PROCEEDINGS

29th

ANNUAL

MEETING

THE

AMERICAN ASSOCIATION OF VETERINARY PARASITOLOGISTS

July 15-17, 1984

New Orleans, Louisiana

PROCEEDINGS

of the 29th

ANNUAL MEETING

of the

AMERICAN ASSOCIATION OF VETERINARY PARASITOLOGISTS

JULY 15 - 17, 1984

NEW ORLEANS, LOUISIANA

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PROGRAM

AMERICAN ASSOCIATION OF VETERINARY PARASITOLOGY

ANNUAL MEETING

New Orleans Hilton

Sunday, July 15

7:00 AM Registration

SESSION 1: EPIDEMIOLOGY
Moderators: E.L. Roberson and J.C. Schlotthauer

1. 8:00 Hypobiotic changes in Ostertagia ostertagi during environmental adaptation in Louisiana.
   K.S. Marbury, J.C. Williams and S.W. Scheide

2. 8:15 Hypobiotic changes in Ostertagia ostertagi during environmental adaptation in Ohio.
   G.R. Frank and R.P. Herd

3. 8:30 Development and survival of the free-living stages of bovine strongylate nematodes under summer conditions in California.
   J.E. Miller and N.F. Baker

4. 8:45 The effect of non-burying dung beetles on nematode parasites of cattle.
   M.F. Andrews

5. 9:00 Integrated control of Ostertagia ostertagi and other gastro-intestinal nematodes in cattle.
   J.C. Williams, J.W. Knox, K.S. Marbury, M.D. Kimball, S.W. Scheide and T.G. Snider

6. 9:15 Epidemiologic approach to the control of horse parasites.
   R.P. Herd, K.A. Willardson and A.A. Gabel

7. 9:30 Epidemiology of strongyles in ponies in Ontario.
   J.O.D. Slocombe

8. 9:45 Environmental contamination by Toxocara species infected dogs.
   A.J. Paul and K.S. Todd, Jr.

10:00 BREAK

SESSION 2: CHEMOTHERAPY I
Moderators: L.S. Blair and G. Myers

9. 10:30 Anthelmintic activity of tricalbendazole.
   G.C. Coles

10. 10:45 Clinical assessment of a new small animal miticide.
S.D. Folz, T.J. Kakuk, C.L. Henke, D.L. Rector, F.B. Tesar and G.A. Conder

11. 11:00 Ctenocephalides felis felis: Failure of ivermectin given per os in miglyol vehicle to control experimental flea infestations of dogs in a double blind controlled trial.
L.S. Blair, J.R. Egerton and D.V. Ewanciw

12. 11:15 Efficacy of ivermectin against Boophilus spp in cattle.
R.A. Roncalli, I.K. Hotson, C. Benitez-Usher and A. Bridi

13. 11:30 The effect of ivermectin on the larval development of Dirofilaria immitis in Aedes aegypti.
C.M. Hendrix, B.L. Blagburn and L.K. Bellamy

14. 11:45 Bovatec^{R}(lasalocid) - a new anticoccidial for sheep.
G.G. Untawale and W.E. Brandt

12:00 PM LUNCH

SESSION 3: IMMUNITY
Moderators: T.R. Klei and J.F. Williams

15. 1:00 Transport of Eimerian sporozoites by lymphocytes: Implications for immunity and recurrent infections.
M.A. Fernando and M.E. Rose

16. 1:15 Pathological and immunological response of the Bobwhite Quail to a new species of coccidia.
M.D. Ruff

17. 1:30 Measurement of antibody responses to experimentally induced Dipetalonema reconditum infection in dogs by ELISA.
B.A. Lindemann, J.W. McCall, M. Mika-Grieve and R.B. Grieve

18. 1:45 Enzyme-linked immunosorbent assay for diagnosis of Baylisascaris larva migrans.
A.S. Little and K.R. Kazacos

19. 2:00 Diagnosis of ovine fascioliasis by a dot-enzyme-linked immunosorbent assay.
G.L. Zimmerman, M.J. Nelson and C.R.B. Clark

20. 2:15 Ascaris suum infection followed by fenbendazole to induce immunity in pigs.
T.B. Stewart and L.L. Southern

21. 2:30 Immunopathological responses of calves infected with Ostertagia ostertagi and Trichostrongylus axei.
T.G. Snider III, J.C. Williams and P.A. Karns

22. 2:45 Dual infections in sheep: Corynebacterium ovis inoculated subcutaneously in two sites with Trichostrongylus colubriformis per os as a stressor mechanism.
R.C. Bergstrom and L.R. Maki

3:00 BREAK

SESSION 4: POSTER PRESENTATIONS

23. 3:30 Effects of high frequency anthelmintic treatment on two herds of horses.
C. Uhlinger and C. Johnstone

24. The effects of continuous anthelmintic administration on experimental infections of Parascaris equorum.
R.M. McCormick and T.J. Kennedy

25. Efficacy of ivermectin in injectable and paste formulations in the resolution of cutaneous lesions associated with Onchocerca cervicalis infection.
D.D. French, T.R. Klei, J.J. McClure, R.I. Miller, C.S. O'Neill, and L. Foil

26. Anthelmintic treatment and production response of California dairy cattle that utilize a pasture-based feed system.
J.E. Miller and N.F. Baker

27. Efficacy of monensin against coccidia infection in calves.
B.E. Stromberg, J.C. Schlotthauer, K.J. Hamann, and W.J. Bemrick

28. Comparative anthelmintic efficacies of fenbendazole, levamisole and thiabendazole in cattle.
T.A. Yazwinski, B.L. Presson and H.E. Featherstone

29. Clinical evaluation of a combination febantel-praziquantel paste in dogs and cats.
H.D. McCurdy

30. Further observations on the prophylactic activity of ivermectin against experimental Dirofilaria immitis infections in Beagles.
R.E. Plue, J.W. McCall, R.L. Seward, P.A. Tanner, and J.J. Jun

31. Diethylcarbamazine-oxibendazole formulation for prophylaxis of experimentally induced Dirofilaria immitis and Ancylostoma caninum infections in Beagles.
J.W. McCall, T.L. Evans, B.A. Lindemann, and J.M. Murphy

32. Patterns of parasitism in Minnesota moose (Alces alces).
J.C. Schlotthauer and P.D. Karns

33. Characteristics of transmission foci of Fasciola hepatica on Louisiana coastal marsh pastures.
J.B. Malone and M. Belcher

34. Epidemiology of Onchocerca cervicalis in Southern Louisiana.
L. Foil, T.R. Klei, C.S. O'Neill, R.I. Miller, D.D. French and J.J. McClure

35. Seasonal variations in nematode egg counts from northern plains beef cattle.
M.F. Andrews and M. Hanson

36. Seasonal occurrance of infective nematode larvae on common Bermuda grass grazed by goats in Louisiana.
K.S. Marbury and J.C. Williams

37. Pasture larval counts of equine strongylid nematodes in Florida.
C.H. Courtney

38. Epidemology and control of beef cattle parasitism - 1983 update.
R.M. Corwin, M.A. Brauer, E.M. Thomas, S.C. Bumgarner, and S.E. Pratt

39. Update on the epidemiology of Ostertagia ostertagi and other gastrointestinal nematodes of cattle in Louisiana.
J.C. Williams, J.W. Knox, K.S. Marbury, K.D. Kimball, S.W. Scheide and T.G. Snider

40. Chemical regulation of reproduction in Trichostrongylus colubriformis (Nematoda).
L.W. Bone and K.P. Bottjer

41. Experimental ocular larva migrans in mice, hamsters, gray squirrels and woodchucks infected with Baliascaris procyonis.
K.R. Kazacos, E.A. Kazacos and W.A. Vestre

42. Dirofilaria immitis infections in cats following transplantation of adult worms with notes on thiacetarsamide treatment.
M.T. Dzimianski, J.W. McCall, E.D. Perry and C.A. Rawlings

43. Serum antibody response to *Isopora suis* in piglets measured by an indirect fluorescent antibody assay.
J.R. Taylor, D.S. Lindsay, W.L. Current and P.H. Klesius

44. Swine ascariasis: Development of protective immunity following natural infection.
J.F. Urban, Jr. and R.D. Romanowski

5:00 Business Meeting

7:00 Society Social Hour, Sponsored by Pfizer, Inc.

Monday, July 16

SESSION 5: EXPERIMENTAL I
Moderators: B. Hammerberg and K.D. Murrell

45. 8:00 AM Quantitation and tissue distribution of encysted cyathostome larvae of the horse.
C.R. Reinemeyer

46. 8:15 *Strongylus equinus*: Development and pathology in the equine host.
B.M. McCraw and J.O.D. Slocombe

47. 8:30 Gastrointestinal parasitism in cows and calves on a once daily suckling program.
H. Ciordia, J.A. Stuedemann and J.V. Ernst

48. 8:45 Potential mechanisms for alteration of development of *Haemonchus* in sheep infected with *Ostertagia*.
J.L. Blanchard and R.B. Wescott

49. 9:00 Chemotactic factors from the third larval stage of cattle nematodes, *Ostertagia ostertagi*.
P.H. Klesius, T.B. Hayes, D.A. Cross and H. Ciordia

50. 9:15 Physiological effects of subclinical ostertagiasis in young lambs.
B. Hammerberg and D. Tally

51. 9:30 Cross-transmission of the ovine lungworm (*Dictyocaulus filaria*) between sheep and marmots.
F.M. Seesee and D.E. Worley

52. 9:45 Temperature-induced larval separation and morphologic differentiation of a mixed culture of *Ancylostoma caninum* and *Uncinaria stenocephala*.
R.L. Hill and E.L. Roberson

10:00 BREAK

SESSION 6: VETERINARY ENTOMOLOGY SYMPOSIUM
Guest Speakers from the Livestock Insect Workshop
Moderator: J.A. Hawkins

53. 10:30 An Update on the Ectoparasites of Swine.
R. Williams

54. 11:00 New Developments in the Control of Flies on Livestock.
G. Kinzer

55. 11:30 Mechanical Transmission of Animal Pathogens by Arthropods.
L. Foil

12:00 PM LUNCH

SESSION 7: CHEMOTHERAPY II
Moderators: J.A. DiPietro and E.L. Roberson

56. 1:00 Clinical trials of febantel-piperizine combinations in horses.
J.A. DiPietro, K.S. Todd, and T.F. Lock

57. 1:15 Reduction of the pathogenic effects of experimental Strongylus vulgaris infections in foals by anthelmintic prophylaxis.
T.J. Kennedy

58. 1:30 The efficacy of closantel against Fascioloides magna in sheep.
G.A. Conboy, J.C. Schlotthauer and B.E. Stromberg

59. 1:45 Levamisole: Its use in controlling the periparturient rise in winter lambing ewes.
C. Johnstone and S. Donoghue

60. 2:00 The sensitivity of mixed, bovine GI nematodiasis to morantel tartrate following the second, consecutive, yearly use of the paratect bolus.
T.A. Yazwinski, T.J. Newby, B.L. Preson and H.E. Featherstone

61. 2:15 Preliminary evaluation of a combination febantel praziquantal paste in puppies.
M.S. Sharp and H.D. McCurdy

62. 2:30 Evaluation of febantel-praziquantel combination paste in dogs and cats under six months old.
E.L. Roberson

63. 2:45 Influence of drugs and anthelmintics on ingestion by Trichostrongylus colubriformis (Nematoda) in vivo.
K.P. Bottjer and L.W. Bone

3:00 BREAK

SESSION 8: EXPERIMENTAL II
Moderators: T.J. Hayes and J.F. Urban

64. 3:30 Experimental Isospora suis infections in nursing piglets: Mortality and effect on 21 day weight gains.
D.S. Lindsey, W.L. Current and J.R. Taylor

65. 3:45 The fine structure of normal and aberrant strains of Eimeria tenella oocysts and a comparison of the protective immunity induced by these oocysts when fed to chickens.
H. Saatara Oz, W.J. Bemrick and B.E. Stromberg

66. 4:00 Cryptosporidiosis in newborn calves.
T.B. Hayes, L.H. Lauerman, P.H. Klesius, F.M. Mitchell, I.R. Long and A.C. Ellis

67. 4:15 Clinical pathologic correlations in equine cutaneous onchocerciasis.
C.S. O'Neill, R.I. Miller, T.R. Kiel, D.D. French, J.J. McClure and L. Foil

68. 4:30 Radiographic changes in cats with transplanted adult Dirofilaria immitis.
R.E. Lewis, J.M. Losonsky, J.W. McCall, M.T. Dzimianski, E.D. Perry and C.A. Rawlings

69. 4:45 Radiographic changes in ferrets infected with Dirofilaria immitis.
R.E. Lewis, P. Supakorndej, J.W. McCall, M.T. Oximianski and R.A. Holmes

SESSION 10: SYMPOSIUM ON CONTROLLED RELEASE TECHNOLOGY IN THE CONTROL OF GASTROINTESTINAL PARASITE INFECTIONS IN GRAZING CATTLE
Sponsored by: Pfizer Inc.
Moderators: D.L. Bliss and T.J. Newby

Session 1

70. 7:00 PM Pharmaceutical development of the morantel sustained release bolus.
D.S. Dresbak

71. 7:20 Epidemiology and progress in the control of parasitic gastroenteritis in Euorpe.
J. Armour

72. 7:40 Mathematical modeling as a technique to predict seasonal parasite control.
R.A. Anderson

Session 2

73. 8:00 Development of a strategic treatment system for the use of the morantel sustained release bolus - Summary of efficacy under field use conditions throughout North America.
D.H. Bliss

74. 8:20 Epidemiology and control of parasitic gastroenteritis in weaned calves and yearling cattle throughout North America - Panel Discussion / Reports of individual studies conducted in Arkansas, Florida, Indiana, Maine, Mississippi, Oregon, Idaho, Wisconsin and Eastern Canada.
R. Bradley, E. Block, S.M. Gaafar, P. Gadboise, J.L. Frechette, J. Hawkins, O. Slocombe, L.L. Smith, H.C. Gibbs, T.A. Yazwinski and G.L. Zimmerman

Session 3

75. 9:00 Epidemiology and control of gastrointestinal parasitic nematode infections in suckling beef calves in North America - Panel Discussion / Reports of individual studies conducted in Arkansas, Georgia, Idaho, Indiana, Missouri, North Dakota and Wisconsin.
M.F. Andrews, H. Ciordia, R.M. Corwin, S.M. Gaafar, E.G. Johnson, L.L. Smith and T.A. Yaswinski

76. 9:30 Potential drug resistance development in anthelmintic programs, including continuous dosage regimes, for the control of parasitic gastroenteritis in grazing cattle - Studies in Arkansas, Indiana and Wisconsin on the influence of the paratect bolus system on the susceptibility of gastro-intestinal helminths of cattle to morantel.
D.H. Bliss, L.L. Smith and T.A. Yazwinski

77. 9:50 Epidemiology and control of gastrointestinal parasite infections in cattle grazing winter pastures - Panel Discussion / Reports of individual studies conducted in California and Mississippi.
E. Illyes, N. Baker and J.A. Hawkins

Tuesday, July 17

SESSION II: RECENT ADVANCES IN PARASITE CONTROL
Moderator: B.E. Stromberg
Joint Session: AAVP and AVMA Research Section

78.	8:30 AM	Recent developments in parasite control options in cattle: Western US. N.F. Baker, G.L. Zimmerman and R.B. Westcott
79.	9:00	Recent developments in parasite control options in cattle: Southeastern US. J.C. Williams, J.W. Knox, J.B. Malone and K.S. Marbury
80.	9:20	Recent developments in parasite control options in cattle: Northeastern US. R.P. Herd
81.	9:40	Recent develpoments in parasite control options in cattle: Midwestern US. R.M. Corwin
	10:00	Panel Discussion: N.F. Baker, J.C. Williams, R.P. Herd, R.M. Corwin, and D.A. Armstrong
82.	10:30	Potential for immunologic control of equine parasites. T.R. Klei
83.	11:00	Recent developments in parasite immunity: Control of swine parasitism. K.D. Murrell

ABSTRACTS

1 & 2. HYPOBIOTIC CHANGES IN OSTERTAGIA OSTERTAGI DURING ENVIRONMENTAL ADAPTATION. G.R. FRANK, R.P. HERD, Department of Veterinary Pathobiology, The Ohio State University, Columbus, OH; K.S. MARBURY, J.C. WILLIAMS and S.W. SCHEIDE. Department of Veterinary Science, Louisiana State University, Baton Rouge, LA.

The object of this project was to study the effects of transfer of Ostertagia ostertagi between northern and southern temperate zones of the U.S.A. on the frequency and pattern of arrested development (hypobiosis) of this parasite in cattle. In this way it was aimed to determine whether different inhibition patterns in the north and the south are due to genetic differences in inhibition-proneness between parasite isolates or to a nongenetic mechanism of environmental adaptation. The degree of hypobiosis was determined from worm burdens recovered at necropsy in tracer calves allowed to graze plots contaminated by northern and southern cattle at both Columbus and Baton Rouge, in the autumn of 1982 and spring of 1983. In the autumn of 1982, the % hypobiosis reached 15.5% for the northern isolate and 1.3% for the southern isolate in Ohio, and 5.3% for the northern isolate and 12.9% for the southern isolate in Louisiana. In the spring of 1983, the % hypobiosis was less than 1% for the northern isolate and 68.9% for the southern isolate in Ohio, and 2.7% for the northern isolate and 45.6% for the southern isolate in Louisiana.

The different response by northern and southern isolates of O. ostertagi when compared side by side in Ohio and Louisiana indicates the existence of genetic differences between the two isolates. Thus the northern isolate exhibited a greater degree of hypobiosis in the northern autumn, the season when northern larvae normally respond to cold conditioning, while the southern isolate did not respond as strongly. In the south, neither strain exhibited appreciable hypobiosis in the autumn. The northern isolate was not subjected to cold conditioning, and the southern isolate was not subject to stimuli that normally trigger inhibition in the spring. The southern isolate exhibited a marked degree of hypobiosis in spring at both locations, whereas the northern isolate did not respond to spring stimuli at either location. It is possible that each isolate will adapt to its new environment, and the study is being continued to monitor any changes in environmental responses.

3. DEVELOPMENT AND SURVIVAL OF THE FREE-LIVING STAGES OF BOVINE STRONGYLATE NEMATODES UNDER SUMMER CONDITIONS IN CALIFORNIA. JAMES E. MILLER and NORMAN F. BAKER, School of Veterinary Medicine, State University, Baton Rouge, LA, and School of Veterinary Medicine, University of California-Davis, Davis, CA.

Free-living stages of strongylate nematode parasites of the bovine could develop (to some extent) but did not survive the hot dry summer (June through early September) on irrigated pasture in central California. High temperature and rapid dessication of the fecal pat during the first week post-deposition were not suitable microclimatic conditions to support extensive development or survival within the fecal pat. The high temperature and low relative humidity microclimate was not suitable for survival of

infective larvae (except Nematodirus) on pasture herbage. Sequestration of infective larvae within the fecal pat did not occur. Pasture infectivity was very low; the lowest numbers of Ostertagia infective larvae were recovered in June and July, and none were recovered in August or September. Only Nematodirus infective larvae were recovered in August and infectivity when the lowest.

4. THE EFFECT OF NON-BURYING DUNG BEETLES ON NEMATODE PARASITES OF CATTLE. MYRON F. ANDREWS, Department of Veterinary Science, North Dakota State University, Fargo, ND.

Individual species of dung beetles were added to cultures of Ostertagia ostertagi in the laboratory. After two weeks at room temperature, the third stage O. ostertagi larvae were counted. Eight species of coleoptera of the family Scarabaeidae, two of the Hydrophilidae, and some undetermined species of the Staphylinidae and Histeridae were utilized. The nematode counts were calculated as a percentage of the mean of the appropriate controls. All cultures with beetles produced less than 60% of the numbers produced in the control cultures with no beetles. Cultures containing Onthophagus pennsylvanicus produced only 3.5% as many as the controls and the cultures with histerids produced only 1.9% as many as those with no beetles. The reasons for the reduction of parasitic nematodes in the cultures with beetles were not obvious. Further work will try to identify the mechanisms involved.

5. INTEGRATED CONTROL OF OSTERTAGIA OSTERTAGI AND OTHER GASTRO-INTESTINAL NEMATODES IN CATTLE. J.C. WILLIAMS,* J.W. KNOX, K.S. MARBURY, M.D. KIMBALL, S.W. SCHEIDE and T.G. SNIDER. Agricultural Experiment Station, Louisiana State University Agricultural Center, Department of Veterinary Science (Baton Rouge) and Red River Research Station (Bossier City) and School of Veterinary Medicine, Department of Veterinary Pathology, Baton Rouge, LA.

Epidemiological data from previous investigations were applied in design of an experiment on integrated control of parasitism. Effects of parasitism and productivity were monitored in calves from weaning (avg. wt. - 188 kg) in November 1982 through stocker development in September 1983. Three groups of 15 cattle per group were observed. Group 1 was treated with thiabendazole at weaning in November, and with levamisole on February 1 and May 1 and grazed on clean pasture from November on. Pasture designated as clean had been used for grazing older dry cows, hay harvest, and spelled between July and November 1982. Group 2 was treated the same as Group 1, but was grazed on contaminated pasture. Only minimal control effort was exerted (single, low-dosage thiabendazole in November) in a 3rd group which was also grazed on contaminated pasture. The primary intent of treatment in November and February was prevention of type I ostertagiasis during winter - early spring and larval contamination on pasture in spring which initiates pre-type II and type II ostertagiasis. Separate sets of tracer calf pairs were grazed for 1 month on each set of experimental pastures in December 1982 and April 1983. Maximal productivity and control of parasitism was attained with cattle of Group 1. Fecal egg counts, pasture larval counts, and plasma pepsinogen remained lowest in this group. Abomasa of tracer calves grazed on clean pasture were essentially normal in contrast to extensive pathology found in those calves grazed on contaminated pasture, particularly in the April period.

Effects of parasitism were evident in Group 2 and Group 3, being most prominent in the latter. Greatest rates of gain during the experiment were reached by Group 1 animals during spring, the period of highest infection risk. Final average weights for cattle of each group, recorded in September, after 9 months on forage only, were: Group 1 - 368 kg, Group 2 - 337 kg, Group 3 - 262 kg. Slaughter of 3 representative cattle of each group in September yielded minimal worm burdens for Group 1 with small numbers of O. ostertagi; large worm burdens were recovered from both Group 2 and Group 3, with O. ostertagi being prominent in the former and Trichostrongylus axei in the latter.

6. EPIDEMIOLOGIC APPROACH TO THE CONTROL OF HORSE STRONGYLES. R.P. HERD, K.L. WILLARDSON, and A.A. GABEL. Department of Veterinary Pathobiology, The Ohio State University, Columbus, OH.

Studies in Ohio from 1981-1983 have demonstrated the need to treat horses in spring/summer to block seasonal rises in egg counts and to prevent the resulting explosive rise in pasture infectivity in summer/fall. The results have also shown that as few as two strategic treatments a year can result in a six-fold reduction in pasture infectivity. It has consistently been found that 94-100% of eggs passed and infective larvae recovered from pasture are small strongyles, and that a successful control program must employ strategies to counter the development of drug resistant parasites. Such strategies include limited numbers of strategic treatments, annual rotation of anthelmintics, periodic pre- and post-treatment egg counts, treatment of new arrivals with non-benzimidazole drugs, and changing the drug family once resistance has developed. The spring/summer strategy is recommended for northern regions only, and is inappropriate for southern states, where a late summer/autumn strategy may be more on target.

7. EPIDEMIOLOGY OF STRONGYLES IN PONIES IN ONTARIO. J.O.D. SLOCOMBE, Department of Pathology, Ontario Veterinary College, University of Guelph, Guelph, Ontario.

Fifty-one Shetland-cross pony mares were divided into 3 groups and each group with a stallion was placed on separate pastures on May 30, 1983. The pastures had been grazed for several years by the ponies which also had had minimal anthelmintic treatment. Feces from each pony and herbage from 2 pastures were examined fortnightly from May through November. Two foals were weaned and removed from pasture when they were 2-1/2 months old on August 3 and one when 3 months on September 7. The foals were housed for a period prior to necropsy.

Mean fecal eggs per gram for the 3 groups ranged from 585 to 838 on May 30 to over 1000 by mid-July to early August and 413 to 532 on November 22. Larvae per kg of dry herbage were 8036 and 17,197 on May 17 and decreased to 0 and 1709 on June 21, then to a high of over 150,000 on October 11 and fell to 43,367 on November 22. Foals removed from pasture on August 3 had few nematodes and bots and minimal arteritis in the abdominal arteries, but the foal removed on September 7 had many parasites and severe arteritis and thrombosis.

8. ENVIRONMENTAL CONTAMINATION BY TOXOCARA SPECIES INFECTED DOGS. A.J. PAUL and K.S. TODD, JR., Department of Veterinary Pathobiology, University of Illinois at Urbana-Champaign, IL.

A total of 135 composite 50 g soil samples were collected from 23 parks and public places in three cities in central Illinois. Of these, 16.3% contained from one to thirteen Toxocara spp. eggs, 8.9% contained one to seventeen hookworm eggs and 0.74% containing Trichuris spp. eggs (12). Helminth eggs were recovered from 56.5% of the parks and Toxocara spp. eggs were recovered from 47.8%.

A total of 40 fecal samples were collected from the parks. Toxocara spp. eggs were found in 5% of the samples, 30% contained hookworm eggs and 15% were positive for Trichuris spp. eggs. Helminth eggs were recovered from 37.5% of the samples.

9. ANTHELMINTIC ACTIVITY OF TRICALBENDAZOLE. G.C. COLES, Department of Zoology, University of Massachusetts, Morrill Science Center, Amherst, MA.

Triclabendazole (6-chloro-5-(2,3 dicholorphenoxy)-2-methyl thio benzimidazole) is a novel potent fascioloicide with excellent activity against immature and mature Fasciola hepatica in sheep. Its spectrum of activity has been studied in vitro and in vivo against a range of laboratory helminths. In contrast to other benzimidazole anthelmintics it was inactive against the nematodes Caenorhabditis elegans and Nematospiroides dubius (500 ppm in the diet for 5 days). Adult Fasciola hepatica were killed in vitro by 2.5 ug/ml and 98% efficacy was obtained at 40 mg/kgxl in the rat. Although the cestode Hymenolepis diminuta was killed in vitro in 24 hrs. with 0.5 ug/ml, 200 mg/kgxl failed to remove the worms from rats. Both the larval cestode Taenia crassiceps and the fluke Schistosoma mansoni were killed in vitro in 24 hrs by 50 ug/ml of drug but no activity was observed in vivo in the mouse. In vitro tegumental damage was visible in both H. diminuta and S. mansoni suggesting that the prime site of action of triclabendazole may be the platyhelminth tegument. Its lack of activity against these species could therefore be due to the pharmacokinetics of the drug within the host.

10. CLINICAL ASSESSMENT OF A NEW SMALL ANIMAL MITICIDE. S.D. FOLZ, T.J. KAKUK, C.L. HENKE, D.L. RECTOR, F.B. TESAR and G.A. CONDER, The Upjohn Company, Kalamazoo, MI.

Amitraz (Mitaban(R) Liquid Concentrate) was clinically evaluated by 25 veterinary investigators. Small animal practitioners and dermatologists in specialty practices and at University Veterinary Clinics cooperated with these investigations.

A total of 1,721 demodicosis patients were included in the study; 1,107 had generalized demodicosis and 614 had the localized form. The miticide was topically applied at 14 day intervals and at a concentration of 250 ppm active drug. A high percentage (90.3%) of the patients with the localized form became clinically normal after three to six treatments; an additional 8.9% were clinically normal after receiving six to twelve supplementary treatments. Only a limited number (.08%) of localized demodicosis patients were not returned to normalcy, even after 18 treatments.

Likewise, a high percentage (80.3%) of the generalized demodicosis patients were clinically normal after three to six treatments; an additional 16.5% became normal after receiving six supplementary treatments, and another six treatments returned an added 2.6% to clinical normalcy. Of all localized and generalized patients treated,99% were clinically normal after three to eighteen topical treatments.

Recorded side-effects were minimal and transient. The most frequently observed side-effect was mild and transient sedation; this effect was often less apparent when additional treatments were applied.

11. CTENOCEPHALIDES FELIS FELIS: FAILURE OF IVERMECTIN GIVEN PER OS IN MIGLYOL VEHICLE TO CONTROL EXPERIMENTAL FLEA INFESTATIONS OF DOGS IN A DOUBLE BLIND CONTROLLED TRIAL. LYNDIA SLAYTON BLAIR, JOHN R. EGERTON and DEBRA VISLOCKY EWANCIW. Merck Sharp & Dohme Research Laboratories, Rahway, NJ.

Ivermectin in miglyol vehicle given orally at 0.5 mg/kg weekly or at 0.05 mg/kg daily was tested against experimental infestations of Ctenocephalides felis felis in a blind randomized control trial with three male beagles per group. Each dog was infested with approximately 200 unfed fleas on Day 0 and again on Days +7 and +77 and was isolated in conditions designed to support flea reproduction. Each beagle was treated daily with ivermectin or placebo vehicle from Day +5 to Day +173. Periodic counts of flea adults on the host were made in situ. The environment was also checked periodically for developing stages. On Day +151, +152, or +153 each dog was clipped and all fleas removed and counted. The dog was returned to its own "dirty environment" for an additional week before all fleas were again removed and the dog clipped again. Ivermectin, as tested, did not control infestations. At this time the dogs were housed in groups of three (one from each treatment group and one control) for one week in the quarters of the most heavily infested of the three dogs. Under these conditions, the drug did not protect dogs from acquiring new fleas even though the fleas had equal opportunity to chose an untreated host. The authors gratefully acknowledge the technical assistance of Carl Sutphin, Mark Gnozzio, Dale Jasaitis, Gary Mickle and Herbert Haines in this experiment.

12. EFFICACY OF IVERMECTIN AGAINST BOOPHILUS SPP. IN CATTLE. R.A. RONCALLI, I.K. HOTSON, C. BENITEZ-USHER and A.A. BRIDI, Merck Sharp & Dohmne Research Laboratories, Rahway, NJ.

Boophilus spp. are one-host ticks, which occur on cattle raised in many countries throughout the world. They cause serious losses in terms of decreased body weight gain and, sometimes, death. In addition, these ticks are vectors of highly pathogenic organisms including Babesia spp. and Anaplasma spp.

The results of trials conducted in several countries showed that ivermectin given subcutaneously once to cattle at 200 mcg/kg of body weight was 85 to 96.5% effective against Boophilus spp. Strains resistant to organophosphates, D.D.T., synthetic pyrethroids and amidine were sensitive to ivermectin. A repeated treatment at intervals shorter than 21 days afforded increased activity against Boophilus microplus.

13. THE EFFECT OF IVERMECTIN ON THE LARVAL DEVELOPMENT OF DIROFILARIA IMMITIS IN AEDES AEGYPTI. C.M. HENDRIX, B.L. BLAGBURN and L.K. BELLAMY. College of Veterinary Medicine, Auburn University, Auburn, AL.

Abstract not available

14. BOVATEC(R) (LASALOCID) - A NEW ANTICOCCIDIAL FOR SHEEP. GOVIND G. UNTAWALE* and W.E.BRANDT, Hoffman-La Roche Inc., Nutley, NJ.

Eight well-controlled replicated studies were conducted with sheep under commercial conditions in the U.S. and Canada. Data were evaluated for dose-response relationship of dietary lasalocid to fecal oocysts count and animal performance in the face of coccidiosis challenge. The overall analysis of these eight trials indicates that:

A) Dietary levels of 20 to 30 gm lasalocid/ton of complete feed were significantly ($P < .05$) more efficacious than unmedicated controls in the improvement of animal performance and the prevention of natural and induced ovine coccidiosis caused by the predominant species of Eimeria (E. ovina, E. crandallis, E. ovinoidalis, and E. parva).

B) Lasalocid levels up to 91 grams per ton of feed (3X highest use level of 30 g/ton) were safe with no toxicity or adverse reaction observed in the sheep fed these levels for 106 days. Performance of sheep fed 91 g/lasalocid/ton of feed was significantly ($P < .05$) better than the control sheep indicating a wide margin of safety.

C) Hoffmann-La Roche Inc. has requested that FDA appprove lasalocaid 20-30 g/ton as the dose to be fed to sheep for the prevention of coccidiosis.

15. TRANSPORT OF EIMERIAN SPOROZOITES BY LYMPHOCYTES: IMPLICATIONS FOR IMMUNITY AND RECURRENT INFECTION. M.A. FERNANDO, Department of Pathology, Ontario Veterinary College, University of Guelph, Guelph, Ontario and M. ELAINE ROSE, Houghton Poultry Research Station, Houghton, Huntingdon, CAMBS PE17 2DA England.

Shortly after chickens are inoculated with sporulated oocysts of Eimeria tenella, E. necatrix, E. maxima, E. acervulina, E. praecox, or E.brunetti, sporozoites of these species are found within intraepithelial lymphocytes. The sporozoites travel around the body within these lymphocytes for 24 to 48 h post-infection, eventually returning to develop into first generation schizonts within crypt or villus epithelial cells. During this peirod of travel, lympohcytes harbouring sporozoites are found in the blood, liver, spleen and kidneys of the infected birds. If an irritant is injected intraperitoneally (i.p.) at the time of oocyst inoculation the return of the sporozoites to the intestine is delayed by 24 to 48 h. In i.p. injected birds infected lymphocytes are also found in the peritoneal exudate.

16. PATHOLOGICAL AND IMMUNOLOGICAL RESPONSE OF THE BOBWHITE QUAIL TO A NEW SPECIES OF COCCIDIA. M.D. RUFF. USDA-ARS-Animal Parasitology Institute, Beltsville, MD.
Abstract Not Available.

17. MEASUREMENT OF ANTIBODY RESPONSES TO EXPERIMENTALLY INDUCED DIPETALONEMA RECONDITUM INFECTION IN DOGS BY ELISA. BRUCE A. LINDEMANN, JOHN W. McCALL, Department of Parsitology, College of Veterinary Medicine, University of Georgia, Athens, GA; and MARCIA MIKA-GRIEVE, ROBERT B. GRIEVE, Department of Pathobiology, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA.

Three male and 3 female Beagles, 6 to 7 months old were inoculated subcutaneously with 30 infective larvae per dog. A similar group of dogs served as noninoculated controls. Serum collection and modified Knott tests were done before inoculation and biweekly thereafer through postinoculation week (PIW) 61, and at PIW 20, 24, and 28. Fecal flotations were performed at PIW 28. Antibody titers were determined using a crude and semi-purified soluble Dirofilaria immitis whole worm extract as antigen in an ELISA. Inoculated dogs were examined for worms at PIW 28. Five dogs with chronic, experimentally induced dipetalonemiasis were evaluated also at PIW 70 to 89.

Mean $\log_2$ of reciprocal antibody titers were significantly ($P < 0.05$) greater for inoculated dogs (range 5 to 11) than for non-inoculated dogs (range 2 to 9) at PIW 6 to 16 using crude antigen. With the semi-purified antigen, values for inoculated dogs (range 1 to 11) were significantly greater than for noninoculated dogs (range 1 to 3) at PIW 4 to 16. Microfilariae were detected as early as PIW 10 and sporadically thereafter in 2 male and 1 female inoculated dogs. Mean microfilaremias ranged from 0 to 9 microfilariae per ml. Intestinal parasitism was not significant. One male D. reconditum was recovered and no D. immitis were found. $\log_2$ reciprocal antibody titers for 5 dogs with chronic dipetalonemiasis ranged from 3 to 7. Microfilarial counts ranged from 2 to 147 microfilariae per ml. Fecal flotations were negative.

18. ENZYME-LINKED IMMUNOSORBENT ASSAY FOR DIAGNOSIS OF BAYLISASCARIS LARVA MIGRANS. A.S. LITTLE and K.R. KAZACOS, Department of Veterinary Microbiology, Purdue University, West Lafayette, IN.

Baylisascaris procyonis is gaining increased recognition as a cause of VLM, OLM and CNS disease in animals and human beings. The purpose of these studies was to develop an enzyme-linked immunosorbent assay (ELISA) for the immunodiagnosis of Baylisascaris larva migrans. Larval antigens were prepared as homogenates/aqueous extracts of embryonated B. procyonis, Toxocara canis and Ascaris suum eggs. Several rabbits were immunized by multiple intradermal injections of these antigens in adjuvant. Four groups of 6 test rabbits each were orally infected with 1,000, 5,000, or 10,000 B. procyonis eggs or 10,000 T. canis eggs, with 2 uninoculated controls; all were bled sequentially over several weeks. The ELISA was developed as a microtiter system using an immunoperoxidase conjugate. Computerized ELISA programs were used to determine optimal antigen, conjugate and serum dilutions. Positive reactions were seen in the B. procyonis immunized or infected rabbits reacted against B. procyonis antigen; similar results were seen in the homologous T. canis system. The B. procyonis ELISA detected dose related differences in the test rabbits. Cross reactions were seen between B. procyonis and the other

ascarids, and were much stronger against A. suum than I. canis. Absorption of the sera with concentrated heterologous antigens removed or diminished this cross reactivity. Ouchterlony diffusion also indicated much stronger identity between B. procyonis and A. suum antigens; several major I. canis bands showed non-identity with B. procyonis. A human system was developed based on the rabbit system. Sera from 2 children with confirmed fatal baylisascariasis were positive for B. procyonis using the ELISA, and one who was tested was positive by Ouchterlony methods; similar low level cross reactivity was seen against the other 2 ascarids. This work indicated that the specific immunodiagnosis of Baylisascaris larva migrans by ELISA or other methods is feasible. Further specificity refinements are necessary, such as the use of larval excretory-secretory antigens or antigens derived from fractionation or other separation methods.

19. DIAGNOSIS OF OVINE FASCIOLIASIS BY A DOT-ENZYME-LINKED IMMUNOSORBENT ASSAY. G.L. ZIMMERMAN, M.J. NELSON and C.R.B. CLARK, College of Veterinary Medicine, Oregon State University, Corvallis, OR

The Dot-ELISA was modified for immunodiagnosis of ovine fascioliasis. Experimental groups consisting of six uninfected controls and two groups of seven sheep each infected with 250 or 500 metacercariae were bled bi-weekly for 16 weeks. Presence or absence of flukes was confirmed by fecal egg counts and necropsy. The Dot-ELISA incubations were at room temperature. Nitrocellulose discs "dotted" with 1 ul (50 ng protein) of Fasciola hepatica excretory/secretory products (ESP) were placed in 96-well microtiter plates. After blocking with BSA-TBS (bovine serum albumin-triethanolamine buffered saline) dilutions (2x - 1000x) of positive and negative control serum samples or experimental serum samples were placed in appropriate wells for a 30 minute incubation. Wells were washed (X 3) and 50 ul of horseradish peroxidase conjugated rabbit anti-sheep IgG added to each well for a 30 minute incubation and then aspirated off. Fifty microliters of sustrate solution (4-chloro-1-naphthal, methanol, TBS, and H_2O_2) was added for a 30 minute incubation and then aspirated off. Discs were air dried for visualization of a dark purple dot for a positive sample or no dot for a negative sample. Using the Dot-ELISA, antibodies against F. hepatica ESP were consistently detected by 4 weeks PI.

20. ASCARIS SUUM INFECTION FOLLOWED BY FENBENDAZOLE TO INDUCE IMMUNITY IN PIGS. T.B. STEWART and L.L. SOUTHERN, Department of Veterinary Microbiology and Parasitology, School of Veterinary Medicine and Department of Animal Science, Louisiana Agricultural Center, Louisiana State University, Baton Rouge, LA.

Forty-eight pigs (21.2 + 3.35 kg) were divided into 4 groups of 12 pigs each (4 pigs in each of 3 pens) on the basis of sex, weight, and origin. Each pig in groups 1 through 3 was infected orally with 2,000 embryonated Ascaris suum eggs on days 0, 11, and 22. Infections were terminated by fenbendazole treatment (3 mg/kg body weight) on days 2, 3, and 4 (group 1) or days 6, 7, and 8 (group 2) after each infection. No fenbendazole was given to groups 3 and 4. All pigs, including group 4, were challenged on day 39 with 100 embryonated A. suum eggs. At slaughter on days 93 and 101, a total of 4, 3, 49, and 34 A. suum were recovered from groups 1 through 4, respectively. All infections in groups 1 and 2 were unisexual. Repeated infections with A. suum did not induce an immune response (group 3) unless the infections were

terminated with fenbendazole (groups 1 and 2) as measured by worm populations at necropsy.

21. IMMUNOPATHOLOGICAL RESPONSES OF CALVES INFECTED WITH OSTERTAGIA OSTERTAGI AND TRICHOSTRONGYLUS AXEI. T.G. SNIDER III, J.C. WILLIAMS, and P.A. KARNS. School of Veterinary Medicine and Department of Veterinary Science, Louisiana State University, Baton Rouge, LA.

A project was designed to evaluate the responses of parasite-free calves to infection with Ostertagia ostertagi and Trichostrongylus axei in monospecific and mixed infections. A second objective was evaluation of the effect of an initial infection of Ostertagia ostertagi on the subsequent development of Type II ostertagiosis. At 16 weeks of age 20 calves were randomly divided in to 4 treatment groups for initial infection: 1) control; 2) O. ostertagi-66,000 L_3; 3) T. axei-66,000 L_3; and 4) O. ostertagi-33,000 L_3 and T. axei-33,000 L_3. After 6 weeks, 4 calves in groups 2 and 4 were given serial inoculations (3X per week for 8 weeks) of O. ostertagi L_3 (total of 505,000 L_3 per calf). Calves were monitored for ova production, plasma pepsinogen and were necropsied 10-13 days after the last serial inoculation of O. ostertagi. Worm burdens, gross and microscopic lesions were recorded. Hematological, serum chemistry and serum immunoglobulins values were correlated with lymphocyte blastogenesis using specific and non-specific mitogens.

22. DUAL INFECTIONS IN SHEEP: CORYNEBACTERIUM OVIS INOCULATED SUBCUTANEOUSLY IN TWO SITES WITH TRICHOSTRONGYLUS COLUBRIFORMIS PER OS AS A STRESSOR MECHANISM. R.C. BERGSTROM and L.R. MAKI, Division of Microbiology and Veterinary Medicine, University of Wyoming, Laramie, WY.

Artifically posed infections in sheep (C ovis subcutaneously and T. colubriformis per os singly and en duo) elicit a different host reponse and degree of pathogenecity depending on the site of inoculation of the bacterium. Six month-old lambs were inoculated subcutaneously in the right inguinal area with either 1×10^4 C. ovis (A.T.C.C. strain, 0.1 ml dose) plus T. colubriformis (90,000 L_3/lamb per os) or 1×10^5 C. ovis singly in the same body area. Uninfected lambs were maintained in a separate pen as controls. As in prior experiments with inoculations nearer the lungs of sheep (subcutaneously, left axilla) the dually infected lambs were found to carry lung lesions (2 or 4 animals) at necropsy about 100 days post infection. At the log higher level but infected with C. ovis only no lung lesions were found at necropsy 105 days post-infection. ELISA test results continue to show high Ab titers to the toxin of C. ovis in singly infected lambs but even higher Ab titers to the toxin in the dually infected group of lambs.

Funding by the University of Wyoming Agricultural Experiment Station and USDA Animal Health grant (Hatch) is acknowledged.

23. EFFECTS OF HIGH FREQUENCY ANTHELMINTIC TREATMENT ON TWO HERDS OF HORSES. CHRISTINE UHLINGER, and COLIN JOHNSTONE, University of Pennsylvania, School of Veterinary Medicine, New Bolton Center, 382 W. Street Road, Kennett Square, PA.

Two herds of horses naturally infected with benzimidazole (BZD) resistant small strongyles were used in this study. Initial base line data established geometric mean fecal egg counts and reinfection rates following administration of non-BZD products. The horses were placed on a monthly anthelmintic schedule using non-BZD produts for one year. After one year, geometric mean egg counts and reinfection rates decreased, indicating successful pasture decontamination.

24. THE EFFECTS OF CONTINUOUS ANTHELMINTIC ADMINISTRATION ON EXPERIMENTAL INFECTIONS OF PARASCARIS EQUORUM IN FOALS. R.M. McCORMICK and T.J. KENNEDY. Pfizer, Inc., Lee's Summit, MO and AEF Research, Waunakee, WI.

Thirty-two foals, raised worm free, were assigned to one to four treatments (n=8). Continuous daily mediction with pyrantel tartrate in the feed at 0, 0.44 mg/kg, 2.64 mg/kg or 4.4 mg/kg was started on Day 0. On Day 1, all foals received 5,000 infective eggs of Parascaris equorum with 20,000 more eggs given on Day 14. Twenty-eight days after the start of medication, all foals were sacrificed. At necropsy, the average number of liver lesions due to Parascaris was 68.3 for controls, 53.2 for the low dose foals, 18.4 for the middle dose and 6.7 for the high dose foals. Few larvae were recovered from the lungs of any foals, and no intestinal stages were found. It was concluded that the efficacy demonstrated here showed promise for the reduction of Parascaris equorum lesions in foals. More study is necessary to determine whether sensitizing doses are necessary or detrimental, the optimum dose of eggs to use, and the timing of liver and lung passage in order to collect the migratory stages.

25. EFFICACY OF IVERMECTIN IN INJECTABLE AND PASTE FORMULATIONS IN THE RESOLUTION OF CUTANEOUS LESIONS ASSOCIATED WITH ONCHOCERCA CERVICALIS INFECTIONS. D.D. FRENCH, T.R. KLEI, J.J. McCLURE, R.I. MILLER, C.S. O'NEILL and L. FOIL, Departments of Veterinary Science and Department of Entomology, Louisiana Agricultural Experiment Station, Louisiana State University, Agricultural Center and Departments of Veterinary Microbiology and Parasitology, Veterinary Clinical Sciences, and Veterinary Pathology, Louisiana State University, School of Veterinary Medicine, Baton Rouge, LA.

The efficacy of a single treatment of ivermectin at 200 mg/kg in injectable and paste formulations against microfilariae of Onchocerca cervicalis and associated skin lesions was evaluted in 20 naturally infected quarter horse mares. All horses possessed marked to severe dermatitis of the ventral midline and/or legs, shoulders, chest and withers. Efficacy was monitored at 21, 42 and 64 days post treatment (DPI). Observations made at these time intervals included; microfilarial counts from 6 mm skin biopsies taken from areas of ventral midline dermatitis; gross lesion assessment scoring and photographs; and of histologic assessment ventral midline biopsies. Microfilarial numbers were reduced to 0 by 21DPI in all but one treated individual. Active lesions improved or completely resolved in all cases by 64DPI. Total inflammation as judged by histologic observations was reduced but some inflammatory cells remained in at 64 DPI. Although, adverse reactions were not seen in any of these 20 horses, one horse treated for other purposes with ivermectin in the paste formulation, showed massive mid ventral line edema 3DPT. A biopsy of mid ventral line skin at that time revealing 8

living microfilariae. The microfilariae were absent and skin lesions of this horse resolved by 21 DPT.

26. ANTHELMINTIC TREATMENT AND PRODUCTION RESPONSE OF CALIFORNIA DAIRY CATTLE THAT UTILIZE A PASTURE-BASED FEED SYSTEM. JAMES E. MILLER and NORMAN F. BAKER, School of Veterinary Medicine, Louisiana State University and School of Veterinary Medicine, University of California-Davis, Davis, CA.

Six hundred and eighty five (340 control and 345 treated dairy animals from 3 California dairies (Holstein, Jersey and Milking Shorthorn) that utilize a pasture-based feed system, did not show any significant ($P > .05$) increase in production following treatment with coumaphos or thiabendazole. The Holstein dairy, by itself, did show a significant ($P < .05$) increase of 33 and 29 pounds of total lactation actual and mature equivalent butterfat respectively, after treatment with coumaphos. No seasonal patterns were observed. There were no significant differences between heifers and cows as far as production response to treatment.

27. EFFICACY OF MONENSIN AGAINST COCCIDIA INFECTION IN CALVES. B.E. STROMBERG, J.C. SCHLOTTHAUER, K.J. HAMANN, and W.J. BEMRICK, University of Minnesota, Department of Parasitology, School of Veterinary Medicine, St. Paul, MN.

Calves experimentally infected with Eimeria bovis and/or E. zuernii were used in two controlled experiments to determine the anticoccidial activity of monensin. The first experiment utilized 36 Holstein bull calves with an average weight of 68.1 kg + 1.3 kg. These animals were allotted into nine (9) groups of four (4) calves each based on weight. One group (A) was the uninoculated-untreated control. Four (4) groups (B-E) were incoulated with 150,000 oocysts of E. bovis and the remaining four (4) groups (F-I) were inoculated with 235,000 oocysts of E. zerunii. The inoculated groups received monensin in their feed at the rate of 0 (B, F), 10 (C, G), 20 (D, H) and 30 (E, I) gm/ton. The monensin effectively controlled the E. bovis infection at the 20 and 30 gm/ton. It was difficult to evaluate its efficacy against E. zuernii due to a poor challenge infection. These conclusions were based primarily on the effect of the drug on the clinical signs (primarily diarrhea) and oocyst shedding.

In an attempt to create a better challenge infection, calves were inoculated with both E. bovis and E. zuernii in a second experiment. Thirty-two (32) Holstein bull calves (83.5 kg $\pm$ 2.5 kg) were allotted on the basis of weight. One group of four (4) served as the uninoculated-untreated control group and the remaining animals were allotted onto four (4) groups of seven (7) calves each, which were inoculated with 300,000 oocysts of E. bovis and 500,000 E. zuernii. Each of the four (4) inoculated groups received monensin in their feed at one of the following levels, 0, 10, 20 or 30 gm/ton. Efficacy was judged by reduction in oocyst shedding and clinical signs (primarily diarrhea). The 20 and 30 gm/ton dose levels successfully reduced clinical coccidiosis, as shown by greatly reducing oocyst shedding of both species.

28. COMPARATIVE ANTHELMINTIC EFFICACIES OF FENBENDAZOLE, LEVAMISOLE AND THIABENDAZOLE IN CATTLE. T.A. YAZWINSKI*, B.L. PRESSON and H.E. FEATHERSTONE, Department of Animal Sciences, University of Arkansas, Fayetteville, AK.

Twenty-four, naturally parasitized calves of Holstein and Angus breeding were used in this trial. The animals were allocated into 4 treatment groups on the basis of pre-treatment "Strongyle" EPG counts. The treatment groups were: 1) unmedicated controls; 2) fenbendazole suspension at the rate of 5 mg/kg BW; 3) Tramisol injectable at the rate of 6 mg/kg BW and; 4) Thiabendazole paste at the rate of 66 mg/kg BW. All animals were treated within 3 days of last grazing and necropsied 7 days after treatment for gastrointestinal nematode quantifications. In regard to all stages and species combined, efficacies were 90, 77 and 64% for Fenbendazole, Tramisol and Thiabendazole, respectively. Efficacies were 99, 93 and 91%, in the same order as above for combined adult nematode forms.

Differences in drug effectiveness were most pronounced for Ostertagia spp. In regard to the adults, efficacies were 98.1, 80.7 and 88.9% for Fenbendazole, Tramisol and Thiabendazole, respectively. For early 4th stage Ostertagia, efficacies were 70, 42.7 and 9.2%, respectively. In the same order and for late 4th stage Ostertagia larvae, efficacies were only 44.6, -68.3 and -120.1%. A post-treatment "stage-supplementation effect" was therefore most pronounced in this study.

29. CLINICAL EVALUATION OF A COMBINATION FEBANTEL-PRAZIQUANTEL PASTE IN DOGS AND CATS. H.D. McCURDY, BAYVET Division Miles Labs., Shawnee, KS.

A clinical evaluation of a combination paste formulation of febantel and praziquantel was conducted with 814 dogs and cats at 15 mixed and small animal practices across the United States. Animals were selected by the pratitioners based on a positive fecal examination for intestinal parasites. Over 60 breeds of dogs and six breeds of cats of all ages and both sexes, including females at various stages of their reproductive cycle, were studied. In addition to the normal animals brought in for worming, there were those admitted for surgery of one kind or another, for routine vaccinations, or for treatment of various diseases or illnesses.

The combination febantel (3.4%)-praziquantel (0.34%) paste was given in disposable syringes at a rate of 1 ml/7.5 lb. body weight once daily for three days. The positive control medication was Telmintic(R) for dogs and Vermiplex(R) for cats. Following treatment the animals were observed for side effects and were re-examined for remaining intestinal parasites. The parasites observed included Dipylidium canium, Taenia sp., Ancylostoma sp., Toxocara sp., Trichuris vulpis, Toxascaris leonina and Uncinaria stenocephala. The infections of specific parasites were eliminated, based on fecal examinations, from 91.3 to 100% of the animals treated with the combination paste. Infections were apparently reduced in the occasional animal where ova were still prsent. Drug related side effects were very few, mild and self limiting.

30. FURTHER OBSERVATIONS ON THE PROPHYLACTIC ACTIVITY OF IVERMECTIN AGAINST EXPERIMENTAL DIROFILARIA IMMITIS INFECTIONS IN BEAGLES. R.E. PLUE[1], J.W. McCALL[2], R. LEE SEWARD [3], PATRICK A. TANNER[2], and JUNG J. JUN[2]. [1]Merck, Sharp and Dohme Research Labortories, Athens, GA; [2]Department of Parasitology, College of Veterinary Medicine, The University of Georgia, Athens, GA; [3]Merck, Sharp and Dohme Research Laboratories, Rahway, NJ.

Ivermectin was evaluated for prophylactic activity against Dirofilaria immitis to determine 1) the minimum effective dose at 30 days post-incoulation (PI) and 2) the effectiveness of a 2 mcg/kg dose adminstered at 45 days PI. A total of 42 Beagle dogs (22 males and 20 females) were allocated to 6 groups containing 7 dogs each and each dog was given 50 infective larvae by subcutaneous injection. Ivermectin was administered as a single, oral dose of either 0.3, 1.0,. 2.0 or 3.3 mcg/kg at 30 days PI or 2.0 mcg/kg at 45 days PI. One group served as a vehicle-treated control. All dogs were euthanatized at 184 days PI.

Treatment at a dose level of 2.0 mcg/kg at 30 days PI was 100% effective in preventing infection. Treatment at 1.0 mcg/kg at 30 days singificantly reduced (65% efficacy) the worm burden, but all dogs treated at this regimen had at least one worm at necropsy. Treatment at 0.3 mcg/kg at 30 days PI was ineffective. Administration of 2.0 mcg/kg at 45 days PI prevented infection in 4 dogs, but each of the remaining 3 dogs had a few worms (91.7% efficacy). All control dogs had worms, with a mean percent receovery of 44.9. No adverse reactions to either the drug or the vehicle were noted.

The results of this trial indicted that a single, oral treatment with ivermectin at 2.0 mcg/kg at 30 days PI was comletely effective in suppressing infection, but that treatment at this level 45 days PI did not completely suppress infection in all dogs.

31. DIETHYLCARBAMAZINE-OXIBENDAZOLE FORMULATION FOR PROPHYLAXIS OF EXPERIMENTALLY INDUCED DIROFILARIA IMMITIS AND ANCYLOSTOMA CANINUM INFECTIONS IN BEAGLES. J.W. McCALL, TERI L. EVANS, B.A. LINDEMANN, Department of Parasitology College of Veterinary Medicine, The University of Georgia, Athens, GA; and J.M. MURPHY, Norden Laboratories, Lincoln, NE.

Chewable formulations containing either a combination of diethylcarbamazine (DEC, 3 mg/lb/day) plus oxibendazole (2.268 mg/lb/day), DEC (3 mg/lb/day) alone or oxibendazole (2.268 mg/lb/day) alone were evaluated for prophylactic activity against Dirofilaria immitis and Ancylostoma caninum in experimentally infected Beagle dogs. Each dog was given 50 infective larvae by subcutaneous injection and a total of 2,000 A. caninum larvae (1,000 orally and 1,000 subcutaneously) 17 to 18 weeks later. The drugs were given daily beginning 1 week prior to inoculation of D. immitis and continuing through necropsy at 23 weeks. Acceptability of the wafers was scored as 1 if taken freely, 2 if taken in meat, and 3 if manual dosing was required.

DEC plus oxibendazole and DEC alone were 100% and 99.6% effective, respectively, in preventing heartworm infection; and oxibendazole alone was 39.1% effective. DEC plus oxibendazole and oxibendazole alone were 100% effective in preventing hookworm infection; and DEC alone was 81.1% effective.

All control dogs were infected with both D. immitis and A. caninum, with average worm burdens of 33 and 168, respectively. Overall mean acceptance scores were 1.008 for the controls, 1.032 for the oxibendazole alone group and 1.084 for both the DEC alone and DEC plus oxibendazole group.

In conclusion, the formulation containing DEC plus oxibendazole was 100% effective in preventing infections of both D. immitis and A. caninum. The formulation was well accepted by the dogs and was free of side effects. Thus, this formulation offers an effective, safe, and convenient method for preventing both hookworm and heartworm disease in dogs.

32. PATTERNS OF PARASITISM IN MINNESOTA MOOSE (ALCES ALCES).
J.C. SCHLOTTHAUER, Department of Veterinary Pathobiology, College of Veterinary Medicine, University of Minnesota, St. Paul, MN, and P.D. KARNS, Forest, Wildlife and Populations Groups, Minnesota Department of Natural Resources, Grand Rapids, MN.

Current surveys indicate there is a stable population of approximately 10,000 moose, Alces alces, scattered over portions of the northern one-third of Minnesota. These animals are a valued resource and overlap widely in their natural range with domestic and wild cervidae such as cattle, sheep and white-tailed deer, (Odocoileus virginianus), and various domestic and wild carnivors such as dogs, timber wolves,(Canis lupus), coyotes,(Canis latrans),red foxes (Vulpes vulpes), bobcats (Lynx rufus), and lynx, (Lynx lynx). This intermingling provides unique food chains which often contribute to making moose a visible and significant reservoir for fluke and larval tapeworm infection. Information gathered from field inspection of hunter killed moose carcasses have shown varied levels of infection by Fascioloides magna, Taenia krabbei, Taenia hydatigena and Echinococcus granulosus.

33. CHARACTERISTICS OF TRANSMISSION FOCI OF FASCIOLA HEPATICAi ON LOUISIANA COASTAL MARSH PASTURES.
J.B. MALONE and M. BELCHER, Louisiana State University, Baton Rouge, LA.

A cow-calf operation in the Chenier Plain region of Southwest Louisiana was studied over a 2-year period to develop means of assessing fascioloiasis risk on an individual farm basis. Using a general farm survey of the 2.2 square mile farm and 9x9 inch B & W aerial photographs (1:12,000), four transect lines were established through representative topographic features and vegetation communites. Natural coastal marsh forages typical of saline, brackish, intermediate, and freshwater marsh zones supported 500 cattle. By extrapolation of data on 1) transect observations made at 30-45 day intervals on presence of snails, standing water, vegetation, and forage utilization, and 2) line-plot vegetation survey of 5 primary Fossaria bulimoides habitats, potential F. bulimoides habitats were mapped by stereoscopic interpretation of 1:3,400 B & W aerial photographs. Six major vegetation/topographic zones were identified. Lymnaeid snail habitats were found to be clustered at the zonal interface of 2 of the 6 zones. A vegetation profile typical of lymnaeid habitats was defined. Habitat area was estimated to be less than 5% of total farm area. Results suggest that lymnaeid snail habitats can be mapped and that individual farm risk can assessed for use in design of control programs based on pasture management or snail control.

34. EPIDEMIOLOGY OF ONCHOCERCA CERVICALIS IN SOUTHERN LOUISIANA. LANE FOIL, T.R. KLEI, C.S. O'NEILL, R.I. MILLER, D.D. FRENCH and J.J. McCLURE, Departments of Veterinary Science and Department of Entomology, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center and Department of Veterinary Microbiology and Parasitology, Veterinary Clinical Sciences, and Veterinary Pathology, Louisiana State University, School of Veterinary Medicine, Baton Rouge, LA.

Onchocerca cervicalis has been reported in high prevalence in most of the U.S. (East, 61%; Midwest, 57%; Kentucky, 52%; West 48%). Previously reported prvalence rates from Louisiana were far below these values. Microfilariae of O. cervicalis were found in mid ventral skin biospies of 64 of 84 (76%) mixed-breed ponies more than two years old from the Gulf coast area and of 42 of 51 (82.4%) horses from Louisiana breeding herds. The assessment of wild-caught Culicoides species as natural vectors of O. cervicalis was made. A total of 7,125 blood engorged Culicoides representing 6 species were collected over a two year period from a stable trap baited with O. cervicalis-infected ponies. Only C. variipennis supported the natural development of O. cervicalis with an infection rate of 7%. Monthly mid ventral skin biopsies of a group of 20 Shetland ponies were taken over a 15 month period. These biopsies were evaluated for microfilariae density by histological and exraction techniques. Both methods of evaluation clearly indicate seasonal variation in microfilaremia with a large increase in the spring followed by a summer decrease, a slight fall increase, and a large winter decrease. The seasonality of the microfilaremia is shown to correspond to the seasonality of C. variipennis. Histologic examination indicates that the winter decrease in microfilarial numbers is correlated to an emigration from the outer layers of the dermis. The summer decrease appears to reflect a different mechanism. A correlation of seasonality of mirofilariae with seasonal mid ventral inflammation may present.

35. SEASONAL VARIATIONS IN NEMATODE EGG COUNTS FROM NORTHERN PLAINS BEEF CATTLE. MYRON F. ANDREWS and MARY HANSON, Department of Veterinary Science, North Dakota State University, Fargo, ND.

Fecal egg counts in 1981-1982 from adult beef cattle located on ten ranches from different geographical areas of North Dakota showed seasonal variations. Total counts of all species of nematodes showed a sharp peak in late April and early May. A second, but smaller peak, was demonstrated in the late summer and early fall. Ostertagia ostertagi was most responsible for the early peak, while Cooperia punctata and C. onchophora had a rise in numbers in the fall that equaled or exceeded the numbers found in the spring. Other species of nematode eggs were found only in low numbers throughout the year. Anthelmintic usage by the ranchers was not necessarily correlated with nematode egg counts in a way that would reduce pasture contamination.

36. SEASONAL OCCURRENCE OF INFECTIVE NEMATODE LARVAE ON COMMON BERMUDAGRASS GRAZED BY GOATS IN LOUISIANA. K.S. MARBURY and J.C. WILLIAMS. Agricultural Experiment Station, Louisiana State University Agricultural Center, Department of Veterinary Science, Baton Rouge, LA.

Pairs of goat kids (Capra hircus) raised under conditions free of infection with nematode parasites were grazed as tracer animals at monthly

intervals throughout the year on a 0.8 ha common bermudagrass pasture with a flock of twenty bush-type does and three bucks. Tracer animals were allowed to graze for one month; they were slaughtered for worm population characteristics at 10 to 15 days post removal from pature. The abomasum and small intestine were removed, opened and washed to remove all adult nematodes. To obtain the immature stages, the abomasum was allowed to soak overnight in water at 24°C before scrubbing and worm recovery. Temperature and rainfall data were collected to determine the effect of climatic conditions on larval availability. Haemonchus contortus and Trichostrongylus axei in the abomasum and T. colubriformis in the small intestine were the most prominent genera recovered. Other genera recovered were Ostertagia circumcincta, O. trifurcata, O. ostertagi, Cooperia spp, Strongyloides papillosus, and Nematodirus spp. Trichostrongylus axei was most prevalent during the spring (April and May); Haemonchus contortus was most prominent in the fall (August through December).

37. PASTURE LARVAL COUNTS OF EQUINE STRONGYLID NEMATODES IN FLORIDA.
C.H. COURTNEY, Department of Preventive Medicine, College of Veterinary Medicine, University of Florida, Gainesville, FL.

Pasture larval counts of equine strongylid nematodes were followed in a band of 9 ponies from March, 1983 to February, 1984. Larval counts per kg dry herbage were highest (mean 61,525; S.D. 39,392) during the cooler months (early November to mid May) and lowest (mean 1,513; S.D. 1,100) during the hottest months (mid May to mid September). Counts began to increase (mean 14,522; S.D. 7,841) in the early fall months (mid September through October). Simiarly in a band of 6 mares, highest strongylid larval counts (mean 45,494; S.D. 45,171) were found during spring and lowest counts (mean 2,619; S.D. 1,970) during summer. Mares were removed from pasture at summer's end, and counts remained low (mean 1,705; S.D. 1,533) through the following winter. It appears that Florida's hot, humid summer was unfavorable to the prolonged survival of equine strongylid larvae and populations were therefore low. In contrast, L_3 survival during the cooler months was prolonged and large populations, frequently exceeding 100,000 L_3/kg, developed. The rise in larval populations during the fall was primarily a result of newly deposited ova rather than the emergence of preexisting larvae from summer refugia. Strategic treatments in fall and winter may be sufficient to control equine strongylid nematodes in Florida.

38. EPIDEMIOLOGY AND CONTROL OF BEEF CATTLE PARASITISM - 1983 UPDATE.
R.M. CORWIN, M.A. BRAUER, E.M. THOMAS, S.C. BUMGARNER, and S.E. PRATT. University of Missouri, Columbia, MO.

Two deworming programs were evaluated in beef cow/calf herds at separate sites in northern Missouri. The deworming objectives were to evaluate (1) the anthelmintic efficacy of fenbendazole paste[a] in cows at spring calving and cows and calves at midsummer on trichostrongylid egg contamination of pasture, and (2) the efficacy of morantel in sustained release bolus[b] in calves only to provide direct protection from larval contamination during the second half of the grazing season. Body weights and rectal fecal examinations were made monthly. In addition, weigh-suckle-weigh records were made for calves at the fenbendazole site, and plasma pepsinogen evaluations were made monthly for the morantel group. Tracer calves were grazed on study sites to determine monthly worm populations and the appearance

of arrested development of Ostertagia. Climatic conditions were recorded.

Ostertagia again proved to be the predominant trichostrongylid parasite, with arrested development observed through mid June. Monthly fecal egg counts were significantly different for calves from deworming (July) through the remainder of the grazing season for both anthelmintics.

Also, body weights of treated calves with both anthelmintics increased over those of untreated animals. For fenbendazole, the final weights of calves were 453.3 vs. 434.7 lbs for a 19 lb/hd weight advantage and weigh-suckle-weigh values were significantly different at each of 3 monthly observations. For morantel, the final weights were 453.1 vs. 436.3 lbs for a 17 lb/hd weight advantage. Plasma protein values are being evaluated. Climatically, weather was a major factor with extremely high temperatures combined with little precipitation in July and August. These factors hampered forage growth and dampened weight gain of calves at a time when they were first grazing. Nevertheless, both anthelmintics, when strategically used, diminished parasite burdens and improved calf performance.

[a]Panacur(R); Safeguard
[b]Paratect(R)

39. UPDATE ON THE EPIDEMIOLOGY OF OSTERTAGIA OSTERTAGI AND OTHER GASTROINTESTINAL NEMATODES OF CATTLE IN LOUISIANA. J.C. WILLIAMS, J.W. KNOX, K.S. MARBURY, M.D. KIMBALL, S.W. SCHEIDE AND T.G. SNIDER. Agricultural Experiment Station, Louisiana State University Agricultural Center, Department of Veterinary Science, Baton Rouge and Red River Research Station, Bossier City and School of Veterinary Medicine, Department of Veterinary Pathology, Baton Rouge, LA.

Epidemiological investigation of gastrointestinal parasitism of cattle in Louisiana has been conducted since 1976. During a 2-year period (1980-81 and 1981-82) more intensive investigation was made possible by a USDA Special Research Grant. Over the 24 month period pairs of weaner-stocker cattle and tracer calves were killed at monthly intervals for analysis of worm population characeristics in relation to seasonal weather factors, pasture larval availability, productivity, and clinical factors. Results and conclusions yielded confirmation of previous observations and improved understanding of certain phenomena, e.g., the occurrence of type I ostertagiasis from winter into spring, the simultaneous availability of normally developing and inhibition-prone larvae on pasture during late winter-spring, and the late-summer through autumn occurrence of type II ostertagiasis. Certain differences were apparent in the 2 years being considered. Rainfall was generally adequate during all of 1980-81, but drought conditions persisted from May through September of 1981-82; both summers were typically hot and winter temperatures were slightly lower in year 2. Levels of inhibited larvae acquired in year 1 were not high and it was indicted that maturation began earlier than usual (June); maturation continued to autumn, but was not associated with significant clinical diseases. Very large numbers of inhibited larvae were acquired in spring prior to the dry 1982 summer. Little maturation of larvae was apparent in the summer. After July and through October, the observation of large numbers of adult worms, decreased numbers of inhibitied larvae, signs of severe clinical parasitism and abomasal pathology, and elevated plasma pepsinogen, indicated that the maturation of worms occurred on a continuous and large scale basis. Pasture transmission of

infection was virtually nil during summer and autumn. The severe clinical disease (type II ostertagiasis) was due entirely to maturation of larvae acquired in spring. Several animals died in October and November.

40. CHEMICAL REGULATION OF REPRODUCTION IN TRICHOSTRONGYLUS COLUBRIFORMIS (NEMATODA). L.W. BONE and K.P. BOTTJER, USDA, ARS, Regional Parasite Research Laboratory, Auburn, AL.

Reproduction by the nematode Trichostrongylus colubriformis from goats is apparently regulated by internal and external chemical signals. Male helminths responded during in vitro assay to pheromone from incubation of females. Preexposure of the males to pheromone caused reduced responsiveness during subsequent assay. However, rinsing of the males with Tyrode's solution prior to assay enhanced their responses. Preexposure of males to selected neurotransmitters had no influence on the helminth's attraction to pheromone.

Production of eggs by female T. colubriformis was influenced by biological amines. The in vitro release of eggs was reduced by exogenous treatment with the neurotransmitters octopamine and GABA. Serotonin significantly elevated oviposition in vitro. Other neurotransmitters, such as glutamic acid,dopamine, norepinephrine, epinephrine, acetylcholine and histamine, had no effect on oviposition in vitro.

41. EXPERIMENTAL OCULAR LARVA MIGRANS IN MICE, HAMSTERS, GRAY SQUIRRELS AND WOODCHUCKS INFECTED WITH BAYLISASCARIS PROCYONIS. K.R. KAZACOS, E.A. KAZACOS and W.A. VESTRE, School of Veterinary Medicine, Purdue University, West Lafayette, IN.

Baylisascaris procyonis is a cause of VLM and CNS disease in animals and man; evidence exists that it can produce OLM in subhuman primates and probably in man. The purpose of these studies was to further assess the ability of B. procyonis to cause OLM, in experimentally infected mice, hamsters, gray squirrels and woodchucks. Groups of 20, 192, 153 and 134 mice were inoculated per os with 0(control), 100(low,L), 250(med,M) or 1000(high,H) embryonated B. procyonis eggs, respectively. Three groups of 18 hamsters each received 200(L), 500(M) or 1500(H) eggs, with 7 uninoculated controls. Three, 11 and 6 gray squirrels received 500(L), 2500(M) or 5000(H) eggs, and 1 and 2 woodchucks received 5000(L) or 18000(H) eggs, respectively. Ten mice per group were clinically examined by ophthalmoscopy and then killed at 0.25, 0.5 and 1.0 days after inoculation (DAI) and daily thereafter. The eyes from 5 per group were dissected for larvae and the other 5 were examined histologically. The hamsters were clinically examined daily and killed for ocular histology after 10 DAI or more. The gray squirrels and woodchucks were clinically examined and killed for ocular histology when they developed CNS disease, usually 3-6 weeks AI. Evidence of OLM was seen in all species both clinically and histologically. In mice, clinical lesions were seen by 2 DAI and larvae were recovered from the eyes beginning at 3 DAI. Clinical lesions in mice and hamsters involved chorioretinitis, vitreal hemorrhage and hyalitis. Larvae were recovered from the eyes of 1/109 L, 3/83 M and 20/68 H mice, usually involving 1-2 larvae per mouse. Histopathologic lesions of OLM were seen in 6/47 L, 9/66 M and 16/64 H mice and in 0/18 L, 4/18 M and 14/18 H hamsters. They had larvae in the retina and vitreous; anterior chamber, retinal and vitreal hemorrhage; eosinophilic hyalitis, retinitis and iritis; and granuloma formation. Affected gray squirrels and woodchucks had clinical

chorioretinitis; histologic lesions were seen in 0/3 L, 0/11 M and 2/6H squirrels and in both high woodchucks. They consisted of larvae in the retina with associated retinal disruption and necrosis, eosinophilic retinitis and vasculitis, and hyperplasia and migration of the pigment epithelium. Larval granulomas were seen in the periorbital tissues of all species. These studies indicated that B. procyonis has the ability to cause OLM in mice, hamsters, gray squirrels and woodchucks following oral infection. The larvae are aggressive, reaching the eyes by at least 2-3 DAI. These results, combined with previously reported primate studies, provide evidence of the probable role of B. procyonis as a cause of animal and human ocular disease.

42. DIROFILARIA IMMITIS INFECTIONS IN CATS FOLLOWING TRANSPLANTATION OF ADULT WORMS WITH NOTES ON THIACETARSAMIDE TREATMENT. MICHAEL T. DZIMIANSKI, JOHN W. McCALL, ERIC D. PERRY, Department of Parasitology, College of Veterinary Medicine, The University of Georgia, Athens, GA and CLARENCE A. RAWLINGS, Department of Small Animal Medicine, College of Veterinary Medicine, The University of Georgia, Athens, GA.

Three pairs of adult D. immitis were transplanted via the jugular vein into 10 young adult cats. At 4 weeks post-transplantation (PT), 2 cats were necropsied and the remaining 8 cats were allocated to 2 groups containing 4 cats each. Cats in 1 of these groups were treated with thiacetarsamide (2.2 mg per kg B.I.D., for 2 days) and the other group served as non-treated controls. The 8 cats were necropsied 8 weeks after treatment.

Eight of the 10 cats produced a microfilaremia (MF). Four of these had microfilaria as early as 1 week PT, but microfilariae were not seen in the other 4 until 2 weeks PT. Of the 8 cats held for 12 weeks, 5 had a transient MF, 1 had a continuously increasing MF and 2 did not produce a MF.

Live worm recovery was 91.7% (average) for the 2 cats at 4 weeks PT with worms present in the right ventricle, pulmonary arteries and right caudal lobar arteries. Live worm recovery at 12 weeks PT was 48.4% (range, 1-4 worms) and 45.8% (range,0-4 worms) in non-treated and thiacetarsamide-treated cats, respectively. All live worms were present in the right ventricle. Non-treated cats had intact dead worms and worm fragments and moderate endarteritis in the caudal lobar arteries. Thiacetarsamide-treated cats had worm fragments and moderate to severe endateritis primarily in the caudal lobar arteries.

43. SERUM ANTIBODY RESPONSE TO ISOSPORA SUIS IN PIGLETS MEASURED BY AN INDIRECT FLUORESCENT ANTIBODY ASSAY. J.R. TAYLOR*, D.S. LINDSAY, W.L. CURRENT, and P.H. KLESIUS. USDA, ARS, Regional Parasite Research Laboratory (Taylor, Klesius) and the Department of Zoology-Entomology Auburn University (Lindsay, Current), Auburn, AL.

Acquired resistance and the serum antibody response to Isospora suis in piglets were studied by challenge inoculation and indirect fluorescent antibody (IFA) assay. Piglets given a primary inoculation of I. suis shed oocysts and developed the following clinical signs: diarrhea, dehydration, and weight loss. Resistance was demonstrated by absence or reduction of the patency period and absence of clinical signs in piglets after challenge inoculations. Antibodies to I. suis sporozoites were detected in

L. suis-inoculated, weaned piglets but not in noninoculated, weaned or colostrum-deprived piglets. All piglets, except those deprived of colostrum, had serum antibodies to *L. suis* the first few weeks of life. The colostral antibody was not protective for 3-day-old piglets. The actively acquired serum antibody response was investigated in *L. suis*-inoculated, 3-week-old, weaned piglets. Serum antibody titers peaked one week after a primary inoculation. In comparison, titers after challenge were higher and reached a maximum in 3 weeks. The highest titers occurred after a 3rd inoculation. The results indicated that serum antibody titers did not correlate with resistance to clinical disease, but may be useful in detecting exposure to *L. suis* in weaned piglets.

44. SWINE ASCARIASIS: DEVELOPMENT OF PROTECTIVE IMMUNITY FOLLOWING NATURAL INFECTION. J.F. URBAN, JR. and R.D. ROMANOWSKI. USDA-ARS-Animal Parasitology Institute, Beltsville, MD.

We have previously shown that continuous exposure of pigs to infection with *Ascaris suum* for 5 mo induces virtually complete gut level resistance (>99%) to a challenge infection. An important question concerning this observation is, what is the minimum time of exposure required to elicit this type of immunity? The following experiment was designed to determine whether pigs exposed to *A. suum* eggs from birth to 8-10 wks of age acquire immunity to a challenge infection and, if not complete, what time of re-exposure is necessary to boost resistance to near absolute levels. Eight groups (Gr) of five pigs each were either born and maintained in helminth-free pens (Gr I and II) or on lots contaminated with *A. suum* eggs (Gr III through VIII). After 8-10 wks of exposure, pigs from Gr III through VIII were treated with Dichlorvos to remove adult *A. suum*, and then moved to helminth-free pens. Three wks later, pigs from Gr I and III were challenged with 10,000 eggs and the number of challenge larvae in the lungs 7 da later was determined. Previously exposed pigs from Gr III averaged 57% fewer lung larvae than Gr I pigs indicating they had acquired immunity to challenge infection after 8-10 wks of exposure. Because immunity was not complete, previously exposed pigs from Gr IV through VII were re-exposed to *A. suum* by returning them to contaminated lots for varying lengths of time as follows: Gr IV, re-exposed immediately for 4 mo; Gr V, kept helminth-free for 1 mo, re-exposed for 3 mo; Gr VI, kept helminth-free for 2 mo, re-exposed for 2 mo; Gr VII, kept helminth-free for 3 mo, re-exposed for 1 mo; GR VIII and GR II remained helminth-free for the entire 4 mo period. All pigs were bled biweekly throughout the experiment and, after 4 mo, all were challenged with 10,000 eggs. A total of 2198 $\pm$ 392 lung larvae were recovered from helminth free control pigs (Gr II) 7 da after challenge; 57% fewer larvae were recovered from pigs in Gr VIII that had been initially exposed to *A. suum* for 8-10 wks after birth and kept helminth-free for 4 mo. Pigs from Gr IV, V, VI, and VII that had been re-exposed to *A. suum* for 4, 3, 2, and 1 mo, respectively, yielded <1% of the challenge larvae compared to Gr II. In addition, the livers from Gr IV through VII had <5 liver lesions (white spots) over the surface, while Gr III pigs exhibited >200 intensely fibrotic lesions. Analysis of the serum antibody response to larval antigens by ELISA, using anti-pig light chain antibodies, showed that the pigs exposed to *A. suum* from birth through 8-10 wks developed high titers that waned after removal from contaminated lots, and re-exposure resulted in an anamnestic antibody response. Thus, initial exposure of pigs from birth through 8-10 wks of age induces a partial resistance to a challenge infection. However, complete

resistance is expressed at the level of the gut after re-exposure of these pigs for as little as 1 mo.

45. QUANTITATION AND TISSUE DISTRIBUTION OF ENCYSTED CYATHOSTOME LARVAE OF THE HORSE. C.R. REINEMEYER, The Department of Veterinary Pathobiology, The Ohio State University, Columbus, OH.

Accurate quantitation of larval populations is essential for monitoring dynamic changes of parasites, and for determining the larvicidal efficacy of anthelmintics. The few attempts at quantitation of cyathostome larvae encysted in the cecum and colon of the horse have utilized modifications of pepsin/HCl digestion techniques used for abomasal nematodes of ruminants.

A technique was devised by which uniform segements of equine cecum and colon were transilluminated and examined microscopically, and encysted larvae counted. Subsequent digestion of these tissues yielded lower numbers of larvae than were viewed directly, and digested larvae exhibited distinct, often severe, morphologic damage.

The ceca and colons of 10 horses were divided into 12 regions and numbers of cyathostome larvae in weighed segments were determined. Encysted larvae were observed to be most prevalent in the cecum and right ventral colon, and were virtually absent in the distal left ventral colon and the entire dorsal colon.

46. <u>STRONGYLUS EQUINUS</u>: DEVELOPMENT AND PATHOLOGY IN THE EQUINE HOST. B.M. McCRAW and J.O.D. SLOCOMBE, Department of Pathology, Ontario Veterinary College, University of Guelph, Guelph, Ontario.

<u>Strongylus equinus</u> was studied in 17 pony foals and one horse foal raised in isolation inoculated with 15000 infective larvae and examined at necropsy from seven days to 40 weeks postinfection. Larvae penetrated the wall of the ileum, cecum and colon. The third molt occurred mostly in the wall of the ventral colon before two weeks PI and larvae attained the liver mainly via the peritoneal cavity as early as eight days PI and persisted until 17 weeks PI. Following migration within the liver, the pancreas was invaded at least by seven weeks PI with maximum numbers at 17 weeks. The fourth molt occurred about 15 weeks PI with preadults present in the wall of the colon at 30 weeks PI and in the lumen at 40 weeks.

Early lesions at four weeks PI were small raised hemorrhagic areas on the serosa of the ileum and colon and small submucosal lymphoid nodules in the colon. White foci on the surface of the liver at one week PI were followed by serpentine tracks three weeks later. Pathologic changes in the pancreas were evident at three months PI and more severe by four months. Granulomas containing larvae were common in the pancreas, flanks, diaphragm, omentum and occasionally beneath the pleura.

Depression and diarrhea were correlated with invasion of the pancreas, the fourth molt, maximum globulin values and high circulating eosinophils.

47. GASTROINTESTINAL PARASITISM IN COWS AND CALVES ON A ONCE DAILY SUCKLING PROGRAM. H. CIORDIA, J.A. STUEDEMANN, and J.V. ERNST, USDA, ARS, Experiment, GA.

Two yearly studies involving 168 angus cows were conducted to evaluate the effects of once daily suckling on cow reproduction, calf growth, and degree of gastrointestinal parasitism. Experiment I compared 2 groups of 24 cows each with calves suckled once daily (RS) during the first 45 days of the breeding season with one group of 24 cows suckled normally (NS). Experiment II compared 2 groups of 24 RS cows with 2 groups of 24 each NS cows. In Exp. I, there were no differences ($P < 0.05$) in postpartum interval, conception rate or average number of nematode eggs per gram of feces between the cows from the two treatment groups. The RS calves consistently had higher egg counts than the NS calves during the restricted suckling period and during their return to pasture until weaned. RS calves also had higher coccidia oocyst counts during the restricted period. In Exp. II, RS cows had a higher conception rate ($P < 0.05$) and shorter calving interval than NS cows. Again, there was no difference in epg from cows, but RS calves had higher epg during the RS period and during the pasture period than the NS calves. In both years, NS calves had higher ($P < 0.05$) adjusted 205-day weights and actual weaning weights than RS calves. The once daily suckling technique improved conception rates in young cows, but resulted in lighter calves with a higher degree of gastrointestinal parasitism.

48. POTENTIAL MECHANISMS FOR ALTERATION OF DEVELOPMENT OF HAEMONCHUS IN SHEEP INFECTED WITH OSTERTAGIA. J.L. BLANCHARD and R.B.WESCOTT, Department of Veterinary Microbiology and Pathology, Washington State University, Pullman, WA.

This study was performed to determine if prior infection with Ostertagia circumcincta in young lambs reduced the establishment of Haemonchus contortus. Observations also were made to examine the relationship of elevated serum gastrin (produced by Ostertagia) in the interaction. Twenty eight two-month old worm free lambs were divided into four exposure groups which included: 4-uninfected controls (C), 6-Ostertagia alone (O), 6-Haemonchus alone (H), and 12-Ostertagia plus Haemonchus (O+H). Numbers of larvae given were 25,000 Ostertagia and 10,000 Haemonchus. Observations included weekly egg counts, recovery and enumeration of parasites at the end of the experiment, and biweekly determination of serum gastrin levels. Fecal egg counts (EPG) were significantly ($P < 0.05$) lower in the O+H group than in the H group. There was no difference in EPG between the O and O+H groups. The mean number of Haemonchus recovered at necropsy was significantly ($P < 0.05$) lower in the O+H group (308) than in the H group (1172). Serum gastrin levels in Osertagia-infected groups (O and O+H) were significantly ($P < 0.05$) higher than in the H group at the time the H and O+H groups were exposed to Haemonchus larvae. These results indicate that prior infection with Ostertagia protected young lambs against Haemonchus. An increase in serum gastrin at the time of exposure to Haemonchus was associated with reduced number of Haemonchus adults at the termination of the experiment, suggesting alteration of abomasal pH was involved in the demonstrated interaction.

49. CHEMOTACTIC FACTORS OBTAINED FROM THE THIRD LARVAL STAGE OF CATTLE NEMATODES, OSTERTAGIA OSTERTAGI. P.H. KLESIUS*, T.B. HAYNES, D.A. CROSS, and H. CIORDIA. USDA-ARS Regional Parasite Research

Laboratory, Auburn, AL.

The effects of Ostertagia ostertagi 3rd stage larvae (L_3) and L_3 extract on migration of bovine neutrophils, eosinophils and macrophages were investigated. Culture supernatants (lymphokines) of lymphocytes cultured with L_3 extract for 3 to 6 hours were also examined using lymphocytes from peripheral blood of helminth-free cattle and cattle infected with either O. ostertagi or Trichostrongylus axei. Live exsheathed L_3 and L_3 extracts enhanced the migration of eosinophilis, but not of neutrophils and macrophages. L_3 extracts were shown by the Zigmond-Hirsh checkerboard assay to have chemotactic activity for eosinosphils. Lymphokines that enhanced migration of neutrophils, eosinophils and macrophages were found in culture fluids of L_3 extract-stimulated lymphocytes from cattle infected with O. ostertagi but not from helminth-free cattle or those infected with T. axei. The present study shows that enhanced migration of immune cells is mediated by parasite factors and that its possible relationship of acute inflammatory reactions, a hallmark of Ostertagiasis, can be investigated.

50. PHYSIOLOGICAL EFFECTS OF SUBCLINICAL OSTERTAGIASIS IN YOUNG LAMBS. B. HAMMERBERG and D. TALLY, School of Veterinary Medicine, North Carolina State University, Raleigh, NC.

The physiological effects of repeated, low level dosing of lambs with monocultures of infective larvae of Ostertagia circumcincta have been reported for isolated strains of O. circumcincta in Great Britain, Australia and New Zealand. It was necessary to evaluate comparable patho-physiological effects of a strain of Ostertagia circumcincta isolated in the United States at Beltsville, MD and maintained at Raleigh, NC.

Two groups of six lambs each were dosed with either 5,000 infective stage larvae or water (uninfected controls) every day for three months starting at two months of age. Weight gain, food consumption, fecal egg counts, fecal nitrogen, plasma protein, plasma calcium and phosphorus and absomasal pH were monitored for three months. Carcass weights and nitrogen content, bone analysis (including volume, weight and histology) and worm counts were done when the lambs were five months old.

In accordance with previous reports this level of larval intake produced no signs of obvious debilitation or diarrhea; yet there were marked changes in most of the parameters measured with the exception of abomasal pH which did not differ between infected and non-infected lambs. These results indicated a reduced nitrogen utilization and bone growth. Possible pathogenic mechanisms related to gut hormone changes reported by other investigtors during Osertagia infection will be discussed.

51. CROSS-TRANSMISSION OF THE OVINE LUNGWORM (DICTYOCAULUS FILARIA) BETWEEN SHEEP AND MARMOTS. F.M. SEESEE and D.E. WORLEY, Veterinary Research Laboratory, Montana State University, Bozeman, MT.

Natural Dictyocaulus filaria infections were found in 3 yellow-bellied marmots (Marmota flaviventris) from a colony located near a group of penned domestic sheep at the Montana Agricultural Experiment Station in Bozeman. Fertile adult worms ranging in numbers from 2 to 65 per animal were present in the trachea and bronchi, with a maximum larval output of 1625 larvae per gram

of feces in an immature marmot harboring 54 D. filaria females. Acute penumonic lesions affecting from about 10 to 45% of the total lung tissue were found in infected individuals. Numerous ecchymotic hemorrhages in the apical and cardiac lobes and extensive areas of inflammation in the diaphragmatic lobes were present in 2 of 3 positive marmots.

The reciprocal infectivity of D. filaria larvae cultured from marmot feces was tested by oral intubation of domestic sheep. Doses of 1500 to 3000 third-stage larve induced patent infections in 2 of 3 exposed lambs. In both instances, prolonged prepatent periods of 49 and 54 days elapsed before lungworm larvae were demonstrable in feces. Peak larval production occurred between day 94 and 101 postinoculation. Output of larve persisted in lambs of 59 to 62 days, indicating that the rodent-adapted isolate survived nearly as long in sheep as an ovine isolate currently being maintained at this laboratory. Transient clinical signs (coughing, rapid breathing) were noted in one lamb on the 12th day of patency. First-stage larvae cultured from lambs infected with the marmot isolate were comparable morphologically to ovine isolates maintained in lamb-to-lamb passage.

52. TEMPERATURE-INDUCED LARVAL SEPARATION AND MORPHOLOGIC DIFFERENTIATION OF A MIXED CULTURE OF ANYCLOSTOMA CANINUM AND UNCINARIA STENOCEPHALA. ROBERT L. HILL, JR. and EDWARD L. ROBERSON, College of Veterinary Medicine, University of Georgia, Athens, GA.

While naturally occurring infections of Ancylostoma caninum are common in the southeastern United States, the occurrence of Uncinaria stenocephala is almost always concomitant with A. caninum. Stool samples containing eggs of Uncinaria and Ancylostoma were cultured at 15°C in granulated charcoal. Pure isolates of infective Uncinaria larvae were recovered via Baermann technique after 8 days of incubation while Ancylostoma could not be recovered until day 12 of incubation. Both species of larvae recovered from cultures at 15°C were observed for a 14-day period utilizing interference contrast photomicroscopy and were differentiated on the basis of intestinal cell morphology and extrainestinal granulation. Fresh Uncinaria larvae exhibit 32 well demarcated intestinal cells with fine cytoplasmic granulation and highly visible nuclei. There is an absence of extraintestinal granulation along the lateral margins of the larvae. Ancylostoma larvae exhibit coarse granulation along the lateral margins to the degree that intestinal cells are obscured in freshly cultured larvae. By day 14, Uncinaria larvae show both an overall decrease in intestinal cell cytoplasmic granulation and a reduction in intestinal cell size anteriorly and posteriorly; extraintestinal granulation is not present. While Ancylostoma larvae exhibit a decrease in extraintestinal granulation, these larvae may still be distinguished from Uncinaria on day 14 by the presence of extraintestinal granules and lack of intestinal cell features. Helminth-naive Beagles inoculated with larvae obtained from mixed cultures after 8 days of incubation at 15°C became patent with pure infections of Uncinaria as judged by egg measurements, fecal culture at 15°C, and recovery of adult specimens.

53. AN UPDATE ON THE ECTOPARASITES OF SWINE. R. WILLIAMS.
Invited Symposium Speaker

54. NEW DEVELOPMENTS IN THE CONTROL OF FLIES ON LIVESTOCK. G. KINZER.
Invited Symposium Speaker

55. MECHANICAL TRANSMISSION OF ANIMAL PATHOGENS BY ARTHROPODS. L. FOIL. Invited Symposium Speaker

56. CLINICAL TRIALS OF FEBANTEL-PIPERAZINE COMBINATIONS IN HORSES. J.A. DiPIETRO, K.S. TODD and T.F. LOCK, Departments of Veterinary Clinical Medicine and Pathobiology, College of Veterinary Medicine, University of Illinois, Urbana, IL.

Fifty horses from a herd known to have benzimidazole-resistant small strongyles were treated with febantel (6.0 mg/kg), combinations of febantel (6.0 mg/kg) and piperazine citrate (25 or 55 mg base/kg), thiabendazole (44 mg/kg), or placebo (0.6 mls water/kg) to determine if and identify the combined dosage of febantel and piperazine citrate that would be most effective in the treatment of benzimidazole-resistant strongyles. Pretreatment and 7 day post-treatment fecal examinations were done. Strongyle larvae per gram (lpg) counts, strongyle egg per gram (epg) counts, sugar flotation fecal examinations and in vitro testing for benzimidazole resistance were performed. Fecal examination results prior to treatment were similar, and results of benzimidazole resistance testing were positive in all treatment groups. Horses treated with febantel and piperazine at all dosages had significantly lower mean strongyle epg counts (1.7-2.5), greater % reduction in mean strongyle epg counts (99.5-99.8%) and lower mean lpg counts (1.6-2.0), 7 days after treatment compared with those determined for horses treated with febantel, thiabendazole or placebo. Retreatment of 16 horses remaining strongyle positive 7 days after originally receiving thiabendazole or febantel with either 6.0 mg febantel and 55 mg piperazine base/kg (n=8) or 55 mg piperazine base/kg (n=8) demonstrated excellent efficacy against the benzimidazole resistant strongyle population. Adverse reactions to treatment were not observed.

57. REDUCTION OF THE PATHOGENIC EFFECTS OF EXPERIMENTAL STRONGYLUS VULGARIS INFECTIONS IN FOALS BY ANTHELMINTIC PROPHYLAXIS. T.J. KENNEDY, AEF Research, Waunakee, WI.

Thirty-two worm free foals were infected with 750 L_3's of Strongylus vulgaris over three days while medicated with daily doses of pyrantel tartrate at 0.44, 2.64, and 4.4 mg/kg body weight. One group was infected, but not medicated. Foals were monitored for 28 days post infection. At necropsy on Day 28, the artery of each foal was scored for wall thickness, mesenteric adhesions, intimal lesions and tracks, and number of larvae recovered from the arteries. Foals medicated with 2.64 or 4.4 mg/kg of pyrantel had normal arteries with no larval recovery while foals medicated with 0.44 mg/kg, or foals not medicated, had thickened arterial walls, numerous intimal tracks, and from 2-21 larvae in the artery.

58. THE EFFICACY OF CLOSANTEL AGAINST FASCIOLOIDES MAGNA IN SHEEP. G.A. CONBOY, J.C. SCHLOTTHAUER and B.E. STROMBERG. College of Veterinary Medicine, University of Minnesota, St. Paul, MN.

Closantel, a salicylanilide anthelmintic has been found to have lethal activity against several species of nematodes, trematodes, and arthropods. Efficacy against both the adult and immature liver flukes, Fasciola hepatica

and F. gigantica has been demonstrated. This study evaluates the efficacy against Fascioloides magna in sheep. The initial study was performed on twelve (12) ewes of less than 1-year-of-age, mean weight 38.7 kg, from an area not endemic for F. magna. The sheep were allotted into two groups. Each of the sheep was infected with 100 viable metacercaria of F. magna suspended in saline. The metacercaria originated from F. magna ova collected from livers of Minnesota white-tailed deer and were harvested following conversion in the snail, Lymnea columella, (Baldwin Enterprises, Monmouth, OR). Eight (8) weeks post-inoculation, the animals in one group were treated with 20 mg/kg of closantel. All sheep were necropsied 16 weeks after infection (8 weeks post-treatment) and examined primarily for liver flukes. Necropsy revealed an average of 8.8 flukes per sheep in the untreated group and no flukes in any of the treated animals.

A second experiment was initiated to determine the optimal dose of closantel to control an F. magna infection. Thirty (30) ewes of less than 1-year-of-age were allotted into five (5) groups of six (6) animals each on a weight basis (group averages were from 43.2 to 44.3/kg). Group 1 was the inoculated-untreated control and Groups 2-5 were treated with 5.0, 7.5, 10.0 and 15.0 mg/kg, respectively.

All sheep were infected orally with 100 metacercaria in saline and Groups 2-5 were treated with closantel eight (8) weeks later. Sixteen (16) weeks post-inoculation, all animals were necropsied. Necropsy revealed an average of 3.5, 2.5, 0.5, 0.8, and 0.2 flukes/sheep in the groups treated with 0, 5.0, 7.5, 10.0 and 15.0 mg/kg, respectively. The degree of pathology caused by the flukes was also reduced with increasing levels of closantel. Our data suggests that clinically, the 15 mg/kg dose of closantel is the optimal dosage for use against F. magna in sheep.

59. LEVAMISOLE: ITS USE IN CONTROLLING THE PERIPARTURIENT RISE IN WINTER LAMBING EWES. COLIN JOHNSTONE and SUSAN M. DONOGHUE, University of Pennsylvania, School of Veterinary Medicine, Philadelphia, PA.

Ewes naturally infected with gastrointestinal nematodes showed post-parturient rises in their fecal egg counts with 2 significant peaks at 9 and 15 weeks after the beginning of lambing.

Levamisole treatment of ewes at lambing and allowed free access to pasture eliminated the first but not the second peak in the post-parturient rise.

It was concluded that the probable source of the second peak was overwintering pasture larvae, emphasizing the need to develop control programs based on epidemiological factors responsible for nematode transmission.

60. THE SENSITIVITY OF MIXED, BOVINE GI NEMATODIASIS TO MORANTEL TARTRATE FOLOWING THE SECOND, CONSECUTIVE, YEARLY USE OF THE PARATECT BOLUS. T.A. YAZWINSKI, T.J. NEWBY, B.L. PRESON and H.E. FEATHERSTONE, University of Arkansas, Fayetteville, AR.

This trial was conducted to determine the sensitivity of nematodes to morantel treatment in tracer calves rendered parasite free and then allowed to

graze pastures used the previous two grazing seasons for either control or Paratect-treated animals. Onto each pasture were placed 10 such tracer calves. These animals were allowed to graze for three weeks and then placed on concrete for the next 28 days. Five animals from each group were then treated with morantel tartrate at the rate of 10 mg/kg BW, and the other 5 left as controls. Necropsy and parasite enumeration commenced 7 days latter. Levels of Ostertagia, Cooperia and Nematodirus nematodes from both infection sources were reduced at equivalent rates. Tolerance to morantel therefore was not found in this study. Minimal efficacies for Ostertagia, Cooperia and Nematodirus spp. adults were 91.5, 95.7, and 98.3, respectiely. Only low levels of I. axei and H. placei were found.

61. PRELIMINARY EVALUATION OF A COMBINATION FEBANTEL PARAZIQUANTEL PASTE IN PUPPIES. M.L. SHARP, Sharp Veterinary Clinic, Vernon TX and H.D. McCURDY, BAYVET Division Miles Labs, Shawnee, KS.

A combination paste formulation containing parziquantel and febantel was administered to 42 puppies (< 6 mo.) with natural infections of Ancylostoma caninum and/or Toxocara canis. Another 19 similar aged puppies, some littermates to those that were treated, were studied at the same time as an untreated control group. There were four treated groups of puppies, three being dosed at 1 g paste/7.5 lb and the fourth at 1 g paste/5.0 lb body weight. Group I were unweaned puppies where the feeding times were uncontrolled. Groups II-IV were weaned puppies in which the feeding times, in relationship to dosing, were controlled. Groups II and IV were dosed on a full stomach and Group II on an empty stomach.

Following dosing the feces were collected daily for 5-7 days and examined for nematodes passed. Seven days after dosing was started the pups were euthanized and the intestinal tracts examined for retained parasites. This study demonstrated that efficacy was improved by dosing the puppies on a full stomach. Also, a dose of 15 mg febantel/kg given on a full stomach produced optimal results (> 99% elimination of A. caninum and I. canis). No side effects were observed in any of the treated animals.

62. EVALUATION OF FEBANTEL-PRAZIQUANTEL COMBINATION PASTE IN DOGS AND CATS UNDER SIX MONTHS OLD. E.L. ROBERSON, College of Veterinary Medicine, University of Georgia, Athens, GA.

A dose titration study of febantel-praziquantel combination paste was done in 40 6- to 12-week-old pups to determine the required dosage of febantel (10, 15, or 20 mg/kg body wt.) against naturally occurring infections of Ancylostoma caninum and Toxocara canis when treatment was adminstered orally to full stomached pups once daily for 3 consecutive days. Evaluation was based on numbers of worms expelled during a 7-day post-treatment colection of feces and numbers retained at necropsy. The 10 mg dosage was insufficient (<71.2% expulsion of both parasites); 15 mg was satisfactory (91.3% of A caninum and 97.9% of I. canis expelled); 20 mg was not markedly more efficacious than the 15 mg dosage.

A similar 3-day treatment of 36 cats (26 adults, 10 juveniles) harboring induced infections of A. tubaeforme, I. cati, and Taenia taeniaeformis indicated that a 10 mg/kg dosage of febantel satisfactorily expelled hookworms (93.3%) and ascarids (98.8%) from older cats but not from

young cats (< 6 months old and weighing < 1.4 kg). In a subsequent study of 24 experimentally parasitized kittens (7-16 wks old, weighing 0.29-1.33 kg), 15 mg febantel/kg given on a full stomach was used to achieve 95.9-100% efficacy against prepatent and patent infections of both hookworms and ascarids in young cats.

63. INFLUENCE OF DRUGS AND ANTHELMINTHICS ON INGESTION OF TRICHOSTRONGYLUS COLUBRIFORMIS (NEMATODA) IN VIVO. K.P. BOTTJER and L.W. BONE, USDA, ARS, Regional Parasite Research Laboratory, Auburn, AL.

Some commonly used anthelminthics and drugs were tested for their effect on feeding by the intestinal parasite of goats, Trichostrongylus colubriformis. Feeding was determined by fluorometric analysis of a marker dye, Rhodamine B, that was ingested by the worms. The tested compounds were administered to the host 1 hr prior to the dye. Hosts were sacrificed 4 hr after receiving dye and the worms were collected by 6 hr in groups of 250 worms for determination of dye uptake. Feeding by helminths was significantly reduced in goats that received 75% and 100% of the commercially recommended dosages of tetramisole, piperazine citrate, pyrantel pamoate, thiabendazole, levamisole and ivermectin. Feeding by helminths was not affected by asperin administered at a dose of 36mg/kg body weight B.I.D. for 4 days or by the antihistamine tripelennamine hydrochloride administered I.M. for 4 days at 0.8 mg/kg body weight. The in vivo effect of anthelminthics on helminth feeding suggests that an in vitro assay of helminth feeding may allow screening of compounds for pharmaceutical usage, based on pharyngeal pumping by the nematode.

64. EXPERIMENTAL ISOSPORA SUIS INFECTIONS IN NURSING PIGLETS: MORTALITY AND EFFECT ON 21 DAY WEIGHT GAINS. D.S. LINDSAY, W.L. CURRENT, Department of Zoology/Entomology, Auburn University, AL and J.R. TAYLOR, USDA/AR, Regional Parasite Research Laboratory, Auburn, AL.

Our previous studies have shown that experimental inoculation of piglets with 300,000 sporulated Isospora suis oocysts at 3-days-of-age produces clinical coccidiosis similar to that seen in natural cases. In this study, we examined the effect of I. suis infection (300,000 sporulated oocysts per 3-day-old piglet) on mortality and 21 day weight gain in 49 piglets from 6 litters. Fifty-one piglets from 6 additional litters were not infected and served as controls. All liters were maintained on their sow and common production practices were employed in their management. Diarrhea began 3 to 5 days post-inoculation in all infected piglets and lasted for 5 to 15 days. Infected piglets became dehydrated, emaciated, and lethargic, but continued to nurse. Weight gains were significantly higher in control piglets compared to infected piglets at 7, 14, and 21 days-of-age. Total mean weight gains at 21-days-of-age were 8.7 lbs for controls and 5.1 lbs for infected piglets. Mortality was 20.4% in the infected piglets with 6.1% dying of acute coccidiosis on days 4 or 5 PI. No deaths occurred in the control piglets. These studies are consistant with reports from swine producers that I. suis infections result in economic losses due to mortality and reduced weight gains.

65. THE FINE STRUCTURE OF NORMAL AND ABERRANT STRAINS OF EIMERIA TENELLA OOCYSTS AND A COMPARISON OF THE PROTECTIVE IMMUNITY INDUCED BY THESE OOCYSTS WHEN FED TO CHICKENS. HELIEH SAATARA OZ, BERT E. STROMBERG, and WILLIAM J. BEMRICK. College of Veterinary Medicine, Department of Pathobiology, University of Minnesota, St. Paul, MN.

Aberrant oocysts of Eimeria tenella were induced by cleaning the oocysts before sporulation. These oocysts, when fed to chickens, were less pathogenic than normal oocysts. Birds that were immunized with the aberrant strain showed increased weight gains when compared to birds which had received normal oocysts. The antibody titers in these birds, detected by the ELISA technique, were comparable to those birds inoculated with normal oocysts.

Some morphological developmental variations were also observed by light or transmission electron microscopy. Normal oocysts began sporulating at approximately 16 hours, while the aberrant strains started dividing at about 24 hours. Aberrant oocysts lacked sporocysts and contained 8 free, banana-shaped sporozoites.

The transmission electron microscopy stuides of the normal oocysts, showed an electron-lucent, double-membraned, sporocyst veil around each sporocyst wall. The aberrant oocyst had a polar granule, micropyle cap, oocyst residum and 8 free sporozoites. No sporocyst walls were observed.

66. CRYPTOSPORIDIOSIS IN NEWBORN CALVES. T.B. HAYNES*, L.H. LAUERMAN, P.H. KLESIUS, F.M. MITCHELL, I.R. LONG and A.C. ELLIS. USDA-ARS Regional Parasite Research Laboratory (Haynes, Klesius) and C.S. Roberts Veterinary Diagnostic Lab, Dept. of Agri. & Indust. (Lauerman, Mitchell, Long and Ellis), Auburn, AL.

Primary infection of newborn cavles with Cryptosporidium, when clinically apparent, may range from mild to severe enteritis. Calfhood mortality is associated with cryptosporidiosis but circumstances are equivocal. The purpose of this study was to investigate epidemiological factors associated with this mortality. The presence and signs of Cryptosporidium, enterotoxigenic Escherichia coli, Clostridium perfringens, Salmonella sp., Campylobacter sp., chlamydia, rotavirus and coronavirus were monitored in Holstein-Freisian calves from the day of birth through 45 days of age. Forty-four newborn calvs of both sexes were obtained from a dairy and maintained in calf crates, designed to prevent exogenous parasitic infection, throughout the study. All calves passed Cryptosporidium oocysts beginning at a mean age of 8 days and continued shedding oocysts for an average of 7 days. Twenty out of 44 calves (45%) died. Necropsy of 10 calves showed mild to moderate enteritis. In the remaining calves, all were passing oocysts within 5 days of death. Gross pathology revealed emaciation, dehydration and serous fat atrophy. Enterotoxigenic E. coli was found in the feces of eleven (25%) of the calves but was not found in any of the necropsied calves. Six of the 20 calves that died had previously shed enterotoxigenic E. coli. None of the other enteric pathogens tested for were found. Cryptosporidium was the primary pathogenic agent in an outbreak of diarrhea in newborn calvs and concurrent or multiple infection with other pathogens was not a prerequisite for the observed mortality. Mortality was associated with cryptosporidial related enteritis leading to emaciation, the loss of fluid in affected calves,

and the stress created by the extreme cold temperatures during the 2 months (December 1983 and January 1984) of this study.

67. CLINICAL PATHOLOGIC CORRELATIONS IN EQUINE CUTANEOUS ONCHOCERCIASIS. C.S. O'NEILL, R.I. MILLER, T.R. KLEI, D.D. FRENCH, J.J. McCLURE and LANE FOIL, Departments of Veterinary Science, and Entomology, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, and Departments of Veterinary Microbiology and Parasitology, Veterinary Clinical Sciences, and Veterinary Pathology, Louisiana State University School of Veterinary Medicine, Baton Rouge, LA.

Diffuse ventral midline dermatitis has been purported to be a form of cutaneous onchocerciasis, a manifestation of hypersensitivity to ventral-feeding species of Culicoides, or caused by a combination of both. In the present study, 50 horses with naturally occurring Onchocerca cervicalis infections were examined. Clinical assessment, gross lesion description, histopathological evaluation of inflammatory pattern, histopathological assessment of microfilaria counts and positions within the dermis, and direct microfilarial quantitations were evaluated. Twenty of these with the most severe lesions were treated with ivermectin. In addition, skin test responsiveness to intradermal injections of serial dilutions of Culicoides varipenis and commercial, stable fly, tabanid and mosquito antigens were observed. The majority of horses exhibited the clinical syndrome known as ventral midline dermatitis. Gross lesions were largely confined to ventral abdomenal sites and included, papules, crusts, excoreations, scale, alopecia and depigmentation. Lesion scores decreased dramatically in all ivermectin treated horses folowing treatment. Histopathologic patterns exhibited marked variation. Microfilariae were situated in the dermis and were rarely associated with inflammatory cells. Inflammation was characterized by a mixed population of eosinophils, plasma cells, and lymphocytes. Inflammation decreased following ivermectin treatment, became less diffuse and more perivascular where it occurred. Skin reactivity to fly antigens was generally low and could not be correlated with severity or nature of clinical or histopathologic lesions.

68. RADIOGRAPHIC CHANGES IN CATS WITH TRANSPLANTED ADULT DIROFILARIA IMMITIS. ROBERT E. LEWIS, JOHN M. LOSONSKY, Department of Anatomy and Radiology, JOHN W. McCALL, MICHAEL T. DZIMINASKI, ERIC D. PERRY, Department of Parsitology, and CLARENCE A. RAWLINGS, Department of Small Animal Medicine, College of Veterinary Medicine, The University of Georgia, Athens, GA.

Radiographic changes were evaluated in cats with transplanted adult heartworms. The purpose was to determine: (1) the severity of disease changes with a known number of heartworms; and (2) the sequence of changes and how rapidly they develop.

The cats were radiographed 2 days prior to transplantation of 3 pairs of adult heartworms via the jugular vein. The cats were radiographed at 2, 4, 6, 8, and 12 weeks after transplantation. Non-selective angiography was performed prior to necropsy.

Size of the lobar arteries was determined and measurements were made

of the heart. Within 2 weeks, significant increases in the size of the heart and lobar arteries were evident. The heartworms were easily visualized with non-selective angiography.

69. RADIOGRAPHIC CHANGES IN THE FERRET INFECTED WITH DIROFILARIA IMMITIS. R.E. LEWIS, P. SUPAKORNDEJ, J.W. McCALL, M.T. OXIMIANSKI and R.R. HOLMES.
Abstract Not Available.

70. PHARMACEUTICAL DEVELOPMENT OF THE MORANTEL SUSTAINED RELEASE BOLUS. D.S. DRESBACK
Invited Symposium Speaker

71. EPIDEMIOLOGY AND PROGRESS IN THE CONTROL OF PARASITIC GASTROENTERITIS IN EUROPE. J. ARMOUR.
Invited Symposium Speaker

72. MATHEMATICAL MODELING AS A TECHNIQUE TO PREDICT SEASONAL PARASITE CONTROL. R.A. ANDERSON
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73. DEVELOPMENT OF A STRATEGIC TREATMENT SYSTEM FOR THE USE OF MORANTEL SUSTAINED RELEASE BOLUS - SUMMARY OF EFFICACY UNDER FIELD USE CONDITIONS THROUGHOUT NORTH AMERICA. D.H. BLISS.
Invited Symposium Speaker

74. EPIDEMIOLOGY AND CONTROL OF PARASITIC GASTROENTERITIS IN WEANED CALVES AND YEARLING CATTLE THROUGHOUT NORTH AMERICA - PANEL DISCUSSION/REPORTS OF INDIVIDUAL STUDIES CONDUCTED IN ARKANSAS, FLORIDA, INDIANA, MAINE, MISSISSIPPI, OREGON, IDAHO, WISCONSIN AND EASTERN CANADA. R. BRADLEY, E.BLOCK, S.M. GAAFAR, P. GADBOISE, J.L. FRECHETE, J. HAWKINS, O. SLOCOMBE, L.L. SMITH, H.C. GIBBS, T.A. YAZWINSKI and G.L. ZIMMERMAN.
Invited Symposium Speakers

75. EPIDEMIOLOGY AND CONTROL OF GASTROINTESTINAL PARASITIC NEMATODE INFECTIONS IN SUCKLING BEEF CALVES IN NORTH AMERICA - PANEL DISCUSSION/REPORTS OF INDIVIDUAL STUDIES CONDUCTED IN ARKANSAS, GEORGIA, IDAHO, INDIANA, ISSOURI, NORTH DAKOTA and WISCONSIN.
Invited Symposium Speakers

76. POTENTIAL DRUG RESISTANCE DEVELPMENT IN ANTHELMINTIC PROGRAMS, INCLUDING CONTINUOUS DOSAGE REGIMES, FOR THE CONTROL OF PARASITIC GASROENTERITIS IN GRAZING CATLE - STUDIES IN ARKANSAS, INDIANA AND WISCONSIN ON THE INFLUENCE OF THE PARATECT BOLUS SYSTEM ON THE SUSCEPTIBILITY OF GASTROINTESTINAL HELMINTHS OF CATLE TO MORANTEL. D.H. BLISS, L.L. SMITH and T.A. YAZWINSKI.
Invited Symposium Speakers

77. EPIDEMIOLOGY AND CONTROL OF GASTROINTESTINAL PARASITE INFECTIONS IN CATTLE GRAZING WINTER PASTURES - PANEL DISCUSSION/REPORTS OF INDIVIDUAL STUDIES CONDUCTED IN CALIFORNIA AND MISSISSIPPI. E. ILLYES, N. BAKER and J.A. HAWKINS.
Invited Symposium Speakers

78. RECENT DEVELOPMENTS IN PARASITIE CONTROL OPTIONS IN CATTLE; WESTERN UNITED STATES. NORMAN F. BAKER, DAVIS, CA, GARY L. ZIMMERMAN, CORVALLIS, OR, and RICHARD B. WESTCOTT, PULLMAN, WA.

Increased knowledge of the dynamics of parasite infection, along with the development of anthelmintics, has led to newly formulated parasite control options in cattle. Some of these options, such as the treatment of all dairy and beef cows prior to or at calving, have largely evolved from an empirical base. Other options, wherein the administration of selected anthelmintics and the implementation of additional management practices are applied at times determined by the stage of parasite development in the host and the concept of safe and unsafe pastures, have evolved from a more scientific base. This paper reviews the development of these options and the results of experiments wherein the options hae been evaluated in the western states.

79. RECENT DEVELOPMENTS IN PARASITE CONTROL OPTIONS IN CATTLE: SOUTH-EASTERN U.S. J.C. WILLIAMS, Baton Rouge, LA; J.W. KNOX, Bossier City, LA; J.B. MALONE, Baton Rouge, LA; and K.S. MARBURY, Baton Rouge, LA.

Comprehensive epidemiological investigations or the determination of how, when, and where parsitic infections occur in cattle under different seasonal weather conditions and under differing managment circumstances are indispensible in development of rational and efficient means of parsaite control. Research on epidemiology of gasrointestinal nematodes and the liver fluke, Fasciola hepatica, has been conducted in Louisiana over the last several years. Results of this work have yielded information on population dynamics of worms both in the host and in the environment and defined patterns of seasonal availability of infection to grazing animals. Infections with gastrointestinal nematodes gradually increase from late summer through autumn, may incrase or remain static in winter, and reach peak levels during spring. While type I Ostertagia disease may occur from winter into spring, spring (March-May) is when inhibition-prone larvae are acquired. Type II disease can result from this spring infection during late summer and autumn. Infection with liver fluke occurs minimally from autumn into winter, but is greatly increased from February-July (highest rate in April-May). Experimental control programs based on anthelmintics and pasture management are currently in progress.

80. RESENT DEVELOPMENTS IN PARASITE CONTROL OPTIONS IN CATTLE: NORTH-EASTERN UNITED STATES. R.P. HERD, Columbus, OH.

Improved knowledge of the epidemiiogy of Ostertagia ostertagi, the predominant parasite, has led to better parasite control recommendations for beef and dairy replacement heifers at pasture. These recommendations are based on seasonal patterns of pasture infectivity, hypobiosis (arrested development), and the acquisition of immunity. Differences for dairy cattle, cow/calf, and fedlot operations need to be considered. Routine control programs are strongly recommended for dairy heifers and weaned beef calves, but are seldom required for adult beef or dairy cattle. Control strategies include the choice of anthelmintics, prophylactic treatments in the spring, controlled release devices, treat and move strategies, and alternate grazing systems.

81. RECENT DEVELOPMENTS IN PARASITE CONTROL OPTIONS IN CATTLE: MIDWESTERN U.S. R.M. CORWIN, Columbia, MO.

For the past 4 years, the epidemiology of bovine gastroenteritis has been studied. This has generated data which have allowed prediction of schedule for deworming, which age groups are most at risk, and the performance benefits to be expected. Additionally, it has been shown that epidemiologic conditions in Missouri do differ from the traditional description for northern regions, thus emphasizing regional differences and necessity for regional studies. The cattle industry is a major one for Missouri and the whole spectrum of production should be analyzed for herd health care. Thus, stocker cattle as well as cow/calf herds must be studied. Hopefully, even feedlot operations can be addressed in the future.

82. POTENTIAL FOR IMMUNOLOGIC CONTROL OF EQUINE PARASITES. T.R. KELI, Baton Rouge, LA.

It is well-accepted that Strongylus vulgaris produces verminous arterites and colic. Natural resistance to acute verminous arteritis is well-documented. The feasibility of vaccinating against these parasites by using immunogenic attenuated live larvae is being investigated. To date, third stage infective larvae of S. vulgaris attenuated by gamma irradiation and administered per os have been shown to: 1) protect yearling ponies from fatal infections, 2) protect 13- to 18-week-old pasture-reared foals from fatal infections, and 3) to reduce the worm burden and arterial lesions of pony foals on pasture during the first 6 to 7 months of life. Many questions remain and other approaches to the solution of this problem are being studied.

83. RECENT DEVELOPMENTS IN PARASITE IMMUNITY: CONTROL OF SWINE PARASITES. K.D. MURRELL, Beltsville, MD.

In spite of the introduction of new anthelmintics and improved management practices, economic losses due to swine parasitism remain high. Recent developments in immunology have rekindled interest in the potential for the control of swine parasites by immunological means. The application of new concepts and technologies in developing anti-parasite vaccines will be discussed. For example, good progress has been made recently in protecting pigs against Trichinella spiralis with partially-purifed secretory antigens. Using monoclonal antibody and affinity technics, prospects for the separation and identification of protective antigens appear good. Similar approaches are now being followed to develop a vaccine for swine ascariasis because although a highly protective immunization procedure for Ascaris suum has already been developed, its commercial application is uncertain.

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