Investigations In Forage Quality

I. Variation in Forage Quality in the Northeast

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II. Variability in Forage Quality Parameters for Corn Hybrids

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Abstract
Forages are an integral part of livestock farming in the northeastern United States, and information concerning quality of forages provides benefit to farmers and other agricultural professionals alike. Two studies have been conducted at Miner Institute to assess variation in forage quality and the factors that influence quality parameters. The first study involved collecting 136 forage samples from farms throughout the northeast (ME, NH, NY, and VT) and performing forage quality analyses on them. These results were compiled to assess the extent of variation in forage types. The second study evaluated the quality of 144 corn silage samples representing 31 different hybrids grown on nineteen different farms across four states (MN, NY, WI, and VT) in the northern US. These data were combined with information on growing conditions and then analyzed to identify factors that had the greatest influence on forage quality parameters. The results of the first study revealed that there is considerable variation in forage quality among farms throughout the region. The second study suggested that considerable variation exists between corn hybrids and identified NDF concentration, and rainfall as factors which significantly affect digestibility of dry matter and fiber.

Introduction
Forages are a major component of feeding programs for dairy farms in the northeast. It follows, then, that producing high-quality forage will help producers to maximize on-farm resources. While much is known about characteristics of many feeds used on farms across the country, less is known about forages. Forage quality can vary depending on variety (Jung et al., 1997; Jung et al., 1998), stage of maturity at harvest (Coors et al., 1997), and cropping management. Nonetheless, little is known about the extent of variation in forages across a region. Therefore, any information that farmers and associated agricultural professionals can obtain regarding forages and their quality would provide substantial insight for proper management. The objective of these studies is to 1. assess the variability of *in vitro* digestibility, *in vitro* fiber digestibility, and neutral detergent fiber concentration for forages grown in the northeast and 2. identify factors that have the greatest influence on forage quality.

Literature Cited

Coors, J.G., K.A. Albrecht, and E.J. Bures. 1997. Ear-fill effects on yield and quality of silage corn. Crop Sci. 37 (1): 243-247

Jung, H.G., C.C. Sheaffer, D.K. Barnes, and J.L. Halgerson. 1997. Forage quality variation in the U.S. alfalfa core collection. Crop Sci. 37(4): 1361-1366

Jung, H.G., D.R. Mertens, and D.R. Buxton. 1998. Forage quality variation among maize inbreds: *in vitro* digestion kinetics and predictions with NIRS. Crop Sci. 38(1): 205-210

I. Variation in Forage Quality in the Northeast

Materials and Methods

A total of 136 forage samples were sent from 87 farms throughout Maine, New Hampshire, Vermont, and New York to the Miner Institute forage laboratory. These samples were representative of crops grown on farms throughout the northeast region of the US: corn silage, haycrop silages, and pasture. Samples were dried and ground, and then were analyzed for neutral detergent fiber concentration (NDF) *in vitro* true dry matter disappearance (DMDt), and *in vitro* fiber disappearance (NDFd). All analyses were carried out using the ANKOM system. *In vitro* analyses were carried out using the ANKOM Daisy jar apparatus with the Kansas State buffer system. After analysis, results were compiled and trends in variation among forage types were characterized.

Results and Discussion

Table 1 summarizes the results of the analyses.

Table 1.Extent of Variation for Forages

		Alfalfa silage (n=35)	Corn silage (n=50)	Grass silage (n=49)
% NDF	Max.	**69.71**	**63.42**	**72.55**
	Min.	**35.88**	**32.09**	**47.61**
	Mean	**50.60**	**46.65**	**61.35**
	C.V., %	*15.48*	*17.60*	*10.08*
% DMDt	Max.	**85.67**	**85.00**	**83.68**
	Min.	**56.03**	**61.79**	**53.37**
	Mean	**75.15**	**73.87**	**67.59**
	C.V., %	*9.06*	*6.39*	*11.11*
%NDFd	Max.	**65.26**	**61.56**	**65.72**
	Min.	**36.93**	**24.87**	**35.10**
	Mean	**51.90**	**43.45**	**48.21**
	C.V., %	*14.14*	*19.53*	*16.47*

There was a wide range in values – approximately 20 to 30 percentage points – for all forage quality parameters in alfalfa, grass, and corn silages. The smallest degree of variation, as evidenced by coefficients of variation (C.V.), was in DMDt. Since this is essentially a measure of whole-plant digestibility, the analysis may not be sensitive to variation in the levels of digestible fractions. There was a greater degree of variation in both NDF and NDFD measurements. Plant fiber concentration and fractionation is affected by a host of factors, including stage of maturity at harvest, plant variety, and growing conditions. For instance, warm, moist growing conditions may promote greater lignification in plants, and this may in turn decrease fiber digestibility. Whereas crop hybrid selection, management, and growing conditions varies between farms and between location within a region, they probably account for the observed variation in values.

Conclusions

Based on these results, forage quality varies widely among farms. The greatest degree of variation exists in NDF and NDFd. These differences need to be taken into consideration when formulating rations and developing crop management programs in order to optimize the use of on-farm forage resources. In addition, these results illustrate the importance of forage testing in order to have an accurate assessment of its quality for use on the farm.

II. Variability in Forage Quality Parameters for Corn Hybrids

Materials and Methods

A total of 144 corn samples were collected and ensiled in mini-silos. These samples represented 31 different hybrids grown on 19 farms throughout four states (Minnesota, New York, Vermont, and Wisconsin) in the northern U.S. Samples were analyzed for neutral detergent fiber concentration (NDF), *in vitro* true dry matter disappearance (DMDt), and *in vitro* fiber disappearance (NDFd). Analyses were carried out using ANKOM apparatus, and in vitro analyses were carried out using the buffer system outlined by Goering and van Soest (USDA Agriculture Handbook 379). Additional data was collected on rainfall and growing degree-day accumulation for each farm. These data were then analyzed using multivariate regression to determine those factors which significantly affected DMDt and NDFd.

Results and Discussion

There was a wide range in values for NDF, DMDt, and NDFd. NDF ranged from 41.7 – 51.2%, DMDt ranged from 66.3 – 77.1%, and NDFd ranged from 27.0 – 48.4% (Figures 1-3).

Table 1. Range in NDF for 31 corn hybrids

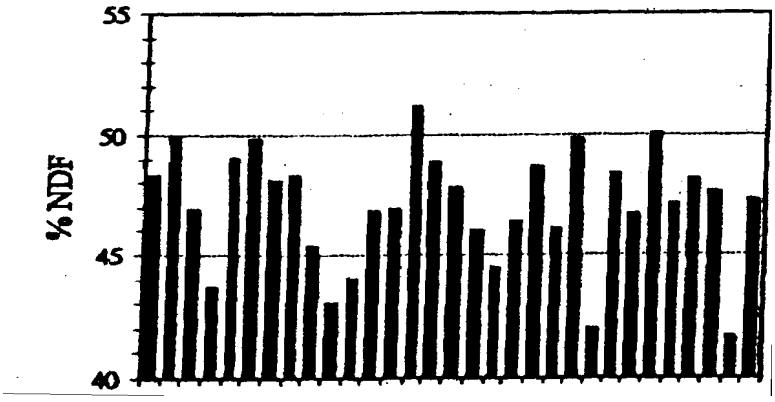


Table 2. Range in DMDt for 31 corn hybrids

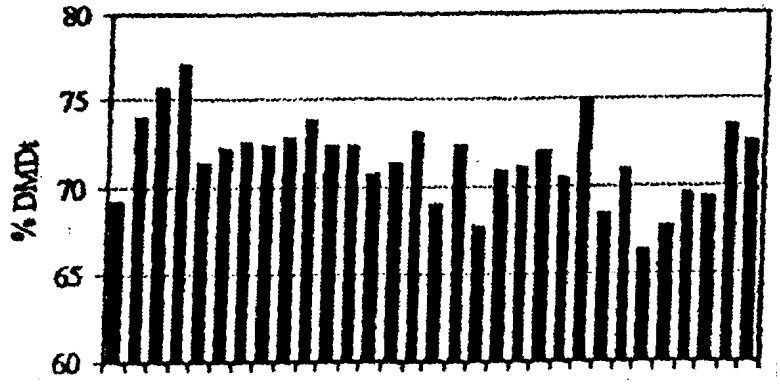
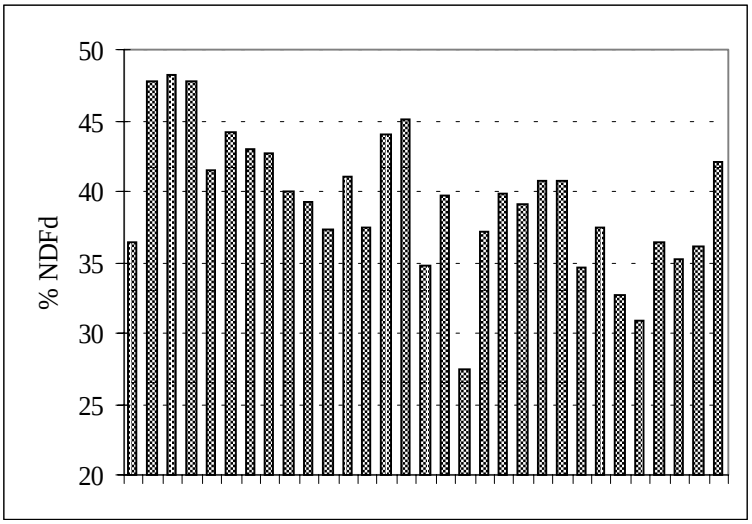
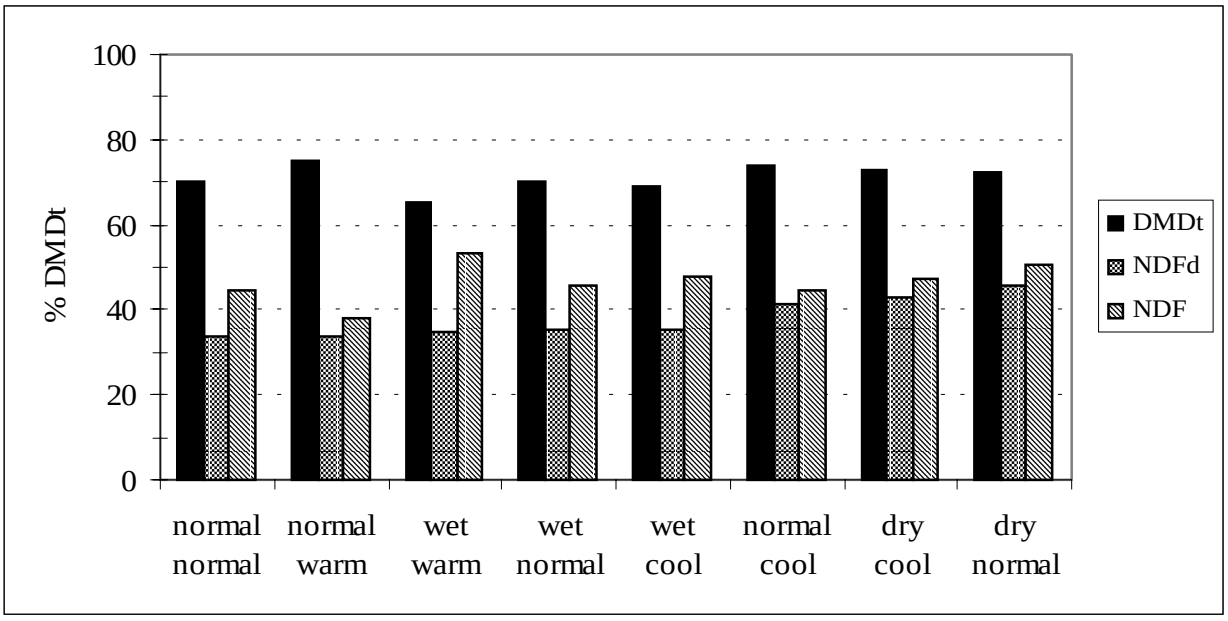


Table 3. Range in NDFd for 31 corn hybrids



Based on multivariate analysis, corn hybrid, rainfall, and NDF all significantly contributed to variation in DMDt. Only hybrid and rainfall contributed to the variation in NDFd. This suggests that the actual composition of plant fiber is more important than concentration where digestibility is concerned. Certain trends were established relating growing conditions to forage quality. NDFd was highest for samples grown under dry, cool conditions and lowest in samples grown under warm, moist conditions (Figure 4). This illustrates the role rainfall and soil moisture play in plant lignification and the subsequent impact on fiber digestibility. Since lignification tends to be greater in plants grown in moist conditions, lignin probably comprises a larger proportion of plant NDF than those grown in drier conditions and therefore decreases NDF digestibility.

Figure 4. Effect of growing conditions on forage quality



Conclusions

Based on the results of this study, significant variation exists between corn hybrids. While some of these differences can be attributed to inherent differences in plant breeding, multivariate regression analysis suggests that growing conditions also have an effect. In particular, soil moisture seems to have an effect on plant fiber digestibility, probably due to increased lignification in plants grown under moist conditions.

Future research efforts should focus on the effect agronomic growing conditions have on the fractionation of plant iber and the resulting impact on the digestibility of dry matter and fiber.