Agriculture, Our Renewable-Biodegradable Resource

The Role of North Dakota's Agricultural Experiment Station in Expanding the State's Agricultural Base

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The North Dakota Agricultural Experiment Station, with facilities located across the state, has been a key factor in improving the amount and quality of North Dakota's crop and livestock production and quality. The importance of crop and weed scientists, plant pathologists, soil scientists, entomologists, agricultural engineers and cereal scientists, working as a team to improve the yield and quality of the state's crops, is documented in Table 1, which shows North Dakota's high national ranking in the production of agricultural commodities.

In addition to continuously increasing the yield of each of the eleven major crops grown in North Dakota over the years, the experiment station's plant and soil scientists have developed plant varieties and improved production practices that have allowed the state's farmers to survive periods of drought, blight, heavy insect infestation, and other extremes of nature that have occurred over the years. The positive economic impact of this effort to increase yields over the past 50 years is shown in Table 2.

Table 1. North Dakota's 1992 crop production rank among states.

N.D. Ranks		N.D. Produces
1st in	Barley	38%
	Beans, all dry edible	21%
	Beans, pinto	35%
	Flaxseed	83%
	Sunflower	49%
	Wheat, all	19%
	Wheat, durum	84%
	Wheat, other spring	51%
2nd in	Beans, navy	28%
	Oats	13%
3rd in	Honey	10%
	Potatoes	7%
	Crops harvested	7%
	Total cropland - 1987 census	6%
4th in	Rye	10%
	Sugarbeets	13%

North Dakota Agricultural Statistics, 1993.

The experiment station has also been instrumental in introducing new crops into North Dakota. The first recorded date of commercial soybean production in the state was 1946. Dry edible beans were first produced in 1967, sunflowers in 1971, and, the newest crop, crambe, in 1990. As experiment station scientists plan for the next 50 years, they must continue to work to improve the North Dakota farmer's ability to produce high quality new crops, as well as traditional crops.

Livestock production in North Dakota accounts for 26 percent of total farm income vs 56 percent for crop production. To maintain a strong production agriculture base, the state must keep both the crop and livestock sectors of the agricultural economy strong and in balance. While continuing to excel in agricultural production, the state must become increasingly active in the design and development of agricultural commodities and agricultural products that meet the needs of changing world markets. The paragraphs that follow describe some of the ways in which experiment station research is helping to make this possible.

Table 2. Yield and income increases in major North Dakota Crops, 1943-1992.

Crop	50 Year Yield Increase	Current Price	Annual Value (000)	Avg. Annual Increase	Value of Avg. Incr. (000)
		($)	($)	(%)	($)
Hard Red Spring Wheat	18 bu.	3.20	394,560	3.6	22,095
Durum Wheat	17 bu.	2.70	138,510	3.4	7,064
Barley	25 bu.	2.00	141,500	2.5	6,467
Potatoes	100 cwt.	5.40	83,160	3.3	4,391
Sugarbeets	7 ton	48.30	65,558	1.4	2,707
Sunflower	200# (21 yr.)	0.086	28,638	1.0	1,718
Soybean	15 bu. (47 yr.)	5.40	51,030	3.0	2,654
Corn	60 bu.	2.25	76,950	6.0	6,156
Dry Beans	100# (25 yr.)	0.121	6,171	0.4	272
Rye	20 bu.	1.65	1,056	4.0	44
Flax	6 bu.	3.50	5,670	2.4	295
Total			**992,803**		**53,743**

North Dakota Agricultural Statistics, 1992. Data was compiled by Dr. D.E. Anderson.

Livestock for the Export Market

Livestock production has the highest multiplier effect of any sector of the North Dakota economy, generating $4.49 in gross business volume for each dollar of sales in the livestock sector (Coon et al., 1985). With per capita consumption of beef increasing in Japan and other Asian countries, a potential market for North Dakota grown beef exists in the Far East. Instead of shipping feed and feeder cattle out of the state, increased economic activity could be generated by feeding cattle for the export market. Specialty beef slaughter plants to process beef to meet the specifications of the export markets would create additional jobs and generate additional economic activity, especially in the smaller cities found across the state. Such plants would each have business activities ranging from $0.5 million to $1.3 million

Producing beef for export to Asia could become a new niche market for North Dakota.

dollars per year and employ from seven to 18 employees each. (Wulff et al., 1986) These employment levels would be significant in many small North Dakota cities.

Producing beef for export markets is quite different from producing products for the U.S. market. Experiment station scientists Marty Marchello and Tim Petry are researching how North Dakota beef producers and processors can create beef products that will successfully compete in Asian markets. Figure 1 lists the three key factors that must be addressed to satisfy the quality-conscious Asian consumer. Marchello (a meat scientist) and Petry (an agricultural economist) are working directly with beef producers to determine the production, processing and marketing characteristics of North Dakota beef that will successfully penetrate the Asian market.

International Marketing of North Dakota Beef

Designing North Dakota beef for the Asian market

- Feeding to desired market weight and degree of finish
- Processing and packaging the beef to meet the needs of the Asian markets
- Aid in establishing ties between North Dakota producers and processors and Asian markets

Figure 1. Provided by Dr. M Marchello and T. Petry, ND-AES.

North Dakota's Newest Crop, Crambe

Meal	Oil
Limiting factor for crambe production/utilization	Industrial Uses
Improving the uses of crambe meal as a livestock feed.	Slip agents
Provide livestock producers with a locally grown and processed oilseed meal	Lubricants
	Plasticizers

Figure 2. Provided by Vernon Anderson, ND-AES, Carrington.

Crambe, a New Industrial Crop

North Dakota's newest crop is crambe, which is valued by the plastics and lubricant industries for its oil. Since crambe produces an industrial oil, it does not compete directly with sunflowers and soybeans, two other North Dakota oilseed crops. Crambe oil will compete directly against petro-chemicals used as lubricants or in the plastics industry and is valued as a renewable-biodegradable industrial oil. But, as is shown in Figure 2, the amount of crambe meal that can be fed to livestock is one of the limiting factors for the expansion of this new oil crop in North Dakota.

Since crambe oil is prized as an industrial oil, since North Dakota is the pioneering state for the production of crambe, and since North Dakota is also the site for the processing of the crop to produce both oil and meal, experiment station scientists are working to improve the production of the crop as well as utilization of its oil and meal. Vernon Anderson, an experiment station scientist at the Carrington Research Center, is actively seeking ways to improve the uses and value of crambe meal as a livestock feed. Anderson's research is critical to the expansion of this oilseed crop in North Dakota, since both the meal and the oil must find good markets if production of the crop is to grow in North Dakota. The crambe meal research is also important to the state's livestock industry; If this research is successful, it will provide the livestock industry with a new locally produced oilseed meal.

New Uses for Sunflower Oil

The total production of oilseed sunflowers in the state has decreased since the early 1980s. North Dakota has the ability to grow a much larger acreage of sunflowers, as well as to process the crop to oil and meal, since it has excess capacity in its existing oil extraction plants. To stabilize the state's sunflower industry, experiment station scientists are seeking additional uses for this important crop. The oilseed-bearing sunflower currently produces sunflower oil for human consumption, meal for livestock feed, and heads and stems (crop residues) that go back on the land (Figure 3). D.K. Srivastava, an experiment station biochemist, is studying the fractionation of sunflower oil to yield a series of compounds that have value to the industrial chemical and food industries (Figure 4). Initial estimates of the cost of producing these compounds show the process to be feasible, able to add significant value to the oil, and able to open new industrial markets for the oil. The production of the

industrial compounds (azelaic acid and oleic acid) from a renewable oil resource and one that yields biodegradable products is essentially the direction the world's chemical industry is wanting to go.

New Uses for Crop Residues

In addition to Srivastava's work with sunflower oil, Sam Chang, an experiment station food scientist, is looking at the sunflower crop residue fraction (the head and stem) as a source of food and industrial compounds. Sunflower heads from one acre of North Dakota farmland yield approximately 50 pounds of pectin (Figure 5). Pectin is a carbohydrate that forms the gels we find in foods such as the jams and jellies, as well as in the many fruit-flavored yogurts found in refrigerated display cases throughout America today. Pectin is also a key ingredient in many pharmaceuticals, and has been shown to have the ability to clean up waste streams polluted with toxic heavy metals, such as mercury and lead, as well as radioactive waste.

Almost every pound of pectin used in the United States is imported. North Dakota's sunflower crop is a rich source of pectin, one that Sam Chang would like to see become the basis of a new processing industry in North Dakota. This is an example of how a crop residue can yield valuable food and industrial ingredients, create new markets for our commodities and, in turn, build a more stable base for our state's agriculture.

In this article I have shared with you just a few examples of the research which is ongoing in the Experiment Station, and which is focused on expanding the uses and markets of North Dakota commodities. The North Dakota Agricultural Experiment Station, with scientists located on the NDSU campus in Fargo and at eight outstate research centers, is committed to building North Dakota's primary industry, agriculture, through research that both improves the farmers and rancher's ability to efficiently produce crops and livestock and also expands the markets for those commodities.

Adding Value to North Dakota's Sunflower Crop

Sunflower

Sunflower head	Meal	Oil
Crop residue. Value added?	(110.00/ton) Animal feed	(27 cents/pound) Vegetable oil Value added

Figure 3.

Sunflower Oil

100 lbs. at 20 cents/pound ($20)

Fractionation

Azelaic Acid	Hexanoate	Oleic Acid	Glycerine
34.2 lbs. at $1.80/lb. ($61.56)	20.7 lbs. at $4.25/lb. ($87.98)	34.3 lbs. at 40¢/lb. ($13.72)	4.1 lbs. at 20¢/lb. (82¢)

Cost of oil	=	$ 20.00
Processing costs	=	$50.00
Value of products	=	$164.08
Net profit	=	$ 94.08

Figure 4. Provided by Dr. D.K. Srivastava, ND-AES.

Sunflower Heads

(Crop residue approximately 500 lbs./acre)

Extraction

Pectin*

(50 lbs. at $7.00/lb. — $350)

***Pectin uses**

1. Gelling agent for low calorie jams/jellies/yogurt.
2. Pharmaceutical uses.
3. Industrial uses — extract toxic heavy metals and radioactive elements from wasts streams.

Figure 5. Provided by Dr. Chang, ND-AES.

Dr. Sam K.C. Chang, right. In his IACC laboratory, Chang seeks new uses for North Dakota crops. (Photo by Anne Lennox)

References

Coon, R.C., F.L. Leitstritz, T.A. Hertsgaard and A.G. Leholm. 1985. The North Dakota Input-Output Model: A Tool for Analyzing Economic Linkages. NDSU Agricultural Economics Report No. 187, North Dakota Agricultural Experiment Station.

North Dakota Agricultural Statistics. 1992. North Dakota Agricultural Statistics Service Report No. 61, Fargo, ND.

North Dakota Agricultural Statistics. 1993. North Dakota Agricultural Statistics Service Report No. 62, Fargo, ND.

Wulff, S.M., T.A. Petry, D.L. Helgeson and R.C. Coon. 1986. Feasibility of Establishing Small Livestock Slaughter Plants in North Dakota. NDSU Agricultural Economics Report No. 208, North Dakota Agricultural Experiment Station.