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AAVP

American Association of Veterinary Parasitologists

32nd Annual Meeting
July 19-21, 1987
Chicago, Illinois

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PROGRAM

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AMERICAN ASSOCIATION OF VETERINARY PARASITOLOGY

32nd Annual Meeting

Hyatt-Regency Hotel - Chicago
Room - Regency A (West Tower, Ballroom Level of Hyatt-Regency)

Sunday, July 19

730 AM - Registration

Session 1: **CHEMOTHERAPY AND CONTROL**
Moderators: Bert Stromberg and Joe Dipietro

1. 8:30 Keynote Address - The challenge of drug resistance in the control ectoparasites.
R. Rousch

2. 9:00 Evaluation of Ivermectin in the treatment of 11 day-old Parascaris equorum infections in ponies.
J. A. Dipietro, T. F. Lock and K. S. Todd

3. 9:15 Ivermectin in a sustained release bolus and productivity of beef cattle in Oregon.
E. P. Hoberg, G. L. Zimmerman, L. G. Rickard, J. K. Erno and D. H. Wallace

4. 9:30 Influences of Ivermectin and Clorsulon treatment in a cow-calf herd in Oregon.
G. L. Zimmerman, L. G. Richard, E. P. Hoberg, J. K. Erno, D. W. Brisky and R. J. Pettitt

5. 9:45 Effect of Paratect in control of g.i. nematodes of weaner-yearling beef cattle in Louisiana.
J. C. Williams, W. M. Oliver, K. S. Marbury, J. M. Turpin, E. R. Willis, R. A. Swalley, D. G. Luther and D. J. Walstrom

10:00 Coffee

6. 10:15 Efficacy of Clorsulon against Fascioloides magna in sheep.
E. A. Conboy, B. E. Stromberg and J. C. Schlotthauer

7. 10:30 Motility response of benzimidazole-resistant Haemonchus contortus to several anthelmintics.
S. D. Folz, R. A. Pax, E. M. Thomas, J. L. Bennett, B. L. Lee and E. A. Conder

8. 10:45 Milbemycin: Efficacies against mature and immature hookworms (Ancylostoma or Uncinaria sp.) in dogs.
B. L. Blagburn, C. M. Hendrix, D. S. Lindsay, J. L. Vaughan, R. H. Mysinger, W. C. Purcell and D. I. Hepler

9. 11:00 Milbemycin: effects on precardiac and microfilarial stages of Dirofilaria immitis in dogs.
C. M. Hendrix, B. L. Blagburn, D. S. Lindsay, J. L. Vaughan and D. I. Hepler

10. 11:15 Anthelmintic efficacy of Flubendazole chewable tablets in naturally infected dogs.
J. R. Laursen, B.E. Stromberg and J. C. Schlotthauer

11. 11:30 Effects of Milbemycin on the adults of Toxocara canis in experimentally infected dogs.
D. D. Bowman, J. C. Parsons, R. B. Grieve and D. I. Hepler

12. 11:45 Cestocidal effect of Epsiprantel, a Praziquantel - related compound in dogs: dose titration and confirmation studies.
R. M. Corwin, S. P. Green and T. J. Keefe

12:00 Lunch

Session 2. Immunology
Moderators: Debra Cross and Gary Zimmerman

13. 1:00 Keynote Address - Immune effector mechanisms in parasitic infections.
P. H. Klesius

14. 1:30 Induction of immune resistance to the tick Amblyomma americanum in the sheep.
O. O. Barriga, F. Andujar and W. J. Andrzejewski

15. 1:45 Investigations into the mechanisms of resistance to Haemonchus contortus in genetically resistant sheep.
B. L. Presson, G. D. Gray, S. K. Burgess, D. B. Adams and L. F. Lejambre

16. 2:00 Breed variations in ovine resistance to trichostrongyles.
A. Zajac, R. P. Herd and G. S. Krakowka

17. 2:15 Immunonodulatory effects of Ostertagia ostertagi infection in calves.
C. J. Wiggin and H. C. Gibbs

18. 2:30 Immunosuppressive properties of soluble larval substances from Ostertagia ostertagi.
D. A. Cross and P. H. Klesius

19. 2:45 Immunodiagnosis of canine dirofilariasis-uses and abuses.
C. H. Courtney

3:00 Coffee

Session 3. SYMPOSIUM ON HOST-PARASITE INTERRELATIONSHIPS
Moderator: Ray Fetterer

20. 3:15 Host genetics and the regulation of parasite populations.
D. L. Wassom

21. 3:45 Development of genetic resistance to parasitism in the host.
C. M. Courtney

22. 4:15 Genetic manipulation of the parasite in the control of trichostrongylid parasites of ruminants.
L. F. Lejambre

4:45 Presentation of AAVP Distinguished Parasitologist Award to Prof. E. J. L. Soulsby

5:00 Presidential Address

5:15 Annual Business Meeting

6:30 Society Social

Monday, July 20

Session 4: EPIDEMIOLOGY
Moderators: James Miller and Jim Williams

23. 8:30 Keynote address - Application of modelling techniques in studies of helminth epidemiology.
G. Smith

24. 9:00 The epidemiology of cattle parasites in Maryland: Northern or Southern transmission patterns?
K. D. Murrell, L. Gasbarre and E. Leighton

25. 9:15 Seasonal incidence and impact of internal parasites on developing pony foals in Louisiana.
T. R. Klei, M. R. Chapman and H. W. Taylor

26. 9:30 Incidence of Trichuris suis in Midwestern swine at slaughter.
T. J. Kennedy, V. C. Gutierres-Poster and D. J. Bruer

27. 9:45 Trypanosoma vivax in the Caribbean basin.
S. Ferenc, C. H. Courtney and M. J. Burridge

28. 10:00 Fatal encephalitis in cattle due to a Sarcocystis-like organism.
J. P. Dubey, A. Perry and M. J. Kennedy

10:15 Poster session (Coffee will be served)

29. Effect of disinfectants on in vitro excystation of Cryptosporidium baileyi.
C. A. Sundermann, D. S. Lindsay and S. L. Blagburn

30. Prevalence of Eimeria spp. in Oregon llamas.
L. E. Rickard and J. K. Erno

31. Biosynthesis and metabolism of biogenic amines in the threadworm Trichostrongylus colubriformis (Nematoda).
J. C. Frandsen and L. W. Bone

32. Ovicidal activity of Bacillus sphaericus (Strain 1593) for eggs of Trichostrongylus colubriformis.
L. W. Bone and R. Tinelli

33. Factors influencing the lethality of Bacillus thuringiensis kurstaki for Trichostrongylus colubriformis eggs.
J. Meadows, L. W. Bone and S. S. Gill

34. A fast and accurate fecal examination technique for diagnosis of Fasciola hepatica.
R. C. Dixon and R. B. Wescott

35. Quantitation of habitat area of snail hosts of Fasciola hepatica as a measure of individual farm risk.
J. B. Malone, J. Ritchie, T. E. Williams, A. F. Loyocano and R. A. Muller

12:00 Lunch

Session 5: CLINICAL AND EXPERIMENTAL
Moderators: Dave Lindsay and Anne Zajac

36. 1:00 Keynote address - Recent advances in Toxoplasmosis research.
J. P. Dubey

37. 1:30 Pathology and immunogenesis of theileriosis.
H. Ouhelli

38. 1:45 Studies on the mode of inoculation and site specificity of cryptosporidium baileyi in broiler chickens.
D. S. Lindsay, B. L. Blagburn, C. A. Sundermann, F. J. Hoerr and J. J. Giambrone

39. 2:00 Studies in Sarcoystis fusiformis and Sarcoystis levinei from water buffaloes utilizing the cat and dog as definitive hosts.
Baoan Yao

40. 2:15 Coccidiosis in game birds.
M. D. Ruff

41. 2:30 Effect of Diflubenzuron on the development of Ascaris suum and Harmonchus contortus.
R. H. Fetterer, J. F. Urban and R. Miller

42. 2:45 Haemonchus contortus: characterization of an enzyme mediating the ecdysis of infective larvae.
H. R. Gamble and R. H. Fetterer

3:00 Coffee

43. 3:15 Identification of a Strongylus vulgaris induced eosinophil chemotactic factor from pony pheripheral blood mononuclear cell cultures.
K. A. Dennis, T. R. Klei and M. R. Chapman

44. 3:30 Identification of surface molecules on the nematode Nematospiroides dubius.
G. C. Coles and L. H. Semprevivo

45. 3:45 Experimental control of gastro intestinal parasites of goats using Ivermectin.
T. G. Hoyt, J. E. Miller, D. D. French, J. C. Williams, R. Willis, M. J. Hoyt and S. Turnquist.

46. 4:00 Efficacy of Netobimin against levamisole-resistant Haemonchus contortus in Louisiana lambs.
J. E. Miller, F. G. Hembry, M. T. Kearney and J. C. Williams

Tuesday, July 21

Session 6: JOINT AAVP..AVMA SYMPOSIUM
RESISTANCE OF NEMATODES TO ANTHELMINTICS IN LARGE ANIMALS
Moderator: K. D. Murrell

47. 8:30 Overview of the problem.
V. J. Theodorides

48. 9:10 Genetics of anthelmintic resistance in nematodes.
L. F. Lejambre

9:50 Coffee Break

49. 10:20 Control strategies for countering anthelmintic resistance.
G. C. Coles

50. 11:00 Novel approaches to control nematode parasites.
L. W. Bone

1140 Open discussion.

1. **THE CHALLENGE OF PESTICIDE RESISTANCE IN THE CONTROL OF ECTOPARASITES.** **R.T. ROUSH*. DEPARTMENT OF ENTOMOLOGY. CORNELL UNIVERSITY. ITHACA, NY 14853**

Pesticide resistance has been reported in more than 450 species of insects, mites, and ticks. Approximately 38% of these species are of medical or veterinary importance, including ticks, mites, mosquitoes, horn flies, blow flies, stable flies, lice and fleas. For many of these species, resistance is so severe in some regions that only one or two types of pesticides still provide effective control. Another problem compounding the seriousness of resistance is that fewer new pesticides are being developed now than was the case 20 years ago, partly because the costs of developing pesticides are increasing dramatically.

Pesticide resistance therefore creates a challenging problem for pest management; how can the evolution of resistance he prevented or delayed? Interest in this research area, which has come to be called "resistance management" has significantly increased during the last decade, and considerable progress has been made. While there are still many technical controversies and societal constraints to implementation some resistance management programs are in place around the world.

In the case of ectoparasites, most of the technical controversies concern whether high doses (or pesticide mixtures) should be used to delay resistance. However, observations, experimental data, and theory suggest that pesticide dose is only part of the problem and is, in any event, usually constrained by practical considerations. Therefore, the major solutions to resistance problems in ectoparasites include discontinuous pesticide release devices and non-persistent pesticides or formulations.

2. EVALUATION OF IVERMECTIN IN THE TREATMENT OF 11 DAY-OLD PARASCARIS EQUORUM INFECTIONS IN PONIES. J.A. DIPIETRO*, T.F. LOCK AND K.S. TODD, JR., UNIVERSITY OF ILLINOIS, URBANA, IL 61801

Fifteen pony foals were inoculated with 1500 infective Parascaris equorum eggs. The foals were allocated to replicates of 3 based on order of birth. Within each replicate foals were randomly assigned to 1 of 3 treatments. Treatments administered 11 days after inoculation included 200 mcg of ivermectin /kg formulated as paste (n=5) or liquid (n=5) and no treatment (controls;n=5). The foals were euthanatized 25 days after inoculation and examined for the presence of P equorum larvae in the small intestine, lung and liver. P equorum larvae were not found in foals treated with ivermectin liquid or paste, while significantly ($P<0.05$) higher mean numbers (960.9 $\pm$ 2.00) of 4th-stage P equorum larvae were found in the controls. Larvae were not found in the lung or liver tissue of any of the foals. Gross pathology due to the migration of P equorum larvae was noticed in the lungs and livers of all foals. Adverse reactions to treatment with ivermectin were not observed.

3. IVERMECTIN IN A SUSTAINED RELEASE BOLUS AND PRODUCTIVITY OF BEEF CATTLE IN OREGON. E.P. HOBERG*, G.L. ZIMMERMAN, L.G. RICKARD, J.K. ERNO. COLLEGE OF VETERINARY MEDICINE, OREGON STATE UNIVERSITY, CORVALLIS, OR 97331. D.H. WALLACE, MERCK & CO INC, RAHWAY, NJ 07065.

The influence of ivermectin, administered in a sustained release bolus, on the productivity of beef cattle was assessed in Oregon during the spring and summer of 1986. Twenty spring calves were randomly allocated to two equal groups: controls (Group I) received placebo boluses: treated animals (Group II) received active boluses containing ivermectin. During the trial (150 days), Groups I and II were grazed on separate pastures. Weights and fecal samples (for EPG) were taken from each animal, and counts of larvae in herbage from each pasture were taken every 30 days; 2 animals from each group were necropsied at the termination of the trial. As of day 150, Group II showed a 17 kg advantage over Group I; EPG's were significantly reduced. A reduction in pasture larval counts, between treatment and control was also observed. At necropsy, levels of infection in animals of Group II were substantially lowered.

4. INFLUENCES OF IVERMECTIN AND CLORSULON TREATMENT IN A COW-CALF HERD IN OREGON. G.L. ZIMMERMAN*, L.G. RICKARD, E.P. HOBERG, J.K. ERNO. COLLEGE OF VETERINARY MEDICINE, OREGON STATE UNIVERSITY. CORVALLIS, OR 97331. D.W. BRISKEY. MSD AG-VET, MERCK & CO, INC. RAHWAY NJ 07065. R.J. PETTITT, BANDON OR 97411.

The influences of ivermectin and clorsulon were evaluated in a cow-calf herd on the southern Oregon coast. In November 1985, 150 pregnant cows were randomly divided into 3 groups of 50 to provide controls (group I), group II given oral clorsulon at 7.0 mg/kg, and group III given injectable ivermectin at 200 ug/kg and oral clorsulon at 7.0 mg/kg. Following spring calving, compared to controls, groups II and III showed weight advantages of 30 and 89 lbs respectively, and better body condition scores. By August 1986, the weight advantage of the previous November treatment had decreased to 24 lbs (groups II and III); in groups II and III there were fewer open cows, with pregnant cows of group III averaging nearly one breeding cycle ahead of controls. Compared to controls, calves of groups II and III cows showed 28 and 29 lb weight advantages in April 1986 and 57 and 54 lb advantages in August, 1986.

5. EFFICACY OF PARATECT® IN CONTROL OF G-I NEMATODES OF WEANER-YEARLING BEEF CATTLE IN LOUISIANA. J.C. WILLIAMS*, W.M. OLIVER, K.S. MARBURY, J.M. TURPIN, E.R. WILLIS, R.A. SWALLEY, D.G. LUTHER, AND D.J. WALSTROM. LOUISIANA AGRICULTURAL EXPERIMENT STATION, BATON ROUGE AND HOMER, LA.

The major objective of this investigation was to determine efficiency of the Paratect bolus in preventing the progressive increase in level of parastism in cattle and larval contamination of pasture that occurs in the south from fall through spring. In Louisiana this entailed a comparison of Paratect given to one group of calves at weaning with a 2nd group given Paratect during late winter following treatment at weaning with other anthelmintics. The trial extended from Oct. 3, 1985 through June 4, 1986. Seventy-three weaner calves, were randomly allotted into 2 groups of 37 (Gp1 - Paratect Feb. 6, 1986) and 36 (Gp2 - Paratect Oct. 3, 1985), respectively. Under conditions of mild temperatures and abundant rainfall, pasture infectivity was high during fall and winter. Egg counts of both groups were reduced and remained low after February as did herbage larval counts. Worm counts in fall tracer calves were low (Haemonchus and Cooperia dominant); worm counts in spring tracers were higher, esp. O. ostertagi and T. axei in Gp1. Based on weight gain advantages of Gp2 from Dec. to Feb., the weaning Paratect treatment (Gp2) was superior to the Feb. treatment (Gp1). Group 2 final weights in June were 8.4 kg greater than those of Gp1, but not significant ($P<0.05$).

6. EFFICACY OF CLORSULON AGAINST FASCIOLOIDES MAGNA IN SHEEP. G.A. CONBOY*, B.E. STROMBERG, AND J.C. SCHLOTTHAUER. DEPARTMENT OF VETERINARY PATHOBIOLOGY, COLLEGE OF VETERINARY MEDICINE, UNIVERSITY OF MINNESOTA, ST. PAUL, MN. 55108.

The efficacy of clorsulon against Fascioloides magna in sheep was evaluated. Twelve ewes were infected orally with 100 metacercariae of F. magna and six were treated 8 weeks post-infection with clorsulon (15mg/kg body weight). Sheep were euthanized at 16 weeks post-infection, flukes were recovered and the liver and other tissues were subjectively scored for the degree of pathology (0 to 4+). Clorsulon significantly reduced (62.0%) the number of flukes recovered in the treated group (3.8 $\pm$ 1.2 flukes) as compared to the untreated controls (10.0 $\pm$ 6.6 flukes). The degree of pathology was significantly reduced (45.9%) in the treated group (2.0 $\pm$ 1.1) compared to the untreated controls (3.7 $\pm$ 0.5). Three sheep died and one became moribund in the untreated group at 14-16 weeks post-infection. The data suggest that a single treatment with clorsulon at 15 mg/kg was not sufficiently effective against F. magna at 8 weeks post-infection in sheep to reliably prevent mortality since only a few F. magna are generally fatal in sheep within 6 months after infection.

MOTILITY RESPONSE OF BENZIMIDAZOLE-RESISTANT HAEMONCHUS CONTORTUS TO SEVERAL ANTHELMINTICS. S.D. FOLZ*, R.A. PAX, E.M. THOMAS, J.L. BENNETT, B.L. LEE AND G.A. CONDER. THE UPJOHN COMPANY, KALAMAZOO, MICHIGAN, AND MICHIGAN STATE UNIVERSITY, EAST LANSING MICHIGAN.

The effects of several benzimidazoles and levamisole on the motility of two Haemonchus contortus (L-3) populations (in vitro) were determined. At 100 µg/ml, the motility of a **cambendazole-resistant population** of H. contortus was significantly affected by all treatments; cambendazole had a minimal and significantly lesser effect on larval motility than any other treatment, whereas albendazole and levamisole had vastly greater effects. Consequently, substantial resistance was noted with cambendazole. Treatment with 10 µg/ml of cambendazole, fenbendazole, oxfendazole or thiabendazole did not significantly affect the motility of the cambendazole-resistant larval population, thereby indicating complete resistance. Albendazole, oxibendazole and levamisole (10 µg/ml) significantly reduced the motility of the larvae; the effect of levamisole was significantly greater than for either oxibendazole or albendazole, thereby indicating partial resistance to the latter two therapies. None of the treatments significantly impacted on larval motility at 1.0 or 0.1 µg/ml. An **Upjohn/Illinois H. contortus (L-3) population** was also evaluated. At 100 µg/ml, the larval motility of this population was also significantly affected by all drug treatments. Again, larval motility for the cambendazole group was significantly less than for other treatments. Levamisole, albendazole and oxibendazole had comparable effects on motility (100µg/ml). At 10 µg/ml, all treatments again affected motility; the greatest effect was with levamisole. At 1.0 µg/ml, levamisole, albendazole, fenbendazole, oxibendazole and thiabendazole significantly affected the motility of larvae; the effects of the drugs were low and comparable. No effect was observed with cambendazole or oxfendazole at the 1.0 µg/ml. Only levamisole and thiabendazole significantly impacted on motility at 0.1 µg/ml. The data presented indicate the micromotility meter method may offer several advantages as an adjunct to other techniques used to evaluate anthelmintic resistance.

8. MILBEMYCIN: EFFICACIES AGAINST MATURE AND IMMATURE HOOKWORMS (ANCYLOSTOMA OR UNCINARIA SPP.) IN DOGS. B.L. BLAGBURN*, C.M. HENDRIX, D.S. LINDSAY, J.L. VAUGHAN, R.H. MYSINGER, N.C. PURCELL AND D.I. HEPLER. AUBURN UNIVERSITY, AL 36849 AND CIBA-GEIGY CORPORATION, GREENSBORO, NC 27419.

Milbemycin (MB) is a broad spectrum antiparasitic macrolide derivative isolated from Streptomyces hygroscopicus. In the following, we report efficacies of MB (mixture of A_3 & A_4 oximes) against adult and immature Ancylostoma or Uncinaria spp. In studies A & B, pound-source dogs, naturally infected with hookworms were treated with MB (1% powder) in gelatin capsules at dosages of 0.1 (n=9; Study A); 0.25 (n=9 & 8; Studies A & B); 0.5 (n=9 & 8; Studies A & B); 0.75 (n=8; Study B) mg/kg BW. Control dogs received anhydrous lactose in gelatin capsules. EPG of feces were determined prior to treatment and at necropsy 7 (Study B) or 10 (Study A) days after treatment, when hookworms were also recovered. In study C, MB (tablet, 12 mg A.I.) was given to 6- to 7-month-old beagle dogs at 0.5 mg/kg at the following times after SC injection of approximately 5,000 infective hookworm larvae: 36 h, 120 h, 216 h, or 360 h. Control dogs were infected but not treated. Adult hookworms were counted at necropsy 21 days after SC injection of larvae. For naturally infected dogs percentage reduction (based on comparisons to controls) for each of the dosages & studies was as follows: Study A: 0.1 mg/kg-61%, 0.25-62%, 0.5-92%; Study B: 0.25- 69%, 0.5-95%, 0.75-99%. Approximate reductions resulting from stage specific treatments were: 36 h-50%, 120 h-80%, 216 h-80%, 360 h-90%. Adverse reactions to treatment with MB were not seen.

9. MILBEMYCIN: EFFECTS ON PRECARDIAC AND MICROFILARIAL STAGES OF DIROFILARIA IMMITIS IN DOGS. C.M. HENDRIX*, B.L. BLAGBURN, D.S. LINDSAY, J.L. VAUGHAN AND D.I. HEPLER. AUBURN UNIVERSITY, AL 36849 AND CIBA-GEIGY CORPORATION, GREENSBORO, NC 27419.

Twenty commercially-obtained beagle dogs were inoculated with approximately 40 infective 3rd stage larvae of D. immitis. On day 28 postinoculation (PI), one group of 5 dogs was dosed with milbemycin (MB) at 0.5 mg/kg BW and one group of 5 dogs at 1.0 mg/kg. On day 58 PI, two additional groups were treated similarly. Four control dogs were infected but not treated. Two dogs served as noninfected, nontreated sentinels. All dogs were necropsied between 189 and 192 days PI. Sentinel dogs and all treated dogs except one (1.0 mg/kg, day 58) were negative. All nontreated controls were infected. To determine the microfilaricidal effects of MB at 0.01 (n=8), 0.10 (n=8), 0.25 (n=8) or 0.50 (n=8) mg/kg BW, dogs were treated with MB 2 weeks following treatment with thiacetarsamide. Eight dogs served as nontreated controls. Results indicated that MB is an effective microfilaricidal agent when administered at dosages of 0.1 mg/kg BW and above. At day 14 posttreatment efficacy of MB at 0.1 mg/kg BW when compared to day -1 was 96% and when compared to controls was 98%. In a study to confirm the optimal effective oral dose of MB at 0.25 mg/kg BW, the efficacy at day 14 when compared to day -1 was 98% and when compared to controls was 98%. Posttreatment DEC-like reactions were observed in 2 dogs harboring 13125 or 77750 mff per ml of peripheral blood. No other adverse reactions were observed.

10. ANTHELMINTIC EFFICACY OF FLUBENDAZOLE CHEWABLE TABLETS IN NATURALLY INFECTED DOGS. J.R. LAURSEN*, B.E. STROMBERG AND J.C. SCHLOTTHAUER. UNIVERSITY OF MINNESOTA, ST. PAUL, MN 55108.

The efficacy of chewable Flubendazole tablets was evaluated in 40 dogs naturally infected with Ancylostoma caninum and Uncinaria stenocephala; Trichuris vulpis; Toxocara canis and Toxascaris leonina. Dogs were selected from the general population and included both sexes, different age groups and variable body weights. The dogs were allocated into two groups based on the species and ova count of the helminth(s) present and designated as the treatment or control groups. The treated group received 33mg of flubendazole/kg of body weight (15mg/lb) for three days. Six days after the initial treatment all dogs were euthanized and necropsied. The entire gastrointestinal tract was opened and examined for parasites. All parasites recovered were identified to species. Efficacy was determined by comparing recoveries from the treated animals to the untreated controls.

Flubendazole administered at 33mg/kg was greater than 99% efficacious against A. caninum, U. stenocephala, T. vulpis, T. canis and T. leonina. There was little efficacy demonstrated against tapeworms (Taenia spp. and Dipylidium caninum).

11. EFFECTS OF MILBEMYCIN ON THE ADULTS OF TOXOCARA CANIS IN EXPERIMENTALLY INFECTED DOGS. D.D. BOWMAN, J.C. PARSONS, R.B. GRIEVE*, AND D.I. HEPLER. UNIVERSITY OF WISCONSIN-MADISON AND CIBA-GEIGY CORPORATION.

To determine the efficacy of Milbemycin in treating patent infections of Toxocara canis, 8 male and 7 female, 10-week-old beagles were each given 125 eggs of T. canis. Feces from each dog was examined for parasites 2 days preinfection and on days 28, 56, and 67 through 75 postinfection. On day 70 postinfection the dogs were assigned to one of three different groups and treated; one group received a placebo while the other two groups received either 0.5 or 3.0 mg of Milbemycin. The feces of each dog were collected daily from the time of treatment to necropsy on day 75 postinfection, and any worms or fragments found therein or at necropsy were sexed and counted. Feces of all dogs were negative for eggs of T. canis before infection, and all dogs had patent infections on day 56 postinfection. The number of worms passed in the feces of both the high and low dosage groups was greatest on the day of treatment, but worms and fragments of worms were passed up to the day of necropsy. At necropsy, worms were found only in the control group; there were 2 to 19 worms per dog. Although no worms were found in the treated dogs at necropsy, a few eggs, 1 to 18 per gram, were still present in the feces of 5 of these 10 dogs. The numbers of eggs per gram of feces in the control group on the day of necropsy ranged from 74 to 1926. It would appear that Milbemycin at both the dosage levels tested was successful in causing the elimination of adult T. canis from the intestine.

12. CESTOCIDAL EFFECT OF EPSIPRANTEL, A PRAZIQUANTEL-RELATED COMPOUND, IN DOGS: DOSE TITRATION AND CONFIRMATION STUDIES. R.M. CORWIN[1]*, S.P. GREEN[1] AND T.J. KEEFE[2]. UNIVERSITY OF MISSOURI, COLUMBIA, MO 65211[1] AND BEECHAM LABORATORIES, BRISTOL TN 37620[2]

Fifty-two dogs, naturally infected with Taenia sp and/or Dipylidium caninum, were assigned to the following treatment groups for dose titration studies with epsiprantel: 14 nonmedicated control dogs, 14 medicated dogs at a dose level of 1.25 mg/lb (2.75 mg/kg), 14 medicated dogs at 2.50 mg/lb (5.50 mg/kg), and 10 medicated dogs at 3.75 mg/lb (8.25 mg/kg). Medication was given orally in a tablet formulation. Feces were examined for cestodes passed and the gastrointestinal tract at postmortem for retained cestodes. Efficacy was calculated as: 92.9% Taenia and 100% Dipylidium at 1.25 mg/lb, 100% Taenia and Dipylidium at 2.5 mg/lb, and 94.6% Taenia and 100% Dipylidium at 3.75 mg/lb.

For dose confirmation, 20 dogs naturally infected with Taenia sp and/or D. caninum were in 2 treatment groups: 10 nonmedicated control dogs and 10 medicated dogs at 2.50 mg/lb (5.50 mg/kg). Efficacy was 100% for both Taenia and Dipylidium.

In summary, epsiprantel proved highly efficacious (100%) at 2.5 mg/lb for Taenia sp and Dipylidium caninum given in tablet formulation. There were no adverse effects observed following treatment.

13. IMMUNE EFFECTOR MECHANISMS IN PARASITIC INFECTIONS. P.H. KLESIUS, USDA, ARS, ANIMAL PARASITE RESEARCH LABORATORY, AUBURN, AL 36830.

Studies of the effector mechanisms in parasitic infections provide evidence for the presence of multiple components that are operating in a complex interactive web to provide antiparasitic activity. Nonspecific and specific effector mechanisms have been demonstrated, but not completely understood. Functions of eosinophils that characterize the inflammatory response and that are altered by parasitic products include chemotaxis, enzyme and toxic peptide releases and phagocytic activities. Further, interactions of eosinophils with other cells, both immune and accessory, provide a complex expression of immunity and/or pathology. The role of the eosinophil in parasitic infections will be the principal topic presented.

14. INDUCTION OF IMMUNE RESISTANCE TO THE TICK AMBLYOMMA AMERICANUM IN THE SHEEP. O.O. BARRIGA*, F. ANDUJAR AND W.J. ANDRZEJEWSKI. THE OHIO STATE UNIVERSITY, COLUMBUS, OHIO 43210.

Cattle ticks cause worldwide losses estimated in 18.5 billion lb of meat and 27 billion gallons of milk per year. Because acaricide application is too expensive and complex for many countries and ticks are developing resistance to these drugs rapidly, we are investigating the production of anti-tick immune resistance in ruminants with the model A. americanum-sheep.

Three sheep were infested, 4-5 successive times each, with 100 pairs of adult ticks. After each infestation we recorded: the times to complete engorgement, to oviposition, and to hatching; the weight of the engorged females and of the egg-mass; and the survival of ticks to complete engorgement and to oviposition. We also studied by Western blots the antigens of tick salivary gland and digestive tract to which the sheep serum reacted after each infestation.

In every case the times to engorgement and to oviposition were significantly larger, and the weight of the engorged ticks and of the egg-mass significantly smaller, after the 3rd-4th infestation or earlier. Three antigens to which the tick-naive sheep did not react were detected after the first infestation (MW between 39,000 and 34,000), one additional one after the second and third infestation (MW 30,000), and three additional ones after the fourth infestation (MW 28,000, 22,000 and 17,000).

Because the last three antigens appeared in coincidence with manifestations of anti-tick resistance, we believe that they may be related to protection.

INVESTIGATIONS INTO THE MECHANISMS OF RESISTANCE TO HAEMONCHUS CONTORTUS IN GENETICALLY RESISTANT SHEEP. B.L. Presson*, G.D. Gray, S.K. Burgess, D.B. Adams, and L.F. Le Jambre. University of New England, Armidale, NSW 2351, Australia.

15.

Previous work has identified Haemonchus contortus resistant progeny originating from a single Merino sire. Differences between progeny from this sire and offspring from sires of normal H. contortus susceptibility were to be delineated in experiment 1. During artificial infection with H. contortus, haemotological changes, fecal egg counts, and skin sensitivity reactions to Haemonchus antigens were monitored. Sheep were slaughtered at fortnightly intervals to obtain organ weights, abomasal tissue sections, abomasal pH and worm burden determinations. Significant accumulations of globule leukocytes were found in the abomasum of the genetically resistant animals. The effect of dexamethasone treatment on H. contortus infection in the progeny groups were investigated in experiment 2. Dexamethasone treatment abrogated resistance to H. contortus and eliminated the globule leukocyte response in the abomasum. Thus, a strong association between H. contortus resistance and the presence of globule leukocytes was found. H. contortus adults obtained from the two progeny groups revealed an inverse relationship between genetic resistance and worm weight. Since worm numbers were not significantly different between groups, results of these studies suggest resistance is being expressed as depression of worm growth/vigor and not, necessarily, as a decrease in worm numbers.

BREED VARIATION IN RESISTANCE OF SHEEP TO TRICHOSTRONGYLES. A.M. ZAJAC,* R.P. HERD, G.S. KRAKOWKA. DEPARTMENT OF PATHOBIOLOGY, VIRGINIA-MARYLAND REGIONAL COLLEGE OF VETERINARY MEDICINE, BLACKSBURG, VA 24061 AND DEPARTMENT OF VETERINARY PATHOBIOLOGY, THE OHIO STATE UNIVERSITY, COLUMBUS, OH 43210.

16.

Previous studies have shown that several exotic sheep breeds develop lower fecal egg counts and worm burdens following infection with Haemonchus contortus than common domestic breeds. Parasitologic and immunologic characteristics of experimental primary and challenge H. contortus infections were measured in 9-month-old parasite susceptible Dorset/Rambouillet lambs and resistant Florida Native and St. Croix lambs. No difference was found amongst breeds in initial parasite establishment 7 days after primary infection. Fecal egg counts were highest in Dorset/Rambouillet lambs after a single infection and hematologic parameters were most severely affected by infection of that breed. No difference in worm burden was found amongst the 3 breeds 2 weeks after challenge infection. All breeds showed similar blastogenic responses to H. contortus larval antigen and conventional mitogens. No significant increase in peripheral antibody level was found by ELISA test in any breed following infection but abomasal mucus IgA and IgM were increased in infected sheep of all breeds. These results suggest that mature sheep of these 3 breeds are capable of developing effective resistance to challenge H. contortus infection.

IMMUNOMODULATORY EFFECTS OF OSTERTAGIA OSTERTAGI INFECTION IN CALVES.
C. J. WIGGIN AND H. C. GIBBS. UNIVERSITY OF MAINE, ORONO, ME 04469.

The role of O. ostertagi infections in modulating the immune response was investigated in 4 month old male Holstein calves. Lymphocyte stimulation responses were done using phytohemagglutin mitogen (PHA), poke weed mitogen (PW) and O. ostertagi L_3 antigen (OA) on peripheral blood lymphocytes in groups of calves infected continuously over a 13 week period with O.ostertagi infective larvae. It appeared that parasitized animals had lower Δ CPM responses to PHA and higher responses to OA than non-infected, control calves but no response to PW was observed.

IMMUNOSUPPRESSIVE PROPERTIES OF SOLUBLE LARVAL SUBSTANCES FROM OSTERTAGIA
18. OSTERTAGI. D.A. CROSS* AND P. H. KLESIUS. ANIMAL PARASITE RESEARCH LABORATORY, AGRICULTURAL RESEARCH SERVICE, U.S. DEPARTMENT OF AGRICULTURE, AUBURN, AL 36830.

BALB/c mice were immunized with antigens from the third larval stage or adult Ostertagia ostertagi. Simultaneous immunization with either keyhole limpet hemocyanin (KLH) or sheep erythrocytes (SRBC) was performed to determine the potential immunomodulatory effects of the antigens. All antigens elicited an antibody response. Mice were immunosuppressed when immunized with a soluble substance derived from soluble larval antigen fractionated on a Sephacryl S-300 column. The immunosuppressive antigen contained proteins ranging from 36 to 20.1 kDa and caused either decreased serum antibody to KLH or a decreased number of anti-SRBC IgM-secreting splenic B cells. This immunosuppressive antigen may play a role in the immunosuppression of cattle infected with O. ostertagi and may help to explain the lack of resistance to infection even after repeated exposures.

19. IMMUNODIAGNOSIS OF CANINE DIROFILARIASIS - USES AND ABUSES OF ANTIGEN TESTS. C.H. COURTNEY.* UNIVERSITY OF FLORIDA. GAINESVILLE, FL 32610.

Data will be presented on the evaluation of 6 heartworm antigen immunodiagnostic test kits in more than 500 dogs whose heartworm infection status was confirmed at necropsy. Guidelines for the use of these tests in the diagnosis of canine dirofiliariasis, pretreatment evaluation of the patient, and the confirmation of successful treatment will be proposed.

20. HOST GENETICS AND THE REGULATION OF PARASITE POPULATIONS. D.L. WASSOM, UNIVERSITY OF WISCONSIN-MADISON, MADISON, WI 53706

Populations of parasites in their natural hosts are often aggregated or overdispersed. Thus, a small segment of the host population often harbors most of the parasites in the parasite population. Genetic factors contribute to this overdispersion when individuals in the host population possess defects in the genes which regulate the host's ability to resist infection. In outbred host populations, a few genetically susceptible hosts with heavy infections may account for a disproportionate share of the parasite infective stages released into the environment. Such susceptible hosts are the obvious targets of control programs, yet these individuals may be difficult to vaccinate and readily reinfected following treatment. In some experimental systems it has been possible to identify and characterize the specific genes which confer susceptibility or resistance upon the host. For example, in Trichinella-infected mice, three closely linked genes on chromosome 17 and a gene on chromosome 4 interact to regulate the host's immune response to infection; the expression of certain alleles at one or more of these gene loci renders the host increasingly susceptible to Trichinella infection. An understanding how such "immune response genes" function to regulate levels of susceptibility may be of value in designing novel ways to limit parasite numbers at the population level. In addition, armed with the knowledge of how these genes function, the tools of recombinant DNA technology may offer specific ways to enhance host resistance in the absence of new drugs or vaccines.

21. DEVELOPMENT OF GENETIC RESISTANCE TO PARASITISM IN THE OVINE HOST. C.H. COURTNEY. UNIVERSITY OF FLORIDA. GAINESVILLE, FL 32610.

That certain breeds of sheep or certain individuals within breeds of sheep are more resistance to parasites than others and that these effects are heritable has been well established. Mechanisms involved appear to fall into two categories: "resistance," or the ability to reject or prevent infection, and "resilience," or the ability to tolerate the effects of infection. Mechanisms of resistance include increased ability to "self cure", increased acquired immunity, and a decreased periparturient relaxation of immunity. In general acquired immunity appears to play a important role, although in some instances anthelmintic treatment is needed to eliminate the primary infection. Inheritance of resistance is thought to be by multiple genes, but in some instances a single gene or group of closely associated genes may be involved.

22. GENETIC MANIPULATION OF THE PARASITE IN THE CONTROL OF TRICHOSTRONGYLID PARASITES OF RUMINANTS. L.F. LE JAMBRE. CSIRO, PASTORAL RESEARCH LABORATORY. ARMIDALE 2350, AUSTRALIA.

The biology of trichostrongylids appears to make them ideal candidates for control by genetic manipulation. They complete few generations per year, they must enter their host to reproduce and they do not travel far in their infective stages. An attempt was made to exploit these traits in the genus *Haemonchus* which had the additional feature of a pre-mating barrier against species hybridization that prevented a less adapted species from colonizing a host already infected with the adapted species. The pre-mating barrier was found to be host mediated as it could be stopped by immunosuppressing the host. Artificial production of interspecific hybrids led to the discovery that one particular cross had the *Haemonchus* trait of excluding competing species enhanced by hybrid vigor to the point where it could prevent the parental species from establishing in penned sheep. This hybrid consisted of sterile males and semi-sterile females that would produce some offspring with severe chromosomal abnormalities when back crossed to wild males. A hybrid release program was undertaken to determine the effect of these traits on the wild population of *Haemonchus*.

23. The application of modelling techniques in studies of the population biology of helminth parasites and the epidemiology of parasitic disease. SMITH G.*, UNIVERSITY OF PENNSYLVANIA SCHOOL OF VETERINARY MEDICINE, NEW BOLTON CENTER, KENNETT SQUARE, PA 19348.

The paper reviews the basic techniques for modelling the development and mortality of various phases in the life cycle of helminth parasites of veterinary importance (Fasciola hepatica, Ostertagia ostertagi, Teladorsagia circumcincta) and describes the role of density dependent and density independent processes in determining parasite numbers.

The uses of mathematical models of the population biology of helminth parasites are reviewed under three headings: significance for field studies, screening anthelmintic strategies, and comparing control policies with respect to the development of anthelmintic resistance.

24. THE EPIDEMIOLOGY OF CATTLE PARASITES IN MARYLAND: NORTHERN OR SOUTHERN TRANSMISSION PATTERNS? K. D. MURRELL*, L. GASBARRE. ANIMAL PARASITOLOGY INSTITUTE, USDA-ARS, BELTSVILLE, MD 20705 AND E. LEIGHTON, WYE RESEARCH AND EDUCATION FOUNDATION, UNIVERSITY OF MARYLAND, QUEENSTOWN, MD 21658

The transmission patterns for gastrointestinal parasites in a cattle herd located on the Eastern shore of Maryland were determined by the use of tracer calf and herbage larvae recovery methods; the sampling period began February 1985 and will terminate December 1987. The data obtained to date (24 months) reveal a transmission pattern that approximates the Northern Pattern, with peak pasture contamination levels peaking in late summer and early fall. Overwintering of larvae on pasture appeared to be a significant factor in ensuring transmission during the early spring months when a new susceptible host population (spring calves) was introduced. Hypobiosis did occur, to a limited degree (10-20%), with most arrestment-prone larvae transmitted from pasture during September-October. Although summer transmission occurred during both years, the influence of rainfall was marked and variable between years. The results emphasize the importance of microclimate variables, such as temperature and moisture. Attempts to derive a simple microclimate predictor, such as vapor pressure deficit, will be discussed.

25. SEASONAL INCIDENCE AND IMPACT OF GASTROINTESTINAL PARASITES ON DEVELOPING PONY FOALS IN LOUISIANA. D.D. FRENCH*, T.R. KLEI, M.R. CHAPMAN, AND H.W. TAYLOR, LOUISIANA STATE UNIVERSITY, BATON ROUGE, LA 70803.

Thirty-two pony mares and their foals were divided into similar groups and placed on separate but similar 8 acre pastures in Feb. 1986 and monitored through Dec. 1986. One group of mares and foals served as untreated controls and the other group recieved anthelmintic (ivermectin) treatment at regular 8 week intervals. Condition of mares and foals of both groups were monitored by a scoring system, body weights and back fat values as determined by ultrasonic techniques. Fecal egg per gram counts (EPG) and strongye larval cultures were made at monthly intervals. Pasture strongyle larvae (L_3) burdens were assessed biweekly by collection of transect grass samples.

Results of the study indicate that peak transmission of equine strongyles occured in May, as judged by pasture L_3 numbers (25,000 L_3/kg) and fecal EPG values. Larval burdens were dramatically reduced during the hot summer months (<1,000 L_3/kg). Eight week anthelmintic treatment effectively reduced pasture larval burdens by 93 to 100% and EPG values in the treated group remained at or near 0. Strongyloides westeri transmission was almost completely inhibited in the treated group of mares. Parascaris equorum eggs were not seen in treated foals. Yearlings raised from treated mares weighed an average of 45% more than those from nontreated controls. Other measurements of condition showed similar marked differences between groups, quantiatively demonstrating the role of parasitism in foal development. (Supported in part by grants from Merck & Co. and the LSU-Equine Vet. Res. Prog.)

26. INCIDENCE OF TRICHURIS SUIS IN MIDWESTERN SWINE AT SLAUGHTER. T.J. KENNEDY*, V.C. GUTIERRES-POSTER AND D.J. BRUER. AEF RESEARCH, INC. WAUNAKEE, WI 53597

A recent survey, based on fecal egg counts, estimated the prevalence of Trichuris on swine farms to be 45%, with 31% of all slaughter hogs infected. The present study was designed to establish, by worm collections, the incidence of Trichuris suis in market weight hogs from the Mid-Western U.S.

Overall, 19.4% of all pigs sampled (127 of 653) were positive for Trichuris at necropsy, with an average worm burden of 10 worms. Sixty five percent of all cecal contents showed ova of Ascaris, Trichuris, or coccidia, or various combinations of these parasites. Ascaris was found in 60% of all samples, Trichuris in 18% and coccidia in 29%. The level of parasitism seen at slaughter may reflect the minimal use of anthelmintics in growing-finishing swine.

27. TRYPANOSOMA VIVAX IN THE CARIBBEAN BASIN. S.A. FERENC*, C.H. COURTNEY AND M.J. BURRIDGE. UNIVERSITY OF FLORIDA. GAINESVILLE, FL 32610.

Sera collected from cattle and small ruminants throughout the greater and lesser Antilles were examined for the presence of antibodies to Trypanosoma vivax using indirect fluorescent antibody (IFA) and indirect enzyme-linked immunosorbent assays (ELISA). The sensitivity and specificity of antigens prepared from a bovine-derived field strain and a murine-adapted laboratory strain of T. vivax, both of New World origin, were compared for the IFA test. Cross reactivity with a murine-adapted African strain of T. evansi was evaluated in the ELISA system. The results and their implications will be discussed with respect to the direction further research should take in assessing the impact of this disease in the Caribbean basin and its potential for spread to the continental United States.

28. FATAL ENCEPHALITIS IN CATTLE DUE TO A SARCOCYSTIS-LIKE ORGANISM. J.P. DUBEY*, A. PERRY AND M.J. KENNEDY. USDA, ARS, ANIMAL PARASITOLOGY INSTITUTE, BELTSVILLE, MD 20705 AND ALBERTA AGRICULTURE, ANIMAL HEALTH DIVISION, EDMONTON, ALBERTA, CANADA T6H4P2.

An 18 month old Hereford steer from a farm in Alberta became ataxic, recumbent, blind, and was euthanatized. One half of the brain fixed in 10% formalin was submitted for diagnosis. Grossly, on sectioning, a 1 cm diameter area of gray discoloration was seen in the cerebellum. Microscopically, the most severe lesion was that which was visible grossly in the cerebellum but lesions were seen throughout the brain. Histologically, it was characterized by multifocal granulomatous meningoencephalitis with focal malacia. Numerous immature and mature schizonts and free Sarcocystis-like organisms were seen in unidentified cells. However, other pertinent information do not confirm this diagnosis.

No other animal in the herd was clinically ill. The nature of the lesion, the avascular location of the organism, and epidemiologic data suggest that the etiologic agent is unlikely to be Sarcocystis cruzi.

EFFECT OF DISINFECTANTS ON IN VITRO EXCYSTATION OF CRYPTOSPORIDIUM BAILEYI. C.A. SUNDERMANN,* D.S. LINDSAY AND B.L. BLAGBURN. AUBURN UNIVERSITY, 29. AUBURN, AL 36849.

Cryptosporidium sp. has been reported from a variety of exotic, pet, and economically important avian species. Thus far, no drug (monensin, halofuginone, salinomycin, lasalocid, amprolium) has been effective in preventing or treating experimental infections in birds. Therefore, nine commercial disinfectants were tested for ability to prevent excystation of Cryptosporidium baileyi isolated from chickens. In experiment I, each disinfectant was tested at the strongest concentration recommended by the manufacturer. One million oocysts were incubated for 30 min. in 10 ml of each chemical (Vinco formaldehyde^R, Iofec 80^R, Pine Sol^R, Parsons' Ammonia^R, Creolin^R, Microphene^R, DC&R^R, Nolvasan^R, and Clorox^R) at 25°C. A control sample included oocysts incubated in Hanks' balanced salt solution. The percent of excysted oocysts in each solution was determined after a 30 min. incubation. After rinsing, the oocysts were placed in excystation medium (0.75% sodium taurocholate), incubated for 2 hr at 40°C, and again the percent of oocysts that excysted was determined. None of the disinfectants were effective in preventing exit of sporozoites from oocysts. In experiment II, the disinfectants were tested at 50% strength (v/v in water), and the same assay for excystation was employed. Excystation was completely inhibited by ammonia and partially inhibited (11.3% excysted) by Clorox^R. Alabama Agricultural Experiment Station Project No. 13-0061.

PREVALENCE OF EIMERIA SPP. IN OREGON LLAMAS. L.G. RICKARD* AND J.K. ERNO. COLLEGE OF VETERINARY MEDICINE, OREGON STATE UNIVERSITY. CORVALLIS, OR 30. 97331.

Fecal samples from over 200 llamas were examined via saturated salt flotation for the presence of Eimeria. Three species were found in both adults and crias. Eimeria alpacae was the most prevalent species in both groups of animals. Eimeria lamae and E. punoensis were the other two species found. A fourth, E. macusaniensis, was found in only one adult animal and was the only species present.

BIOSYNTHESIS AND METABOLISM OF BIOGENIC AMINES IN THE THREADWORM, TRICHOSTRONGYLUS COLUBRIFORMIS (NEMATODA). J.C. FRANDSEN* AND L.W. BONE. USDA, ARS, ANIMAL PARASITE RESEARCH LABORATORY. AUBURN, AL 36831-0952.

31.

The metabolic pathways of biogenic amines are being studied in the ruminant threadworm, Trichostrongylus colubriformis, via use of radiolabeled precursors followed by identification of labeled metabolites through HPLC. Investigations to date have been conducted in vitro, using whole-worm homogenates of mixed sexes of adults.

As in vertebrates, 4-hydroxy-3-methoxy-phenyl glycol (HMPG), metanephrine and vanillylmandelic acid (VMA) were formed from epinephrine, indicating that at least one of the two common pathways for production of these metabolites may be present in the threadworm. HMPG and VMA were also formed from norepinephrine, as was normetanephrine, indicating that the pathways for catabolism of this other common biogenic amine may be the same in this worm as in vertebrates. Histamine was converted into acetylhistamine (AH), imidazole-4-acetic acid and 1,4-methylimidazole acetic acid. The latter two compounds are common metabolites of histamine in vertebrates, but acetylation of histamine does not appear to be common in animals, though it is in some groups of bacteria. Bacterial contaminants may have produced the AH found in the homogenates. Though deamination can be "forced" with enzyme inhibitors, the common pathway for catabolism of octopamine in vitro is through hydroxylation and methylation, with formation of norepinephrine, synephrine, and epinephrine.

OVICIDAL ACTIVITY OF BACILLUS SPHAERICUS (STRAIN 1593) FOR EGGS OF TRICHOSTRONGYLUS COLUBRIFORMIS. L.W. BONE* AND R. TINELLI. USDA, ARS, ANIMAL PARASITE RESEARCH LABORATORY, AUBURN, AL 36830 AND PASTEUR INSTITUTE, 75724 PARIS CEDEX 15, FRANCE.

32.

Certain bacilli, such as Bacillus thuringiensis, are lethal to eggs and larvae of several zooparasitic nematodes. Another entomocidal bacterium Bacillus sphaericus (Strain 1593) also produced a sporal toxin that was lethal to eggs of the nematode Trichostrongylus colubriformis. Lethality of this sporal toxin was not affected by pH (4.5-9.5), increased osmolarity, calcium chloride (5 mM) or the enzyme inhibitor PMSF (10^{-5}M). The lethality of sporal toxin was reduced by autoclaving, heating (50 C for 1 hr) and the enzyme inhibitor TPCK (10^{-4}M). Toxicity of the sporal toxin was reduced by membrane filtration, ultrafiltration or elution through a reverse-phase Sep-pak. No synergism of the B. sphaericus toxin and the toxins from B. t. israelensis or B. t. kurstaki was observed. These results indicated that the B. sphaericus sporal toxin differed from the ovicidal toxins of B. thuringiensis.

FACTORS INFLUENCING THE LETHALITY OF BACILLUS THURINGIENSIS KURSTAKI FOR TRICHOSTRONGYLUS COLUBRIFORMIS EGGS. J. MEADOWS*, L.W. BONE AND S.S. GILL. USDA, ARS, ANIMAL PARASITE RESEARCH LABORATORY, AUBURN, AL 36830 AND UNIVERSITY OF CALIFORNIA, RIVERSIDE, CA 92521.

33.

Bacillus thuringiensis kurstaki is one of many B. thuringiensis strains that is lethal to nematode eggs and larvae. Little information, however, is available about factors that influence toxicity.

Elevation of the pH from 3 to 11 for 1 hr increased the toxin's lethality for nematode eggs. The toxin retained ovicidal activity when heated to 65 C for 1 hr, but lost activity after a similar time at 100 C. Storage of the toxin at ambient temperature reduced ovicidal activity after 1 week, but no loss of activity was found with freezing for lengthier periods. Certain inhibitors of membrane transport also affected the toxicity of B. t. kurstaki for nematode eggs. Sodium vanadate (200 μm) caused a 9-fold increase in toxicity while 4,4'-diisothiocyana-2-'disulfonic acid stilbene (DIDS; 200 μM) caused a 333-fold decrease in ovicidal activity.

A FAST AND ACCURATE FECAL EXAMINATION TECHNIQUE FOR DIAGNOSIS OF FASCIOLA HEPATICA. R.C. DIXON AND R.B. WESCOTT*. WASHINGTON STATE UNIVERSITY, PULLMAN, WA 99164.

34.

A standard fecal sedimentation procedure for diagnosis of Fasciola hepatica was modified by straining samples mixed in tap water through a series of 3 stacked screens prior to examination. The first 2 screens were made of mesh of sufficient size (425 and 100 μ) to remove large particulate matter but allow passage of F. hepatica eggs. The final screen contained a finer mesh (45 μ) which collected the eggs. The material trapped by the fine mesh was examined with a dissecting microscope in the same manner used for examination of samples obtained by the standard sedimentation procedure. Analysis of results of >400 examinations, performed by 3 different technicians, using the standard and modified techniques revealed that the former detected 66% of positive samples while the latter was 94% effective. In addition, the multiple screen technique reduced preparation time in half (12 minutes) and required only one third (5 minutes) of the examination time. These savings increased as technicians became more familiar with the modified procedure and decreased the reluctance of laboratory assistants to perform fecal analysis to diagnose F. hepatica infections.

35. QUANTITATION OF HABITAT AREA OF SNAIL HOSTS OF FASCIOLA HEPATICA AS A MEASURE OF INDIVIDUAL FARM RISK. J.B. Malone*, J. Ritchie, T.E. Williams, A.F. Loyocano and R.A. Muller, Louisiana State University, Baton Rouge, LA. and Hydrology Laboratory, USDA, Beltsville, MD.

Fifteen potential habitats of Fossaria bulimoides were mapped and visited twice/week for 28 months to measure water depth and/or moisture scores under various daily climatic water budget conditions. Snails were recorded as present or not each 25 feet along the length of habitats, a 1-minute timed count was done each 100 feet, and a 7.5 minute count was done at the strongest part of habitats. Habitats typically represented low points in ditch-and-crown pasture drainage systems. Habitats were ranked on total number of snails found (range 0-2108) and classified as strong, $\geq$ 200; moderate, 100-200; weak, > 100 or non-habitat. Habitats became weaker as the number of dry soil days increased and the number and extent of snails decreased in shallower, drier portions of habitats. Black and white infrared photographs (1:3000) of study pasture were analyzed by densitometer and image analysis to determine if habitats could be identified and quantitated. Results indicate that remote sensing/or ground survey methods may be used to reliably map and quantitate habitat area if done under appropriate water budget conditions. A farm risk factor can thus be assigned to individual cattle operations that can be used, with regional climate forecasts, in planning control programs for fascioliasis.

36. TOXOPLASMOSIS - RECENT ADVANCES. J.P. DUBEY. USDA, ARS, ANIMAL PARASITOLOGY INSTITUTE, BELTSVILLE, MD 20705.

Approximately 30 to 40% of human adults in the U.S. have antibody to Toxoplasma gondii. Epidemiologic data suggest that the ingestion of tissue cysts in undercooked meat is an important source of infection of people in the U.S. Infected porcine tissues may be the main meat source of T. gondii. We have found viable tissue cysts in several edible tissues of live pigs up to 875 days post-inoculation (DPI) and in naturally infected pigs. Of the 4 sows killed between DPI 759 and 865, viable tissue cysts were found in hearts of all 4, tongues of 3, bacons, hams, arm picnics, Boston butts, spareribs, diaphragms of each 2, livers, kidneys, tenderloins, and bacons of 1 each. T. gondii was found to be inconsistently distributed among the organs and muscles but brain, heart and tongue were more heavily infected than other organs.

Gamma irradiation (50 krads) of whole body carcass was found to be one of the practical ways to kill T. gondii in meat.

37. PATHOLOGY AND IMMUNOGENESIS OF THEILERIOSIS. H. OUHELLI. INSTITUT AGRONOMIQUE ET VETERINAIRE HASSAN II. RABAT, MOROCCO.

Theileriosis shows a variety of symptoms, with lesions characterized by small areas of necrosis and cellular infiltration mostly lymphoid in the lung, digestive tract, liver, kidney and adrenal glands. The appearance of schizonts and merozoites of Theileria annulata in the body is associated with disturbances in the permeability and secretory activity of the mucosa in the abomasum and in the duodenum. These disturbances are revealed by an increase in the transmural potential difference in these organs and in the amount of Na^+, Ca^{++}, Cl^- ions and total protein content. At an immunological level, the production of leucocyte migration inhibitory factor confirmed the role of cellular immunity. Humoral immunity was also demonstrated. It had an effect when the parasite released from the host cell. Also, the role of specific antibodies and of complement in the opsonization of Theileria before phagocytosis was revealed. The antigenic relationship between T. annulata from Morocco and of Turkey was shown by in vitro and in vivo studies.

38. **STUDIES ON THE MODE OF INOCULATION AND SITE SPECIFICITY OF CRYPTOSPORIDIUM BAILEYI IN BROILER CHICKENS. D.S. LINDSAY*, B.L. BLAGBURN, C.A. SUNDERMANN, F.J. HOERR AND J.J. GIAMBRONE. AUBURN UNIVERSITY, AL 36849**

To determine how the mode of inoculation influences site specificity of Cryptosporidium baileyi (AU-B1 isolate), 14 broiler chicks were inoculated intraocularly (IO) onto the conjunctival sacs with 1 x 10^6 oocysts, 12 broiler chicks were inoculated intravenously (IV) with 2 x 10^6 oocysts, and 12 broiler chicks were inoculated intraabdominally (IA) with 2 x 10^6 oocysts. Twelve chicks were not inoculated and served as controls. Chicks were killed and examined on various days postinoculation. Tissues collected at necropsy from each bird were conjunctiva, nasopharynges, larynx, trachea, lung, air sacs, bursa of Fabricius (BF) and cloaca. Additionally, duodenum, jejunum, ileum, cecae, liver, pancreas and kidney were examined in birds inoculated IV or IA. Cryptosporidia were present in the BF and cloaca of all 14 chicks inoculated IO, but in the conjunctiva of only 3 of these birds. No cryptosporidia were observed in the birds inoculated IV or in controls. Birds inoculated IA developed clinical signs of respiratory cryptosporidiosis and gross lesions of airsacculitis. Cryptosporidia were observed in the larynx, trachea, primary and secondary bronchi, air sacs, BF and cloaca of all birds inoculated IA. The present study suggests that naturally acquired respiratory or renal cryptosporidiosis does not result from venous dissemination of oocysts or sporozoites. Birds inoculated IA respond as do birds inoculated intratracheally with oocysts. This technique (IA inoculation) may be useful to workers studying respiratory cryptosporidiosis.

39. STUDIES IN SARCOCYTIS FUSIFORMIS AND SARCOCYSTIS LEVINEL FROM WATER BUFFALOES UTILIZING THE CAT AND DOG AS ITS DEFINITIVE HOSTS.

BAOAN YAO. DEPT. OF ANIMAL SCIENCE & VETERINARY MEDICINE, HUAZHONG AGRICULTURAL UNIVERSITY, WUHAN, THE PEOPLE'S REPUBLIC OF CHINA.

Sarcocysts of Sarcocystis fusiformis in muscles (major parts in oesophageal muscles) of naturally infected water buffaloes in China are white spindle-shaped, 6.4-25.0 mm long and 2.1-5.7 mm in diameter. It was called macrocysts. Bradyzoites are banana-shaped, 12.4-15.6 X 5.2-6.5 um. Utilizing cat as its definitive host. The sporocysts in cat feces are ellipsoidal, 12-13 X 8-8.8 um. The number of sporocysts ranged 1-6 per gram of feces. The prepatent peroid is 13-21 days, the patent peroid 4-26 days.

Sarcocysts of Sarcocystis levinei in muscles (major parts in oesophageal muscles) of naturally infected water buffaloes in China are thin , while streaks and spindle-shaped, 0.75-2.25 mm long and 0.08-0.15 mm in diameter. It was called microcysts. Bradyzoites are banana-shaped, 12-13 X 3.3-3.9 um. Utilizing dog as its definitive host. The number of sporocysts ranged 6-25 per gram of feces. The sporocysts in dog feces are ellipsoidal, 15-16.7 X 9.5-10.5 um. The prepatent peroid is 12-27 days, the patent peroid 20-35 days.

40. COCCIDIOSIS IN GAME BIRDS.

M.D. RUFF, USDA, ANIMAL PARASITOLOGY INSTITUTE, BELTSVILLE, MD 20705.

Coccidiosis is a frequent and often severe problem in game birds which includes any species of pheasant, quail, or partridge that are raised commerically either for food, hunting, or hobbies. Overall dollar losses are relatively small compared to those from coccidiosis of chickens and turkeys. However, losses can be quite extensive for an individual producer. There is mounting evidence that the response of different game birds and their species of coccidia to specific anticoccidials (efficacy and level) differs from that of chickens and turkeys and their parasites. For example, most commonly used anticoccidials, such as the ionophores, halofuginone, amprolium, and nicarbazin, are ineffective for the control of coccidiosis in the chukar partridge. Furthermore, two ionophores that have been submitted to FDA for approval for use in quail are effective at lower levels (80 ppm for monensin; 55 ppm for salinomycin) than the levels used in chickens.

41. THE EFFECT OF DIFLUBENZURON ON DEVELOPMENT OF ASCARIS SUUM AND HAEMONCHUS CONTORTUS. R.H. FETTERER,* J.F. URBAN, JR. AND R. MILLER. USDA, ARS, HELMINTHIC DISEASES LABORATORY AND LIVESTOCK INSECT LABORATORY. BELTSVILLE AGRICULTURAL RESEARCH CENTER, BELTSVILLE, MD 20705

Diflubenzuron (DFB) is a potent specific inhibitor of arthropod chitin synthesis. DFB prevents development of insect larvae by altering the normal course of chitin synthesis in the exoskeleton. The potential of chitin synthesis inhibitors to alter nematode development was investigated by determining the effect of DFB on H. contortus and A. suum. DFB given orally (10mg/kg/day for 21 days) to sheep inoculated with H. contortus infective larvae did not alter the adult worm burden or fecal egg output. DFB treatment of lambs with patent H. contortus adults caused a significant (90%) decrease in the number of infective larvae recovered from fecal cultures. However, DFB was without effect on egg hatching, and chitin was not detected in untreated eggs or larvae. Oral administration (10mg/kg/day for 20 days) of DFB to swine harboring patent A. suum adults had no effect on the adults or the eggs; eggs from both treated and control worms were found to contain significant amounts of chitin. DFB, however did inhibit in vitro chitin synthesis in the isolated reproductive tract of A. suum adults. These results indicate that DFB can inhibit the development of H. contortus larvae independent of an effect on chitin synthesis, and DFB does not effect A. suum development although their eggs contain chitin.

42. HAEMONCHUS CONTORTUS: CHARACTERIZATION OF AN ENZYME MEDIATING THE ECDYSIS OF INFECTIVE LARVAE. H.R. GAMBLE* AND R.H. FETTERER. USDA, ARS, ANIMAL PARASITOLOGY INSTITUTE, HELMINTHIC DISEASES LABORATORY. BELTSVILLE MARYLAND 20705.

The ecdysis of infective third stage trichostrongyle larvae is characterized by the digestion of a specific region of the L_2 cuticle resulting in the formation of a cap which falls off and allows the larvae to escape. The digestion of this region of the cuticle, a phenomenon termed refractile ring formation, is presumably mediated by the release of an enzyme from the parasite in an area proximal to this region of the cuticle.

Preparations containing an enzyme mediating refractile ring formation were collected from Haemonchus contortus L_3 by incubation in Earle's balanced salt solution under CO_2 for 1 hr at 37 C. Enzyme(s) contained in this preparation hydrolyzed the proteolytic substrate azocoll and several other protein and collagen substrates. Enzyme activity hydrolyzing azocoll and mediating refractile ring formation had similar pH optima, required Ca^{++} for activity, and had similar characteristics with respect to inhibitors. High performance liquid chromatography of this enzyme preparation yielded a single peak of azocoll and refractile ring activity with a molecular weight of approximately 10K Da, associated with a very minor protein peak.

43. IDENTIFICATION OF A STRONGYLUS VULGARIS INDUCED EOSINOPHIL CHEMOTACTIC FACTOR FROM EQUINE PERIPHERAL BLOOD MONONCULEAR CELLS. V.A. DENNIS, T.R. KLEI* AND M.R. CHAPMAN. LOUISIANA STATE UNIVERSITY. BATON ROUGE, LA 70803.

Previous studies utilizing an in vitro chemotaxis assay indicated that soluble S. vulgaris female extract (SV-EXT; >100 ug/ml) was slightly chemotactic for eosinophils from ponies with S. vulgaris induced eosinophilia (immune EOS) but not for neutrophils (immune PMN) from similarly infected animals. By use of a similar in vitro chemotaxis assay the incubation (37°C) of SV-EXT (50 ug/ml), heat inactivated autologous immune serum (10%) and different concentrations of mononuclear cells from hyperimmune ponies (sensitized mono) resulted in the release of a cytokine which was chemotactic for immune EOS. The maximum number of cells required to generate this cytokine was observed to be 6 X 10^6 cells/ml. A kinetic study also demonstrated that highest chemotactic activity for immune EOS was observed from cytokine produced by 90 minutes. Cytokine generated utilizing normal MONO instead of sensitized MONO was less chemotactic for immune EOS. The cytokine was also demonstrated to be specifically chemotactic for immune EOS but not for immune PMN. A high chemokinetic response instead was observed for immune PMN. This data suggests that there is an in vivo relationship of immune EOS to the host immune response. (Supported in part by USDA Grant 82-CRSR-2-2033 and the LSU-Equine Vet. Res. Prog.).

44. IDENTIFICATION OF SURFACE SPECIFIC MOLECULES ON THE NEMATODE NEMATOSPIROIDES DUBIUS. G.C.COLES* AND L.H.SEMPREVIVO. UNIVERSITY OF MASSACHUSETTS, AMHERST, MA 01003.

As an alternative to preparation of monoclonal antibodies to examine the surface antigens of the mouse nematode Nematospiroides dubius, polyclonal antibodies were isolated by a novel procedure. Adult worms were incubated in immune serum, rinsed and the bound antibodies removed by incubation in 3M sodium iodide. Sodium iodide was removed by gel chromatography. Using immunofluorescent labelling it was shown that the surface specific antibodies (SSA) rebound to the surface of live worms. As determined by SDS gel electrophoresis and immunoblotting, in contrast to immune sera the SSA bound to a select group of proteins from homogenised worms. These were of higher molecular weight and compared favorably with previous reports of surface proteins. Glycolipids were extracted with chloroform/methanol, cleaved with trifluoro acetic anhydride and the oligosaccharide residues joined to carrier proteins. The surface specific antibodies reacted with these neoglycoproteins in an ELISA assay. These results suggest that the SSA were directed against both surface active glycolipids and (glyco?)proteins on N.dubius.

EXPERIMENTAL CONTROL OF GASTROINTESTINAL PARASITES IN GOATS USING IVERMECTIN. P.G. HOYT*, J.E. MILLER, D.D. FRENCH, J.C. WILLIAMS, M.J.
45. HOYT, S. TURNQUIST AND R. WILLIS. LOUISIANA STATE UNIVERSITY, BATON ROUGE, LA 70803.

A herd of 37 mixed breed brush goats was monitored for parasite loads by fecal egg count (EPG) and microhematocrit (PCV) every 7-14 days from March to November, 1986. When the PCV's of 10% of the goats in the herd dropped below 20, or when one animal's PCV dropped below 10, the entire herd was treated with ivermectin. The goats were treated on Mar. 4, May 23, July 11, Aug. 29 and Oct. 24 with a dosage based on the average weight of the goats. Based on average weights all individual animals were treated with ivermectin at 294 meg/kg. Culture of the feces showed an infection of 6% Haemonchus and 94% Trichostrongylus species. Post treatment fecal EPG decreased to ten or less in 100% of the goats 14 days after the first treatment. Fourteen days after the last treatment, the EPG decreased to 10 or less in only 52.8% of the goats. The EPG's ranged from 11 to 99 in 27.8% and 100 to 499 in 19.4% of the goats following the last treatment. These results suggested a reduced efficacy of ivermectin for the goat gastrointestinal parasite during the period observed.

EFFICACY OF NETOBIMIN AGAINST LEVAMISOLE-RESISTANT HAEMONCHUS CONTORTUS IN
46. LOUISIANA LAMBS. J.E. MILLER*, F.G. HEMBRY, M.T. KEARNEY, J.C. WILLIAMS. LOUISIANA STATE UNIVERSITY, BATON ROUGE, LA 70803.

Two trials were conducted to evaluate whether the population of Haemonchus contortus present in the Louisiana State University sheep flock demonstrated some level of resistance to levamisole. In addition, the efficacy of netobimin against this population was evaluated.

The first trial involved 10 naturally infected lambs of which 5 were treated with a commercial drench of levamisole (8 mg/kg) and 5 remained as untreated control animals. Nematode recovery after slaughter demonstrated 0% efficacy against H. contortus indicating that the population was resistant to levamisole.

The second trial involved 30 experimentally infected lambs of which 10 were treated with a commercial levamisole drench (8 mg/kg), 10 were treated with a netobimin drench (20 mg/kg) and the remaining animals were assigned to a control group. Nematode recovery after slaughter demonstrated 62.3% efficacy and 99.8% efficacy for levamisole and netobimin, respectively, against H. contortus. Results of both trials indicate that the population of H. contortus present in the Louisiana State University sheep flock was resistant to levamisole and that netobimin was highly effective against that population.

47. OVERVIEW OF THE PROBLEM OF ANTHELMINTIC RESISTANCE. V. J. THEODORIDES. SMITHKLINE ANIMAL HEALTH PRODUCTS, WEST CHESTER, PA 19380

The introduction of phenothiazine in 1939 to combat nematodes in cattle and sheep was followed by reports of treatment failure, which soon faded away with the introduction of 2-3 micron particle size purified Phenothiazine. The problem of resistance emerged almost at once with the advent of thiabendazole in 1961. Soon after its introduction one report in 1964 indicated that thiabendazole failed to control Haemonchus contortus in sheep in Arkansas at the recommended dose level of 50 mg/kg. Reports on thiabendazole and other benzimidazole resistance began to trickle into the literature from around the world but Australia provided the lion's share of publications. Although, it was first thought that resistance emerged de novo during therapy one now finds benzimidazole use selecting for resistant nematodes which were present but very uncommon in the sheep population before treatment began. Where did the resistance traits themselves come from in the first place? Why did only a handful of nematodes invented genes for resistance to benzimidazole drugs before the clinical use of these anthelmintics? Why do nematodes of sheep, goats and horses, but not cattle or swine carry the resistance traits? These issues and the hypothesis that resistance is due to a change in tubulin will be discussed. It was said that we would not have diseases without physicians, illiteracy without teachers and crime without police and perhaps anthelmintic resistance without parasitologists.

48. GENETICS OF ANTHELMINTIC RESISTANCE IN NEMATODES. L.F. LE JAMBRE*. CSIRO, PASTORAL RESEARCH LABORATORY. ARMIDALE 2350, AUSTRALIA.

The role of anthelmintics as the keystone in our control of nematodes is being threatened by the emergence of drug-resistant strains. Development of anthelmintic resistance is an evolutionary process that can be more clearly understood when the genetic basis is defined. The rate at which resistance develops is influenced by the amount of variation available and the way in which selection channels that variation. Resistance may be due to either a single gene or be polygenically determined. Delaying resistance through an exploitation of the genetic system involved in confering that resistance will be emphasized.

49. CONTROL STRATEGIES FOR COUNTERING ANTHELMINTIC RESISTANCE.
G.C.COLES. UNIVERSITY OF MASSACHUSETTS, AMHERST, MA 01003.

Anthelmintic resistant nematodes are a problem in sheep, goats and horses and are possibly present in cattle. Once resistance has developed to a drug it is probably permanent. Therefore the effectiveness of existing drugs must be conserved by their optimal use, as anthelmintics with novel mechanisms of action are rarely developed. In theory development of resistance can be delayed by i) use of an anthelmintic dose to obtain a complete worm kill, ii) reducing the frequency of dosing and therefore the selection pressure for resistance, iii) annual alternation of anthelmintic types, iv) treatment of all animals introduced onto a farm with at least two types of anthelmintic before they go onto pasture. Unfortunately some modern control strategies, whilst epidemiologically correct, are likely to enhance selection for resistance.

50. NOVEL APPROACHES TO CONTROL NEMATODE PARASITES.
L. W. BONE, USDA, ARS, ANIMAL PARASITE RESERCH LABORATORY, AUBURN, AL 36830.

Several novel methods may allow nematode control. Exposure of male nematodes to concentrated pheromone from females inhibited their subsequent responses to living females in vitro and in vivo, presumably due to receptor saturation. Lectins also bound to putative receptors on the nematode cuticle to reduce mating and feeding.

Phagostimulants elevated in vitro ingestion of radiolabelled anthelmintic by ruminant nematodes. Drug efficacy in mice was improved by administration of a phagostimulant.

Microbial toxins from Bacillus thuringiensis were ovicidal and larvicidal to zooparasitic nematodes in media and feces. Lethality of microbial toxin(s) was evident within 1.5 hours while nematode egg permeability was altered in 5 minutes.

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