

interactions. Increasingly, those who specialize in archival information enhance their holdings with images. For example, the liberal use of images in the holdings within the Animal Welfare Information Center (AWIC, <http://awic.nal.usda.gov/>) at the National Agricultural Library (NAL) significantly enhances information transfer. As another kind of example, NAL now facilitates use of many of their holdings such as those in AWIC through the National Digital Library for Agriculture which provides easy access to up-to-date authoritative agricultural

information, data, and services for consumers, policymakers, researchers and other agricultural specialists, farmers and other agribusinesses, libraries, educational institutions, and the general public. Images have proven to be especially useful to preserve historical information, such as the Poultry historical images now being assembled. The “Breeds of Livestock” and “Breeds of Poultry” web sites (<http://ansi.okstate.edu/breeds/>) also are examples of how images efficiently enhance cognition.

Key Words: Vision, Images, Learning

Graduate Student Competition ADSA Northeastern Branch - ASAS Northeastern Section

180 The effect of microbial inoculants on the fermentation and aerobic stability of orchard grass silage. C. M. Klingerman*, R. J. Schmidt, W. Hu, E. E. McDonnell, and L. Kung, Jr., *University of Delaware, Newark.*

Microbial inoculants were tested for their effects on the fermentation and aerobic stability of silage. Wilted orchard grass (about 38% DM) was chopped and treated with A) nothing, B) a “grow up” culture (*Lactobacillus lactis* and *L. plantarum* AberF-1 with the ability to ferment fructose), C) a low dose of a dry formulation of B, D) a high dose of a dry formulation of B, E) Sil-All 4 × 4 inoculant (*L. plantarum*, *Pediococcus acidilactici*, *Enterococcus faecium* and *Bacillus pumilis* and amylase enzymes), F) Pioneer 1127 inoculant (*L. plantarum* and *E. faecium*), G) Biomax Multipurpose inoculant (*L. plantarum* and *P. pentosaceus* and H) *L. buchneri* and *P. pentosaceus*. The sources of products were: B, C and D (ABS Global, DeForest, WI), E (Alltech, Nicholasville, KY), F (Pioneer, Johnston, IW), G (Chr. Hansens Biosystems, Milwaukee, WI) and H (Lallemand, Milwaukee, WI). Silages were packed in vacuum/heat-sealed pouches. Data were analyzed separately for each time point using the PROC GLM procedure of SAS for a completely randomized design. After 90 d of ensiling, the concentrations of lactic (ave. 6.04%) and acetic (ave. 0.43%) acids were higher and lower, respectively, in silages B through G when compared to that of A (4.71% and 1.93%) ($P < 0.05$). Silages B through D had less NH₃-N (ave. 0.07%) than A and H (0.14%) ($P < 0.05$). Silage H had the least lactic acetic (1.53%) but most acetic acid (6.58%) compared to all other silages ($P < 0.05$). Silages B through G had more yeasts ($> 5.5 \log \text{ cfu/g}$) than did A (2.76 $\log \text{ cfu/g}$) and H (0.85 $\log \text{ cfu/g}$). Aerobic stability was worse for silages B through G (ave. 42 h) but better for H (400 h) compared to A (178 h) ($P < 0.05$). Dry matter recovery was lowest for H ($P < 0.05$) and similar among other silages. Homolactic acid-based silage inoculants can improve silage fermentation but can make aerobic stability worse. An inoculant containing *L. buchneri* had the best aerobic stability but lowest DM recovery of all treatments. A “grow up” inoculant with the ability to ferment fructose improved the early rate of fermentation but final silage quality was generally similar to that from other treatments after storage.

Key Words: Silage, Forage

181 Effects of feeding alfalfa silage at two levels with and without Rumensin to high producing Holstein cows on animal performance. C. M. Martinez*, Y. H. Chung, T. W. Cassidy, V. Ishler, K. S. Heyler, and G. A. Varga, *The Pennsylvania State University, University Park.*

Eight multiparous high producing Holstein cows (BW=699 kg \pm 13; DIM=158 d \pm 4.5) were used in a replicated 4x4 Latin Square design with a 2x2 factorial treatment arrangement to evaluate the effects of feeding two levels of forage inclusion with and without Rumensin on dry matter intake, milk production, milk composition and blood metabolites. The diet was formulated to contain 50 or 60% forage (DM basis) in which alfalfa haylage comprised 55% and corn silage comprised 45% of the total forage in the diet. Rumensin was top dressed at a rate of 300 mg/cow/d. The length of each period was 4 wks and samples were collected during the last wk. Dry matter intake was higher ($P < 0.01$) for cows consuming the 50% forage diet than for cows consuming the 60% forage diet (29.6 vs. 27.3 kg/d, respectively). Milk yield and fat corrected milk (46.4 and 46.6 kg/day, respectively) were not affected by forage level or Rumensin in the diet. Milk fat % increased with forage level (3.39 and 3.51% for 50 and 60% forage, respectively, $P < 0.05$). However, a significant forage level by Rumensin interaction was observed showing that Rumensin decreased milk fat % for the 60% forage diet with no effect on milk fat % for the 50% forage diet. Cows consuming the 50% forage diets had higher ($P < 0.05$) milk protein % (3.12) than cows consuming the 60% forage diets (3.07). Milk protein % was lower for Rumensin-fed cows (3.07) compared to no Rumensin (3.12). Neither fat nor protein yields were affected by forage level or Rumensin. Cows consuming the 60% forage diets had a higher ($P < 0.05$) feed efficiency (1.71) when compared to the 50% forage diets (1.56). Blood glucose was higher for cows receiving 50% forage than cows receiving 60% forage (69 vs. 65 mg/dL, respectively). Results from this study suggest that higher forage levels can be achieved in dairy cow rations without affecting milk production while improving feed efficiency compared to lower forage inclusion. When feeding alfalfa silage based rations supplemented with Rumensin, milk components may be altered dependent upon forage level in the diet.

Key Words: Rumensin, Alfalfa, Forage level

182 Trans-7-octadecenoic acid decreased milk fat and altered CLA composition in milk of lactating mice. A. K. G. Kadegowda*¹, B. B. Teter¹, J. Sampugna¹, P. Delmonte², L. S. Piperova¹, and R. A. Erdman¹, ¹University of Maryland, College Park, ²Food and Drug Administration, College Park, MD.

Principal component analysis of data from studies with MFD in cows has indicated that trans-7-18:1 (t-7) could be associated with regulation of milk fat synthesis. We used a lactating mouse model to compare the effects of t-7-, t-9-, t-11-18:1, t10c12 CLA (Sigma Chemicals, Co.,

St. Louis, MO), and PHVO (partially hydrogenated vegetable oil) on milk fat content and fatty acid composition. Thirty lactating C57Bl6J mice were fed a Control diet until day 6 postpartum, and were randomly assigned (n=5) to 6 treatments until day 10 postpartum. The trans-18:1 isomers or PHVO were added as 5% and t10c12 CLA was added as 1% of the calories, replacing equal parts of the oleic acid in the Control diet. Milk samples were collected on days 6 and 10 postpartum. Milk fat did not differ among groups at day 6. On day 10, milk fat percentage was 36.4, 28.1, 20.4, 26.7, 36.6 and 32.1 in mice fed Control, PHVO, t10c12 CLA, t-7-, t-9-, and t-11-18:1, respectively. Milk fat percentage was decreased by t10c12 CLA (44%; $P < 0.001$), t-7-18:1 (27%; $P < 0.001$) and PHVO (23%; $P < 0.001$). Compared to the Control (0.25g/100g), CLA were increased in milk of mice fed t10c12 CLA (1.87g/100g; $P < 0.001$) and in those fed t-11-18:1 (1.12g/100g; $P < 0.001$) due to the endogenous synthesis of c9t11. However, the greatest increase in CLA was found in mice fed t-7-18:1 (2.24g/100g; $P < 0.001$), where t7c9 was the predominant isomer representing 87 % of total CLA. PHVO treatment also increased milk CLA content (0.76g/100g; $P < 0.001$) by providing t-11-, and t-7-18:1 precursors for endogenous synthesis of CLA. The t7c9 CLA (10% of total CLA) observed in milk of mice fed diet supplemented with PHVO, confirmed the presence of t-7-18:1 in the oil. The data showed unequivocally that t-7-18:1 was converted to t7c9 CLA in mice. These results suggested that the t-7-18:1 and/or its $\Delta 9$ desaturation product may be involved in regulation of milk fat synthesis.

Key Words: Trans fatty acids, CLA, Milk fat

183 An evaluation of two methods to cover bunker silos to maintain the nutritive value of silage. E. E. McDonnell*, C. M. Klingerman, R. J. Schmidt, W. Hu, and L. Kung, Jr., *University of Delaware, Newark.*

The objective of this experiment was to test the effect of different methods for covering corn silage in bunker silos. Three bunker silos (44 × 7 m) were filled with chopped whole-plant corn (30% DM). Immediately after filling, one half of each silo was covered with one of two methods. The first method (A) was comprised of a 6 mil black/white polyethylene (Up North Plastics Bunker Covers, Cottage Grove, MN), weighted down with split-tires. The second method (B) was comprised of a single layer of triple co-extruded film (1.77 mil) with low permeability to O₂ (Silostop, Mongralese, Italy), a protective tarpaulin, and weighted down with reusable bags filled with pea-gravel (99 × 15 cm). Method B also included a layer of the extruded film, which was placed along the length of the sidewall prior to filling. Corn silage was sampled at 5, 7 and 10 months of ensiling. Silage was sampled at three depths extending in 15.24 cm increments downward, and three widths extending in 20.32 cm increments outward from the wall. Repeated-measures mixed model was used to test the main effects of covering system, time, width, and height, along with all interaction effects. The interaction of width × treatment is shown below. Corn silage covered with method B had higher DM, NDF, pH, and butyric acid for each width away from the silo wall ($P < 0.05$) than corn silage covered with method A. This corn silage also had numerically less lactic acid compared to corn silage covered with method A. Corn silage covered by method B maintained a higher quality than corn silage covered by method A.

Table 1.

Item	Width1* A**	Width1 B***	Width2 A	Width2 B	Width3 A	Width3 B
DM,%	19.77 ^c	29.01 ^{abc}	23.52 ^d	29.13 ^{ab}	27.80 ^{bc}	30.33 ^a
NDF,%	62.29 ^a	46.07 ^{cde}	54.86 ^b	46.44 ^{cd}	47.87 ^c	43.00 ^e
pH	5.20 ^a	3.96 ^{bc}	4.22 ^b	3.76 ^c	4.04 ^{bc}	3.74 ^c
Lactic Acid,%	0.39 ^e	1.67 ^{cd}	1.09 ^d	2.21 ^{abc}	2.44 ^{ab}	2.76 ^a
Butyric Acid,%	0.22 ^b	0.07 ^d	0.39 ^a	0.02 ^d	0.21 ^{bc}	0.08 ^d

*Width 1 is closest to the silo wall. **A= low O₂ plastic, tarp, and gravel bags. ***B=plastic and tires. ^{abcde}Means in rows with unlike superscripts differ ($P < 0.05$)

Key Words: Bunker silo, Silage

184 Effect of level of fermentable NDF on feed intake and production of lactating ewes. M. A. Schotthofer*, M. L. Thonney, and D. E. Hogue, *Cornell University, Ithaca, NY.*

The objective of this experiment was to quantify the effect of level of fermentable NDF (FNDF) on DMI and production of highly productive, lactating ewes. Within one wk of parturition, 21 ewes and their triplets or twins (2.7 lambs per ewe) were penned individually in expanded metal floor pens and fed one of three diets for 6 wk. The diets were formulated to contain 15, 25, or 35% FNDF with associated decreases in nonstructural carbohydrates based upon estimated ingredient digestibility values at 1X maintenance. The 15% FNDF diet (19% NDF) contained 48.2% corn gluten feed (CGF), 44.9% corn, 2.9% calcium carbonate, 2% mineral-vitamin premix, and 2% corn oil. Soy hulls replaced 3 percentage units (PU) of the CGF and 17 PU of the corn for the 25% FNDF diet (30% NDF), and 6 PU of the CGF and 33 PU of the corn for the 35% FNDF diet (41% NDF). Chromic oxide was used as a marker to determine digestibility. Milk production was measured during wk 3 by lamb removal, oxytocin administration, and milking followed 3 h later by a second milking. Almost all ewes had sore teats by wk 4, often followed by mastitis, which was treated with penicillin and udder balm. For ewes fed the 15% FNDF diet, DMI was similar to 2007 NRC values, but DMI was substantially higher for ewes fed the 25 and 35% FNDF diets (Table 1). In line with digestibility depression from increased intake, actual FNDF values were substantially lower than the 1X maintenance values upon which the diets were formulated, but ewe and lamb gains, and milk production increased substantially as dietary FNDF increased (Table 1). These data indicate that diets for lactating ewes with 2 or 3 lambs should contain a minimum of 25 to 35% 1X FNDF in the dry matter and that diet formulation can have a marked effect on DMI.

Table 1. Effect of fermentable NDF level on lactating ewes

Item	FNDF, % of DM			SEM	P-value	
	15	25	35		15 vs others	25 vs 35
Number of ewes	7	7	7			
Initial ewe weight, kg	58	63	62	2.6	0.16	0.76
Final ewe weight, kg	57	67	66	3.6	0.04	0.91
DMI, kg/d	2.3	3.3	3.9	0.21	<0.01	0.07
Gain, g/d	-29	86	100	50.3	0.06	0.86
Actual DMD, %	68	61	55	1.3	<0.01	0.02
Actual FNDF, %	8	12	16	0.9	<0.01	<0.01
Milk yield, kg/d	2.6	3.1	3.6	1.23	0.32	0.56
Lambs raised	1.7	2.3	2.4	0.32	0.11	0.75
Avg lamb ADG, g/d	125	170	190	34	0.20	0.67

Key Words: Fermentable NDF, Lactating ewes, Fiber

185 The effect of *Lactobacillus buchneri* 40788 with or without *Pediococcus pentosaceus* on the fermentation and aerobic stability of corn silage made at different locations. R. J. Schmidt*, W. Hu, C. M. Klingerman, E. E. McDonnell, and L. Kung Jr., *University of Delaware, Newark.*

Whole-plant corn (32 – 38 %DM) was chopped and treated with nothing (C), *Lactobacillus buchneri* 40788 (400,000 cfu/g) (Lallemand Animal Nutrition, Milwaukee, WI) (LB) or *Lactobacillus buchneri* 40788 (400,000 cfu/g) and *Pediococcus pentosaceus* (100,000 cfu/g) (LBC) from five locations and packed into 20-L buckets to determine their effects on silage fermentation and aerobic stability after 120 d of storage. The experiment was a randomized complete block design with main effects of inoculation (I), location (L) and I × L interaction. Data were analyzed by the GLM procedure of SAS. Dry matter recovery was different among L but unaffected by I ($P < 0.05$). Numbers of lactic acid bacteria and yeasts were greater and lower respectively, in LB and LBC than C ($P < 0.05$) and different among locations ($P < 0.05$). Numbers of *L. buchneri* (determined by real-time qPCR) were higher ($P < 0.05$) in four of five locations for LB and LBC vs. C (I × L interaction, $P < 0.05$) with values for the main effect of I ($P < 0.05$) being an average 6.7 log cfu/g of LB and LBC vs. 4.87 log cfu/g for C. Inoculation with LB or LBC raised ($P < 0.05$) silage pH and concentrations of acetic acid, 1,2 propanediol and decreased ($P < 0.05$) concentrations ethanol and water soluble carbohydrates but there was an I × L interaction ($P < 0.05$) for all of these components. Similarly, inoculation with LB (136 h) and LBC (136 h) improved ($P < 0.05$) aerobic stability compared to C (44 h) but there was an I × L interaction ($P < 0.05$). In general, locations with the largest increases in acetic acid due to LB and LBC had the greatest improvements in aerobic stability. The addition of *L. buchneri* 40788 alone or with *P. pentosaceus* resulted in similar effects on silage fermentation and aerobic stability but the effects were not consistent among locations suggesting that unknown factors in the field may alter the effectiveness of microbial inoculation

Key Words: Corn silage, *L. buchneri*, Real-time qPCR

186 Effect of weight gain and diet on insulin sensitivity in Thoroughbred geldings. R. W. Quinn*¹, A. O. Burk¹, T. G. Hartsock¹, K. H. Treiber², and R. C. Boston³, ¹*University of Maryland,*

College Park, ²*Virginia Polytechnic and State University, Blacksburg,* ³*University of Pennsylvania, Kennett Square.*

Altered glucose and insulin dynamics, including a reduction in insulin sensitivity (SI) have been observed in equine obesity and may contribute to the onset laminitis in susceptible individuals. The body condition score (BCS, scale 1-9) at which such changes occur is unknown. Fifteen mature Thoroughbred geldings (BW 516±13 kg, BCS 4.3±0.1) were fed hay and concentrate twice daily at 20 mcal/d above maintenance until ≥90.8 kg BW was gained (≤9 mo). During weight gain, horses were fed either a high starch (HS, NSC 57%, FAT 4%, n = 9) or a high fat/fiber diet (HF, NSC 20%, FAT 17%, n = 6). A frequently-sampled i.v. glucose tolerance test was carried out prior to treatment initiation (BASAL) and at the start (INITIAL) and end (FINAL) of weight gain. Thirty-six venous blood samples were collected from -30 to 240 min, with 300 mg/kg BW glucose injected at 0 min and 20 mIU/kg BW insulin at 20 min. The minimal model of glucose dynamics was used to estimate SI, glucose-stimulated glucose disposal (SG), the first-phase insulin response (AIRg) and the disposition index (DI). No treatment differences were found at BASAL, INITIAL or FINAL for SI, SG or DI. The AIRg was higher in HS vs. HF at FINAL ($P = 0.02$). The SG was higher ($P = 0.002$) at INITIAL vs. BASAL and FINAL for HF. It is likely that weight gain over the middle of the BCS range (BCS 4-7) has little impact on glucose and insulin dynamics. However, the higher AIRg in HS at FINAL suggests that the changes which have previously been observed in horses on high starch diets may be beginning. The higher SG in HF during INITIAL may reflect dietary adaptation to fatty acid utilization. Loss of this effect by FINAL may indicate a weight-gain associated loss of this adaptation. Because no negative changes to SI were observed in this study, the lower limit of fatness associated with metabolic problems remains unknown but most likely lies above the BCS range examined in this study.

Key Words: Equine, Insulin, Minimal model

187 Digestibility of limit fed high and low concentrate diets with corn silage as the sole forage for dairy heifers with *Saccharomyces cerevisiae*. G. J. Lascano* and A. J. Heinrichs, *The Pennsylvania State University, University Park.*

Restricted feeding and high concentrate (HC) diets are potential methods for growing dairy heifers. Ruminal manipulation with additives such as *Saccharomyces cerevisiae* yeast culture (YC) could alter digestibility when added to these diets. A study was designed to study effects of YC on dry matter digestibility (DMD) and N digestibility (ND). An additional objective was to evaluate effects of YC on DMD and ND added to limit-fed HC diets. A split plot design with heifer age as the whole plot and treatment as sub-plot was administered in a 4 period (21 d) 4 × 4 latin square. Eight Holstein heifers (288 ± 4 and 410 ± 2 d of age and 234 ± 15 and 409 ± 20 kg BW) were allocated to 4 treatments consisting of HC TMR (40% CS, 60% grain; 12.6% CP, 25% NDF), and a low concentrate (LC) TMR (80% CS, 20% grain; 12.3% CP, 35% NDF) without YC addition and the same treatments with YC top dressed (1 g/kg intake as fed basis). Diets were fed once/d to provide 0.22 Mcal ME intake/kg EBW^{0.75}. Periods consisted of 17 d adaptation and 4 d total fecal and urine collection. Urine was collected using non-invasive urinary devices attached to heifers (pH adjusted to minimize NH₃ volatilization); feces were collected hourly and stored in airtight containers. DMD was different between HC and LC (75.67 vs. 72.96 ± 0.7%; $P < 0.01$), and

YC addition increased DMD in both diets (74.97 vs. 73.65 ± 0.7%; $P < 0.05$). No differences were found among the 2 ages ($P > 0.3$). N intake (128.13 ± 1.85 g/d) and apparent ND were similar in all treatments. HC diets decreased fecal output on DM (1.49 vs. 1.77 ± 0.06; $P < 0.01$) and wet (10.48 vs. 7.28 ± 0.36 kg; $P < 0.01$) bases, and YC had a significant effect in both parameters ($P < 0.05$). Urine volume

excretion was not different; therefore total manure output was lower for HC diets. We conclude that YC increased DMD in HC and LC diets; HC diets were more digestible and generated less fecal output, with YC enhancing this effect.

Key Words: Yeast culture, Forage:concentrate, *In vivo* digestibility

ADSA-SAD Undergraduate Competition - Dairy Production

188 The potential for use of sexed semen technology in the dairy industry. S. N. Van Exel*, *California Polytechnic State University, San Luis Obispo.*

Recent developments in flow cytometry have made sexed dairy cattle semen a potential tool for dairy producers. This technology makes possible a 90% probability of conceiving a heifer calf using sexed semen. What are the economics of this technology? Will sexed semen technology be accepted as an alternative to conventional artificial insemination in the dairy industry? Beneficial and potentially negative aspects of this technology will be discussed. What producers may likely benefit from the use of sexed semen in their reproductive programs? A profile of the potentially successful candidate for adoption of sexed semen will be discussed.

Key Words: Sexed Semen, Artificial Insemination, Reproduction

189 Management considerations for automated milking systems. S. J. Miller*, *The Pennsylvania State University, University Park.*

As labor costs increase and technology advances, more producers will find automated milking systems (AMS) to be a viable option. However, there are management considerations when switching from a conventional milking system to an AMS. Van de Vorst and de Koning (2002) showed that the introduction of robotic milking systems caused an increased milk SCC. Gygax et al. (2006) indicated that cows milked using AMS exhibited elevated cortisol secretion which may be linked to these higher SCC levels. Canadian producers reported between a 0% and 3.2% cull rate due to the switch to robotics. Culled cows had very close teat placement, rear teats that touched, or raised rear udders that made teats hard to detect in a horizontal plane. Genetic selection should be placed on these traits to avoid future culls. The biggest challenge will be to decrease the percentage of involuntary milkings. Involuntary milkings occur when cows do not enter the milking station in a specified period of time and producers must bring the cows to the system. Rodenburg and Wheeler (2002) found that it takes 3 to 4 weeks to reach an 80% voluntary milking rate. After the transition to an AMS, the study showed that an average of 12.6% of milkings were involuntary. Almost half of the involuntary milkings were due to lazy milkings, where cows with no signs of physical distress did not go to the milking station. Lazy milking fetch rates can be reduced by feeding small amounts of concentrate in the AMS to entice cows to be milked. The same study showed that by switching the concentrate from low energy (1.56 Mcal/kg) to high energy (1.96 Mcal/kg), voluntary visits per day increased from 3.40 to 4.04 and voluntary milkings per day increased from 1.72 to 2.06. Milk from AMS will have to comply with the Pasteurized Milk Ordinance in the U.S. The PMO has been revised to specifically address issues related to AMS. As labor becomes more of a challenge and producers become more aware of the management

adaptations necessary to make a smooth transition, AMS will become more commonplace in the dairy industry as long as they are approved to meet legal milk standards according to the PMO.

Key Words: Automatic Milking System, Robotic Milking

190 The sale and consumption of raw milk. T. Webb* and D. Winston, *Virginia Polytechnic Institute and State University, Blacksburg.*

Niche marketing of dairy products including organic and raw milk sales are growing. Historically, raw milk has been consumed by producers themselves. Recently, the sale of raw milk has received great attention. Some consumers prefer raw milk over pasteurized milk because they believe it is more natural, is healthier and tastes better. Producers prefer it because of its convenience. Others claim that it is part of their culture to consume raw milk and milk products. The level of cheese illegally produced from raw milk in California is equivalent to four percent of all cheese produced in the state each year, much of it attributed to the culture in the area. Raw milk contains many pathogens, such as *Salmonella*, *Campylobacter jejuni*, *Escherichia coli* and *Listeria monocytogenes* that can cause severe health issues when consumed by humans. Nearly 76 million people are affected by food borne illness and 5000 people die each year, costing society nearly \$20 billion. On average 250 of these deaths are from raw milk consumption, which tarnishes the image of the dairy industry. Twenty-eight states have banned the sale of raw milk to prevent such illness. Some consumers are circumventing these regulations through cow share and lease programs. Educational programs should be developed to educate dairy producers, consumers and decision makers about the health risks associated with the consumption of raw dairy products. Pasteurization has been shown to reduce microbial content in milk. The level of inactivation depends upon the temperature and time at which the milk is pasteurized.

Key Words: Raw Milk, Pasteurization

191 Breeding strategies for today's commercial dairy producers. M. M. Welper*, *Iowa State University, Ames.*

Implementation of crossbreeding programs is becoming increasingly popular as many commercial dairy producers try to take advantage of heterosis, or hybrid vigor. Heterosis describes the desirable outlying traits of a crossbred individual that are obtained by combining the diverse traits of its purebred parents. In today's dairy industry, many outstanding sires are readily available through AI to almost every producer across the globe, but these sires come from relatively few genetically distinct lines. Producers often utilize only bulls ranking in