Four weeks of crowding will reduce overall performance during the grow/finish phase

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Two hundred eighty-eight pigs (24 pens of 12) were involved in a study of the effects of crowding for various periods of time on productivity and behaviour. Floor space allowance was calculated based on the average weight of the pigs during each period within the study. An allometric equation, based on $BW^{.667}$ (in kg), was used to determine space allowances, with a *k* of 0.30 (in m^2) used for the crowded condition, and 0.40 for non-crowded. These levels are approximately 15% below and above the Code of Practice. The 12-week trial was divided into three 4-week periods. Pigs began the trial in either a crowded or non-crowded condition. At 4 weeks, and again at 8 weeks, one third of the pens on each initial treatment were changed to the alternate condition. Weight gain, feed intake, aggression, behavioural time budgets, neutrophil/lymphocyte ratio and carcass characteristics were determined during the study.

Crowding resulted in a reduction in average daily gain and reduced feed intake compared to the non-crowded condition. This effect was evident within 4 weeks of the imposition of crowded conditions. Changing from crowded to non-crowded conditions resulted in normal levels of growth during subsequent periods, but no compensatory growth was evident. Overall, the effect of time spent in crowded conditions was cumulative, with the least amount of growth observed in those pigs that spent more time in crowded pens. This was particularly evident among males. Pigs did not differ in aggression or behavioural time budgets between spatial treatment. Nor did neutrophil/lymphocyte or carcass characteristics differ among treatments. It is concluded that crowding reduces productivity in grow/finish pigs, and this effect is evident within 4 weeks of the conditions being imposed.

Implication

Overcrowding of pigs for as little as 4 weeks at any part of the grow/finish period is likely to result in a reduction in feed intake and growth rate. Returning the pigs to non-crowded conditions does not appear to allow pigs to recover from their set-back. It is important that producers provide adequate amounts of space at all times for their pigs, unless they are prepared to accept a reduction in growth.

Social facilitation of eating between pens is affected by feeder design

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The 12-week experiment consisted of 40 pens, each containing 5 pigs (initial live weight 25 kg) and equipped with a single-space feeder. The pens were arranged in 20 pairs that shared a common treatment wall, which was either solid plastic (Solid) or vertical metal bars (Spindle), designed to prevent or allow visual contact, respectively. The feeders in each pair of pens were incorporated into the treatment wall and their feeding spaces were either separated by their side panels (Divided) or joined by the removal of the side panels (Open), to prevent or allow pigs visual and physical contact, respectively. The resulting 2 x 2 factorial arrangement of treatments was replicated 5 times. The eating behaviour of the *ad libitum* fed pigs in 16 pairs of pens was videotaped for 24 hours during weeks 3, 7 and 11 of the trial. The eating behaviour of the pigs was analyzed to determine the total duration of eating, and the proportion of time when pigs were eating in both pens within a pair. Average daily gain and feed intake were determined on all pairs of pens.

Total duration of eating did not differ between wall or feeder treatments. Pigs spent an average of 84 min/day eating. Pigs were eating in both pens within a pair more frequently when the feeder space was Open to the adjoining pen than when it was Divided (249 vs 176 min/day; $P<0.05$). The frequency of simultaneous eating did not differ between wall treatments. Social facilitation occurred between pens that were equipped with Open feeders to the extent that simultaneous eating was more common. However, social factors did not increase total duration of eating. The pigs consumed an average of 2.20 kg of feed per day, and had an average daily gain of 836 g/day. Neither intake nor rate of gain was affected by the wall or feeder treatment.

Implication

Visual or physical contact through the feeder with a pig in an adjoining pen increased the likelihood of two pigs eating simultaneously but had no effect on total duration of eating nor production measures was evident. Visual contact through the wall of the adjoining pen did not significantly affect the level of simultaneous eating. Social facilitation may be of some benefit during short periods of time when eating is limited, such as immediately after weaning, but does not improve productivity over the entire grow/finish period.

Performance and carcass quality of growing-finishing pigs subjected to a reduced nocturnal temperature

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During summer months, elevated barn temperature reduces animal growth rate by decreasing feed intake. Recent experiments showed that a reduced nocturnal temperature setpoint during summer could sustain pig performance by stimulating the daily feed intake and potentially modifying pig eating behavior. The objective of this project is to evaluate the impact of a reduced temperature control strategy during summer nights on growing-finishing pig performance and carcass quality. A preliminary experiment was conducted in the summer of 1997 for eight weeks. The temperature setpoint of the treatment room was 6°C lower than the control room. The reduced nocturnal temperature increased the daily weight gain by 5%. However, only one replication was included. The experiment was repeated in six growing-finishing rooms for eight weeks during the summer of 1998. Three treatment rooms and three control rooms formed three replicates. The control rooms had a typical temperature setpoint of 24°C for 25 kg pigs which was reduced to 18°C when pigs were 75 kg and over, while the temperature setpoint for treatment rooms was 6°C lower. The temperature monitoring results indicated that daytime temperatures (09:00 am to 23:00 pm) were the same in all rooms since the average daytime temperature in the treatment rooms was merely 0.2°C lower than the control rooms over eight weeks. However, The treatment rooms were cooler than the control rooms at night. The average nocturnal (23:00 pm to 09:00 am) temperature in the treatment rooms was 1.6°C lower than the control rooms. The average daily gain of pigs in treatment rooms was increased by 2.2% (0.872 vs. 0.853 kg/day) over the eight week period, while the last four weeks had an increase of 3.6% (0.955 vs. 0.922 kg/day) with similar feed conversion (2.675 vs. 2.652 kg/kg) and back fat thickness (11.4 vs. 11.0 mm at the last ribbon loci).

Implication

A reduced nocturnal temperature control strategy could ease the heat stress and sustain pig performance during summer time. This strategy is effective regardless of farm size.

Evaluation and selection of relative humidity sensors for livestock buildings

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Humidity monitoring and control are very important to livestock buildings since extreme relative humidity levels can reduce animal performance and building longevity. However, the corrosive environment in livestock buildings affects the humidity sensor accuracy. New sensor models should be tested under actual barn conditions to assess their long-term integrity. An experimental procedure combining the sensor in-barn operation and laboratory calibration was developed to meet this requirement. A bank of 72 TDK humidity sensors with 12 different filter and coating treatment combinations were evaluated for one year in a grower/finisher room from Oct. 1996 to Oct. 1997. Another five different types of commercial humidity sensors with three replicates have been evaluated in the same room for one year beginning in December 1997. After the initial static and dynamic calibrations in laboratory, tested humidity sensors were installed in the grower/finisher room and operated continuously without any maintenance. Meanwhile the sensors were taken back to the laboratory and calibrated periodically for static and dynamic properties including accuracy, hysteresis, linearity and time response. Various environmental variables were also monitored at the same time.

The environment monitoring results confirmed the poor air quality in the room especially in winter. Prior to the in-barn trial, all TDK humidity sensors respected their nominal accuracy of ±5%. All 36 TDK CHS-GSS sensors and 3 CHS-UGS sensors failed during the experiment. The CHS-UGS sensors with coating and filter 5 had the lowest mean error of ±8.0% after one year and maintained good linearity and hysteresis characteristics. The other five commercial humidity sensors had errors ranging from ±3.2 to 8.1% prior to the in-barn trial. After eight months, two of the 15 sensors failed. The mean errors for the working sensors ranged from ±4.9 to 10.2%, while the best TDK treatment had an error of ±5.5% after nine months in the barn. Therefore, the TDK CHS-UGS sensor with coating and filter 5 constitutes a promising sensor configuration to measure humidity in livestock buildings.

Implication

With this humidity sensor evaluation procedure, the drifts of various sensor properties under real livestock building environment can be identified and conclusions on sensor selection can be drawn.

Environmental control strategies for swine buildings in cold-climates

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To provide adequate indoor air quality, ventilation systems aim to control temperature, humidity and gases in a hog barn. An optimum environmental control system should provide a proper balance between high air quality and low energy requirements. Conventional environmental control systems utilize temperature as the measurable parameter, and set a constant minimum ventilation rate to ensure acceptable humidity and gas levels. With this arrangement, high humidity and/or air quality problems may occur especially during cold weather. Heating/ventilating systems with humidity control are presently available on the market for the livestock industry but are rarely used in swine facilities.

To evaluate the benefits that temperature-humidity control systems could provide, a computer model describing the steady-state heat and mass balances of swine buildings has been developed. This model considers a full-scale facility of growing/finishing pigs and simulates commercial environmental control systems. Instead of setting a constant minimum ventilation rate, the humidity controller adjusts the ventilation according to the humidity level. A comparison of the two main control strategies for heating/ventilating systems (temperature control and temperature-humidity control) has been made. This analysis is based on the total energy demand on a yearly basis and on an estimation of the air quality in terms of temperature and relative humidity fluctuations, and carbon dioxide concentration.

Implication
This comparison will determine the relative value of the two control strategies based on energy costs and ability of the system to maintain setpoint temperature and humidity levels. This computer model will reduce research costs in control strategy analysis in predicting humidity control benefits without requiring expensive full-scale trials.

A method for evaluating manure pit additives in manure channels and simulated outdoor lagoons

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Odour complaints and manure handling issues are influencing many pork producers to reconsider their manure management practices. Some of the desired improvements regarding manure management include reducing odours, reducing and solubilizing solids, retaining nutrients, suppressing gas production and limiting the addition of heavy metals through spreading on land. To attain these improvements, many producers have opted for the use of manure pit additives in their facilities, although the effectiveness of these treatments is still in question. The objective of the methodology is to determine the effectiveness of manure pit additives on a commercial scale in underfloor manure channels and on a reduced scale in simulated outdoor storage lagoons. The testing is completed in a full-scale commercial room with four individual manure channels per pen. Manure is accumulated and pretreated to simulate continuous barn activity. Then the manure is treated with the manure pit additive for the actual testing period. Treatments are evaluated over two trials, providing eight replicates of each treatment. Slurry and air samples are taken after four and five weeks of treatment during the indoor trial and seven and nine weeks in the following outdoor trial. To evaluate the treatments' performance, a number of parameters are determined. Nitrogen, phosphorous and potassium levels are determined to evaluate nutrient content. Total solids, total suspended solids and total dissolved solids are measured to indicate reduction and solubilization of solids. Heavy metal levels that are determined include arsenic, copper and lead. Air samples are evaluated for odour concentration by forced-choice dynamic olfactometry. In addition, ammonia, hydrogen sulphide and carbon dioxide concentrations are also measured. Following the indoor trial, treated manure is transferred to simulated outdoor lagoons to determine if the treatment has a residual effect.

Implication
This methodology provides results that are representative of full-scale treatment of manure channels with manure pit additives. The resulting information will allow both producers and regulators to determine if manure pit additives are capable of producing the desired results.

Developing guidelines for liquid hog manure application to native and tame pastures

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This research was initiated in the fall of 1998, and is designed to develop proper guidelines for the appropriate rates, timing, and method of applying liquid hog manure to both native and tame pastures in central Alberta. Liquid hog manure is being applied to 4 vegetation types, including dry crested wheatgrass, a moist alfalfa-meadow brome site, as well as a native dry mixed grass and moist rough fescue grassland in the Hanna-Drumheller region.

Rates of available N as determined through manure analysis are approximately 10, 20, 40, 80, and 160 kg/ha, applied in the fall and spring, using both injection and surface application techniques. The vegetation response in each treatment will be measured in terms of plant species composition, forage production, and the presence and abundance of invasive plant species. Baseline soil tests were conducted in the fall of 1998 on each site to determine starting nutrient levels. Additional testing will occur on each treatment just before and after the 1999 growing season to determine the extent of nutrient enrichment, as well as nutrient depletion following plant growth.

Implications

This research integrates hog production with pasture management, and will lead to the development of a sustainable liquid hog manure application protocol for native and tame pastures in Alberta, including the proper rates, timing, and method of application. This information, in turn, will enable these land bases to be safely and effectively used as sinks for liquid hog manure. This is particularly important in the semi-arid region of the province where expansion of the hog industry is unaccompanied by extensive cultivation (i.e., the traditional manure sink).

This project is being supported by the Alberta Hog Industry Development Fund and Norwest Labs, and involves the additional cooperation of Sunterra Farms, Special Areas, and the Prairie Agricultural Machinery Institute.

A personal environmental sampling backpack

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A personal environmental sampling backpack (PESB) was constructed at the University of Alberta to assess acute worker exposure in poultry and swine operations. The PESB is capable of recording, on a minute-by-minute basis over an eight-hour period, the following environmental parameters: temperature (-40 to 70°C, ±0.5°C), relative humidity (RH) (0-100% RH @ 25°C, ±2%), NH_3 (0-50 ppm), CO_2 (0-5000 ppm, ±5% of reading) and dust (0.3, 0.5, 1 and 5 microns). These environmental conditions are measured via thermistor (temperature), capacitance (humidity), electrochemical (NH_3), non-dispersive infrared (CO_2) and laser (dust). For endotoxin and gravimetric dust measurements, two constant air-flow pumps deliver air flow rates of 500 to 3000 cc/min. Graphs of the environmental parameters over time illustrate the dynamic nature of potential acute worker exposure in poultry and swine operation environments. A PESB demonstration will be part of this poster presentation.

Odour prediction for hog operations using computer dispersion modelling

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Owners and developers of hog operations can face considerable challenges when proposing a new or expanding an existing operation. One of the major oppositions is the concern about odour. Hog operations are typically sited a minimum distance separation (MDS) from adjacent residences to allow for natural dispersion of odours. The MDS approach is based on research and the experiences of agricultural engineers working closely with the hog industry. However, the MDS does not easily allow for actual weather conditions, local topography, or beneficial management practices for odour control.

A computer dispersion model has been utilized to predict the odour levels surrounding a 1200 sow farrow to wean operation. The model predicts that the peak odour levels in the surrounding areas are high enough to be noticeable and could be an annoyance to neighbors of the hog operation. However, this event happens only a very small fraction of the time. The majority of predicted odour levels in the surrounding areas cannot be detected by the normal human olfactory response. This corroborates anecdotal observations that odours are infrequently detected in the surrounding areas but are, for the large majority of the time, not detected. The model also predicts that the odour levels are greatest during the summer months when the barn ventilation is highest and the manure storage pond temperature is the warmest. The effect of odour control methods, such as a straw cover for the pond or manure pit additives, have also been modeled to determine the predicted impacts to the surrounding area odour levels.

Implications
Odour dispersion modeling is an effective method for predicting ambient odour levels in the surrounding areas of hog facilities. It can be used to help alleviate the concerns of neighbors by illustrating the predicted odour levels (peak and typical) using local weather, topography, and beneficial manure management practices. Another use for the model is to predict the effects of odour control practices and determine how much odour control is necessary to reduce the surrounding odours to acceptable levels.