual barrier to the barns. Planting trees also may indicate to neighbors that the farm's owners and managers are concerned about not only protecting our natural resources but enhancing them.

### Installing a Shelterbelt

The effectiveness of a shelterbelt depends on the physical characteristics of the vegetation. Vegetative buffers should have a porosity of 40 to 60% (Tyndall and Colletti, 2000; NRCS-Missouri, 2004). Porosity expresses how dense the foliage is and is quantified by the simple ratio of plant surface area to the total area. Effective shelterbelts meet porosity guidelines and have reached a minimum height to create the mixing and wind speed reduction necessary. Tyndall and Colletti (2000) suggest that vegetative buffer height must reach 20 to 30 feet before the shelterbelt will become fully effective.

When installing a shelterbelt some general guidelines should be followed relative to location on livestock facility premises, setbacks from odor source structures, and the design

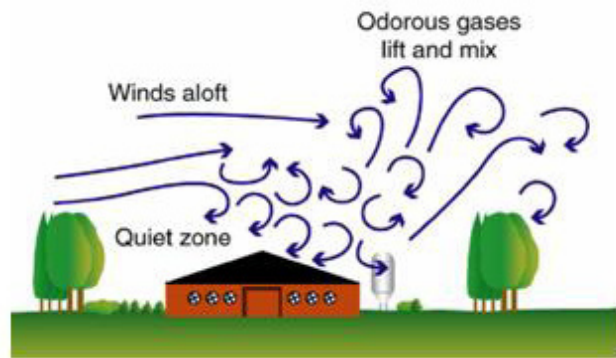


Figure 1. Shelterbelts located upwind and downwind from livestock facilities reduce and manipulate air flow around the facility to reduce odors. Winds aloft lift and mix particles and gases into the lower atmosphere to help dilute and disperse odors. (Queen's Printer for Ontario, 2004. Reproduced with permission).

and plant species of the actual shelterbelt (Ward, 2005). For specific recommendations for your geographic location, soil type, and situation, visit your local Natural Resource Conservation Service (NRCS) or Conservation District office.

**Location.** Shelterbelts are most effective when established on both sides of the odor source. Locate the vegetative shelterbelt 75 to 100 feet both upwind and downwind from the odor source. Because Michigan is subject to weather fronts from all directions, ideally the shelterbelt should extend around the entire perimeter of the odor source.

**Setbacks.** The possibility of roots penetrating the liner of earthen manure storages or disturbing other facilities is remote provided that shelterbelts are located at the recommended distances from the odor source. By locating the shelterbelt the minimum 75 feet from the odor source it is unlikely that

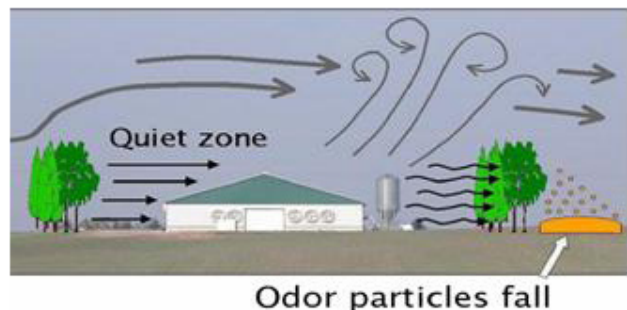


Figure 2. Shelterbelts located downwind of livestock barns allow settling of odorous wind-borne dust particles. Windbreaks should be located 75 to 100 feet from barns. (Queen's Printer for Ontario, 2004. Reproduced with permission).

the roots will extend to the odor source during the lifetime of the vegetative buffer (50 to 80 years). For naturally ventilated buildings the shelterbelt should be a minimum of 100 feet from the building to allow for sufficient airflow for ventilation.

**Species.** A three row shelterbelt incorporating three different tree species is most effective (Figure 3). Using a row of shrubs (e.g., chokecherry and elderberry), a row of tall growing conifers (e.g., eastern white pine and northern white cedar), and a row of fast growing deciduous trees (e.g., hybrid poplar) is recommended.

The shrubs nearest the odor source divert air upward and filter air nearest the ground surface that might otherwise pass underneath the foliage of trees.

The tall growing conifers in the middle row provide excellent long-term, year-round windbreak and air filtering protection.

The tall, fast growing deciduous trees in the shelterbelt offer quick odor control results while the slower growing conifers mature. Generally, these rapid growing trees do not live as long as conventional species, but that is okay. By the time the last row of trees die, the middle row of trees will have reached adequate maturity to provide an effective shelterbelt without them.

### Make Your Plan Now

Similar to making field crop planting decisions, winter is the time to plan for establishing vegetative shelterbelts next spring. Local NRCS offices regularly hold tree sales in February and March with an early spring delivery. These tree sales are an excellent resource for young trees and shrubs appropriate for your area. While young trees fail to meet the height and porosity requirements for an effective shelterbelt, by incorporating fast maturing deciduous trees, they will provide quick results with the greatest height in the least amount of time.

Shelterbelts are effective because they mix and dilute odor compounds, they capture dust particles with odor compounds attached, and they contain microorganisms that metabolize odor compounds. When developing a plan to mitigate odor concerns from a livestock facility of any type, shelterbelts should receive substantial consideration. Shelterbelts are not

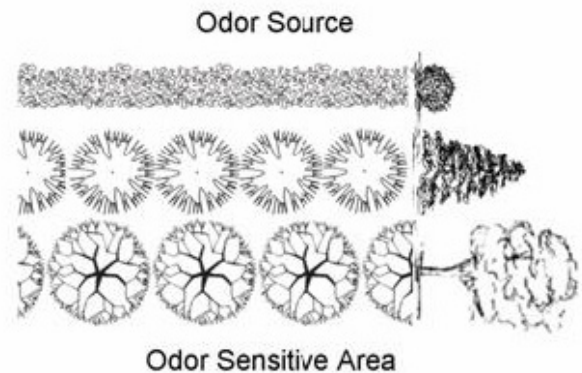


Figure 3. A 3-row shelterbelt using three different tree species is most effective.

only effective for odor control, but project the farm owner's proactive attention to environmental stewardship.

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