863 Management of twinning cow herds. B.W. Kirkpatrick*, *University of Wisconsin-Madison*.

Many beef producers oppose twin birth for the perceived detriments associated with the trait. These include lower calf survival, increased dystocia (malpresentation), increased stillbirth, increased abortion, calf abandonment, retained placenta, lengthened interval from parturition to conception and freemartin heifers when born co-twin with a male. Some of these problems can be overcome with changes in management, others lack an obvious managment fix and still others are of little practical significance. Management alterations which may be required for successful exploitation of twin birth include (1) pregnancy checks to determine twin versus single pregnancy, (2) adequate calving facilities and (3) early calf weaning. Determining whether a cow is pregnant with twins elminates surprises at calving time in that cows at high risk for malpresentation are identified beforehand. In addition, cows gestating twins could be fed a higher plane of nutrition in recognition of the higher demands on them both during late gestation and subsequently while nursing twins. Adequate calving facilites are a necessity given the significant fraction of twin births which are malpresentations. Additionally, availability of calving pens facilities penning of cows with their twins which is sometimes needed to address potential calf abandonment problems. Early weaning is well documented to have beneficial effects on postpartum reproductive performance. Given the typically longer interval from parturition to conception for twin bearing cows, early calf weaning may help maintain adequate reproductive performance. Considering the remaining problems, there are no obvious alterations of management which will improve twinning-related problems with stillbirth, abortion or retained placenta. Freemartinism falls into the last category of something which is more a percieved than real problem. Given that absolute number of fertile females produced from a twinning system will differ little from a single-birth system, freemartinism is not a serious drawback of twinning in beef cattle.

Key Words: Twinning, Cattle, Management

864 Comparison of the profitability of single-calf with twinning cow herds. M. L. Thonney*, *Cornell University, Ithaca, NY*.

A spreadsheet available at http://www.ansci.cornell.edu/courses/as360/lab/budget.htm was developed to compare the profitability of cow herds on 202 hectares (500 acres) of moderately productive forage land with three levels of twinning (1%, 50%, 90%) with or without 2 kg supplement ($0.12/kg) for 90 days in early lactation expected to maintain fertility in cows with twins to the same level as cows with singles. Purchased hay was priced at $0.07/kg and extra hay was sold at $0.06/kg. Land was valued at $741 per hectare ($300/acre) and there were about $62,736 of other capital items. Calf and replacement numbers were determined by twinning rate, fertility, and death rates. Carrying capacity was determined by monthly pasture and hay field productivity and energy requirements of cows with a 10% increase for twinning cows supplied by increased forage or mostly by the supplemental grain mix during early lactation. Cash expenses per cow included extra vet supplies and labor for calving twinning cows which increased as percentage of twinning cows increased (Table). All assets were assumed to be 100% owned. Net farm income accounted for $8,115 depreciation as well as cash expenses and increased (Table) over single calf herds by 32 and 60% for 50 and 90% nonsupplemented twinning herds and by 61 and 113% for supplemented herds. After accounting for $3,500 of unpaid family labor and about $28,600 for possible return on equity, return to operator's labor and management ranged from a loss of $8,946 for a single-calf herd with 1% twins to a gain of $17,706 for a supplemented herd with 90% twins. These results show that properly managed twinning cow herds could significantly increase profitability over traditional single-calf cow herds.

Percentage of cows twinning (supplement?):	1 (no)	50 (no)	90 (no)	50 (yes)	90 (yes)
Cows	100	95	91	99	98
Open cows, %	5	10.5	14.9	5	5
Calf loss, %	3.8	11.8	15.8	12.2	15.8
Calves per cow	0.8	1.1	1.3	1.2	1.5
Replacements	15	20	23	16	16
Cash expenses, $	19,802	21,607	22,137	22,429	23,522
Net farm income, $	23,411	30,860	37,519	37,768	49,872

Key Words: Cattle, Twinning, Economics

ASAS Horse Species: Historical Aspects of Equine Research—How We Got Here and Where Are We Going?

865 Historical aspects of equine nutrition. H.F. Hintz*[1], [1] *Cornell University*.

The modern horse was introduced to the North American continent in 1519. During the late 1800's and early 1900's a significant number of basic and applied studies were conducted on horse nutrition. Horse research was conducted at many experiment stations and even in territories such as Utah before they became states. However as the number of horses declined, research declined. By 1950, there were no research units at experiment stations dedicated to horse nutrition. As the popularity of horses increased in the 1960's nutrition units were established at several universities including the University of Florida, Texas A&M, University of Kentucky, Cornell University, and University of Minnesota. Research efforts have continued to grow, though not as great as some would like, and it appears the importance of the horse will continue to deserve research support.

Key Words: horse, nutrition, history

866 Effect of fasting on blood lipid concentrations in horses. N Frank*, J Sojka, and M Latour, *Purdue University, West Lafayette, Indiana*.

Triglyceride (TG) is exported from the liver in the form of very low-density lipoproteins (VLDL). This study examined the effect of fasting on plasma lipids, specifically VLDL. Four horses aged 13.5 + 3.9 yr were fasted or fed mixed grass hay (2.1% fat DM) *ad libitum* for a 36 h period beginning at 0800. Each horse served as its own control with a 7 d interval between study periods. Blood samples were collected every 2 h and plasma isolated. A density < 1.006 g/mL plasma fraction containing VLDL (and potentially chylomicron lipoproteins in fed horses) was separated from plasma by ultracentrifugation. Components of VLDL including TG, total cholesterol (TC), free cholesterol, phospholipid (PL), and protein (PRO) were quantified. Plasma TG, TC, glucose, and NEFA concentrations were also measured. Total VLDL concentration was calculated by summing TG, TC, PL, and PRO concentrations. Repeated measures analysis revealed that fasting had a significant ($P < 0.10$) effect on VLDL concentration over time. Compared with fed horses, mean VLDL concentration was higher in fasted horses at 16 h and means differed significantly ($P < 0.05$) by 36 h. However, individual variation was observed. Fasting induced significantly higher VLDL concentrations in only two of the four horses. The percentage of TG in VLDL increased significantly ($P < 0.10$) with time in fasted horses. Plasma NEFA concentrations were significantly higher ($P < 0.001$) in fasted versus fed horses with mean (SE) concentrations of 299.9 (19.9) μmol/L and 46.4 (2.1) μmol/L, respectively. Plasma TG, TC, and glucose concentrations did not differ significantly between groups. Results indicate that lipid-rich VLDL particles accumulate in the circulation of fasted horses, either as a result of accelerated secretion or inhibited clearance. Further studies are required to determine why individual horses respond differently to fasting. Potential contributing factors include body composition, endocrine status, genetic predisposition, and stress tolerance.

Key Words: Fasting, Lipids, VLDL

867 Plasma glucose responses of growing horses to different concentrate feeds. A. C. St. Lawrence*[1], L. M. Lawrence[1], S. H. Hayes[1], and M. Adams[2], [1] *University of Kentucky, Lexington, KY,* [2] *Cooperative Research Farms, Guelph, ON*.

Fourteen horses (9 mos) were used to determine the effects of two concentrate feeds on glucose response to a meal. Initially, all horses received

a diet consisting of a control concentrate (16.9% CP, 10.3% NDF, 3.1% fat, 1.41% Ca, 1.0% P, 519ppm Fe, 184ppm Zn, 66ppm Cu) at 65% of the DE required for moderate growth, and ad libitum access to alfalfa hay. Following a 10-d period, the horses were fasted overnight and blood samples were collected immediately prior to a meal (25% of daily meal, .9-1.2 kg) and at 30-min intervals for 5 h after the meal was offered (B1). After B1, horses were blocked by age and assigned to treatment groups. Group C (n=7; 308 kg) continued to receive the control concentrate and Group F (n=7, 309 kg) received an isocaloric concentrate (16.1% CP, 16.5% NDF, 5.1% fat, 1.59% Ca, .96% P, 417ppm Fe, 155ppm Zn, 59ppm Cu). After 21 d, horses were bled (B2) following the same procedure as B1 except that each group received their respective dietary treatments as the test meal. To determine long-term effects of receiving diet F, horses were maintained on their respective diets for another 21-d and a third bleed was conducted (B3). In B3 all horses received the control concentrate as the test meal. Effects of diet on plasma glucose were determined by comparing areas under the response curve (AUC) and peak glucose concentrations between groups. Mean ADG was .53 kg and did not differ between groups. Differences in AUC were not observed between groups in B1, B2, or B3 (P>.05). Peak glucose concentrations were similar between groups during B1 and B3 but were lower in Group F during B2 (P<.05) The dietary component responsible for the differences in peak glucose between Group F and Group C is not clear. Both dietary soluble carbohydrates and dietary Zn have been implicated in altering glucose concentrations. The relatively small differences in soluble carbohydrates between diets may partially explain why differences in AUC were not observed in B2.

Key Words: Horse, Plasma Glucose, Diet

868 Fecal phosphorus excretion in yearling horses fed typical diets with and without exogenous phytase.

M.T.M. Hainze*, K. A. Condon, J. A. Rush, R.B. Muntifering, and C.A. McCall, *Auburn University, Auburn, AL 36849*.

Phosphorus (P) returned to the environment in animal manures may detrimentally affect soil and water resources. Solubility of P returned to soil determines its rate and extent of assimilation by plants, which in turn affects P runoff and transport. Fecal P excretion was characterized in eight yearling geldings fed four typical diets differing in ingredient composition, with and without exogenous phytase. The experimental design was a 4 X 4 Latin square with repeated measures in which horses were fed Coastal bermudagrass hay at a rate of 1.5% of BW daily plus sufficient 12% CP sweet feed, 12% CP pelleted concentrate, whole oats or alfalfa cubes to meet NRC (1989) requirements for DE and CP. Phytase status represented a within-unit repeated measures factor. Each experimental period consisted of a 10-d acclimation to dietary treatments, 2-d fecal sampling, 7-d acclimation to exogenous phytase and another 2-d fecal sampling, followed by a 7-d diet changeover between periods. Diets were fed twice daily, and water and plain salt were available for *ad libitum* consumption. Phytase was delivered orally via syringe at time of feeding. When not being fed, horses were maintained in a drylot. Fecal samples were collected by rectal grab and were composited on an individual animal basis. Diet DM digestibility and fecal DM output were calculated by reference to AIA concentrations in feed and fecal DM. Fecal samples were analyzed for concentrations of total P and water-extractable P, and insoluble P was calculated as the difference between total and water-extractable P concentrations. Fecal output of total P, water-extractable P and insoluble P differed ($P < 0.05$) among diets, and total P excretion across all diets tended to be lower ($P = 0.16$) when phytase was administered (12.3 vs 13.8 g/d). Fecal output of total P, water-extractable P and insoluble P was 8.4, 3.0 and 5.4 g/d; 10.1, 3.9 and 6.9 g/d; 14.9, 5.3 and 9.6 g/d; and 19.0, 7.9 and 11.1 g/d, respectively, for diets containing oats, alfalfa cubes, sweet feed and pellets. Results are interpreted to mean that typical diets for horses, formulated to meet DE and CP requirements, can be expected to differ markedly with respect to quantity and solubility of P returned to the environment in feces.

Key Words: Equine, Phosphorus, Phytase

869 Passage rate of ingesta in Standardbred race horses.

J. VandenBrink and J. H. Burton*, *University of Guelph, Guelph, Ontario, Canada*.

A trial was conducted on six Standardbred horses in race training to investigate the effects of training stress on rate of ingesta passage. Three horses were in their early phase of training (low intensity (LI): jogging 4 miles per day, six days per week); three horses were race trained in 2:05 (minutes per mile) or less (high intensity (HI)). Two markers were used simultaneously to estimate passage rate: Cr-mordanted bran fiber to follow particulate matter; CoEDTA as a fluid phase marker. Mordanted fiber was fed in pellet form in one meal and CoEDTA was administered as a drench. Total fecal collection took place over 72 h commencing 6 h after marker administration. A 10 percent subsample of feces from each time period was retained for analysis of dry matter, Cr and Co. Feces were pooled over 3 hour intervals from 6 to 36 h and 6 h intervals from 36 to 72 h. Cr and Co were analysed in feces using atomic absorption spectrometry. Average fecal dry matter from all horsese was 20.5 percent. Average mean retention times (MRT) for particulate matter as determined from Cr data were 30.7 h and 33.3 h for HI and LI horses respectively. Fluid phase had significantly lower retention times with MRT of 23.3 h for HI and 18.8 h for LI. Results indicate that particulate material was retained about 50 percent longer than the fluid phase.

Key Words: Rate of pasage, Standardbred race horses, Cr-mordanted fiber CoEDTA

870 Effects of melatonin implants on plasma concentrations of leptin and body weight in obese pony mares.

P.R. Buff*, C.D. Morrison, E.L. McFadin-Buff, and D.H. Keisler, *University of Missouri-Columbia*.

Our objectives were to determine if subcutaneous melatonin implants would alter the diurnal rhythm of leptin secretion and subsequently alter body weight in obese pony mares. Seven ovariectomized and eight intact pony mares (initial weight 273.6 ± 17.9 kg) were used. Four mares from each group were implanted with 144 mg melatonin (Regulin®, Sanofi, Watford, UK) and the remaining mares received no implant. All mares were allowed *ad libitum* pasture. Beginning at 10:00 h and 17:00 h plasma samples were collected every 15 minutes for one hour. This sampling protocol was repeated weekly from 7 July 2000 until 7 October 2000. Body weights were taken weekly following the 10:00 h blood sample. Plasma samples were analyzed for leptin using a double antibody homologous radioimmunoassay validated for equine leptin in our laboratory. The mean concentration of leptin from each of the 4 plasma samples was used for statistical analysis. Separate analyses for leptin were performed for 10:00 h and 17:00 h sampling periods to determine treatment differences. No differences in plasma concentrations of leptin were detected between melatonin implanted and non-implanted mares for the 10:00 h sampling period ($P = 0.62$). A significant treatment by day effect was detected for the 17:00 h sampling period ($P = 0.0012$), but post-test comparisons of the means resulted in no differences between treatment groups. No differences in plasma leptin levels were detected between ovariectomized and intact mares ($P > 0.7$). In contrast, plasma concentrations of leptin differed between morning (10:00 h) and evening (17:00 h) samples 22.07 ± 1.7 vs. 28.24 ± 1.7, respectively; $P < 0.0001$). Treatment with melatonin had no effect on body weight change ($P = 0.09$). From these data we conclude that neither melatonin implants nor ovariectomy influences plasma concentrations of leptin in pony mares. However, differences in plasma concentrations of leptin were detected between the 10:00 h and 17:00 h samples, indicating that melatonin may not influence the diurnal pattern of leptin secretion.

Key Words: Equine, Leptin, Melatonin

871 Determination of pregnancy outcome of mares grazed on a non-toxic endophyte-infected tall fescue.

B. J. Rude*, B. A. Warren, D. J. Lang, and P. L. Ryan, *Mississippi State University*.

Tall fescue infected with *Neotyphodium coenophilaum* (E+) is known to be toxic to late-term pregnant mares. A non-toxic endophyte-infected fescue (NTE+) has been developed for grazing cattle, but safety for pregnant mares grazing this new fescue is unknown. The objectives of this study were to 1) evaluate the toxicity risks of pregnant mares grazing NTE+, and 2) determine the persistence of NTE+. Fifteen mares were allotted to graze one of three pasture treatments: 1) Endophyte-free fescue (E-); 2) NTE+; and 3) E+. Five mares grazed on each of the paddocks from March 1 until 3 weeks post-partum. Urine was collected weekly from mares for ergot alkaloid analysis. Placental membranes were submitted for histopathology. Results indicated that only mares

grazing E+ exhibited symptoms of fescue toxicity which included agalactia (n=4 of 5), compromised delivery (n=2), retained placenta (n=3), and one mare aborted at 301 days gestation. Additionally, mares exposed to E+ had longer ($P < 0.05$) gestation (353 d) compared to those grazing NTE+ and E- (333 and 340 d, respectively). Mean urine ergot alkaloid content was greatest ($P < 0.01$) for E+ (38.5 ng/mg creatinine) compared with NTE+ and E- mares (5.9 and 3.4, ng/mg creatinine, respectively). Placental measurements showed increased ($P < 0.03$) thickening of the cervical aspect of the placenta in E+ (4.49 mm) compared with NTE+ and E- mares (1.58 and 1.57 mm, respectively). A difference ($P < 0.05$) was also seen for amnion thickness between E+ and NTE+ mares (2.37 vs. 1.0 mm, respectively). Pasture endophyte infestation rates were 2.3%, 63% and 91% in March and 1.5%, 92% and 91% in May for E-, NTE+ and E+ pastures, respectively. Of the infected tillers during May, 6% of the E- and NTE+ samples were positive for ergot alkaloids while 100% of the tillers in the E+ pasture were positive. Tall Fescue stands were 32 % for E-, 96 % for NTE+, and 95 % for E+ pastures in mid-March and 1 % (E-), 41 % (NTE+), and 27 % (E+) at the end of September, after a dry and hot summer (< 1 cm rainfall, 27 days > 37 C during July- September). Stand decline and survival in both NTE+ and E+ were related to soil type and landscape features. These findings suggest that NTE+ is a safe herbage for the grazing of late-term pregnant mares.

Key Words: Equine, Preganncy, Non-toxic infected-fescue

872 Manipulation of the dopaminergic system affects prolactin but not LH secretion in anestrous and cycling mares. K. Bennett-Wimbush*[1], B. Musolf[2], and D. Keisler[3], [1]*Ohio State University Agricultural Technical Institute, Wooster, Ohio,* [2]*Cuyahoga Community College, Parma, Ohio,* [3]*University of Missouri, Columbia, Missouri.*

Previous research has shown that dopamine antagonists can hasten follicular growth and ovulation in transitional mares. The mechanism of action appears to be by modulation of prolactin and not FSH. However, the effect of dopamine antagonists on LH is unknown. The purpose of this study was to determine the effects of 2-bromo-ergocriptine (dopamine agonist) and perphenazine (dopamine antagonist) on prolactin and LH secretion during different reproductive stages. Six mares were used in a 3x3 Latin Square design experiment. Treatments included .375 mg/kg oral perphenazine (P), 0.08 mg/kg$^{.75}$ 2-bromo-ergocriptine (B) intramuscularly (IM) or an equivalent volume of saline (S), IM. Each mare received all treatments once during anestrus, estrus and diestrus. Prior to treatment, each mare was fitted with an indwellling jugular catheter and pre-treatment blood samples were collected every 20 minutes for one hour, starting at time 0. After pre-treatment samples were collected, a single dose of either P, B or S was administered as described above. Blood samples were obtained every 20 minutes for 7 hours following treatment. Samples were analyzed for prolactin and LH via radioimmunoassays. Differences in mean prolactin (PRL), mean LH (LH), maximum prolactin (MAXPRL) and maximum LH (MAXLH) for cycle, treatment and cycle*treatment were tested using GLM. The relationship of prolactin and LH observed during this study parallels previously published works. Plasma PRL and MAXPRL were lower ($p < .01$) during anestrus (13.4 $\pm$ 7.3 , 18.0 $\pm$ 9.0 ng/ml) when compared to concentrations observed during estrus (18.3 $\pm$ 9.8, 26.2 $\pm$ 13.1 ng/ml) or diestrus (18.8 $\pm$ 9.3, 30.0 $\pm$ 14.1 ng/ml). As expected, plasma concentrations of LH and MAXLH were higher ($p < .01$) during estrus. Perphenazine treatment increased ($p < .01$) PRL and MAXPRL during all stages of the mares' cycles. PRL was 23.7 $\pm$ 9.3, 12.2 $\pm$ 5.6, 14.1 $\pm$ 7.0 ng/ml for P, B and S treatments respectively. Treatment with B did not significantly alter either PRL or MAXPRL when compared to the control (S). Similarly neither of the treatments had any effect on LH or MAXPRL. In conclusion, the dopaminergic system plays a key role in the regulation of pituitary prolactin secretion, but does not appear to regulate LH.

Key Words: Dopamine, Prolactin, LH

873 Temporal variables of the park walk and park trot of the Morgan Horse. M.C. Nicodemus*[1], K.M. Holt[1], and H.M. Clayton[2], [1]*Mississippi State University, Mississippi State, MS/USA,* [2]*McPhail Equine Performance Center, East Lansing, MI/USA.*

During competition, two of the gaits performed by the Morgan Park Horse are the park walk and park trot. According to judging standards, the park trot is a definite 2-beat diagonal gait but the park walk can be either a 2 or 4-beat walk with both being snappy, collected, and cadenced. Distinguishing between these gaits can be difficult for the novice judge. Therefore, the objective was to clearly define the park walk and park trot. Frame-by-frame analysis was done on 5 Morgan Park Horses performing 4 strides of the park walk and park trot at Morgan Horse Nationals. The mean (SD) of the following stride variables were determined: stride duration, fore and hind stance durations, lateral and diagonal step intervals, and limb support phases. Both gaits demonstrated a diagonal footfall sequence (RH-LF-LH-RF) with short contact intervals between the hind and diagonal forelimb. In each park walk half-stride, the support sequence was: tripedal (2 hind and 1 fore), quadrupedal, tripedal (2 hind and 1 fore), and diagonal bipedal. In each park trot half-stride, the support sequence was: single hind, diagonal bipedal, single hind, and suspension. Both gaits demonstrated a diagonal footfall sequence with diagonal couplets. The park walk had walking support characteristics with trotting footfall characteristics, whereas the park trot was similar to the trot. The shorter stride duration, the lack of tripedal and quadrupedal support, and the inclusion of suspension in the park trot differentiate it from the park walk.

	Park Walk	Park Trot
Stride Duration (ms)	835 (60)*	673 (33)*
Fore Stance Duration (ms)	513 (14)*	316 (18)*
Hind Stance Duration (ms)	443 (22)*	232 (22)*
Lateral Step Interval (%)	50 (7)	51 (8)
Diagonal Step Interval (%)	4 (1)	6 (2)
Suspension (%)	NA	10 (2)
Hind Single Support (%)	NA	20 (4)
Diagonal Bipedal Support (%)	75 (1)	70 (3)
Tripedal Support (%)	20 (1)	NA
Quadrupedal Support (%)	5 (2)	NA

Table 1: Park walk and park trot temporal variables (mean, SD) with significant differences ($P<0.05$) between variables of the gaits indicated (*).

Key Words: Equine locomotion, Temporal variables, Morgan Horse

ASAS Nonruminant Nutrition: Growth Management and Sow Nutrition; Aquaculture

874 Effects of feed deprivation prior to slaughter on changes in body weight and stomach morphology of finishing pigs. C. M. Dodd*, D. L. Rader, J. D. Hancock, G. A. Kennedy, C. W. Starkey, C. L. Jones, and D. J. Lee, *Kansas State University, Manhattan.*

A total of 176 pigs were used to determine the effects of feed deprivation (none, 12 h, 24 h, and 48 h) prior to slaughter on changes in BW and stomach morphology of finishing pigs. The pigs were blocked by sex and weight and allotted to 16 pens with 11 pigs per pen. The pigs were fed a corn (mean particle size of 600 microns)-soybean meal-based diet (0.8% lysine, 0.6% Ca, and 0.5% P) for 36 d (from 92 kg until slaughter). The diet had 4% soybean oil, was fed in pelleted form, and was consumed on an ad libitum basis. For the feed deprivation treatments, feeders were removed from the pens. To end the experiment, the pigs were loaded onto a truck at 0000, shipped to a commercial meat packing plant, and killed at 0600. The pars esophagea of the stomachs were collected and scored on a scale of 0 to 3 (0 = none, 1 = slight, 2 = moderate, and 3 = severe) for keratinization and ulceration. The mean BW of all pigs at initiation of the feed deprivation treatments was 127 kg. At shipping (i.e., 48 h later), BW changes ranged from 1.5 to 5.4 kg as duration of feed deprivation was increased from none to 48 h (linear effect, $P < 0.001$). Also, hot carcass weight decreased as duration of feed deprivation was increased (linear effect, $P < 0.04$). Keratinization score increased from 0.44 to 1.77 as duration of feed deprivation was increased (cubic effect, $P < 0.03$). Ulceration score increased slightly (from 0.02 to 0.56) but the changes were negligible except for the 48 h treatment (cubic effect, $P < 0.04$). In conclusion, feed deprivation prior to shipping for slaughter decreased final BW and hot carcass weight. Also, keratinization of the pars esophagea increased as duration of feed deprivation was increased but changes in ulcer scores were minor.