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EFFECT OF AMBIENT TEMPERATURE ON FARROWING RATE IN PIGS

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OPSOMMING: INVLOED VAN OMGEWINGSTEMPERATUUR OP JONGINGSTEMPO IN VARKE

Gegewens wat oor 'n periode van 4 jaar op 'n 300-sog Natal se noordkus plaas ingesamel is dui daarop dat die doeltreffendheid van reproduksie in varke aansienlik onderdruk word tydens die warmste maande van die jaar. Gemiddelde maandelikse temperature wat 22°C oorskry is skynbaar krities in die opsig.

SUMMARY:

Records kept over a 4-year period on a 300-sow Natal north coast farm show that reproductive efficiency in pigs is markedly depressed during the hottest months of the year. Under these conditions mean monthly temperatures in excess of 22°C appear to be critical.

The depressing effect of high ambient temperatures on the reproductive performance in mammals is well-documented. The findings in many species is that heat-stressed gametes are perfectly capable of fertilisation, but invariably result in early embryo death. Ulberg & Burfening (1967) reported that ewes subjected to high air temperature at about the time of mating will have a reduced reproductive rate because of an increased embryonic death rate. Salisbury & Flerchinger (1961) reported early foetal mortailty in cattle inseminated with aged sperm. Howarth, Alliston & Ulberg (1965) indicated that rabbit sperm can be influenced by environmental conditions prior to fertilisation in such a way that they retain their fertilising capacity but contribute to subsequent embryo mortality.

The effect of elevated temperatures on the reproductive performance of pigs has, however, not been studied extensively. Warnick, Wallace, Palmer, Soza, Duerre & Caldwell (1965) found that gilts kept continuously at 60°F (15,6°C) produced 1,9 more embryos at 25 days post-breeding than those kept at 90°F (32,2°C). Their work indicates that similar temperatures did not affect the fertility of boars. They suggested that cooling sows during periods of high temperature, particularly soon after breeding, may increase embryo survival and subsequent litter size. Tomkins, Heidenreich & Stob (1967) reported that elevated temperature has an adverse effect upon embryonic survival in sows if the thermal stress is applied from days 1–5 of gestation. Exposure of sows from days 20–25 of pregnancy to the same temperatures had no adverse effect on embryonic mortality. Earlier work by Heitman, Hughes & Kelly (1951) had also shown that exposing sows 77 or more days pregnant to high ambient temperature for 8 days had no effect on foetal resorption. Work by Omtvedt, Nelson, Edwards, Stephens & Turman (1971) shows that both conception rate and litter size are affected by heat stress during the first 16 days after breeding. They also found that although gilts are fairly resistant to heat stress during mid-pregnancy, elevated temperature during the last week or two before farrowing results in fewer live pigs and more stillborn pigs.

Wettemann, Wells, Omtvedt, Pope & Turman (1976) found that heat-stressed boars had reduced sperm mortality, fewer normal sperm and reduced sperm output. Both conception and embryo survivial were significantly reduced when gilts were bred with the sperm from heat-stressed boars. These findings confirm earlier studies by Thibault and others (1966) who observed lower farrowing rates by gilts bred with semen from boars kept outside at higher temperatures as compared to control boars maintained indoors at 22°C. Breeding performance records of entire herds in America show lower conception rates during hot weather. Whilst the precise temperature at which this effect takes place is not known, continuous temperatures in the 32°C range is definitely detrimental (Anonymous, 1976).

As similar observations have not been reported in South Africa, and as the high summer temperatures experienced in many parts of the country can have an economically important bearing on the pig industry, it was decided to investigate the relationship between ambient temperature and farrowing rate in pigs on a Natal north coast farm.

Procedure

Farrowing rates have been accurately recorded at

the Tongaat Milling piggery situated at Tongaat, over a 4-year span of time. During this period the size of the piggery (300 sow unit), its breeding programme (Large White x S.A. Landrace), its feeding and management, have remained essentially unchanged. The term, farrowing rate, as used in the context of this report, refers to the percentage of sows served in any given month and having later farrowed. The mean monthly temperatures and relative humidity for the period in question were recorded at a meteorlogical station situated at Tongaat. These figures represent the monthly average of measurements taken twice each day at 0800 hours and 1400 hours.

Results

The average monthly temperature, relative humidity and farrowing rates are recorded in Table 1. The details of the farrowing percentage is given in Table 2. The relationship between mean monthly temperature and farrowing rate is also illustrated in Figure 1.

When comparing the average monthly temperature with the farrowing rate, it is evident from Table 1 that the highest summer temperatures, namely those recorded during January and February, are associated with the lowest farrowing rates. It is also evident that the crucial temperature, as far as conception rate is concerned, exists at mean temperatures above about 22°C. At mean temperatures of about 20°C or less, conception rate appears to stabilize at approximately 80%. Above this mean temperature, conception rate drops precipitously, particularly as exposure to such temperatures is prolonged from November onwards (Figure 1). It is of interest to record that, in spite of the sharp drop in conception rate, litter size did not appear to be significantly reduced during the hot months of the year (Table 3).

Table 1

Monthly farrowing rate, mean monthly temperature and relative humidity recorded over a 4-year period at Tongaat.

Month	Farrowing Rate (%)	Mean Temperature (°C)	Relative Humidity (%)
January	70	24	77
February	64	24	78
March	78	23	80
April	80	20	77
May	77	18	74
June	81	16	69
July	81	15	71
August	86	17	73
September	80	19	76
October	78	20	76
November	83	21	77
December	80	23	78

Table 2

Monthly average farrowing rates of sows over the 4-year period of observation

Month	Farrowing Percentage				Average Farrowing %	
	1974	1975	1976	1977		
January	43	75	87	75	70,0	± 18,9
February	46	69	74	67	64,0	± 12,4
March	68	88	84	73	78,3	± 9,3
April	71	90	80	77	79,5	± 7,9
May	67	77	75	87	76,5	± 8,2
June	68	90	88	79	81,3	± 10,0
July	79	81	78	84	80,5	± 2,7
August	76	89	89	83	84,3	± 6,2
September	75	83	86	77	80,3	± 5,1
October	76	79	79	80	78,5	± 1,7
November	86	85	81	81	83,3	± 2,6
December	75	84	74	85	79,5	± 5,8

Fig. 1 *Relationship between mean ambient temperature and farrowing rate in sows.*

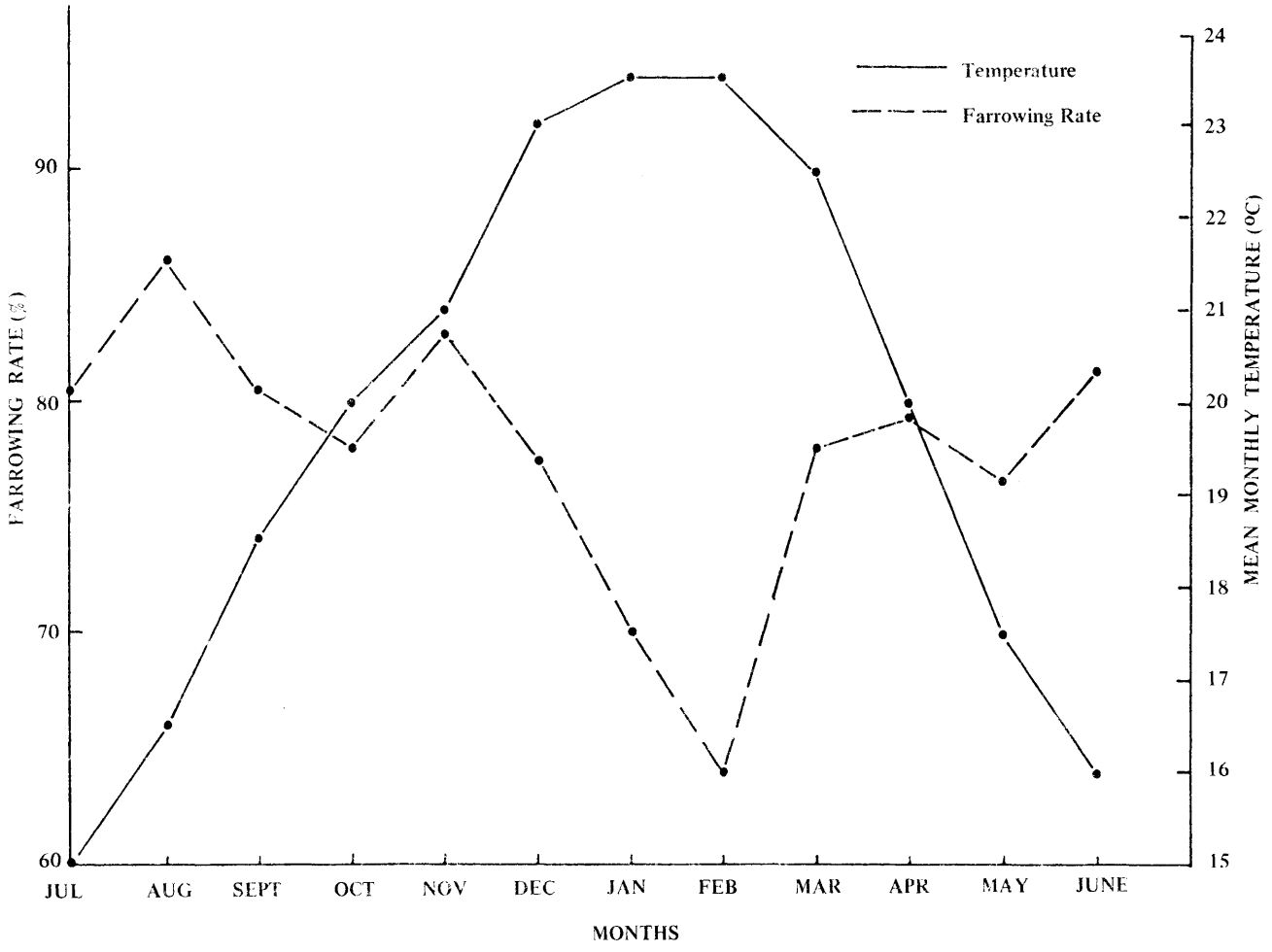

Table 3

Monthly average litter size of sows over the 4-year period of observation

Month	Litter size 1974	1975	1976	1977	Average Litter size
January	10,3	10,5	10,6	10,6	10,5 ± 0,14
February	10,3	11,0	8,0	10,8	10,0 ± 1,38
March	10,9	9,2	9,8	11,5	10,4 ± 1,04
April	10,6	10,9	11,5	10,8	11,0 ± 0,39
May	9,7	10,4	10,5	10,6	10,3 ± 0,41
June	10,8	11,4	11,0	10,7	11,0 ± 0,31
July	10,1	10,8	10,5	10,9	10,6 ± 0,36
August	10,5	10,1	10,6	11,5	10,7 ± 0,59
September	11,4	10,6	10,8	11,3	11,0 ± 0,39
October	11,3	10,9	11,1	10,5	11,0 ± 0,34
November	9,9	11,7	10,6	10,6	10,7 ± 0,74
December	11,0	10,8	10,4	10,8	10,8 ± 0,25

In relating these results to those reported in the literature, it must be pointed out that the *mean monthly* temperatures recorded in this paper do not reflect the fact that maximum daily temperatures as high as 43°C have been registered during the past 4 years, while maximum daily temperatures well in excess of 30°C are sometimes experienced for weeks on end with very little cooling at night. During such periods, the relative humidity will often exceed 90%.

Boar libido and behaviour during the hottest months of the year did not seem to be unusually low. This could be due to the fact that mating, during hot spells, was restricted to the cooler hours of the mornings and late afternoons while a sprinkler system was applied in the boar pens during periods of exceptionally high environmental temperature. However, a difference in the oestrus behaviour of newly weaned sows was noted, especially first litter sows, taking longer to show signs of oestrus and accepting the boar. The farrowing rate of sows first served in February appeared to be up to 10% lower than sows first served in January. This would tend to indicate the effect of prolonged heat stress on farrowing rate.

Boars were housed in large well-ventilated pens with adequate shade. Dry sows were kept in pairs or threes in pens of roughly 5 m long and 3 m wide. The pens were well-ventilated with plenty of shade. No difference in feed intake was noticed with the dry sows as they were restrictively fed.

Discussion and Conclusions

Although it is clearly evident from these results that farrowing rate in sows is markedly depressed by high summer environmental temperatures, it is not known to what extent this represents the direct effect of heat stress on the sow or to what extent it is due to the indirect effect of heat stress on boar fertility. From overseas results conducted under controlled conditions it is obvious, however, that both sow and the boar fertility would be adversely affected by the high ambient temperatures to which pigs are exposed in the area under investigation.

In regions where high environmental temperatures are normally experienced it will therefore be necessary to investigate means of minimising the adverse effects of heat stress on both sows and boars if productivity is to be optimised throughout the year. More consideration should, for example, be given to the siting of the piggery. By placing buildings on exposed hilltops maximum advantage can be taken of natural air movement. The use of trees to provide shade without restricting air movement would further help to keep the animals cooler. Consideration should furthermore be given to the type of roofing materials used. Asbestos roofing has an insulating effect while roofing materials painted white or alternatively aluminium roofing have been found to reflect solar radiation causing a marked reduction in temperature within the buildings.

Artificial means of cooling can also be considered. Both air conditioned rooms and water sprinklers have been reported to significantly improve boar fertility under conditions of high ambient temperatures (Wettemann, 1977). These experiments were, however, conducted in an area with a relative humidity of only 40–50%. Because the sprinkler system depends on evaporative cooling, its value is questionable in area such as the Natal north coast which has an exceptionally high relative humidity.

As only certain limited periods of the sows reproductive cycle are influenced by heat stress, their reproductive efficiency could be improved by controlling the temperature to which sows are exposed only during these critical periods. With boars the situation is more problematic as their fertility is adversely influenced by high temperature at all times and is prolonged for up to 5 weeks after the end of heat stress (Wettemann, 1977).

In view of the considerable economic implications of the results reported in this paper, there is a need for research work to be conducted on practical methods of minimising heat stress on pigs in areas which experience high ambient temperatures.

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