Project objectives

This project will deliver necessary information to develop cost effective programmes to reduce animal production losses in organic systems, provide a system to identify animals requiring treatment for parasitism, and increase our understanding of this important animal health issue in organic farms typical of the growing direction of the NZ industry.

1. Demonstrate the TST strategy can identify animals suffering from parasitism and show that grazing bioactive forages is beneficial to animal performance and health.
2. Identify the most appropriate sward or combination of swards that can be used to provide a short term curative treatment for parasitism suitable for all organic farms.

The ability of short-term grazing of a herbage lay to provide a curative treatment and improve resilience to further infection for animals infected with gastro-intestinal parasites will be evaluated

Approach

The trial was performed at the Biological Husbandry Unit of Lincoln University, Canterbury, New Zealand during December 2011- April 2012. The area was divided into four paddocks (3.6 ha altogether) (Fig. 1); two main paddocks (1.6 and 2 ha respectively) sown with ryegrass and white clover (TCIR and TCOL) and two smaller “hospital paddocks” (each about 0.7 ha) sown with a herb mix of chicory (*Cichorium intybus* cv. Grasslands Puna), plantain (*Plantago lanceolata* cv. Grasslands Lancelot) and red clover (*Trifolium pratense* cv. Minshan) (H-TCIR and H-TCOL). 12 weeks prior to the start of trial each main paddock was grazed by fifteen peri-parturient ewes which lambed on the paddocks. The ewes were treated with anthelmintic to remove any residual parasite burden before being artificially infected with either *Trichostrongylus colubriformis* (Paddock TCOL) or *Teladorsagia circumcincta* (Paddock TCIR) within seven days of lambing and kept on the pastures for four weeks to seed the pastures with monospecific contamination. The ewes and their lambs were removed before the trial started. The hospital paddocks were sown in the autumn and resown in the spring (September) due to weed contamination. They were mown once in early February to maintain pasture quality. In early February an irrigation system was set up in the hospital paddocks to increase the growth of the forages.

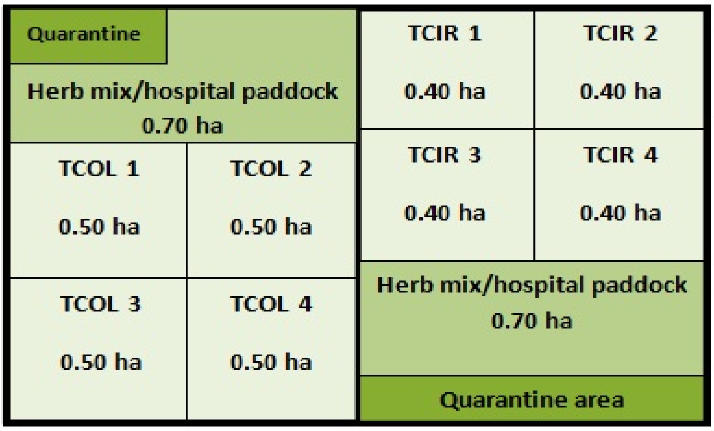

Fig. 1. Schematic picture of the trial site. TCOL =paddocks grazed by lambs infected with *Trichostrongylus colubriformis*; TCIR = paddocks grazed by lambs infected with *Teladorsagia circumcincta*.

Sixty male Coopworth lambs with a mean live weight of 27 kg (SD: 3.4 kg) and age of 12 weeks were included in the study and arrived on 06 December 2011 (week 0). The lambs had been reared under normal commercial conditions at the Lincoln University, Ashley Dene Research Farm and had been weaned on the day of arrival. The lambs were drenched with a mixture of abamectin (1g/l), albendazol

(25g/l) and levamisol hydrochloride (40g/l) (1 ml per 5 kg live-weight orally; Trio® Sheep, Ravensdown Animals Health, Christchurch) the same day and put in a quarantine area for two days. The lambs were fitted with electronic ear tags and allocated hierarchically by live weight into one of two groups of thirty lambs. The groups were introduced to two separate paddocks with ryegrass and white clover contaminated with either *Trichostrongylus colubriformis* or *Teladorsagia circumcincta* and allowed to adjust for one week.

From one week after entry into the paddocks, on a fortnightly basis the liveweight gain of the lambs was assessed, with individuals not performing to a preset target removed and grazed on a separate paddock with herbs and minimal larval contamination (hospital paddock). The target liveweight for each lamb was calculated at each weighing following measurement of herbage mass and estimation of quality which allowed for the calculation of the 'Happy Factor' grazing efficiency as described by Greer et al, (2009). Target weights were calculated assuming a happy factor of 0.74 (Greer et al., 2010) which were then uploaded onto a Tru-test head unit (XR3000, Tru-Test Ltd, New Zealand). At the time of weight recording, animals were drafted according to their ability to reach their target liveweight gains. The lambs from each parasite-species infected pasture that achieved their target level of performance were returned to pasture. Those that did not reach their performance target at each sampling time were drafted out and put to graze in the hospital area for the next two week period.

The main pasture paddocks were rotationally grazed, with animals spending one week in each quadrant. Animals were set-stocked in the hospital paddocks. Pre-grazing and post-grazing herbage masses were collected on a weekly basis for all paddocks that either had been, or were about to be grazed.. Pasture mass was measured using a FILIP's rising plate pasture meter (JENQUIP, Fielding, New Zealand) with measurements taken every 10 paces in a 'W' pattern down the field.). The rising plate meter was calibrated using eight forage cuts from each pasture taken using a quadrate (0,2m^2). The dry matter (DM) of each fraction was determined following drying the samples in an oven at 70 °C for 48 hours. The pasture mass was estimated using the rising plate meter and a linear calibrations equation: $y = 150x + c$ where y = pasture mass (kgDM/ha), x = plate meter reading (counts/click) and c = a constant.

For calibration of the pasture meter these values were compared with the pasture mass determined by the quadrate cutting. The pasture mass (kg DM per ha) was measured at every grazing rotation using the rising plate meter and used for estimating the targeted live weight of the lambs according to the Happy Factor model (Greer,A.W. 2009).

Main findings from this project

The suitability of bioactive forages as a hospital paddock cannot be determined from the current results due to a poor establishment and growth of the forages. The study did not reveal any antiparasitic effect following hospitalisation on neither intestinal nor abomasal parasites. The lack of effect on FEC may be attributed to a low proportion of the bioactive plants and/ or concentration of their bioactive components, due to the poor growth of the forages.

Grazing the hospital paddocks did provided a benefit to parasitised animals with an increase in mean daily LWG on 50% of occasions after time in the hospital paddock. The observed improvement in LWG seen in lambs after periods in the hospital paddocks is considered to be a consequence of the reduced larval challenge, rather than any direct benefit of bioactive forages. Based on these findings the overall conclusion is that it was not possible in this study to judge the effectiveness of the bioactive forages on liveweight gain or in reducing worm burdens. However, the provision of a hospital paddock with a low larval contamination to provide animals with respite from continued larval challenge does appear to confer some benefits in terms of short-term responses in LWG. The mean daily liveweight gains, estimated over fortnightly periods, were significantly different between TCIR and H-TCIR ($p<0.05$) as well as TCOL and H-TCOL ($p<0.01$) at every sampling time, being reduced in those animals that were placed onto the hospital paddock. The overall mean LWGs were 0.252 kg/day and -

0.077 kg/day for TCIR and H-TCIR respectively and 0.292 kg/day and -0.035 kg/day for TCOL and H-TCOL.

Lambs spent different lengths of time in the hospital paddocks, with 47% and 58 % of the lambs in H-TCIR respectively H-TCOL returning to graze the main paddocks after two weeks, 40% of the lambs in H-TCIR and 23% in H-TCOL stayed in the hospital paddocks for four weeks and 13% respectively 19% stayed for six weeks or longer.
Overall, mean FEC increased markedly for animals on both suites of pastures. Mean FEC for TCIR and H-TCIR and TCOL and H-TCOL are shown in Figures 2 & 3, as can be seen FEC were very high (>2000 epg) and pasture larval levels reflected a high level of challenge on both pasture suites. There appeared to be a heavy parasite loading on the pastures seeded with T. circumcincta with pasture larval levels and FEC levels double that seen on the T. colubriformis seeded pastures.

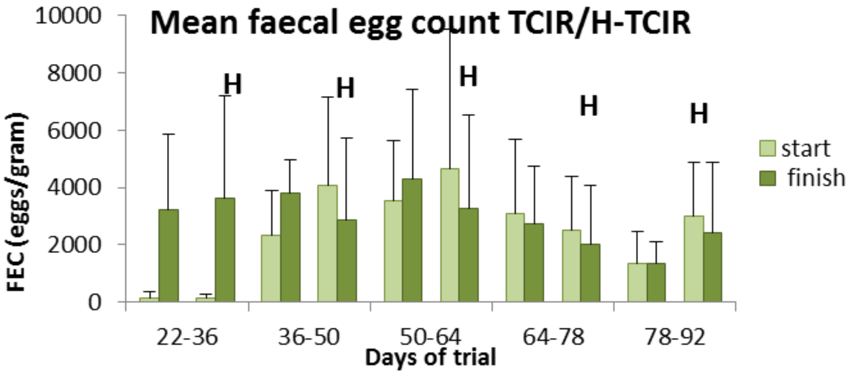

Fig. 2. Arithmetic mean faecal egg count for TCIR at the start and end of each grazing period.
H indicates hospital paddock. * indicates significant difference (p<0.01) between TCIR and H-TCIR.
Note that there are different animals in each group at every sampling time.

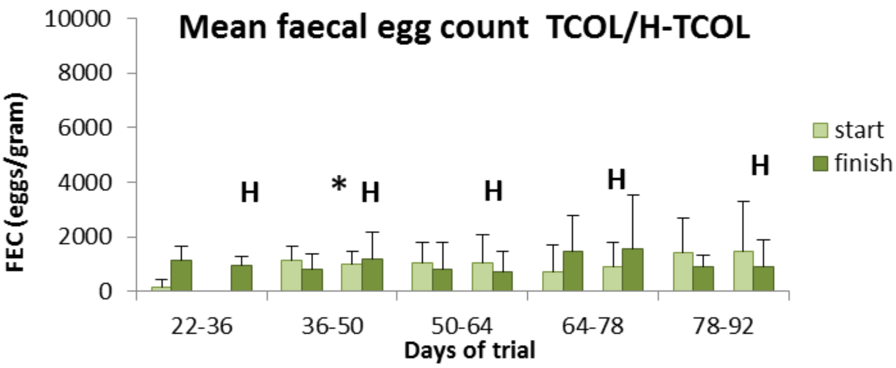

Fig. 3. Arithmetic mean faecal egg count for TCOL at the start and end of each grazing period.
H indicates hospital paddock. *indicates significant difference (p<0.05) between TCOL and H-TCOL
Note that there are different animals in each group at every sampling time

Individual FEC decreased for lambs with grazing time in the hospital paddocks in 11 of 35 occasions (31%) for H-TCOL lambs and in 21 out of 41 occasions (51%) for H-TCIR lambs There were significant difference in mean FEC between the animals in the TCIR and H-TCIR paddocks and between the TCOL and H-TCOL paddocks at some time points in the study. There were no significant interactions between paddocks and time on any occasions.

Pasture dissection of the hospital paddocks confirmed overall poor growth of clover, chicory and plantain through the whole trial in both paddocks with ryegrass consistently contributing to greater than 50% of the dry matter present. The proportion of clover and plantain increased from mid-February but each remained at less than 20% of the DM (Fig 4 & 5).

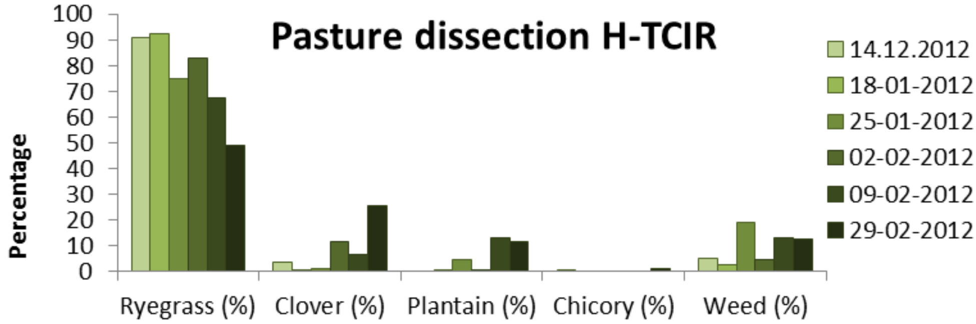

Fig. 4. The distribution of the different species found in the H-TCIR paddock
At pasture dissections performed throughout the trial (% of DM).
H-TCIR= hospital paddock grazed by sheep infected with *T. circumcincta*

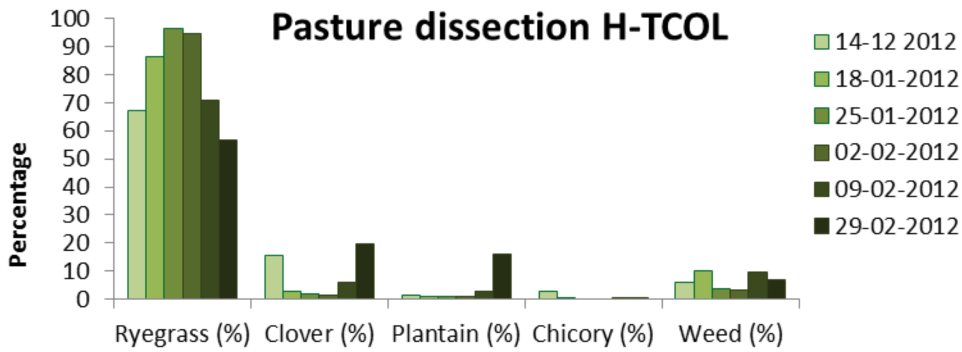

Fig. 5. The distribution of the different species found in the H-TCOL paddock
at pasture dissections performed throughout the trial (% of DM).
H-TCOL= hospital paddock grazed by sheep infected with *T. colubriformis*

The pasture mass was in general higher for the TCIR and TCOL paddocks than for H-TCIR and H-TCOL throughout the trial with a decrease seen in January, mid-February and mid-March for both main paddocks (Fig 6). The pasture mass for the hospital paddocks were even and constant throughout the trial.

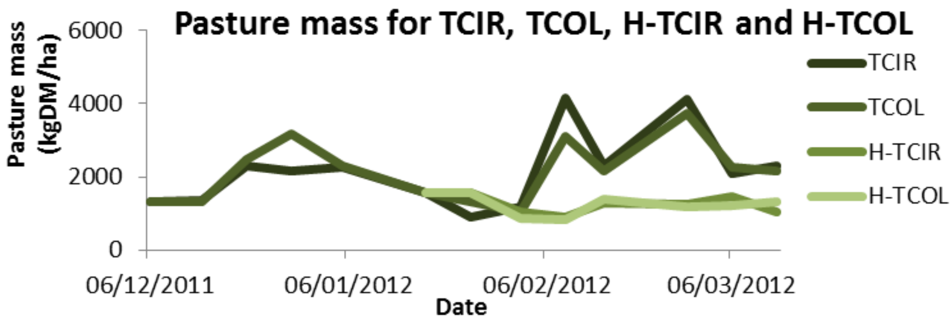

Fig. 6. Pasture mass registrations for TCOL, TCIR, H-TCOL and H-TCIR paddocks throughout the trial.

Distribution of lambs staying for different lengths of periods in the hospital paddocks. 47% and 58 % of the lambs in H-TCIR respectively H-TCOL returned to graze the main paddocks after two weeks can be seen in Table 1., 40% of the lambs in H-TCIR and 23% in H-TCOL stayed in the hospital paddocks for four weeks and 13% respectively 19% stayed for six weeks or longer. There were lambs grazing the hospital paddocks at all times whilst the main paddocks were rotationally grazed.

Tabel 1. Distribution of lambs staying in H-TCIR and H-TCOL for different periods of time

	Time in hospital paddocks	

Paddock	2 weeks	4 weeks	6 weeks	8 weeks	10 weeks	12 weeks	Total
H-TCIR (n)	22	19	3	1	1	1	47
H-TCOL (n)	21	8	3	2	2	0	36

Results from the pasture larval counts are shown in figure 7, where two large peaks in larval availability occurred on the T. *circumcincta* infected pastures and two medium peaks on the *T. colubriformis* infected pastures. These pasture larval levels reflect a heavy larval challenge was experienced by all grazing animals on these pasture suites. The consequences of this level of larval challenge were highlighted by an associated scouring occurring in a majority of animals which in turn led to a large flystrike problem. From the middle of January a problem with myiasis (flystrike) arose amongst the lambs and continued throughout the trial. The affected lambs were crutched and treated cutaneously with Tea tree oil. Five lambs died during January and February; all of them were affected by myiasis and from the group infected with T. *circumcincta*.

Lambs that had lost more than 20% of their previous bodyweight(last two weeks) were judged to be in poor a condition and were drenched with a mix of abamectin (1g/l), albendazol (25g/l) and levamisol hydrochloride (40g/l) (1 ml per 5 kg liveweight orally; Trio® Sheep, Christchurch) and hereafter put in the quarantine areas for 48 hours. 3 TCOL/H-TCOL lambs and 13 TCIR/ H-TCIR lambs were drenched in total.

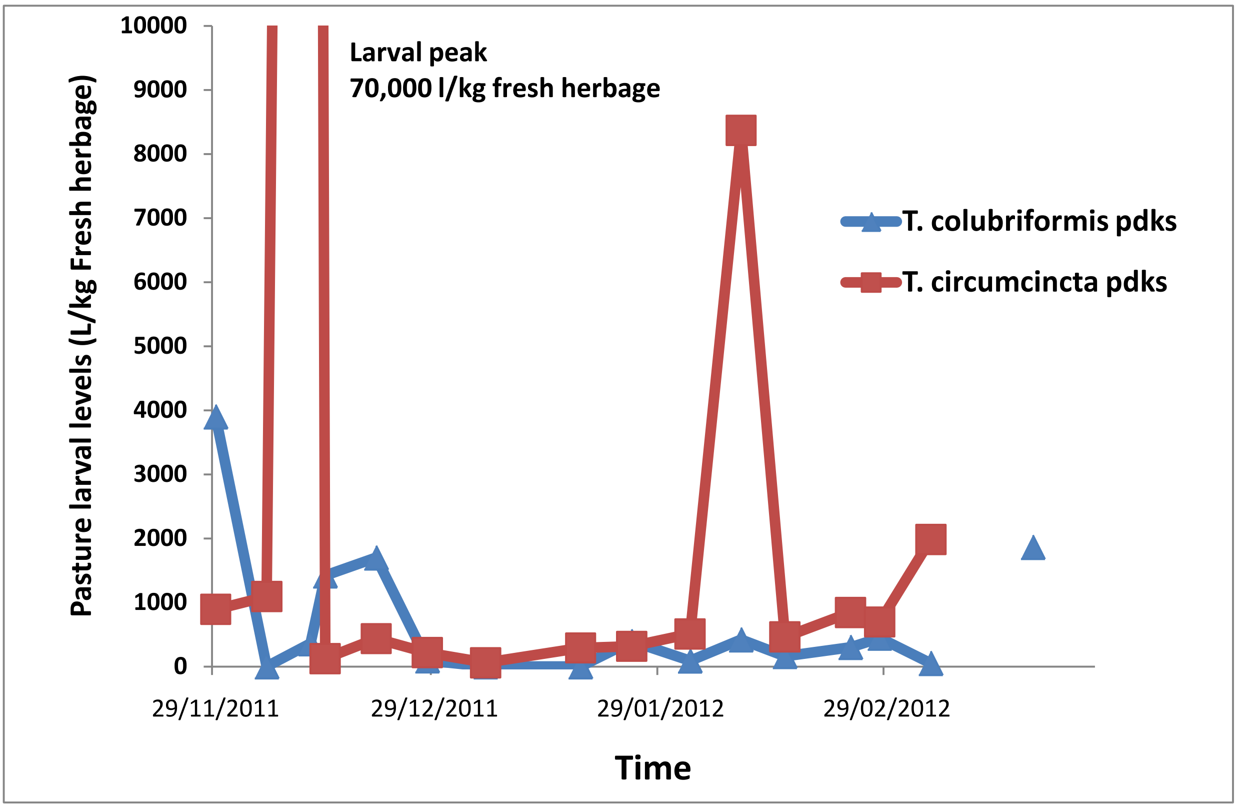

Fig 7. Pasture larval levels (l/kg fresh herbage) that lambs were consuming at the start of each grazing shift.

What difference has this project made?

Enabled us to develop a strong on-going working relationship between Organic farmers and the LBHU Organic trust. Highlighted the problems associated with parasite control in organic systems and identified some potential products that could be beneficial in achieving a level of parasite control.

Provide an organic pasture resource which has already been utilised for an additional parasitology trial and acted as catalyst for future research discussions between various commercial companies.
Help provide the impetus to set out a dedicated organic area for animal research and provide a forum for discussion on running animals within an organic system.

Major outputs from the project

Scientific reports
Sara Sofia Lundberg
Master thesis in Veterinary Medicine
Faculty of health and medical sciences, University of Copenhagen
"Use of strategic short-term grazing of bioactive forages in the control of gastrointestinal nematodes; *Trichostrongylus colubriformis* and *Teladorsagia circumcincta* in organic lamb"

- links to websites http://www.bhu.co.nz