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MINNESOTA AGRIPOWER PROJECT

Quarterly Report for the
Period July - September 1996

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MINNESOTA AGRI-POWER PROJECT
Instrument No.: DE-FC36-96GO10147

PROGRAM STATUS AND ACCOMPLISHMENTS

SECOND QUARTERLY REPORT

FOR PERIOD
01 JULY 1996 THROUGH 30 SEPTEMBER 1996

TASK 1 - DESIGN PACKAGE

Economic Analysis

Optimize Feedstock Transportation System

Established an inventory of off-the-shelf software to track feedstock inventory. Reviewed software and previous research regarding transportation and storage models. Reviewed and selected mapping software (MAPINFO). Designed survey form for grower locations and volumes to record location of current feedstock production.

Developed conceptual framework for a model that will incorporate transportation and storage costs along with loss data and weather risk. Will combine soil types and precipitation records with location information to develop a comprehensive model for transportation and storage.

In August, grower location and volume survey results were entered into a database, analyzed, and the results of the survey were reported.

In September, received hay surveys from shareholders and entered data in Paradox format, which is readable by either ArcView or MAPINFO software. Called shareholders, when necessary, to clarify their reports.

Analyze Market Potential for New Alfalfa Products

Attended and co-sponsored meetings with potential customers to determine customer's needs. Reviewed literature for new market developments and opportunities and updated information for using alfalfa as dedicated feedstock.

Total System Analysis

The Excel spreadsheet ProdPC was run to determine how current high corn and soybean prices would affect the economics of rotations including alfalfa. Research on data sources for rainfall amounts, within generalized production regions was also carried out. Evapotranspiration was chosen as the appropriate model to predict alfalfa dry matter yields.

TASK 2 - REVIEW AND CONFIRM FEEDWATER SUPPLY PLAN

Alfalfa Supply System

Worked with Priam alfalfa processing plant staff to determine the status of NIR instrument and reviewed the technical and personnel requirements needed to establish a quality control system. Performed routine NIR diagnostics, collected spectra using sealed sample set for standardization checkup, and entered 10 hay and 6 pellet samples on their instrument and returned with samples to perform conventional chemistry at St. Paul Campus. Conventional chemistry was compared with NIR analysis at both MnVAP and St. Paul locations.

MnVAP staff were instructed to proper hay sampling procedures and MnVAP's NIR quality output form was modified to reflect CP, DM, ADF, NDF, and RFV. A commercial NIR equation was purchased from Perstorp, Inc. and hay equations were modified to match the analysis of the NIRS Forage and Feed Testing Consortium labs.

Microwave drying of cored hay samples for analysis of "as is" moisture of hay entering MnVAP processing plant, fine grinding of hay samples, and NIR analysis using those samples was initiated. The calibration of MnVAP's small sample weigh scale was checked to confirm accuracy.

Hay samples were collected at the processing plant and analyzed for protein at the St. Paul lab to confirm that the NIR is accurately analyzing samples. Pellet samples were also brought back to St. Paul for chemical analysis. A questionnaire to collect data on hay quality was developed to be handed out to growers.

MnVAP's technician was taught sample preparation and NIR procedures. Protocols were written, and data sheets created; rearranged the MnVAP NIR setup to help lessen vibration; revised the NIR output forms to better meet the needs of the MnVAP staff; ran chemistry on fine ground and pellet samples to confirm the integrity of the machine and equations; collected revised farmer questionnaires; demonstrated and explained the NIR procedure to interested growers; and worked on an ongoing sampling study using the medium and large square bales. The sampling study was started at MnVAP and will continue with bales stored at Morris.

In September, the focus was on the bale sampling studies. Samples from the MnVAP bales were weighted and ground. The density and dry matter were recorded and the samples were analyzed on the NIR for CP, ADF, and NFD. Sampled bales on the Dru Tosel farm was part of an ongoing study.

Alfalfa Varieties for Biomass Production

The variety research protocol was established and a literature search completed for each portion of the task. The study to determine the effect of plant density on the quality and yield of experimental alfalfa varieties was seeded at the Agricultural Experiment Station at Rosemount, MN. Samples were ground for NIRS testing on the maturity and leaf stem ratio of exotic germplasms.

Completed the first harvest of the four cut treatment at Rosemount, MN, the first harvest of the three cut treatments at Rosemount, Lamberton, and Morris, MN, and the first harvest of the two cut treatments at Morris, MN. Samples were taken at all harvests to determine; dry matter, leaf stem ratios, and Kalu & Fick (a maturity rating protocol). Experimental plots were sprayed to control leafhoppers.

The SEAE trial, which was designed to study the effect of plant spacing on yield and quality of selected alfalfa germplasms, was sprayed three times. One spray was to control insect damage, and the other two

were to control weeds within the plots. Plots were checked for missing plants and replanted were necessary.

In July, completed the second harvest of the four cut treatment at Rosemount, MN, the second harvest of the three cut treatments at Rosemount, Lamberton, and Morris, MN, and the first harvest of the two cut treatments at Lamberton , and Rosemount, MN. Samples were taken at all harvests to determine; dry matter, leaf stem ratios, and Kalu & Fick. Plots were sprayed to control leafhoppers where needed. The SEAE trial was sprayed twice in July; one spray was to control insects, and the other was to control weeds within the borders. The plots were hand hoed once to control weeds within the plots. The plants were cut back to 6 inches on July 30th. Seed was packaged to fall-seed the SEAE trial in Becker, MN.

In August, the third harvest, of the four cut treatment was taken at Rosemount, MN. The third harvest of the three cut treatment the second harvest of the two cut treatment were taken at Rosemount, Lamberton, and Morris, MN. Samples were taken at all harvest to determine; dry matter, leaf stem ratios, and Kalu & Fick (a maturity rating protocol). Plots were sprayed to control leafhoppers where needed. Some leaf hopper damage occurred in spite of the spray treatments. Grinding of leaf/stem and dry matter samples has been started and will continue into fall.

A second SEAE trial, which was designed to study the effect of plant spacing on yield and quality of selected alfalfa germplasm, was planted in Becker, Minnesota. Also, a fourth biomass trail was planted at Granite Falls, Minnesota at a farmer co-operator location. Data from this location will begin to be taken in the spring of 1997.

In September, five experimental alfalfa lines being developed for biomass were evaluated for resistance to three major alfalfa diseases common in the upper Midwestern U.S., Phylophthora root rot, Aphanomyces root rot, and Spring blackstem and leafspot. All five lines were susceptible to the root rot diseases (not significantly different from the susceptible check variety Saranac). All five lines showed moderate resistance to the follar disease Spring blackstem and leafspot with an average of 25 percent of the plants having a resistant reaction. Moderate resistance is the highest level of resistance currently available in a limited number of commercial varieties. Based on available data, these biomass lines will need to be selected for root rot resistance to ensure good establishment over a range of environmental conditions. Follar disease resistance may be adequate for most Minnesota locations. Three additional disease tests will be carried out over the next three months for Fusarium wilt, bacterial wilt, and Verticillium wilt. A multi-spectral radiometer was purchased in order to measure leaf retention and folier disease progress in field experiments in 1997.

Efficiency of Harvest and Storage Systems

In August revised research protocol for measuring harvest and storage losses for baled hay. Contacted a farm co-operator for use of bay and baling equipment, lined up storage space at the West Central Experiment Station, and obtained crushed rock and tarps for the storage tests.

In September, 96 large round alfalfa bales and 88 medium square alfalfa bales were baled, field core sampled, loaded and hauled to the West Central Experiment Station, individually weighed and placed into four types of storage at the station. Each of the 4 storage treatments (under permanent cover, covered by tarpaulin on gravel, exposed on gravel, and exposed on pasture) were filled with 2 stacks (pyramidal - 3 high) of 12 round bales and 2 stacks of 11 square bales (4 high). The round bale stack integrity was difficult to maintain, as many stacks in storage differentially settled and required restacking.

TASK 6 - ENVIRONMENTAL MONITORING PLAN

Biomass Energy Production Effects on environment

Water Quality

Met with MnVAP research committee and project director to establish research priorities. Established research design. Designed custom equipment needed for research and located potential vendors.

TASK 8 - PROJECT MANAGEMENT, ENGINEERING, AND ADMINISTRATION

Project Director

Managed the operations of the Priam pilot plant in April 1996, and made a number of process and equipment alterations to improve processing efficiency and production capacity. Producing and marketing alfalfa pellets with protein values of 16 percent to 17 percent. Working with business and engineering consultants to develop the commercial processes for ALM and HiFibre. Separated stem and leaf material to supply the University of Minnesota with ALM for testing.

Three Power Purchase Agreement negotiations sessions were held with Northern States Power.

Developed proposal for Minnesota Extension Service Grant program to increase MAP project funding.

Held research and development meeting to clarify budget issues.

Examined possibility of developing proposal for Minnesota Technology technical support grant for new product and process development.

Project Director delivered presentation on MAP at Bio-Energy 96 Conference in nashville, Tennessee.

Board of Directors met to provide policy direction for staff on all aspects of project.

Performed a preliminary cost benefit analysis of the increased costs to densify the feed stock (either cubes or pellets) versus the potential cost savings in the gasifier feed system.

Continued to perform evaluations and comparisons of both the Foster Wheeler pressurized gasifier option and the Carbona/Kvaerner base case. Our emphasis was to evaluate the Phase One study costs, cost sharing and schedules to complete the work. At the end of the month, Foster Wheeler notified us that they were withdrawing their proposal. Foster Wheeler stated that there were several reasons for their withdrawal: Lack of support by their partner - Sydkraft; insufficient funding; and scheduling constraints to adequately address their process. Their concerns with sintering and agglomeration and with the method of feeding the gasifier were also identified.

Performed scoping evaluations of other technologies to assess their viability for the MnVAP project in case the base case should prove to be not commercially viable. These alternative gasification and power generating cycles included: Atmospheric biomass gasifiers; the FERCO indirect gasifier; the Hague ceramic heat exchanger indirect IGCC; the Kalina boiler cycle; and a conventional boiler cycle integrated with a natural gas-fired gas turbine.

Atmospheric gasifiers are not as efficient as the base mass pressurized/not gas clean-up approach. They may not improve the commercial viability of the MnVAP project. The FERCO indirect gasifier, although

atmospheric, produces a higher quality gas and could be a possible choice. The FERCO demonstration project in Burlington, Vermont, is scheduled to start-up in early 1997. The feed for the demonstration plant is wood chips. A decision to use FERCO cannot be made until the plant has produced acceptable results (mid to late 1997). The Hague ceramic heat exchanger has only been tested on a small scale and the Kalina boiler cycle has not been pilot tested. Neither of these technologies are likely to be viable candidates. A conventional boiler cycle integrated with a gas turbine cannot approach the efficiency of the base case and is therefore not viable.

Continued discussions with environmental consulting firms having strong local and state experience with permitting agricultural and industrial plants. The purpose will be to select a firm that will be able to supplement the project team's experience.

Initiated discussions with DOE and DOE's environmental consultant on the scope and schedule for the preparation of the required NEPA Environmental Assessment.

Prepared a listing of needed local data/information, at the request of the Granite Falls/Chippewa County Task Force, which will assist in gathering information for the permitting effort. The Task force was formed to aid the MnVAP project.

Responded to a request by Yellow Medicine County, for MnVAP requirements with respect to water needs, site requirements, and highway access limitations. Yellow Medicine County is performing scoping study to identify potential alternate sites in lieu of the MnVAP project's Granite Falls site.

Reviewed the Phase One Schedule to determine if work could be performed in parallel enabling the Phase Two Application to be submitted by the summer of 1997. This review was performed due to the delay in selecting the gasification technology and commencing the gasification tests. The results of the review indicate that the gasification testings were performed in the first quarter of 1997, then the application could be submitted on time. The final report would then be ready by early fall 1997. However, in order to perform the tests in early 1997, a commitment as to the gasification technology needs to be made by late November or an alternate technology needs to be selected.

Feeding Trails and Analysis

Dairy Research

Analyzed ALM delivered in September for crude protein, ADF and NDF. Research scheduled to begin october 1996.

Turkey Research

Continued to provide daily care for rearing of breeder stock. Set-up breeder facility in preparation for breeder trial. Rescheduled use of digestibility facility for digestibility study to begin in October.

Research Coordination

Developed financial and task reporting procedures. Met with University researchers and department administrators to communicate financial and reporting requirements. Performed necessary accounting, reporting, and research coordinating tasks including developing, evaluating, and preparing for submission a Creative Grant proposal to the Minnesota Extension Service; coordinating September 13 University of Minnesota MAP team meeting; revising project budgets to meet MnVAP's requests; preparing and

submitting to MnVAP University MAP financial and progress reports for April 1 to July 31, 1996, August 1996, and September 1996.