RESEARCH ABSTRACT

ENVIRONMENT

Title: Field and Wind Tunnel Evaluation of Vegetative Buffers for Particulate Trapping and Odor Reduction Near Swine Production Facilities **(NPB #07-048)**

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Scientific Abstract:

The purpose of this study was the measure the effectiveness of a tree buffer in reducing particulate and odor movement from a swine confinement operation and an economic analysis of costs associated with establishing and maintained vegetative buffers around swine confinement facilities in Iowa. Optical particle counters (OPC) were used to measure the number of particles within and outside the tree buffer and group them into 8 size fractions. When the winds were from the south there was an overall reduction of 44% in particulates due to the tree buffer. Large particles (> 10 microns) contributed less than 0.1% of the total. Differences were observed for 4 of the 6 size fractions. For the 0.3-0.49 micron fraction, the values were 94.3% and 88.9% for OPC 3 and OPC 2, respectively, indicating a larger proportion of small particulates in the north side (away from building) of the buffer. For size fractions 0.5-0.69 microns, 0.7-0.99 microns, and 1.0-5.0 microns there was an increase in the percentages for OPC2 versus OPC 3.

The buffer was effective for removing VFAs with peak concentrations occurring at 5:00-7:00 pm (18:00:00) and concentrations reduced by over 50% in both the August and September samplings. While this is a positive result, the odor threshold concentrations for these compounds (VFAs) are significantly higher (less odorous) than for the aromatic compounds (i.e., phenol and indole compounds) so removing these compounds from air stream will not have the same effect as removing the aromatic compounds. The more odorous compounds represented by 4-methylphenol (p-cresol) indicate that the buffer had mixed results with the August sampling showing little to no difference between the north and corn field samplers, and September sampling showing that levels of this compound are reduced when comparing the different field samplers. There results show that buffer removed aromatic compounds from the air stream just not as effectively as for the VFAs.

The wind tunnel experiments indicated that the effect of both buildings and trees on wind velocity and turbulence was observed at heights lower than 100 feet (200 mm in our experimental scale). The impact of buildings perpendicular to air flow parameters was greater than for tree models further downwind. The lower wind velocity and greater mixing near the trees should enhance particulate trapping and odor sorption to the tree tissues.

By taking a random sample of existing hog confinements throughout Iowa (n=60), site specific shelterbelt systems were designed for each production site. Assuming each shelterbelt was designed as a retrofit system, the full costs of establishing and managing these shelterbelt systems were calculated for each facility. The effects of the Environmental Quality Enhancement Program (EQIP) were then examined. Individual farm level costs were averaged regionally and aggregated by county to estimate the total investment needed by the Iowa hog industry to utilize shelterbelt systems for air quality purposes and to get a baseline understanding of potential cost share program outlays.

Examining first the low cost scenarios (based on seedling prices for planting stock), producers in SE Iowa would experience the lowest average costs of $3,896 total for establishing and managing a shelterbelt system over a 20 year period. Producers in SW Iowa would face the highest costs of $4,500 per site. In terms of upfront cost only there is just a $229 difference between high and low costs ($1,671 versus $1,447). Across all of Iowa the total costs per pig produced (over 20 years) comes to $0.036 per pig. Overall, EQIP reduces total 20 year costs by 18% and upfront costs by just under 50%. Per pig costs are lowered by almost a penny per animal. As yet another way to think about costs, with the low cost situation the total costs come to about $1.40 per linear foot of shelterbelt.