

MINNESOTA AGRIPOWER PROJECT

Quarterly Report for the
Period October - December 1996

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Minnesota Valley Alfalfa Producers

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MINNESOTA AGRI-POWER PROJECT

Instrument No.: DE-FC36-96GO10147

PROGRAM STATUS AND ACCOMPLISHMENTS

THIRD QUARTERLY REPORT

FOR PERIOD

01 OCTOBER 1996 THROUGH 31 DECEMBER 1996

TASK 2 - REVIEW AND CONFIRM FEEDSTOCK SUPPLY PLAN

Feeding Trials and Analysis

Alfalfa leaf meal (ALM) is a critical co-product to the economics of the alfalfa biomass energy system. Research is being conducted to characterize the nutritional value of ALM in dairy, beef and turkey diets and provide an estimate of the economic value of alfalfa leaf meal to livestock producers.

Dairy Research

The value of ALM as a feed supplement in lactating dairy cow diets is being determined in laboratory and animal performance trials.

Objectives

- Determine substitution rate for ALM in lactating cow diets.
- Laboratory evaluation of methods to enhance protein value of ALM.
- Formulation and evaluation of combination products containing ALM.
- Dairy cow lactation trial to determine animal performance.
- Determination of rumen functioning parameters.

Progress

The original dairy feeding study was four diets with ALM contributing 20, 40, 60, or 80% of the supplemental protein fed (4x4 Latin square design replicated 4 times). With a leaf meal containing 23% CP, cows received about 2, 4, 8 and 14 lb/day of ALM pellets. Because cows were eating more total DM and the inclusion rate of the ALM was higher than projected (because its protein content was lower than anticipated), more ALM would be needed than the original amount delivered. Subsequently, the number of diets was reduced to 3 (in which 20, 50, or 80% of the supplemental protein would come from ALM). With these diets, cows were receiving about 2, 6, and 14 lb/d of ALM pellets. However, after feeding the diets for 10 days, it became evident cows fed the 14 lb/d of ALM pellets would not consume this amount of pellets. Pellets were being sorted out, and overall feed intake was reduced. Because of this, the study was interrupted, redesigned, and diets reformulated to include less pellets. With the new diets now being fed, cows receive about 0, 4, or 8 lb/d of ALM pellets. Also, instead of 16 cows on the study originally, 18 cows are now used in a 3x3 Latin square design, replicated 6 times.

The second period of the lactation study was completed on December 16, 1996. Diets are fairly well accepted, and sorting of pellets is not as evident as it was before the amount of pellets in experimental diets was reduced. Given that alfalfa hay in the diet is being replaced with leaf meal to a larger extent than is soybean meal, we are concerned about the effects that substitution will have on chewing activity and overall rumen health. For this reason, chewing activity and rumen parameters (pH, ammonia, and volatile fatty acids concentrations) were added to the list of measurements to be made.

The lactation trial will be completed on Wednesday, January 8, 1997. The third period was shortened because alfalfa leaf meal was running out. The adjustment and data collection periods will respectively be 4 and 2 days shorter than originally planned.

Beef Research

The value of ALM as a feed supplement for beef cattle is being evaluated in both steer and beef cow diets.

Objectives

- Evaluation of different levels of ALM in transition diets for steers coming into a feedlot environment.
- Evaluation of different levels of ALM in transition diets for steers coming into a feedlot environment.
- Evaluation of different levels of ALM in beef cow diets.

Progress

Alfalfa leaf meal for the receiving-finishing study at Crookston was delivered on 11/8/96, and the feeding study started on 11/14/96. The protein content of the leaf meal (23%, DM basis) was lower than expected. The receiving phase of the study is almost completed.

The receiving study in St. Paul and the beef cow wintering study in Grand Rapids started on 12/20 and 12/21, 1996 respectively.

Inputs needed: The balance of the alfalfa leaf meal required for the study in Grand Rapids, and, when available, higher quality (~ 30% CP) alfalfa leaf meal (in meal form) for the laboratory evaluation.

Turkey Research

The value of ALM as a feed supplement in the poultry diets is being evaluated in laboratory and animal performance trials.

Objectives

- Determination of metabolizable energy and amino acid availability.
- Effect of inclusion of different levels of ALM in market turkey diets.
- Effect of inclusion of different levels of ALM in breeder hen diets.

Progress

Digestibility trial - In order to start the trial, we were able to obtain 6-week old turkeys from a commercial farm and house them in the digestibility cages on campus. After a period of acclimation, turkeys were fed alfalfa meal for determination of digestibility according to the TME (true metabolizable energy) method by Sibbald (1986). Excreta were collected and sample preparation initiated for subsequent analyses.

Excreta samples are being freeze dried and prepared for analyses in January.

Market turkey study - Poults were ordered for market turkey study and the research facility was cleaned in preparation for the start of the study.

Diets were formulated using the same source of alfalfa meal as in the breeder study. Poults were delivered in November 12 at which time the test diets were fed. This trial is scheduled to end in early April 1997.

Poults were weighed on December 9th when they were 4 weeks of age. Preliminary results indicated the 2.5% addition of alfalfa leaf meal increased body weights by 4.6% in comparison to the control. Addition of 5% ALM lowered body weights but this effect appeared to be due to poor performance of one of the 4 replicate pens. Addition of 7.5% ALM had no effect on 4 week old poult weight.

Alfalfa meal is still running lower in protein and higher in fiber than anticipated. Once higher quality material is available, some tests may need to be repeated. I could also incorporate higher quality meal as it becomes available if so desired.

Breeder hen trial - The final protocol for the experiment was developed. Diets for the study were formulated with ground alfalfa meal delivered to the Rosemount Experiment Station on November 8. Hens were started on the experimental diets on November 21 at which time the hens were light stimulated to bring them into egg production.

Egg production commenced on December 12th. Data is collected and summarized in 4-week production blocks.

Alfalfa Supply System

Rapid Analysis of Hay Attributes Using NIRS

The goal of this research area is to establish a commercial quality control system for alfalfa feedstock and alfalfa product evaluation.

Objectives

- Establish Quality Control Systems and Procedures.
- Evaluate Alfalfa by Variety and Management System.

Progress

Monitored hay and pellet equations for crude protein (CP) and compared NIR to chemistry. The grinder setup was modified to reduce the dust problem. NIR sample holders were converted from small round to rectangular cups.

Personnel directed installation of new NIR lamp and instructed personnel in checking NIR for proper diagnostics. Initiated work on 30 pellets and 30 hays for ADF and NDF. Worked on testing for spiked hay (hay which has been fertilized to raise protein levels). Began organization of CP analyzed since initiation of project.

Finished ADF and NDF on 30 hay and 30 pellet samples. Used them to monitor the NIRS Forage and Feed Testing Consortium hay equation. Planning protocol of leaf meal pelleting experiment. Split leaf meal sample ran NIR to confirm uniformity of samples. These samples will be used for pelleting experiments.

Alfalfa Varieties for Biomass Production

The goal of this research is to develop new biomass-type alfalfa varieties.

Objectives

- Development of New Biomass-Type Alfalfa Varieties.
- Establish Alfalfa Variety Trials for Biomass Energy Production.
- Determine Leaf and Stem Yield of Experimental Alfalfas.

Progress

Biomass leaf/stem samples from several alfalfa varieties were scanned using NIRS and prepared for wet lab analysis. This data will be used to develop a leaf/stem equation for predicting leaf/stem values based on NIRS. A preliminary analysis of yield data was run on PC SAS. No significant differences were found in the preliminary analysis for entry or treatment at each location. Yield data across locations will also be evaluated. A final statistical analysis will be conducted following completion of the quality analysis protocol.

Grinding of dry matter samples continues as student labor is available. Biomass leaf/stem samples are scanned by NIRS and wet lab analysis for crude protein is determined.

Alfalfa samples from the Rosemount Experiment Station are completely ground, and tumbled and grinding of Lamberton samples has begun. A leaf/stem monitor set has been weighed out for fiber analysis.

Efficiency of Harvest and Storage Systems

Research in this area will compare the efficiencies of different harvest and storage systems.

Objectives

- Compare the Profitability of Various Harvest Systems.
- Compare the Profitability of Various Storage Systems.

Progress

Bale temperatures taken at the Morris storage test site found that hay in storage is quite temperature erratic with outside bales having a significantly higher temperature. Sampling of bales in storage at the former cooperator site is in progress.

Samples of leaf meal sent to Crookston by the MnVAP pelleting plant were analyzed. Found that by physical fractionation of ground product prior to pelleting, the mass fractions were 53% leaf and 47% stem. A meal sample, previously analyzed in Crookston as 22% protein, was found to be 26% protein by UM lab.

In an effort to understand apparent loss in protein during extrusion and other alfalfa processing (from 26% to 22% protein), characterization of a small extruder on the U of MN campus is being undertaken. The required instruments were procured: (1) an infrared thermometer for measuring extruder eye temperatures and (2) a strobe-tachometer for measuring machine rotational speed. Testing will be performed January 1997.

On-Farm Demonstrations -

MnVAP cooperator farms will be developed to provide on-farm demonstration sites and hands-on educational program opportunities.

Objectives

Water Consumption and N Response following Alfalfa

- Identify sites and establish treatments
- Monitor Treatments for crop response

Alfalfa Varieties

- Identify sites and establish treatments
- Characterize varietal differences in stems and leaves

Biomass Packaging and Storage Systems

- Identify sites and establish treatments
- Characterize packaging and storage system effects on biomass quality and quantity

Progress

The team is working to plan and establish demonstrations on MnVAP cooperator farms in 1997.

Biomass Energy Production Effects on Environment

One of the major potential attributes of biomass energy production systems is the ability to create large-scale environmental improvements. This research will document the alfalfa biomass production system's potential impact on the Minnesota River watershed.

Ash

Research will determine the environmental liability and/or the economic value of the ash generated from the gasification process.

Objectives

- Obtain ash
- Physically and chemically characterize the ash

Progress

Research scheduled to begin Spring 1997 following gasification testing.

Water Quality

Research will measure the impact of alfalfa production on ground and surface water quality.

Objectives

- Identify sites at the Lamberton and Morris Agricultural Experiment Stations
- Custom design environmental monitoring systems for each site
- Design data acquisition system: software, telemetry approach, and sampling protocol
- Purchase or develop hardware and software
- Assemble hardware and software, calibrate, and test
- Field installation and testing
- Physical and chemical characterization of watersheds (areal extent, soils, climate, landscape, crops, and hydrology)
- Retrieve runoff samples and prepare for analysis
- Chemical determination of potential pollutants
- Perform statistical analysis, determine loadings, and organize data for interpretation

Progress

Paired watersheds at Morris Agricultural Experiment Station are being instrumented to measure the impact of alfalfa production on water quality. Alfalfa and corn yields were determined for 1996 crops in the watershed and the soluble and total P associated with the plant residues were estimated. Neutron probe access tubes were installed and used to measure soil water on plots that have an alfalfa cutting schedule treatment.

Tipping buckets for CR10 data loggers for snow melt runoff were installed. Nitrogen bubblers for determining flume water depth were calibrated. Campbell Scientific 21x data loggers are being programmed and installed for monitoring flumes. The snow pack in the watershed plots has been characterized temporally and spatially.

Wildlife

Research will quantify wildlife diversity and abundance under various cropping sequences with and without alfalfa grown for biomass.

Objectives

- Finalize study and sampling design
- Use aerial photos and ground reconnaissance to develop a geographic information database.

Progress

Research scheduled to begin Spring 1997.

Economic Analysis

Optimize Feedstock Transportation System

Work in this area will focus on optimizing the feedstock transportation system.

Objectives

- Select, Obtain and Create Operational Software Programming to Track Feedstock Inventory.
- Record Location of Current Feedstock Production.
- Analyze Various Transportation and Storage Models (w/Task IIg).
- Optimize Feedstock Transportation System.

Progress

Obtained and reviewed information on several types of inventory control software packages. Contacted software companies, small businesses, and a CPA to obtain software recommendations and information.

Contacted several shareholders to clarify their answers on the hay surveys. After examining both MAPINFO and ArcView mapping software we have determined that ArcView is better suited for the task. We received data, gathered by MnVAP staff, regarding shareholder inventories.

We are awaiting the findings of the Task II research groups as they measure harvest and storage losses. Some data will be available this winter, but the majority of the harvest and storage loss data needed to analyze transportation and storage models will not be available until Spring 1997.

In November, Task IV personnel met with John Baloun to discuss MnVAP's need for an integrated software system to help book sales, reserve processing capacity, and maintain inventory numbers for finished products and raw materials. A meeting with MnVAP management was scheduled for December to identify any additional inventory control system requirements and then a recommendation for an inventory control system will be made to MnVAP. Researchers obtained a copy of ArcView Network Analyst to compute road distances between plant locations and on-farm storage.

The team proceeded with direct discussions with John Soderholm of R.D.I. in Spicer regarding customizing an inventory control system. Continued contacting shareholders to obtain data missing on survey forms. Transportation costs to Priam, Granite Falls, and other area locations will be modeled to optimize location of additional processing facilities.

Analyze Market Potential for New Alfalfa Products

Objectives

- Evaluate Domestic Market Opportunities.
- Evaluate International Market Opportunities.

Progress

We are awaiting data from the Task I animal feeding trials. When the initial analysis of alfalfa leaf meal (ALM) products in livestock diets is complete and animal performance is reported, we will evaluate the value and market potential for ALM products.

Total Systems Analysis

Objectives

- Sensitivity Analysis on Total System Performance.
- Production Task Analysis on Total System Performance.

Progress

The Excel spreadsheet ProdPC was used to determine how current high corn and soybean prices effect the economics of rotations including alfalfa. While \$67/T was a break-even alfalfa value determined in the DFSS rotation versus Corn-Soybeans in the original feasibility study, \$75/T now represents a reasonable break-even with corn priced at \$2.80 and soybean priced at \$7.00.

Based on rainfall amounts within generalized production regions, evapotranspiration was chosen as an appropriate model to predict future alfalfa dry matter yields.

With grower survey data completed, work began on defining production regions and determining their Crop Equivalent Ratings. Precipitation data will be used to model evapotranspiration, which should predict dry matter yield. Year to year yield variation will be determined. Potential yield will also consider freeze-up soil moisture levels.

Community Education

Demonstrate Alfalfa Biomass Crop Production Systems

This sub-task provides education and information to the local community on alfalfa biomass crop production systems through on-farm and experiment station demonstrations.

Objectives

- Organize Four (4) On-Farm Demonstrations.
- Conduct Four (4) On-Farm Demonstrations in 1997.

TASK 5 - CONSTRUCTION AND ENVIRONMENTAL PERMITTING PLAN

- Prepared a preliminary engineering analysis of alternative sources for obtaining cooling water makeup. Two potential sources are available; the Minnesota River and the local groundwater. The results of the study indicate that neither source alone may be sufficient. It appears that a combination of both or withdrawal, for some period of the year, from onsite storage with either source will be required.
- The Yellow Medicine County Task Force has identified a number of potential power plant sites for MnVAP's consideration as an alternate to Granite Falls site. They are currently compiling and evaluating information on these sites prior to submitting their results to MnVAP.

TASK 8 - PROJECT MANAGEMENT, ENGINEERING, AND ADMINISTRATION

- NSP Power Purchase Agreement (PPA) negotiations continued throughout the period on good terms. The majority of contract issues have been resolved to the satisfaction of both parties. Contract issues that require input from project lenders have been tabled pending the development of a financing package.
- Contracts with participating organizations under the DOE Cooperative Agreement continue to be delayed pending resolution of basic design parameters for MAP. Technology options continue to be evaluated as no group of technology companies has been able to satisfy MnVAP concerns over cost and commitment to the long-term success of the project.
- The MnVAP Board of Directors authorized the CEO to purchase Polsky Energy Corporation's interest in the MAP project under specific terms and conditions as set forth by staff and as adopted by the Board. As of year end, MAP ownership structure had not been finalized.
- Farm Credit Services (FCS), the nation's largest ag lender, has expressed a continuing interest in providing debt financing, working capital, and other financial services to MnVAP members and to the cooperative. FCS developed a one page credit application specifically for MnVAP members for the purchase of shares in the cooperative.
- FCS personnel are also working with MnVAP to expand geographic coverage of Federal Multi-Peril Crop Insurance for alfalfa. Federal Crop Insurance is now provided to alfalfa producers only in a limited number of counties in the state.
- MnVAP developed a five-year Business Plan for Alfalfa Operations. The plan describes scale up from the current production level of 50,000 tons/year FY97 to a production level of about 400,000 tons/year in FY01 (MnVAP's Fiscal Year ends April 30). The plan has been reviewed and adopted by the Board of Directors.
- MnVAP developed a Disclosure Statement, Financial Statement, and other documents for a Stock Offering. The Board of Directors authorized the sale of 50,000 shares of MnVAP stock at \$55 dollars per share to open in January 1997. This share offering if fully subscribed would result in net proceeds after the cost of the offering of about \$2.7 million dollars and the additional production of 50,000 tons of alfalfa per year.
- Mr. Hanson has transferred the scope of work and responsibilities of Project Director to Mr. John Baloun, MnVAP CEO. Mr. Hanson proposes a continuing role as Project Advisor with responsibility for developing and coordinating public sector support and for University of Minnesota budget control, oversight, and reporting.
- Issued for comment, to each of the principal subcontractors, revised standard subcontract terms and conditions for their final agreement.
- MnVAP authorized Carbona/Kvaerner to conduct all preparatory activities to begin the gasification testing in February 1997.
- Arrangements were made to send a small sample of alfalfa to Finland to begin the gasification testing program.

- MnVAP and its subcontractors are working with DOE's Environmental Engineer to develop a punch list of tasks, and to further agree on responsibilities and assignments in support of environmental review and permitting.

Research Coordination

Objectives

To provide research coordination, project reporting, and budget oversight.

Progress

Performed monthly accounting, reporting, and research coordinating tasks. Coordinated team meetings; revised budgets and prepared and submitted monthly expense and progress reports through December 1996; and prepared and submitted 2nd Quarterly report.