ARTIFICIAL INFESTATION OF CATTLE
IN SOUTHEASTERN USA WITH PSOROPTES OVIS¹,²

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Abstract: Cattle were artificially infested with Psoroptes ovis to evaluate their susceptibility and to document development of psoroptic mange in southeastern coastal plain of Georgia, an area outside the normal distribution of this parasite. Sixteen Hereford heifer calves were purchased at a local stockyard and placed in an isolation facility near Statesboro, Bulloch Co., GA; five heifers were stanchioned under an open shed and 11 were confined in an adjacent, small feed lot. All calves were exposed to P. ovis three times: 19 December; 16 and 29 January. All five stanchioned calves developed extensive lesions. From 8 to 18 wk after the last exposure to mites, were required for lesions to develop on at least 40% of the body of the stanchioned calves. No living mites were detected by scraping nor vacuum sampling methods on the 11 non-stanchioned calves in feed lot. Normal self-grooming probably prevented the establishment of P. ovis populations on these calves during the short, mild winter.

Key Words: Psoroptes ovis, cattle mange, mange, psoroptic mange.

Psoroptic mange of cattle is caused by Psoroptes ovis (Hering). Most psoroptic mange outbreaks in cattle have been within an area from northern Texas through South Dakota, between the Mississippi River and the Rocky Mountains, and with few reported cases in southeastern USA (Meleney and Christy 1978; Hourigan 1979; Meleney and Roberts 1979). Since cattle are freely and frequently shipped throughout the USA, it is possible that climate may be the prime factor determining the geographical distribution of the reported cases. Guillot and Cole (1984) under feed lot conditions, compared the transmission and development of mange on cattle from an endemic northern Texas area with cattle from a non-endemic area in central Texas. These workers found that northern feed lot cattle that experience colder winter temperatures were significantly more affected by the mange than those cattle from a warmer climate. The rarity of clinical psoroptic mange in the southeast may be partially explained by the mild winter climate.

However, other factors also contribute to the survival of P. ovis on cattle. Summer climatic conditions are associated with reduction of P. ovis populations and mange symptoms (Downing 1936a). Summer hair coat and general skin conditions have been suggested as factors contributing to the seasonal decline of P. ovis populations (Downing 1936b; Guillot 1981a). Guillot (1981a) reported that

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ambient temperature and humidity did not limit development of large populations of *P. ovis* on stanchioned cattle; concurrently, unstanchioned cattle in a similar covered corral had very low populations of mites. Cattle removed from stanchions and allowed to groom had dramatic declines in mite populations, whereas large populations developed under stanchioning of cattle with low populations (Guillot 1981a).

This study, under southeastern USA weather conditions, was conducted (1) to evaluate the transmission of psoroptic mange to cattle restricted in stanchions and to cattle in a small feed lot, and (2) to document the development of psoroptic mange in cattle in this non-endemic region.

**MATERIALS AND METHODS**

Sixteen Hereford heifer calves weighing 136-220 kg were purchased in November 1984, through a stockyard in Bulloch County in the eastern coastal plain of Georgia. Conditioning of the calves for the experiment near Statesboro, GA, included acclimatization to new location, diet, and handling. All were treated with thiabendazole paste for gastrointestinal roundworms and vaccinated against *Clostridium* (5 spp.), *Haemophilus* (1 sp.), *Leptospira* (5 spp.), *Pasteurella* (2 pp.), and the viruses of bovine rhinotracheitis and diarrhea-parainfluenza.

On 5 December, 16 heifers were divided into two groups: five confined in individual stanchions under an open shed and 11 in an adjacent, small feed lot. The five stanchions were centered under the roof of an open-sided shed. A slightly sloping corrugated metal roof, 3 X 8 m, was centered over the decking of 2 X 4 lumber. Each stanchion side was 1.1 m long and consisted of two horizontal steel pipes. An adjustable head gate closed one end of the stanchion. The internal width of a stanchion was 0.6 m with 0.6 m between stanchions. The five heifers were continuously confined within stanchions until the body lesions exceeded 50% of the skin surface; the minimum confinement was 17 wk and the maximum 25 wk. In stanchions, heifers could lie down or stand and could rub laterally against the top horizontal pipe of each side. The head gate prevented oral grooming except around the mouth. The feed lot was ca. 121 m² and was constructed of woven livestock wire and wooden posts. Within the lot were five water oak trees with trunks 14-24 cm diam. and a wooden feeding bunker. All heifers had access to automatic watering devices and those in the feed lot were fed from the common bunker. The average ration consumed per calf was 2.7 kg of 12-14% protein, custom-ground feed per day with bermuda hay free-choice.

All calves were infested with *P. ovis* obtained from the US Livestock Insects Laboratory, Kerrville, TX. The mites were shipped in rice paper packages, resembling tea bags, (Wright and Riner 1979). Approximately 100-200 mites were released on the withers of each heifer three times: 19 December, 16 and 29 January.

All calves were treated for chewing louse, *Bovicola bous* (L.), on 9 January 1985, with one gallon of 0.05% lindane applied by a 1-gal hand sprayer. Each of the five stanchioned calves was retreated 8 February with 1 gal of 0.5% malathion applied by a hand sprayer for the sucking louse, *Linognathus vituli* (L.)

Sampling for mites was done (1) by scraping a 25 mm² area of skin and (2) by vacuum (Callcott 1985; French and Callcott 1987). A household vacuum cleaner was used with an in-line screen support for Whatman® #4 filter paper and an
individual collecting head for each sample. Individual vacuum samples collected on filter paper and scraping samples were processed by soaking in 70% ethyl alcohol with 1% eosin, rinsing the sample on to lined filter paper, and observing at 10-12X with a stereoscopic microscope (Meleney et al. 1982; Callcott 1985; French and Callcott 1987).

Lesions on the five stanchioned calves were mapped weekly from 19 March to 6 June, following the grid mapping procedure of Guillot (1981a, b). Skin surface temperature of lesions and adjacent non-lesion areas was recorded by a Bailey Microprobe Thermometer, Model BAT-4. The foot of the probe was pressed against the skin for 30 s and the maximum temperature was recorded for 10 paired-samples taken from four stanchioned calves on 9 April, with body lesions from ca. 5 to 41%. Temperature and relative humidity were recorded by a hygro-thermograph located under the open shed at 1.7 m above the floor decking.

Arithmetic mean of sample and standard error of the mean of the sample (SEM) were computed for number of mites per skin scraping and skin temperature data; the latter was also analyzed by the paired t-test.

RESULTS AND DISCUSSION

The weather conditions during this experiment differed from the data published by Guillot and Cole (1984). Maximum and minimum temperature and relative humidity recorded at Kerrville (Guillot and Cole 1984) and at Statesboro, in our experiment, are presented in Table 1. During the first 4 wk post-inoculation with *P. ovis* the mean maximum daily temperatures of 19.4°C at Statesboro exceeded that at Kerrville by 2.9°C and the daily low of 6.5°C was 1.8°C higher than at Kerrville; the relative humidities were essentially the same (Table 1).

Table 1. Mean daily temperatures and humidities at Statesboro, GA and Kerrville*, TX.

<table>
<thead>
<tr>
<th>Week</th>
<th>Max. (°C) Stat†</th>
<th>Min. (°C) Stat</th>
<th>RH Max. (%) Stat</th>
<th>RH Min. (%) Stat</th>
<th>Max. (°C) Kerr‡</th>
<th>Min. (°C) Kerr</th>
<th>RH Max. (%) Kerr</th>
<th>RH Min. (%) Kerr</th>
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</thead>
<tbody>
<tr>
<td>1§</td>
<td>20.8</td>
<td>11.6</td>
<td>99.9</td>
<td>69.0</td>
<td>24.4</td>
<td>12.2</td>
<td>100.0</td>
<td>41.0</td>
</tr>
<tr>
<td>2</td>
<td>15.3</td>
<td>2.5</td>
<td>90.4</td>
<td>40.9</td>
<td>12.2</td>
<td>3.3</td>
<td>100.0</td>
<td>55.7</td>
</tr>
<tr>
<td>3</td>
<td>17.5</td>
<td>1.7</td>
<td>100.0</td>
<td>31.6</td>
<td>18.2</td>
<td>3.2</td>
<td>100.0</td>
<td>37.3</td>
</tr>
<tr>
<td>4</td>
<td>24.0</td>
<td>10.2</td>
<td>100.0</td>
<td>53.3</td>
<td>11.3</td>
<td>0.4</td>
<td>100.0</td>
<td>44.8</td>
</tr>
<tr>
<td>5</td>
<td>22.2</td>
<td>9.6</td>
<td>98.6</td>
<td>45.6</td>
<td>19.9</td>
<td>0.9</td>
<td>100.0</td>
<td>25.8</td>
</tr>
<tr>
<td>6</td>
<td>24.4</td>
<td>2.5</td>
<td>90.4</td>
<td>40.9</td>
<td>13.2</td>
<td>3.1</td>
<td>100.0</td>
<td>40.2</td>
</tr>
<tr>
<td>7</td>
<td>20.1</td>
<td>1.7</td>
<td>100.0</td>
<td>31.6</td>
<td>6.6</td>
<td>-2.6</td>
<td>100.0</td>
<td>51.0</td>
</tr>
<tr>
<td>Mean Avg.</td>
<td>20.6</td>
<td>5.7</td>
<td>97.0</td>
<td>44.7</td>
<td>15.1</td>
<td>2.9</td>
<td>100.0</td>
<td>42.3</td>
</tr>
</tbody>
</table>

* Data from Guillot and Cole (1984).
† Stat = Statesboro, GA.
‡ Kerr = Kerrville, TX.
§ Wk 1 starting = Statesboro 29 January, Kerrville 18 November.

We were unable to determine the consequences of the unfortunate use of lindane to control lice in January. Control of *B. bovis* was required to avoid problems with this mallophagan which may reduce *P. ovis* populations (Meleney et al. 1982). Although lindane is not currently recommended for control of psoroptic mange on cattle, it has been recommended in the past and some control has been reported
(Kemper and Peterson 1953; Wright 1980). The lindane, as applied, did not control the Anoplura and 1 mo later malathion was used to control *L. vivulii* on the five stanchioned calves. Mites were applied 3 wk prior and 1 and 3 wk after the lindane spray. The lindane treatment may have negated the first inoculation with *P. ovis* and possibly the second; the third inoculation on 29 January, 20 d post-lindane spray, should have been successful in establishing mite populations on the unstanchioned calves. The first confirmed lesion with *P. ovis* was detected 7 wk after the lindane treatment on a stanchioned calf (4 wk after last mite inoculation = 2.8 mite life cycles).

**Development of Psoroptic Mange on Stanchioned Heifers**

Lesions with mites were confirmed 26 February on calf V, 4 wk after the last inoculation with *P. ovis*, and by 7 wk all five stanchioned calves had developed observable lesions. The initial lesions were scattered along the top line of the back and withers; later, other lesions developed along flanks and hips. Development of lesions varied considerably among the five calves (Table 2). Calf I had mange on 41% of the body 18 wk after the final inoculation. The other four calves responded more quickly with at least 50% of the body with lesions by wk 8, 11, 11, and 13 after final inoculation.

We define self-grooming as those behavioral actions taken by unrestrained cattle to maintain a healthy skin and hair coat. The principle grooming actions are tongue licks and rubbing against solid vertical objects (eg., tree trunks, fence post) (Kemper and Peterson 1953). Photographs were taken of calves III and IV, 1 h after release from stanchions on 1 May. The photographic slides were projected on a grid and lesions were estimated to cover 55 and 50% of the lateral aspects respectively, approximating the ratings of 57.8 and 54.9% on 30 April (Table 2). Bright red, highly vascular granulomas had developed under the scabs and were visible, in the photograph, where the scabs had been removed. In 1 h after release from stanchions, calves III and IV had removed ca. 10 and 20% of the scabs, respectively. We observed these calves attacking the scabs primarily with their tongues for the first h of unrestrained self-grooming and occasionally using a tree or fence post to rub accessible areas. A similar self-grooming behavior was observed with all calves when released from stanchions. To further test the effect of grooming, after 68.7% of body with lesions was recorded on calf V, it was released into a small feedlot and allowed to self-groom. After a 4 wk period when the active lesion rating had decreased to 0.5% (Table 2), calf V was restanchioned; 6 wk later the restanchioned calf had lesions over 46% of the body. Our data support the theory that self-grooming in cattle is a primary factor preventing development of psoroptic mange.

Mapping of the lesions was used to document the progression of mange. All five stanchioned calves were sampled by skin scraping at least twice between April 10 and 5 June; 33 of 46 samples were positive, $\bar{X} = 30.9 \pm 6.8$ SEM, range 1-206 mites. Free eggs were identified in 27 of the 33 positive samples. These mite counts were considerably lower than those of Guillot (1981a) whose counts exceeded 950 per scraping, and Guillot and Cole (1984) who reported mean counts exceeding 145 for wk 3, 7 and 10 post-exposure. The extent of the scabies lesions reported in those papers did not differ greatly from the data reported herein.

Inflammation due to psoroptic mange caused a localized and significant ($t = 2.432, d.f. = 9, P \leq 0.05$) increase in skin temperature. The surface of active skin
lesions had a mean temperature of 0.98°C higher than adjacent non-lesion skin. The lesion temperature mean was 35.8°C ± 0.35 SEM, n = 10, and the non-lesion mean was 34.8°C ± 0.15 SEM, n = 10. No *P. ovis*-free calves, stanchioned for extended periods of time, were available to check the effect of prolonged confinement on skin surface temperature. However, we observed on 9 April, that the skin temperature measurements were lowest on calf I with a 5.2% lesion rating and 0 mite count in skin scraping samples. Since psoroptic mites cause inflammation, a general increase in skin temperature was expected (Runnels et al. 1967). Our study demonstrates that psoroptic mange will develop on stanchioned cattle in southeastern Georgia similar to that demonstrated in central Texas (Fisher and Wright 1981; Guillot 1981a) despite some difference in environmental temperature.

Table 2. Percent of body with lesions/mite count* for stanchioned calves inoculated with *P. ovis* on 19 December, 16 and 29 January.

<table>
<thead>
<tr>
<th>Date</th>
<th>Calf</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 19</td>
<td>I</td>
<td>1.9</td>
<td>8.8</td>
<td>7.0</td>
<td>0.8</td>
<td>24.6</td>
</tr>
<tr>
<td>March 27</td>
<td>II</td>
<td>2.9</td>
<td>24.4</td>
<td>15.0</td>
<td>1.8</td>
<td>68.7</td>
</tr>
<tr>
<td>April 2</td>
<td>III</td>
<td>4.9</td>
<td>28.0</td>
<td>25.9</td>
<td>3.1</td>
<td>r</td>
</tr>
<tr>
<td>April 9</td>
<td>IV</td>
<td>5.2*</td>
<td>40.7/81</td>
<td>36.0/35</td>
<td>10.1/10</td>
<td>r/5</td>
</tr>
<tr>
<td>April 16</td>
<td>V</td>
<td>5.7</td>
<td>58.6</td>
<td>51.8</td>
<td>29.8</td>
<td>r</td>
</tr>
<tr>
<td>April 24</td>
<td></td>
<td>9.3</td>
<td>r</td>
<td>53.9</td>
<td>47.9</td>
<td>0.5</td>
</tr>
<tr>
<td>April 30</td>
<td></td>
<td>10.4</td>
<td>r</td>
<td>57.8</td>
<td>54.9/206</td>
<td>3.4</td>
</tr>
<tr>
<td>May 7</td>
<td></td>
<td>12.2</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>9.6</td>
</tr>
<tr>
<td>May 14</td>
<td></td>
<td>14.5</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>17.1</td>
</tr>
<tr>
<td>May 21</td>
<td></td>
<td>18.9/24</td>
<td>r/1</td>
<td>r/18</td>
<td>r/1</td>
<td>18.1/14</td>
</tr>
<tr>
<td>June 5</td>
<td></td>
<td>40.9/49</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>45.6/24</td>
</tr>
</tbody>
</table>

* total count of all stages, egg through adult, scraping sample.
† r = calf was released from the stanchion.

Transmission Attempt with Feed Lot Heifers

Calves allowed normal self-grooming in the feed lot showed no clinical signs of psoroptic mange, as no lesions were observed and no living mites were collected. These calves were sampled three times by standard scraping methods, 4, 16 January and 26 February. The vacuum method was also utilized on the last sampling date. The test was terminated on 26 February 4 wk after the final inoculation (= 2.8 life cycles of *P. ovis*) and 11 wk after the first exposure (= 7.7 life cycles of *P. ovis*). At termination of this phase of the study, winter hair coats had been shed and the weather was warm (see wk 4, Table 1).

The Statesboro feed lot infection test did not succeed in successful transmission whereas the Kerrville test did (Guillot and Cole 1984). There was a difference in method of exposing the cattle but the numbers of mites per animal were similar. The Kerrville test utilized a 1000 mite dose on each of two steers penned with six other steers (3 replicate pens), thus ca. 2000 mites for eight steers (= 250 mites/steer). In Statesboro each of the 11 heifers in the small feed lot received an estimated 100-200 mites. At Kerrville the six steers, receiving ca. 1000 mites, had mite populations of 145.2 ± 51.7 per skin scraping 3 wk post-exposure and nine of 18 steers penned with the six infested cattle developed psoroptic mange by wk 13. The number of mites transferred to an animal may greatly influence the
speed of extensive mange development. We terminated the feed lot test at the end of wk 4 because no living mites were detected by either the scraping or vacuum methods, the winter hair coats had been shed, of the onset of milder weather, and for economic reasons.

CONCLUSIONS

Our studies show that psoroptic mange will develop on stanchioned cattle in southeastern Georgia, similar to that demonstrated in central Texas (Guillot 1981a), also a non-endemic area. Self-grooming, after release from a stanchion, dramatically reduces the psoroptic lesions; however, restanchioning will again promote development of extensive lesions. Psoroptic lesions have a surface temperature of ca. 1°C higher than adjacent non-lesioned skin.

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