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Effect of transhumance and the use of a native breed on infection of sheep with pasture borne parasites

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Abstract. Pasture borne parasites, particularly gastrointestinal nematodes (GIN), substantially impact on animal health and production of sheep. For several decades GIN control relied on anti-parasitic drugs (anthelmintics). Because of the rapid evolution of nematode resistance to these compounds, new strategies to control these parasites are being developed. Here we report on a study which aimed at combining transhumance and the use of a native, less susceptible sheep breed (i.e. Red Engadine Sheep, RES) in order to control GIN. One-hundred and seventeen lambs infected with GIN (69 RES and 48 Swiss White Alpine, SWA) were blocked by the number of excreted GIN eggs (FEC) and breed and were distributed to either an alpine or a lowland pasture group. The 2 groups were grazed on the respective sites for approximately 12 weeks. For both groups individual FEC were performed at weeks 5, 7 and 12. All animals with FEC > 1000 eggs per gram of faeces were treated with an anthelmintic at week 7. The lambs of the transhumant flock had a lower FEC at week 7 (p = 0.001) and no transhumant lamb needed anthelmintic treatment, whereas 55 % of the lowland lambs needed treatment (p = 0.001). Irrespective of the grazing site, RES had lower FEC than SWA throughout the trial (p < 0.001). It is concluded that the incorporation of transhumance into the grazing management may keep the GIN infection level at an acceptable level. Furthermore, the native RES controlled GIN more efficiently than SWA lambs and therefore this breed, at least in Switzerland, may be of importance as an element of GIN control in the future.

Keywords. Sheep – Gastrointestinal Nematodes – Integrated control.

Effets de la transhumance et de l'utilisation d'une race rustique sur le niveau d'infestation des ovins par les strongles gastro-intestinaux

Résumé. *En systèmes herbagers, les parasites, et particulièrement les strongles-gastro intestinaux (SGI) ont des effets majeurs sur la santé et la production des ovins. Jusqu'à présent, le contrôle de ces parasites a reposé sur l'utilisation de produits chimiques de synthèse, les vermifuges. L'utilisation fréquente de ces substances ayant provoqué l'apparition de fortes résistances de la plupart des populations de parasites, de nouvelles stratégies non-chimiques de contrôle sont en cours de développement. Nous présentons ici une étude où la transhumance et l'utilisation d'une race d'ovins (Rouge d'Engadine, RE) naturellement moins susceptible aux SGI ont été combinées pour contrôler ces parasites. Cent-dix-sept agneaux (69 RE et 48 Blanche Alpine de Suisse, BAS) infestés naturellement avec des SGI ont été allotés sur la base de la race et du niveau de parasitisme par les SGI (nombre d'œufs de SGI par gramme de fèces) puis ont pâturé soit en estive soit sur des pâturages en plaine. Les deux lots ont pâturé sur les sites respectifs (estive, plaine) pendant environ 12 semaines. Des comptages d'œufs de parasites (OpG) ont été effectués pour chaque agneau aux semaines 5, 7 et 12. Tous les animaux présentant une valeur d'OpG > 1000 en semaine 7 étaient vermifugés. Les agneaux pâturant en estive ont présenté des OpG plus faibles en semaine 7 (p = 0,001) et aucun d'entre eux n'a nécessité un traitement antiparasitaire, alors que 55 % des agneaux pâturant en plaine ont dû être vermifugés (p = 0,001). Indépendamment du site de pâture, les agneaux RE ont excrété moins d'œufs de SGI que les agneaux BAS pendant la période d'étude (p < 0,001). Il est conclu que l'utilisation d'une estive dans la gestion du pâturage peut aider à maintenir le niveau d'infestation avec les SGI à un niveau acceptable. En outre, la race rustique (RE) contrôle les SGI plus efficacement que la race BAS Pour cette raison au moins en Suisse, cette race peut être importante comme élément de contrôle des SGI dans le futur.*

Mots-clés. *Ovin – Strongles gastro-intestinaux – Contrôle intégré.*

I – Introduction

Resistance of gastrointestinal nematodes (GIN) to anthelmintic drugs threatens small ruminant husbandry worldwide (Kaplan and Vidyashankar, 2012). This situation as well as the demand for reduced chemical inputs by organic farmers and consumers has stimulated the search for alternatives, such as the use of bioactive forages, the use of sheep breeds with lower susceptibility as well as nutritional and grazing management strategies to control GIN (Hoste and Torres-Acosta, 2011).

Compared to the high performing Swiss White Alpine Sheep (SWA), the native Red Engadine Sheep (RES) has shown to be less susceptible to GIN infection in previous studies (unpublished results). On the other hand, the use of alpine pastures (transhumance) would allow a reduced stocking density that hypothetically leads to a lower infection pressure on alpine pastures and furthermore to a lower infection level of transhumant sheep with GIN. Hence, the objectives of this study were to assess if the use of a less susceptible breed on alpine pastures reduces the reliance of synthetic anthelmintics due to additive effects.

II – Materials and methods

Sixty-nine RES and 48 SWA lambs were grazed on common pastures for 52 days (preparation period). The age of the lambs at grazing start ranged from 74 to 116 days and there was no difference between the breeds. Prior to the preparation period all lambs were artificially infected with 5000 *Haemonchus contortus* and 2200 *Trichostrongylus colubriformis* third stage larvae. Individual faecal samples were drawn from every lamb at the end of the preparation period. According to the number of nematode eggs per gram faeces (FEC) and breed, the lambs were distributed to either an alpine or a lowland pasture group. Thirty-seven RES and 25 SWA were assigned to the alpine flock and 32 RES and 23 SWA to the lowland flock. Due to animal welfare reasons, all lambs with a FEC > 1000 were treated with a commercial anthelmintic before the animals were moved to the corresponding pastures. The experimental animals were subsequently grazed on alpine or lowland pastures for a period of 82 days. Faecal samples were drawn on day 37 (FEC 1), 50 (FEC 2) and 82 (FEC 3) during this period. Anthelmintic treatment was again applied to those lambs that had a FEC > 1000 at day 50 (FEC 2). The alpine pastures were located in the Valley of Misox, Switzerland. The alpine pastures were at 1800 – 2750 m above sea level. Except for the grazing period from day 50 to 64, the alpine flock was always pushed to pastures which were never grazed before in the trial year. The stocking density of the grazing range could not be quantified due to the geographically complex situation on these alpine pastures. The lowland pastures were located close to the research facilities of the Research Institute of Organic Agriculture, Switzerland. The lowland pastures were at 350 – 600 m above sea level. During the preparation period, the lowland pastures were grazed by the entire flock for the first time in the corresponding trial year. During the 82 days after the preparation period, the lowland flock was rotated two times on the same pastures. The stocking density of the lowland pastures was 1.6 livestock units per hectare.

Data analysis was performed with the statistical computing environment R (R Development Core Team, 2012, version 2.15.1). The development of the FECs (1 – 3) was analysed using a linear mixed model. For the stabilisation of the variances all FEC data were log(x +1) transformed. Post-hoc tests were performed for the identification of differences between the sampling events. P-values were corrected for multiple testing by the Bonferroni method. Chi-square-tests were applied for the analysis of the difference of the anthelmintic treatment frequency between the two breeds.

III – Results and discussion

1. Anthelmintic treatment

The first anthelmintic treatment directly after the preparation period concerned 43.5% RES and 64.6% SWA (chi2, $p = 0.025$). A second anthelmintic treatment at trial day 50 was solely applied to lambs of the lowland flock, as no lamb of the transhumant flock exceeded the threshold of 1000 FEC. Within the lowland flock 37.5% RES and 82.61% SWA received the second drench (Chi2, $p = 0.001$). In total, 55% of the lowland lambs were treated with anthelmintics.

2. Faecal egg counts

There was no FEC difference between the alpine and the lowland flock at trial start ($p = 0.290$). The analysis of the repeated FEC revealed no difference between the alpine and lowland flock over the entire trial ($p = 0.277$). Post-hoc tests indicated, however, that the FEC of the alpine flock was lower at day 50 ($p = 0.001$) and higher at day 82 ($p < 0.001$) compared to the lowland flock. The RES showed a significantly lower FEC compared to the SWA throughout the trial ($p < 0.001$) (Table 1). Lambs that were treated with anthelmintics at day 50 had a considerable lower FEC at trial end ($p < 0.001$). There was no effect of other parameters such as age, weight or gender of the animals on the repeated FEC.

Table 1. Mean faecal egg counts (FEC) of the Red Engadine Sheep (RES) and the Swiss White Alpine (SWA) grazing either on alpine (ALP) or lowland (LOW) pastures

Trial days	RES x ALP		SWA x ALP		RES x LOW		SWA x LOW	
	Mean	SE†	Mean	SE†	Mean	SE†	Mean	SE†
1	285	55	156	51	303	56	193	61
37	241	37	325	88	317	115	848	115
50	224	35	226	31	1183	206	2776	346
82	1097	119	1876	284	253	52	209	55

† Standard error of the mean.

As all experimental lambs with a FEC > 1000 were treated with an anthelmintic at day 50 due to animal welfare reasons, we could not demonstrate an effect of the grazing site over the entire trial. But it has been shown that 55% of the lowland animals exceeded the threshold of 1000 FEC at trial day 50. In contrast, no alpine animal exceeded this threshold at this time of the trial. Therefore, the infection level of the alpine pastures must have been low compared to the lowlands for the first half of the trial. Depending on the environmental conditions in Switzerland, sheep are set out for grazing in April on lowland pastures. In contrast, grazing on alpine pastures usually starts in early July. This shift of the grazing start impacts on the epidemiological pattern of infection on alpine pastures towards a lower infection level compared to the lowlands (Eckert and Hertzberg, 1994). Farmers might incorporate the use of alpine pastures as a strategic grazing management tool to avoid periods with high nematode larval challenge on lowland pastures.

Compared to the lowland lambs, the alpine lambs had significantly higher FECs at the end of the trial on day 82. It is known that the number of infective nematode larvae increases with proceeding vegetation period on alpine pastures (Gruner *et al.,* 2006). Except for the period from trial day 50 to 64, the experimental lambs on alpine pastures were routinely pushed to pastures that were never grazed before in the same season. For the period from day 50 to 64, the experimental lambs were introduced to a pasture that was grazed by another sheep flock for several weeks before. We assume that this grazing period caused the increased FEC of the alpine lambs at trial end (day 82). This would emphasise the need for a pasture management to control the infection with GIN on alpine pastures with proceeding vegetation period.

The repeated measurement analysis revealed a significantly lower FEC of the RES compared to the SWA throughout the trial. As a consequence, the frequency of anthelmintic treatments applied to this breed was considerably lower compared to the treatment frequency of the SWA. We assume that the breeding progress of the high performing SWA took place when anthelmintics were available on the market. We hypothesise that the susceptibility against infection with GIN was not an important trait when selecting the animals for breeding during the last decades. The RES, however, persisted without much genetic modification since the middle of the last century. When breeding progress took place in that breed, resistance to GIN infection must have been a natural trait when animals were selected for breeding, as no anthelmintics were available during those times.

IV – Conclusions

The native RES has shown to be less susceptible to GIN infection compared to the high performing SWA. The use of the native RES could therefore reduce the number of applied anthelmintics treatments and might decrease the resistance development of GIN to anthelmintics. At least for the first half of the vegetation period the strategic use of alpine pastures resulted in significantly reduced FEC compared to lambs grazing on lowland pastures. We consider the effect of the breed and the grazing site as additive. Thus, the grazing of RES on alpine pasture may result in a considerably reduced number of anthelmintic treatments compared to a conventional grazing system.

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