

TREES AS A VEGETATIVE FILTER

George Malone and Garrett Van Wicklen

Emissions of ammonia, particulates, odor and noise from poultry operations are an increasing concern for the poultry industry from both a neighbor-relations and an environmental standpoint. Odor, dust, feathers and noises associated with poultry operations are issues the poultry industry must deal with to maintain good neighbor-relations. With more frequent use of tunnel fans during warm weather and more outdoor activities by neighbors, summer is often a critical time for nuisance complaints to surface. During the past few years there have been an increasing number of legal cases involving nuisance complaints associated with neighbors next to and downwind tunnel-ventilated poultry houses. Compounding nuisance concerns is the increase in human population in poultry producing areas. As many poultry and livestock producing areas of the country become more urbanized, the likelihood of increased nuisance-related complaints will only increase. These issues are exacerbated as the size of poultry farms increase.

To further add to the poultry industry's future challenges, emissions from poultry houses may be regulated in the future. The National Ambient Air Quality Standards under the Clean Air Act has been revised to include a particulate matter standard of 2.5 μm diameter. Both ammonia and dust may fall under this regulation. In some coastal areas of the U.S. there is the added concern that ammonia emissions from poultry houses may be a significant source of atmospheric nitrogen and that this nitrogen may stimulate algae growth particularly during the summer – a time of year for maximum ammonia emissions from poultry houses. The poultry industry is also being challenged for not reporting ammonia emissions from the larger production units.

The adoption of sound, practical, efficient and cost-effective technologies to address these issues will be increasingly important in the poultry industry. One such technology is strategically planting trees around poultry houses. Although the poultry industry has not previously recommended the planting of tall crops, shrubs or trees around houses fearing they will interfere with natural ventilation during the summer in open sidewall housing, as housing shifts to tunnel, black-out and windowless-type systems, this no longer a major concern.

There are three “potential” advantages of a tree program (Figure 1). A tree program may foster improved neighbor-relations by filtering dust, feathers, odor and noises from houses; provide a visual screen of the houses and the routine farm activities; and improve public perception of the industry via a proactive, “green” initiative. Potential environmental benefits include a reduction in ammonia, particulates, odor, surface and groundwater nutrients leaving the proximity of farms and promote carbon sequestration. There are also possible production benefits of a designed tree program, particularly for tunnel-ventilated poultry farms. Trees strategically planted for windbreaks, shade and to filter air-borne pathogens offer potential energy conservation and improved farmstead biosecurity.

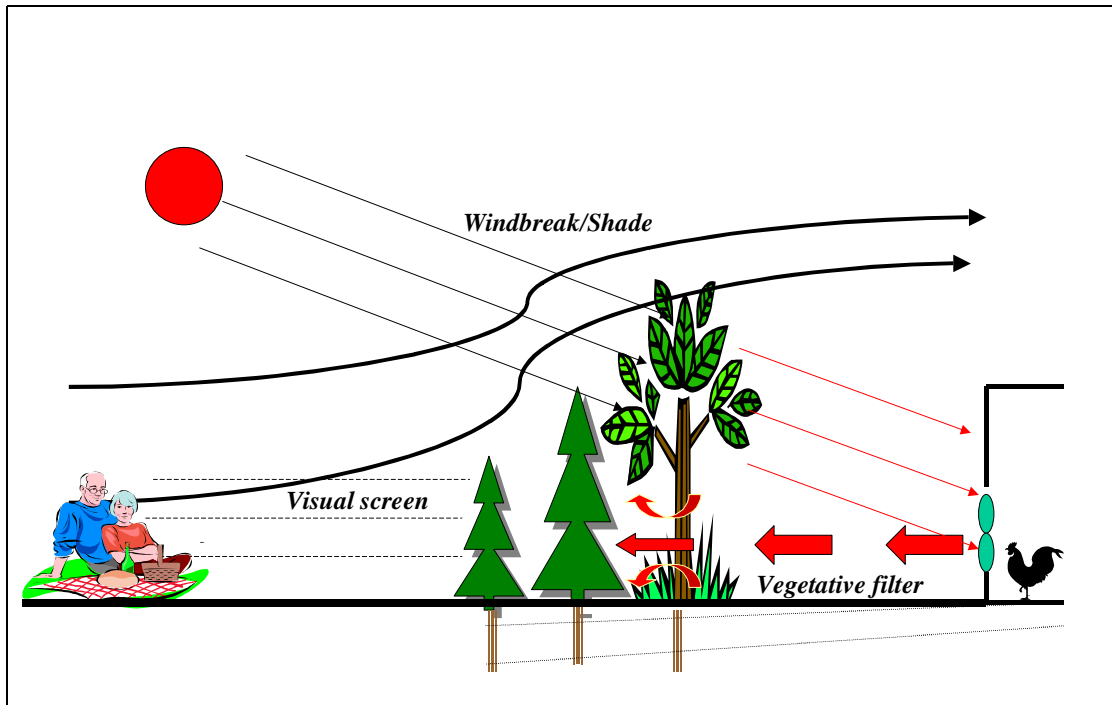


Figure 1. Objectives of using trees around poultry houses.

Literature Review

Although much is known about the aesthetic value, environmental and energy conservation benefits of trees for numerous applications, little is available on the merits of a designed tree program for poultry (and livestock) facilities.

Tree barriers around production sites have high aesthetic value with the potential of increasing property values of both the poultry farm and adjoining neighbors. It been suggested that trees increase residential property values by 5 to 20%. Planting trees creates a positive image and helps the farm take on a landscaped appearance. As the trees mature, the houses and routine activities are obstructed from view. The negative images of poultry operations by neighbors and the public is blocked by this visual screen and the “out-of-sight-out-of-mind” concept may well represent a major benefit of a tree barrier. In a recent survey of neighbors near swine operations in Pennsylvania, farms that were “attractive” were perceived by the neighbors as having less odor (Mikesell, *et al.*, 2001).

The use of shelterbelts (defined as tree plantings to provide wind protection for farmsteads and feedlots) around livestock facilities to mitigate odor and improve air quality has been recently reviewed by Tyndall and Colletti (2000). They concluded shelterbelts have the potential to be an effective and inexpensive odor control technology particularly when used in combination with other odor control methods. Shelterbelts ameliorate odors by dilution of odor, encourage dust and aerosol deposition by reducing wind speeds, physical interception of dust and aerosols, and acting as a sink for chemical constituents of odor. They reported there are a number of barriers to adoption of shelterbelts for livestock odor control. There is a lack of technical information on shelterbelts (i.e. tree species best suited for shelterbelts, site prep

and planting techniques and maintenance, and effective designs). Other barriers include a cost-benefit analysis, cost share opportunities, quantifying the efficacy for odor control and cultural barriers to erecting non-agricultural structures (trees) within the farmstead. In another recent report (Iowa State University and University of Iowa Study Group, 2002), tree barriers was one of four methods recommended to the Governor of Iowa for reducing emissions from animal feeding operations. The recommendations from these two reports for using trees as vegetative filters to mitigate emissions from animal facilities are supported by the following studies. Wind tunnel modeling of a three-row shelterbelt has found reductions of 35% to 56% in the downwind transport of dust and aerosols (Laird, 1997; Thernelius, 1997). It is well documented that odorous compounds are attached to dust particles (Burnett, 1969). Hartung (1985) suggested that filtering the dust from exhaust air could reduce odors from animal facilities up to 65%. Efficacy of tree filters to specifically reduce ammonia and odor emissions from poultry houses has not been determined.

Other environmental benefits of using trees to filter nutrients in runoff and groundwater, and capturing carbon dioxide (a greenhouse gas) has been well documented. Through root absorption or reduced overland flow, it is estimated a riparian buffer can remove more than 80% of nitrogen and phosphorus, thus keeping these nutrients from entering adjacent water courses.

Very little is known on how a designed tree planting around the perimeter of poultry farms might influence poultry production. It is believed, based on other applications that trees planted for windbreaks, shade and filters may offer the potential for energy conservation and improved biosecurity for poultry farms. Previous research for other applications suggest properly established windbreaks are an energy efficient, natural system, which can reduce winter heating costs 10 to 40%. When trees are planted to maximize shading of residential homes, summer cooling cost can be reduced up to 20%. The potential energy efficiency of designed tree windbreaks and shading for modern tunnel-ventilated poultry farms is not known. Malone (unpublished) has collected some very *preliminary* data on two sets of paired farms (open versus wooded) during a one-week period in both summer and winter. He observed shading around houses in the summer can reduce ground/surface temperatures by 20 F. The air temperature next to houses having shaded (wooded) area on the western exposure was 7 F cooler in the afternoon than air around houses without any shade. However, these shaded farms had morning air temperatures that were slightly higher (~3 F). During winter, air temperature on the western exposure of these shaded farms was slightly higher (~2 F) midday but generally lower in the afternoons and at night. Wind speed and wind chill were not determined on these farms. A slight increase in relative humidity was observed around the wooded farms in both summer and winter. This observation is supported by Brandle and Finch (1991) who indicated that depending on porosity of the shelterbelt, relative humidity may be 2 to 4 percent higher in sheltered areas compared to open areas.

By filtering air-borne particulates, there is some speculation that trees surrounding poultry houses may block the transfer of air-borne diseases. Airborne transmission of several poultry disease has been recognized, including Salmonella enteritidis (Holt, *et al.*, 1998), Newcastle disease (Hopkins and Drury, 1971; Hugh-Jones, *et al.*, 1973) and infectious laryngotracheitis virus (Johnson, *et al.*, 2001). Johnson *et al.*, (2001) recently found a relationship between

wind direction and the spread of larynogracheitis on Delmarva where distance of surrounding farms from the infected house(s) was not as important as wind direction. Farms located within the wind vector of a case farm had a four-fold increased risk in developing the disease within the next 14 days. Houses oriented north-south had 40% greater chance of infection than east-west orientation and conventional houses were 3½ times more likely than tunnel houses to be infected. It is speculated that using trees as vegetative filters may reduce airborne disease transmission, particularly in highly concentrated production areas. However, there may be some health risk associated with trees around poultry houses, namely a potential increase in wild birds and rodents. The authors are not aware of documented studies of increased disease incidence associated with wild bird populations due house surroundings (i.e., trees). On the contrary, Villafane *et al.* (2001) found lower rodent populations on poultry farms having trees with the speculation that trees may provide perches for raptors that feed on the rodents.

STATUS OF DELMARVA'S TREE INITIATIVE

In response to growing neighbor-relation concerns with retrofits to tunnel ventilation, and increasing environmental concerns with emissions from houses, a proactive tree planting program was first discussed for Delmarva two years ago. Although not intended to be a substitute for good farmstead practices or the total solution to eliminating emissions, this program was thought to be a cost-effective, long-term approach in addressing emerging issues and trends in the industry.

Over the past two years, the University of Delaware in collaboration with numerous stakeholders has developed the criteria for this tree program for Delmarva poultry farms. Among those contributing in this University of Delaware lead initiative include the Delmarva Poultry Industry Inc.'s grower and company committees, state departments of agriculture and natural resources, soil conservation districts and the Natural Resources and Conservation Service (NRCS). This program involves strategic planting of multiple rows of trees or shrubs around the perimeter of poultry farms. This is a "designed tree program" which takes into account a number of factors, including house ventilation type, fan location, house orientation, proximity to neighbors and other farm layout considerations. A tree plan is specifically designed for each farm and each individual side of the farm, taking into consideration the three major objectives to be achieved – a visual screen, vegetative filter and windbreak/shade. The appropriate trees to plant must take into consideration the objectives to be achieved and trees that are suitable for the local climate and soil conditions. Given these criteria, it is advisable to seek technical assistance in developing a tree plan from those who are well informed on the overall goals of this program. NRCS in both Maryland and Delaware have revised their windbreak/shelterbelt establishment standard (code 380) to reflect this practice, and have developed ranking criteria and conservation practice job sheets for windbreaks for poultry houses. Currently, Maryland is using the Environmental Quality Incentive Program and Delaware is using the Agriculture Management Assistance Program to cost-share this practice. Some local Soil Conservation Districts in Delaware also offer cost-share for this practice. Cost-share assistance up to 75% of the practice is offered and includes the costs associated with site preparation, weed control, the trees and having them planted, installation of an irrigation system, and maintenance for several years. Local NRCS and Soil Conservation District planners are actively writing tree plans for poultry farms for implementation starting this Fall.

The University of Delaware has developed two extension bulletins (Malone and Donnelly, 2001a and 2001b) which describe the benefits of a tree program, recommendations on the type and requirements for planting trees around farms and where growers can get technical assistance for this program. Since factual data to support the potential benefits of this initiative for the poultry industry is very limited, the University of Delaware has implemented a number of demonstrations. In April 2001 a tree program was designed and implemented for a three-house tunnel ventilated poultry farm that was faced with urban encroachment (Malone and Donnelly, 2002). Total cost associated implementing the tree program using two-year old seedlings from commercial nurseries was estimated at \$750. The importance of weed control and irrigation to insure livability have been “lessons learned” from this demonstration to date. Because 7 to 10 years would be required to measure potential emissions reduction when starting with seedling stock, Non-Point Source Program section 319 funding from EPA and Delaware’s Department of Natural Resources and Environmental Control is being used to measure efficacy of a designed, mature tree program in reducing emissions. On a commercial farm opposite one section of the tunnel fans, a three-row tree program was planted in April 2002. This program consisted of 16-18 feet tall bald cypress (inter row, 30 feet out from fans), 12-15 feet Leyland cypress (middle row) and 8-10 feet Eastern red cedar (outer row). Particulates, ammonia, odor, bioaerosols and the potential fate of nutrients emitted from fans are being measured. Preliminary results to date suggest this three-row tree program appears to be a viable, affordable method of reducing airborne contaminants emitted by broiler house tunnel fans. A fully implemented tree program using different examples of plantings is scheduled for a new University of Delaware model poultry house this fall. Efficacy of trees to improve water quality will be measured at this new facility.

The Delaware Nursery and Landscape Association has provided support to evaluate potential local tree species best suited for high emission loading sites. Eastern white pine, Eastern red cedar, Leyland cypress and Nelly Steven holly were planted in April 2002 at four locations to assess livability when placed in close proximity (25 to 50 feet) to the tunnel fans. Another proposal has been submitted to support an assessment of the influence of trees surrounding existing farms on select production parameters and to monitor the microclimate around houses with and without trees.

The goal of these demonstration efforts are to strengthen our regional efforts and to generate data that will aid in supporting a comprehensive, national tree initiative for poultry and livestock operations throughout the U.S. This initiative has been well received by local poultry growers and companies; conservation and environmental groups and interest has spread to other regions of the country.

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