

# Making roundworm data ewe-niversal for all

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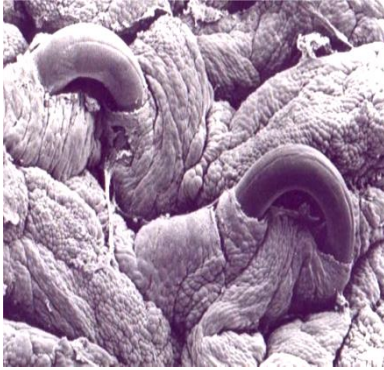
MoreDun

# Top health and welfare issues in UK sheep industry



Rank	Meat sheep
	Mostly outdoor
1	GI parasites
2=	Lameness
2=	Nutritional issues
4	Mastitis
5	Ectoparasites
6	Poor maternal relationship
7	Morbidity and mortality rate

# Roundworms are everywhere!



Infection affects productivity, carcass quality and lower sale value

Infections with multiple worm species common, so standard FEC doesn't tell the whole story

Subclinical disease common, so difficult to spot

Recent estimates suggest annual costs to UK meat sheep industry of:  
£15 million (€ 16.9 million) in lost production  
£27.3 million (€ 30.7 million) in treatment  
Total (£42.4 million/year)





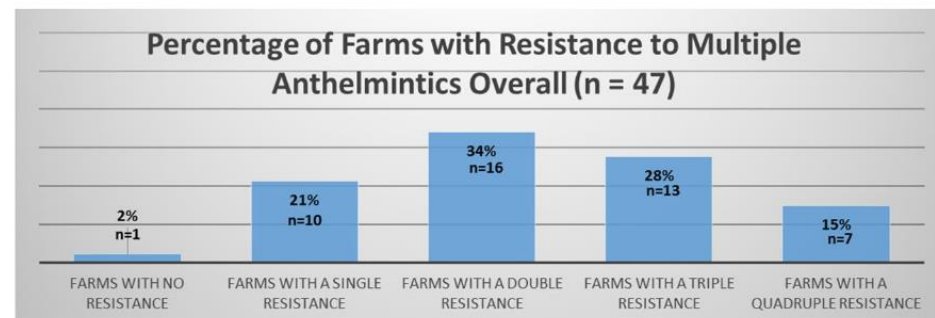
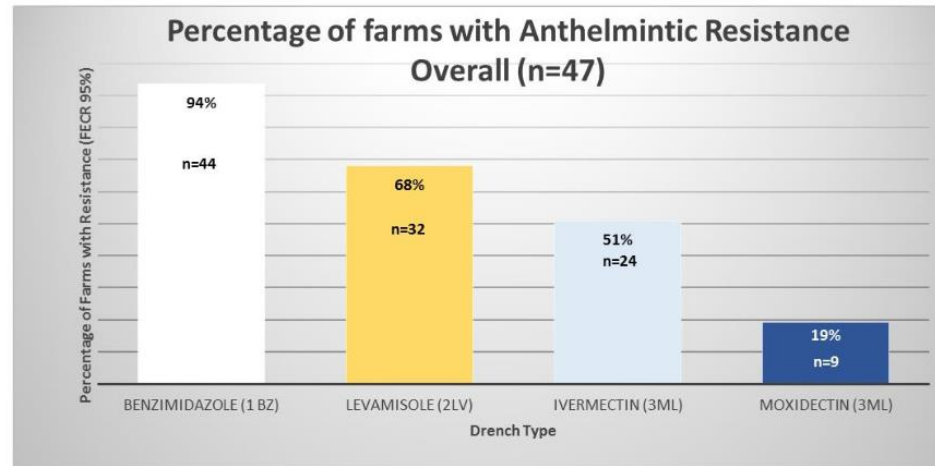
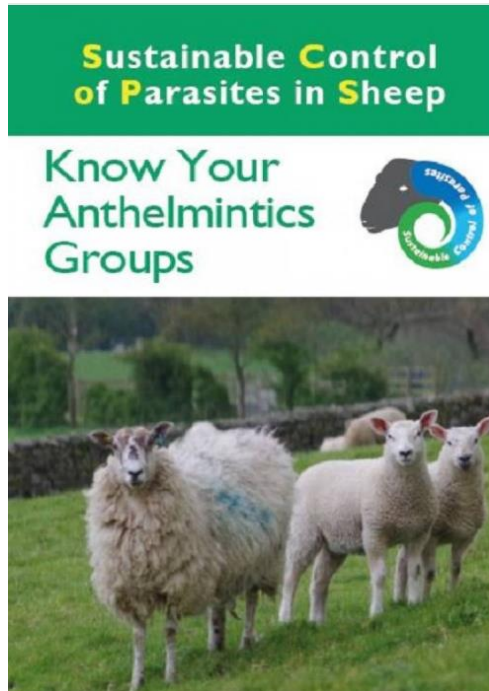
# Current control

Wormers (anthelmintics) are only curative treatments available

Five classes available:

BUT worms can develop resistance

- can lead to treatment failures
- clinical disease
- sub-clinical production loss more common





## Need to use anthelmintics carefully

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- ‘Little as possible, as much as needed’!
- Target treatments by monitoring
  - Faecal Egg Counts (FEC)
  - Wormer efficacy through Faecal Egg Count Reduction Test (FECRT)
- BUT these test are labour intensive, expensive and complex to interpret

# Value of FECs

- Benefits

- Monitor parasite challenge
- Do I need to treat?
  - Who/when
- Was my wormer effective?

- Challenges

- Delay between sample collection and result delivery (7-10 days)
- Cost of repeated sampling
- Interpretation of results

# Can simplified 'drench check' offer practical advice?

## FECRT

Faecal collection from the SAME 10-15 animals at day of worming (d0) and 7-14 days post-treatment

- Gold Standard efficacy test
- 'Paired' FECs from known individuals
- Recommend testing many actives at some time
- Generally *per rectum* collection
- Snapshot of efficacy at one timepoint
- Challenges:
  - finding same animals to re-sample
  - Expensive
  - Limited information across season
- Benefits:
  - Robust, gold standard

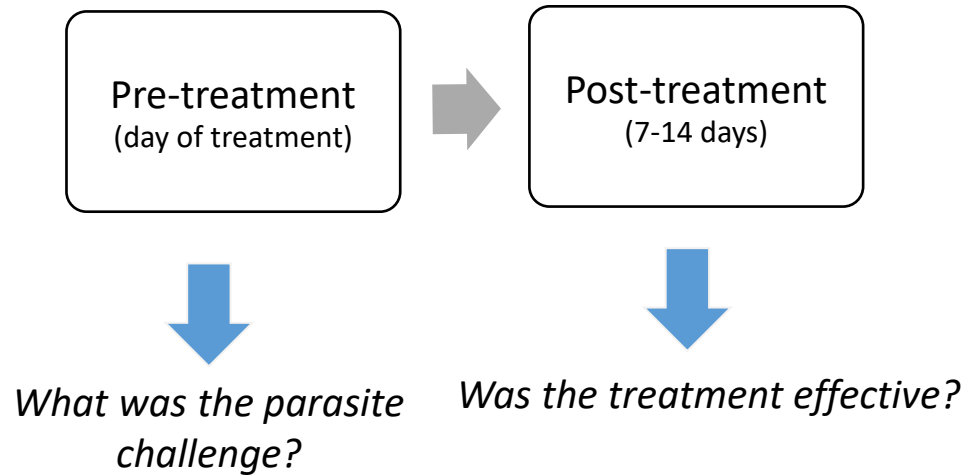
## Drench Check

Faecal collection from 10-15 RANDOMLY selected, treated animals on d0 and d7-14 post-treatment

- Incorporated into normal treatment routine
- Collection from the ground
- Efficacy at each treatment occurrence
- Challenges
  - 'Unpaired' FECs from potentially different individuals
- Benefits
  - Cheaper
  - Less labour intensive
  - No need to mark or keep sampled animals separate from group
  - Pooled FECs can be used to further reduce costs



# Can regular FECs and a simplified 'drench check' offer practical advice?

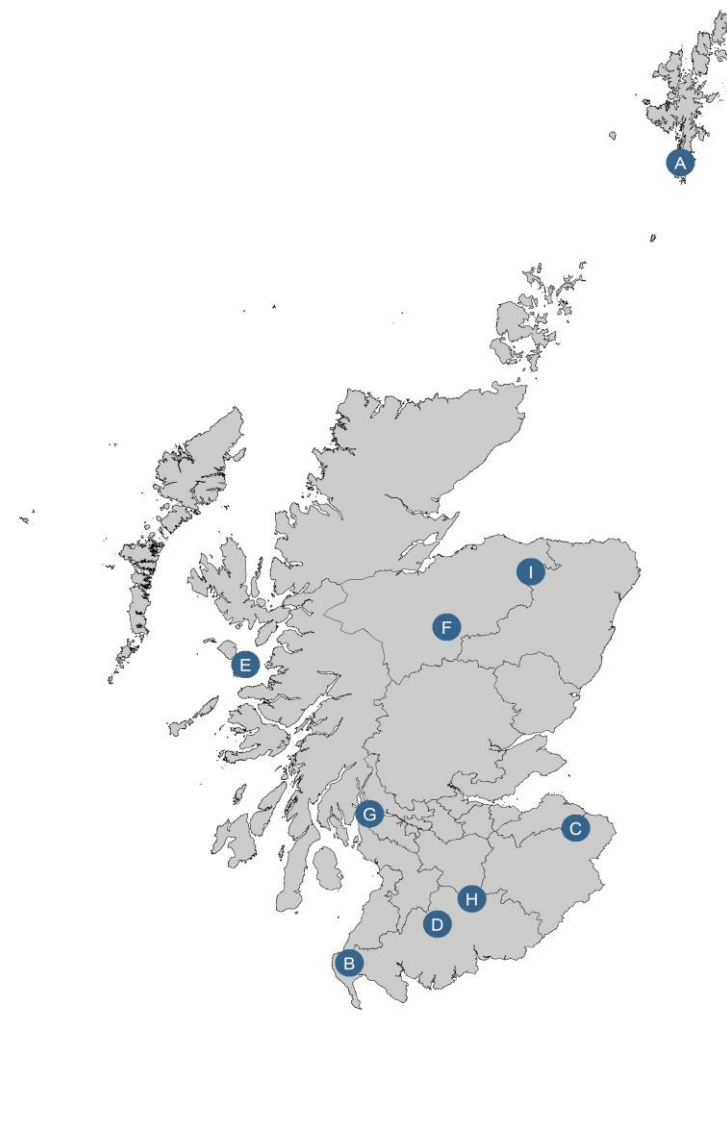


- Focus farmers recruited across the UK for 2 studies:
  - 18 lowland (May to Oct of 2020/21)
  - 9 Hill and upland (July 2021 to Oct 22)
- Farmers asked to collect samples and post them to Moredun for testing:
  - ✓ Samples collected each time they treated sheep/lambs
  - ✓ 10-15 fresh faecal samples collected from the ground pre- and post- treatment
  - ✓ Information about the treatment administered
- FEC and worm species ID collected
- Feedback results





Lowland farms



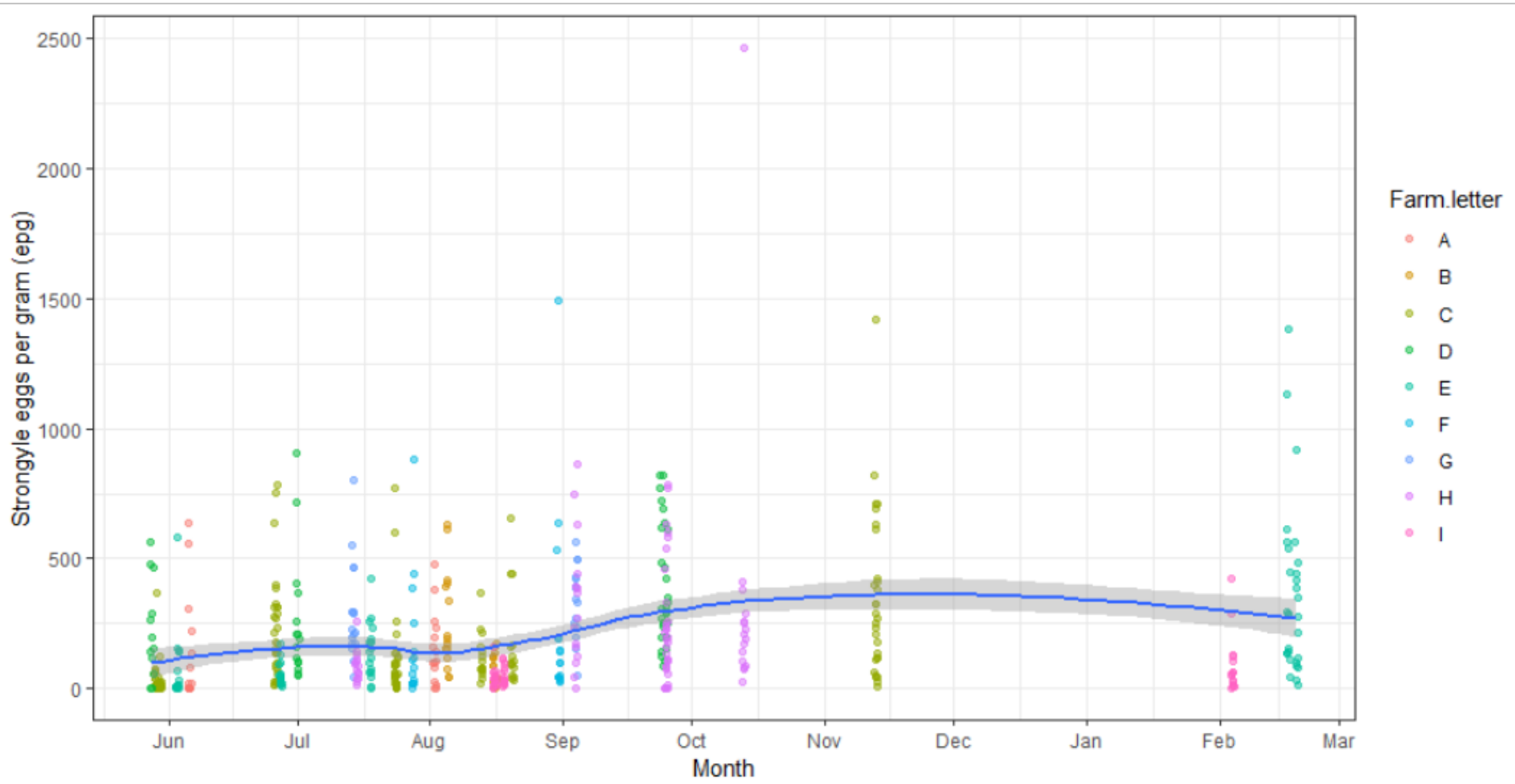
Hill and upland farms

# Lowland studies

- 77 completed drench checks
  - Reduction >90% in only 30% of tests
- **Pre-treatment:** mean 295 epg  
(range: 12 - 2681)
- **Post-treatment:** mean 94 epg  
(range 0 – 323)
- Mean **anthelmintic efficacy:** 53%  
(range: 0 – 100)

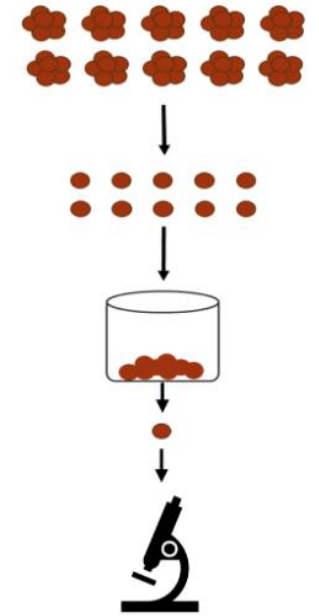
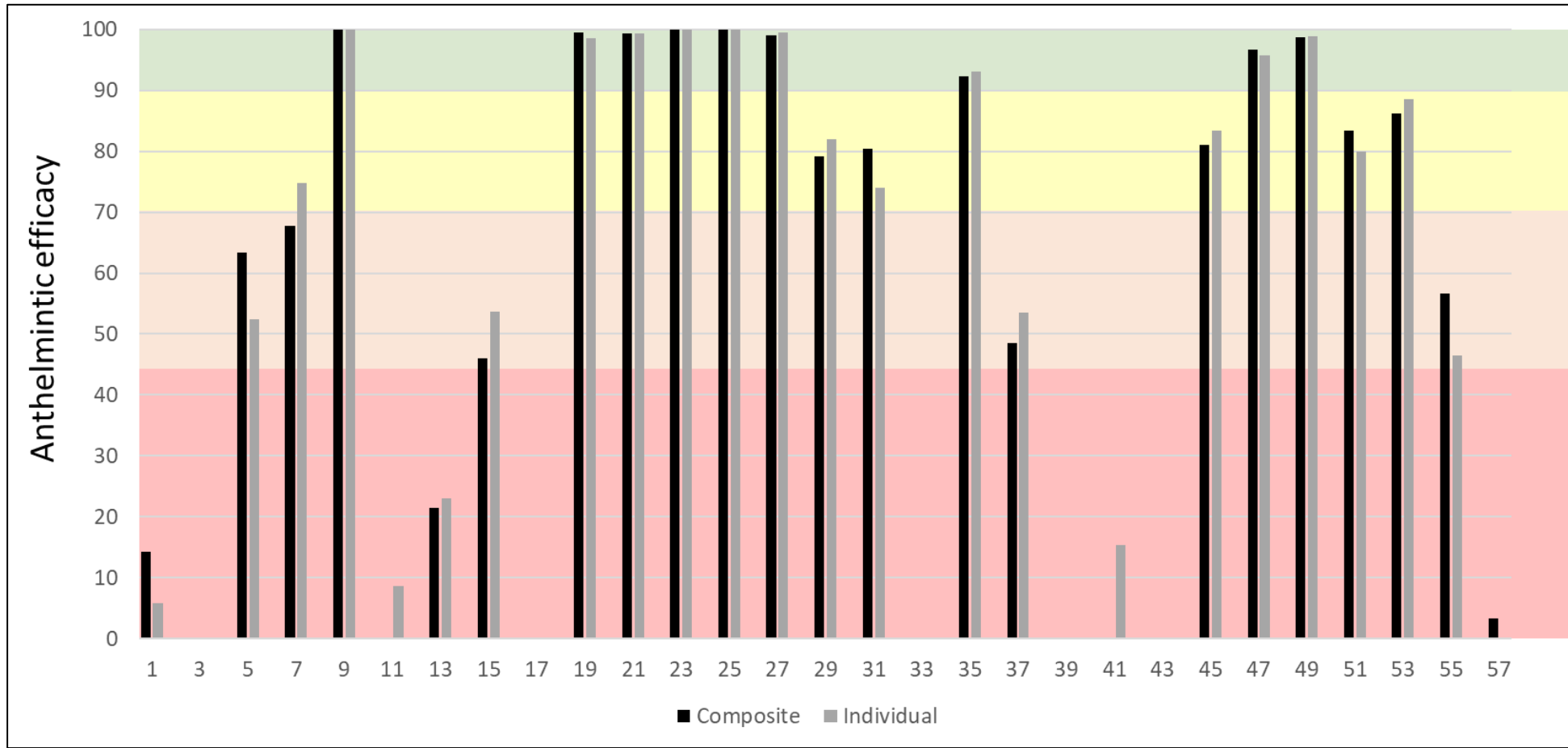
# Hill/upland studies

- 75 completed drench checks  
(composed of 2365 total FECs)
- **Pre-treatment:** mean 191 epg  
(range: 0-2466)
- **Post-treatment:** mean 50 epg  
(range 0 – 1305)
- Mean **anthelmintic efficacy:** 70%  
(range: 0 – 99.9)



# Can simplified 'drench check' offer practical advice?

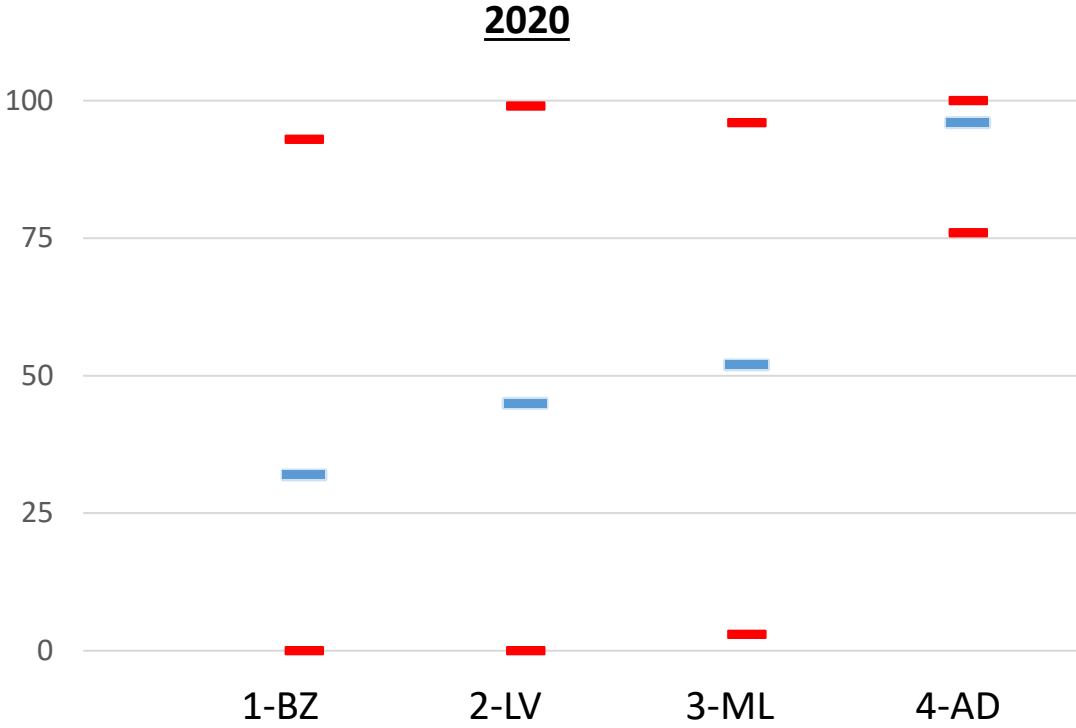
## Pooled vs individual samples



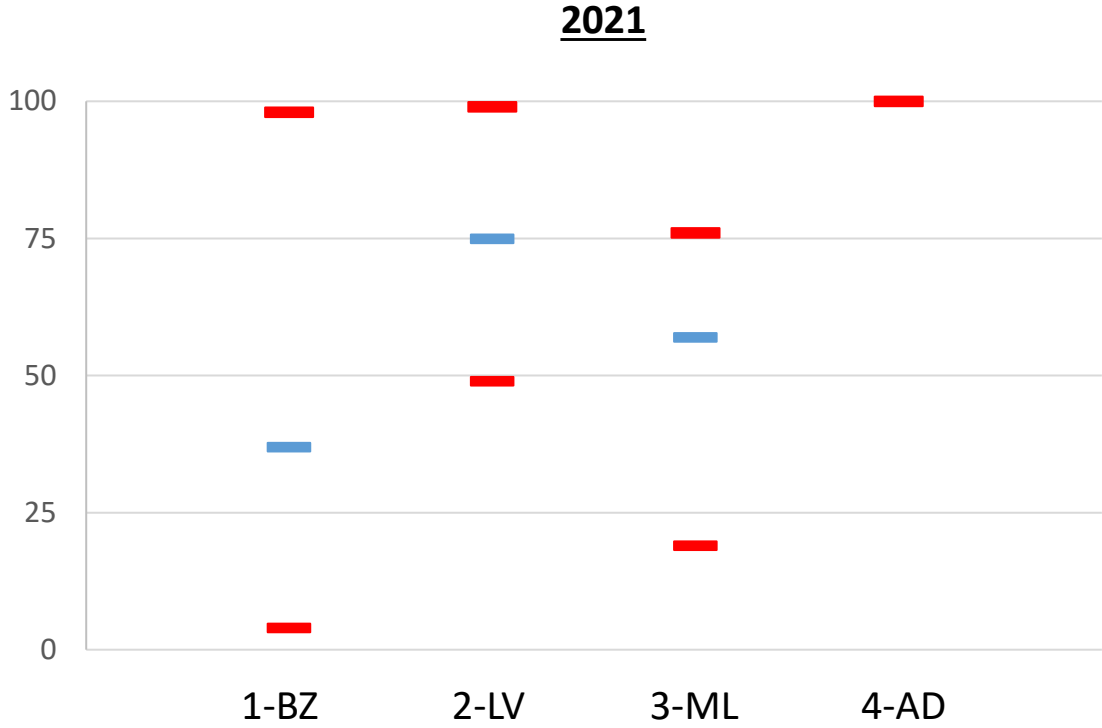
Lin's CCC = 0.99  
(95% CI 0.989, 0.996)



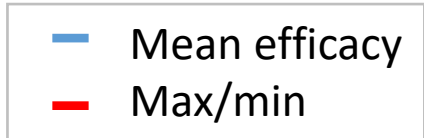
# Efficacy varies between drug classes, but resistance present to 3 of 4 classes used



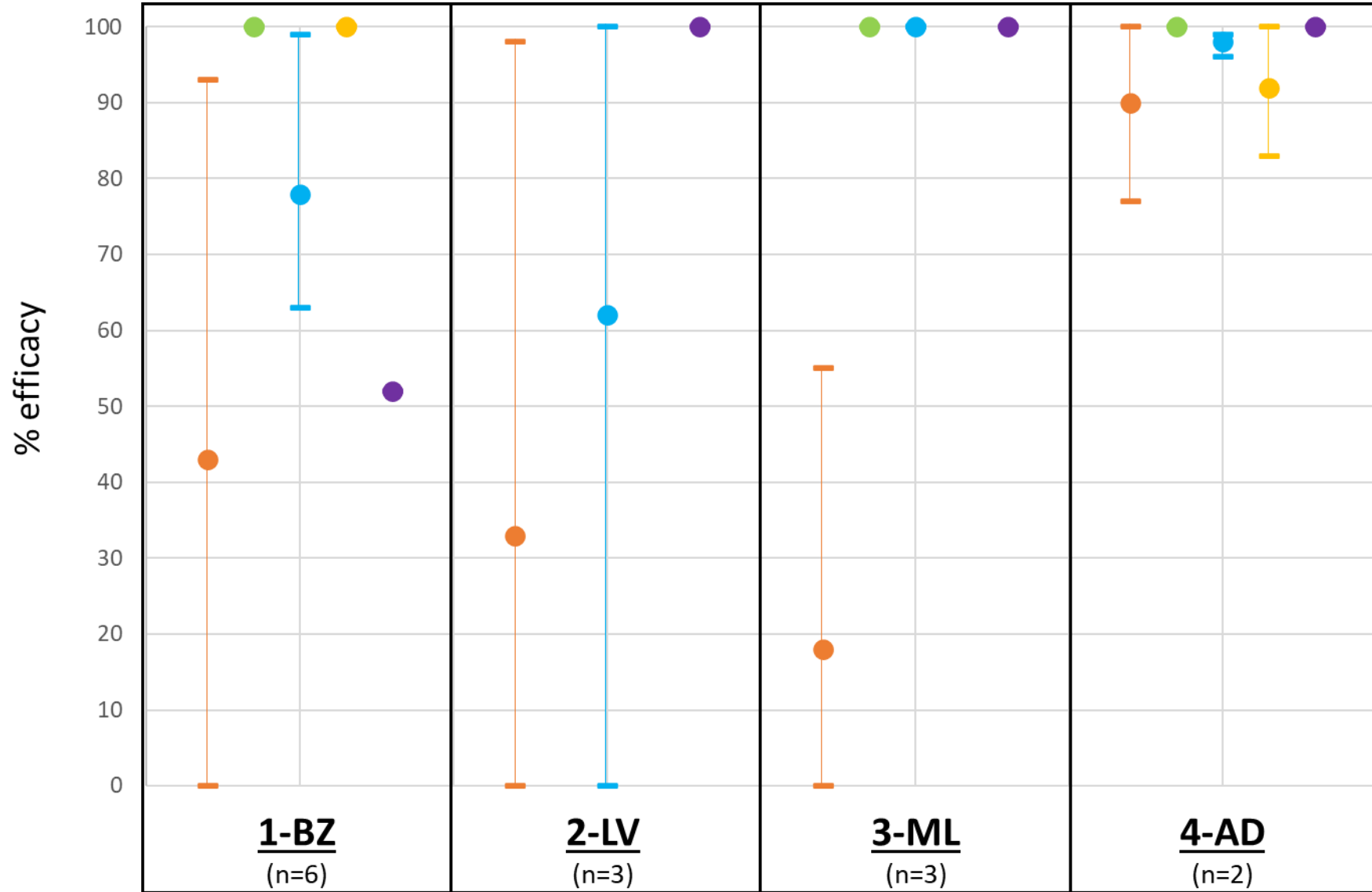
12 tests (4 farms)      6 tests (4 farms)      8 tests (3 farms)      7 tests (5 farms)



17 tests (7 farms)      9 tests (5 farms)      14 tests (7 farms)      4 tests (3 farms)



# Anthelmintic efficacy varies by species



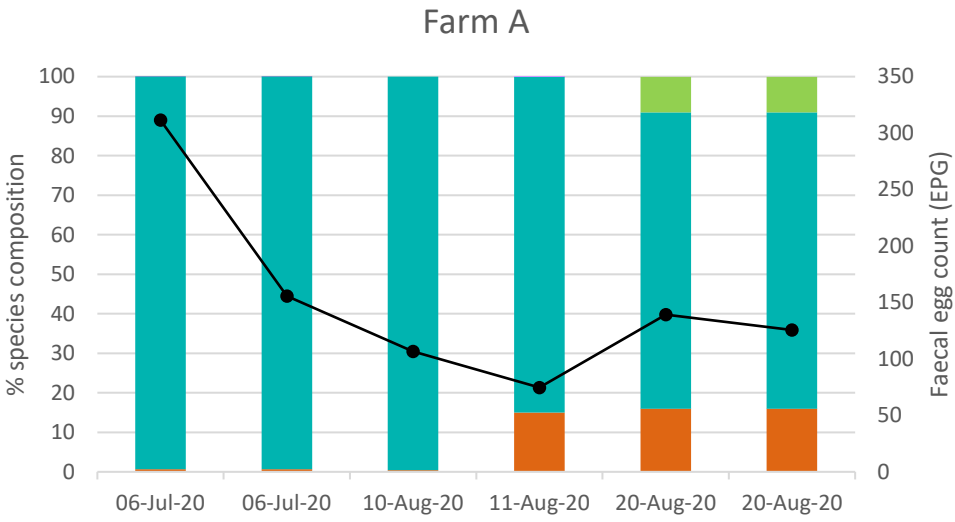
- Teladorsagia
- Haemonchus
- Trichostrongylus
- Chabertia
- Oesophagostomum

Plots represent mean efficacy per species/anthelmintic and max/min efficacy observed

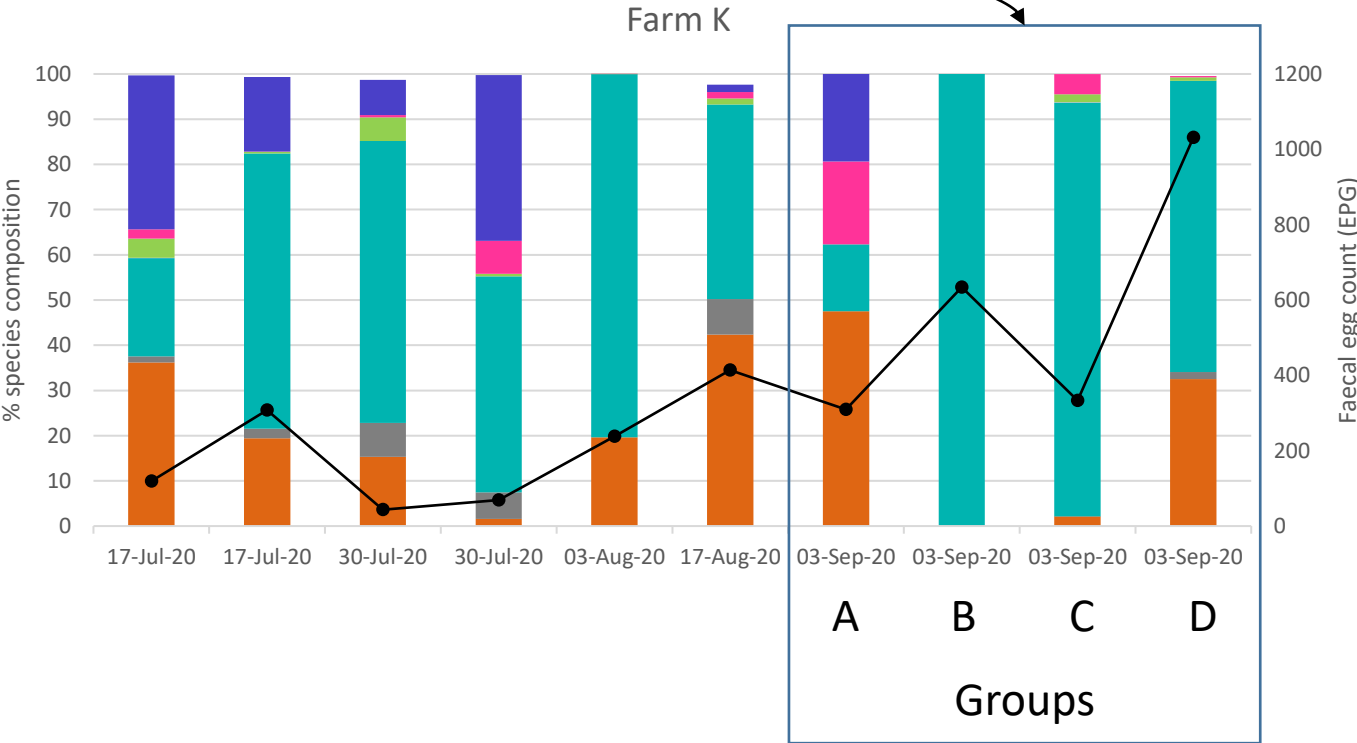
(Note – not all species present in each sample)

# AND Species composition changes across season

Across a season



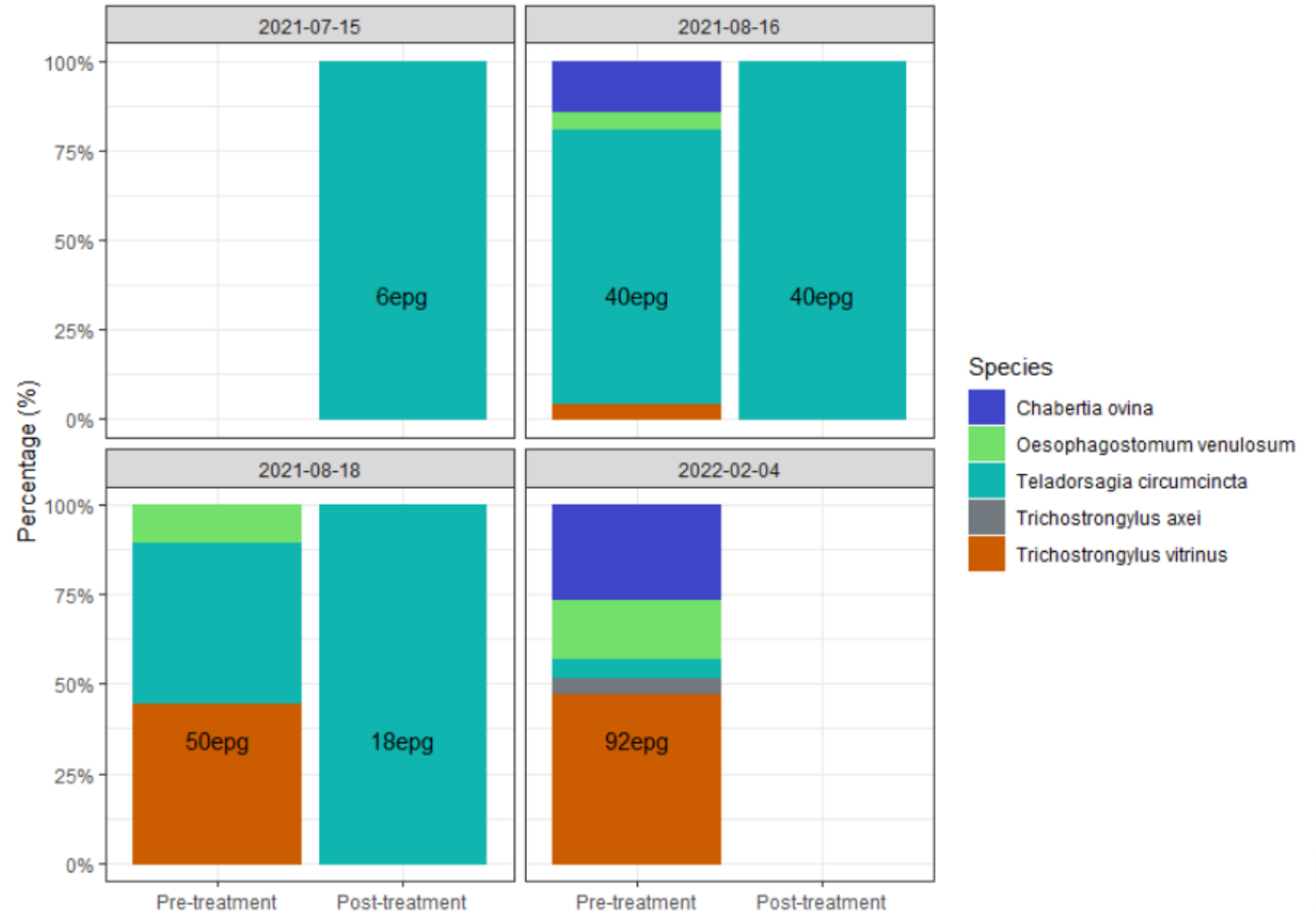
...And between grazing groups



- Trichostrongylus\_vitrinus
- Trichostrongylus\_colubriformis
- Teladorsagia\_circumcincta
- Haemonchus\_contortus
- Cooperia\_curticei
- Chabertia\_ovina
- Trichostrongylus\_axei
- Oesophagostomum
- mean\_indiv

# Worm species data is valuable for farmers

- Low challenge here
- 4 X Albendazole treatments from July – February, while low FECs
- Efficacy: 0 – 97.5%
- Now using FEC monitoring to decide when treatment required





# Summary

- Simplified 'drench check' can improve farmers' knowledge, with reduced effort than a full FECRT, and results sufficient to show when efficacy drops
- Pooled FECs highly correlated to individual counts and would not alter advice given
- Species show that *T. circumcincta* is most resistant species, but *Trichostrongylus spp.* also has resistance to some actives.
- Knowledge of FEC, efficacy and species can allow farmers to make evidence-based decisions to plan interventions.

Interesting information for researchers, but CRUCIAL for farmers to apply for sustainable worm control

- LYNSEY's slide
- How can we make this complex information available to farmers?



Giving farmers resources to make evidence-based decisions

- Project exemplifies the benefits of prolonged FEC monitoring to inform decision-making
- How do we ensure that farmers get the most out of these results?
  - Interpreting them well – do I need to treat? Is there resistance?
  - Saving results to refer back to – creating a long term picture of what is happening on their farm

# Improved results reporting

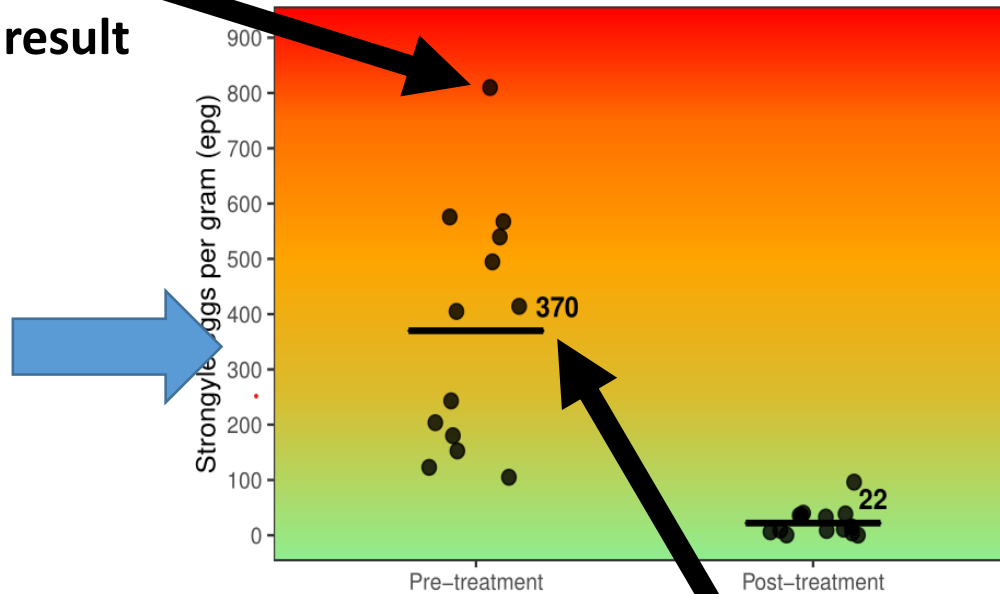
From a table...

Sample	Pre-treatment	Post-treatment
1	261	0
2	207	0
3	162	9
4	207	3
5	72	0
6	369	46
7	189	0
8	99	42
9	909	0
10	405	5
11	117	9
12	105	0
13	720	8
14	54	1
15	48	7
Average	262	9

... to a simple visual

Individual sample result

Percentage reduction: 94%  
Confidence interval: 89.2% – 97.2%

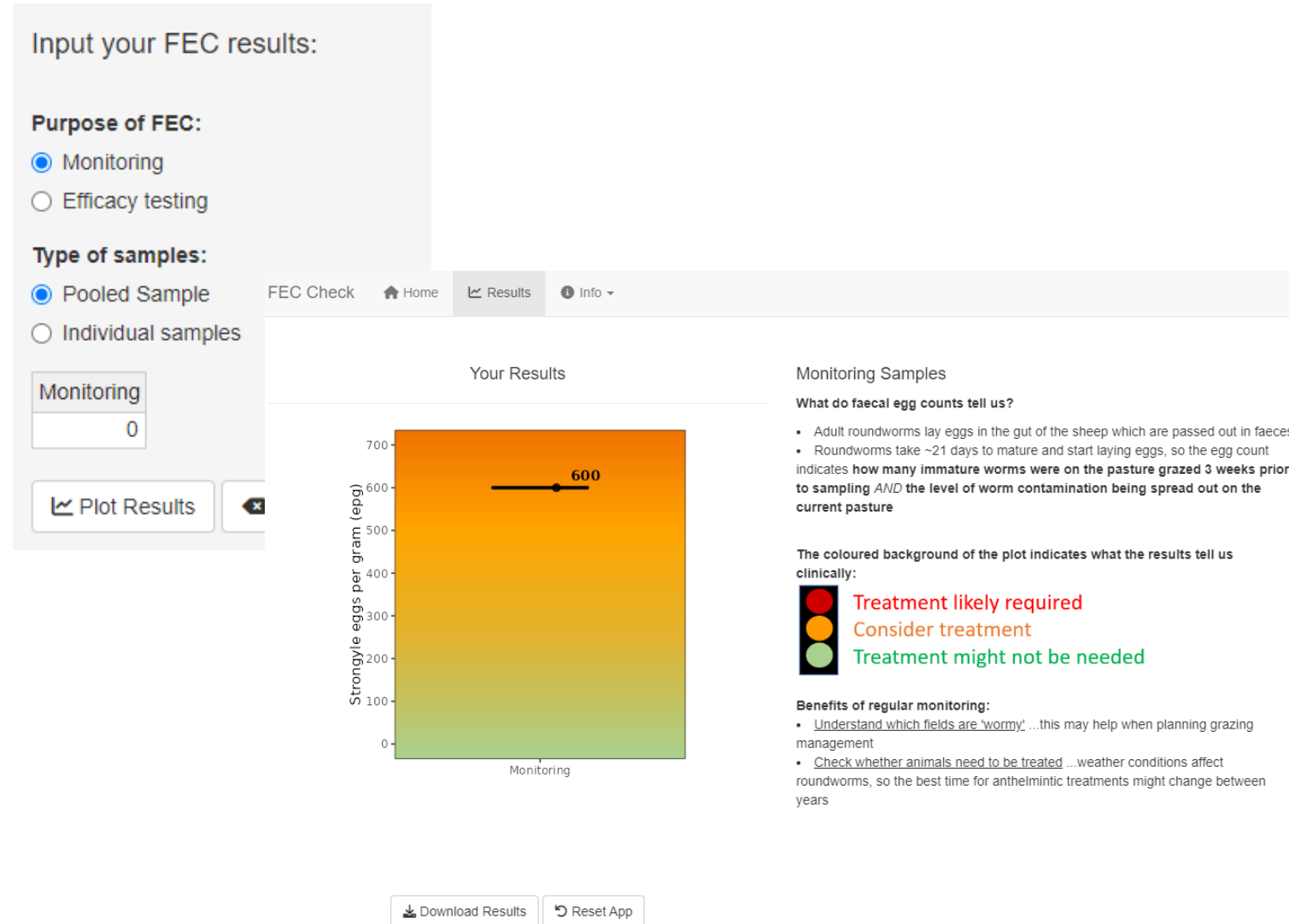


Potential clinical impact



# An app for egg count results

- Prototype designed in R Shiny
- Farmers input results – receive easy visual advice and resources
- For monitoring and efficacy testing
- Standardises results reporting



# Trialled with farmers and advisors

***“Farmers need the ability to turn data, into information, into knowledge and that is what an app should be able to do.”***

*“What you are doing is really good, spot on”*

*“Vets who are engaged prefer to have farmers that are also interested and engaged”*

*“Good that app explored why we need to treat but biggest challenge will be getting message across”*



*“You will only get out of the app what you put in”*

*“Good for engaging with younger farmers”*

*“As long as it’s easy to use”*

*“If I have the app, I am more likely to do FEC more often if I can build a bigger history which will provide me with a better understanding”*

*“Great tool for people doing FEC at home”*

*“App finetunes it all”*

# FEC Check App

- App launched on Moredun website
- Incorporates feedback
  - usability from initial focus groups
  - accessibility with new features such as post-drench checks
- Results reporting in a mutually beneficial way – quicker and more efficient and enabling greater autonomy guided by good resources
- Includes SCOPS-designed decision tree for managing multiple anthelmintic resistance
- Introduction to app – still going through teething issues and not “officially launched”

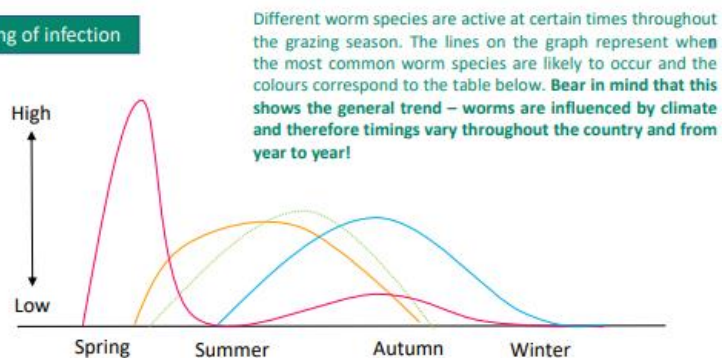


# Results feedback of complex species ID

## Roundworms infecting sheep in the UK

Roundworms are one of the top five commonly diagnosed issues in sheep and cattle, costing the European sheep industry an estimated £185 million per year, therefore targeted, effective control is a top priority. Like bacteria and viruses, there are many different types of roundworm which infect livestock, known as worm species. Although often treated as a single infection, there are differences between these worms; when they are typically seen, symptoms of infection and wormer-resistance status. Knowledge of which type of worms you are treating and which drugs are effective will allow for informed choices and more effective control.

### Timing of infection



Species	Common name	Symptoms	Severity of symptoms
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<u>Nematodirus</u>	Thread-neck worm		High
<u>Teladorsagia</u>	Brown stomach worm		High
<u>Haemonchus</u>	Barbers' pole worm		High
<u>Trichostrongylus</u>	Black scour worm		Medium

For more information on sheep roundworms and their control visit [scops.org.uk](http://scops.org.uk) and [moredun.org.uk](http://moredun.org.uk)



## Project results so far

Roundworm eggs were saved from the faecal samples sent in throughout the grazing season to see which species (type of worms) were present and which survived treatment.

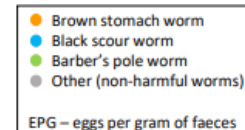
Remember - each species develops wormer-resistance independently, therefore resistance in one species doesn't necessarily mean that all species will be resistant. Although infections are normally mixed species, the predominant species will vary throughout the grazing season (see graph on page 1). Knowing which drugs work against which species lets you target wormer choices effectively.

For example... a drug effective against black scour worm but not brown stomach worm may be most useful in late summer/autumn when the black scour worm is most common.

### Below is a summary of the results from your farm...

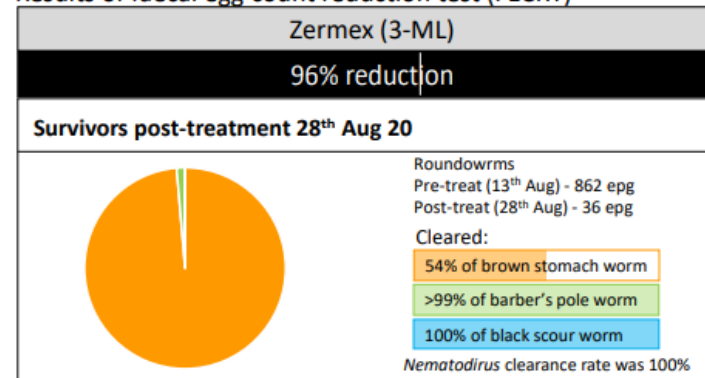
The colours in the pie charts represent the roundworm species present before and after treatment and match the colours used in page 1 (this analysis includes only roundworms, not *Nematodirus*).

### Home farm



Predominant worm species on your farm in late summer (August) before treatment was barber's pole worm (79%), black scour worm (11%) and brown stomach worm (9%) were also present.

### Results of faecal egg count reduction test (FECRT)





# Funding



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# Thanks to.....

FOCUS FARMERS



THE UNIVERSITY of EDINBURGH  
The Royal (Dick) School of Veterinary Studies



Dr Andrew Duncan

Dr Kate Lamont

Moredun parasitology team





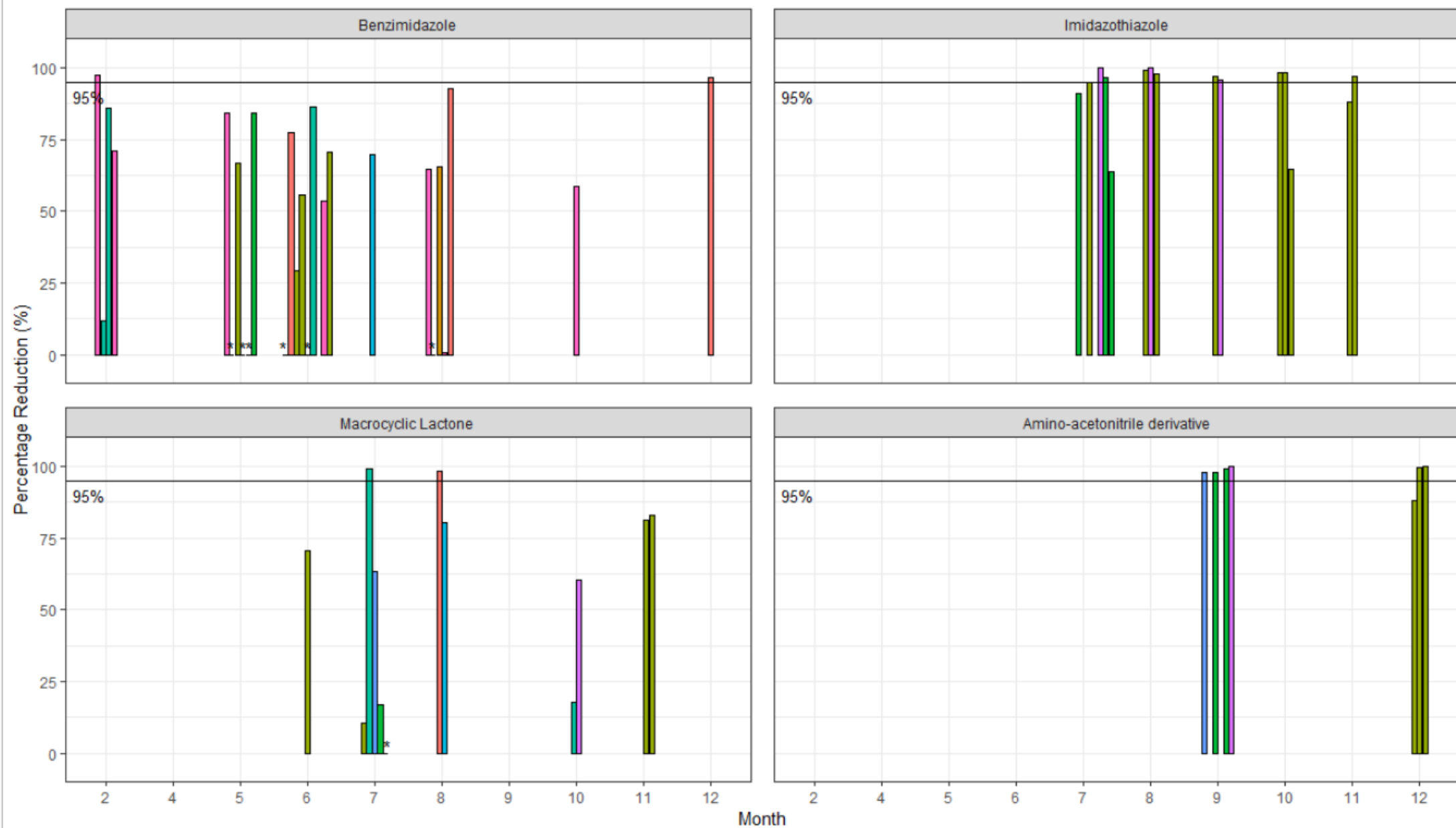
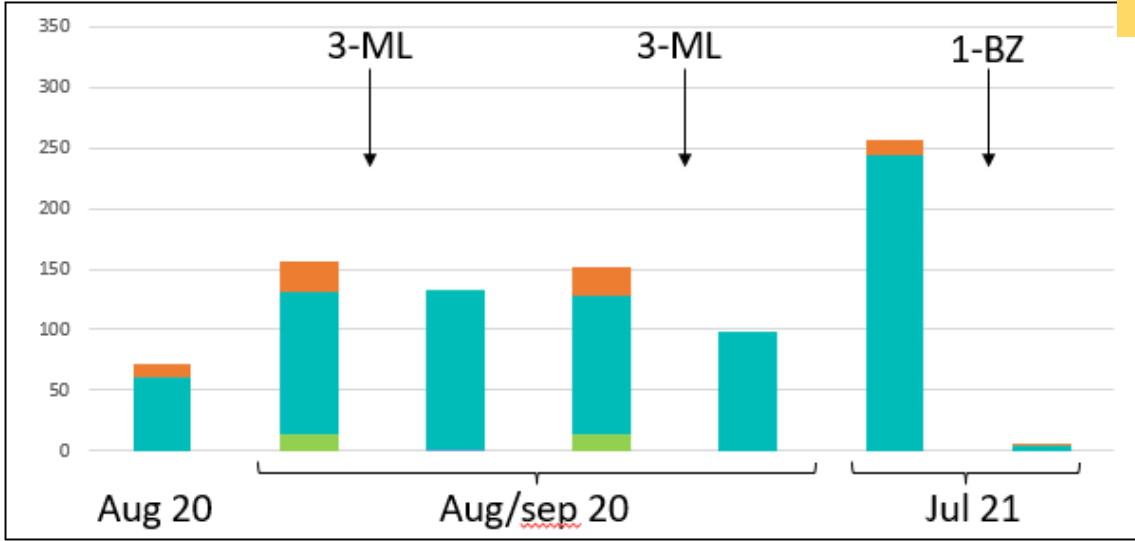


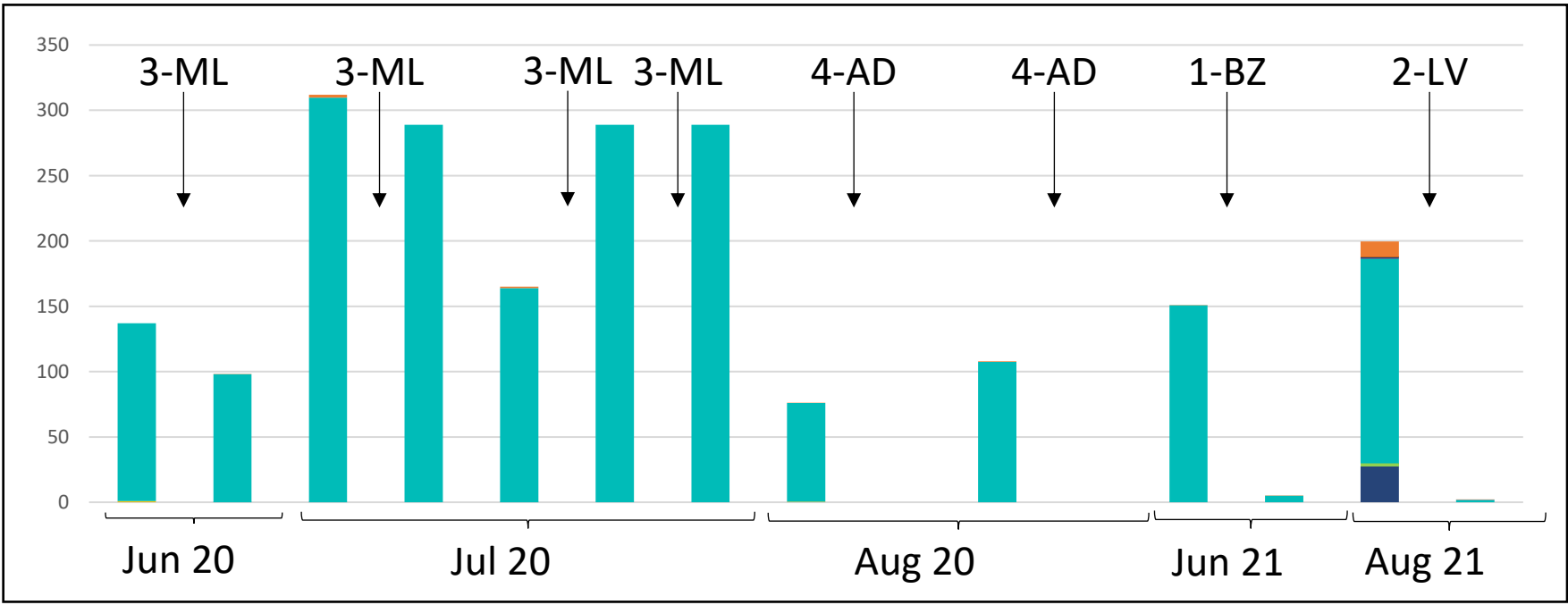
Figure 6

My individual farm data looks like this...it's a bit messy and Eilidh's probably shows the point more clearly. Let me know if you need mine though

Management group 1



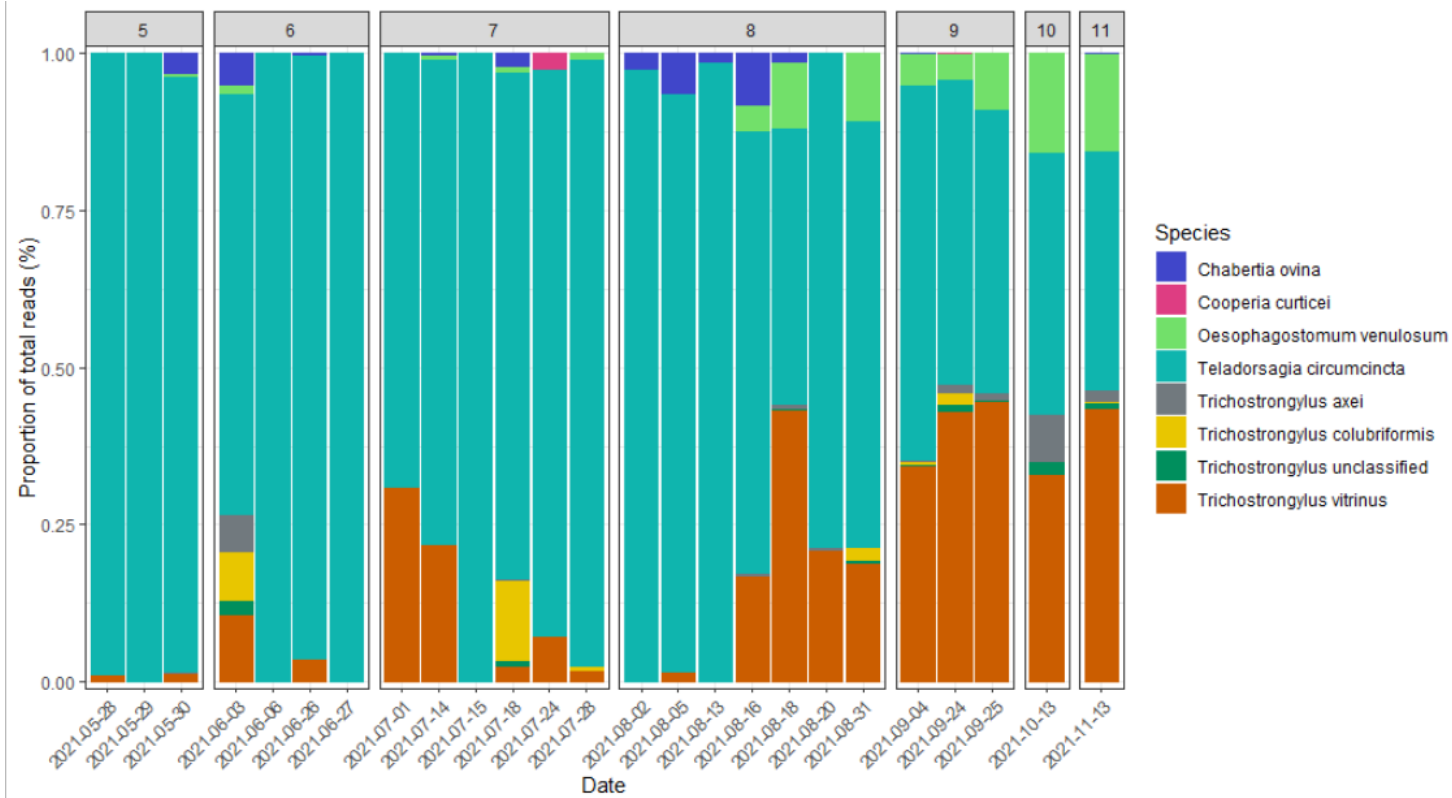
Management groups 2&3



- *T. circumcincta*
- *T. vitrinus*
- *Oesophagostomum*
- *Chabertia*

# Species diversity

At time of treatment – faceted by month



- Samples from lambs at time of treatment & post-treatment
- DNA extracted from eggs (pooled across submission)

Post-treatment

