OUT:H19) cause other illnesses, and 19 have not been reported previously in cattle. Lower ($P < 0.05$) STEC prevalence was associated with animal factors such as decreasing stock density (≤ 1.0 cow/acre), early separation of calves (≤ 6 mo), increasing the size of calving pasture (> 120 acres), and absence of diarrhetic calves 2 to 4 mo prior to fecal sampling. Of the dietary factors tested (e.g., supplementation of pregnant cows with alfalfa, molasses, or selenium), only molasses decreased ($P < 0.05$) STEC prevalence from 6.7 to 0%. Thus, decreasing fecal shedding of STEC by range cattle appears possible by altering management practices.

Key Words: Shiga Toxins, *Escherichia coli*, Beef Cattle

Forages and Pastures - Livestock and Poultry: Forage Quality and Nutritive Value

M99 Mineral concentrations of tropical forages in the regions of San Vicente de Caguan, Colombia. R. Vargas, L. R. McDowell*, R. Van Alstyne, and N. S. Wilkinson, *University of Florida*, *Gainesville*.

In the San Vicente Zone of Colombia, South America, south of Llanos Orientales, beef cattle have been dying of a disease linked to nutrient deficiencies. Botulism is the major disease linked to the bovine mortality with 4000 deaths from 1995 to 2003. Animals were observed with abnormal appetite (pica) consuming old bones and bones from decaying carcasses. Mineral deficiencies, particularly P, are the suspected reason for the large consumption of bone. An experiment was designed to determine the mineral status of forages in relation to cattle requirements from eight ranches in the region of San Vicente de Caguan, Colombia. Forage samples (64) were collected equally between the rainy (September–December, 2002) and dry (January–March, 2003) seasons. The major forage was Brachiaria decumbens, with other important grasses including Axonopus pursuii, Tachypogan vestitus and Leersia hexandra. Samples were collected, dried, ground and analyzed by standardized procedures for 12 minerals. Significant ($P<0.05$) forage concentrations were found among farms and there were season differences ($P<0.05$) for K, Co and Zn. Potassium and Co were higher in the rainy season and Zn higher in the dry season. Forage macromineral concentrations (%) for rainy and dry seasons were as follows: Ca (0.18, 0.15); P (0.07, 0.07); Na (0.04, 0.04); K (5.5, 1.3); Mg (0.22, 0.14) and for trace minerals (ppm); Cu (6.7, 8.3); Co (0.09, 0.34); Se (0.07, 0.08); Zn (15, 34); Fe (108, 136); Mn (173, 238); Mo (0.08, 0.08). In relation to beef cattle requirements almost all samples were severely deficient in P, Na and Ca. Cobalt was deficient only in the rainy season. Potassium, Mg, Fe and Mn were not deficient and Mo was not in excess. The minerals most deficient and most likely causing death and botulism are P, Na, Ca, Se, Cu and Zn.

Key Words: Cattle, Botulism, Minerals

M100 Effect of selenium fertilizer on forage selenium content. S. J. Filley*, A. Peters, and C. Bouska, *Oregon State University*, *Corvallis*.

The objective of this experiment was to determine the effect of source and rate of Se applied as fertilizer on forage Se content. Low-Se pasture plots (three per treatment) containing perennial ryegrass (*Lolium perenne*) and subterranean clover (*Trifolium subterranean*) were assigned randomly to treatments of 0.0 (control), 0.6, 1.1, and 2.2 kg/ha sodium selenite, and 0.6 kg/ha sodium selenate. Plots were protected from grazing by use of electric fence, and total forage DM production and Se concentrations were measured after the spring growing season in year one. Pastures were grazed by sheep over the fall growing season, but then protected from spring grazing to enable sampling of residual forage Se concentrations during year two. Differences among treatments within year were analyzed with a Kruskal-Wallis non-parametric test. Welch's t-tests were conducted for each two-way comparison between the four active treatments and the control. The significance level was adjusted using a Bonferroni correction. Fertilization with 0.6 kg/ha selenate provided the highest ($P<0.01$) average forage Se content in year one (8.44±0.08 mg/kg). Plots treated with 0.6 and 2.2 kg/ha selenite contained greater ($P<0.01$) forage Se content (1.17±0.05 and 4.24±0.35 mg/kg, respectively) than control (0.09±0.06 mg/kg), whereas the 1.1 kg/ha selenite treatment only tended ($P=0.06$) to increase forage Se content (3.11±0.79 mg/kg). The second year after treatment, forage Se concentrations for the 0.6 kg/ha selenate and 2.2 kg/ha selenite application (0.43±0.04 mg/kg and 0.51±0.06 mg/kg, respectively) were greater ($P=0.04$ and $P=0.01$, respectively) than control (0.06±0.03 mg/kg). Fertilization with Se had no effect ($P=0.37$) on forage yield during year one. These data suggest that selenite and selenate fertilization increases forage Se concentrations for up to two years, and is a cost-effective method of supplying Se for grazing livestock.

Key Words: Selenium, Fertilization, Forage

M101 Effect of organic and chemical nitrogen fertilization on mulberry (*Morus alba*) fodder production. J. A. Elizondo Salazar* and C. Boschini Figueroa, *Estación Experimental Alfredo Volio Mata. Facultad de Ciencias Agroalimentarias*, *Universidad de Costa Rica, Costa Rica.*

Feeding woody plants as a supplement in dairy and beef systems has been widely used in Costa Rica and many other areas of the world. However, high fodder yields and adequate crude protein levels require application of large doses of chemical N, increasing production costs and pollution risk. To reduce cost, producers are utilizing organic fertilizers from manure without knowing the impact on production. For this reason, a study was conducted to evaluate the application of 150 kg/ha per yr of N from 2 organic fertilizers: vermicompost and compost; and from 1 chemical fertilizer: ammonium nitrate (33.5% N) on fodder production. A 12-yr-old mulberry plantation planted at spacings 0.9 × 0.40 m (27,777 plants/ha) was utilized in a randomized block design with 4 treatments: 2 organic fertilizers, ammonium nitrate, and a control (no fertilizer). All plots were uniformly pruned at 0.6 m from the ground at the beginning of the trial. Fertilizers were applied in 2 doses during the rainy season. For a 365-d period, plants were pruned consecutively every 90 d. Leaves and stems were separated and analyzed for dry matter and crude protein content. Dry matter production was 23% higher for the chemical fertilizer. Crude protein content was also significantly higher for the chemical nitrogen, while dry matter content was lower. The amount of N in the soil was sufficiently high for the control treatment to yield fodder and crude protein levels similar to those of organic fertilizers.

Table 1.

Item	Treatment					
	Vermi-compost	Compost	Chemical	Control	SEM	*P*
Dry matter, kg/ha/yr						
Leaves	12,603.7[b]	12,943.3[b]	15,153.0[a]	12,601.3[b]	545.9	0.001
Stalk	8,807.3[b]	8,637.7[b]	11,413.3[a]	8,874.7[b]	601.4	0.001
Total	21,410.7[b]	21,581.3[b]	26,556.7[a]	21,476.3[b]	1,039.0	0.010
Dry matter, %						
Leaves	22.67[a]	22.58[a]	21.50[b]	22.67[a]	0.28	0.010
Stalk	23.33	23.08	22.17	23.50	0.50	NS
Total	22.83[a]	22.75[a]	21.67[b]	22.92[a]	0.29	0.001
Crude protein, %						
Leaves	15.67[b]	15.33[b]	17.25[a]	16.00[b]	0.33	0.001
Stalk	5.67	5.33	6.25	5.50	0.29	NS
Total	11.67[b]	11.50[b]	12.58[a]	11.67[b]	0.25	0.010

Key Words: Morus alba, Organic Fertilizer, Fodder Production

M102 The economics of liming coastal dairy pastures. T. W. Downing* and J. Hart, *Oregon State University*, *Corvallis*.

Soil acidity is a universal problem for crop production in high rainfall environments. Research has shown for many crops that low soil pH can significantly reduce plant productivity. Consequently, applying lime to increase soil pH is a common practice. Coastal Oregon pasture managers continue to question the economic returns and benefit from lime application even with low soil pH values. The objectives of this study were to: 1) measure soil pH change from different rates and method of lime application in coastal-pastures, 2) calculate the economic returns of lime application by measuring increases in pasture productivity and feed value. Twenty four plots measuring 1.5m x 6m were planted in the fall in perennial ryegrass. Lime treatment levels were at 2.4, 4.8 and 9.6 tons per hectare. Each treatment was replicated three times in both the incorporated and top dress blocks. Three control plots were also included in each lime treatment block. For two years, plots were harvested 6 times annually, yield data was recorded and samples of each treatment were collected and analyzed for protein, TDN, NDF, Ca, P and other trace minerals. Soil samples were taken from each treatment block and rate at the end of each growing season. Data were statistically analyzed to understand any differences in yield, treatment method, treatment rate, and any interactions. Lime increased soil pH and extractable Ca ($P<0.01$). No interaction between method and rate was measured. Method of application did not influence yield. Liming had no significant effect on forage quality parameters measured. Lime treatments increased soil pH from 5.1 up to 6 in the highest lime treatments ($P<0.01$). However, the total increase was only around 500 kg of forage per hectare per year. The increased forage production would take four years to cover the costs of lime. This project has improved our understanding of the economic returns of liming coastal pastures. Coastal soils that are high in organic matter and low in pH appear to respond differently to lime application than other acidic soils reported in the literature.

Key Words: Acidic Soils, Liming, Economics of Liming

M103 Nitrogen fertilization and weather influence winter yield and nutritive value of stockpiled bermudagrass. J. A. Guretzky*, J. B. Ball, B. J. Cook, S. L. Norton, and F. J. Motal, *The Samuel Roberts Noble Foundation, Inc.*, *Ardmore, OK*.

Management strategies that extend the grazing season and reduce hay demands may improve the profitability of cow-calf operations. Our objective was to evaluate the yield and nutritive value of fall stockpiled bermudagrass (*Cynodon dactylon* (L.) Pers.) in response to N fertilization rate, N application time, and winter harvest date. Research was conducted on a fine, sandy loam soil near Burneyville, OK from 2000 to 2003. Nitrogen rates included 0, 56, 112, and 168 kg ha^{-1} applied 15 Aug, 1 Sep, 15 Sep, 1 Oct, and 15 Oct. Dry matter yield was measured ten days after the first killing frost. Samples were collected every 15 days from 6 Dec through 20 Feb to evaluate CP and TDN. The experiment design was a split-plot with repeated measures over years and harvest dates. Nitrogen application dates served as whole plots and N rates as subplots. Forage yields were 123, 3735, 5541, and 4021 kg ha^{-1} in 2000, 2001, 2002, and 2003, respectively. In the latter three years, N affected yields in a quadratic manner. Yields averaged 3864, 4480, 4645, and 4738 kg ha^{-1} with 0, 56, 112, and 168 kg N ha^{-1}. Although interactions of year, N rate, application date, and harvest date occurred, nutritive value from 2001 to 2003 was largely affected by N rate. Of 17 winter harvest date-year combinations, CP increased in a linear or quadratic manner 16 times as N rate increased and exceeded 71 g kg^{-1} DM on most harvest dates with 112 kg N ha^{-1}. Total digestible nutrients increased from 565, 555, and 582 g kg^{-1} DM at 0 kg N ha^{-1} to 571, 563, and 585 g kg^{-1} DM at 168 kg N ha^{-1} in 2001, 2002, and 2003, respectively. Drought limited the accumulation of fall stockpiled bermudagrass and inflated nutritive values in 2000. As a consequence, N fertilization is not recommended during dry falls. In years of favorable fall precipitation, 112 kg N ha^{-1} will produce 4645 kg ha^{-1} of forage with CP and TDN concentrations that meet the nutrient requirements of beef cows during the middle third of pregnancy. Nitrogen application date and winter harvest date had minimal effects on yield and nutritive value.

Key Words: Forage Management, Beef Cow Nutrition, Forage Quality

M104 Macro and micro mineral concentrations of annual cool season pasture forages in north Florida–a four year summary. R. O. Myer*, G. Chelliah, J. N. Carter, L. R. McDowell, N. S. Wilkinson, and A. R. Blount, *University of Florida*, *Gainesville*.

Concentrations of selected macro (Ca, P, Na, K, Mg) and trace (Cu, Fe, Zn, Mn, Co, Se) minerals were determined from annual pasture forages over four winter-spring grazing seasons (2001-2005). Forage samples were taken from eight experimental pastures per year used in beef cattle grazing studies. Two, 2-yr experiments were done; animal and pasture data were reported previously. Each experiment was of a similar 2×2 design comparing clean tilled vs. sod-seeded pastures with two different forage combinations (Exp. 1, rye + oats vs. rye + oats + ryegrass (Lolium multiflorum L.); Exp. 2, oats + ryegrass vs. ryegrass only). Pastures were planted in Oct or Nov, and grazed (and sampled) starting Nov, Dec, Jan or Feb and ending Apr or May. Overall, forage type or pasture planting method had little effect on pasture forage mineral concentrations except for Zn ($P<0.01$). Year effected ($P<0.01$) forage P, K, Mg, Cu, Fe and Zn. Month during the grazing season had a large effect ($P<0.01$) on P, K, Fe, Mn and a smaller effect ($P<0.05$) on Mg, Cu, Zn and Co concentrations. Overall pasture forage mean

concentrations and S.D. for macro minerals (% of DM) were Ca, 0.31 ± 0.05; P, 0.38 ± 0.03; Na, 0.035 ± 0.005; K, 2.9 ± 0.2; and Mg, 0.21 ± 0.03; and for micro minerals (ppm of DM) were Cu, 5.7 ± 0.7; Fe, 78 ± 14; Zn, 40 ± 5; Mn, 110 ± 18; Co, 0.06 ± 0.04; Se, 0.05 ± 0.01. Results indicate that year and month within year can influence concentrations of various macro and micro minerals of annual cool season pastures in the southeastern USA. Of the minerals evaluated, Na, Cu, Co and Se would be deficient for beef cattle.

Key Words: Minerals, Forages, Pastures

M105 Nutritive value of low DCAD timothy forage produced with Cl fertilization. G. F. Tremblay*[1], S. Pelletier[1], G. Bélanger[1], P. Seguin[2], R. Drapeau[1], and G. Allard[3], [1]*Agriculture and Agri-Food Canada*, *Québec, QC, Canada*, [2]*McGill University*, *Ste-Anne-de-Bellevue, QC, Canada*, [3]*Université Laval*, *Québec, QC, Canada*.

To prevent hypocalcaemia, dairy producers feed dry cows a ration with a low dietary cation-anion difference [**DCAD**=(Na+K)-(Cl+S)]. Because anionic salts used to decrease the ration DCAD may reduce DM intake, low DCAD forages should be fed to dry cows. We have shown that Cl fertilization decreased the DCAD of timothy forage by as much as 266 meq/kg DM with no effect on DM yield. Here, we assessed the effect of Cl fertilization on the nutritive value of timothy forage at four locations in Québec, Canada, in 2003 and 2004. Ten fertilizer treatments were applied (0, 80, 160, and 240 kg Cl/ha as $CaCl_2$; 160 kg Cl/ha as NH_4Cl; all combined with 70 or 140 kg N/ha) in a split application: 60% in spring and 40% after the first harvest. A split-split-plot design was used with locations assigned to main plots, fertilizer treatments to sub-plots, and harvests to sub-sub-plots. Concentrations of crude proteins (**CP**) and neutral detergent fibers (**NDF**), in vitro true DM digestibility (**IVTDMD**), and NDF digestibility (**dNDF**) were measured in forage samples. Average values across harvests and locations were used because of no significant interactions with Cl fertilization. At the lowest N fertilization rate (70 kg N/ha), Cl fertilization had no effect on the four measured parameters of nutritive value. At the highest N rate (140 kg N/ha), increasing Cl fertilization did not affect CP concentration but it increased NDF concentration (+10 g/kg DM) and decreased IVTDMD (-10 g/kg) and dNDF (-12 g/kg NDF); this effect, however, was small and would most likely be of no biological importance. Decreasing DCAD with Cl fertilization would not significantly affect the timothy forage nutritive value.

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Key Words: Grass Forage, Milk Fever, Chloride Fertilizer

M106 Nutritive quality of a species-rich, extensively managed pasture exposed to elevated ozone in a free-air fumigation system. J. C. Lin*[1], K. Nadarajah[1], M. Volk[2], R. B. Muntifering[1], and J. Fuhrer[2], [1]*Auburn University*, *Auburn, AL*, [2]*Swiss Federal Research Station for Agroecology and Agriculture*, *Zurich, Switzerland*.

Effects of tropospheric ozone (O_3) on nutritive quality of O_3-sensitive species grown as monocultures or in simple mixed cultures are well established, but its effects on complex, species-rich plant communities are unknown. A 5-year field experiment was conducted near Le Mouret, Switzerland to investigate the effects of exposure to elevated O_3 on nutritive quality of an extensively managed, semi-natural pasture containing a diverse mixture of grasses, legumes and forbs. Using a free-air fumigation system, six circular plots (7-m diam.) were randomly exposed to either ambient air (control) or to air containing approximately 1.5 × ambient O_3 concentration (n = 3). Six subplots (0.5 m^2) in each ring were harvested each year in mid-June, early August and late October. Compared with controls, annual biomass yields from elevated-O_3 plots decreased by 23% over the 5-yr period. Except for year and seasonal differences, there was no effect of elevated O_3 on forage N concentration. However, there were differences ($P < 0.001$) between control and O_3-enriched plots in forage concentrations of NDF and ADF, but not lignin, and in relative feed value (RFV). Changes in proportions of grasses, legumes and forbs followed a similar pattern within treatments, but the magnitude of these changes was greater ($P < 0.05$) for the elevated-O_3 than control treatment. Between the first harvest (spring, 1999) and spring of 2003, forbs increased ($P < 0.05$) from 23.4 to 36.2%, grasses decreased ($P < 0.001$) from 67.6 to 60.5%, and legumes decreased ($P < 0.01$) from 8.9 to 3.3% of total plant DM within the O_3-enriched plots. Compared with control plots, forage from O_3-enriched plots had lower concentrations of NDF (46.9 vs. 49.9%) and ADF (27.2 vs. 28.2%), and higher RFV (136 vs. 126, by reference to a mature legume forage of RFV = 100). Unlike earlier reports of negative effects of elevated O_3 on nutritive quality resulting from altered leaf chemistry in individual plant species, this is the first report of altered nutritive quality associated with O_3-driven shifts in proportions of plant functional groups in a complex, species-rich pasture.

Key Words: Pasture, Nutritive Quality, Ozone

M107 Evaluation of forage quality, grazing capacity and intake of cool season grasses. C. I. Ward*[1] and H. A. Lardner[1,2], [1]*University of Saskatchewan*, *Saskatoon, Canada*, [2]*Western Beef Development Center*, *Humboldt, Saskatchewan, Canada*.

An experiment was conducted to evaluate the effects of cool season grass varieties on forage quality, animal grazing days (AGD), total beef production (TBP) per hectare and dry matter intake (DMI) of yearling cross-bred steers. Grass varieties were crested wheatgrass (CWG) (*Agropyron cristatum*) cv. 'AC Goliath', meadow bromegrass (MBG) (*Bromus riparius*) cv. 'Paddock', smooth bromegrass (SBG) (*B. inermis*) cv. 'Carlton', hybrid bromegrass (HBG) (*B. riparius* X *B. inermis*) cv. 'AC Knowles' and tall fescue (TF) (*Festuca arundinacea*) cv. 'Courtenay'. A long established CWG stand acted as a control pasture. Each variety was replicated (n=2) in paddocks measuring 0.8 ha. Forage samples clipped at start, end and mid-grazing period were analyzed for neutral detergent fiber (NDF), acid detergent fiber (ADF), crude protein (CP) and *in vitro* organic matter digestibility (IVOMD). In 2004 and 2005, all paddocks were grazed once (averaged 26 and 32 days of grazing, respectively) except in 2004 when the TF and CWG control paddocks were not grazed. In 2006, regrowth allowed for two grazing periods on all paddocks (averaged 35 and 16 days of grazing, respectively) except for the TF and CWG control paddocks, which were only grazed once. MBG and CWG control paddocks had the lowest CP content at the start of grazing ($P<0.05$). CWG paddocks had greater NDF and ADF content compared to TF and MBG ($P<0.05$). The CWG control paddocks had the lowest AGD in 2005 and 2006 while TF had the greatest AGD ($P<0.05$). Total beef production per hectare was similar among grass varieties ($P>0.05$). Results indicate

that new grass varieties have greater potential forage quality and animal production compared to long established CWG pastures. Dry matter intake was measured using the *n*-alkane technique in both grazing periods of 2006.

Key Words: Forage Quality, Beef Production, Intake

M108 Productivity and nutritive quality of dallisgrass (*Paspalum dilatatum*) as influenced by rate of fertilization with poultry litter or commercial fertilizer. E. J. Bungenstab*, J. C. Lin, J. L. Holliman, A. C. Pereira, and R. B. Muntifering, *Auburn University*, *Auburn, AL*.

Dallisgrass (*Paspalum dilatatum*) is well adapted to the clayey and loamy soils and warm, humid climate of the Black Belt physiographic region of the southeastern US, but poor soil fertility can be a major limitation to forage production in the region. In 2006, an existing pasture dominated by dallisgrass was clipped to a height of 10 cm on July 17 and subdivided into 48 cells of 9.3 m^2 each. Each cell received the equivalent of 34 (34N), 67 (67N), 101 (101N) or 134 (134N) kg N/ha from poultry litter (PL; 2.75% N, DM basis) or commercial fertilizer (CF; 35% N as NH_4NO_3), and forage regrowth from each was clipped on August 21 and then again on September 25 (n = 6 cells/treatment). Forage DM yield was not different between CF and PL treatments in the August harvest (836 and 763 kg DM/ha, respectively), but was greater ($P < 0.001$) for CF than PL treatments in the September harvest (436 vs. 346 kg DM/ha). Yields of CF-amended forage from both harvests were lower for the 101N rate than other rates of CF application, whereas yield of PL-amended forage was greater for the 134N rate in August but not different among rates of PL application in September (fertilizer source × rate interaction, $P < 0.05$). Forage concentration of CP was greater ($P < 0.001$) for CF than PL treatments in August (10.4 vs. 9.3%) and September (10.6 vs. 9.3%), and increased in both treatments at both harvests with increasing rates of N application. Forage concentrations of cell-wall constituents were not different between CF and PL treatments, but forage amended with CF at the 134N rate had lower concentrations of NDF ($P < 0.04$) and ADF ($P < 0.05$) in August than did forage amended with CF at the 34N rate (67.5 vs. 70.0% and 33.3 vs. 34.7%, respectively). Forage amended with PL at the 34N rate had higher ($P < 0.02$) concentration of ADF (34.3%) in September than did forage amended with PL at the 67N (32.9%) and 134N (33.0%) rates. Results indicate that poultry litter offers potential as a cost-effective alternative to commercial fertilizer for supporting productivity of dallisgrass on sub-fertile soils.

Key Words: Dallisgrass, Nutritive Quality, Poultry Litter

M109 Effect of clipping on the stolon elongation rate and stolon survival of cultivars *Chloris gayana* Kunth in conditions of salinity. M. V. Cornacchione*[1], H. E. Pérez[2], and A. F. Fumagalli[1,3], [1]*Instituto Nacional de Tecnología Agropecuaria*, *Santiago del Estero, Argentina*, [2]*Instituto Nacional de Tecnología Agropecuaria*, *Leales, Tucumán, Argentina*, [3]*Universidad Nacional de Santiago del Estero*, *Santiago del Estero, Argentina*.

The objective of this trial was to evaluate the effect of clipping on stolon elongation rate (SER) and stolon survival of four cultivars of *Chloris gayana* Kunth, in a moderate saline soil (from 0 to 60 cm depth, the avg. ECe=9.6 dS/m and avg. pH=7.95). Three tetraploid (Callide, Boma and experimental line; EL, INTA-PEMAN) and one diploid cultivar (Topcut) were planted in February of 2005. The initial stolon density (n°/m^2) was evaluated in a completely randomized block design with four replicates. The elongation stolon (L=cm) and stolon survival were measured on 40 stolons identified for cultivar when 20 stolon were clipped every seven weeks to approximately 12 cm of this base including to the first knot. The stolon elongation rate was calculated as SER= L-12/days among cuts. Stolon survival was calculated for each cultivar as follow: %S=(n° of live stolons/20)×100. Initial stolon density was significantly greater in EL ($P<0.01$; 57±12 stolons/m^2), intermediate in Boma and Callide (46±12 and 45±9 stolons/m^2), and lowest in Topcut (24±9 stolons/m^2). EL tended to have greater SER with regards to Topcut ($P=0.06$; 0.50±0.26 vs. 0.15±0.10 cm/d for EL and Topcut respectively). The SER of Callide and Boma were intermediate and did not differ with the previous ones. The % of S in Callide and Topcut was affected negatively by clipping treatment ($P<0.05$; clipping: 27.5% and non-clipping: 67.5%). All cultivars under clipping had low %S (avg. 30%). However clipping affected Callide and Topcut ($P<0.05$) than LE and Boma. In conclusion, in conditions of intermediate salinity, the tetraploid cultivars showed better performance due to: greater initial density of stolon and capacity of growth under clipping (principally EL) with respect to Topcut. The survival stolons in Topcut and Callide was better when they were not cut.

Key Words: *Chloris gayana*, Saline Soil, Stolon Elongation

M110 The effect of wide swathing on wilting times and nutritive value of alfalfa haylage. L. Kung, Jr., E. C. Stough*, E. E. McDonell, R. J. Schmidt, M. W. Hofherr, L. J. Reich, and C. M. Klingerman, *University of Delaware*, *Newark*.

At three separate cuttings, alfalfa (*Medicago sativa*) from a single field was mowed with a John Deere 946 mower-conditioner (4 m cut width) to leave narrow swaths (NS) with widths between 1.2 to 1.52 m (4-5 ft) and wide swaths (WS) ranging 2.44 to 2.74 m (8-9 ft). Samples were collected from windrows and DM was monitored during wilting until a target of 43-45% DM was obtained. Forage from random windrows (n = 4 to 6 depending on cutting) was then chopped and ensiled in replicated vacuum sealed bags for about 65 d. Data were analyzed for the main effects of swath width (NS vs. WS), cutting (1 to 3) and swath width × cutting interaction. There was no swath width × cutting interaction for any parameter tested. Over all cuttings, the resulting silage DM was not different between NS (43.8%) and WS (44.9%). However, wide swathing greatly reduced the time of wilting before making silage. The hours of wilting time for NS and WS at cuttings 1, 2 and 3 were 50 vs. 29, 54 vs. 28, and 25 vs. 6, respectively. On average, wide swathed alfalfa was chopped 22 h earlier than narrow swathed alfalfa. At the time of ensiling, WS had more water soluble carbohydrates (5.1%, $P < 0.05$) than did NS (3.7%). Silages made from WS had a lower pH (4.58, $P < 0.05$) than did NS (4.66) but swath width did not affect fermentation end products (lactic acid, acetic acid and ethanol). Silage made from NS had more NH3-N (0.26%, $P < 0.05$) than WS (0.21%). Swath width did not affect the concentration of ash, NDF or the digestibility of NDF but it lowered the N content of the resulting silage (NS = 3.45%, WS = 3.23%, $P < 0.05$). For the main effect of cutting, the concentrations of N and water soluble carbohydrates decreased and the digestibility of NDF decreased, whereas the concentration of NDF increased with progressive cuttings.

Wide swathing can markedly reduce the time that alfalfa must wilt before it can be chopped for silage but under good conditions, the resulting silage quality was generally not improved.

Key Words: Alfalfa, Swath Width, Wilting

M111 Effects of harvest timing on estimates of rumen degradable protein from alfalfa forages. W. K. Coblentz*[1], G. E. Brink[2], N. P. Martin[2], and D. J. Undersander[3], [1]*US Dairy Forage Research Center*, *Marshfield, WI*, [2]*US Dairy Forage Research Center*, *Madison, WI*, [3]*University of Wisconsin*, *Madison*.

Alfalfa (*Medicago sativa* L.) proteins ingested by dairy cows typically degrade at rapid rates, resulting in low percentages of dietary crude protein (CP) that escape the rumen intact. Our objectives were to determine rumen degradable protein (RDP) for alfalfa managed in a four-harvest system that was clipped on five dates within each harvest. During 2004 and 2005, ″Affinity″ alfalfa was harvested four times (spring, early and late summer, and fall) at Prairie du Sac, WI; within each harvest, plots were clipped initially (d 0) when plants were at least 30 cm tall, but did not exhibit any evidence of buds. Additional sampling dates were scheduled at 5-d intervals for the next 20 d, resulting in a total of five clipping dates (0, 5, 10, 15, and 20 d) within each individual harvest. Forages were evaluated for CP, neutral-detergent soluble CP (NDSCP), and neutral-detergent insoluble CP (NDICP); in addition, RDP and rumen undegradable protein (RUP) were determined by the *Streptomyces griseus* protease method. For 2004, there were no interactions ($P \geq 0.372$) between harvest number and clipping date for any protein component. Crude protein, NDSCP, and RDP declined in a quadratic ($P \leq 0.026$) relationship with clipping dates. A quadratic ($P = 0.002$) pattern also was observed for RUP, but the overall range was small (6.04 to 6.65% of DM); similarly, NDICP exhibited only a quadratic trend ($P = 0.077$) and a small overall range (2.63 to 2.90% of DM). On a percentage of CP basis, RDP declined linearly ($P < 0.001$) from 72.0 to 65.9% of CP during 2004. For 2005, there were interactions ($P \leq 0.020$) of harvest number and clipping date within harvest for all response variables. Although less consistent than in 2004, trends for individual CP pools generally were similar over clipping dates within harvest. Concentrations of RDP (% of CP) declined ($P \leq 0.042$) with clipping date during three of four harvests, but specific polynomial effects varied with harvest number. Overall, RDP (% of CP) declined as alfalfa plants aged, but these responses were due primarily to reduced concentrations of CP within the highly degradable cell-soluble fraction.

Key Words: Alfalfa, Rumen Degradable Protein, Plant Age

M112 Effects of planting density, cultivar and growing day on the dry matter yield and forage quality of Kenaf (*Hibiscus Cannabinus* L.) in the northern area of South Korea. B. W. Kim* and K. I. Sung, *Kangwon National University*, *Chuncheon, Kangwon-Do, South Korea*.

This study was conducted to evaluate the dry matter (DM) yield and forage quality of Kenaf in relation to planting density (10×10 and 10×20 cm^2) and growing days (Day 53, Day 62, Day 73, Day 84, Day 93, Day 104 and Day 115) in the northern area of South Korea from May 20 to September 12, 2005. The experiment was laid out in a split plot design with three replications. The main plots consisted of planting density and growing days with three cultivars of Kenaf as sub-plots; Dowling, Everglade and Tainung. The DM yield increased with maturity in all three cultivars, especially Dowling showed the highest DM yield at each harvest time. The crude protein (CP) contents of all three cultivars decreased with maturity. Especially, the decrease in the CP contents was greater in the early stage than in the late stage. The planting density did not affect the CP contents, even though they are little higher in 10×20 cm^2 compared to 10×10 cm^2. Among cultivars, the higher CP contents were observed in Dowling at each growing day. No difference in the neutral detergent fiber and acid detergent fiber contents was observed in the planting density and cultivars, although the increasing tendency was found with maturity. These results suggest that Kenaf can be a good potential forage crop in the northern area of South Korea, especially Dowling which had the greatest DM yield (29.5 ton/ha) and best forage quality (67.1% NDF and 55.8 % ADF) when harvested on Day 104 at 10×20 cm^2 planting density.

Key Words: Kenaf, Planting Density, Forage Quality

M113 The effect of cutting height on yield and quality of alfalfa/reed canarygrass in northern New York. E. D. Thomas, C. S. Ballard*, K. W. Cotanch, H. M. Wolford, and S. A. Flis, *W.H. Miner Agricultural Research Institute*, *Chazy, NY*.

Reducing cutting height when harvesting alfalfa has been shown to increase yield, however forage quality may be compromised by inclusion of more lignified stem material and soil contamination. The objective of this study was to evalulate forage quality and yield of alfalfa/reed canarygrass harvested at 5 and 10 cm. A 2nd year alfalfa/reed canarygrass stand was divided into four plots. Three 61×91 cm areas within each plot were selected randomly for hand–harvest (**HH**) at 5 cm. The HH forage was composited within plot and separated by species to determine sward composition. To simulate 10 cm cutting height, 5 cm was cut from stem of all plants after separation. Each species and removed stem were weighed, dried and ground for analysis. Forage yield and quality were calculated based on sward composition, analysis of species and removed stem for each cutting. From the same field plots, strips within plot were randomly assigned to a theoretical cutting height of 5 and 10 cm and mechanically harvested (**MH**). Actual cutting height was determined by measuring stubble at 15 random locations within each strip. Yield was estimated and chopped forages were dried and ground for analysis. All samples were analyzed for NDF, ADF, lignin, ash, in vitro 24–h DM and NDF digestibility. Procedures were followed for three consecutive cuttings and data were analyzed as a randomized block. The percent alfalfa in the sward was higher in the 2nd and 3rd (74 and 70%) compared to the 1st cutting (42%). Dry matter yield was higher for HH alfalfa/grass at 5 versus 10 cm ($P<0.01$). The 10 cm HH alfalfa/grass was higher in CP and DMd and lower in NDF, ADF and lignin (%DM) compared to the 5 cm ($P<0.05$). Average actual cutting height for MH forage was 8 and 11 cm for 5 versus 10 cm ($P<0.001$). The MH alfalfa/grass had similar numerical differences as the HH for all parameters except ash which tended to be lower in forages MH at 10 versus 5 cm (8.6 and 8.3 %DM, respectively; $P=0.06$), indicating an increase in foreign material obtained during MH. Overall, increases in forage quality were offset by lower yields when alfalfa/grass was harvested at 10 versus 5 cm.

Key Words: Alfalfa, Cutting Height, Forage Quality

M114 Lineweaver-Burk data transformation to evaluate interaction between nutrients in fertilization of tropical forages. H. J. Fernandes[1,4], R. P. Lana[2], C. E. S. Baroni[2], L. M. Paiva[1,4], and J. C Souza*[3,5], [1]*University of Mato Grosso do Sul*, *Brazil*, [2]*Federal University of Vicosa*, *Brazil*, [3]*Parana Federal Univeristy*, *Palotina, PR Brazil*, [4]*Scholarship of FUNDECT*, *Campo Grande, MS, Brazil*, [5]*University of Missouri*, *Columbia*.

This study evaluated the use of a Lineweaver-Burk data transformation to evaluate the effect of potassium (K) fertilization and the productive response to nitrogen (N) fertilization. Forty observations of the Panicum, Cyndom and Penisetum genera in Brazil were obtained from three published studies. A Lineweaver-Burk transformation was used to predict the maximum dry forage mass production (RESPmax) and the amount of nutrient needed to reach half maximum response (NUTR50). The model adequacy was evaluated by the coefficient of determination (R2) and the simultaneous test of the intercept and slope. In all equations, this test accepted the null hypothesis (P>0.10), and the R2 were greater than 0.80. When another limiting nutrient is supplied at same time as the N, the capacity of the forage to convert N in dry matter is increased (and RESPmax too). The differences between the forages may cause differences in NUTR50 responses. When the NUTR50 did not change, the marginal efficiency (kg increase in DM production / Kg of N) increased at all rates of N fertilization. A decrease in the NUTR50 indicates an increase in the efficiency of use of N at small rates of fertilization. When the rates of K fertilization increase an increase in NUTR50 resulted for Cynodom and a decrease in NUTR50 (until 234 kg/ha) result for the Panicum, with an increase in NUTR50 at higher levels. The NUTR50 was not altered in the Pennisetum. It's possible to use the Lineweaver-Burk transformation to evaluate the interaction between the K fertilization and the response of the tropical forages to the N fertilization. The metabolic differences between genera cause different responses at the interaction between nutrients.

Key Words: Mathematical Models, Nutrient Interaction, Tropical Forages

M115 Lineweaver-Burk data transformation to evaluate the production of tropical forages. H. J. Fernandes[1,5], R. P. Lana[2], C. E. S. Baroni[2], L. M. Paiva[1,5], and J. C. Souza*[3,4], [1]*State University of Mato Grosso do Sul*, *Brazil*, [2]*Federal University of Vicosa*, *Brazil*, [3]*Parana Federal University*, *Brazil*, [4]*University of Missouri*, *Columbia*, [5]*FUNDECT*, *Campo Grande, MS, Brazil*.

This study evaluated the use of the Lineweaver-Burk transformation to estimate the kinetic parameters of growth and the responses of forages to nitrogen (N) fertilization. Data included 43 observations of the principal genera of forages used in Brazil (Brachiaria, Panicum, Cyndom and Penisetum) obtained from published studies considered a random study effect. Linear regressions of the reciprocal of the each 'genus' plant responses (Y) as a function of the reciprocal of N fertilization (X) were developed as the model: $1/Y = a + b\ (1/X)$. The maxima of dry forage mass production were obtained by the reciprocal of the intercept (RESPmax=1/a) and the amount of nutrients needed to reach half maximum response (NUTR50), by dividing the coefficient of the linear regression by the intercept (b/a). The R2 of model of the equations to the genera Brachiaria, Panicum, Cyndom e Penisetum were 0.756, 0.865, 0.994 and 0.703, respectively. Marginal responses of the forages decreased as the N rates increased. This behavior can be explained by saturation of the enzymatic systems. The Penisetum genus had a linear response until the maximum rate of N each (400 Kg N/ha/year). In this case, the maximum rate of fertilization was less than that necessary to reach RESPmax. The kinetics parameters estimated for Brachiaria, Panicum,Cyndom and Penisetum were 8.04, 118.3, 25.3 and 80.8 ton DM/ha/year (RESPmax); and 30.5, 380.8, 105.6 and 176.8 kg N/ha/year (NUTR50). The lower the NUTR50, they greater is slopes of response and the greater the responses to small rates of N. The Lineweaver-Burk transformation efficiently explained the kinetics parameters of growing plant. The Brachiaria genus had the greatest response to small rates of N fertilization and the Penisetum had the capacity to respond at high rates.

Key Words: Mathematical Models, Forage, Fertilization

M116 Effect of planting date on starch accumulation of whole crop barley. L. E. McKeown*[1], M. A. Bal[1], M. Oba[1], and V. S. Baron[2], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lacombe, AB, Canada*.

The objective of this study was to evaluate effect of planting date on rate of starch accumulation and free sugar concentration of whole-plant barley (*Hordeum vulgare*). Two barley varieties (AC Lacombe and Vivar) were planted on either May 5, 2005 (BM) or June 7, 2005 (BJ). Samples of whole plants (n=6) were collected twice weekly after the plant reached the heading stage, until the harvest at late dough stage. Samples were collected on July 5, 8, 12, 15, 19, and 22 for BM and July 26, 29, August 2, 5, 9, 12, 16, 19, and 23 for BJ. The BM took 62 days to reach the heading stage, which was longer than BJ that only took 50 days. However, the period from heading to harvest was shorter for BM (18 d) compared to BJ (29 d). For both BM and BJ, starch concentration increased over time and sugar concentration decreased over time. The final starch concentration of BM at late dough stage was 29.5 and 27.9% for AC Lacombe and Vivar, respectively, and that of BJ was 25.4 and 22.9% for AC Lacombe and Vivar, respectively. Free glucose concentration for BM and BJ were 1.3 and 1.6%, respectively for AC Lacombe, and 1.8 and 1.0% for Vivar. Greater final starch concentration for BM, compared to BJ, might be attributed to lower average temperature throughout the growing period of BM, when compared to the relatively higher average temperature throughout the growing period of BJ. It was also noted that rate of starch accumulation of whole crop barley is decreased regardless of planting date when the daily mean temperature deviated greatly from 15°C. These observations indicate that the ambient temperature during the growing season can affect starch concentration of whole crop barley. Planting dates of barley can alter its growing environment, and affect rate of starch accumulation and its final concentration. Altering planting date may allow for increased management options to harvest whole-crop barley with greater starch concentration, decreasing the amount of supplemental grains fed in dairy diets.

Key Words: Planting Date, Starch, Whole Crop Barley

M117 Seed quality effects on yield, stover nutritional value, and maize grain. C. Perez-Mendoza[1], M. R. Tovar-Gomez*[2], G. Garcia-Santos[1], A. Hernandez-Livera[1], and A. Carballo-Carballo[1], [1]*Colegio de Postgraduados*, *Texcoco, State Mexico, Mexico*, [2]*INIFAP-CEVAMEX*, *Texcoco, State Mexico, Mexico*.

The objective of this study was to evaluate the effect of seed quality on yield, nutritional value of stover and maize (Zea mays L.) grain.

The research was done in 2002 in the Texcoco and Zumpango, State of Mexico and consisted of three phases: 1) seed physical quality and its characterization by form, size and weight was evaluated (flat, large, and medium), 2) seed physiological quality was determined in a microtunnel and 3) yield and nutritional value of maize harvested at physiological maturity were evaluated. Experiments were established using a randomized block design with four replications and a factorial array of treatments. Nine varieties of maize with forage potential were used to study: weight per thousand seeds (W1000S); seed length (LS), width (WS) and thickness (TS); velocity of emergence (VE); dry weight aerial part (DWAP); stover yields (SY) and grain (GY); stover protein (CPS) and grain starch (ST). Significant differences ($P<0.001$) were observed among varieties for all the evaluated parameters; location had a significant effect on SY, GY and ST. Seed size affected W1000, LS, WS, and CPS. Landrace Campen, VS-2000, and VS-22 had the best physical qualities with W1000S and LS of 427.9, 338.6 and 221.4 g; 1.7, 1.4 and 1.3 cm, respectively. With respect to the physiological quality, Landrace Campen had the highest values for VE and DWAP (4.1 and 11.3 g, respectively). Yields of SY for the varieties oscillated between 10.6 and 15 t ha-1 MS and for grain between 4.3 and 10.6 t ha-1. Landrace Campen (7.1%) and VS-22 (6.3%) contained more CPS while VS-2000, H-157, H-358 and Campen had higher concentrations of starch (76.1, 74.8, 74.2, 73.8%, respectively). It was concluded maize seed quality is more affected by the variety than by the seed size. Varieties Campen, HS-2, Promesa and VS-22 showed the best physical and physiological quality. Variety was the most important factor afffecting SY with Campen, VS-22 and VS-2000 having the higher SY. Promesa, H-157 and HS-2 had the higher GY.

Key Words: Maize Stover, Varieties, Seed Size

M118 Evaluation of experimental and commercial maize hybrids for silage in the Highland Valleys Region. M. R. Tovar-Gomez*[1], J. L. Arellano-Vazquez[1], C. Perez-Mendoza[1], A. Peña-Ramos[2], and G. Nuñez-Hernandez[3], [1]*INIFAP-CEVAMEX*, *Texcoco, State Mexico, Mexico*, [2]*INIFAP-CAEPAB*, *Pabellon, Aguascalientes, Mexico*, [3]*INIFAP-CAELALA*, *Toreon, Coahuila, Mexico*.

A study was conducted to determine the productivity and nutritional value of maize cultivars for silage. Twenty experimental and commercial maize (Zea mays L.) hybrids adapted to different areas were evaluated in the Highland Valleys Region. The experiment was done during irrigation cycle PV-2004 in the Texcoco of the State of Mexico. The experiment used a randomized complete block design with three replications. The measured variables were: days to silk (DS), plant height (PH), lodging (LG), common corn rust (Puccinia sorghi Schw.,CCR), green matter yield (GMY) and dry matter yield (DMY), crude protein (CP) and in vitro DM digestibility (IVDMD). Significant varietal differences were observed for variables. Days to silk varied fro, 84 to 109 days and PH ranged from 190 to 283 cm. Cultivars with subtropical and tropical germplasm had higher occurrences of CCR. Fresh forage yeild (GMY) varied from 37.1 to 80 t/ha and DMY ranged from 12.8 to 24.8 t/ha. Across varieties, CP varied from 7.9 to 9.6% and IVDMD ranged from 68.2 to 76.2%. Multivariate analysis indicated that PH, CCR, GMY, IVDMD were most important in this study. The hybrids with subtropical × tropical germplasm were more susceptoble to rust and had lower yield potential. The hybrids with Highland Valleys × Tropical germplasm excelled in this study. Of this group, hybrids H-157E, H-161E, H-159E and H-165E were better.

Key Words: Maize Forage, Yield, Nutritive Value

M119 Green-chop maize forage production in temperate Mexico. H. Crespo-Lira[1], R. D. Améndola-Massiotti*[1], and J. A. Burgueño-Ferreira[2], [1]*Universidad Autónoma Chapingo*, *Chapingo, México, México*, [2]*CIMMYT*, *El Batán, México*.

Green chop maize is used during summer and autumn in dairy farms of temperate Mexico; however, there is little information on maize forage production under this utilization strategy which could imply the use of high levels of N (nitrogen) fertilization and sowing densities. The aim of this experiment was to evaluate forage yield of green chop maize under two levels of N fertilization, during summer and autumn. The study was carried out at Chapingo, Mexico (central area of the country), using an intermediate to late local hybrid (San Jose). The levels of fertilization were 150 (N1) and 200 (N2) kg of N/ha. The sowing density was 178571 seeds/ha. Experimental plots of 66 m^2 were used, in a randomized block design with two treatments (N1 and N2) and six replicates. At 50 (D1), 86 (D2), 122 (D3) and 158 (D4) days after sowing, per plot six systematically chosen samples of one m maize row each were harvested at 20 cm height above ground level. Analysis was performed using a mixed model, considering fixed effects of fertilization, sampling date and their interaction, and random effects of blocks and their interaction with treatment. Means were compared using Tukey's test. Plant density was not affected ($p>0.05$) by fertilization but was higher ($p<0.05$) in D1 (142188 plants/ha) than in the other dates (on average 125521 plants/ha), meaning that with such high plant densities about 12% of the plants were lost in early stages due to intra-specific competition. Forage yield was not affected ($p>0.05$) by fertilization, and increased ($p<0.05$) until D3 (3126, 16110, 23854 and 23480 kg of DM/ha for D1, D2, D3 and D4, respectively), meaning that with the lower level of N fertilization, an average forage accumulation of about 200 kg of DM/ha/d could be achieved in about 120 days. This result shows that green chop maize could be an alternative for dairy farmers at the end of the summer and beginning of autumn, since that level of production can not be achieved with other forage species in temperate Mexico.

Key Words: Plant Density, Nitrogen Fertilization, Days After Sowing