

# Novel Approaches To Parasite Control in Small Ruminants

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# Southern Consortium on Small Ruminant Parasite Control

[www.scsrpc.org](http://www.scsrpc.org)

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# SCSRPC Projects

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- FAMACHA validation and evaluation
- Copper-oxide wire particle bolus
- Condensed tannin containing forage
- Integrated approaches
- Host resistance
- Nematophagous fungi

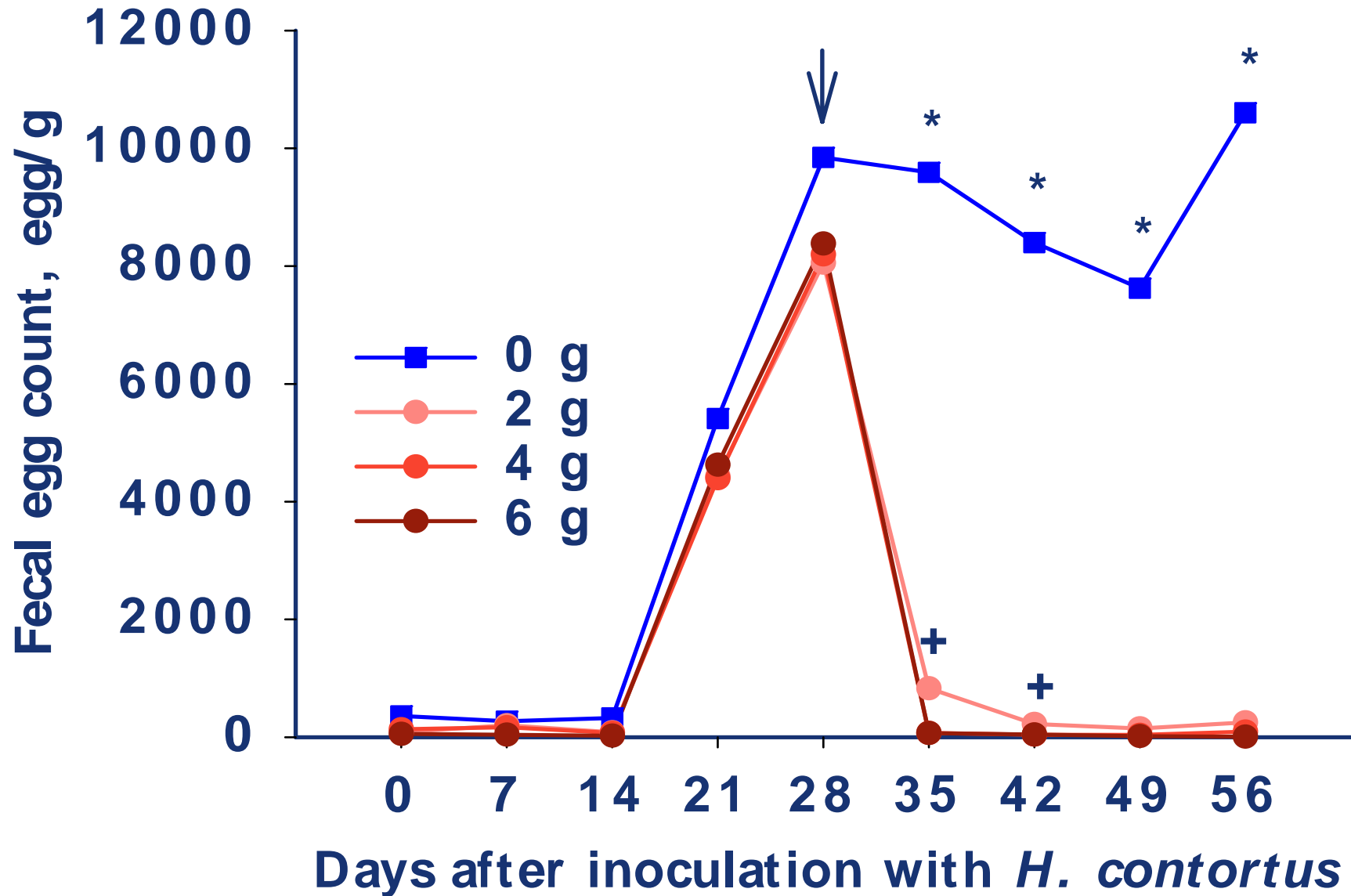
# Copper-oxide wire particle bolus (COWP)

- Copper oxide wire particles have been used to treat copper deficiency
- COWP is retained in the folds of the abomasum where free copper is released
- Results in expulsion or death of *H. contortus*
- Increasing dose of COWP leads to greater concentrations of copper in the liver
- Low doses (0.5 and 1 g) have been effective in reducing *H. contortus*

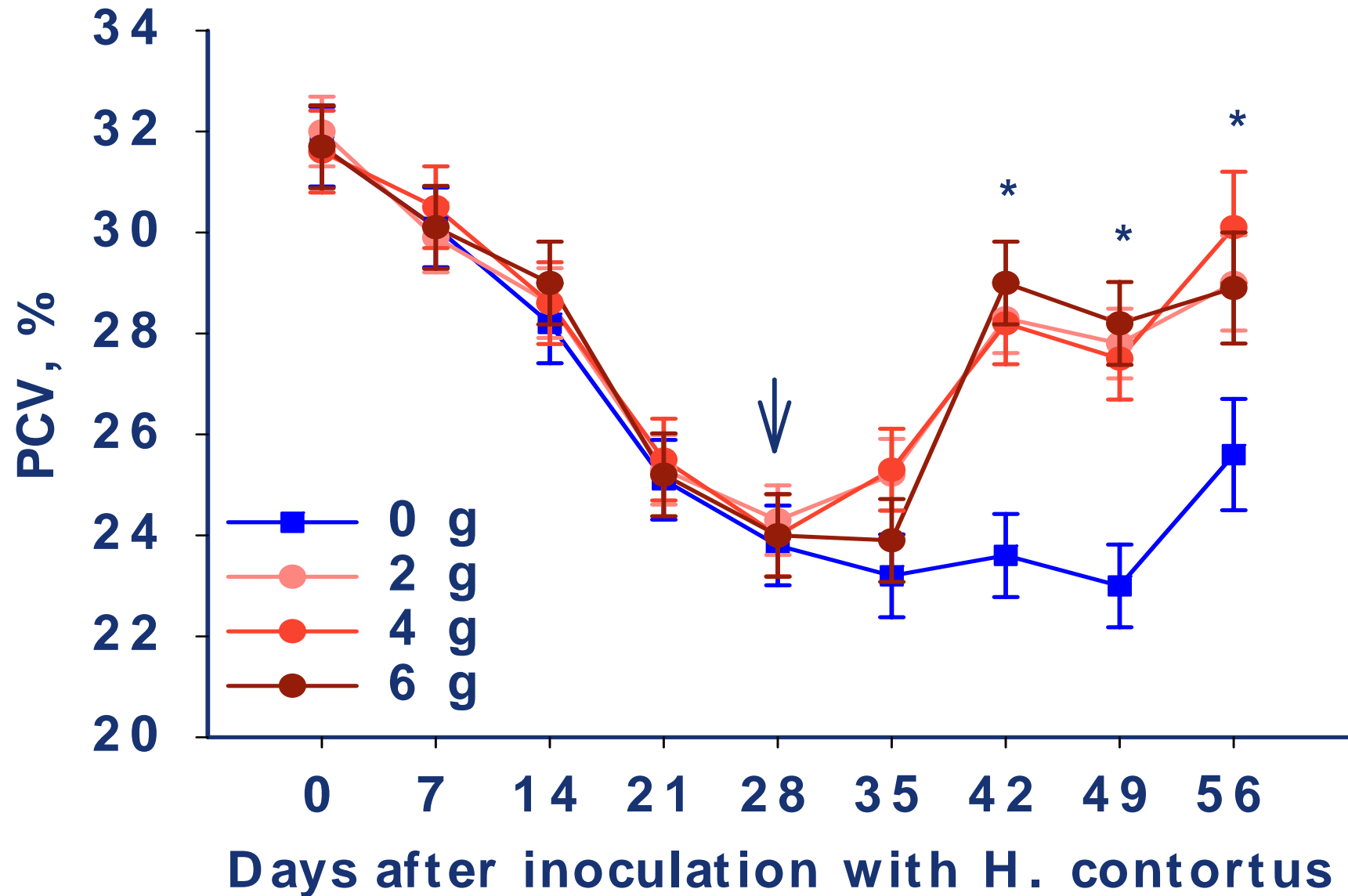
# Copper oxide wire particles (COWP)



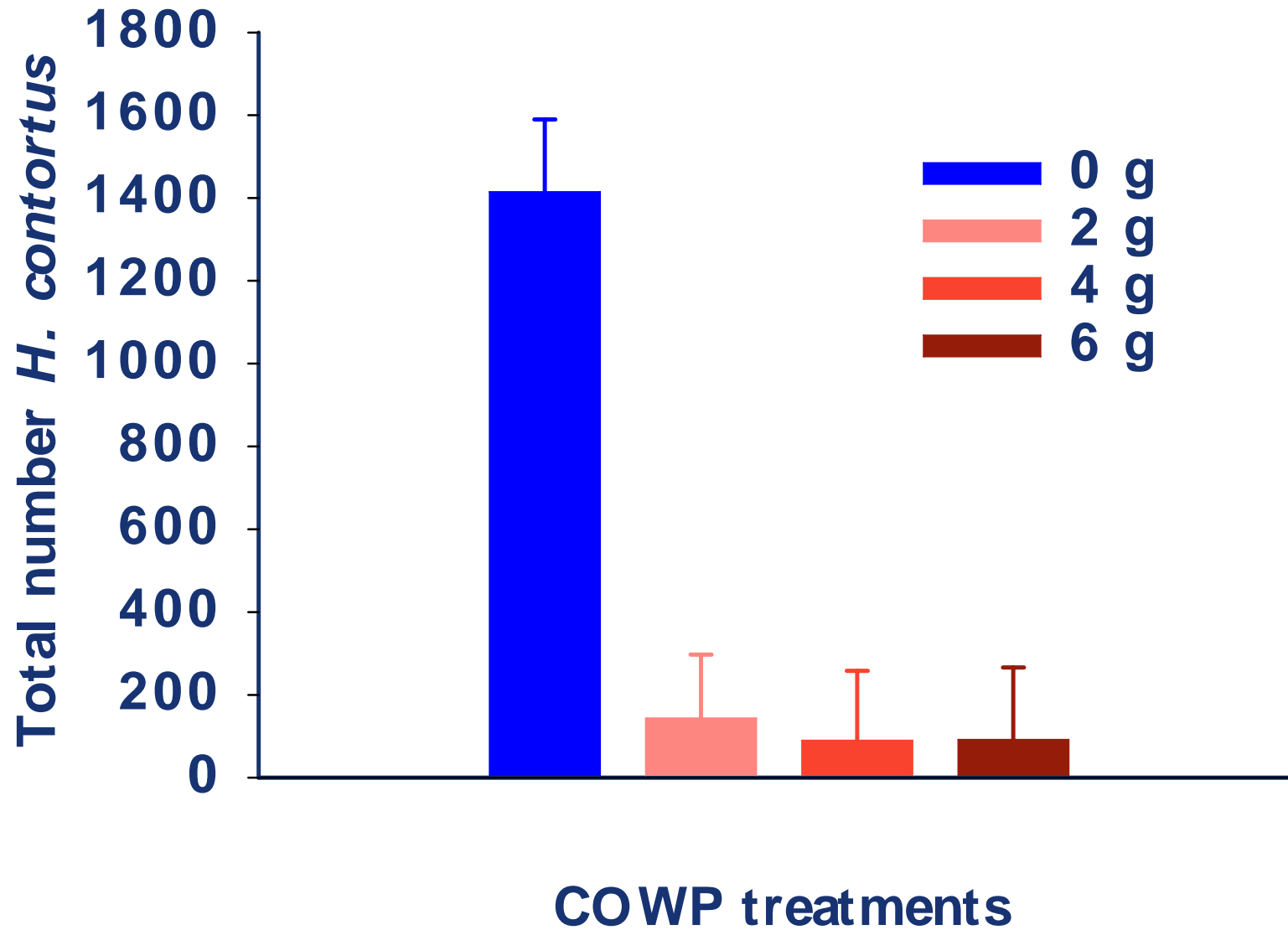
# Effect of CO WP on FEC



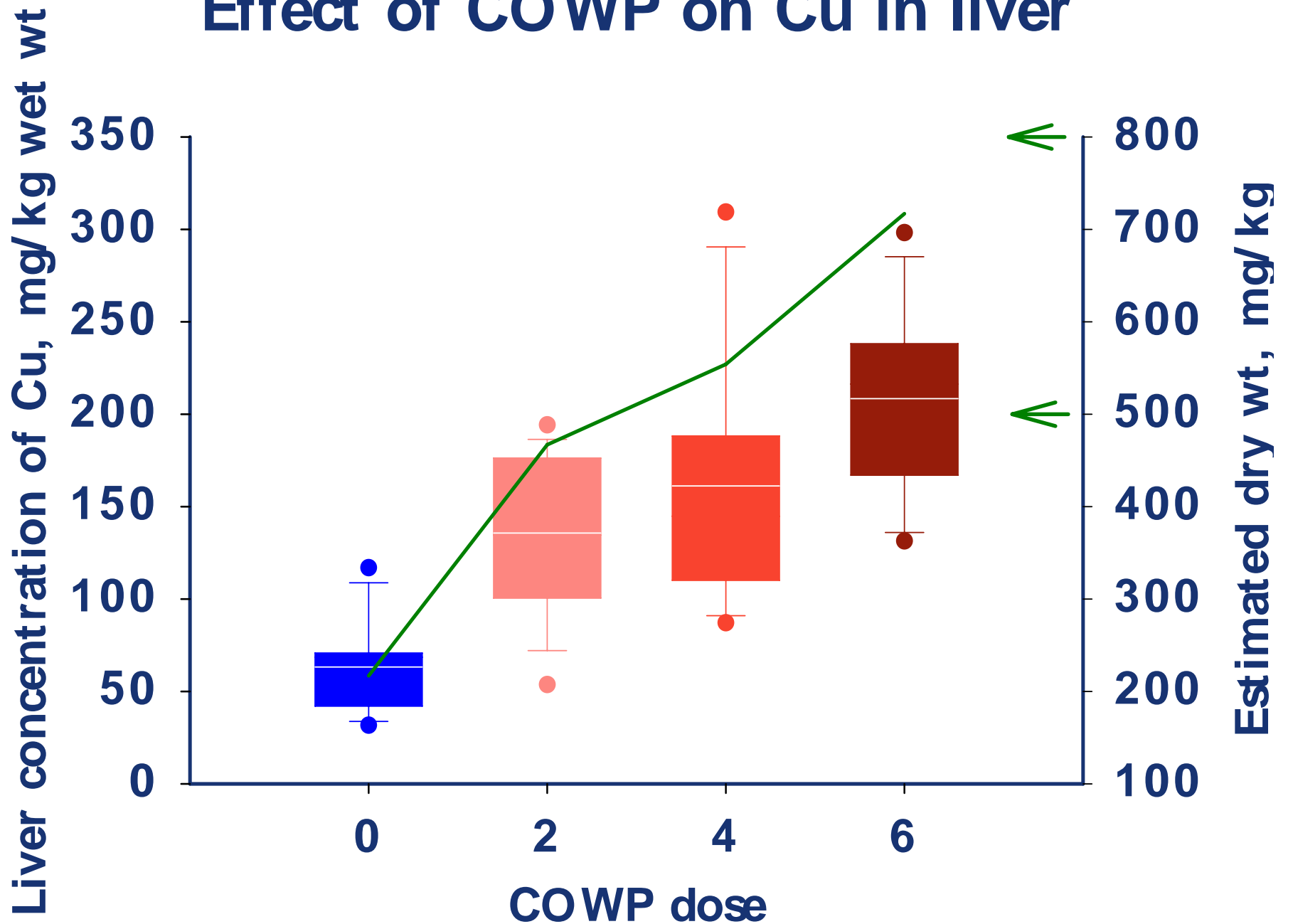
# Effect of CO WP on PCV

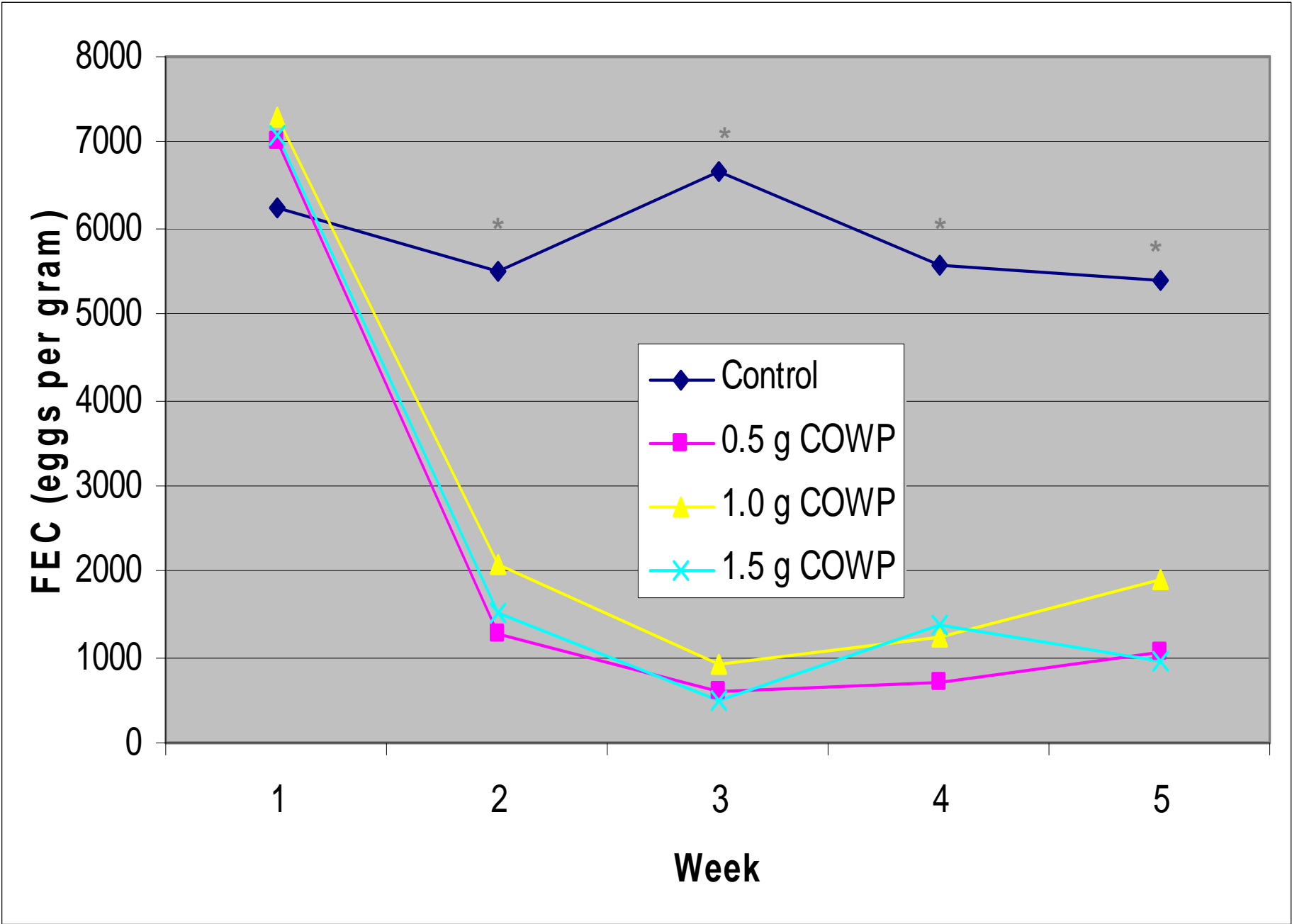


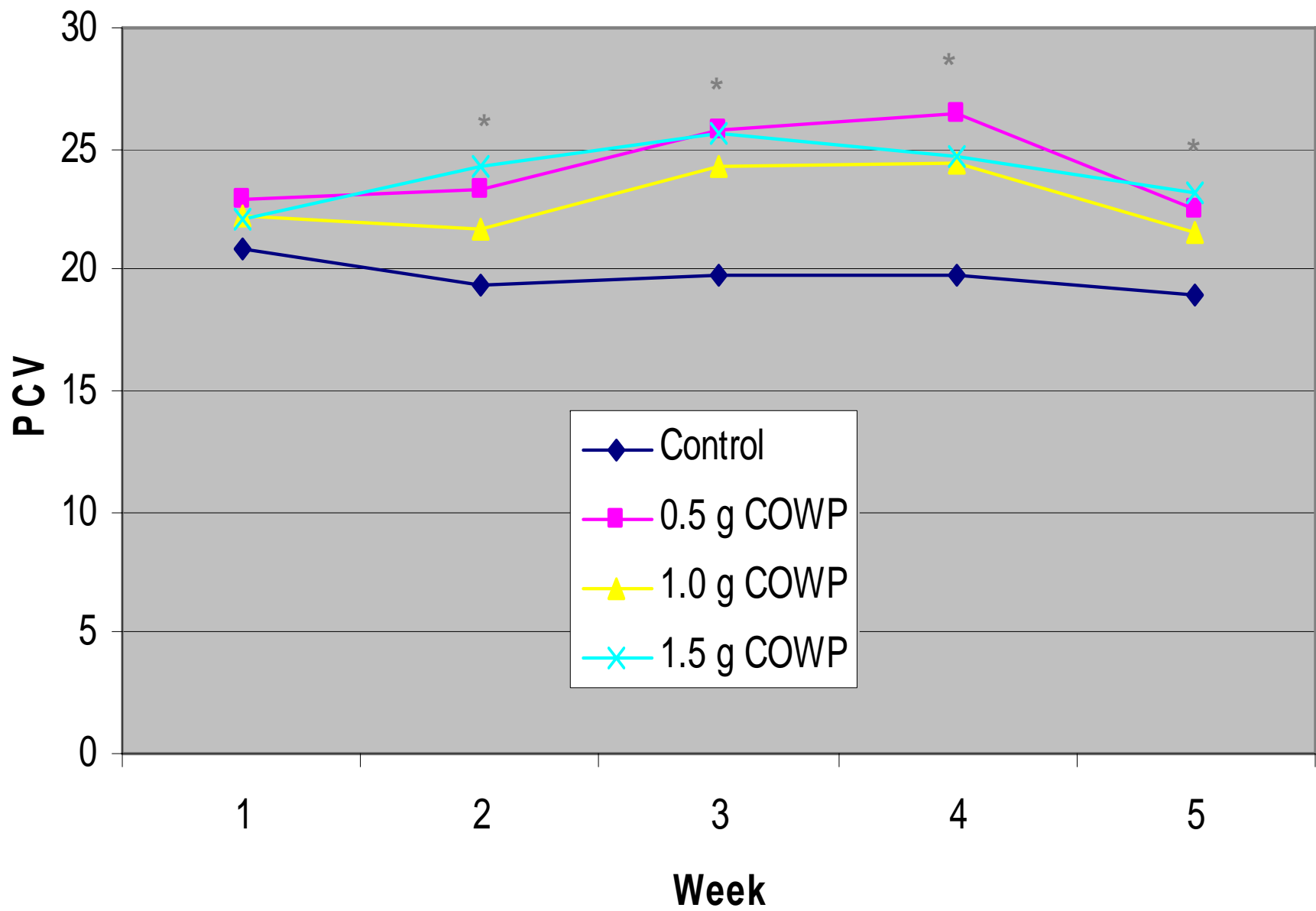
# Effect of COWP on abomasal worm counts



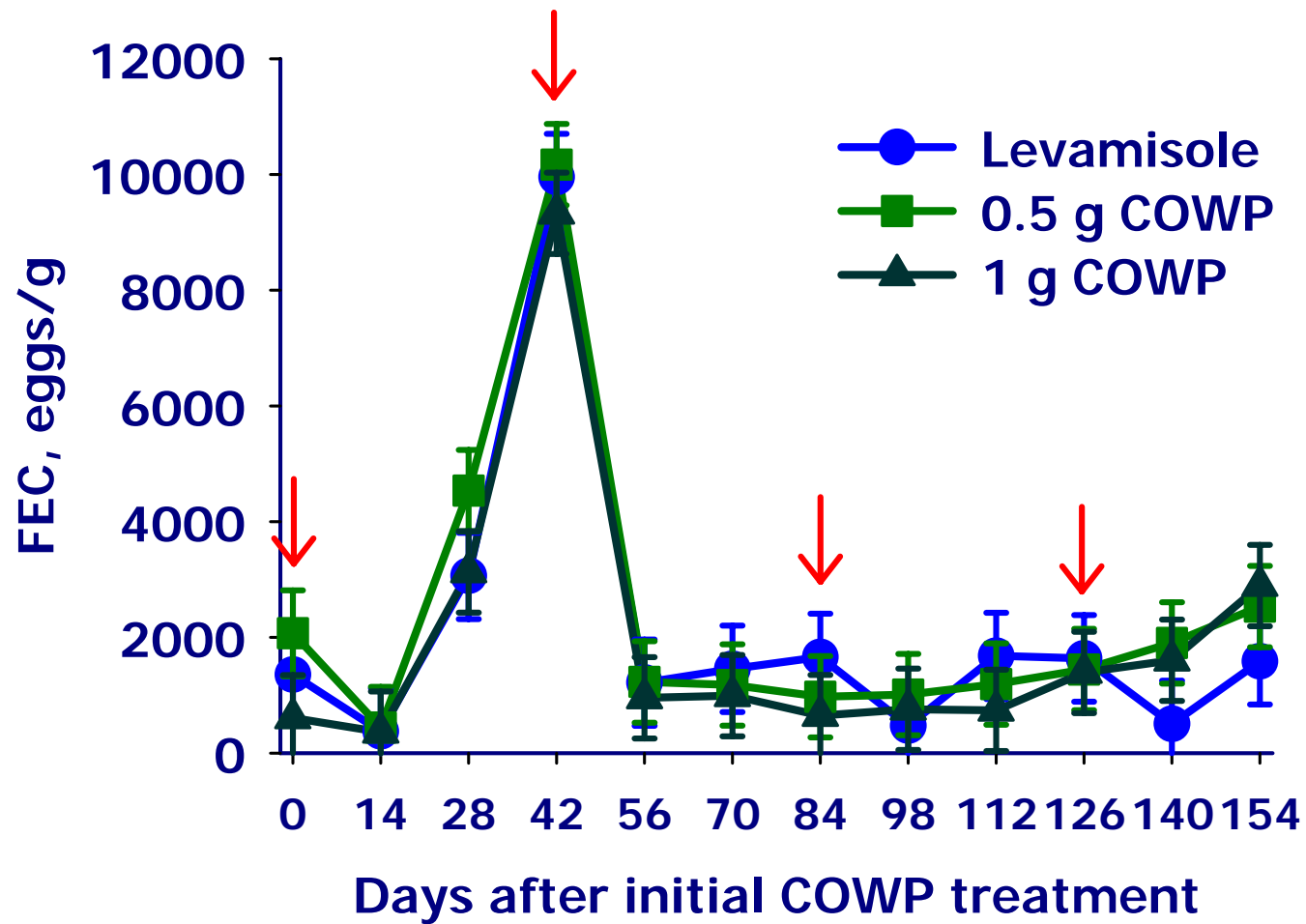
# Effect of COWP on Cu in liver



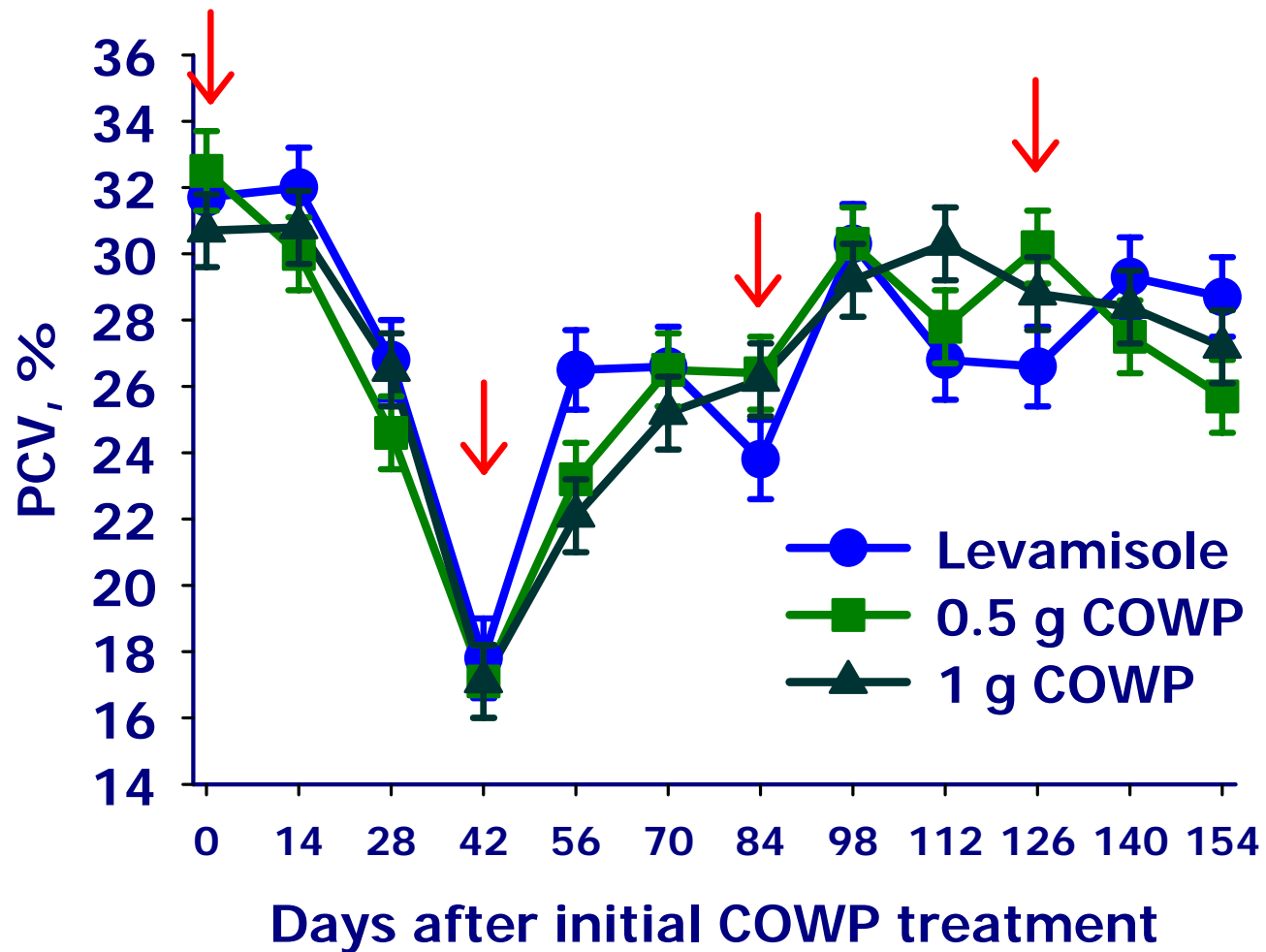




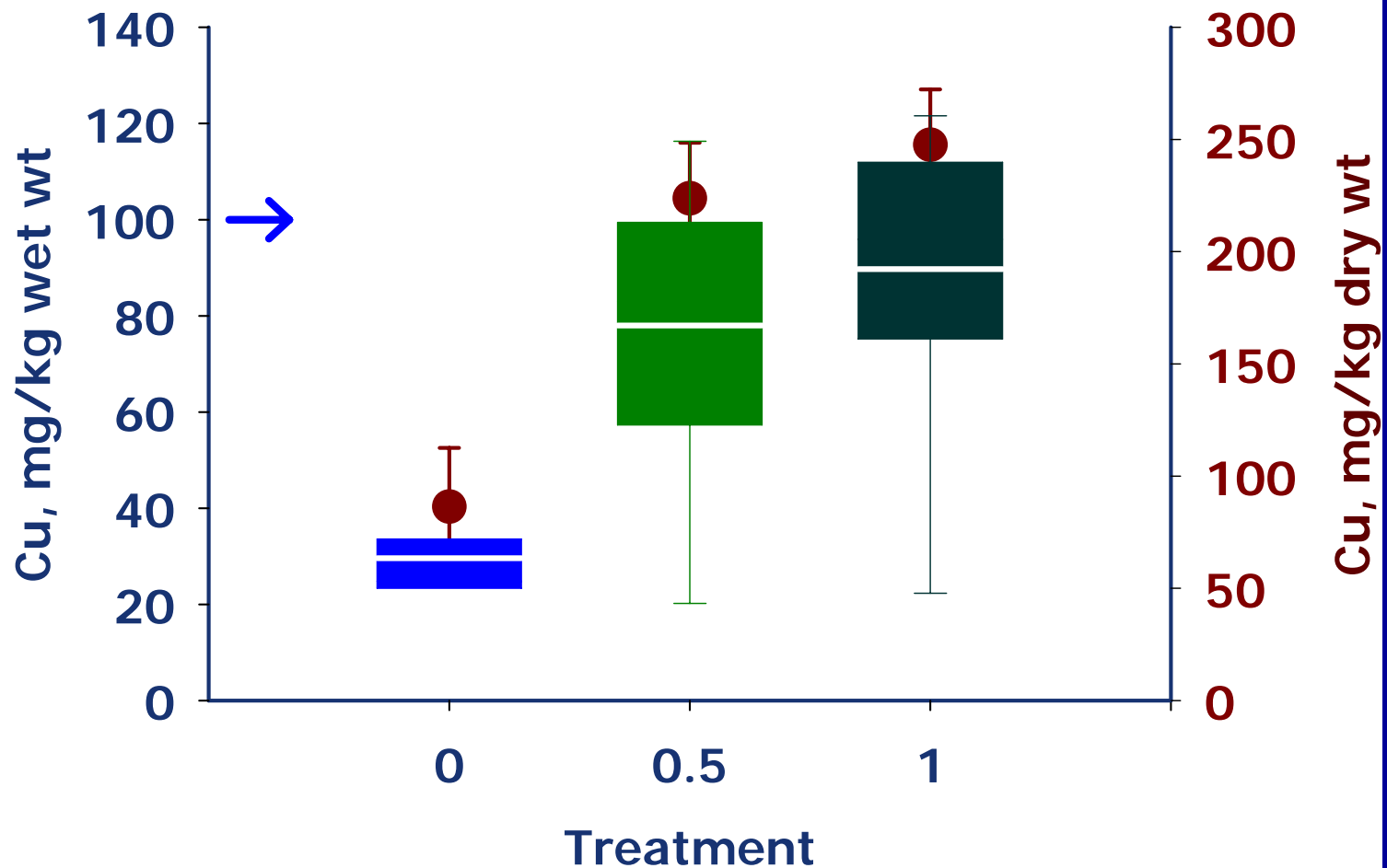
# Effect of COWP on FEC



# Effect of COWP on PCV



# Effect of COWP on Liver Copper Concentrations



# Bioactive Forages

## Condensed Tannins (CT)

- **CT - containing forages**
  - Sericea lespedeza
  - Birdsfoot trefoil
  - Big trefoil
  - Sainfoin
  - Leucaena
- **Purified CT**
  - Quebracho

# Condensed Tannins In Forages

- **Vary in concentration**
  - Alfalfa (none)
  - Birdsfoot trefoil (2-3 %)
  - Big trefoil (4-5 %)
  - Sericea lespedeza (6-7 %)
  - Canary clover (14%)
- **Vary in reactivity**
  - Birdsfoot trefoil CT (low reactivity)
  - Sericea lespedeza CT (high reactivity)

# Condensed Tannins In Ruminant Diets

- Plant CT - occur in 'free' and 'bound' forms
- CT binds to protein at neutral pH (rumen)
- CT disassociates from protein under acid conditions (abomasum)
  - increases bypass protein
- CT not absorbed from the GIT

# **Beneficial Effects Of Condensed Tannins**

- **Increased net absorption of EAAs**
- **Increased wool growth and growth rate**
- **Increased liveweight gain**
- **Higher ovulation rate**
- **Higher milk yield**
- **Reduced bloat**
- **Reduced effects of internal parasites**

# **Detrimental Effects Of Condensed Tannins**

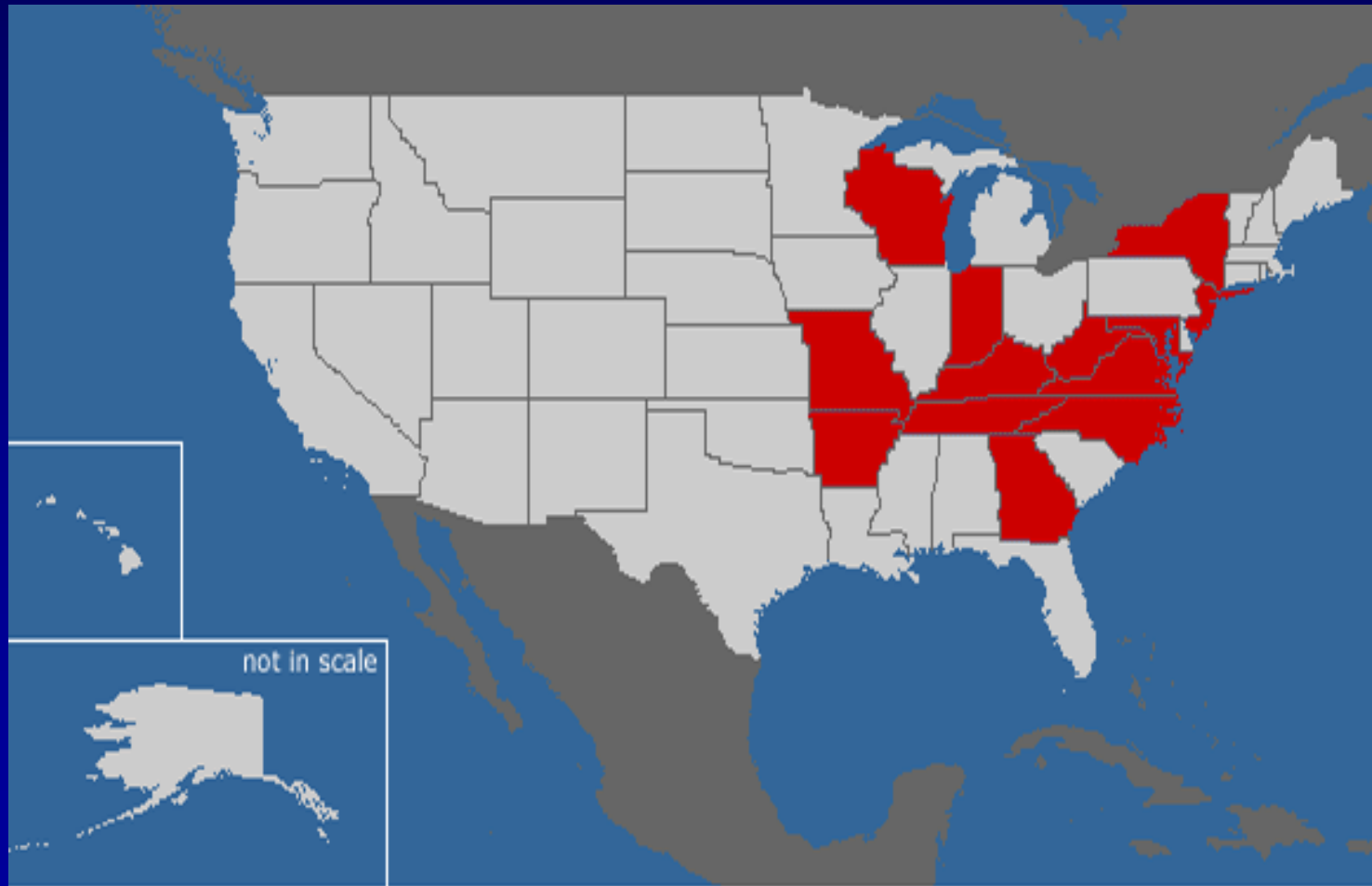
- **Reduced dry matter intake**
- **Decreased fiber digestibility**
- **Reduced wool growth**
- **Reduced digestion of amino acids  
in SI**
- **Reduced N and S digestion**

# Sericea Lespedeza

(*Lespedeza cuneata*)



# State Where *Sericea Lespedeza* is Reported as an Invasive



# Sericea Lespedeza

- Legume forage - first introduced in the US in the early 20<sup>th</sup> century for erosion, different varieties
- Course, stemmy plant that has been declared a “noxious weed” by the Kansas Legislature
- Drought-tolerant, non-bloating leafy perennial – resistant to diseases through plant breeding, resistant to insects
- Can be grazed, fed as hay or a ground feed
- High in condensed tannins



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## Sericea lespedeza hay as a natural deworming agent against gastrointestinal nematode infection in goats

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# Fecal Egg Count Data

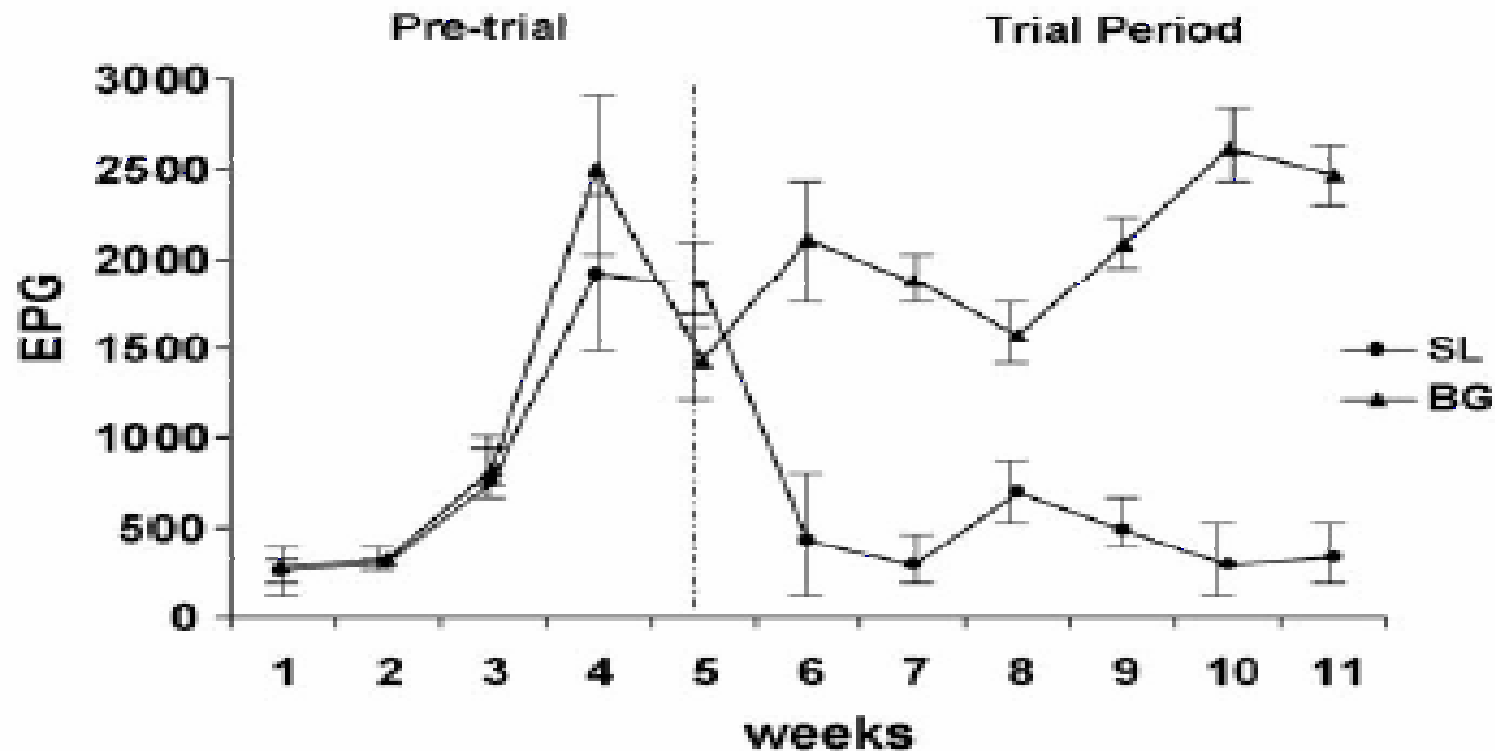


Fig. 1. The effect of feeding sericea lespedeza (SL) or bermudagrass (BG) hay on eggs per gram (EPG  $\pm$  S.E.M.) of feces from parasitized goats.

# Blood Packed Cell Values

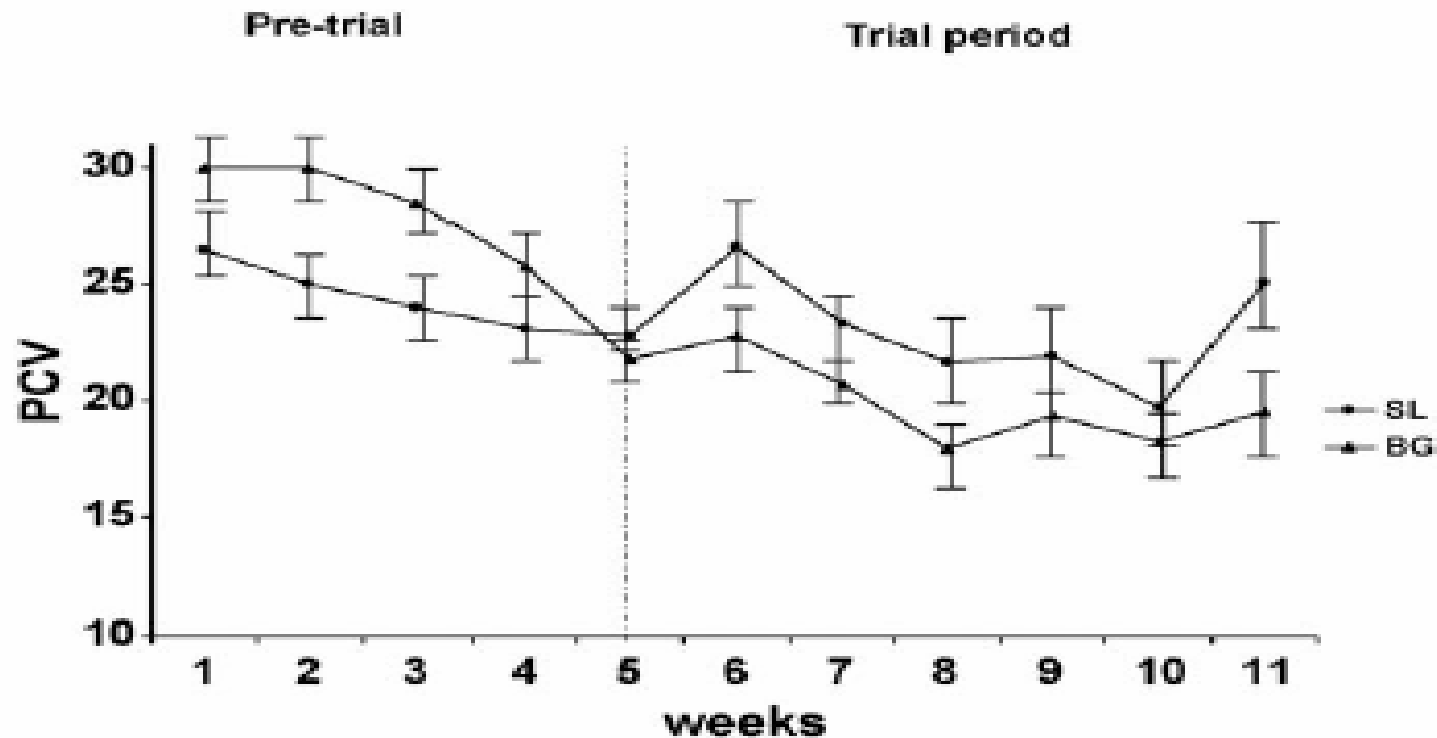


Fig. 2. The effect of feeding sericea lespedeza (SL) or bermudagrass (BG) hay on blood packed cell volume (PCV  $\pm$  S.E.M.) of parasitized goats.

# Fecal Culture Results

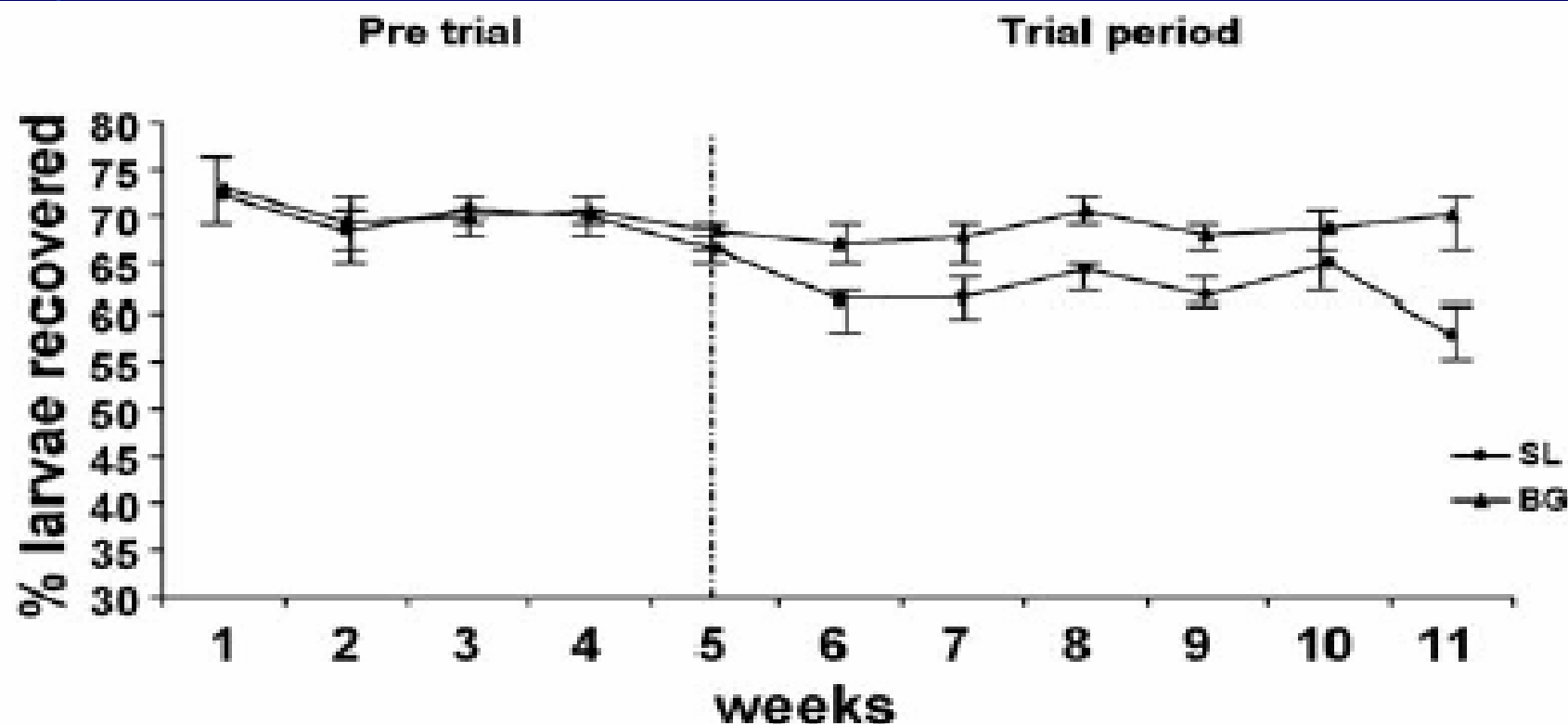


Fig. 3. The effect of feeding sericea lespedeza (SL) or bermudagrass (BG) hay on % nematode larvae recovered from feces of parasitized goats ( $\pm$ S.E.M.).

# Culture Results

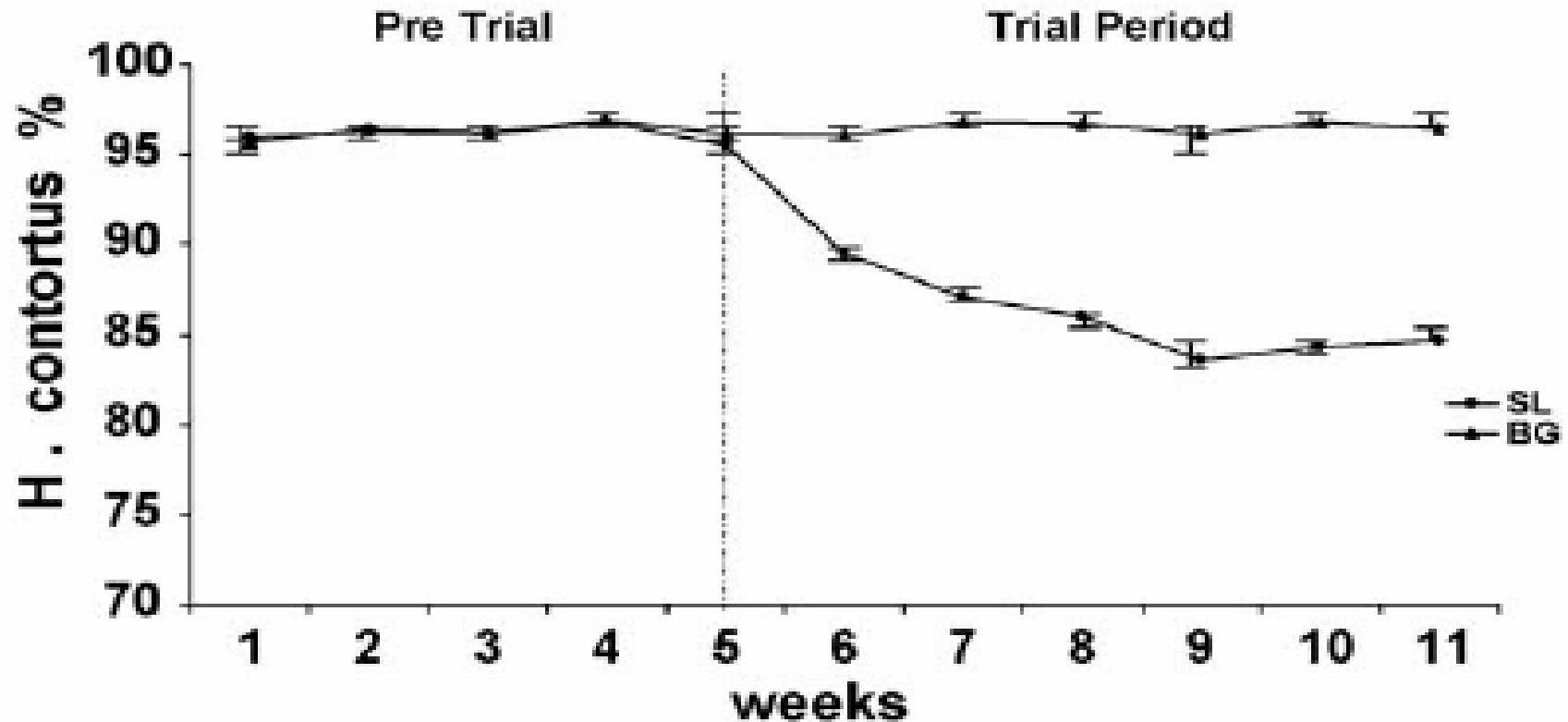


Fig. 4. The effect of feeding sericea lespedeza (SL) or bermudagrass (BG) hay on % *H. contortus* ( $\pm$ S.E.M.) in nematode larvae recovered from feces of parasitized goats.

# Results - Adult Nematodes

Table 2

Total male and female nematodes in abomasum and small intestine of parasitized goats fed sericea lespedeza (SL) or bermudagrass (BG) hay and a small amount of concentrates

Adult nematodes	Diet			
	BG	SL	S.E.M.	<i>P</i>
Abomasum (total)	3450 a	1359 b	70	<0.001
<i>H. contortus</i>	2728 a	834 b	68	<0.001
Male	1269 a	491 b	25	<0.001
Female	1459 a	343 b	49	<0.001
<i>O. circumcincta</i>	712 a	525 b	22	<0.001
Male	318 a	273 b	12	<0.05
Female	394 a	252 b	20	<0.01
Small intestine (total)	949 a	571 b	39	<0.001
<i>T. colubriformis</i>	949 a	571 b	39	<0.001
Male	417 a	305 b	25	<0.01
Female	532 a	266 b	22	<0.001

Row means with unlike letters differ significantly.

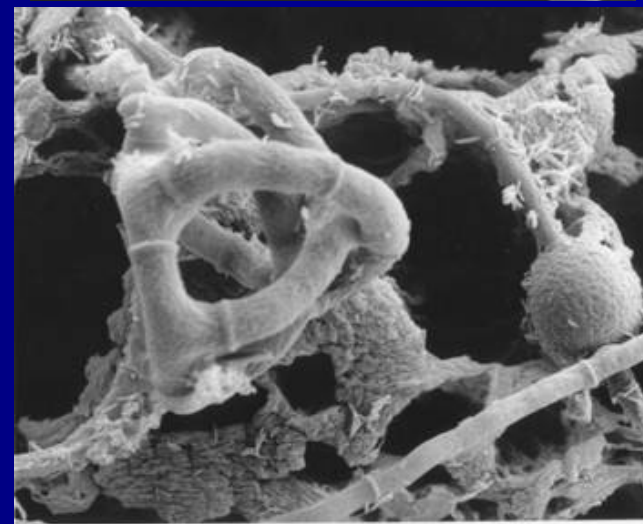
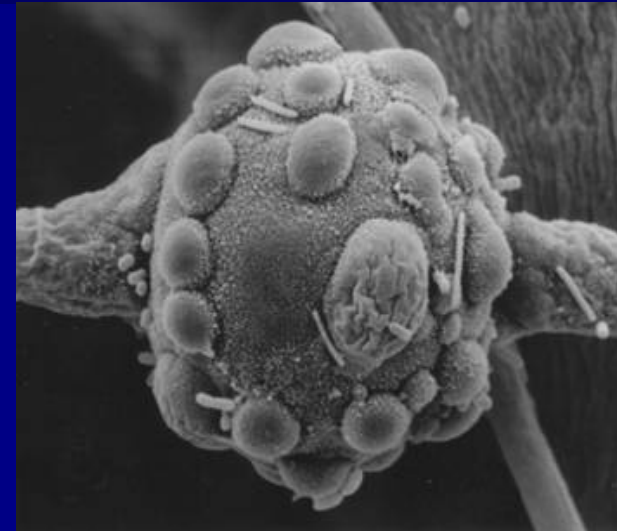
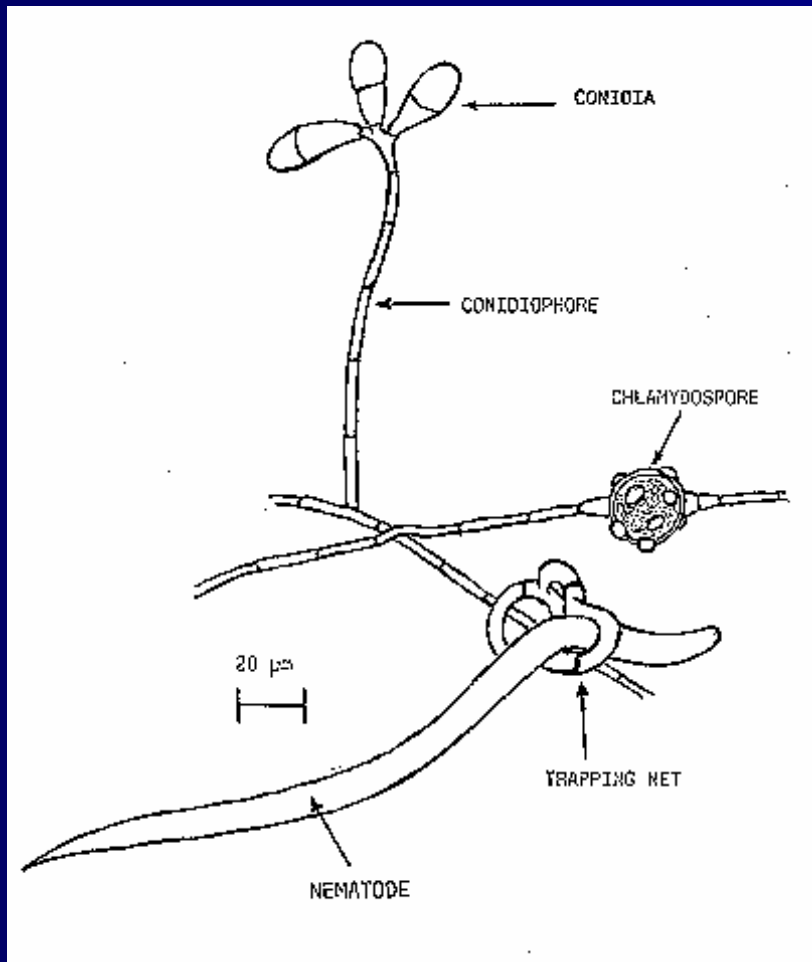
# SL Hay As A Deworming Agent

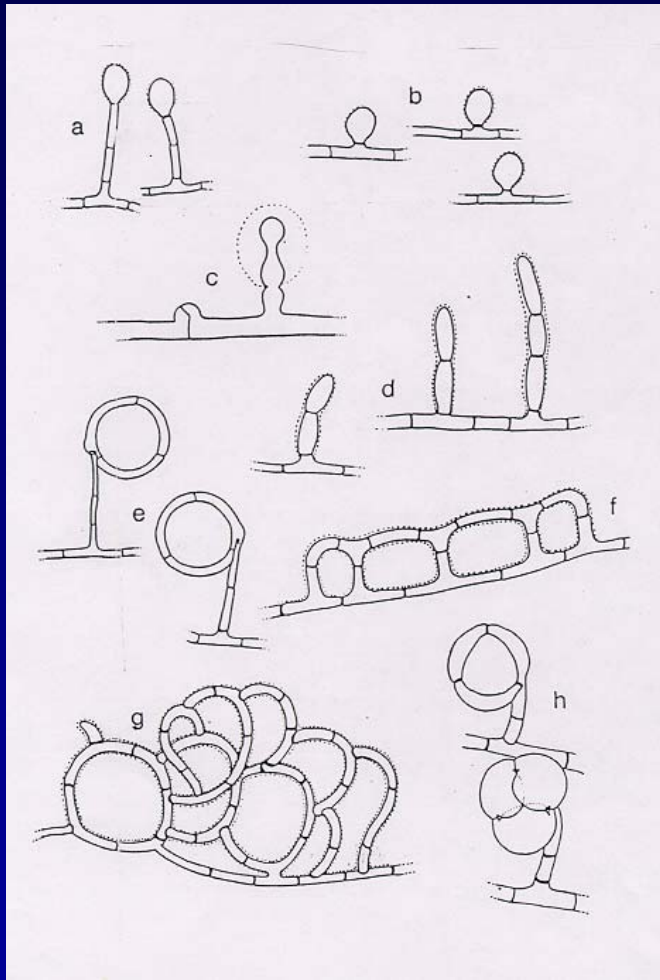
- SL is a crop that can be grazed or cut as hay and acts as a natural dewormer
- It is cost-effective to grow, has agronomic advantages in that it readily grows in acidic or infertile soils common in the SE US
- SL nematocidal effects appear greater than previously reported – may be related to the different types of CT present in various plants and the nutritional effects of different CT

# **Anthelmintic Effects Of CT Summary**

- **Indirect effects**
  - Increased rumen by-pass protein
  - Increased AA absorption to overcome effects of parasitism
  - Improved immune function
- **Direct effects**
  - Toxic to parasite adult worms or larvae
  - Reduced egg viability in feces

# Nematophagous (nematode-trapping) fungi





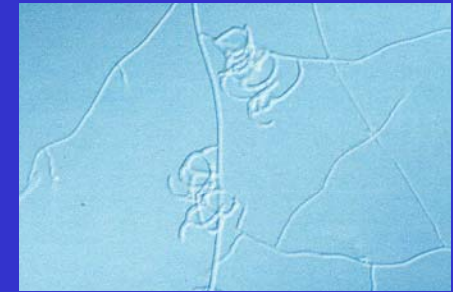
Adhesive hyphae



Adhesive knob

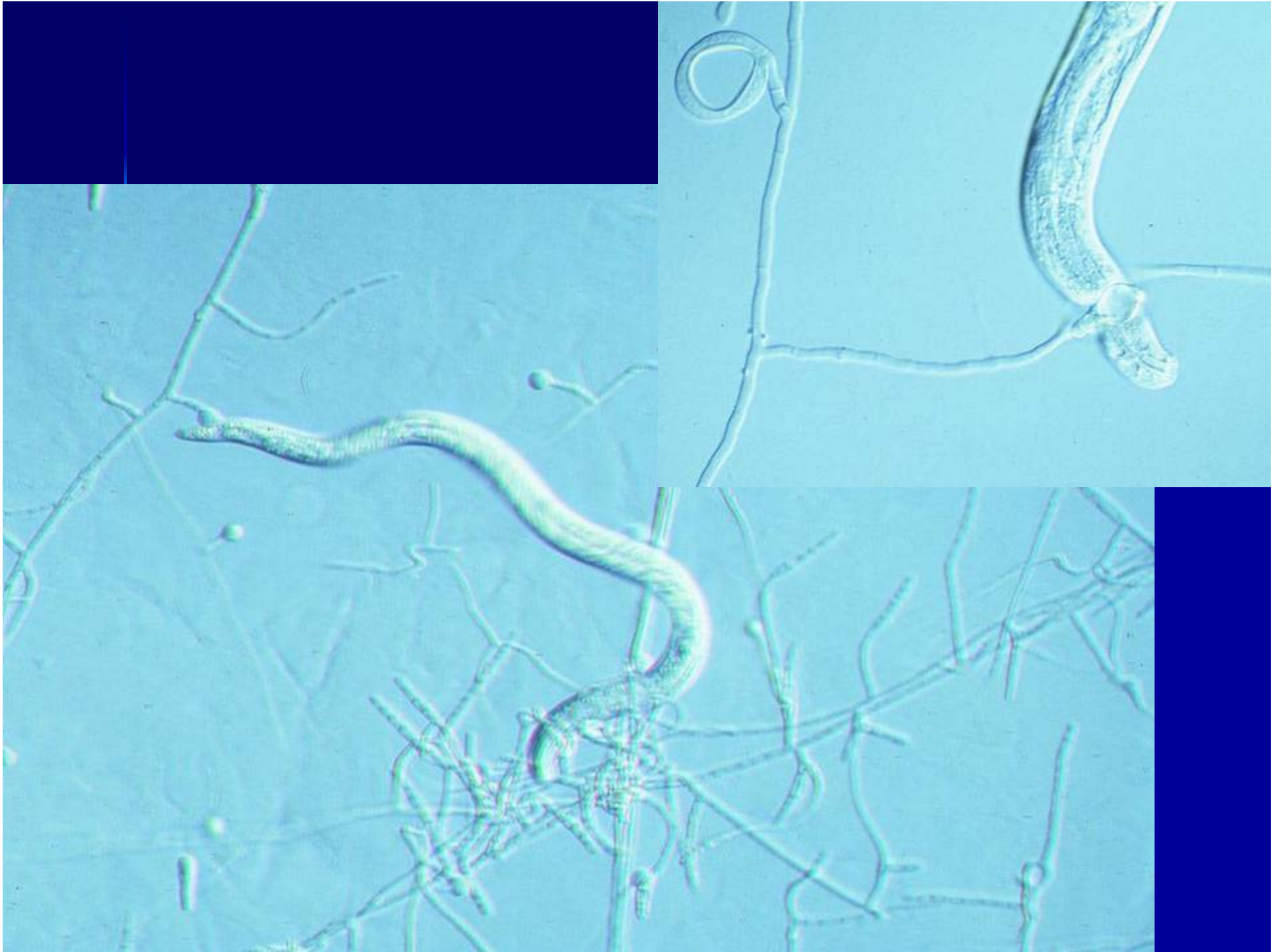


Adhesive network

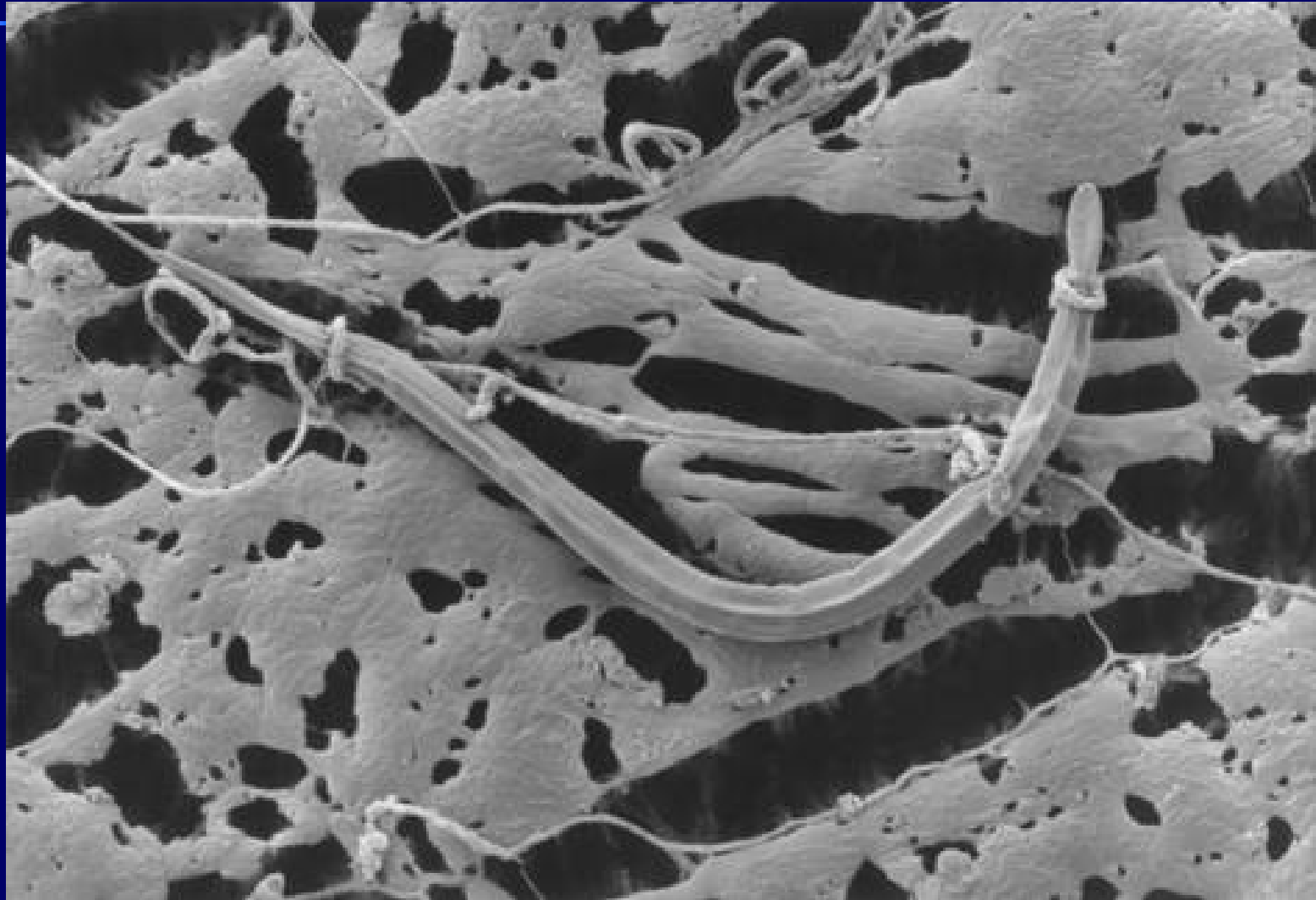


Constricting ring





# Nematophagous (nematode-trapping) fungi

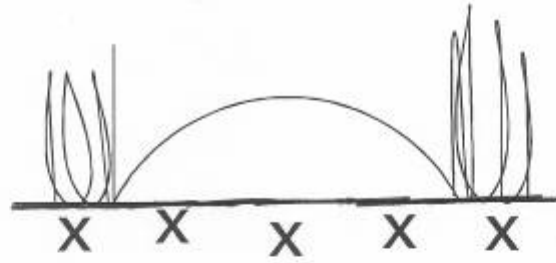


# Distribution of *Duddingtonia flagrans*

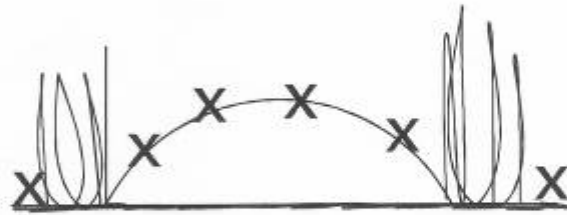
- Found worldwide
  - Dung
  - Soil, rich in organic matter
  - Biological sewage plants



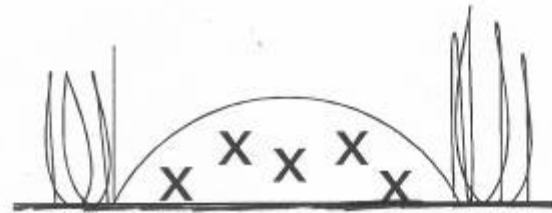
A



B



C



# Biological Control & Predacious Fungi

- **Preventive only – not a therapeutic:**
  - Only active against free-living larvae of parasitic nematodes
  - No effect on adult stages inside the host
  - Reduce pasture larval infectivity
  - Reduced parasitism & increased production over a long grazing period

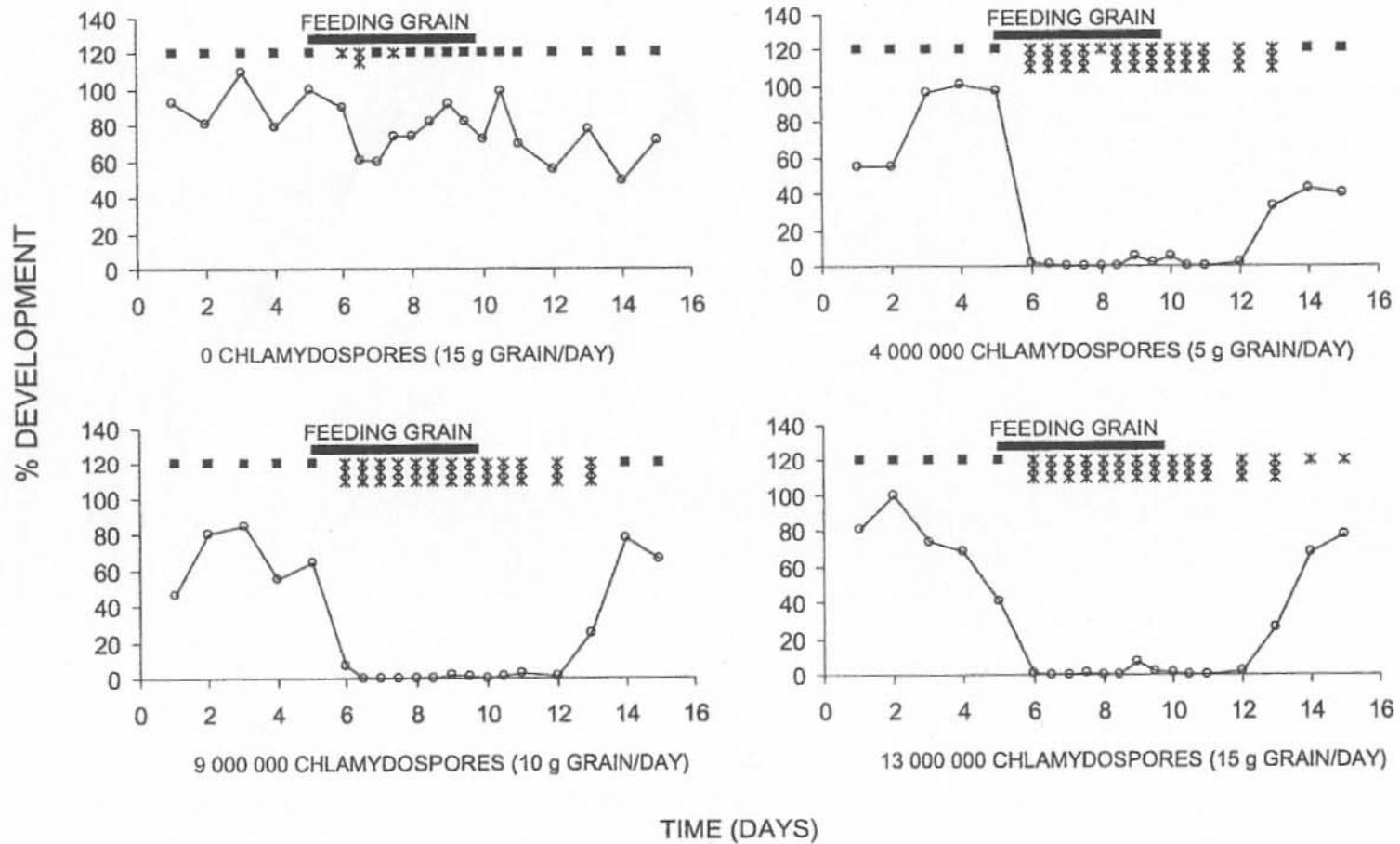


Fig. 2. Mean percentage development of nematode eggs to infective larvae in lambs fed 5, 10 and 15 g of *D. flagrans* barley grains for 5 days: (○—○) percent larval development; (■) no *D. flagrans* growth; (×) *D. flagrans* growth on 1 of 3 cultures; (⊗) *D. flagrans* growth on 2 of 3 cultures; (⊘) *D. flagrans* growth on 3 of 3 cultures.

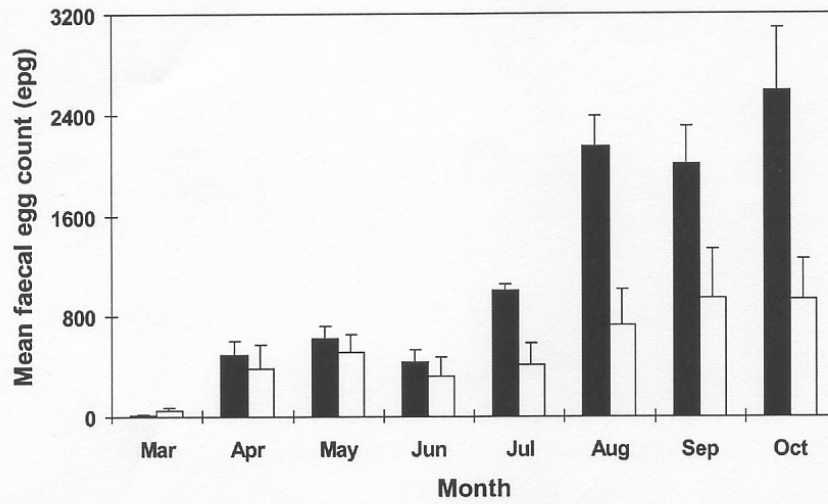


Fig. 2. Treatment mean faecal egg counts (+S.E.) for young sheep fed the *D. flagrans* supplement (□) or not given *D. flagrans* (■).

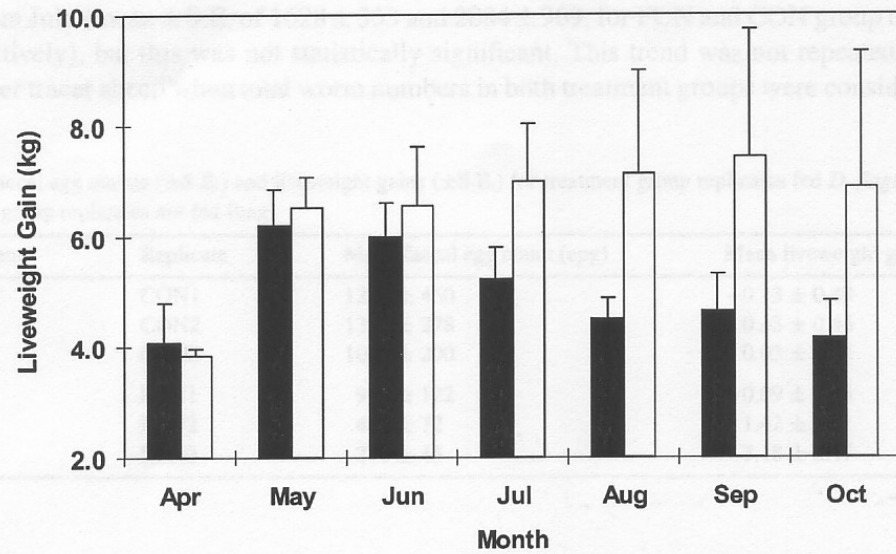


Fig. 3. Treatment mean cumulative liveweight gains (+S.E.) for young sheep fed the *D. flagrans* supplement (□) or not given *D. flagrans* (■).

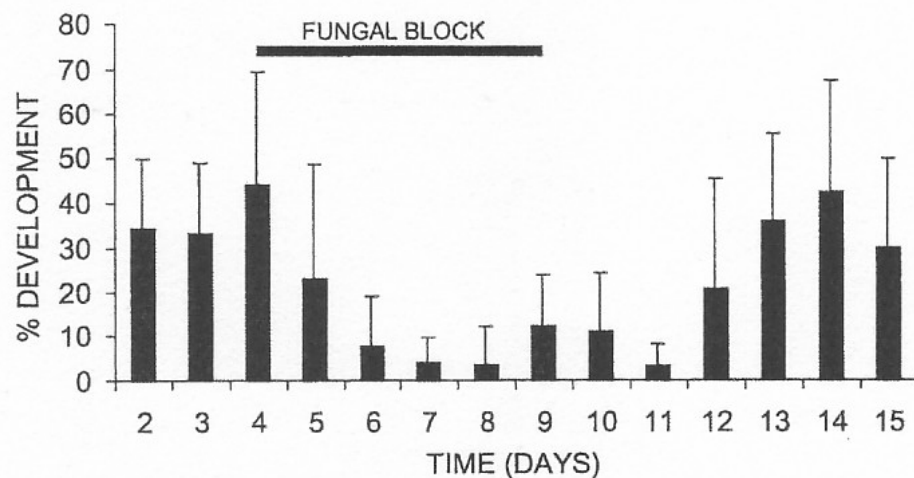


Fig. 3. Mean percentage ( $\pm$ S.D.) development of eggs to infective larvae in lambs offered formulation A fungi block ad libitum for 5 days.

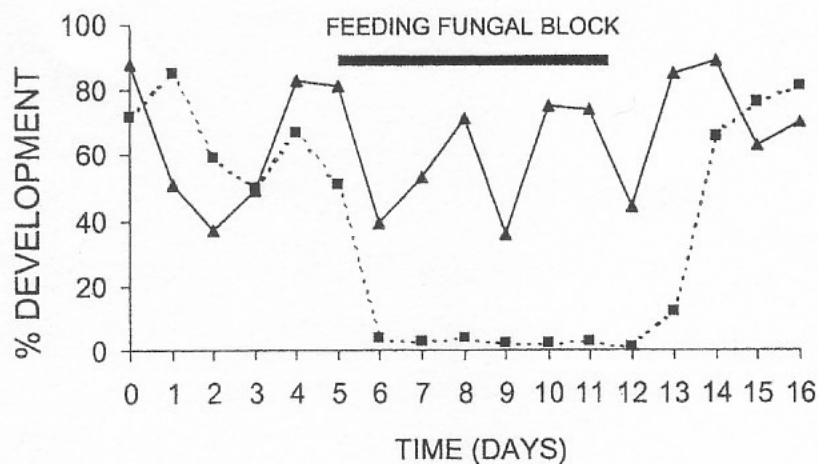


Fig. 4. Mean percentage development of eggs to infective larvae in lambs fed 20 g of compressed block after storage at 5°C for 18 weeks, compared with development of eggs from sheep fed normal block: ( $\blacktriangle$ — $\blacktriangle$ ) percent larval development — normal blocks; ( $\blacksquare$ — $\blacksquare$ ) percent larval development — compressed blocks.

# Acknowledgements

Jim Miller, Tom Terrill, Joan Burke, Michael Larsen and Sue Howell for sharing their slides used in this presentation

