Hot Weather Effects on Swine

controlled air temperatures and relative humidity aid in study of weight gains and well being of hogs

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Environmental temperatures of approximately 75° F for hogs weighing 70 to 144 pounds and 60° F for hogs between 166 and 260 pounds were the temperatures under which experimental swine at Davis made the largest daily gain and required the least amount of feed to produce 100 pounds of gain when the temperature was kept constant.

Changes in environmental temperature and humidity, as they affect swine body temperature, respiration rate, pulse rate and such factors as the utilization of feed consumed, were investigated under controlled conditions by the Division of Animal Husbandry.

A specially designed and constructed room—or psychrometric chamber—made the studies possible. Air motion through the insulated chamber is relatively constant, and the air temperature and relative humidity can be controlled within the limits of these experiments.

Purebred Duroc Jersey or Poland China swine, or their first generation cross, were used. They were fed a complete ration in an open trough twice daily in such amounts as they would clean up without excessive wastage. Water was supplied without restriction.

The pigs—in groups of two, three or four—were acclimated at 70° F, usually for at least one week, while they were becoming accustomed to the surroundings. The air temperature was then changed to that desired for the test.

Test periods, usually seven days in length, were occasionally varied. Body temperature readings, pulse—with the use of a stethoscope, and respiration rates—breaths per minute—were taken twice daily, before feeding in the morning and before feeding in the late afternoon.

Air Temperature

The lower limit of temperature—40° F—used in these experiments was determined by the cooling capacity of the equipment; the upper limit, by the ability of the hogs to withstand heat.

As the air temperature increased from 40° F, the body temperature and respiration rate increased. Pigs weighing under 150 pounds were more comfortable at a given high temperature than the pigs weighing more than 150 pounds. The lighter weight animals could be kept at a temperature of approximately 115° F, whereas the heavier hogs could not be taken much beyond 100° F.

Pulse rate decreased with increased room temperature.

Feed consumption decreased as the air temperature increased from 40° F to 100° F, and it appears that this decrease is more rapid at higher temperatures.

Average daily gain also varied with the changes in air temperature. Hogs weighing 166 to 260 pounds gained more rapidly in the neighborhood of 60° F, while the lighter weight animals weighing 70 to 144 pounds gained most rapidly at approximately 75° F.

The amount of feed required to produce 100 pounds of gain was at a minimum when the rate of gain was at a maximum.

Both below and above these temperatures—approximately 60° F for the heavier weight pigs and about 75° F for the lighter pigs—utilization of feed declined.

Relative Humidity

Experiments in which humidity was the variable were run only at 90° F and 96° F.

At 90° F, the data indicate that there is not much difference in the response of hogs weighing over 200 pounds to relative humidities of 30% and 94%, except that the respiratory rate is increased at the higher humidity.

At 96° F and relative humidity of 30%, swine weighing over 200 pounds lost weight but survived for prolonged periods. When the relative humidity was increased to 94%, they were immediately increasingly distressed.

In one experiment at a temperature of 96° F, the relative humidity was gradually increased during eight hours from 30% to 94%, the body temperature increased 2.5° F, and the respiratory rate more than doubled. It was not deemed advisable to hold the hogs under these conditions, and the relative humidity was lowered. In two hours, the relative humidity was decreased to 58%, the respiratory rate and body temperature were back to that at the start of the experiment.

Cooling by Evaporation

In the first trial, hogs weighing around 250 pounds were kept for a period at 90° F on a dry floor with relative humidity of 35%.

The temperature was then held constant and a trickle of water was run across the floor for a seven-day period. During the period with a wet floor—about 4.5 gallons of water per hour flowing across the floor—the rate of gain was markedly increased; the respiration rate was about 30% of that during the period on the dry floor; and the body temperature was 1.5° F lower. The same comparison was made at 100° F with similar differences.

It was possible to raise the air temperature to 115° F with water on the floor before seriously distressing the animals. On a dry floor the same animals were seriously distressed at 100° F.

The cooling effect due to evaporation of water was very rapid. An experiment

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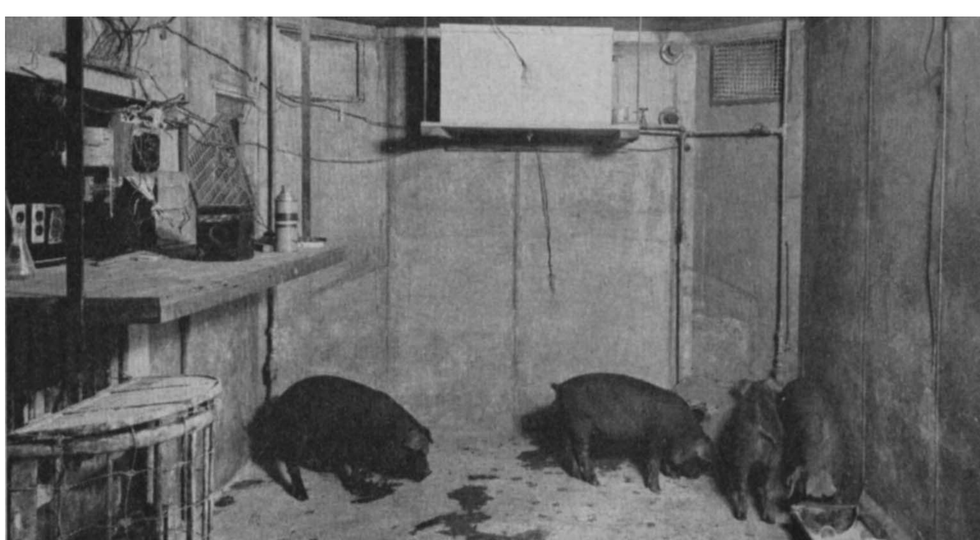

Interior of the psychrometric chamber at Davis, where temperature and humidity changes can be controlled for observation of effects on swine.

SWINE

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was run with three 240 pound hogs at a room temperature of 100° F.

All were distressed, with an average body temperature of 106.8° F and an average respiratory rate of 150 breaths per minute. When four liters of water at 100° F were poured on the floor to make a wet area, the hogs began to roll in the water immediately. In twenty minutes the body temperatures were lowered an average of 1.0° F and the respiratory rate lowered by 50%. In 90 minutes the body temperature was lowered by 2.0° F and the respiratory rate by 80%.

Air Motion

In another experiment three hogs weighing around 250 pounds were on a wet floor at approximately 119° F. Air motion in the chamber varied from 20 to 30 feet per minute at hog level. A fan was turned on, which increased the air motion to an estimated average of 175 feet per minute, but varying from 100 to 250 feet. In 30 minutes, the respiration was lowered by about 60%, and the body temperature was reduced on the average about 2.5° F. In 80 minutes, the body temperature was reduced an average of 3.0° F, when the hogs were on the wet floor with an accelerated rate of air motion.

In contrast, four pigs averaging about 100 pounds were on a dry floor at 113° F. The fan was turned on, increasing the air velocity as before. At first the respiratory rate and body temperature decreased slightly, since it was not possible to have the floor completely dry and the hogs were slightly damp. As the floor and hogs dried, the respiratory rate and body temperature increased again to that at the start.

After five hours with the accelerated air motion and a dry floor, there was no apparent benefit to the comfort of the animals. This type of experiment has been repeated with four hogs averaging 187 pounds at 99° F and another four hogs averaging 236 pounds at 100° F, with no apparent effects.

As the air temperature rose above 80° F the animals became increasingly lazy and lay flat on the floor. The light weight pigs weighing around 100 pounds were still fairly active at 80° F.

Under the conditions of these experiments, with constant temperatures, swine weighing around 100 pounds utilized feed to a greater degree and gained weight more rapidly in the neighborhood of 75° F, whereas heavier weight hogs weighing approximately 200 pounds did better in the neighborhood of 60° F.

As the air temperature was increased or decreased beyond these averages, rate of gain declined and utilization of food was lowered.

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BUDS

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buds were growing on lots 1 and 4 but none on lots 2 and 3. Visible growth of a few buds on the latter two lots did not occur until June 27th. In the succeeding days the number of growing buds increased on all lots of trees, but many more grew on lots 1 and 4 than on lots 2 and 3. The maximum numbers of growing buds were reached on July 3d on lots 1 and 4, but not until July 15th on lots 2 and 3. The final number of buds which grew were as follows: lot 1, 84%; lot 2, 29%; lot 3, 50%; lot 4, 72%; of the total buds present.

It is clear that the treatments applied to lots 2 and 3 both retarded the rest breaking process in comparison with those applied to lots 1 and 4. The retardation expressed itself in two ways: in the smaller numbers of buds growing and in the slowness with which they started growth. In the smaller illustration are shown two trees from each lot, the one with least and the other with most buds growing. The trees in lots 2 and 3 resemble those in the larger photograph which had received too short cold treatment—less than 50 days.

Lots 2 and 3 received a cumulative exposure at 37° F of 52 days, the same as lot 4 received without interruption.

It is apparent that a few hours daily warm treatment partly offset the effect of 18 hours daily cold treatment.

Although lots 2 and 3 were both strongly retarded in comparison with lots 1 and 4, nearly twice as many buds grew on lot 3 as on lot 2.

The average temperature outdoors during the daily warm treatment of lot 3 was 9° F lower than that to which lot 2 was subjected. This difference in temperature may have caused the difference in behavior, but there is also the possibility that the strong summer sunlight may have stimulated growth of buds on lot 3. Strong radiation such as X rays in suitable dosage has been shown to break the rest of buds, and some evidence exists that ordinary light shortens the rest of certain buds. In the orchard it has been generally believed that much direct sunlight during the winter days tends to prolong the rest because it raises the temperature of twigs and buds somewhat. The part that light of varying intensity may play in retarding or hastening the ending of the rest is still not very clear. It may at winter intensities and duration be a retarding influence and become a stimulating influence at the higher intensities and longer duration of spring and summer.

The gardner and orchardist in regions of mild winters is thus confronted with a rather complicated situation involving temperature, light, variation of response of different kinds of plants, and possibly other factors, all of which affect spring growth. It appears clear from experience, however, that shade in winter is beneficial for plants with strong rest periods. It seems a reasonable deduction from the experimental results described above that plants subjected to fluctuating outdoor conditions may require a longer exposure to break the rest of buds than would be required under continuous low temperature.

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CITRUS

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The range of values and the average for each of the constituents in a group of high performance California orange orchards are shown in the table. A section—columns six to 17 inclusive—shows the effect of a deficiency of any given element in the direction of change in other elements, insofar as information is available. These standards are tentative and may need to be shifted in one direction or another as more information develops.

Use of Table on Page 10

As an example of the use of this table: suppose a sample of orange leaves has been collected, cleaned, and analyzed.

If the total nitrogen turns out to be 2% or less, this would suggest that nitrogen may be limiting—deficient—in the orchard sampled. With nitrogen levels of 2% or less, it could be expected to find that other elements—columns six to 17—shifted in the directions indicated. Thus phosphorus likely would be increased, and values greater than 0.13% might be expected.

Total sulfur would be slightly increased, and values greater than 0.25% might be slightly decreased from the average values shown in column four, while potassium would be increased.

Though no actual values for other elements can be stated with certainty when

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