ID-261

University of Kentucky
College of Agriculture, Food and Environment
Cooperative Extension Service

Are Common Stall Fans Effective?

Orientation, Placement, and Fan Style

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Air quality in horse stalls is impacted by temperature, relative humidity, and air movement. Horse owners want to improve these air quality characteristics by using fans. During summer months, horse owners hang fans in their barns and stalls to increase air movement in an effort to reduce temperature and flies in stall areas. Horse barns and riding areas can promote physical activity, social interactions, and stress reduction benefits [1,2], but if the environment is hot and humid, stress to humans and horses in stalls may increase.

Horse owners need fans that they can purchase from local stores to improve ventilation in their barns. The typically selected fans are 20-inch 3-speed box fans or 20-inch high velocity mounted fans. Both fans are easy to find at any home improvement or big box store and are ready to use with little to no assembly. The impact that different ventilation strategies have on air quality in equine environments, particularly during various seasons, is important in understanding how exposures may affect health of horses and humans. Are these commonly used fans really serving their intended purposes?

During the summers (between May and September) of 2017 and 2018, standard box and higher velocity mounted fans were used in various positions and locations in typical horse stalls. Measurements of effectiveness included air speed (ft/min), ambient temperature, and relative humidity. Summer 2017 fan placement was the high velocity fan in the eaves of the stall blowing down, the box fan on the wall outside the stall, and no fan in the stall. In addition, the direction of air movement (orientation) was altered using box fans blowing into the stall as compared to blowing into the aisle. Summer 2018 fan placement was a box fan on the outside of the stall door and no fans in the stall. Similar to summer 2017, the direction of air movement was repeated with an additional factor of fans blowing above centerline and below center of the door placement.

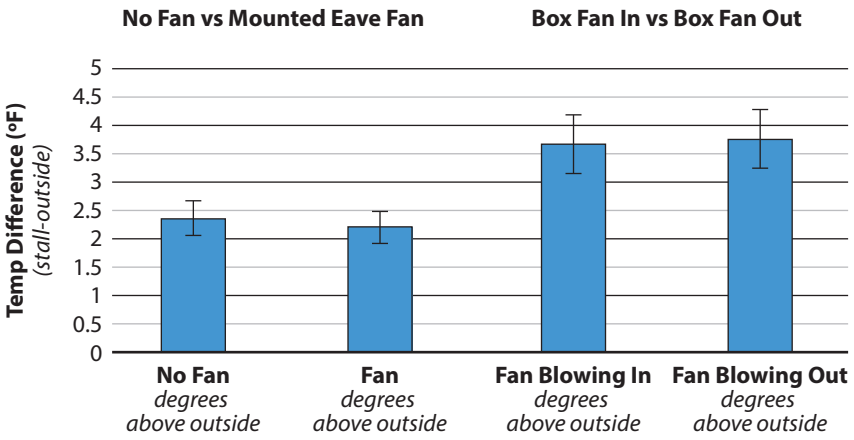

Figure 1. Year 1 (summer 2017) temperature above outside temperature for fan orientation. The figure on the left compares the no fan treatment to the mounted eave fan treatment, and the figure on the right compares the box fan blowing in versus the box fan blowing out. Note that in both graphs, the temperature in the stalls was higher than the outside temperature, and the temperature was not significantly different between the different treatments.

Do fans lower temperatures in stalls?

Reducing the temperature within a barn or stalls is a major reason for fan use. Figure 1 shows the temperature difference between the temperature of the stalls and the outside temperatures in summer 2017. No matter the fan orientation or location, the temperature inside the stall was higher than the outside temperature. Unfortunately, these fans only mix air from one location in the barn with air from another location in the barn. The fans could not create lower air temperatures than the air outside the barn. The temperature in the barn will, typically, be higher than outside the barn due to horses, humans, and their activities within the space. One fan orientation in 2018 demonstrated a lower temperature than the outside air. We suspect this is likely due to impacts from cooler overnight temperatures and the building materials of the barn.

This study confirms that without an active air conditioning or evaporative cooling system it is not possible to actually cool a barn or stall with a fan. The perception that a barn can feel cooler than being outside during the summer months is due to being shaded and use of construction materials. Solar loads can increase the heat felt by humans and horses within these spaces. Having a higher roof and insulating a metal roof can make a barn feel cooler even though the air temperature does not change. A barn constructed of stone or concrete walls will feel cooler during the day than a barn constructed of wood and metal siding. In reality, this type of construction will have higher ambient temperature later in the afternoon; however, the concrete block keeps the facility cooler in the warmest part of the day.

Do fans increase air movement for cooling purposes?

Air speed across the body can serve as a means for cooling horses. According to Jones, Friday, and DeForest at Purdue University, air speeds under 150 feet per

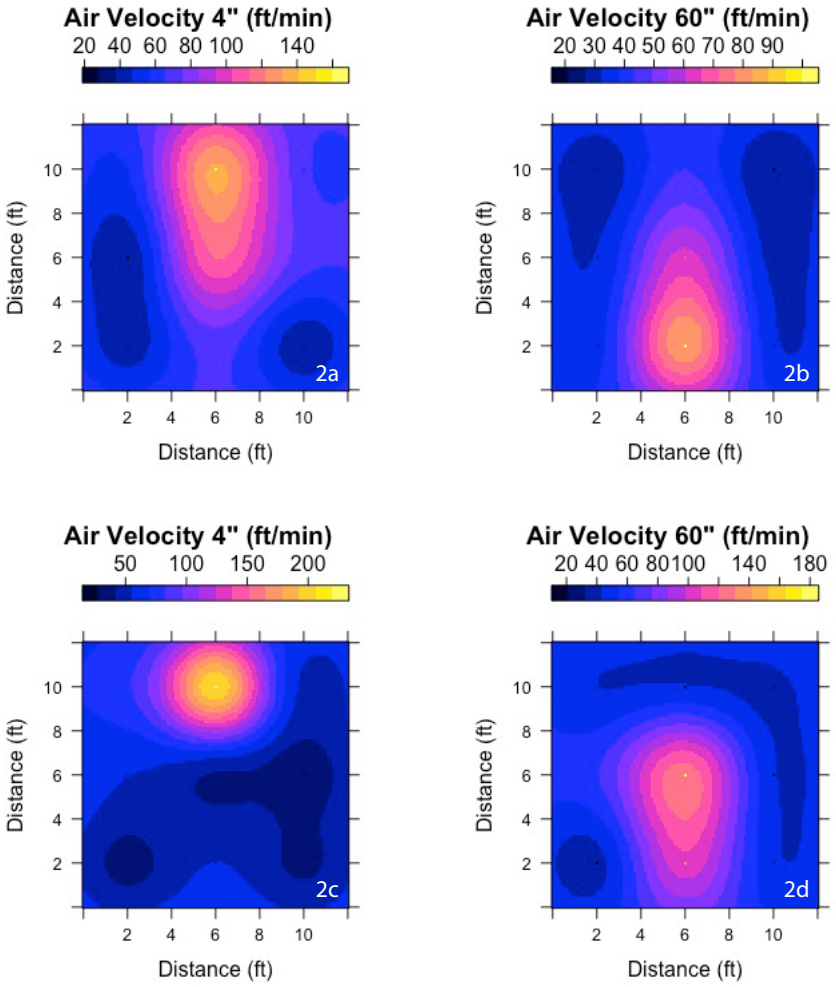

Figure 2. Air speed maps in ft/min for the fan placed in the eaves blowing down into the stalls. 2A and 2B are stall 1. 2C and 2D are stall 2. The maps illustrate how the angle and direction of the fan determines where the air speed is concentrated. The fan is represented by the black oval, and the feed bin is the white triangle.

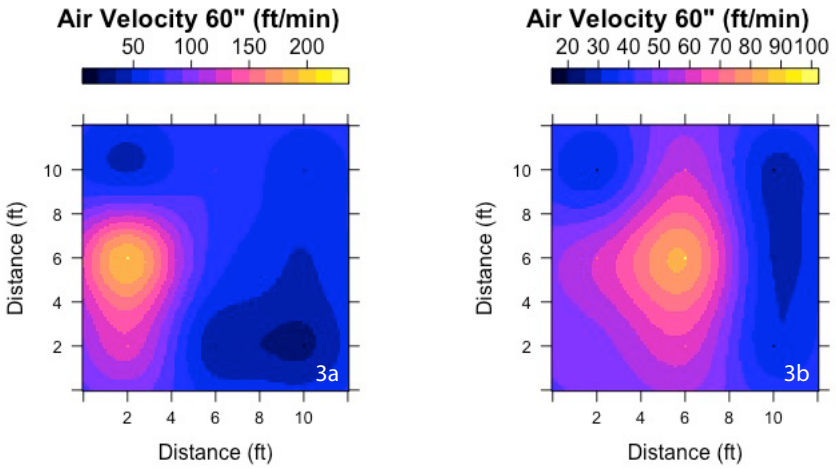

Figure 3. Box fans from year 2. 3A represents a fan mounted below the halfway point of the door, and 3B represents a fan mounted above the halfway point of the door. The fan is represented by the black rectangle, and the feed bin is represented by the white triangle.

min will provide no cooling effects to any livestock animal, be it pigs, cows, chickens, or horses [4]. While there is no definitive air speed determined for cooling horses, it is known that air speeds at about 100 feet per minute will begin to cool humans, and 200 feet per minute will begin to cool cattle. It is assumed horses will be between 100 and 200 feet per minute because they have an incredible ability to sweat like humans, but have hair coats that are similar, though often shorter, than cattle.

During the study, air speeds were measured at four inches and 60 inches; four inches is the air speed at the floor of the stall, and 60 inches is the air speed at wither height of the average horse. Air speeds over 100 feet per minute were considered good air movement in a space. Air speeds in the stall were measured and modeled for the high velocity fan and box fan (Figures 2 and 3). Only one location within the stall experienced air speeds at or above 100 feet per minute with the box fan. As illustrated in Figure 2, the location of the fan within the stall that experiences higher air speeds is highly dependent on how the fan is angled. Stall 1 (Figure 2A) displays a larger region of higher air speeds at the floor level (4 in), whereas stall 2 (Figure 2D) has its largest region of higher air speeds at whither height (60 in). The fan in stall 1 (Figures 2A and 2B) was angled down so the air reached the floor within the stall while the fan in stall 2 (Figures 2C and 2D) was angled out and so the air was aimed at the door. The difference in the air speed throughout the stall is dictated by the angle of the fan.

During year 2, the box fan produced speeds at or above 100 feet per minute at wither height (60 in) when the fan was mounted either above or below the center of the door (Figures 3A and B). As with the eave-mounted fans, the angle and way the box fans are hung greatly impacts the location of the air speeds within the stall. The greatest air speeds are only on one side of the stall with the box fan mounted below the halfway point on the door (Figure 3A). Placement above halfway on the door resulted in greatest air speeds at the center of the stall (Figure 3B). While the fan in Figure 3B looks to be providing the best air movement through the stall, the highest the air speed in the stall is about

90 feet per minute, which is still under the 150 feet per minute necessary for cooling horses. Figure 3B does provide a better distribution of air movement. However, there is still a great deal of space that is experiencing air speeds below 50 feet per minute, which is considered to be still air. Because of the prevalence of still air throughout the stalls, it is clear that none of the tested fans produced necessary air speeds to facilitate continuous cooling of the horses in the stalls. Ideally, the horse should move freely throughout the stall and receive enough air speed everywhere to experience a cooling sensation.

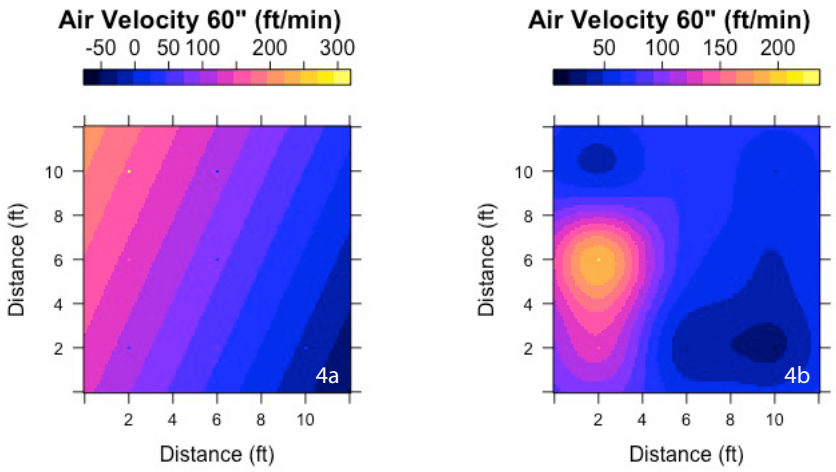

Figure 4. 4A represents box fan from year 1 producing air speeds high enough to deter flies. The air speeds in the orange and yellow regions are above 200 ft/min, which is only in a small portion of the stall. 4B represents box fan from year 2 producing air speeds high enough to deter flies. Again, only a small portion of the stall (the yellow area on the figure) is experiencing those air speeds.

Do fans control flies?

Finally, the effectiveness of the fans for fly control was examined. While we consider speeds of more than 100 feet per minute to be the necessary threshold for whether the air is moving and 150 feet per minute for cooling purposes, for fly control, air speeds must be greater than 200 feet minute [7]. The box fans were the only fans that achieved air speeds of this magnitude, and those speeds were centralized to one small location within the stall in both year 1 and year 2. Figure 4A and 4B both demonstrate air speeds of at least 200 feet per minute using the box fan. In Figure 4A, the fly control air speed is directly in front of the fan, which is also the location of the feed bin. In Figure 4B, the air speed that is high enough for fly control is off to the side of the stall. In both cases these air speeds are only achieved in a very small section of the stall. Overall, air speeds that would serve to control the flies are not achieved with fans that are commonly used in horse barns.

Conclusion

Fans are an integral part of a barn's environment during the summer months, but careful thought should be given as to the purpose of the fans. If the fans are placed to impact the temperature, air movement, or flies within the stalls, then the most commonly used 20-inch box fans and 20-inch high velocity mounted fans are not particularly effective. Although no fans will help reduce the temperature below the outside temperature, some fans, for example a 42-inch drum fan, have been shown in other research to produce air speeds that facilitate cooling and deter flies.

The two fans discussed in detail can help ensure that fresh air is being moved into the stall from the aisle, provided the aisles are receiving fresh outside air. This could be especially beneficial if the stall has walls that are solid and prohibit air flow into the stall. The fans may provide cooling effects for humans in the stalls or possibly even small areas of cooling for some horses. Overall, when considering utilizing a fan, the reason for, the placement of and use of the fan must be considered to determine the proper fan selection.

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Issued 5-2020