

Variation in the Level of Grain Defect Light Flecks and Spots on Cattle Hides

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Nafstad O, Grønstøl H: Variation in the level of grain defect light flecks and spots on cattle hides. Acta vet. scand. 2001, 42, 91-98. – The occurrence of hide damage light flecks and spots was determined on tanned hides from 28 herds during a period of 8 to 12 months. Light flecks and spots are described as small areas of grain loss up to 3 mm in diameter that are seen on dyed crust cattle leather. Damage was found on 75.8% of all hides. The neck and shoulders were the anatomical region with the highest prevalence of damage. Sixty-eight per cent of all hides had light flecks and spots in this region. The forelimbs and dewlap were the anatomical region with the second highest occurrence with a prevalence of 39.1%. This distribution corresponded to the known distribution of lice in cattle. No significant differences were observed in age, sex, prevalence of lice in the herd assessed in March or infestations with different lice species. The frequency of light flecks and spots varied significantly during the year. The frequency was highest in the late winter and early spring, decreased significantly during the summer and was lowest in the autumn. This variation supported the importance of lice in the development of light flecks and spots and suggested a relatively long healing period for the damages induced by lice.

leather; damage; lice.

Introduction

Several ectoparasites can be responsible for damage of cattle hides (Tancoise 1986). Some of the damage is very specific, such as grub damage caused by warble fly larvae, but most ectoparasite damage is more nonspecific. In recent years, light flecks and spots have been considered the main damage caused by ectoparasites. Webster & Bugby (1990) found a significant association between both biting lice (*Damalinia (Bovicola) bovis* (Linnaeus 1758)) and sucking lice (*Linognathus vituli* (Linnaeus 1758)) and light flecks and spots on leather. These investigators described light flecks and spots as small areas of grain loss up to 3 mm in diameter that are seen on dyed crust leather (Webster & Bugby 1990). This damage was reported to be a major problem for the hide indus-

try in Great Britain for the first time in 1983 and has later been reported to be a problem in Holland, Scandinavia, USA and New Zealand (Webster & Bugby 1990). Tanners from Nordic countries found light flecks and spots on 50%-55% of Norwegian cattle hides in 1991, and the problem was estimated to cost the Norwegian cattle industry 24-25 mill NOK each year (Dørum personal communication). The aim of this paper is to describe the variation in the frequency of light flecks and spots damage on the hides from cattle not treated for ectoparasites.

Materials and methods

Design

A prospective cohort study was performed in 33 herds during a period of two and a half years

from 1. January 1994 to 30. June 1996, with animals leaving or entering the herds at any time. Twenty-eight of the herds were treated for lice between September and December 1994. Five of the herds took part in a pilot study for the eradication programme in December 1993. Hides were collected from all herds during the whole study, in order to assess the frequency of damage in hides from untreated and treated animals. The results in the present paper are based on hides collected from the 28 herds in the main group before the start of the lice eradication programme.

The herds

The selection criteria, the prevalence of lice in the herds and the clinical examination procedure used in the herds are described previously (Nafstad & Grønstøl 2001). *D. bovis* was present in 27 of 28 herds and in 27% of the animals. *L. vituli* was present in 11 of 28 herds and in 5% of the animals. At least one of these louse species was present in all the herds. In a few of the herds, other ectoparasite species known to affect the hide quality were also present. Four of the herds had clinical signs of tail mange (*Chorioptes bovis* (Herning 1845)), and the diagnosis was confirmed in laboratory examination. Two of the herds were in the distribution area of *Ixodes ricinus* (Linnaeus 1758). A total of 368 hides sampled from the period before treatment were included. The mean number of hides from each herd was 13.1 with a variation from 2 to 21.

Examination of the hides

The hides were tanned in a commercial tannery and evaluated as aniline dyed crust leather. The leather was chrome tanned and vegetable retanned. The process in the tannery was based on splitting the hides along the back line. Four anatomical regions in every half of the hides were evaluated separately. The regions were

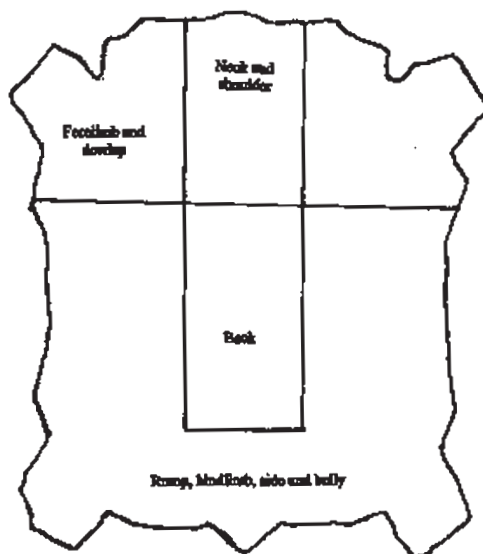


Figure 1. The 4 anatomical regions of the hide which were evaluated after tanning.

chosen according to the known distribution of lice on the skin. The 4 regions were the neck and shoulder, the forelimb and dewlap, the back and the rump, hindlimb, side and belly (Fig. 1). Thus 8 registrations were made on each hide. Each evaluation was based on the number of identifiable flecks and spots according to the following scale:

Score 0: No damage.

Score 1: Slight damage, with 1-2 light flecks or spots per 100 cm².

Score 2: Some damage, with 3-5 light flecks or spots per 100 cm².

Score 3: Severe damage, with more than 5 light flecks or spots per 100 cm².

Light flecks and spots were defined as small areas of grain loss up to 3 mm in diameter (Webster & Bugby 1990).

Statistical methods

All 8 evaluations from 1 hide were used to de-

Table 1. Frequency of hides with light flecks and spots and the frequency of damage within anatomical regions (n= 368).

	Mac. score			
	0	1	2	3
All regions	24.2%	37.2%	31.5%	7.3%
Neck and shoulders	32.1%	40.0%	23.9%	4.1%
Forelimbs and dewlap	60.9%	24.5%	11.4%	3.3%
Back	67.9%	15.2%	13.0%	3.8%
Rump, hindlimbs, sides and belly	84.5%	13.3%	2.2%	0.0%

Score 0 - No damage

Score 1 - Slight damage, with 1-2 light flecks or spots per 100 cm².

Score 2 - Some damage, with 3-5 light flecks or spots per 100 cm².

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termine an overall parameter termed the maximum score. The maximum score was defined as the highest single evaluation in 1 hide. In the statistical analyses the ectoparasite diagnoses were defined at herd level. Total lice prevalence was defined as the prevalence of both *D. bovis* and *L. vituli*. All analyses were made in Statistical Analysis System (*SAS Institute Inc.* 1989). A Spearman rank correlation test was used for testing seasonal variations. Otherwise, statistical hypothesis testing was undertaken using t-test. The statistical testing was based on the frequency of hides without damage (maximum score 0).

Results

The total frequency of light flecks and spots

distributed in different anatomical regions is presented in Table 1. Light flecks and spots were detected in 75.8% of all hides. The neck and shoulders were the region with the highest frequency of damage. Light flecks and spots in this anatomical region were detected in 67.9% of all hides.

Effects of age and sex

The frequencies of light flecks and spots assessed on the basis of sex and age are given in Tables 2 and 3. There were no significant differences between cows and bulls or between the different age classes for any of the sexes. Cows were significantly older at the time of slaughter than bulls, but this difference had no effect on the frequency of light flecks and spots.

Table 2. Frequency of hide damage in cows divided in age classes at the time of slaughter.

Age in months	Number of hides	Mac. score			
		0	1	2	3
< 31.0	52	23.1%	48.8%	25.0%	3.9%
31.0-42.3	57	24.6%	38.6%	31.6%	5.3%
42.4-54.3	38	21.1%	36.8%	36.8%	5.3%
>54.3	59	30.5%	28.8%	32.2%	8.5%
All	206	25.2%	38.0%	31.1%	5.8%

Table 3. Frequency of hide damage in bulls divided in age classes at the time of slaughter.

Age in months	Number of hides	Mac. score			
		0	1	2	3
< 18.4	57	26.3%	36.8%	22.8%	14.0%
18.4-20.3	36	19.4%	38.9%	36.1%	5.6%
20.4-23.2	19	42.1%	31.6%	15.8%	10.5%
>23.2	50	14.0%	38.0%	42.0%	6.0%
All	162	22.2%	36.9%	31.5%	9.4%

Effects of high and low prevalence of lice assessed in March

The herds were divided into 2 equal groups according to the total prevalence of lice, and hides from the 2 groups were compared. The results are presented in Table 4. The prevalence of lice, as assessed in March, had no significant effect on the frequency of damaged hides from the herds during the year. Statistical analyses showed the same result when the same analyses were performed according to the prevalence of just biting lice alone or the prevalence of all lice in animals older than 12 months.

Effects of biting lice compared with the effect of mixed infections

Hides from herds with only *D. bovis* and hides from herds with mixed infections of *D. bovis* and *L. vituli* were compared in Table 5. There was no significant difference in the frequency

of light flecks and spots between hides from these 2 groups.

Seasonal variations in the frequency of light flecks and spots

The seasonal variation in the frequency of light flecks and spots is shown in Table 6. The frequency of hides without damage varied significantly through the year.

Discussion

Webster & Bugby (1990) and Bugby *et al.* (1990) described light spots as small areas of grain loss of 1-3 mm in diameter and light flecks as spots of less than 1 mm in diameter seen on dyed crust bovine leather. These investigators found a significant connection between the occurrence of the 2 types of damage and concluded that the 2 defects had a common cause.

Table 4. Frequency of hide damage according to lice prevalence in the herd in March 1994.

	Number of hides	Average prevalence of lice in March	Mac. score			
			0	1	2	3
Hides from herds with lowest prevalence.	186	17.7%	25.8%	39.8%	29.6%	4.8%
Hides from herds with highest prevalence.	182	41.8%	23.1%	36.8%	30.8%	9.3%

Table 5. Frequency of hide damage in herds infested with biting lice compared with herds infested with biting lice and sucking lice.

	Number of herds	Number of hides	Mac. score			
			0	1	2	3
Biting lice infections	18	189	23.8%	35.5%	35.5%	5.3%
Mixed infections*	12	179	24.6%	39.1%	26.8%	9.5%

*One herd with only sucking lice infestation.

Light flecks and spots were found on 75% of all hides in this study. In 1991, Nordic tanners found lice related damage on 50%-55% of all Norwegian hides (*Dorum*, personal communication). This investigation was based on a commercial evaluation of finished leather and is not directly comparable to the present investigation. The results in the present study were based on the number of flecks and spots found on dyed crust leather. Older damage could have received a different assessment if the hides had been examined at a later stage in the tanning process. The finishing of the leather may mask small and very superficial grain damage. Thus, given this different assessment, these 2 reports suggest about the same level of light flecks and spots. The quality of the hides in the present study should, in the light of the selection criteria, be comparable to the average of Norwegian

cattle hides. In a smaller survey from April 1998, light flecks and spots were present on 44% of the hides (*Nafstad*, unpublished data). Two hundred hides from abattoirs all over the country were included in this study. The animals were slaughtered in March and April when the lice population is at its highest. The hides were tanned and examined after the same procedure as in the main study. The use of insecticides increased significantly from 1990 to 1996 (*Bredal & Grave* 1998), which probably explain the improvement in hide quality observed in the 1998 survey.

The neck and shoulders were the anatomical region with the highest prevalence of light flecks and spots, followed by the forelimbs and dewlap and the back. This distribution corresponded well with the predilection sites for lice (*Chalmers & Charleston* 1980 a, *DeVaney et al.*

Table 6. Seasonal variations in the frequency of damaged hides.

Months	Number of hides	Mac. score			
		0	1	2	3
Jan. Feb.	83	14.5%	31.3%	39.8%	14.5%
Mar. Apr.	65	13.9%	40.0%	35.4%	10.8%
May. Jun.	75	28.0%	44.0%	26.7%	1.3%
Jul. Aug.	70	24.3%	37.1%	32.9%	5.7%
Sep. Oct.	64	35.9%	39.1%	20.3%	4.7%
Nov. Dec.	11	63.6%	9.1%	27.3%	0.0%

p<0.001 (Spearman correlation test)

1988) and supported the hypothesis that lice are the main cause of light flecks and spots. Damage associated with other ectoparasites such as *Demodex bovis* (Stiles 1892), or *I. ricinus* would have given a different distribution. Ticks mostly affect the belly region and demodicosis the forelimbs and dewlap (Urquart *et al.* 1987, Wall & Shearer 1997).

Tancouse (1986) and Baker & Oormadzi (1978) stated that severe lice infestations were responsible for hide and leather damage caused by secondary bacterial infections or scratching behaviour. Bugby *et al.* (1990) found an association between lice and light flecks and spots and suggested that inflammation caused by the lice infestations was the most probable mechanism responsible for this damage. Light flecks and spots were reported to be a major quality problem for cattle hides in Great Britain around 1983. This increase in light flecks and spots took place at the same time as the national eradication programme for warble fly was altered. Systematic treatment with organophosphorous insecticides was changed to a combination of movement restrictions and treatment in affected districts only (Webster & Bugby 1990). A side effect of the systematic treatment was control of lice, and the lice population probably increased as a result of the changes in the eradication programme.

Light flecks and spots or similar damage have also been associated with various tick species and *Psoroptes ovis* (Hering 1838) infestations in cattle (George *et al.* 1986, Everett *et al.* 1977, Rotz *et al.* 1983). With the exception of *I. ricinus*, these parasites do not occur in Norway and can not explain the present level of light flecks and spots. It has been suggested that stable fly *Stomoxys calcitrans* (Linnaeus 1758) can cause light flecks and spots (Bugby personal communication). However, more work is needed to determine whether stable fly may cause light flecks and spots, in addition to lice, under Nor-

wegian circumstances. In an experimental study, Rotz *et al.* (1983) found no obvious change in the leather to be caused by *D. bovis* and only dilated hair pores to be caused by *L. vituli*. In the same study, these authors found inflammatory reactions in the raw hides similar to the changes reported by Webster & Bugby (1990). This discrepancy suggested that the tanning method influences the grain damage shown after tanning.

The results in the present study did not vary with sex and age of the animals. This result was surprising given the age distribution of lice infestations. Calves and young animals have the highest prevalence and heaviest infestations of lice (Chalmers & Charleston 1980 b, Chistensson *et al.* 1994, Nafstad 1998), and consequently a significantly higher occurrence of light flecks and spots among calves and young animals could be expected. For the same reason, the difference between cow and bull in the average age at slaughter should have given a difference in occurrence of light flecks and spots. The absence of the expected age variation in the occurrence of the damage may have been influenced by a long and not exactly known healing period for the damage. Christensson *et al.* (1994) suggested a healing period of more than 12 months. Bugby *et al.* (1990) found only very slight damage 9 weeks after treatment of lice. The expected age variation may also have been disturbed by light flecks and spots caused by ectoparasites other than lice.

The frequency of light flecks and spots showed no significant association with the prevalence of lice in the herds in March. The reason for this lack of association may be that one examination did not give a representative description of the lice situation in the herd and the fact that light flecks and spots also may be caused by other ectoparasites.

Hides from herds with mixed lice infections

had the same prevalence of light flecks and spots as hides from herds with only biting lice infections. This result corresponded with the result of *Bugby & Webster* (1994), who found no additive effects of mixed infections compared with only biting lice on the frequency of light flecks and spots. These results showed the importance of *D. bovis* for the development of light flecks and spots.

The seasonal distribution of the lice population is well known. The population increases during the winter, decreases with the shedding of the winter coat in the spring and remains low during the summer (*Gojmerac* 1959, *Scharff* 1962, *Chalmers & Charleston* 1980 b, *Geden et al.* 1990). The seasonal variation in the frequency of light flecks and spots show a pattern that can be related to the variation in the lice population during the year. The frequency of light flecks and spots was high in late winter and early spring, and the frequency decreased slowly during the spring, summer and autumn. Thus, these observations indicate a relative long healing period, but perhaps not as long as suggested by *Christensson et al.* (1994).

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Sammendrag

Variasjoner i forekomsten av narvfeilen lyse flekker og prikker på storfehud.

Hudene fra 28 storfebesetninger ble samlet inn gjennom en periode på 8 til 12 måneder for å kartlegge forekomsten av skaden lyse flekker og prikker på hudene etter garving. Totalt inngikk 368 huder i undersøkelsen. Skaden lyse flekker og prikker er definert som kratre i overflaten eller narven på storfelær med en diameter på inntil 3 mm. Hudene ble kromgarvet og vegetabilsk ettergarvet til annilinlær og undersøkt før siste overflatebehandling av læret. Skaden lyse flekker og prikker ble påvist 75,8% av alle huder. Nakke og skulder var den anatomiske region med høyest forekomst av skaden (67,9%) etterfulgt av bog og dogglapp (39,1%). Dette utbredelsesmønsteret samsvarer godt med predileksjonsstedene for lus hos storfe. Det var ingen signifikant kjønns-

eller aldersforskjell i utbredelsen av skaden. Det var heller ingen signifikant forskjell i forekomsten av skader på hudene mellom besetninger som hadde en høy prevalens av lus mål i mars måned og besetninger som hadde en lav prevalens av lus på dette tidspunktet. Besetninger som var infisert av både blodlus (*Linognathus vituli*) og pelslus (*Damalinia bovis*) hadde samme forekomst av skader som besetninger som hadde rene pelslusinfeksjoner. Det var en signifikant sesongmessig variasjon i forekomsten av skaden lyse flekker og prikker, forekomsten var høyest hos dyr slaktet fra januar til april, deretter ble kvaliteten gravis bedre utover sommeren og høsten. På bakgrunn av disse resultatene konkluderes det med at det er en sikker sammenheng mellom lus og skaden lyse flekker og prikker på læret. Pelslus (*D. bovis*) er en viktigere årsak enn blodlus (*L. vituli*), på bakgrunn av at det ikke var noen tilleggseffekt av blandede infeksjoner sammenlignet med rene pelslusinfeksjoner. Den aldersuavhengige forekomsten av skaden sammenholdt med kjent kunnskap om at lus i særlig grad forekommer hos kalver og ungdyr, indikerer en lang avhelingstid. På den andre siden kan den sesongmessige variasjonen indikere at en delvis avheling kan inntre i løpet av 2 til 3 måneder.

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